परीक्षण मार्गदर्गक
टीईसी २११११:२०२५

TEST Guide
TEC 21111:2025

ओपन-रेडियो एक्सेस नेटवकक (ओ-रैन)
Open-Radio Access Network (O-RAN)

(**जीआर सं**: **टीईसी** 21110:2024)
(GR No.: TEC 21110:2024)

ISO 9001:2015

दूरसंचार अभियांत्रिकी केंद्र
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CONTENTS

A. INTRODUCTION

This document enumerates detailed test schedule and procedure for evaluating conformance / functionality / requirements / performance of Open-Radio Access Network (O-RAN) as per GR No TEC 21110:2024.

B. HISTORY SHEET

Sl. No.	TSTP No.	Equipment/Interface	Issue
1.	TEST Guide No.: 21111:2024	O-RAN	01

C. General information:

Sn.	General Information [	Details (to be filled by testing team)	
1	Name and Address of the Applicant		
2	Date of Registration		
3	Name and No. of GR/IR/Applicant's Spec. against which the approval sought		
4	Details of Equipment		
	Type of Equipment	Model No.	Serial No.
(i)			
(ii)			
5	Any other relevant Information:-		

D. Testing team: (to be filled by testing team)

Sno.	Name	Designation	Organization	Signatur e
1.				
2.				

E. List of the Test Instruments:

Sno .	Name of the test instrument	Make /Model (to be filled by testing team)	Validity of calibration (to be filled by testing team)
1			dd/mm/yyy
2			
3			
4			
5			
6			
7			
8			

F. **Equipment Configuration Offered:** (to be filled by testing team)

(a) <Equipment/product name> **Configuration:**

S.No.	Item	Details	Remarks

Relevant information like No. of cards, ports, slots, interfaces, size etc. may be filled as applicable for the product

(b) <Other equipment name> **Configuration:**

S.No.	Item	Details	Remarks

Relevant information like No. of cards, ports, slots, interfaces, size etc. may be filled as applicable for the product

G. **Equipment/System Manuals:** (to be filled by testing team) Availability of Maintenance manuals, Installation manual, Repair manual & User Manual etc. **(Y/N)**

H. Clause-wise Test Type and Test No.:

Clause No.	Clause Description	Type of Test / Test No. etc. *
1	Introduction	
1.1	Scope This document contains the Standard for Generic Requirements (GR) of 'Open Radio Access Network (O-RAN)' for deployment in the Indian mobile communication network. O-RAN defines an architecture for radio access network (RAN) that allows to split the RAN functions primarily into CU, DU and RU with well-defined interfaces between them. O-RAN aims to transform the traditional monolithic hardware-centric RAN design into one that uses separate building blocks with open and standardized interfaces. O-RAN focuses on below objectives: - i Leading the industry towards open, interoperable interfaces, RAN virtualization, and big data and AI enabled RAN intelligence. ii Maximizing the use of common-off-the-shelf hardware and merchant silicon and minimizing proprietary hardware. iii Specifying APIs and interfaces, driving standards to adopt them as appropriate, and exploring open source where appropriate. iv The O-RAN Architecture identifies the key functions and interfaces adopted in O-	1. Submit datasheet of O-RAN nodes submitted for Type Approval Network architecture indicating supported interfaces

	RAN. The document specifies Technical Requirements, General Requirements, Features and Functionality of the O-RAN for mobile communication system.	
1.2	**O-RAN**	
1.2.1	**Overview** O-RAN (Open Radio Access Network) offers an open, interoperable, and virtualized architecture that is consistent with 3GPP architecture, enabling network operators to break free from vendor lock-in, reduce costs, and promote innovation. It defines standardized interfaces, supports virtualization, and encourages competition among vendors, fostering flexibility and scalability while ensuring security and readiness for 4G/5G and beyond. O-RAN's global standardization efforts and ecosystem development aim to transform the mobile network landscape, making it more accessible, efficient, and adaptable to evolving telecommunications needs. **Architecture and Interfaces** The Key Component and interfaces of O-RAN are mentioned in GR document.	1. Submit network diagram depicting placement of different Hardware Functional Blocks, Sub-units of O-RAN system submitted for certification. 2. Submit design architecture and functional split of the O-RAN system. 3. Mention the optional interfaces supported by various nodes. 4. Submit undertaking stating class of O-RAN system under testing: Wide Area, Medium Range, Local Area or Home eNodeB.
1.2.4	**Functional Requirements**	
1.2.4.1	**O-RU Functionality**	
1.2.4.1.1	The O-RU shall terminate the Open Fronthaul interface CUS plane (also known as LLS interface) towards O-DU as well as Low-PHY	Explanatory only

	functions of the radio interface towards the UE. This is a physical node.	
1.2.4.1.2	The O-RU shall terminate the Open Fronthaul M-Plane interface towards the O-DU or SMO. O-RU/AAU shall support Open FH interface (including CUS and M Plane) as per O-RAN Alliance specifications.	Explanatory only
1.2.4.1.3	Each O-RU shall manage at least one carrier in LTE/NR (or combination of LTE+NR or DSS) typically in macro outdoor or indoor small cell solutions or as specified by procurer requirements. As per 3GPP specification, O-RU shall support all three modes of IoT (inband, guard band and Standalone).	Submit an undertaking of carriers supported by O-RU in LTE/NR. Test three modes of IoT as per GR_TSTP_1.2.4.1.3
1.2.4.1.4	The O-RU shall support Energy Efficiency & Power Savings i Power saving functionality and shall be power efficient. ii Micro Sleep Transmission, which reduces energy consumption by turning off certain radio hardware components when there is no traffic. iii Low energy scheduler solution (LESS) uses a large amount of resource blocks in the frequency domain to free up space in the time domain. It can help to increase energy efficiency while maintaining the same network performance. iv Discontinuous transmission (DTX) on downlink to save energy during low traffic.	GR_TSTP_1.2.4.1.4

	v Long cycle Discontinuous Reception (C-DRX). vi Decrease of UE battery consumption by typical traffic patterns and reduces the risk of overheating. vii Automatic enablement/ disablement of the main power amplifier (PA) in the radio-unit. The PA may be turned off in the following cases: viii When no PDSCH traffic is scheduled on a subframe; and ix During symbols that do not carry mandatory information	
1.2.4.1.5	In 5G, the O-RU shall support the adaptation of the UL waveform (between CP-OFDM and DFT-s-OFDM) depending on the coverage, doppler effect, scheduling with multiple users and peak rate maximization.	GR_TSTP_1.2.4.1.5
1.2.4.1.6	In 5G, the O-RU shall support at least 4:1 TDD slot pattern configuration: DDDSU and 8:2 TDD slot pattern configuration: DDDSUUDDDD	GR_TSTP_1.2.4.1.6
1.2.4.1.7	The O-RU shall, when operating in 4G TDD mode, support TDD frame structures frame format 1 and 2 and special subframe 6 and 7, according to 3GPP 36.211.	GR_TSTP_1.2.4.1.7
1.2.4.1.8	The O-RU shall support a Cyclic Prefix (CP) between OFDM symbols.	GR_TSTP_1.2.4.1.8
1.2.4.1.9	The O-RU may support below MIMO options:-	GR_TSTP_1.2.4.1.9

	i. SISO, 2X2 MIMO option ii. up to 4 DL MIMO layers in Low Band iii. Downlink Single-User MIMO in Mid Band. iv. Downlink Multi-User MIMO in Mid Band to support minimum 8 layers v.Uplink Multi-User MIMO in Mid Band to support minimum 4-layer UL MU-MIMO for PUSCH transmission	
1.2.4.1.10	Downlink modulation Mode: QPSK,16QAM,64QAM supported in all bands 256QAM in sub-6GHz bands 256QAM in mmWave 1024QAM supported in sub 6GHz bands (Optional) Uplink modulation Mode: π/2BPSK (Optional) ,QPSK,16QAM,64QAM supported in all bands 256QAM supported in sub-6Ghz bands 256QAM supported in mmWave	GR_TSTP_1.2.4.1.10
1.2.4.1.11	O-RU shall support parameter measurement and telemetry including O-RU Alarms Indicators, Status LEDs, support of various counters as defined in ORAN.WG4.MP including transceiver-stat, rx-window-stats, tx-measurement-objects and epe-stats and support for measuring and reporting of EE metrics (power, current voltage, temperature, etc.).	Explanatory only
1.2.4.1.12	O-RU receiver Uplink Noise Figure shall be as per 3GPP requirements and O-RU shall support PIM cancellation methods.	GR_TSTP_1.2.4.1.12

1.2.4.1.13	O-RU shall support AAU Beam-steering capability (user data beam), AAU Front-to-back ratio, AAU Antenna Elements and AAU Number of simultaneous TX user beams/layers per carrier as per capacity requirements.	Explanatory only
1.2.4.14	Sub carrier spacing (SCS) of 15 KHz, 30 KHz and/or 60 KHz and/or 120 KHz shall be supported as per valid combinations of SCS, Cell Carrier Bandwidth and cyclic prefix as specified by 3GPP.	GR_TSTP_1.2.4.1.14
1.2.4.1.15	O-RU shall support Physical layer functions as under:- i Synchronization Signal Block (SSB). ii Uplink (UL) and downlink (DL) demodulation reference signal. iii UL and DL Link Adaptation. iv UL and DL Power Allocation for data channels. v DL Power setting for data channels. vi DL Power setting for signalling and control channels. vii Normal & Extended Cyclic Prefix for OFDM symbols. viii At least one Static TDD Mode with single Bandwidth Part. Communication of timing advance value to UE.	GR_TSTP_1.2.4.1.15
1.2.4.1.16	Operating Frequency & Channel bandwidth i Operating frequency and Channel bandwidth shall be as per the applicable	Explanatory Only

	National Frequency Allocation Plan. ii The system shall be capable of operating in at least one of the frequency bands as per the applicable National Frequency Allocation Plan.	
1.2.4.1.17	In case of 5G O-RU, the Transmitter and Receiver Specification for conducted and radiated mode shall be as per clause 3.24, 3.25, 3.26 and 3.27 respectively of TEC Standard No. 21060:2022 of gNodeB.	TSTP of respective GR may be referred
1.2.4.1.18	In case of 4G O-RU, the Transmitter and Receiver Specification shall be as per clause 2.3.38.2 and 2.3.38.3 respectively of TEC Standard No. 21050:2019 of eNodeB	TSTP of respective GR may be referred
1.2.4.2	O-DU Functionality	

1.2.4.2.1	The O-DU is a logical network function in the O-RAN Architecture. An O-DU, combined with one or more O-RU(s) connected to it, supports and is fully compatible with the functions of a gNodeB-DU as defined by 3GPP TS 38.401.	Explanatory only
1.2.4.2.2	The O-DU shall be implemented either by virtualized or non-virtualized methods.	Undertaking by OEM may be submitted
1.2.4.2.3	The O-DU shall terminate the Open Fronthaul interface CUS plane (also known as LLS interface) towards O-RU as well as the RLC, MAC and High-PHY functions of the radio interface towards the UE.	Explanatory only
1.2.4.2.4	The O-DU may terminate the F1 interface towards O-CU (only if O-CU & O-DU are deployed as split configuration).	Applicable if supported by O-DU, Undertaking by OEM may be submitted
1.2.4.2.5	The O-DU may terminate the O1 interface towards the SMO and E2 interface towards Near RT RIC Platform.	Applicable if supported by O-DU, Undertaking by OEM may be submitted
1.2.4.2.6	The O-DU may terminate the Open Fronthaul M-Plane interface, towards the O-RU, to support O-RU management if hybrid mode is not supported	Applicable if supported by O-DU, Undertaking by OEM may be submitted
1.2.4.2.7	The O-DU shall support CTI to a TN to control UL bandwidth allocation to TUs for UL LLS traffic on shared point-to-multipoint transport network (TN is a PON OLT or DOCSIS CMTS, TU is a PON ONU or DOCSIS Cable Modem).	GR_TSTP_ 1.2.4.2.7
1.2.4.2.8	The number of Front Haul ports shall be according to capacity scenarios	Explanatory Only. To be checked as per specification submitted

1.2.4.2.9	For Layer 1 acceleration, look-aside or inline configuration shall be supported.	GR_TSTP_ 1.2.4.2.9
1.2.4.2.10	O-DU shall support inter gNodeB-O-DU mobility, i.e. when UE moves from one gNodeB-O-DU to another gNodeB-O-DU within the same gNodeB-O-CU.	Self-explanatory (Call Handover may be checked)
1.2.4.2.11	In a centralized scenario where O-DU supports multiple cells on different cell sites, support of intra gNodeB-O-DU mobility shall be there when UE moves from one cell site to other	Self-explanatory (Call Handover may be checked)
1.2.4.2.12	O-DU shall support of inter gNodeB-O-DU mobility for EN-DC, i.e. when UE moves from one gNodeB-O-DU to another gNodeB-O-DU within the same gNodeB-O-CU in case of EN-DC	Self-explanatory (Call Handover may be checked)
1.2.4.2.13	O-DU may support intra gNodeB-O-DU Carrier Aggregation: CA between 2 cells belonging to 2 different O-DUs on the same gNodeB.	GR_TSTP_ 1.2.4.2.13
1.2.4.2.14	O-DU may have routing capabilities to support in-site connection to other/legacy equipment.	GR_TSTP_ 1.2.4.2.14
1.2.4.2.15	O-DU shall support DHCP server to allow O-RU bring-up and IP configuration in a more secure way.	GR_TSTP_ 1.2.4.2.15
1.2.4.2.16	In order to enhance URLLC capabilities, 5G NR O-DUs shall support the existence of non-slot scheduling.	GR_TSTP_ 1.2.4.2.16
1.2.4.2.17	O-DUs may be able to support connectivity to multiple O-CUs for resilience.	GR_TSTP_ 1.2.4.2.17

1.2.4.2.18	DU shall support at least one of the following synchronization options: - NSS (GPS or NAVIC) (to be specified by vendor) EEE 1588 V2 ync E Frequency and Phase Synchronization shall be supported with at least 1 hr hold over mode in case of frequency and phase synchronization loss.	GR_TSTP_ 1.2.4.2.18
1.2.4.2.19	O-DU shall perform the below RLC and MAC functions as under – **1.2.4.2.19.1 Radio Link Control (RLC)** RLC shall be responsible for segmentation and retransmission handling. The RLC shall provide services to the PDCP in the form of RLC channels. There shall be one RLC entity per RLC channel (and hence per radio bearer) configured for a device. Segmentation/ Concatenation: RLC layer shall support segmentation and concatenation to adapt the payload to the transport block size. **1.2.4.2.19.2 Medium Access Control (MAC)** The MAC shall handle multiplexing and de-multiplexing of logical channels, hybrid-ARQ retransmissions, and dynamic resource allocation (scheduling) and scheduling-related functions. The MAC shall provide services to the RLC in the form of logical channels. From the physical layer, the MAC layer shall use the services in the form of transport	GR_TSTP_ 1.2.4.2.19

	channels. Short Buffer Status Report (BSR) and Long BSR Discontinuous Reception (DRX) to enable reasonable UE battery consumption The system shall support: a. Link adaptation and power control; and b. Contention based Random Access (RA) procedure.	

1.2.4.2.20	O-DU may support artificial traffic generation to fill a percentage of Physical Resource Block according to ETSI ES 202 706-1 in order to measure power consumption for different traffic load levels
	• Operator shall set the percentage of PRB to be filled
	• Operator shall choose between below two options:
	  • PDSCH is equally distributed over time within the 10ms radio frame
	  • PDSCH load is concentrated in time, but use the full bandwidth.
		GR_TSTP_ 1.2.4.2.20

1.2.4.3	Open Fronthaul Interface	
1.2.4.3.1	The Open FH (Fronthaul) Interface is between O-DU and O-RU functions. It shall support (as specified in O-RAN alliance from time to time) • CUS (Control User Synchronization) Plane related functions • M (Management) Plane functions	As per O-RAN.WG4.CUS.0-R003-v14.00 As per O-RAN.WG4.MP.0-R003-v14.00

1.2.4.3.2	The Open FH M-Plane interface connects the O-RU to the O-DU in hierarchical mode and the O-RU to the SMO in hybrid mode for FCAPS functionality	Self-Explanatory
1.2.4.4	O-CU Functionality	
1.2.4.4.1	O-CU-CP 1.2.4.4.1.1 The O-CU-CP may terminate the E1 interface towards O-CU-UP (only if O-CU-CP & O-CU-UP are deployed in split configuration). 1.2.4.4.1.2 The O-CU-CP may terminate F1-c interfaces towards O-DU (only if O-DU & O-CU are deployed in split configuration) 1.2.4.4.1.3 The O-CU-CP shall terminate the RRC and PDCP (for SRB) protocols towards the UE. 1.2.4.4.1.4 The O-CU-CP may terminate E2 interface to Near RT RIC Platform. 1.2.4.4.1.5 The O-CU-CP may terminate O1 interface towards the SMO. 1.2.4.4.1.6 The O-CU-CP shall terminate NG-c interface to 5GC. 1.2.4.4.1.7 The O-CU-CP shall terminate X2-c interface to eNB or to en-gNodeB in EN-DC. 1.2.4.4.1.8 The O-CU-CP shall terminate Xn-c to gNodeB or ng-eNB	Self-explanatory (verify from submitted network diagram)
1.2.4.4.2	1.2.4.4.2 O-CU-UP 1.2.4.4.2.1 The O-CU-UP may terminate the E1 interface towards O-CU-CP (only if O-CU-CP & O-CU-UP are deployed in split configuration). 1.2.4.4.2.2 The O-CU-UP may terminate F1-u interfaces towards O-DU (only if ODU & O-CU are deployed in split configuration) 1.2.4.4.2.3 The O-CU-Up shall terminate the PDCP and SDAP protocols towards the UE. 1.2.4.4.2.4 The	Self-explanatory (verify from submitted network diagram)

	O-CU-UP may terminate E2 interface to Near RT RIC Platform. 1.2.4.4.2.5 The O-CU-UP may terminate O1 interface towards the SMO. 1.2.4.4.2.6 The O-CU-UP shall terminate NG-u interface to 5GC. 1.2.4.4.2.7 The O-CU-UP shall terminate X2-u interface to eNB or to en-gNodeB in EN-DC. 1.2.4.4.2.8 The O-CU-UP shall terminate Xn-u to gNodeB or ng-eNB	
1.2.4.4.3	The O-CU may support O-CU-CP and O-CU-UP nodes only if its Control and User part is deployed in split configuration.	GR_TSTP_ 1.2.4.4.3
1.2.4.4.4	gNodeB O-CU and O-vCU may support geo-redundancy mechanism in case of centralized deployment	GR_TSTP_ 1.2.4.4.4
1.2.4.4.5	O-CU-CPs shall be able to support connectivity to multiple O-CU-UPs	GR_TSTP_ 1.2.4.4.5
1.2.4.4.6	O-CU shall provide L3 functions (RRC/RRM, PDCP, SDAP, QoS and VoNR) as under:	Self-Explanatory
1.2.4.4.6.1	QoS requirements as under: ▪ 5QI (5G QoS Identifiers) for NR-Standalone mode as per 3GPP TS 23.501 Table 5.7.4-1. ▪ Multiple data radio bearers (DRBs). ▪ Dynamic addition and deletion of dedicated bearers. ▪ Both UE initiated as well as Network Initiated dedicated bearer creation. ▪ Prioritization of traffic in downlink as per the QCI/ 5QI priority value.	GR_TSTP_ 1.2.4.4.6.1

1.2.4.4.6.2	Voice over NR (VoNR) support as under: - The O-CU shall support Voice over NR (VoNR) functionality, including: ▪ Basic Voice over NR, which provides traffic functions and protocol procedures for establishing, maintaining, and releasing a voice call in NR; ▪ Voice over NR calls, which allow the handling of voice traffic directly; ▪ Intra frequency handover for voice services; and ▪ IP header compression. ▪ Need to include EPS fall-back mechanism since VoNR may not be supported by all the UEs	GR_TSTP_1.2.4.4.6.2
1.2.4.4.6.3	Radio Resource Control/ Radio Resource Management (RRC/ RRM) a) Cell control and AMF support: NG-RAN owns and controls the radio resources of its own cell or cells. Cell resources as requested by and granted to AMF shall be provided in an ordered fashion. b) RRC messages shall be transmitted to the device using signalling radio bearers (SRBs) including SRB0, SRB1and SRB2. c) The O-RAN shall support: i. Event-triggered measurement reporting; ii. System Information Broadcast (SIB); and iii. RRC_IDLE, RRC_CONNECTED, and RRC_INACTIVE states.	GR_TSTP_1.2.4.4.6.3_A GR_TSTP_1.2.4.4.6.3_B GR_TSTP_1.2.4.4.6.3_C
1.2.4.4.6.4	Service Data Adaptation Protocol (SDAP) SDAP shall be responsible for mapping	GR_TSTP_ 1.2.4.4.6.4

	Quality-of-Service (QoS) bearers to radio bearers according to their QoS requirements	
1.2.4.4.6.5	Packet Data Convergence Protocol (PDCP) a) The O-CU shall support; i. integrity protection and ciphering of RRC signalling; ii. RoHC; iii. data recovery; and iv. ciphering of DRBs b) PDCP shall also handle retransmissions, in-sequence delivery, and duplicate removal in the case of handover.	GR_TSTP_1.2.4.4.6.5_A GR_TSTP_1.2.4.4.6.5_B
1.2.4.5	O-CU/O-DU Common features	
1.2.4.5.1	Shall have support of 1.2.4.5.1.1 IPv6 protocol 1.2.4.5.1.2 IPv4 (Optional)	GR_TSTP_1.2.4.5.1
1.2.4.5.2	O-CU/O-DU shall allow SFP ports from 3rd party.	GR_TSTP_1.2.4.5.2
1.2.4.5.3	O-DU/O-CU shall support containerization and containers deployment need to make an efficient use of IP addresses avoiding multiple IP addresses per single CNF with preference only 1 IP address per CNF	GR_TSTP_1.2.4.5.3
1.2.4.5.4	O-DU/O-CU shall support Mid Haul or Back Haul ports as per capacity scenarios.	GR_TSTP_1.2.4.5.4
1.2.4.5.5	O-DU/O-CU shall support platform management through IPMI v2.0 Compliant (or later) or RedFish v1.6.0 Compliant (or later).	GR_TSTP_1.2.4.5.5
1.2.4.5.6	O-CU/O-DU may support stateless implementation.	GR_TSTP_1.2.4.5.6

1.2.4.5.7	In a centralized scenario, where O-DU instances are deployed in a pool of servers, O-RUs may spread load across those multiple O-DU servers such as pooling the processing of many cells in a pool of servers located in the Cloud (edge/regional).	Self-explanatory
1.2.4.5.8	O-DU/O-CU shall support of centralized retransmission in intra gNodeB-OCU/DU scenarios, i.e. the gNodeB-O-CU/DU can switch transmission of data traffic, as well as perform retransmission of undelivered PDCP PDUs, from a gNodeB-O-DU/CU affected by an outage to other available gNodeB-O-DUs/CUs	GR_TSTP_1.2.4.5.8
1.2.4.6	**Midhaul (F1) Interface**	
1.2.4.6.1	The F1 interface shall support: ▪ procedures to establish, maintain and release UE contexts, including handling of the radio bearers for the NG-RAN part of PDU sessions and for EUTRAN Radio Access Bearers; ▪ procedures to establish, maintain and release BH RLC channels; (Optional) ▪ the separation of each UE on the protocol level for user specific signalling management; ▪ the separation of each IAB-MT on the protocol level for IAB-MT specific signalling management; (Optional). ▪ transfer of RRC signalling messages between the UE and the gNodeBCU. Synchronization (S-Plane) Requirements of	GR_TSTP_1.2.4.6.1_A1 GR_TSTP_1.2.4.6.1_A2 GR_TSTP_1.2.4.6.1_A3 GR_TSTP_1.2.4.6.1_A4 GR_TSTP_1.2.4.6.1_A5 GR_TSTP_1.2.4.6.1_A6

	O-RAN	
1.2.4.7	Service Management and Orchestration (SMO) Functionality	
1.2.4.7.1	The key services of the SMO that provide support in O-RAN are: a. OAM interface to O-RAN Network Functions b. Non- RT RIC for RAN optimization c. O-Cloud Management, Orchestration and Workflow Management.	GR_TSTP_1.2.4.7.1
1.2.4.7.2	The SMO shall perform above services through four key interfaces to the O- RAN Elements a.A1 Interface between the Non-RT RIC in the SMO and the Near RT RIC Platform for RAN Optimization b. O1 Interface between the SMO and the O-RAN Network Functions for FCAPS support c. In the hybrid model, Open Fronthaul M-plane interface between SMO and O-RU for FCAPS support TEC Standard No. 21110:2024 31 d. O2 Interface between the SMO and the O-Cloud to provide platform resources and workload management	GR_TSTP_1.2.4.7.2
1.2.4.7.3	SMO shall support FCAPS to O-RAN Network Functions a. The SMO shall provide support for O-RAN network function FCAPS via the O1 Interface b. The following FCAPS functions defined in the O1 Specification shall be provided across the O1 interface :- i. Performance Management (PM) ii. Configuration Management (CM) iii. Fault Management (FM) iv. File Management	GR_TSTP_1.2.4.7.3_A GR_TSTP_1.2.4.7.3_B

	v. Communication Surveillance (Heartbeat) vi. Trace vii. Physical Network Function (PNF) Discovery viii. PNF Software Management	
1.2.4.7.4	SMO shall provide the capability of managing the O-Clouds as well as providing support for the orchestration of platform and application elements and workflow management.	GR_TSTP_1.2.4.7.4
1.2.4.7.5	The SMO shall be able to correlate ME telemetry to Infrastructure and Deployment telemetry to aggregate problems to a root cause and thus correlate a Managed Element to its deployment components	GR_TSTP_1.2.4.7.5
1.2.4.7.6	The O2 interface supports the management of the O-cloud infrastructure and the use of the O-cloud resources allocated to the RAN.	GR_TSTP_1.2.4.7.6
1.2.4.7.7	SMO shall provide the following functionalities: - a. Discovery and administration of O-Cloud Resources b. Scale-In, Scale-Out for O-Cloud c. FCAPS (PM, CM, FM, Communication Surveillance) of O-Cloud d. Software Management of Cloud Platform e. Create, Delete Deployments and Associated Allocated O-Cloud Resources f. Scale-In, Scale-Out Deployments and Allocated O-Cloud Resources g. FCAPS (PM, FM) of Deployments and Allocated O-Cloud Resources h. Software Management of Deployments	GR_TSTP_1.2.4.7.7
1.2.4.8	Non-RT RIC (Non-real time RAN Intelligent Controller) and A1 Interface	
1.2.4.8.1	Non-Real Time RAN Intelligent Controller (Non-	GR_TSTP_1.2.4.8.1

	RT RIC) is the functionality internal to the SMO in O-RAN architecture that provides the A1 interface to the Near-Real Time RIC.	
1.2.4.8.2	The Non-RT RIC is comprised of two sub-functions: a. Non-RT RIC Framework – Functionality internal to the SMO Framework that logically terminates the A1 interface and exposes the required services to rApps through its R1 interface. b. Non-RT RIC Applications (rApps) – Modular applications that leverage the functionality exposed by the Non-RT RIC Framework to perform RAN optimization and other functions. Services exposed to rApps via the R1 interface enable rApps to obtain information and trigger actions (e.g., policies, re-configuration) through the A1, O1, O2 and Open FH M-Plane related services.	Self-explantory
1.2.4.8.3	Non-RT RIC shall support intelligent RAN optimization by providing policy based guidance, ML model management and enrichment information to the Near RT RIC Platform function so that the RAN can optimize.	GR_TSTP_1.2.4.8.3
1.2.4.8.4	The Non-RT RIC framework shall support functionality to register services along with their service producers and Data Producers (including rApps) to register their DME types production capabilities, if such functionality is not supported in the SMO framework.	GR_TSTP_1.2.4.8.4
1.2.4.8.5	The Non-RT RIC framework shall support functionality to allow service consumers to discover services and data Consumers (including rApps) to discover and register available DME types they	GR_TSTP_1.2.4.8.5

	consume, if such functionality is not supported in the SMO framework.	
1.2.4.8.6	The Non-RT RIC framework shall support functionality to allow service consumers to subscribe/unsubscribe notifications about newly registered/updated/deregistered services and Data Consumers (including rApps) to subscribe/request instances of registered DME types for consumption if such functionality is not supported in SMO.	GR_TSTP_1.2.4.8.6
1.2.4.8.7	The Non-RT RIC framework shall support functionality to notify subscribed service consumers about newly registered/updated/deregistered services.	GR_TSTP_1.2.4.8.7
1.2.4.8.8	The Non-RT RIC framework shall support functionality to authenticate and authorize service consumers to access services	GR_TSTP_1.2.4.8.8
1.2.4.8.9	The Non-RT RIC framework shall support functionality to send messages to and receive messages from the Near RT RIC Platform via the A1 interface.	GR_TSTP_1.2.4.8.9
1.2.4.8.10	The Non-RT RIC framework shall support functionality to allow Data Producers (including rApps) to offer instances of registered DME types for collection and storage, if such functionality is not supported in the SMO framework.	GR_TSTP_1.2.4.8.10
1.2.4.8.11	The Non-RT RIC framework shall support functionality to train AI/ML models and allow service consumers to store and retrieve these trained AI/ML models, if such functionality is not supported in the SMO framework.	GR_TSTP_1.2.4.8.11
1.2.4.8.12	The Non-RT RIC framework shall support functionality to monitor the performance for	GR_TSTP_1.2.4.8.12

	deployed AI/ML models in runtime, if such functionality is not supported in the SMO framework.	
1.2.4.8.13	The Non-RT RIC framework shall support functionality to collect external enrichment information from external enrichment information sources.	GR_TSTP_1.2.4.8.13
1.2.4.8.14	The Non-RT RIC framework shall support functionality to retrieve trained ML models (and metadata) from external AI/ML service providers also	GR_TSTP_1.2.4.8.14
1.2.4.8.15	The Non-RT RIC framework shall support functionality to allow external sources to inject RAN intents, suspend/resume/check rApps, and configure/check/initiate/suspend/resume/terminate AI/ML training processes.	GR_TSTP_1.2.4.8.15
1.2.4.8.16	The Non-RT RIC framework shall support functionality to consolidate the alarm information from multiple managed entities, if such functionality is not supported in the SMO framework.	GR_TSTP_1.2.4.8.16
1.2.4.8.17	The Non-RT RIC framework may have the capability to identify the potentially applicable Near RT RIC Platform(s) for A1 policy creation if the Near RT RIC Platform identifier is absent in the create A1 policy request received from the rApp	GR_TSTP_1.2.4.8.17
1.2.4.8.18	The Non-RT RIC framework shall support the functionality to collect trace data, from multiple managed entities and analytical data from the Near RT RIC Platform, if such functionality is not supported in the SMO framework	GR_TSTP_1.2.4.8.18

1.2.4.8.19	The Non-RT RIC framework shall support functionality to allow Data Consumers (including rApps) to consume Deployment and Infrastructure Telemetry metrics collected by the O2- related functions.	GR_TSTP_1.2.4.8.19
1.2.4.8.20	The Non-RT RIC framework shall support functionality that allows managing the configuration, if such functionality is not supported in the SMO framework. Similarly, Non-RT RIC framework shall support functionality that allows obtaining, from an rApp, information about that rApp's performance, fault information related to that rApp, logging information reported by the rApp and to store log information received from rApps, if such functionality is not supported in the SMO framework.	GR_TSTP_1.2.4.8.20
1.2.4.9	Near RT RIC Platform	
1.2.4.9.1	Near RT RIC Platform platform shall provide a database that stores an upto-date RAN information, history of time-varying network state, as well as configurations related to E2 Nodes, Cells, Bearers, Flows, UEs, etc	GR_TSTP_1.2.4.9.1
1.2.4.9.2	Near RT RIC architecture shall also support WG3.RICARCH functional requirements from 5.1.2 (xApp requirements) and 5.1.3 (near-RT RIC API requirements)	GR_TSTP_1.2.4.9.2
1.2.4.9.3	Near RT RIC Platform shall provide AI/ML tools that support for data pipelining, training.	GR_TSTP_1.2.4.9.3
1.2.4.9.4	Near RT RIC Platform shall provide a messaging infrastructure	GR_TSTP_1.2.4.9.4

1.2.4.9.5	Near RT RIC Platform shall provide logging, tracing and metrics collected from Near RT RIC Platform platform and xApps toward SMO.	GR_TSTP_1.2.4.9.5
1.2.4.9.6	Near RT RIC Platform shall provide security functions.	GR_TSTP_1.2.4.9.6
1.2.4.9.7	Near RT RIC Platform shall support resolution of potential conflicts or overlaps of controls from xApps toward an E2 node.	GR_TSTP_1.2.4.9.7
1.2.4.9.8	Near RT RIC Platform shall communicate with xApp(s) via Near RT RIC Platform APIs.	GR_TSTP_1.2.4.9.8
1.2.4.9.9	Near RT RIC Platform shall register the Near RT RIC Platform APIs it produces.	GR_TSTP_1.2.4.9.9
1.2.4.9.10	Near RT RIC Platform shall be capable of discovering the Near RT RIC Platform APIs it consumes.	GR_TSTP_1.2.4.9.10
1.2.4.9.11	Near RT RIC Platform shall provide means to resolve compatibility clashes between xApps and the Near RT RIC Platform services they access.	GR_TSTP_1.2.4.9.11
1.2.4.9.12	Near RT RIC Platform shall support subscription merging from multiple xApps to avoid unnecessary network load.	GR_TSTP_1.2.4.9.12
1.2.4.9.13	Near RT RIC Platform shall provide an O1 interface.	GR_TSTP_1.2.4.9.13
1.2.4.9.14	Near RT RIC Platform shall be able to route A1 policy management messages to the registered xApps based on A1 policy type and operator policies	GR_TSTP_1.2.4.9.14
1.2.4.9.15	Near RT RIC Platform shall control access of A1-EI types for xApps based on operator policies.	GR_TSTP_1.2.4.9.15
1.2.4.9.16	Near RT RIC Platform shall provide APIs enabling the hosting of 3rd party xApps and	GR_TSTP_1.2.4.9.16

	xApps from the Near RT RIC Platform platform vendor.	
1.2.4.9.17	Near RT RIC Platform APIs shall support the Near RT RIC Platform control loop of execution time from 10 milliseconds to 1 second.	GR_TSTP_1.2.4.9.17
1.2.4.9.18	Near RT RIC Platform shall provide APIs decoupled from specific implementation solutions, including a Shared Data Layer (SDL) that works as an overlay for underlying databases and enables simplified data access.	GR_TSTP_1.2.4.9.18
1.2.4.9.19	Near RT RIC Platform shall provide an API repository/registry for the services provided by the Near RT RIC Platform platform and/or xApps.	GR_TSTP_1.2.4.9.19
1.2.4.9.20	Near RT RIC Platform APIs shall provide means for xApps to discover the published APIs based on the xApps' needs;	GR_TSTP_1.2.4.9.20
1.2.4.9.21	Near RT RIC Platform APIs shall provide means to restrict xApps from discovering some published APIs based on configured policies.	GR_TSTP_1.2.4.9.21
1.2.4.9.22	Near RT RIC Platform shall provide APIs enabling all xApps to directly use the information elements of E2SMs with which they are associated.	GR_TSTP_1.2.4.9.22
1.2.4.9.23	Near RT RIC Platform shall provide APIs aiming to simplify the development of xApps and enable rapid innovation.	GR_TSTP_1.2.4.9.23
1.2.4.9.24	Near RT RIC Platform shall provide Near RT RIC Platform APIs supporting xApp development in multiple programming languages (e.g. C, C++, Python, Go).	GR_TSTP_1.2.4.9.24
1.2.4.9.25	Near RT RIC Platform APIs shall support xApp subscription management based on operators' policies. An xApp may be restricted to interface with only a subset of E2 Nodes by such policies.	GR_TSTP_1.2.4.9.25

	Near RT RIC Platform shall be responsible for routing messages between this xApp and the subset of E2 Nodes.	
1.2.4.10	Cloudification and Orchestration	
1.2.4.10.1	The O-Cloud services shall provide the ability to discover what event types the cloud instance supports. The minimal list of supported event types shall be: a. Inventory Change b. Configuration Change c. Fault Events d. Performance Reporting e. Heartbeat f. Shall support O2 interface.	GR_TSTP_1.2.4.10.1
1.2.4.10.2	The O-Cloud shall support O2 interface towards SMO.	GR_TSTP_1.2.4.10.2
1.2.4.10.3	The O-Cloud shall be able to make all Configuration Data and any external changes to it available to the SMO.	GR_TSTP_1.2.4.10.3
1.2.4.10.4	O-Cloud telemetry shall minimally consist of Fault, Performance, and Configuration Data.	GR_TSTP_1.2.4.10.4
1.2.4.10.5	The O-Cloud shall be able to report telemetry of NF deployment relative to those identified in the deployment descriptor.	GR_TSTP_1.2.4.10.5
1.2.4.10.6	The O-Cloud shall be able to report Cloud Infrastructure Resource telemetry and is a major functionality of the O-Cloud represented by the DMS. NF function will have it's own requirement.	GR_TSTP_1.2.4.10.6
1.2.4.10.7	O-Cloud shall provide the collection and reporting of performance information of O-Cloud resources and notify this information.	GR_TSTP_1.2.4.10.7
1.2.4.10.8	O-Cloud shall expose the type of performance information that can be collected for the allocated O-Cloud resource(s) and type of O-	GR_TSTP_1.2.4.10.8

	Cloud resource, for which the performance information can be collected.	
1.2.4.10.9	O-Cloud shall provide the collection and notification of fault information for O-Cloud resources.	GR_TSTP_1.2.4.10.9
1.2.4.10.10	To support the deployments, O-Cloud Provisioning will need to provide several functionalities. There shall be initial support for the following: a. Affinity, Anti-Affinity, Quorum Diversity Rules b. Capacity Query c. Availability Query d. Managed O-Cloud Noe Clusters and Logical Clouds	GR_TSTP_1.2.4.10.10
1.2.4.10.11	O-Cloud shall provide Add, Delete, Update and Query Software Images of O-RAN Cloudified Network Function to O-Cloud repository	GR_TSTP_1.2.4.10.11
1.2.4.10.12	O-Cloud shall provide Software Image properties information of O-RAN Cloudified Network Function	GR_TSTP_1.2.4.10.12
1.2.4.10.13	In O-RAN the O-Cloud Life Cycle Management shall provide the following capabilities: a. Deploy b. Registration c. Scale	GR_TSTP_1.2.4.10.13
1.2.4.11	Operations and Maintenance (OAM) for O-RAN	
1.2.4.11.1	O-RAN OAM Architecture shall support the interaction between the Service Management and Orchestration Framework and the O-Cloud through O2 interface to perform virtualized resource orchestration.	GR_TSTP_1.2.4.11.1
1.2.4.11.2	O-RAN OAM Architecture shall support the capability for the Service Management and Orchestration Framework to consume the provisioning management service exposed by	GR_TSTP_1.2.4.11.2

	the MnF of each O-RAN NF, regardless of whether the NF is implemented as PNF or VNF, through the O1 interface except O-RU.	
1.2.4.11.3	O-RAN OAM Architecture shall support creation, modification and termination of VNFs in an O-RAN network by the Service Management and Orchestration Framework	GR_TSTP_1.2.4.11.3
1.2.4.11.4	O-RAN OAM Architecture shall support registration and inventory of newly activated VNFs and PNFs by the Service Management and Orchestration Framework.	GR_TSTP_1.2.4.11.4
1.2.4.11.5	O-RAN OAM Architecture shall support collection of status change and other indications from VNFs and PNFs by the Service Management and Orchestration Framework	GR_TSTP_1.2.4.11.5
1.2.4.11.6	O-RAN OAM Architecture shall support configuration of VNFs and PNFs by the Service Management and Orchestration Framework, including, for example, addressing information needed to allow them to connect to each other	GR_TSTP_1.2.4.11.6
1.2.4.11.7	O-RAN OAM Architecture shall support management of PM jobs/PM data collection/storage/query/statistical reports from MnFs of O-RAN NFs.	GR_TSTP_1.2.4.11.7
1.2.4.11.8	O-RAN OAM Architecture shall support operation logging, operation authority and management of O-RAN NFs	GR_TSTP_1.2.4.11.8
1.2.4.11.9	O-RAN OAM Architecture shall support management of O-DU, O-CU, ORU and other hardware components	GR_TSTP_1.2.4.11.9
1.2.4.11.10	O-RAN OAM Architecture and interfaces shall support network slicing, where an instance of O-RAN NF may be associated with one or more slices.	GR_TSTP_1.2.4.11.10

1.2.4.11.11	O-RAN OAM Architecture may support O1 interface to the MnF of each O-RAN NF (with the exception of the RU) even if the MnF is deployed behind a NAT.	GR_TSTP_1.2.4.11.11
1.2.4.11.12	The O-RAN OAM architecture shall support the capability of the Service Management and Orchestration (SMO) framework to discover the RAN FCAPS-related management capabilities of the O-RAN MnF that terminates the O1 interface or NF that terminates the Open fronthaul Mplane interface.	GR_TSTP_1.2.4.11.12
1.2.4.12	Operations and Maintenance (OAM) for O-RAN Non-Functional Requirements	
1.2.4.12.1	O-RAN OAM Architecture shall support the introduction of new and more cost-effective technologies into the RAN through open, standard interfaces.	GR_TSTP_1.2.4.12.1
1.2.4.12.2	O-RAN OAM Architecture shall support virtualization of RAN components, allowing operators use of common, off-the-shelf hardware implementations	GR_TSTP_1.2.4.12.2
1.2.4.12.3	O-RAN OAM Architecture shall support use of Analytics and Artificial Intelligence/Machine Learning to improve network efficiency and performance and reduce operations costs.	GR_TSTP_1.2.4.12.3
1.2.4.12.4	O-RAN entities emitting alarms to the SMO shall provide an Alarm Dictionary with the product delivery that is delivered to the SMO at onboarding for O-RAN NFs, xApps and rApps or at registration for OCloud entities and the same shall be updated when the entity emitting the alarm supports a new alarm definition, the information associated with the alarm definition changes or the entity no longer supports an	GR_TSTP_1.2.4.12.4

	alarm definition.	
1.2.4.12.5	The SMO shall maintain the association between an entity version onboarded from a product delivery and its alarm dictionary	GR_TSTP_1.2.4.12.5
1.2.4.12.6	The Alarm Dictionary shall be delivered following the schema to be defined in the IM/DM specification.	GR_TSTP_1.2.4.12.6
1.2.4.12.7	O-RAN OAM Architecture shall support security of interactions between the components of an O-RAN network.	GR_TSTP_1.2.4.12.7
1.2.5	Quality Requirements	
1.2.5.1	The supplier/manufacturer shall conform to ISO 9001:2015 certifications. A quality plan describing the quality assurance system followed by the manufacturer shall be required to be submitted.	GR_TSTP_1.2.5.1
1.2.5.2	For O-RAN, the failure of any component/ sub-system in the system may not result in the failure of complete system.	GR_TSTP_1.2.5.2
1.2.6	EMI/EMC Requirements These requirements are applicable for purposely built hardware or a physical entity only. The equipment shall conform to the following EMC requirements as per TEC Standard No. TEC11016:2016 as modified/ amended from time to time: -	Self-explantory
	1. Conducted and Radiated Emission- CISPR 32 Class-A 2. Immunity to Electrostatic discharge: Contact discharge level 2 {± 4 kV}- IEC-61000-4-2 Performance Criteria-B, Clause 9	GR_TSTP_1.2.6_A1 GR_TSTP_1.2.6_A2 GR_TSTP_1.2.6_A3 GR_TSTP_1.2.6_A4 GR_TSTP_1.2.6_A5

	3. Immunity to Electrostatic discharge: Air discharge level 3 {± 8 kV}-IEC-61000-4-2 Performance Criteria-B, Clause 9 4. Immunity to radiated RF: -IEC 61000-4-3 (2010); Performance Criteria-A, Clause 9 a) Radio Frequency: 80 MHz to 1 GHz, Electromagnetic field: 3V/m b) Radio Frequency: 800 MHz to 960 MHz, Electromagnetic field: 10V/m c) Radio Frequency: 1.4 GHz to 6 GHz, Electromagnetic field: 10V/m 5. Immunity to fast transients (burst): Test Level 2:- IEC 61000- 4- 4 {2012); Performance Criteria-B, Clause 9 a) Immunity to fast transients (burst): Test Level 2: b) 0. 5 kV for signal / control / data / telecom lines 6. Immunity to surges: AC/DC ports: - IEC 61000-4-5 (2014) Performance Criteria-B, Clause 9 a) 2 kV peak open circuit voltage for line to ground b) 1kV peak open circuit voltage for line to line 7. Immunity to surges: Telecom ports: IEC 61000-4-5 (2014) Performance Criteria-C, Clause 9 a) 2 kV peak open circuit voltage for line to ground coupling. b) 2 kV peak open circuit voltage for line-to-line coupling 8. Immunity to conducted disturbance induced by Radio frequency fields:- IEC	GR_TSTP_1.2.6_A6 GR_TSTP_1.2.6_A7 GR_TSTP_1.2.6_A8 GR_TSTP_1.2.6_A9 GR_TSTP_1.2.6_A10

	61000-4-6 (2013) Performance Criteria-A, Clause 9 Under the test level 2 {3 V r.m.s.} in the frequency range 150 kHz-80 MHz for AC / DC lines and Signal /Control/telecom lines. 9. Immunity to voltage dips & short interruptions (applicable to only ac mains power input ports, if any): Limits: - a) a voltage dip corresponding to a reduction of the supply voltage of 30% for 500ms (i.e., 70% supply voltage for 500ms) b) a voltage dip corresponding to a reduction of the supply voltage of 60% for 200ms; (i.e.,40% supply voltage for 200ms) c) a voltage interruption corresponding to a reduction of supply voltage of > 95% for 5s d) a voltage interruption corresponding to a reduction of supply voltage of >95% for 10ms. IEC 61000-4-11 (2004): a) Performance Criteria B for Reduction of Supply 30% for 500ms or Dip to reduction of 60% for 100ms b) Performance Criteria C for Reduction of 60% for 200ms c) Performance criteria C for Voltage Interruption>95% for 5 s (Note: In case of Battery back-up performance criteria A is applicable). d) Performance Criteria B for Voltage	

	Interruption >95% duration :10ms (Note: In case of Battery back-up Performance Criteria A is applicable for above conditions.) 10. Immunity to voltage dips & short interruptions (applicable to only DC power input ports, if any): a) Voltage Interruption with 0% of supply for 10ms. b) Voltage Interruption with 0% of supply for 30ms, 100ms, 300ms and 1000ms. c) Voltage dip corresponding to 40% & 70% of supply for 10ms, 30 ms. d) Voltage dip corresponding to 40% & 70% of supply for 100ms, 300 ms and 1000 ms. e) Voltage variations corresponding to 80% and 120%of supply for 100 ms to 10s as per Table 1c of IEC 61000-4-29. IEC 61000-4-29(2000) a) Applicable Performance Criteria shall be B. b) Applicable Performance Criteria shall be C. c) Applicable Performance Criteria shall be B. d) Applicable Performance Criteria shall be C. e) Applicable Performance Criteria shall be B.	
1.2.7	Safety Requirements 11. The equipment shall conform to relevant safety requirements as per (IS/IEC	GR_TSTP_1.2.7

	62368- 1:2018 or Latest & IS 10437: 2019/IEC 60215: 2016) as prescribed under Table no. 1 of the TEC document 'SAFETY REQUIREMENTS OF TELECOMMUNICATION EQUIPMENT": TEC10009: 2024. These requirements are applicable for purposely built hardware or a physical entity only.	
1.2.8	System Radio Operating Environments	
1.2.8.1	System supervision a. Provision shall be made for continuous testing of the system to allow both system qualities check and fault indication as a fault arises. In case a fault is detected requiring reloading of the program, this shall be carried out automatically. In case of manual re-loading, it shall be possible to stop and start at any particular point in the program.	GR_TSTP_1.2.8.1
1.2.8.2	Relative UE Speed The targeted relative speed between the O-RU and the mobile stations shall be chosen from the following categories: (Applicable for Low/Mid band) a. Stationary (0 km/h) b. Pedestrian (up to 10 km/h) c. Vehicular: 10 km/h to 120 km/h d. High speed vehicular: 120 km/h to 500 km/h For High band, the targeted relative speed between the O-RAN and the mobile station shall be up to 100 km/h.	GR_TSTP_1.2.8.2
1.2.9	Operational Requirements	
1.2.9.1	Availability a. The facility shall be available for	GR_TSTP_1.2.9.1

	introduction of centralized Operation and Maintenance Control (OMC). The maintenance spares supplies shall take in to account the MTBF and MTTR.	
1.2.9.2	Diagnostic Capability a. The diagnostic capability of the system shall be such as to minimize the human efforts required. The diagnostic programs which are normally resident in the on-line program shall be indicated. Details of the off-line diagnostic programs shall be given. The procedure for invoking such programs shall be described. The procedure for consulting fault dictionary for diagnostic programs shall be made available. The system shall provide facility for automatic restart under severe fault conditions. Where automatic restart fails to restore system sanity, facility shall be provided for manual restart of the system.	GR_TSTP_1.2.9.2
1.2.9.3	Environmental Test Conditions: a. Indoor entity (such as CU, DU, RIC, SMO): Category A SD: QM-333 b. Outdoor entity (such as O-RU): Category D SD: QM-333 and IP65 c. Antenna & Feeders: Category E as per SD: QM-333	GR_TSTP_1.2.9.3
1.2.10	General Requirements	Self-Explanatory
1.2.10.1	General	Self-Explanatory
1.2.10.1.1	The operation of the equipment shall be in the frequency band allotted.	Undertaking
1.2.10.1.2	Support of Multiple Equipment Vendors as per	Undertaking

	tender requirement	
1.2.10.1.3	The system shall support the possibility of using equipment and subsystems of different vendors as per defined industry standards, wherever relevant	Undertaking
1.2.10.2	Hardware	
1.2.10.2.1	The system hardware shall be modular in design and shall permit growth in steps. The arrangement shall be such that failure/ deterioration of service shall not occur when implementing the growth.	Undertaking
1.2.10.2.2	Design precautions shall be taken to minimize the possibility of equipment damage arising from the insertion of an electronic package into the wrong connector or the removal of any package from any connector	GR_TSTP_1.2.10.2.2
1.2.10.2.3	The system hardware shall not pose any problem, due to changes in date and time caused by events such as changeover of leap year etc., in the normal functioning of the system.	GR_TSTP_1.2.10.2.3
1.2.10.3	Processors	Explanatory Only
1.2.10.3.1	Provision shall be made to prevent the loss/alteration of memory contents due to power failures, improper operating procedures and the procedure for restoring the system to its normal state, etc	GR_TSTP_1.2.10.3.1
1.2.10.4	Input-Output Devices	Explanatory Only
1.2.10.4.1	The communication facilities provided for exchange of information between the elements of O-RAN and the maintenance and operating personnel shall include facilities for a system test, control and alarm indication at OMC.	GR_TSTP_1.2.10.4.1

1.2.10.4.2	Input / output terminals shall be capable of transmitting/ receiving characters of a subset of the ITU-T T.50 alphabet. The printing/display device shall print/display different graphic symbols for the digit zero and the capital letter O. The input/output terminal shall have the English Keyboard.	GR_TSTP_1.2.10.4.2
1.2.10.4.3	Adequate number of man-machine interfaces shall be available.	GR_TSTP_1.2.10.4.3
1.2.10.4.4	If provision is made for monitoring from a remote terminal, it shall be ensured that the data links conform to the ITU-T Recommendation Q.513. Care shall be taken that the reliability of the data links towards remote terminal does not, in any way, affect the reliability of the O-RAN. Special provision shall also be made for storage of failure event even when the system is unable to transmit an output message.	GR_TSTP_1.2.10.4.4
1.2.10.4.5	A suitable alarm and display system at OMC shall be provided for a continuous indication of the system status.	GR_TSTP_1.2.10.4.5
1.2.10.5	Equipment Practice	Explanatory Only
1.2.10.5.1	For indoor O-RAN components like O-CU, O-DU, SMO, RIC etc., suitable test access points and displays shall be provided for facilitating maintenance. Test access points shall be located on the front side of the bay. All visual display devices shall be located in a position attracting immediate attention of the operation and maintenance personnel.	Undertaking
1.2.10.5.2	For O-RAN components like O-RU, O-CU, O-DU, SMO, RIC etc, it shall be indicated whether printed board connectors are of edge-type or	Undertaking

	plug-andsocket type. They shall not be easily damaged during replacements and removals. The contact particulars as well as life test performance on contact resistance for each type of connector shall be supplied.	
1.2.10.5.3	All components and material used in the equipment shall be noninflammable or in absence of it, self-extinguishable. They shall be fully tropicalised.	Undertaking
1.2.10.5.4	For O-RAN components like O-RU, O-CU, O-DU, SMO, RIC etc, the method used for connection of permanent wiring outside the printed cards shall be indicated.	Undertaking
1.2.10.5.5	The buses, if any, shall be suitably protected against electrical and magnetic interference from neighbouring systems (like electromechanical systems, fluorescent tubes, motors, etc.).	Undertaking
1.2.10.5.6	For O-RAN components like O-RU, O-CU, O-DU, SMO, RIC etc, the different plug-in cards shall have suitable mechanical safeguards to prevent damage due to accidental interchange of cards	Undertaking
1.2.10.5.7	The requirement at the external interface against induced voltages and currents due to lightning, high power system, etc. shall be indicated.	GR_TSTP_1.2.10.5.7
1.2.10.5.8	The system shall provide for human isolation and protection from accidental high voltage power contact.	GR_TSTP_1.2.10.5.8
1.2.10.6	Quality Requirements	Explanatory Only
1.2.10.6.1	The components used shall be available from multiple sources with adequate qualification. Number of proprietary components used shall	Undertaking

	be minimum. List of such components shall be indicated.	
1.2.10.6.2	All the equipment shall have a tropical finish and coated to protect against saline atmosphere.	Undertaking
1.2.10.7	Software	Explanatory Only
1.2.10.7.1	The software shall be written in a High-Level Language. The software shall be modular and structured.	Undertaking
1.2.10.7.2	The software shall include the following characteristics: a. The design of the software shall be such that the system is easy to handle both during installation and normal operations as well as during extensions. b. The functional modularity of the software shall permit introduction of changes wherever necessary with least impact on other modules. c. It shall be open-ended to allow addition of new features. d. Adequate flexibility shall be available to easily adopt changes in service features & facilities and technological evolution in hardware. e. The design shall be such that propagation of software faults is contained. f. Test programs shall include fault tracing for detection and localization of system faults.	Undertaking
1.2.10.8	Software Maintenance	Explanatory Only
1.2.10.8.1	All software updates, for a period as specified,	Undertaking

	shall be supplied on continuing basis. These updates shall include new features and services and other maintenance updates.	
1.2.10.8.2	Integration of software updates without posing any problem to the existing functionality shall be possible.	Undertaking
1.2.10.9	O-RAN Security	Explanatory Only
1.2.10.9.1	The O-RAN shall provide the protection against DOS attack. The vendor shall describe how to protect against DOS attack in their system.	GR_TSTP_1.2.10.9.1
1.2.10.9.2	The different O-RAN components such as O-RU, O-CU, O-DU, RIC, SMO etc. shall comply to the security requirements mentioned in the applicable Indian Telecommunication Security Assurance Requirements (ITSAR) as and when notified by National Centre for communication Security (NCCS).	TSTP will be updated once ITSAR is published. GR_TSTP_1.2.10.9.2_A

TEST SETUP 1

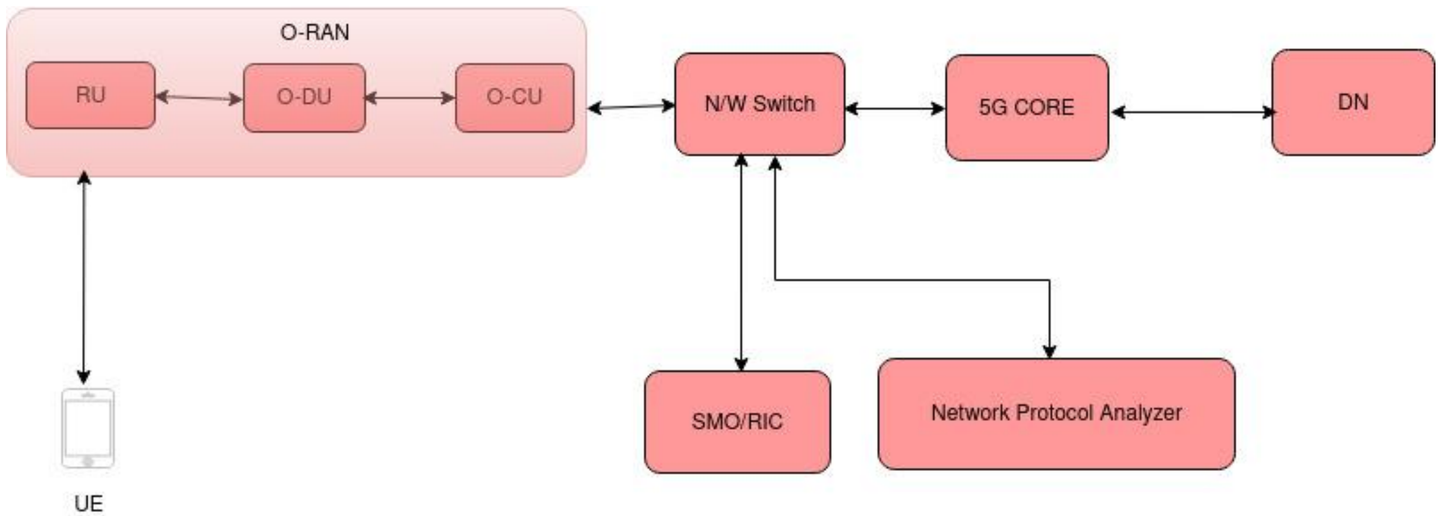
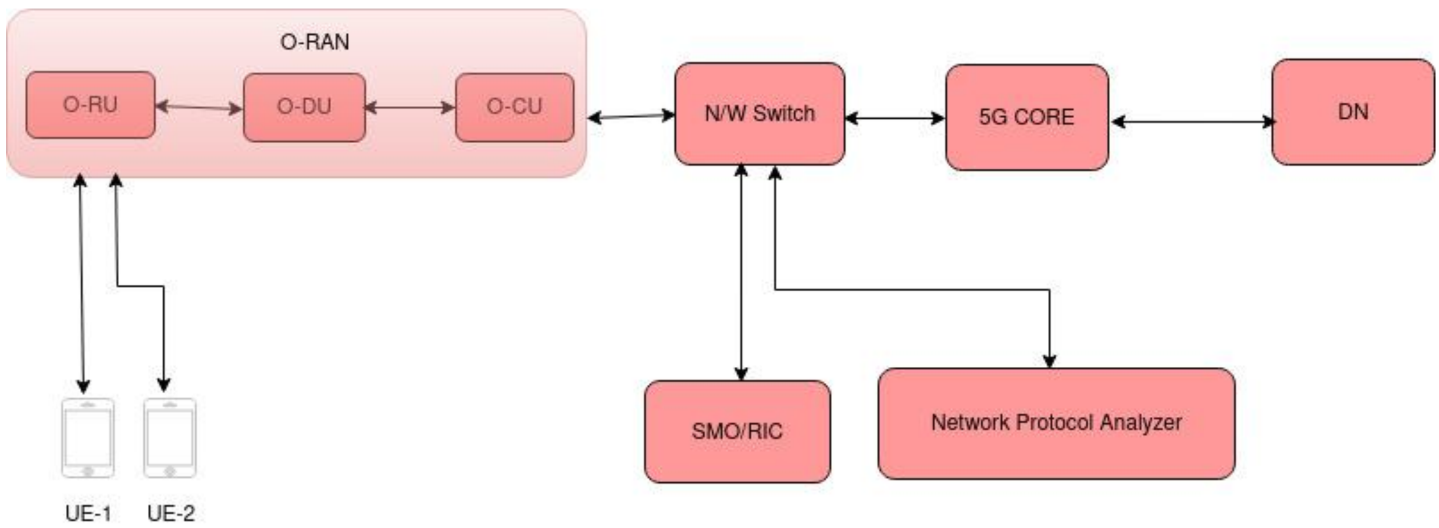


Figure 1: TEST SETUP 1

TEST SETUP 2



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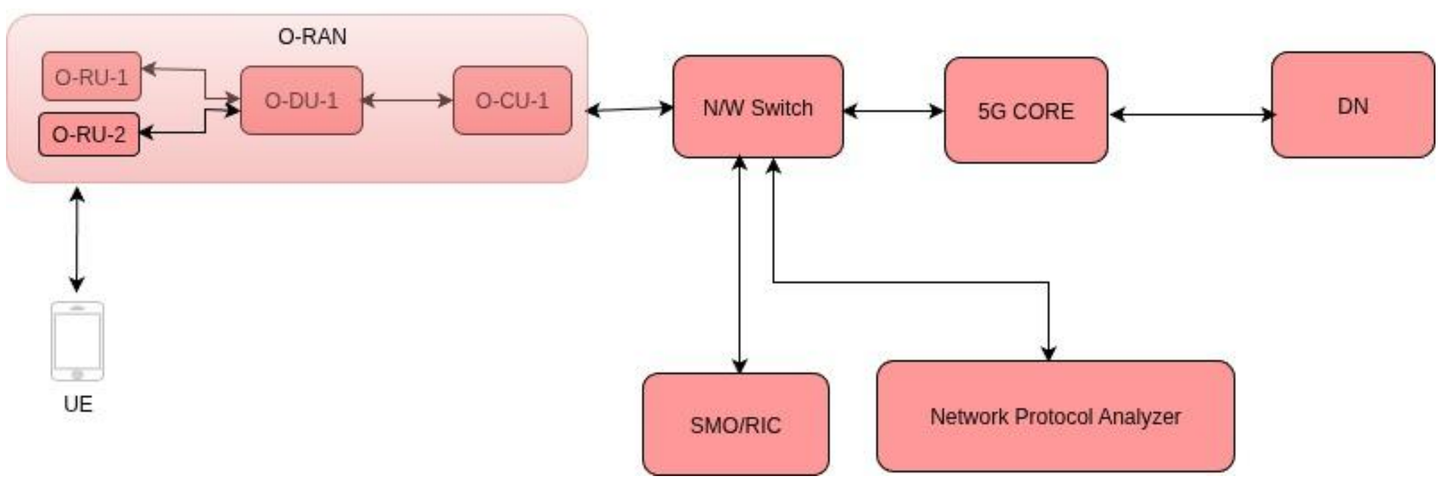
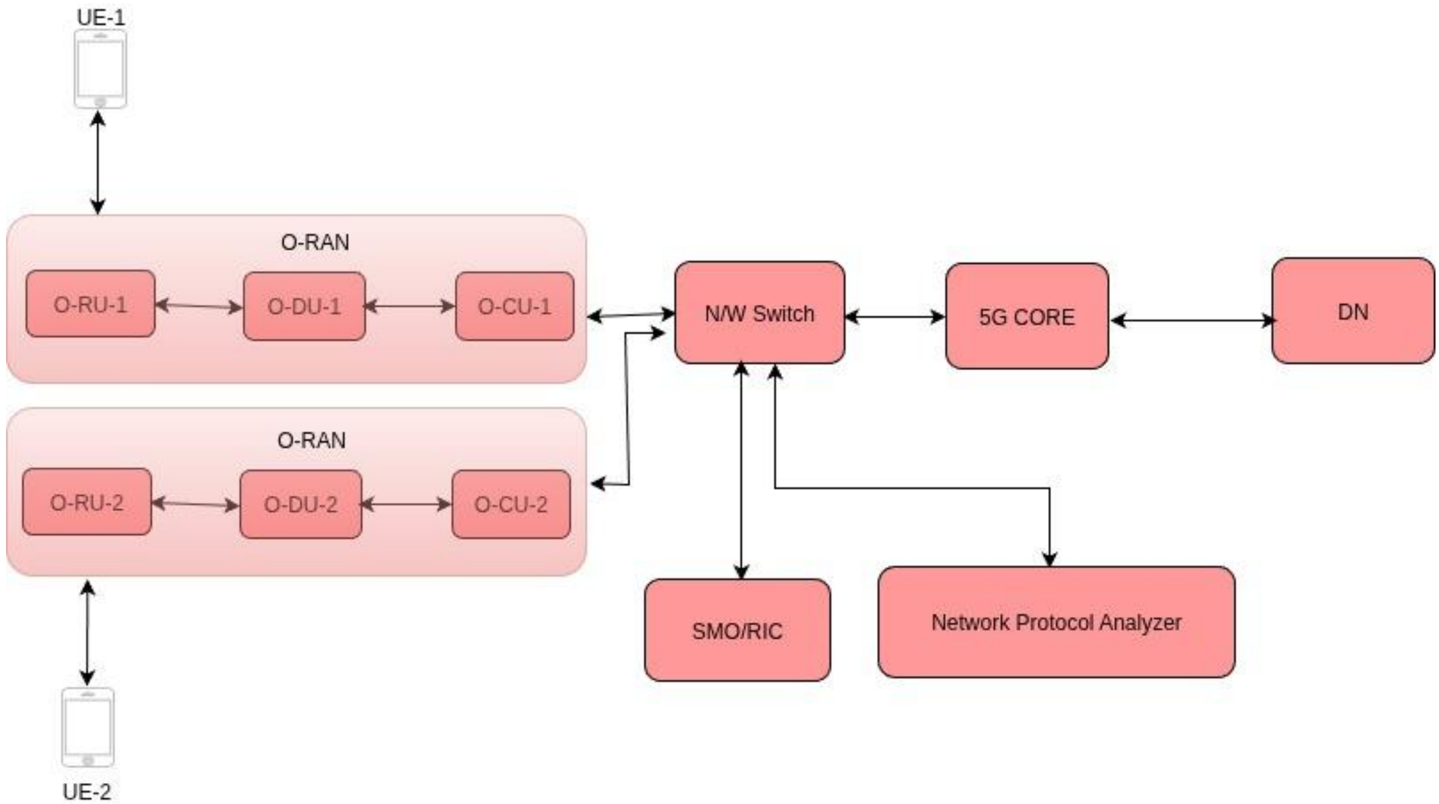
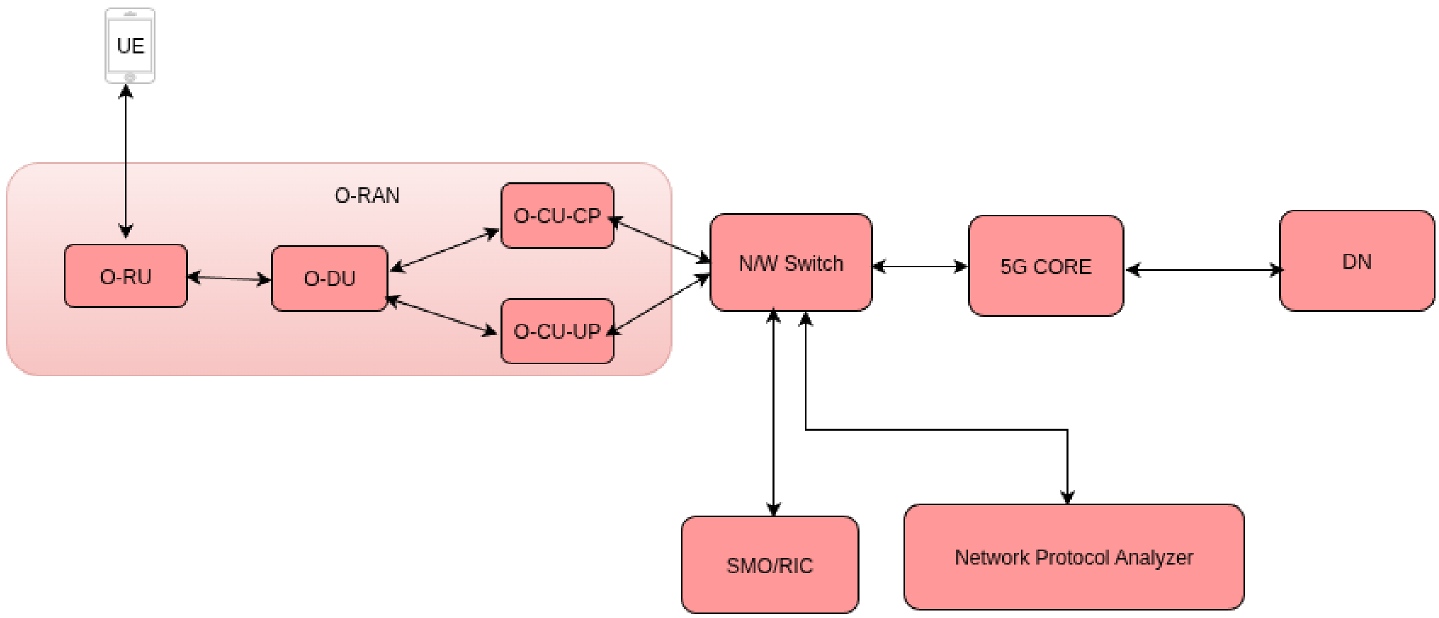


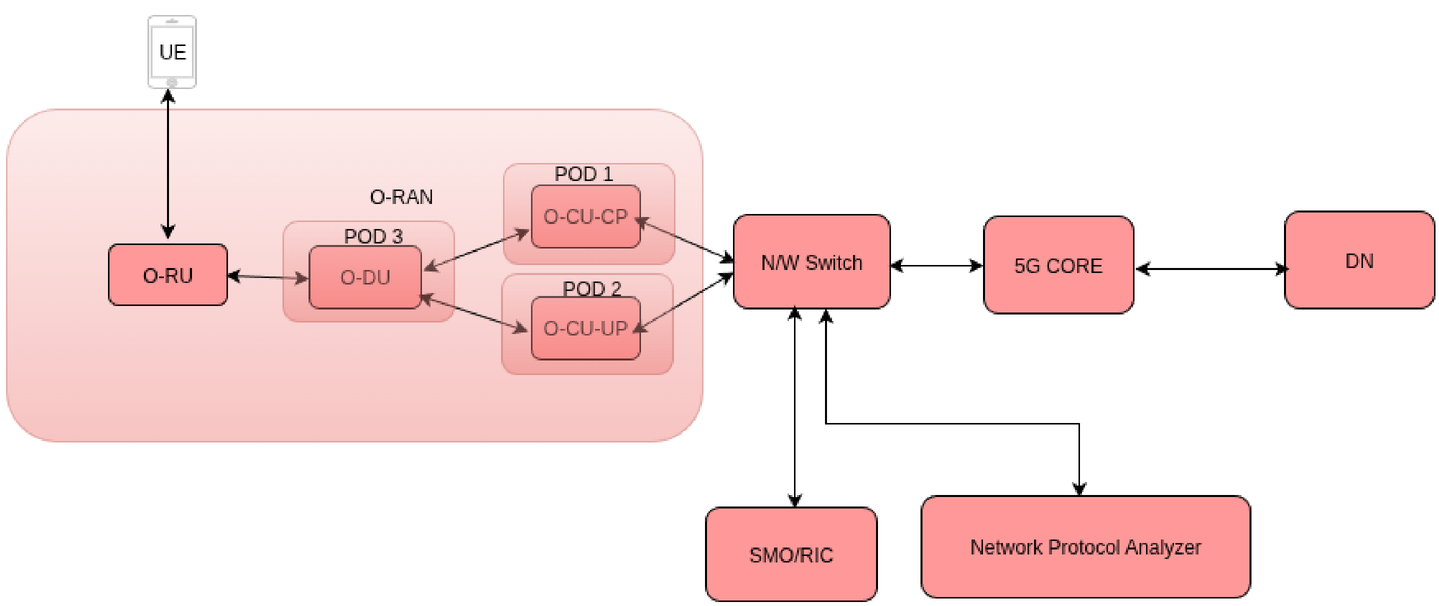
TEST SETUP 4


UE-1
O-RAN
O-RU-1
O-DU-1
O-CU-1
O-RAN
O-RU-2
O-DU-2
O-CU-2
UE-2
N/W Switch
5G CORE
DN
SMO/RIC
Network Protocol Analyzer

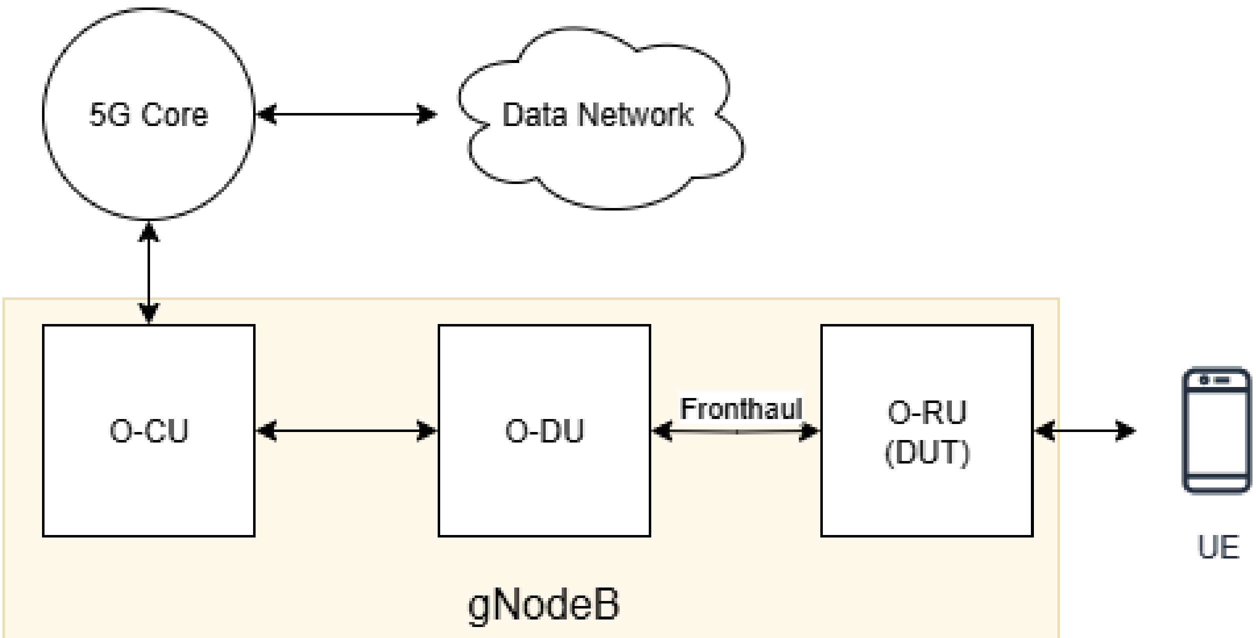
TEST SETUP 5



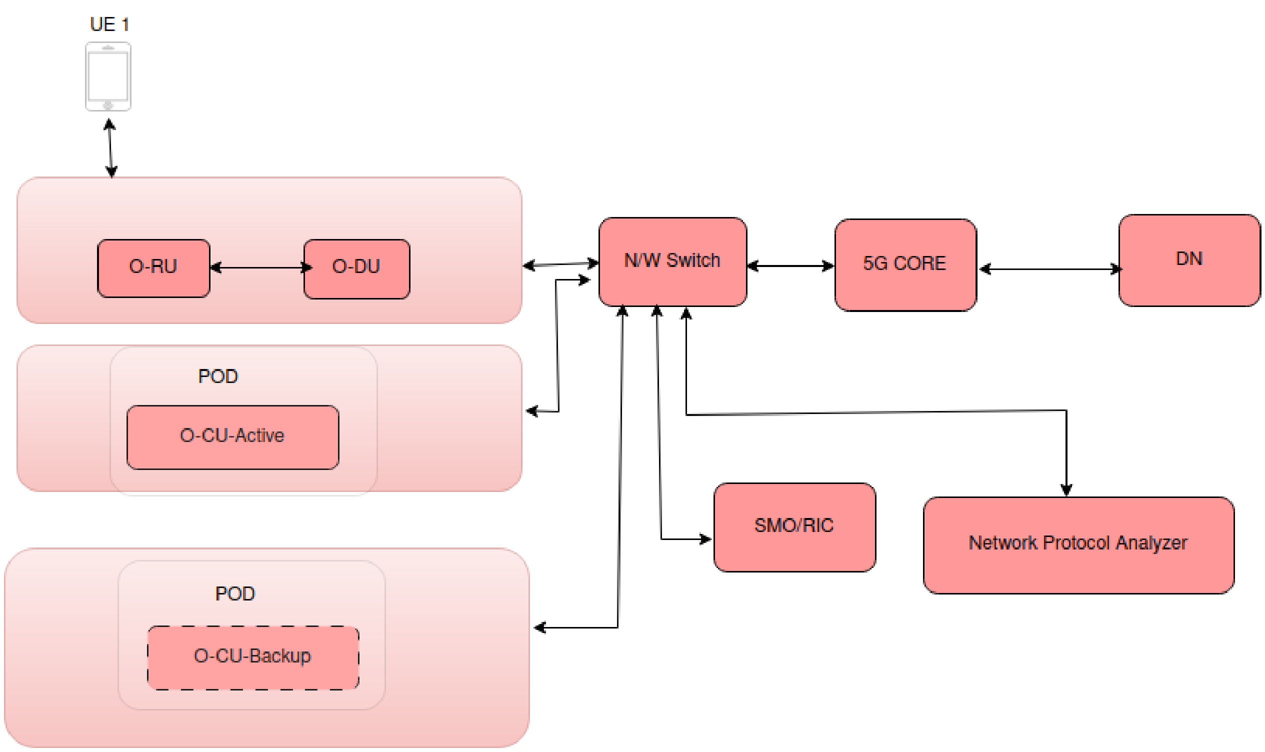
TEST SETUP 6



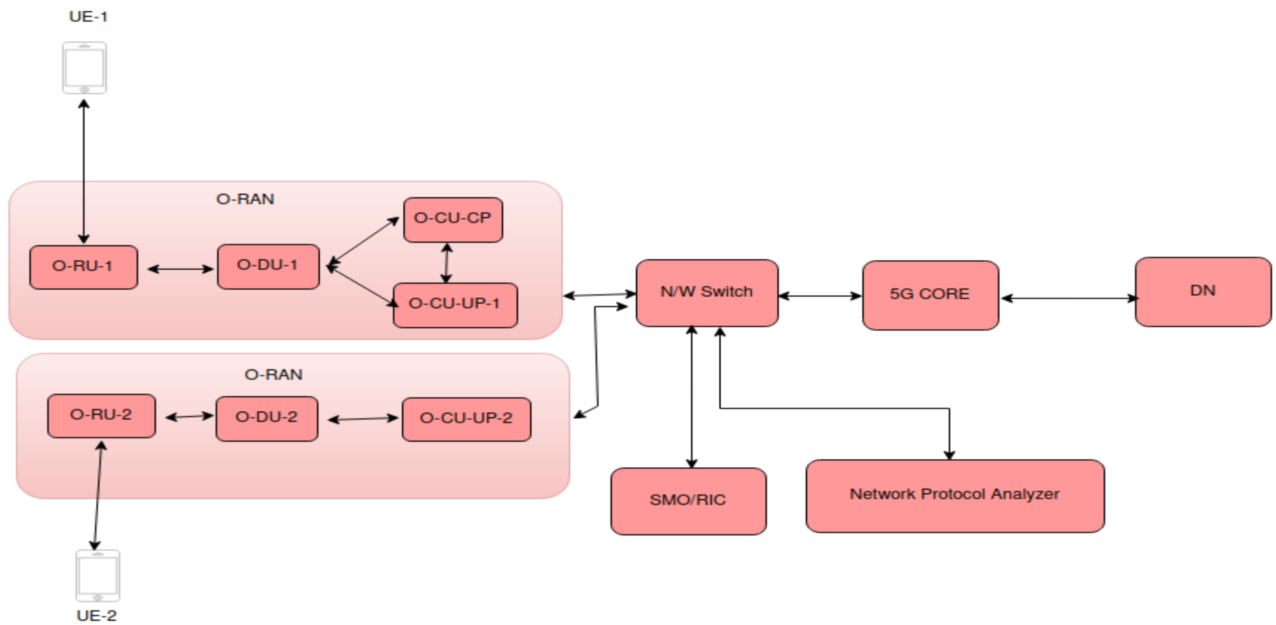
TEST SETUP 7



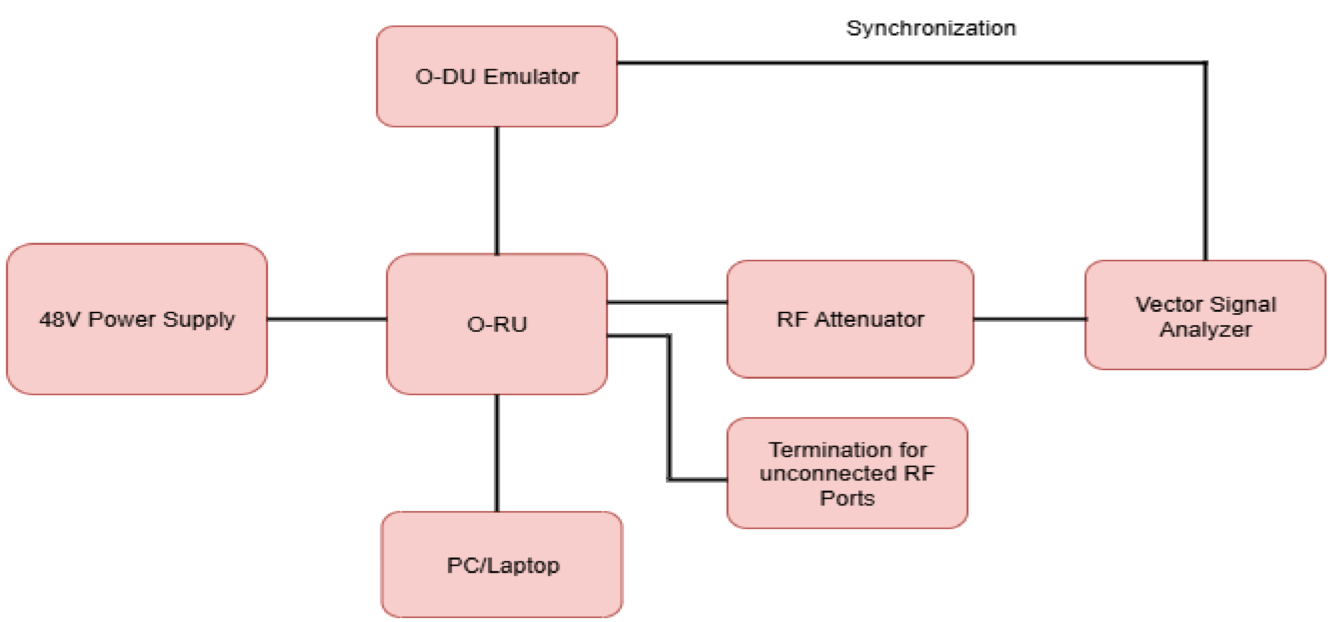
TEST SETUP 8



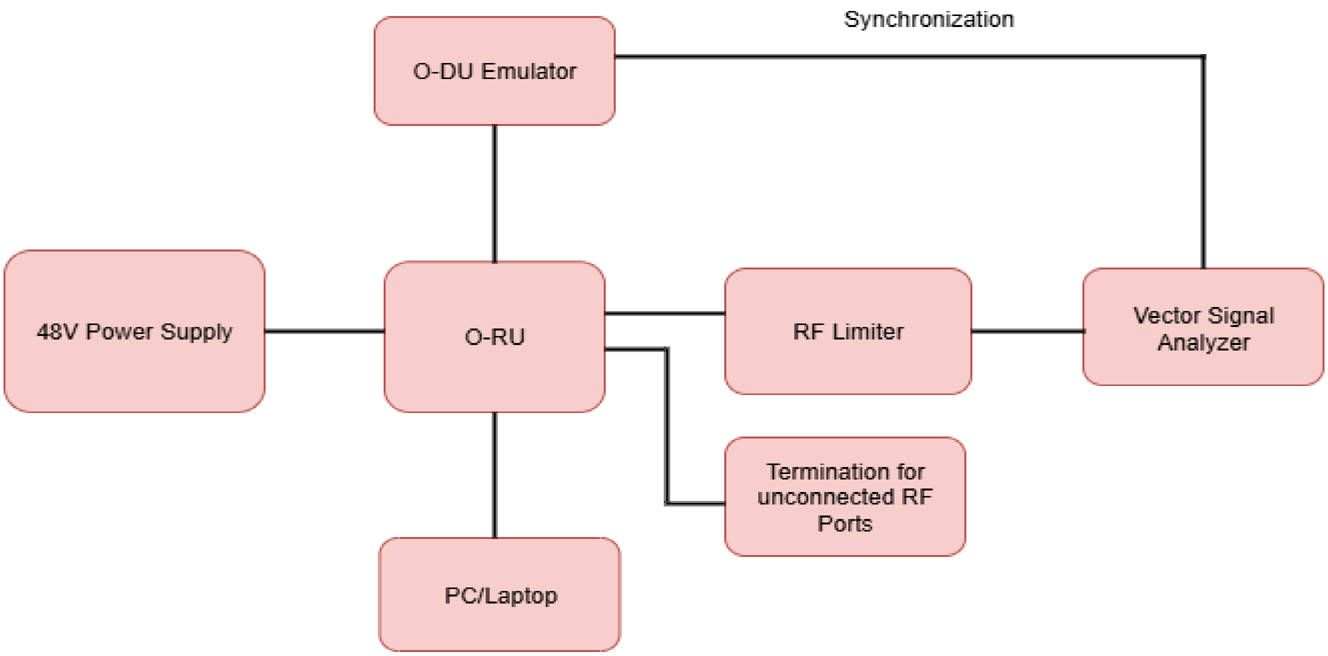
TEST SETUP 9



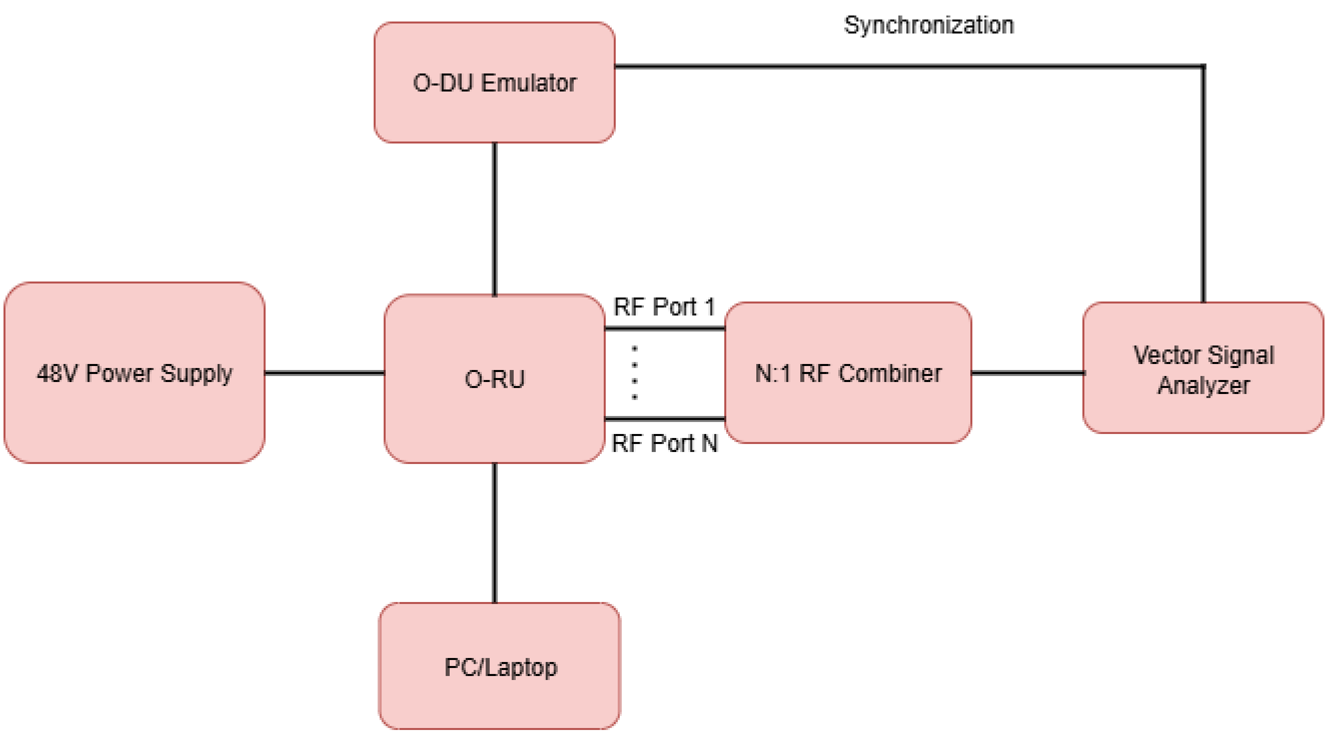
TEST SETUP 10



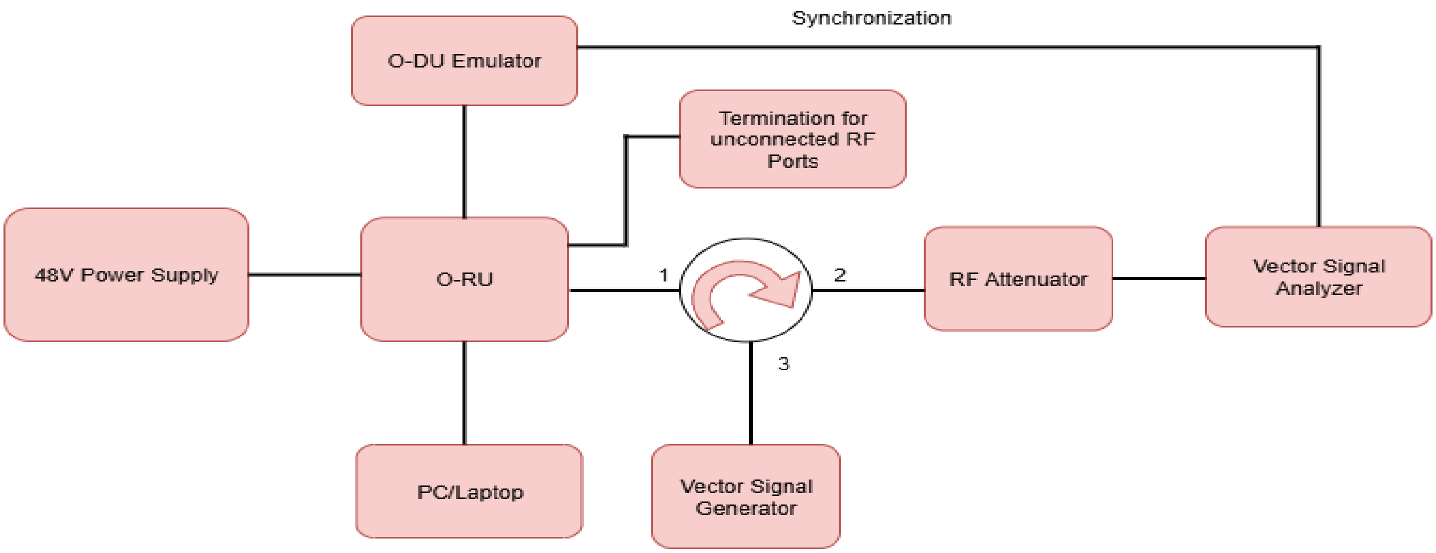
TEST SETUP 11



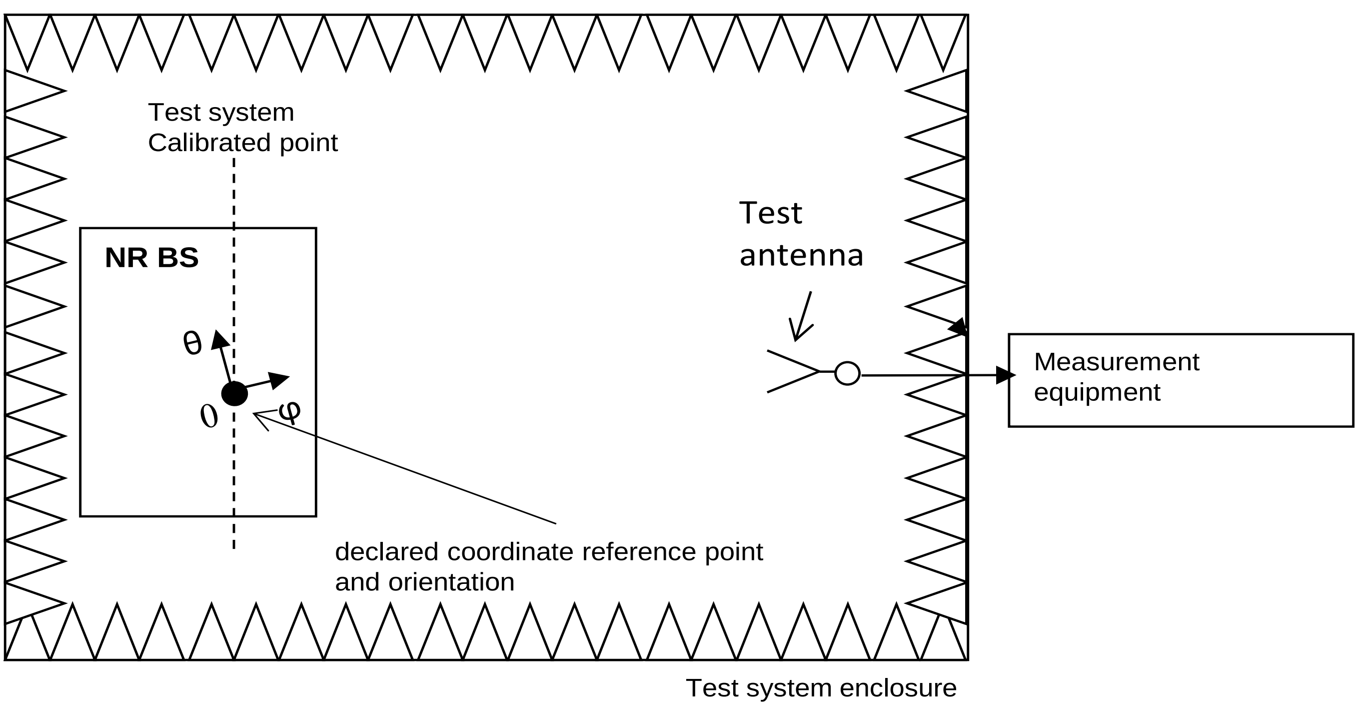
TEST SETUP 12



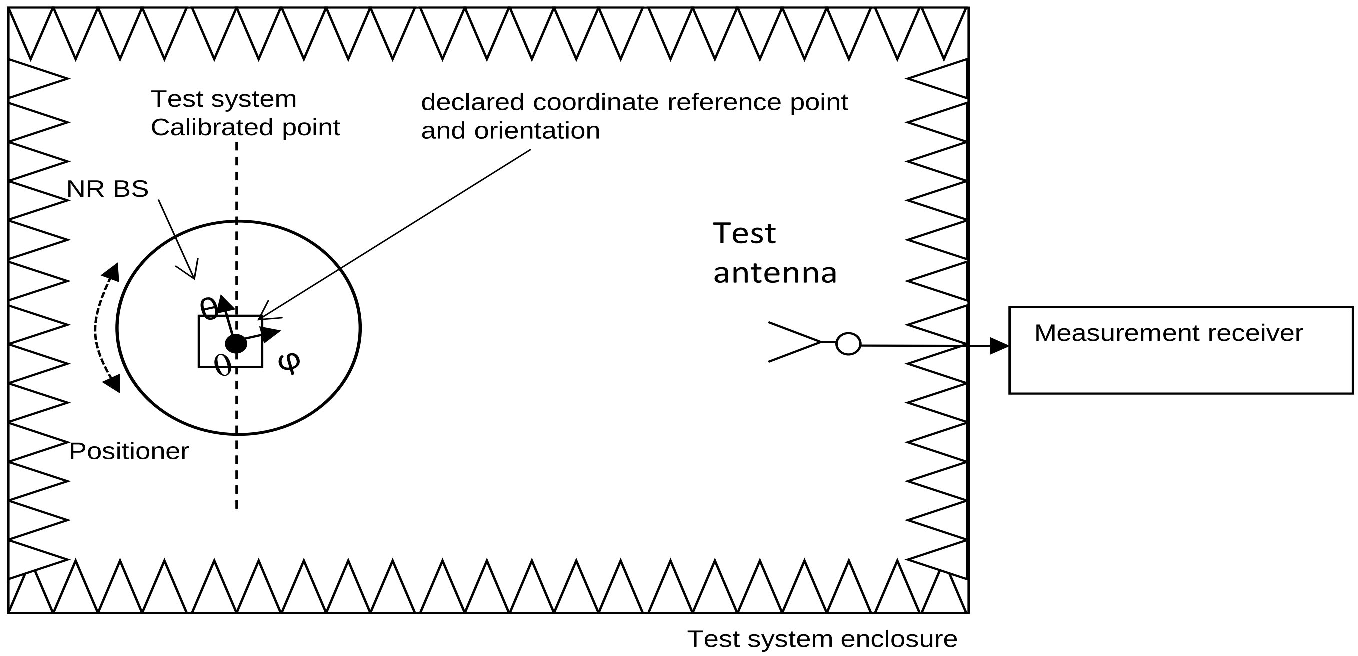
TEST SETUP 13



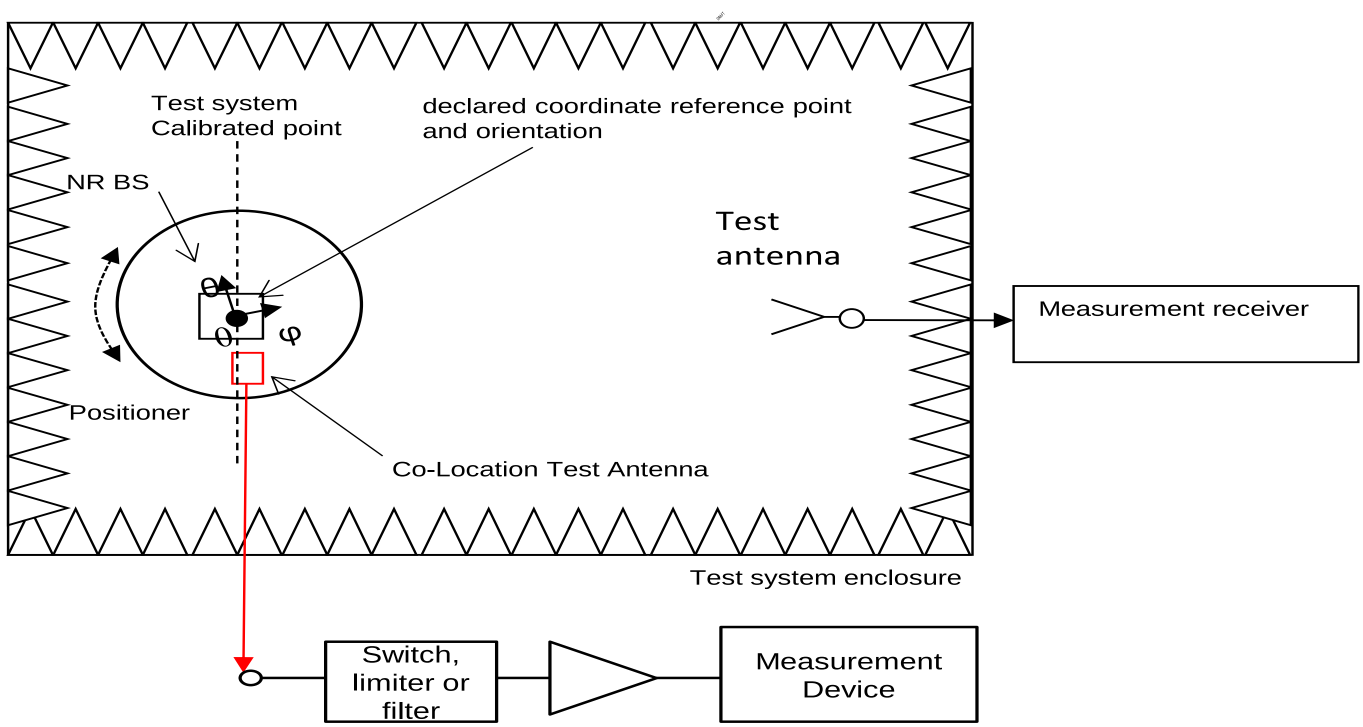
TEST SETUP 14



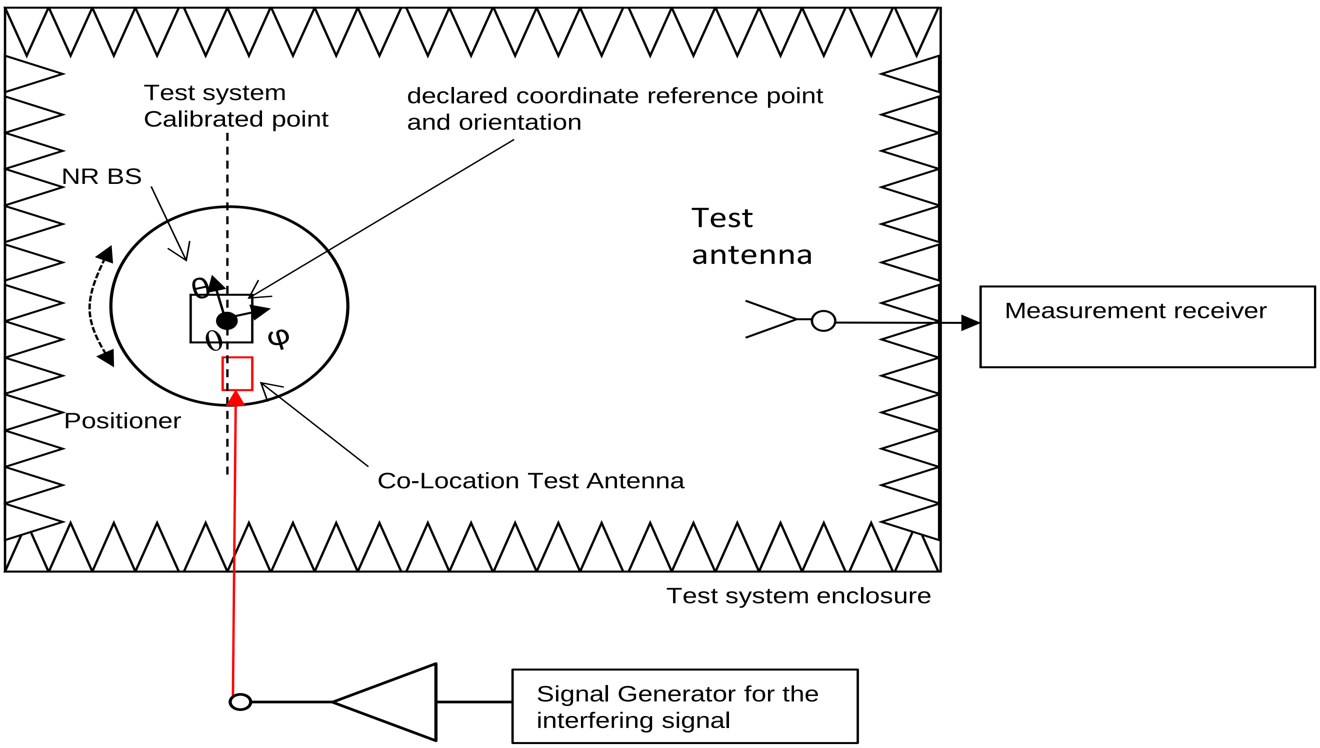
TEST SETUP 15



TEST SETUP 16



TEST SETUP 17



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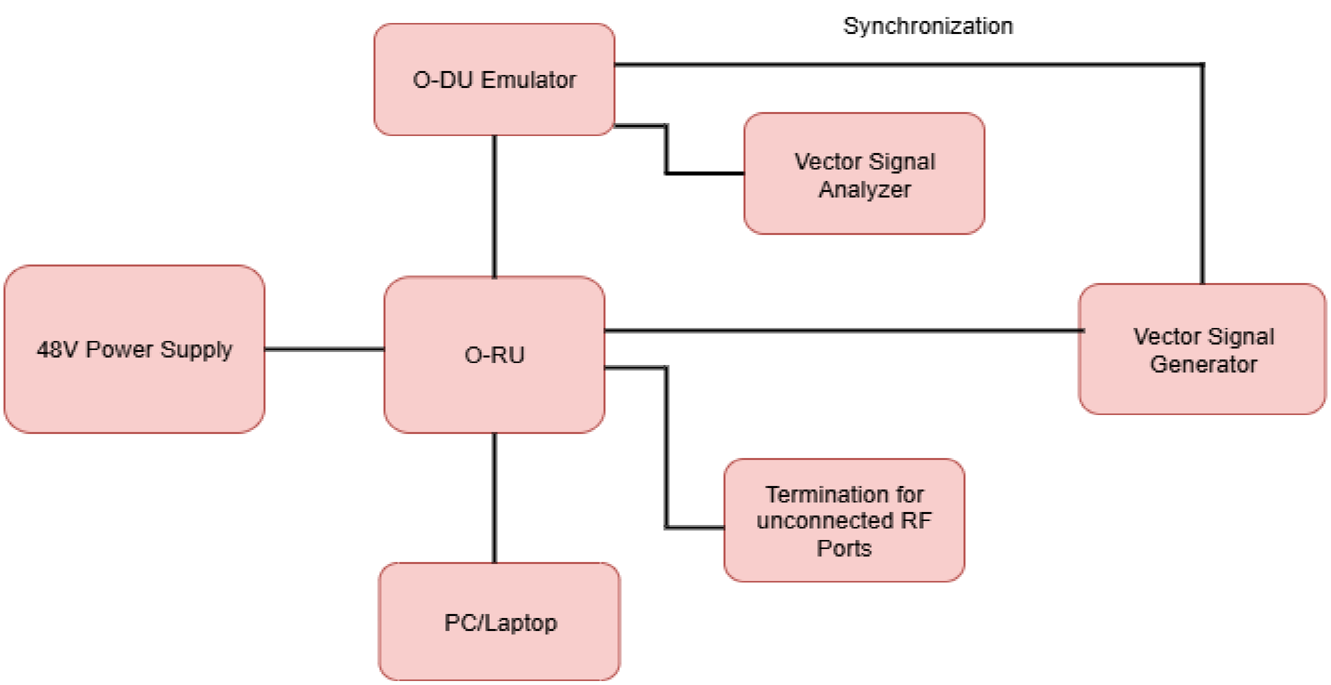
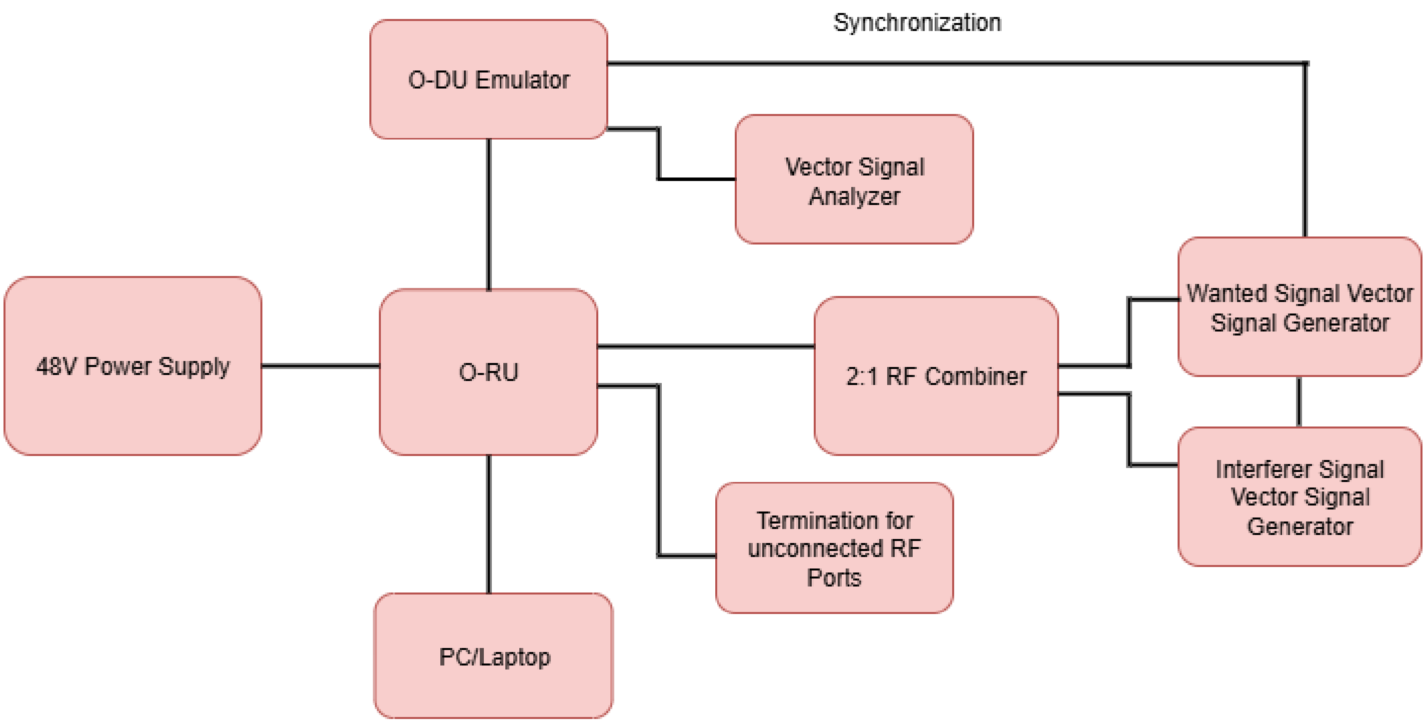
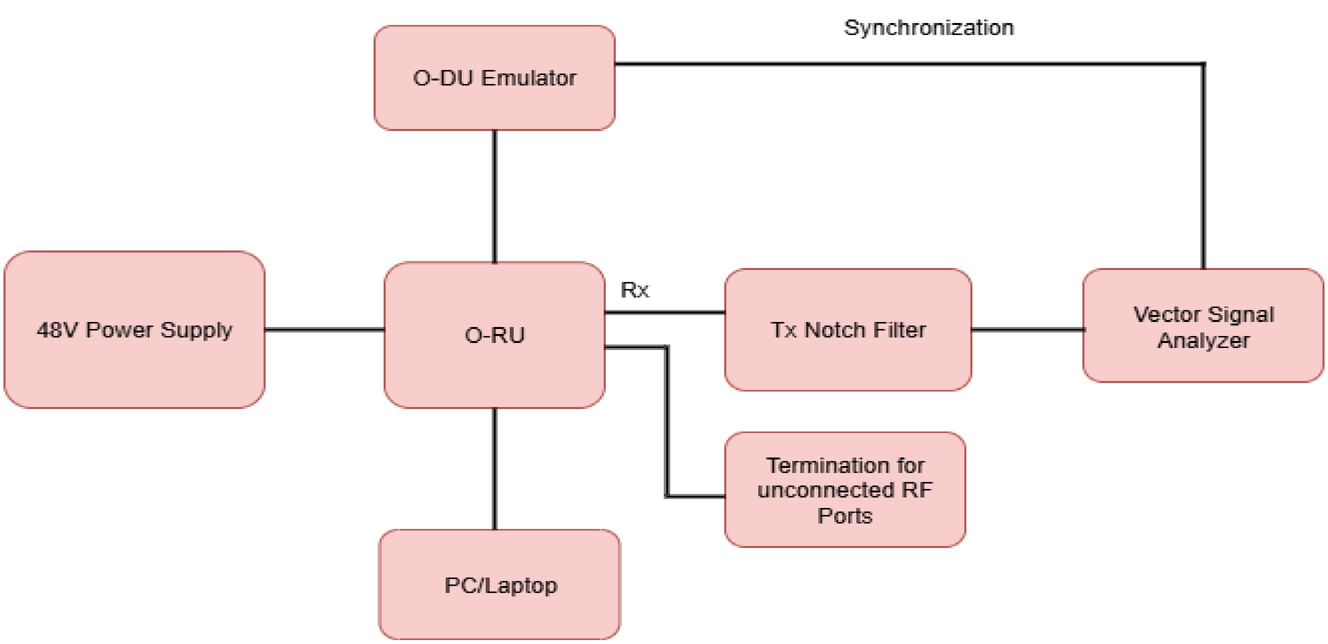


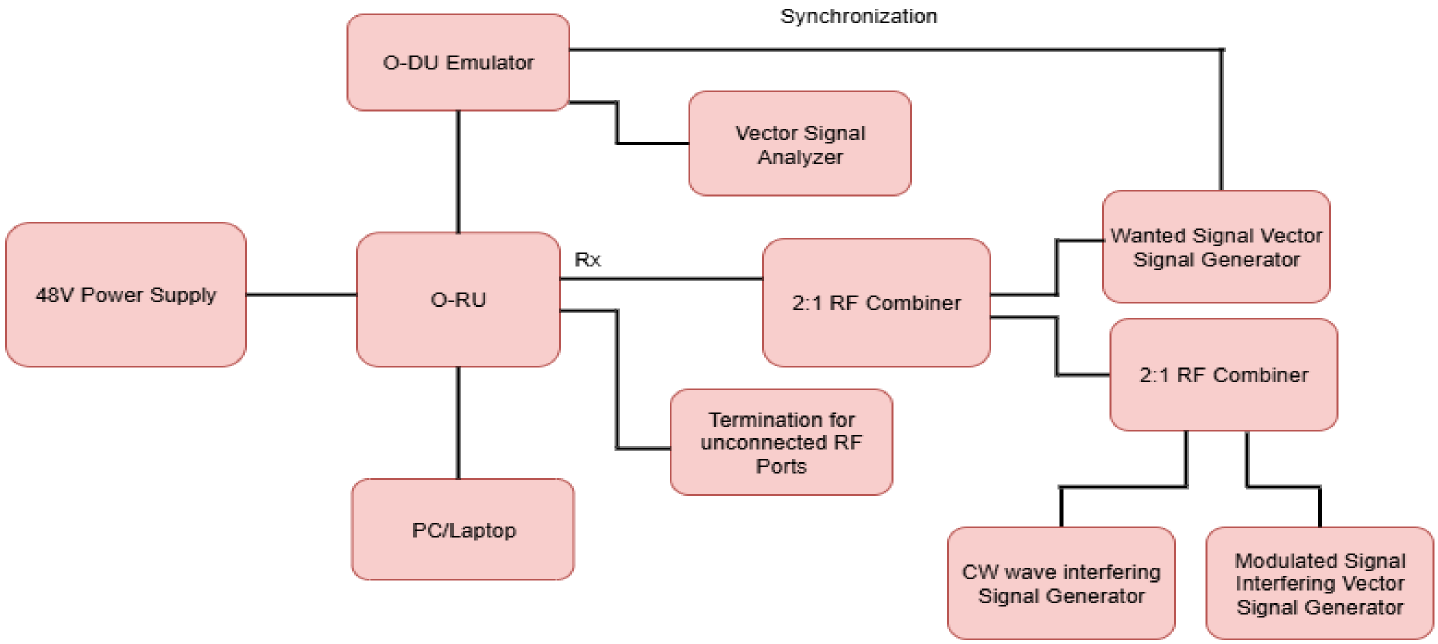
TEST SETUP 19



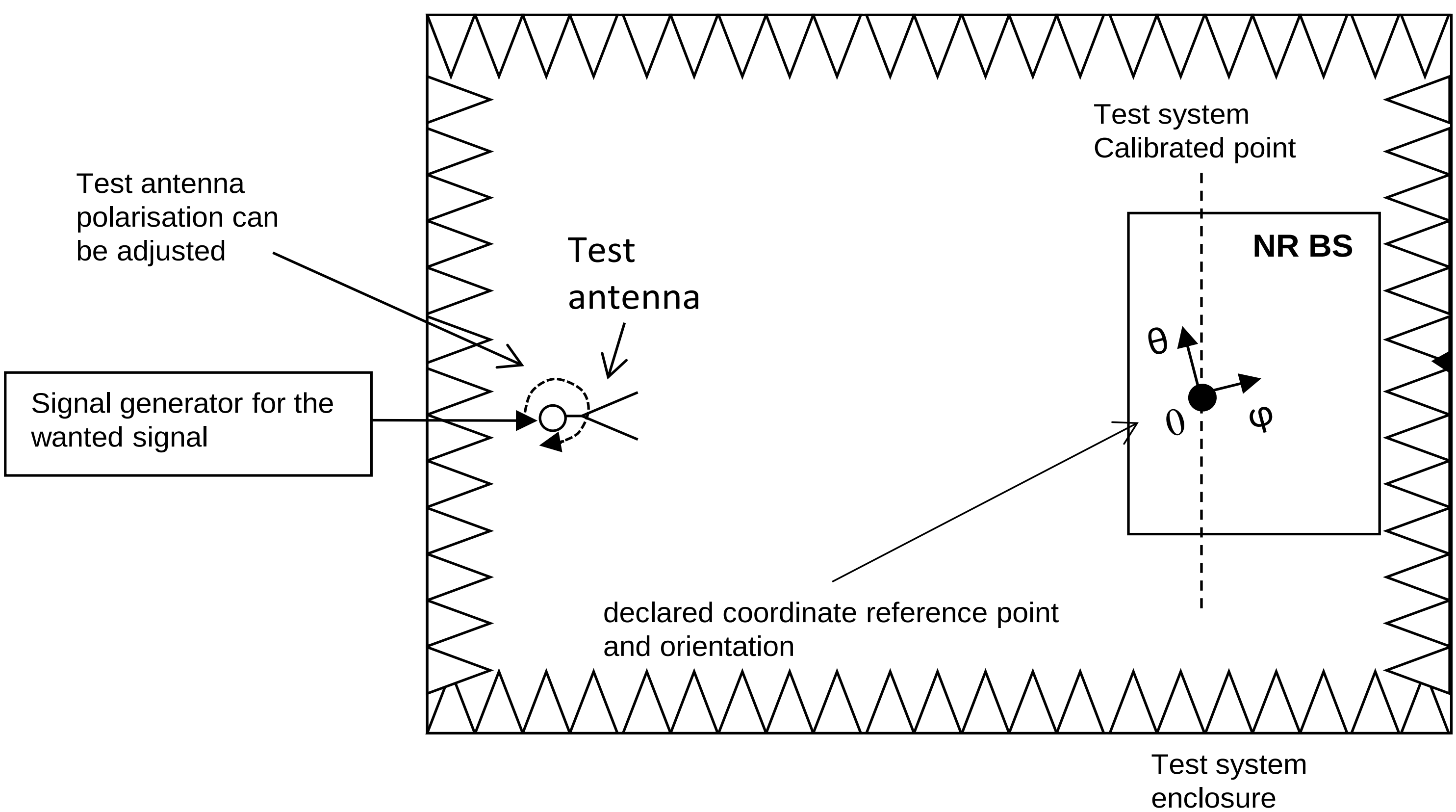
TEST SETUP 20



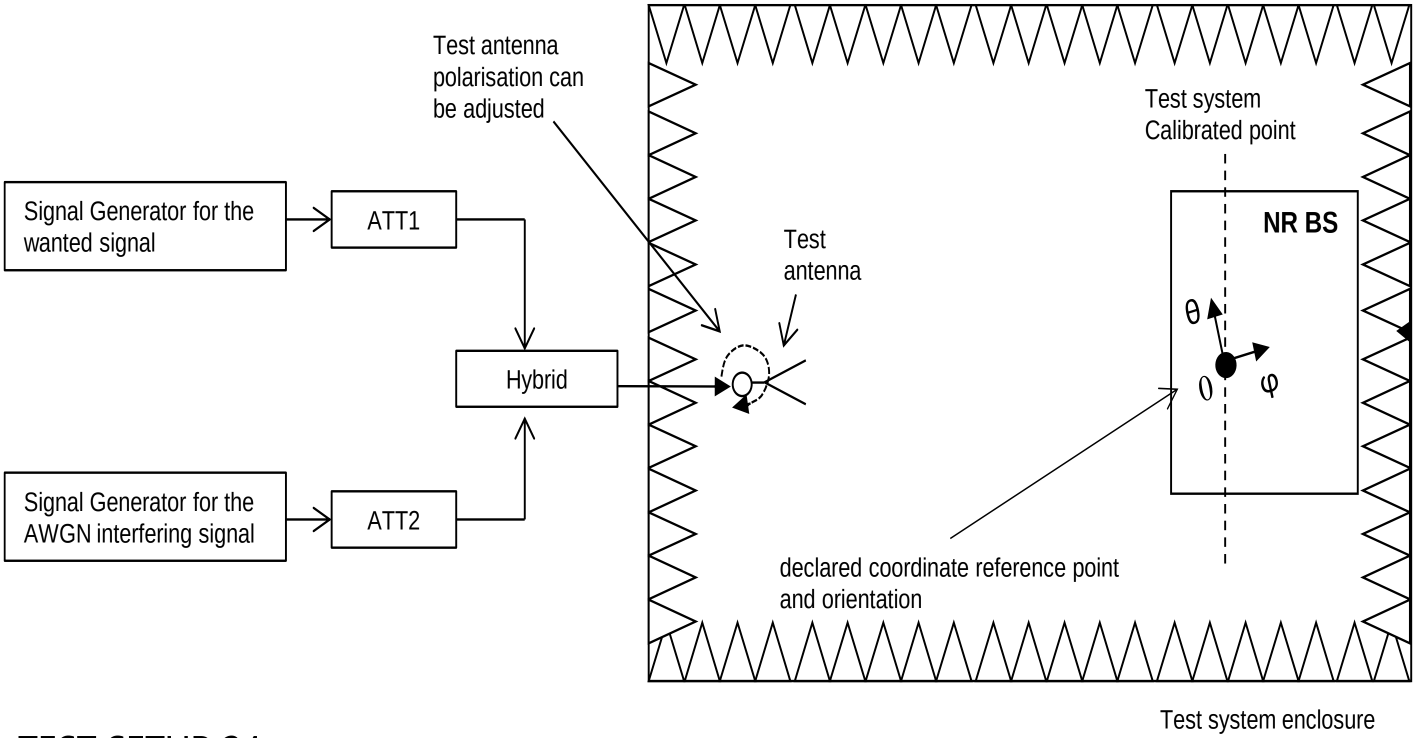
TEST SETUP 21



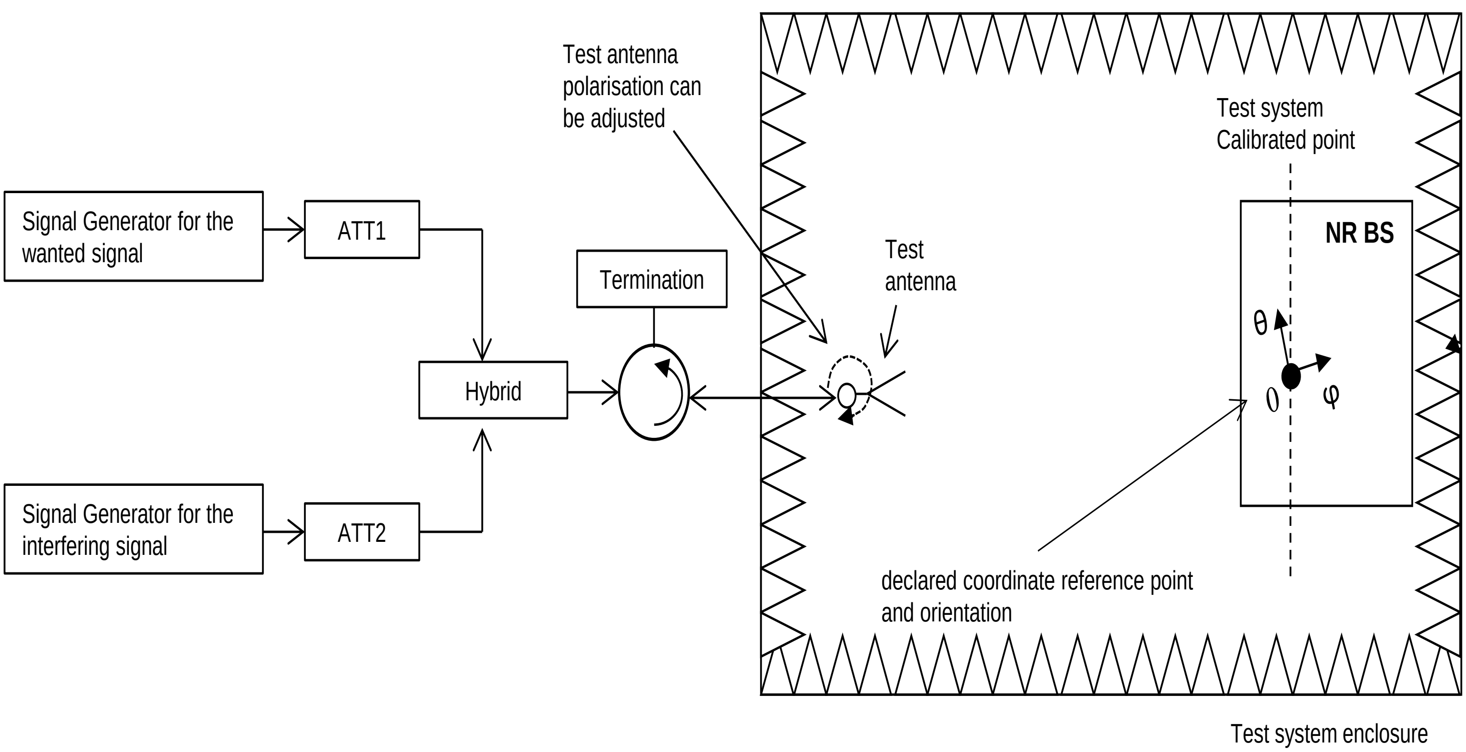
TEST SETUP 22



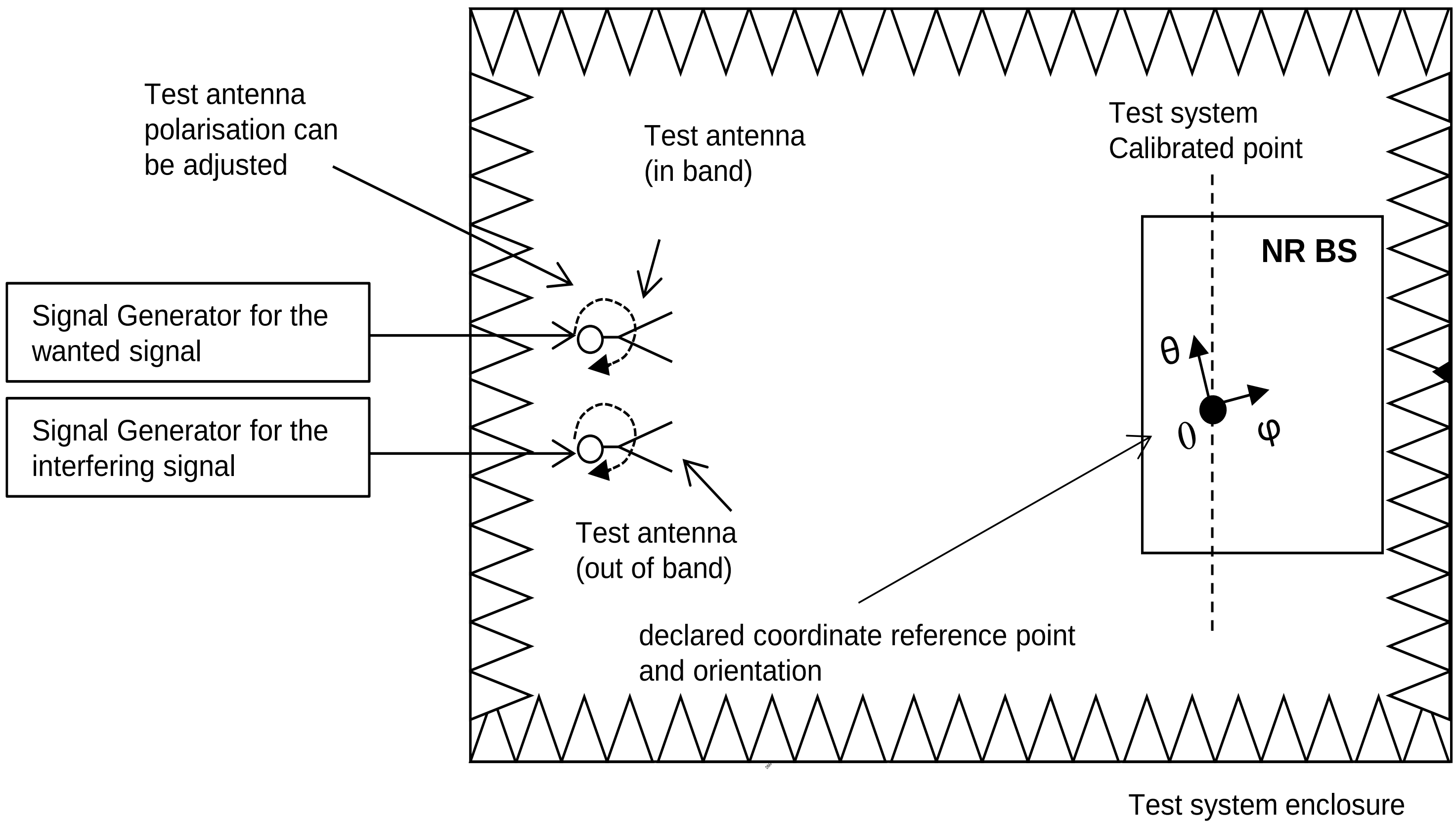
TEST SETUP 23



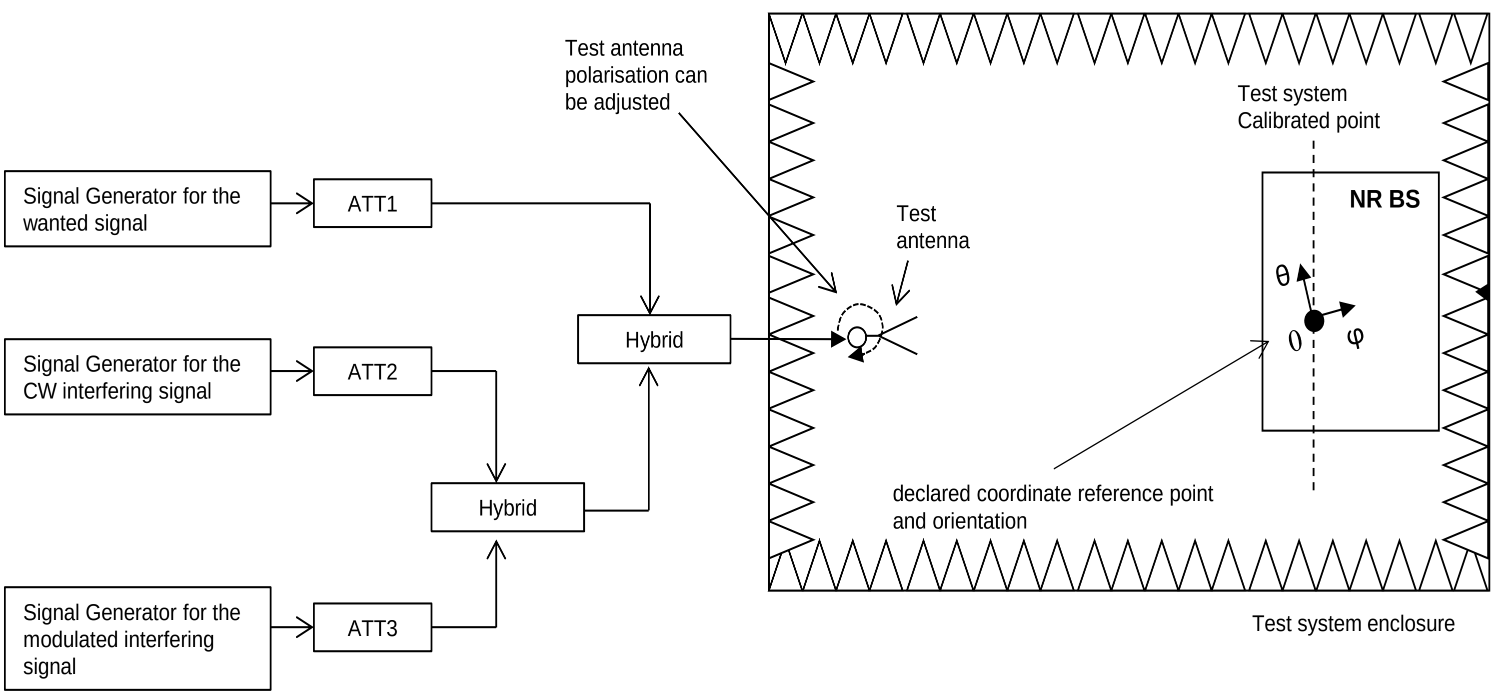
TEST SETUP 24



TEST SETUP 25



TEST SETUP 26



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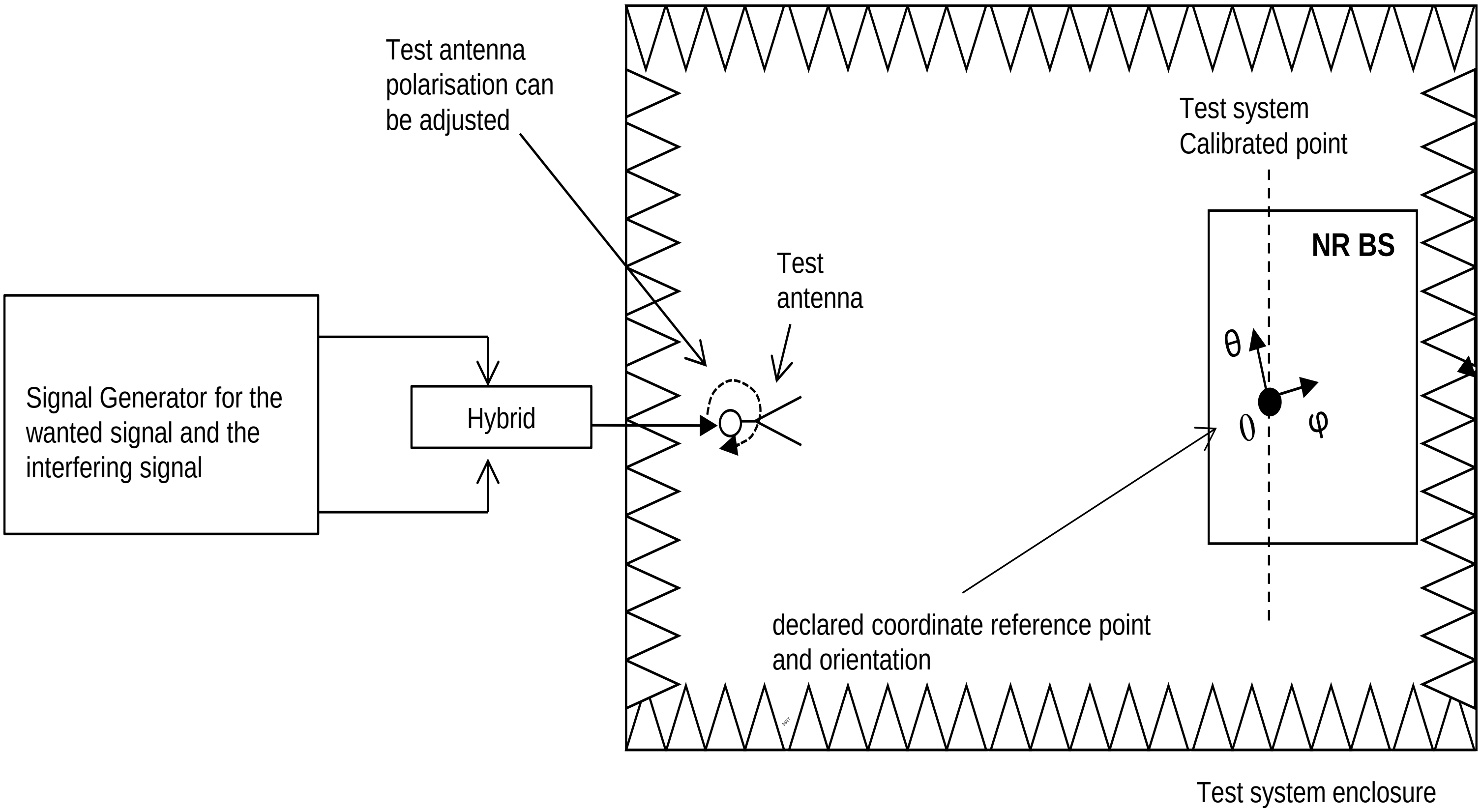
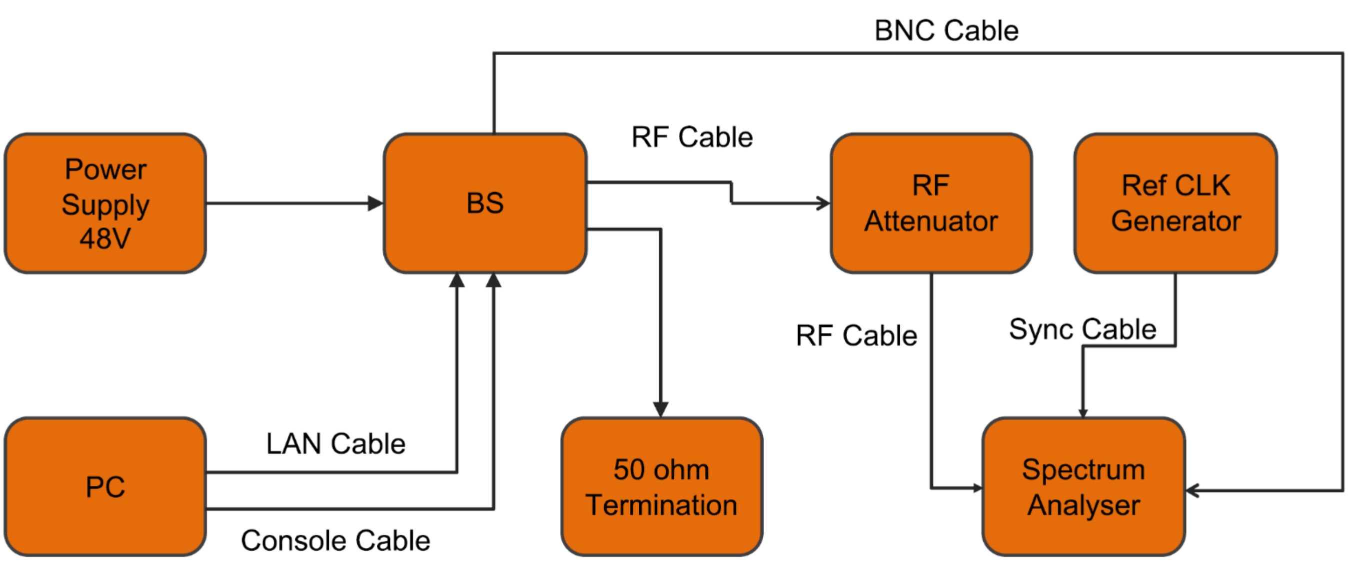


TEST SETUP 28



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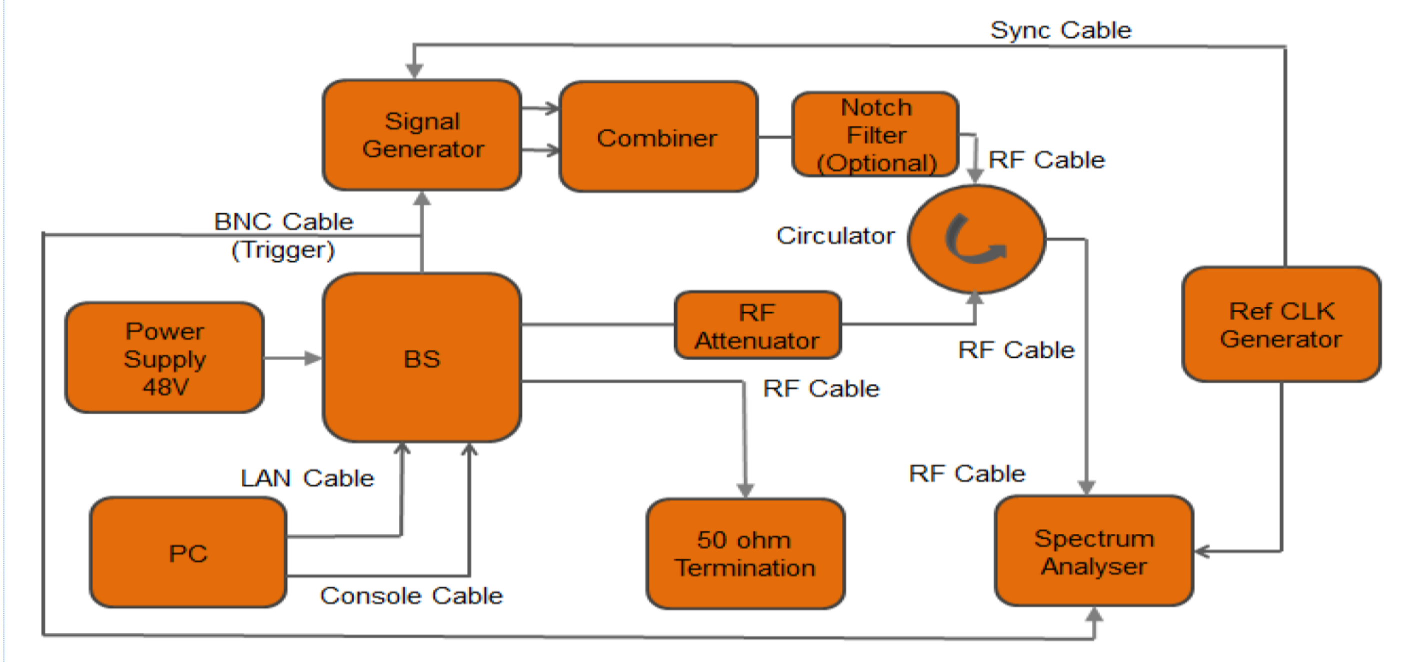
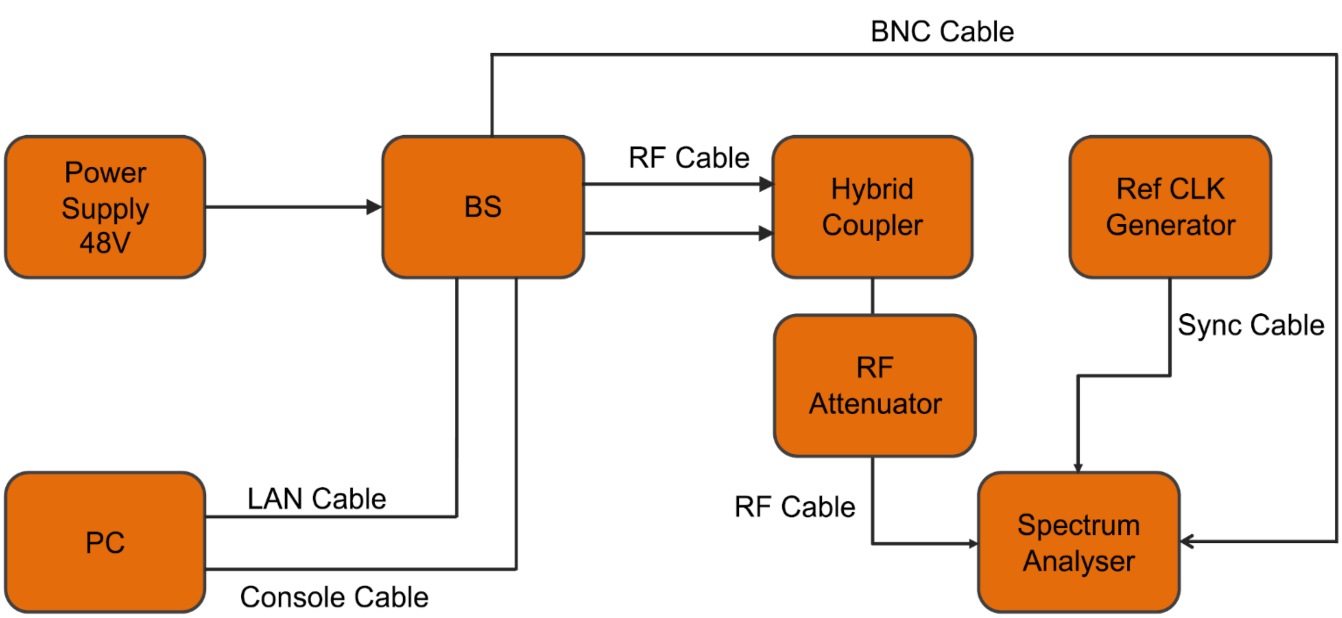
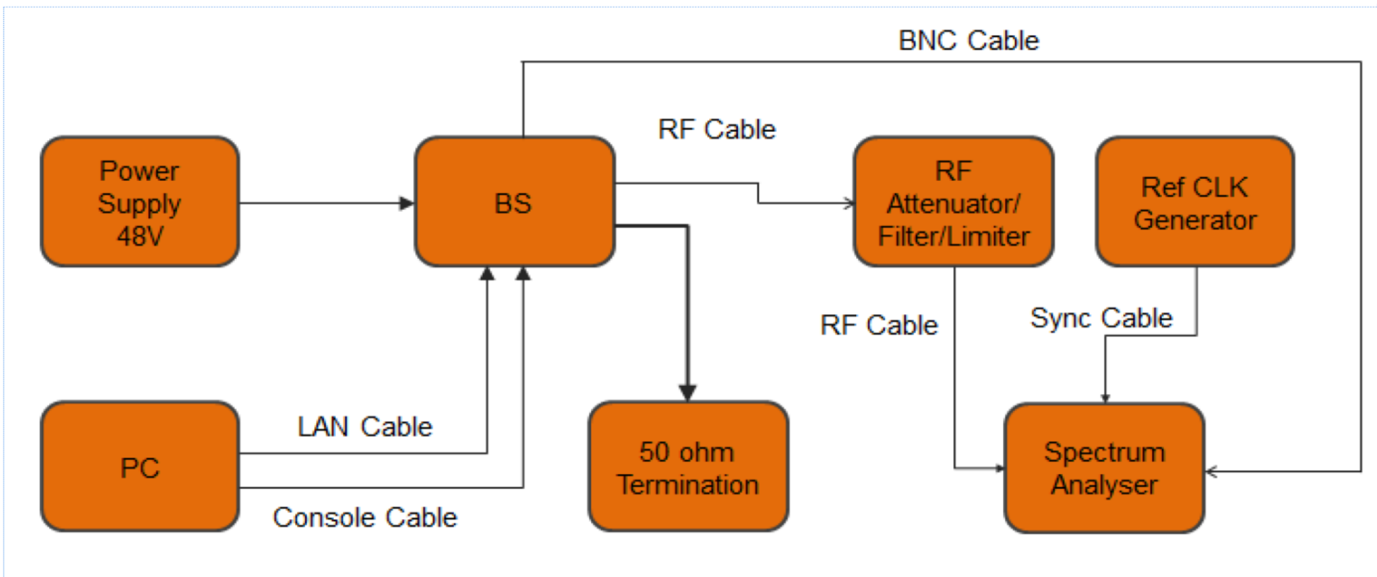


TEST SETUP 30



<u>TEST SETUP 31</u>



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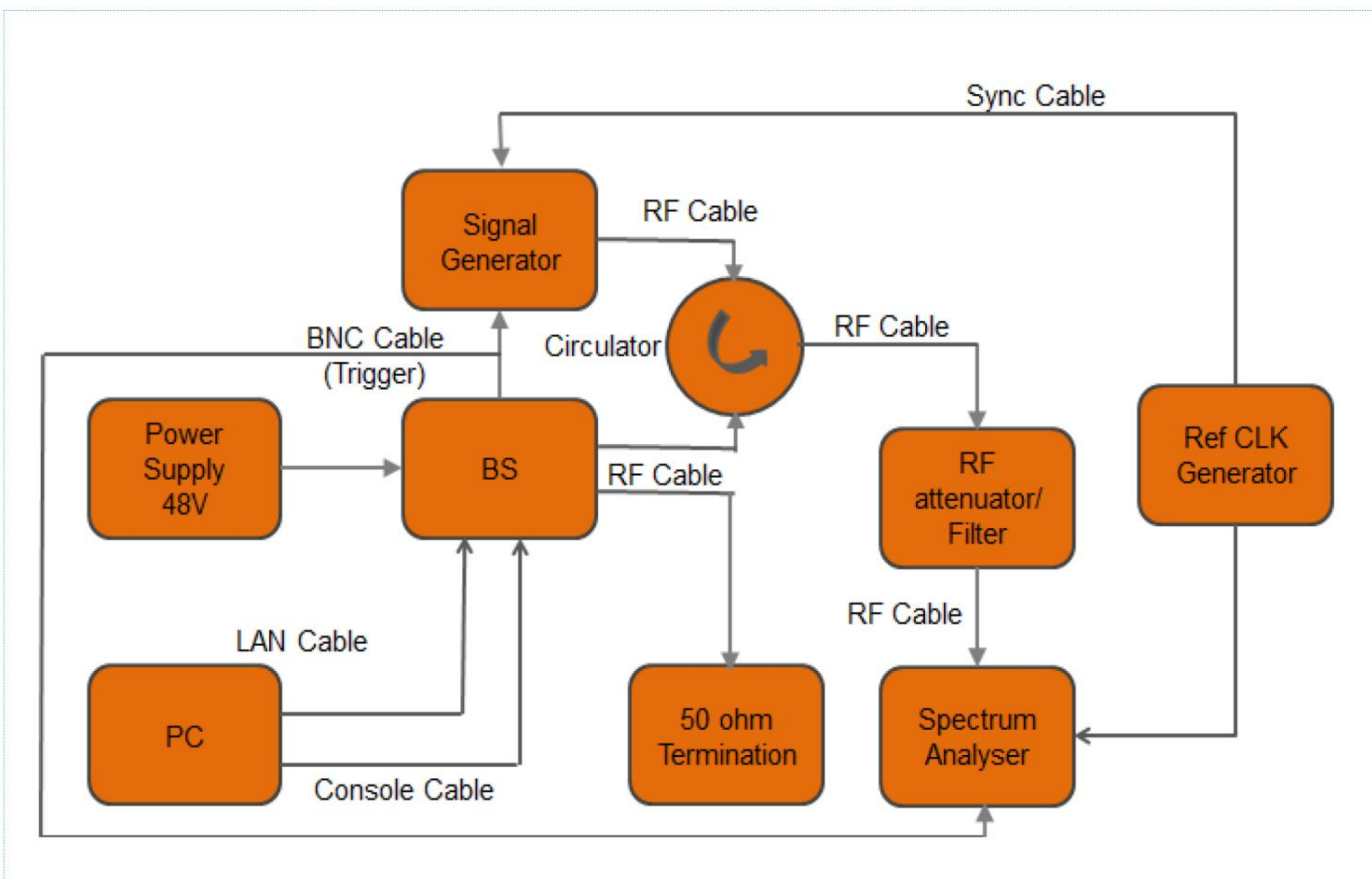
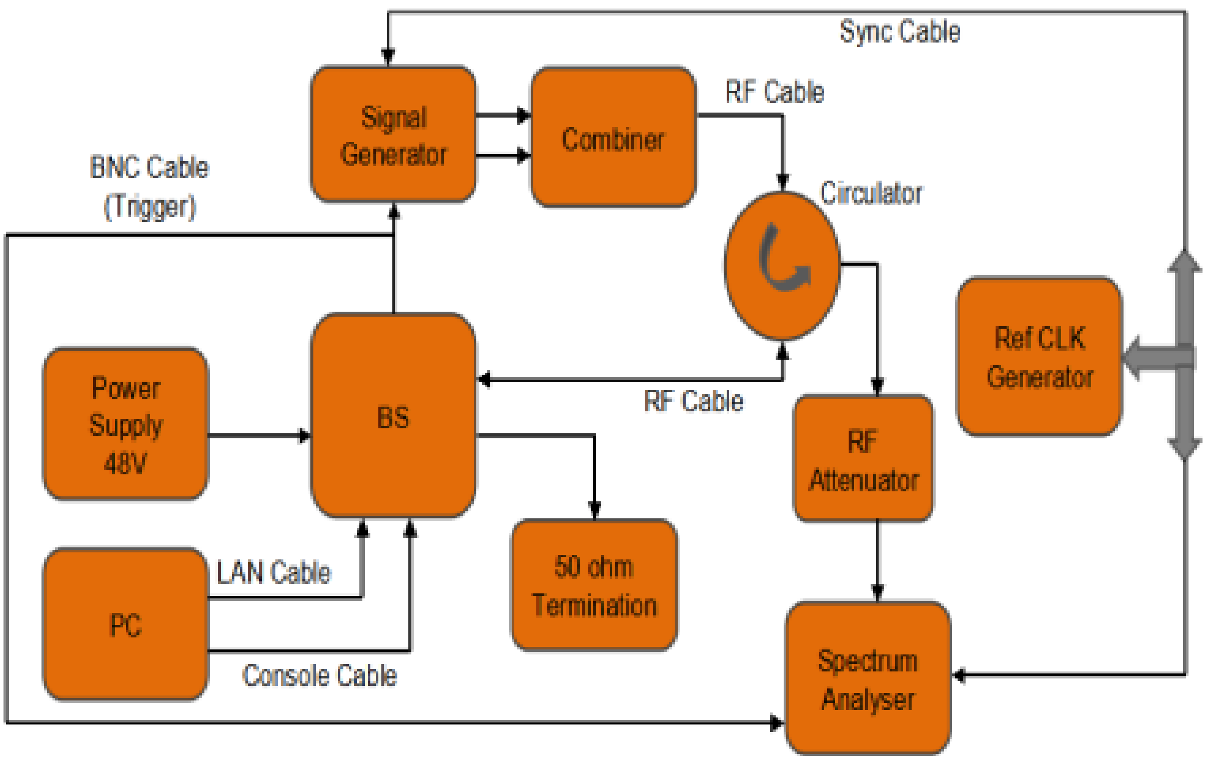
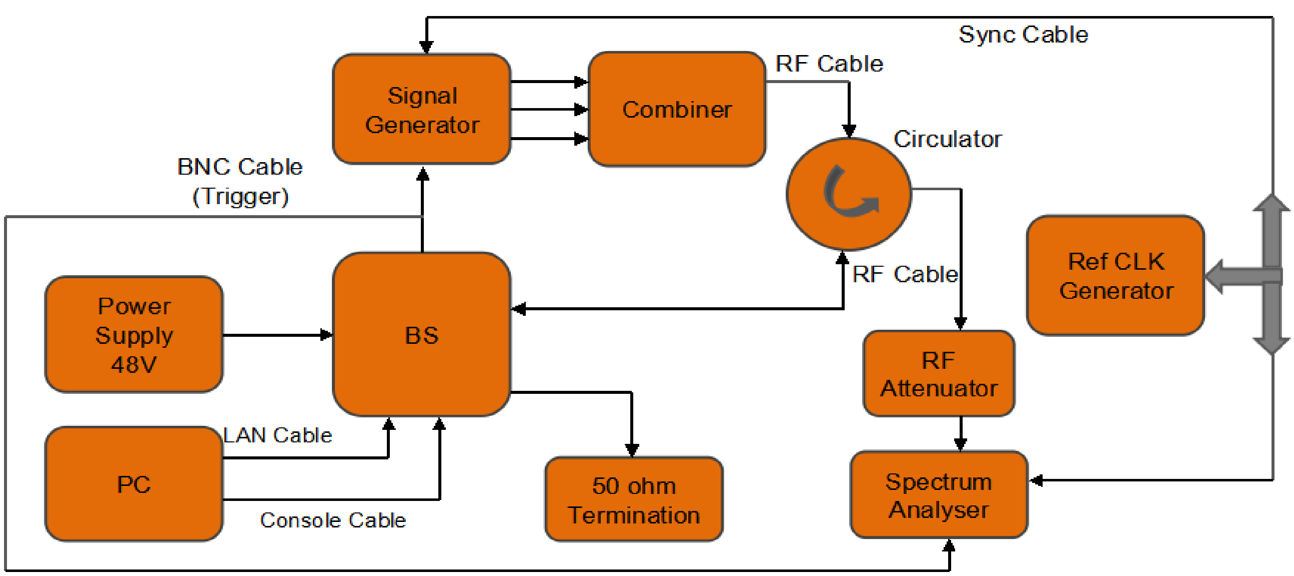


TEST SETUP 33



TEST SETUP 34



I. TEST SETUP & PROCEDURES:

1. Test No.	**GR_TSTP_1.2.4.1.3**
2. Test Details	To verify each O-RU shall manage at least one carrier in LTE/NR (or combination of LTE+NR or DSS) typically in macro-outdoor or indoor small cell solutions or as specified by procurer requirements. As per 3GPP specification, O-RU shall support all three modes of IoT (inband, guard band and Standalone).
3. Test Instruments Required	Power supply, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, gNB/DU Emulator / RAN Tester,, Reference clock generator, UE/UE simulator
4. Test Setup	Test Setup 7
5. Test Procedure	1. LTE/NR (or combination of LTE+NR or DSS) 1.1. Bring-up the 5G Core 1.2. Configure and bring-up the gNodeB for at least one carrier of LTE/NR 1.3. Intitiate registration procedure from UE/UE Sim 2. IoT (inband, guard band and Standalone). 2.1. Bring-up the 5G Core 2.2. Configure gNodeB for IoT (inband, guard band and Standalone). 2.3. Intitiate registration procedure from UE/UE Sim
6. Test Limits	NA
7. Expected Results	Successful Registration Procedure.

1. Test No.	GR_TSTP_1.2.4.1.4
2. Test Details	To Verify that the O-RU shall support Energy Efficiency & Power Savings i Power saving functionality and shall be power efficient. ii Micro Sleep Transmission, which reduces energy consumption by turning off certain radio hardware components when there is no traffic. iii Low energy scheduler solution (LESS) uses a large amount of resource blocks in the frequency domain to free up space in the time domain. It can help to increase energy efficiency while maintaining the same network performance. iv Discontinuous transmission (DTX) on downlink to save energy during low traffic. v Long cycle Discontinuous Reception (C-DRX). vi Decrease of UE battery consumption by typical traffic patterns and reduces the risk of overheating. vii Automatic enablement/ disablement of the main power amplifier (PA) in the radio-unit. The PA may be turned off in the following cases: viii When no PDSCH traffic is scheduled on a subframe; and ix During symbols that do not carry mandatory information
3. Test Instruments Required	Power supply, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, gNB/DU Emulator / RAN Tester,, Reference clock generator, UE/UE simulator
4. Test Setup	Test Setup 7
5. Test Procedure	Power saving functionality 1. Configure O-RU to normal operating mode; log baseline power at rated load. 2. Apply different traffic loads (0%, 25%, 50%, 100% cell load). 3. Enable power-saving features in O-RU; repeat traffic profiles. 4. Compare power consumption vs load before/after enabling

	features; verify reduction at low/zero load within vendor/standard limits Micro Sleep Transmission (MST) 1. Configure periodic bursty DL traffic with idle gaps. 2. With MST disabled, record RF envelope and power vs time. 3. Enable MST; repeat same traffic. 4. Verify: • RF and PA go OFF (no transmission) during idle gaps. • Measurable drop in input power during micro-sleep intervals. • No degradation in KPIs (BLER, throughput, latency) Low Energy Scheduler Solution (LESS) 1. Run reference scenario (same traffic pattern) with standard scheduler; record: a. PRB distribution in time/frequency. b. O-RU power consumption. 2. Enable LESS feature. 3. Repeat same traffic scenario. 4. Confirm: a. Higher frequency-domain PRB concentration and more time-domain idle gaps. b. Overall power reduction with same throughput/latency as baseline. Downlink Discontinuous Transmission (DL DTX) 1. Establish RRC-connected UE with very low or no DL user data. 2. With DTX disabled, capture RF time-domain signal: DL always active (reference). 3. Enable DTX; repeat in same traffic condition. 4. Verify:

	a. DL carrier is muted (no PDSCH / minimal symbols) during inactivity. b. Corresponding power drop during DTX intervals. c. No impact on control channels (PDCCH, CRS/DMRS as per spec). **Long-cycle C-DRX** 1. Configure RRC parameters for long DRX cycle (e.g. long On/Off cycles). 2. Generate typical background traffic (periodic small packets). 3. Verify: a. From signaling: DRX cycles correctly configured and applied. b. UE and O-RU follow DRX pattern (paging, PDCCH monitoring only in On-duration). c. Reduced average UE current (if measuring UE) and reduced DL activity at O-RU during DRX Off. **Decrease of UE battery consumption (typical traffic patterns)** 1. Select representative traffic patterns (e.g. web browsing, chat, background sync). 2. Run scenario with power-saving features disabled; record average UE current/consumption. 3. Enable DRX, DTX, MST and scheduler energy features as per vendor profile. 4. Repeat same traffic scripts. 5. Verify: a. Lower average UE power consumption and lower device temperature (if monitored). b. No significant degradation in QoE (throughput/latency).

	Automatic enable/disable of Power Amplifier (PA) 1. Verify PA auto ON/OFF energy-saving behavior by creating load/no-load scenarios, observing RF envelope and supply power, and ensuring the PA turns OFF during zero/low traffic and ON again without errors or latency. 2. Check no-PDSCH subframes by configuring control-only subframes and confirming that PDSCH-related PA activity is disabled, with only mandatory control/reference signals present and measurable power reduction.
6. Test Limits	NA
7. Expected Results	The O-RU shall enter power-saving mode under low/no traffic and automatically reduce power consumption while remaining fully operational. PA shall turn OFF/on automatically based on traffic without impacting service.

1. Test No.	**GR_TSTP_1.2.4.1.5**
2. Test Details	To Verify that In 5G, the O-RU shall support the adaptation of the UL waveform (between CP-OFDM and DFT-s-OFDM) depending on the coverage, doppler effect, scheduling with multiple users and peak rate maximization.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	Test Setup 7
5. Test Procedure	1. Configure O-RU and UE emulator; verify both CP-OFDM and DFT-s-OFDM UL waveforms are correctly detected using the VSA. 2. Create poor coverage / high path loss using channel emulator; trigger UL transmission and verify O-RU operates with DFT-s-OFDM (low PAPR) and logs indicate waveform adaptation. 3. Apply high mobility / Doppler profile (e.g., high-speed fading); verify UL waveform switches to CP-OFDM and confirm via VSA and O-RU logs. 4. Generate multiple simultaneous UL users; configure DU scheduling so high data-rate user uses CP-OFDM and coverage-limited users use DFT-s-OFDM; verify O-RU correctly receives both waveform types without interference. 5. Configure peak-rate scenario with full bandwidth (e.g., full PRB allocation); verify DU forces CP-OFDM for maximum throughput and confirm peak rate KPIs. 6. Dynamically vary channel conditions (good ↔ poor, low ↔

	high Doppler); verify seamless switching between CP-OFDM and DFT-s-OFDM with: a. correct waveform seen on VSA b. no packet drops c. acceptable BLER and stable KPI performance 7. Capture and confirm all waveform adaptation events in O-RU logs / OAM PM counters to ensure compliance with adaptive UL waveform behavior.
6. Test Limits	NA
7. Expected Results	The O-RU shall accept and operate with both CP-OFDM and DFT-s-OFDM uplink waveforms without any service impact and without raising major alarms.

1. Test No.	**GR_TSTP_1.2.4.1.6**
2. Test Details	To Verify that In 5G, the O-RU shall support at least 4:1 TDD slot pattern configuration: DDDSU and 8:2 TDD slot pattern configuration: DDDSUUDDDD
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	Test Setup 7
5. Test Procedure	1. 4:1 slot pattern (DDDSU) o Bring-up the 5G Core. o Configure and Bring-up the gNodeb with TDD pattern DDDSU. o Intitiate registration procedure from UE/UE Sim 2. 8:2 slot pattern (DDDSUUDDDD) o Bring-up the 5G Core. o Configure and Bring-up the gNodeb with TDD pattern DDDSUUDDDD o Intitiate registration procedure from UE/UE Sim
6. Test Limits	NA
7. Expected Results	Successful Registration Procedure. Observe the SIB1 -> tdd-UL-DL-COnfigurationCommon in UE logs

1. Test No.	GR_TSTP_1.2.4.1.7
2. Test Details	To Verify that the O-RU shall, when operating in 4G TDD mode, support TDD frame structures frame format 1 and 2 and special subframe 6 and 7, according to 3GPP 36.211.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 28
5. Test Procedure	1. Bring the O-RU into operationally enabled state in 4G TDD mode. 2. From OAM/Console configure supported TDD frame formats (frame format 1 and 2) and special subframes (6 and 7). 3. Using Spectrum Analyzer, verify DL/UL switching and special subframe periods as per configuration. 4. Repeat the test across all supported bands/carriers declared by OEM
6. Test Limits	NA
7. Expected Results	The O-RU shall successfully support TDD frame format 1 and 2 and special subframe 6 and 7 in 4G TDD mode without service degradation or major alarms, and the spectrum analyzer shall confirm correct DL/UL switching and special subframe timing.

1. Test No.	GR_TSTP_1.2.4.1.8
2. Test Details	To Verify that the O-RU shall support a Cyclic Prefix (CP) between OFDM symbols.
3. Test Instruments Required	Power supply, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, gNB/DU Emulator / RAN Tester, Reference clock generator, UE/UE simulator.
4. Test Setup	Test Setup 7
5. Test Procedure	1. Bring-up the 5G Core 2. Configure and Bring-up the gNodeB 3. Intitiate registration procedure from UE/UE Sim
6. Test Limits	NA
7. Expected Results	Registration Procedure Success.

1. Test No	GR_TSTP_1.2.4.1.9
2. Test Details	To Verify that the O-RU may support below MIMO options:- i. SISO, 2X2 MIMO option ii. up to 4 DL MIMO layers in Low Band iii. Downlink Single-User MIMO in Mid Band. iv. Downlink Multi-User MIMO in Mid Band to support minimum 8 layers v.Uplink Multi-User MIMO in Mid Band to support minimum 4-layer UL MU-MIMO for PUSCH transmission
3. Test Instruments Required	Power supply, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, gNB/DU Emulator / RAN Tester, Reference clock generator, UE/UE simulator
4. Test Setup	Test Setup 7
5. Test Procedure	1. Bring-up the 5G Core 2. Configure and Bring-up the gNodeB with the respected MIMO configuration to be verified. 3. Intitiate registration procedure from UE/UE Sim. 4. Measure Throughput
6. Test Limits	NA
7. Expected Results	Verify the measured throughput with the expected throughput.

1. Test No	GR_TSTP_1.2.4.1.10
2. Test Details	To Verify that Downlink modulation Mode QPSK,16QAM,64QAM supported in all bands 256QAM in sub-6GHz bands 256QAM in mmWave 1024QAM supported in sub 6GHz bands (Optional) Uplink modulation Mode π/2BPSK (Optional), QPSK,16QAM,64QAM supported in all bands 256QAM supported in sub-6Ghz bands 256QAM supported in mmWave
. Test Instruments Required	Power supply, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, gNB/DU Emulator / RAN Tester, Reference clock generator, UE/UE simulator
4. Test Setup	TEST SETUP 7
5. Test Procedure	1. Bring O-RU (DUT) in operationally enabled state. 2. Establish UE session(s) using UE/UE simulator. 3. Trigger downlink and uplink traffic with forced modulation profiles (QPSK → 16QAM → 64QAM → 256QAM → 1024QAM where applicable). 4. Observe modulation applied via OAM/console and/or UE/UE simulator logs. 5. Repeat across all configured bands as declared by OEM.
6. Test Limits	NA
7. Expected Results	The O-RU shall successfully support the specified DL and UL modulation schemes across applicable bands without service impact and without generating major alarms.

1. Test No	GR_TSTP_1.2.4.1.12
2. Test Details	To Verify that O-RU receiver Uplink Noise Figure shall be as per 3GPP requirements and O-RU shall support PIM cancellation methods
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 28
5. Test Procedure	1. Transmit a low-noise RF signal to the O-RU receiver. 2. Measure the noise figure using a noise figure analyzer and ensure it complies with 3GPP specifications. 3. Verify that the O-RU employs PIM cancellation techniques to mitigate interference, ensuring signal clarity and minimal impact from PIM.
6. Test Limits	NA
7. Expected Results	The O-RU should have a noise figure within 3GPP-specified limits, ensuring minimal noise degradation. PIM cancellation methods should be effective, reducing intermodulation interference to maintain uplink signal quality.

1. Test No	**GR_TSTP_1.2.4.1.14**
2. Test Details	To Verify that Sub carrier spacing (SCS) of 15 KHz, 30 KHz and/or 60 KHz and/or 120 KHz shall be supported as per valid combinations of SCS, Cell Carrier Bandwidth and cyclic prefix as specified by 3GPP
3. Test Instruments Required	Power supply, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, gNB/DU Emulator / RAN Tester, Reference clock generator, UE/UE simulator
4. Test Setup	Test Setup 7
5. Test Procedure	1) Bring-up the 5G Core 2) Configure and Bring-up the gNodeB with the respected SCS, CP and Bandwdith to be verified. 3) Initiate registration procedure from UE/UE Sim. 4) Initiate data transfer.
6. Test Limits	NA
7. Expected Results	Data transfer is successful.

1. Test No	GR_TSTP_1.2.4.1.15
2. Test Details	To Verify that the O-RU shall support Physical layer functions as under:- i Synchronization Signal Block (SSB). ii Uplink (UL) and downlink (DL) demodulation reference signal. iii UL and DL Link Adaptation. iv UL and DL Power Allocation for data channels. v DL Power setting for data channels. vi DL Power setting for signalling and control channels. vii Normal & Extended Cyclic Prefix for OFDM symbols. viii At least one Static TDD Mode with single Bandwidth Part. Communication of timing advance value to UE.
3. Test Instruments Required	Power supply, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, gNB/DU Emulator / RAN Tester, Reference clock generator, UE/UE simulator
4. Test Setup	Test Setup 7
5. Test Procedure	i) to vi) is NA to O-RU 1. Normal Cyclic Prefix for OFDM symbols and Static TDD Mode 1. Bring-up the 5G Core 2. Configure and Bring-up the gNodeB with the Normal Cyclic Prefix and Static TDD Mode 3. Intitiate registration procedure from UE/UE Sim. 2. Extended Cyclic Prefix for OFDM symbols. 1. Bring-up the 5G Core 2. Configure and Bring-up the gNodeB with the Extended Cyclic Prefix. 3. Intitiate registration procedure from UE/UE Sim 4. Inititate data transfer.
6. Test Limits	NA

7. Expected Results	For Normal CP, successful registration procedure. For Extended CP, Data transfer is successful

1. Test No.	GR_TSTP_1.2.4.1.17_A
2. Test Details	Rated output power (Prated,c), of the base station is the mean power level per carrier for BS operating in single carrier, multi-carrier, or carrier aggregation configurations that the manufacturer has declared to be available at the antenna connector during the transmitter ON period
3. Test Instruments Required	Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables, Optical Fiber Cable,Optical Transciever, RF Attenuator, 50Ω Termination, O-DU Emulator.
4. Test Setup	TEST SETUP 10
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 6.2.4.2 of 3GPP38.141-1
6. Test Limits	≤ Declared BS Power ± 2.7 dB, f ≤ 3.0GHz ≤ Declared BS Power ± 3.0 dB, 3.0GHz < f ≤ 6GHz
7. Expected Results	Declared BS Power must be with in Test limits

1. Test No.	**GR_TSTP_1.2.4.1.17_B**
2. Test Details	The RE power control dynamic range is the difference between the power of an RE and the average RE power for a BS at maximum output power for a specified reference condition.
3. Test Instruments Required	Same as GR_TSTP_1.2.4.1.17_F
4. Test Setup	Same as GR_TSTP_1.2.4.1.17_F
5. Test Procedure	GR_TSTP_1.2.4.1.17_F NOTE: No specific test or test requirements are defined for RE Power control dynamic range. The Error Vector Magnitude test, provides sufficient test coverage for this requirement.
6. Test Limits	Same as GR_TSTP_1.2.4.1.17_F
7. Expected Results	Same as GR_TSTP_1.2.4.1.17_F

1. Test No.	**GR_TSTP_1.2.4.1.17_C**
2. Test Details	The total power dynamic range is the difference between the maximum and the minimum transmit power of an OFDM symbol for a specified reference condition. NOTE: The upper limit of the dynamic range is the OFDM symbol power for a BS at maximum output power. The lower limit of the dynamic range is the OFDM symbol power for a BS when one resource block is transmitted. The OFDM symbol shall carry PDSCH and not contain RS, PBCH or synchronization signals.
3. Test Instruments Required	Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables, Optical Fiber Cable,Optical Transciever, RF Attenuator, 50Ω Termination, O-DU Emulator.
4. Test Setup	TEST SETUP 10
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 6.3.3.4.2 of 3GPP38.141-1
6. Test Limits	The downlink (DL) total power dynamic range for each NR carrier shall be larger than or equal to the level in Table Below:

NR channel bandwidth (MHz)	Total power dynamic range (dB)		
	15 kHz SCS	30 kHz SCS	60 kHz SCS
5	13.5	10	N/A
10	16.7	13.4	10
15	18.5	15.3	12.1
20	19.8	16.6	13.4
25	20.8	17.7	14.5
30	21.6	18.5	15.3
40	22.9	19.8	16.6
50	23.9	20.8	17.7
60	N/A	21.6	18.5
70	N/A	22.3	19.2
80	N/A	22.9	19.8
90	N/A	23.4	20.4
100	N/A	23.9	20.9

7. Expected Results	The total power dynamic range should be with in Specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.17_D
2. Test Details	Transmitter OFF power is defined as the mean power measured over 70 us filtered with a square filter of bandwidth equal to the transmission bandwidth configuration of the BS centred on the assigned channel frequency during the transmitter OFF period. The purpose of this test is to verify the NR BS transmitter OFF power is within the limit of the minimum requirement.
3. Test Instruments Required	Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables,RF Limiter, Optical Fiber Cable, Optical Transciever, RF Attenuator, 50Ω Termination, O-DU Emulator.
4. Test Setup	TEST SETUP 11
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 6.4.1.4 of 3GPP38.141-1
6. Test Limits	Mean power spectral density shall be < -83dBm/MHz for f ≤ 3.0GHz < -82.5dBm/MHz for 3.0GHz < f ≤ 6GHz.
7. Expected Results	Transmitter OFF power Should be with in specified Test Limits.

<table>
<tr><td>1. Test No.</td><td>GR_TSTP_1.2.4.1.17_E</td></tr>
<tr><td>2. Test Details</td><td>Frequency error is the measure of the difference between the actual BS transmit frequency and the assigned frequency. The same source shall be used for RF frequency and data clock generation.</td></tr>
<tr><td>3. Test Instruments Required</td><td>Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables, Optical Fiber Cable,Optical Transciever, RF Attenuator, 50Ω Termination, O-DU Emulator.</td></tr>
<tr><td>4. Test Setup</td><td>TEST SETUP 10</td></tr>
<tr><td>5. Test Procedure</td><td>1. Make the setup as shown in Test Setup
2. Follow the procedure given in section 6.5.2.4 of 3GPP38.141-1</td></tr>
<tr><td>6. Test Limits</td><td>The modulated carrier frequency of each NR carrier configured by the BS shall be accurate to within the accuracy range given in Table Below observed over a period of one subframe (1ms).
<table><tr><th>BS class</th><th>Accuracy</th></tr><tr><td>Wide Area BS</td><td>±(0.05 ppm + 12 Hz)</td></tr><tr><td>Medium Range BS</td><td>±(0.1 ppm + 12 Hz)</td></tr><tr><td>Local Area BS</td><td>±(0.1 ppm + 12 Hz)</td></tr></table></td></tr>
<tr><td>7. Expected Results</td><td>Frequency error Should be with in specified Test Limits.</td></tr>
</table>

<table>
<tr><td>1. Test No.</td><td>GR_TSTP_1.2.4.1.17_F</td></tr>
<tr><td>2. Test Details</td><td>The Error Vector Magnitude is a measure of the difference between the ideal symbols and the measured symbols after the equalization. This difference is called the error vector. The EVM result is defined as the square root of the ratio of the mean error vector power to the mean reference power expressed in percentage.</td></tr>
<tr><td>3. Test Instruments Required</td><td>Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables, Optical Fiber Cable,Optical Transciever, RF Attenuator, 50Ω Termination, O-DU Emulator.</td></tr>
<tr><td>4. Test Setup</td><td>TEST SETUP 10</td></tr>
<tr><td>5. Test Procedure</td><td>1. Make the setup as shown in Test Setup
2. Follow the procedure given in section 6.5.3.4.2 of 3GPP38.141-1</td></tr>
<tr><td>6. Test Limits</td><td>The EVM of each NR carrier for different modulation schemes on PDSCH shall be less than the limits in table:
<table>
<tr><th>Modulation scheme for PDSCH</th><th>Required EVM (%)</th></tr>
<tr><td>QPSK</td><td>18.5 %</td></tr>
<tr><td>16QAM</td><td>13.5 %</td></tr>
<tr><td>64QAM</td><td>9 %</td></tr>
<tr><td>256QAM</td><td>4.5 %</td></tr>
</table></td></tr>
<tr><td>7. Expected Results</td><td>Error Vector Magnitude Should be with in specified Test Limits</td></tr>
</table>

1. Test No.	GR_TSTP_1.2.4.1.17_G
2. Test Details	Frames of the 5G NR signals present at the BS transmitter antenna port(s) are not perfectly aligned in time. In relation to each other, the RF signals present at the BS transmitter antenna port(s) experience certain timing differences. For a specific set of signals/transmitter configuration/transmission mode, time alignment error (TAE) is defined as the largest timing difference between any two signals.
3. Test Instruments Required	Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables, Optical Fiber Cable,Optical Transciever, RF Attenuator,RF Combiner, 50Ω Termination, O-DU Emulator.
4. Test Setup	TEST SETUP 12
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 6.5.4.4.2 of 3GPP38.141-1
6. Test Limits	1. For MIMO transmission, at each carrier frequency, TAE shall not exceed 90 ns. 2. For intra-band contiguous CA, with or without MIMO, TAE shall not exceed 285 ns. 3. For intra-band non-contiguous CA, with or without MIMO, TAE shall not exceed 3.025 μs. 4. For inter-band CA, with or without MIMO, TAE shall not exceed 3.025 μs.
7. Expected Results	TAE Should be with in specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.17_H
2. Test Details	The occupied bandwidth is the width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified 0.5% percentage of the total mean transmitted power. The requirement applies during the transmitter ON period.
3. Test Instruments Required	Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables, Optical Fiber Cable, Optical Transciever, RF Attenuator, 50Ω Termination, O-DU Emulator.
4. Test Setup	TEST SETUP 10
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 6.6.2.4.2 of 3GPP38.141-1 for vendor specified channel bandwidths.
6. Test Limits	The occupied bandwidth for each carrier shall be less than the channel bandwidth as defined in TS 38.104, table 5.3.5-1.For contiguous CA, the occupied bandwidth shall be less than or equal to the aggregated BS channel bandwidth as defined in TS 38.104, clause 5.3A.
7. Expected Results	Occupied BW Should be with in specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.17_I
2. Test Details	Adjacent Channel Leakage Power Ratio (ACLR) is the ratio of the filtered mean power centered on the assigned channel frequency to the filtered mean power centered on an adjacent channel frequency.
3. Test Instruments Required	Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables, Optical Fiber Cable, Optical Transciever, RF Attenuator, 50Ω Termination, O-DU Emulator.
4. Test Setup	TEST SETUP 10
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 6.6.3.4.2 of 3GPP38.141-1
6. Test Limits	Test limits as per section 6.6.3.5.2 of 3GPP38.141-1
7. Expected Results	ACLR Should be with in specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.17_J
2. Test Details	Unless otherwise stated, the operating band unwanted emission (OBUE) limits in FR1 are defined from ΔfOBUE below the lowest frequency of each supported downlink operating band up to ΔfOBUE above the highest frequency of each supported downlink operating band. The values of ΔfOBUE are defined in table 6.6.1-1 of 3GPP38.141-1
3. Test Instruments Required	Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables, Optical Fiber Cable, Optical Transciever, RF Attenuator, 50Ω Termination, O-DU Emulator.
4. Test Setup	TEST SETUP 10
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 6.6.4.4.2 of 3GPP38.141-1
6. Test Limits	Test limits for the Operating band unwanted emission is as defined in Section 6.6.4.5 of 3GPP38.141-1
7. Expected Results	Operating band unwanted emission should be with in Specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.17_K
2. Test Details	The transmitter spurious emission limits shall apply from 9 kHz to 12.75 GHz, excluding the frequency range from ΔfOBUE below the lowest frequency of each supported downlink operating band, up to ΔfOBUE above the highest frequency of each supported downlink operating band, where the ΔfOBUE is defined in table 6.6.1 of 3GPP38.141-1. For some operating bands, the upper limit is higher than 12.75 GHz in order to comply with the 5th harmonic limit of the downlink operating band, as specified in ITU-R recommendation SM.329.
3. Test Instruments Required	Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables, Optical Fiber Cable, Optical Transciever, RF Attenuator, 50Ω Termination, O-DU Emulator.
4. Test Setup	TEST SETUP 10
5. Test Procedure	3. a) Make the setup as shown in Test Setup 4. b) Follow the procedure given in section 6.6.5.4.2 of 3GPP38.141-1
6. Test Limits	Test limits for the Operating band unwanted emission is as defined in Section 6.6.5.5 of 3GPP38.141-1
7. Expected Results	Spurious emissions Should be with in specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.17_L
2. Test Details	The transmitter intermodulation requirement is a measure of the capability of the transmitter unit to inhibit the generation of signals in its non-linear elements caused by presence of the wanted signal and an interfering signal reaching the transmitter unit via the antenna, RDN and antenna array. The requirement shall apply during the transmitter ON period and the transmitter transient period.
3. Test Instruments Required	Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables, Optical Fiber Cable, Optical Transciever, RF Attenuator,Signal Generator,Circulator, 50Ω Termination, O-DU Emulator.
4. Test Setup	TEST SETUP 13
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 6.7.4.2 of 3GPP38.141-1
6. Test Limits	Test limits for the Transmitter intermodulation is as defined in Section 6.7.5 of 3GPP38.141-1
7. Expected Results	Transmitter intermodulation Spurious emissions should be with in specified Test Limits.

1. Test No.	**GR_TSTP_1.2.4.1.17_M**
2. Test Details	OTA BS output power is declared as rated carrier TRP(Total Radiated Power), with the output power accuracy requirement defined at the RIB(Radiated Interface Boundary) during the transmitter ON period.
3. Test Instruments Required	Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables, Optical Fiber Cable,Optical Transciever, RF Attenuator, 50Ω Termination, O-DU Emulator, Antenna, Positioner, Test System Enclosure.
4. Test Setup	TEST SETUP 15
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 6.3.4.2 of 3GPP38.141-2
6. Test Limits	Test limits for the OTA BS output power is as defined in Section 6.3.5 of 3GPP38.141-2
7. Expected Results	Declared OTA BS Power must be with in Test limits

1. Test No.	GR_TSTP_1.2.4.1.17_N
2. Test Details	The OTA RE power control dynamic range is the difference between the power of an RE and the average RE power for a BS at maximum output power ($P_{max,c,EIRP}$) for a specified reference condition. This requirement shall apply at each RIB supporting transmission in the operating band.
3. Test Instruments Required	Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables, Optical Fiber Cable,Optical Transciever, RF Attenuator, 50Ω Termination, O-DU Emulator, Antenna, Positioner, Test System Enclosure.
4. Test Setup	Same as GR_TSTP_1.2.4.1.17_R
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 6.4.2.3 of 3GPP38.141-2
6. Test Limits	Same as GR_TSTP_1.2.4.1.17_R
7. Expected Results	Same as GR_TSTP_1.2.4.1.17_R

1. Test No.	GR_TSTP_1.2.4.1.17_O
2. Test Details	The OTA total power dynamic range is the difference between the maximum and the minimum transmit power of an OFDM symbol for a specified reference condition. This requirement shall apply at each RIB supporting transmission in the operating band. NOTE: The upper limit of the OTA total power dynamic range is the BS maximum carrier EIRP ($P_{max,c,EIRP}$) when transmitting on all RBs. The lower limit of the OTA total power dynamic range is the average EIRP for single RB transmission in the same direction using the same beam. The OFDM symbols shall carry PDSCH and not contain PDCCH, RS or SSB.
3. Test Instruments Required	Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables, Optical Fiber Cable,Optical Transciever, RF Attenuator, 50Ω Termination, O-DU Emulator, Antenna, Positioner, Test System Enclosure.
4. Test Setup	TEST SETUP 14
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 6.4.3.4.2 of 3GPP38.141-2
6. Test Limits	Test limits for the OTA total power dynamic range is as defined in Section 6.4.3.5 of 3GPP38.141-2
7. Expected Results	The OTA total power dynamic range should be with in Specified Test Limits.

Test No.	**GR_TSTP_1.2.4.1.17_P**
2. Test Details	OTA transmitter OFF power requirements apply only to TDD operation of NR BS. OTA transmitter OFF power is defined as the mean power measured over 70/N µs filtered with a square filter of bandwidth equal to the transmission bandwidth configuration of the BS (BWConfig) centred on the assigned channel frequency during the transmitter OFF period. N = SCS/15, where SCS is Sub Carrier Spacing in kHz. For BS supporting intra-band contiguous CA, the transmitter OFF power is defined as the mean power measured over 70/N µs filtered with a square filter of bandwidth equal to the aggregated BS channel bandwidth BWChannel_CA centred on (Fedge_high+Fedge_low)/2 during the transmitter OFF period. N = SCS/15, where SCS is the smallest supported Sub Carrier Spacing in kHz in the aggregated BS channel bandwidth.
3. Test Instruments Required	Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables,RF Limiter, Optical Fiber Cable, Optical Transciever, RF Attenuator, 50Ω Termination, O-DU Emulator, Antenna, Positioner, Test System Enclosure.
4. Test Setup	TEST SETUP 16
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 6.5.1.4 of 3GPP38.141-2
6. Test Limits	Test limits for the OTA transmitter OFF power is as defined in Section 6.5.1.5 of 3GPP38.141-2

7. Expected Results	OTA Transmitter OFF power Should be with in specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.17_Q
2. Test Details	OTA frequency error is the measure of the difference between the actual BS transmit frequency and the assigned frequency. The same source shall be used for RF frequency and data clock generation. OTA frequency error requirement is defined as a directional requirement at the RIB and shall be met within the OTA coverage range.
3. Test Instruments Required	Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables, Optical Fiber Cable,Optical Transciever, RF Attenuator, 50Ω Termination, O-DU Emulator, Antenna, Positioner, Test System Enclosure.
4. Test Setup	TEST SETUP 14
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 6.6.2.4 of 3GPP38.141-2
6. Test Limits	The modulated carrier frequency of each NR carrier configured by the BS shall be accurate to within the accuracy range given in Table Below observed over a period of one subframe (1ms). **BS class** — **Accuracy** Wide Area BS — ±(0.05 ppm + 12 Hz) Medium Range BS — ±(0.1 ppm + 12 Hz) Local Area BS — ±(0.1 ppm + 12 Hz)
7. Expected Results	OTA Frequency error Should be with in specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.17_R
2. Test Details	OTA modulation quality is defined by the difference between the measured carrier signal and an idealsignal. Modulation quality can e.g. be expressed as Error Vector Magnitude (EVM). The Error Vector Magnitude is a measure of the difference between the ideal symbols and the measured symbols after the equalization. This difference is called the error vector. OTA modulation quality requirement is defined as a directional requirement at the RIB and shall be met within the OTA coverage range.
3. Test Instruments Required	Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables, Optical Fiber Cable,Optical Transciever, RF Attenuator, 50Ω Termination, O-DU Emulator, Antenna, Positioner, Test System Enclosure.
4. Test Setup	TEST SETUP 14
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 6.6.3.4.2 of 3GPP38.141-1
6. Test Limits	Test limits for the OTA Error Vector Magnitude is as defined in Section 6.6.3.5 of 3GPP38.141-2
7. Expected Results	OTA Error Vector Magnitude Should be with in specified Test Limits

1. Test No.	GR_TSTP_1.2.4.1.17_S
2. Test Details	This requirement shall apply to frame timing in MIMO transmission, carrier aggregation and their combinations. Frames of the NR signals present in the radiated domain are not perfectly aligned in time. In relation to each other, the RF signals present in the radiated domain may experience certain timing differences. For a specific set of signals/transmitter configuration/transmission mode, the OTA Time Alignment Error (OTA TAE) is defined as the largest timing difference between any two different NR signals. The OTA time alignment error requirement is defined as a directional requirement at the RIB and shall be met within the OTA coverage range.
3. Test Instruments Required	Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables, Optical Fiber Cable,Optical Transciever, RF Attenuator,RF Combiner, 50Ω Termination, O-DU Emulator, Antenna, Positioner, Test System Enclosure.
4. Test Setup	TEST SETUP 14
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 6.6.4.4.2 of 3GPP38.141-2
6. Test Limits	Test limits for the OTA Time Alignment Error (OTA TAE) is as defined in Section 6.6.4.5 of 3GPP38.141-2

7. Expected Results	OTA Time Alignment Error (OTA TAE) Should be with in specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.17_T
2. Test Details	The OTA occupied bandwidth is the width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5% of the total mean transmitted power. The OTA occupied bandwidth requirement applies during the transmitter ON period for a single transmitted carrier. The minimum requirement below may be applied regionally. There may also be regional requirements to declare the OTA occupied bandwidth according to the definition in the present clause. The OTA occupied bandwidth is defined as a directional requirement and shall be met in the manufacturer's declared OTA coverage range at the RIB.
3. Test Instruments Required	Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables, Optical Fiber Cable, Optical Transciever, RF Attenuator, 50Ω Termination, O-DU Emulator, Antenna, Positioner, Test System Enclosure.
4. Test Setup	TEST SETUP 14
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 6.7.2.4.2 of 3GPP38.141-2 for vendor specified channel bandwidths.
6. Test Limits	Test limits for the OTA occupied bandwidth is as defined in Section 6.7.2.5 of 3GPP38.141-2

7. Expected Results	OTA occupied bandwidth Should be with in specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.17_U
2. Test Details	OTA Adjacent Channel Leakage Power Ratio (ACLR) is the ratio of the filtered mean power centred on the assigned channel frequency to the filtered mean power centred on an adjacent channel frequency. The measured power is TRP.
3. Test Instruments Required	Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables, Optical Fiber Cable, Optical Transciever, RF Attenuator, 50Ω Termination, O-DU Emulator, Antenna, Positioner, Test System Enclosure.
4. Test Setup	TEST SETUP 15
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 6.7.3.4.2 of 3GPP38.141-2
6. Test Limits	Test limits as per section 6.6.3.5 of 3GPP38.141-2
7. Expected Results	OTA ACLR Should be with in specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.17_V
2. Test Details	The OTA Operating band unwanted emissions define all unwanted emissions in each supported downlink operating band plus the frequency ranges ΔfOBUE above and ΔfOBUE below each band. OTA Unwanted emissions outside of this frequency range are limited by an OTA spurious emissions requirement. The OTA limits for operating band unwanted emissions are specified as TRP per RIB, unless otherwise stated. The values of ΔfOBUE are defined in table 6.7.1-1 of 3GPP38.141-2
3. Test Instruments Required	Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables, Optical Fiber Cable, Optical Transciever, RF Attenuator, 50Ω Termination, O-DU Emulator, Antenna, Positioner, Test System Enclosure.
4. Test Setup	TEST SETUP 15
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 6.7.4.4.2 of 3GPP38.141-2
6. Test Limits	Test limits for the OTA Operating band unwanted emission is as defined in Section 6.7.4.5 of 3GPP38.141-2
7. Expected Results	OTA Operating band unwanted emission should be with in Specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.17_W
2. Test Details	The OTA transmitter spurious emissions limits are specified as TRP per RIB, unless otherwise stated. The OTA transmitter spurious emission limits for FR1 shall apply from 30 MHz to 12.75 GHz, excluding the frequency range from ΔfOBUE below the lowest frequency of each supported downlink operating band, up to ΔfOBUE above the highest frequency of each supported downlink operating band, where the ΔfOBUE is defined in subclause 6.7.1 of 3GPP38.141-2. For some operating bands, the upper limit of the spurious range might be higher than 12.75 GHz in order to comply with the 5th harmonic limit of the downlink operating band, as specified in ITU-R recommendation SM.329 [5]. The OTA transmitter spurious emission limits for FR2 shall apply from 30 MHz to 2nd harmonic of the upper frequency edge of the downlink operating band, excluding the frequency range from ΔfOBUE below the lowest frequency of each supported downlink operating band, up to ΔfOBUE above the highest frequency of each supported downlink operating band, where the ΔfOBUE is defined in subclause 6.7.1 of 3GPP38.141-2.
3. Test Instruments Required	Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables, Optical Fiber Cable, Optical Transciever, RF Attenuator, 50Ω Termination, O-DU Emulator, Antenna, Positioner, Test System Enclosure.
4. Test Setup	TEST SETUP 15
5. Test Procedure	5. a) Make the setup as shown in Test Setup 6. b) Follow the procedure given in section 6.6.5.2.4.2 of 3GPP38.141-2

6. Test Limits	Test limits for the OTA Operating band unwanted emission is as defined in Section 6.7.5.2.5 of 3GPP38.141-2
7. Expected Results	Spurious emissions Should be with in specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.17_X
2. Test Details	The spurious emissions power is the power of emissions generated or amplified in a receiver that appear at the BS receiver antenna connector. The requirements apply to all BS with separate RX and TX antenna ports.
3. Test Instruments Required	Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables, Optical Fiber Cable, Optical Transciever, RF Attenuator,Tx Notch Filter, 50Ω Termination, O-DU Emulator.
4. Test Setup	TEST SETUP 19
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 7.6.4.2 of 3GPP38.141-1
6. Test Limits	Limits as per section 7.6.5 of 3GPP38.141-1
7. Expected Results	Spurious emissions Should be with in specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.17_Y
2. Test Details	The blocking characteristics is a measure of the receiver ability to receive a wanted signal at its assigned channel in the presence of an unwanted interferer which are either a NR signal for in-band blocking or a CW signal for out-of-band blocking. The test stresses the ability of the BS receiver to withstand high-level interference from unwanted signals at specified frequency offsets without undue degradation of its sensitivity.
3. Test Instruments Required	Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables, Optical Fiber Cable, Optical Transciever, RF Attenuator,Circulater,RF Combiner,Signal Generator for Wanted and Interfering Signal, 50Ω Termination, O-DU Emulator.
4. Test Setup	TEST SETUP 18
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 7.4.2.4.2 (for in-band blocking) and 7.5.4.2 (for out-of-band blocking) of 3GPP38.141-1
6. Test Limits	Test limits for the Blocking is as defined in Section 7.5.5(for out-of-band blocking) and 7.4.2.5(for in-band blocking) of 3GPP38.141-1
7. Expected Results	Blocking results should be with in specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.17_Z
2. Test Details	Third and higher order mixing of the two interfering RF signals can produce an interfering signal in the band of the desired channel. Inter modulation response rejection is a measure of the capability of the receiver to receive a wanted signal on its assigned channel frequency in the presence of two interfering signals which have a specific frequency relationship to the wanted signal.
3. Test Instruments Required	Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables, Optical Fiber Cable, Optical Transciever, RF Attenuator, RF Combiner,Signal Generator for Wanted,Interfering NR and Interfering CW Signal, 50Ω Termination, O-DU Emulator.
4. Test Setup	Test Setup 20
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 7.7.4.2 of 3GPP38.141-1
6. Test Limits	Test limits for the Rx Intermodulation is as defined in Section 7.7.5 of 3GPP38.141-1
7. Expected Results	Rx Intermodulations results should be with in specified Test Limits.

1. Test No.	**GR_TSTP_1.2.4.1.17_AA**
2. Test Details	Adjacent channel selectivity (ACS) is a measure of the receiver's ability to receive a wanted signal at its assigned channel frequency in the presence of an adjacent channel signal with a specified center frequency offset of the interfering signal to the band edge of a victim system. The narrowband blocking characteristics is a measure of the receiver's ability to receive a wanted signal at its assigned channel at the antenna connector in the presence of an unwanted interferer, which is an NR signal with one resource block.
3. Test Instruments Required	Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables, Optical Fiber Cable, Optical Transciever, RF Attenuator,Circulater,RF Combiner,Signal Generator for Wanted and Interfering Signal, 50Ω Termination, O-DU Emulator.
4. Test Setup	TEST SETUP 18
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 7.4.1.4.2(ACS) & 7.4.2.4.3(Narrowband Blocking) of 3GPP38.141-1
6. Test Limits	Test limits for the ACS & Narrow Band Blocking is as defined in Section 7.4.1.5 and 7.4.2.5 respectively of 3GPP38.141-1
7. Expected Results	ACS & Narrow Band Blocking results should be with in specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.17_AB
2. Test Details	The reference sensitivity power level PREFSENS is the minimum mean power received at the antenna connector at which a throughput requirement shall be met for a specified reference measurement channel.
3. Test Instruments Required	Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables, Optical Fiber Cable, Optical Transciever, RF Attenuator, Signal Generator, 50Ω Termination, O-DU Emulator.
4. Test Setup	TEST SETUP 17
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 7.2.4.2 of 3GPP38.141-1
6. Test Limits	Test limits for the Reference sensitivity level is as defined in Section 7.2.5 of 3GPP38.141-1
7. Expected Results	Reference sensitivity level results should be with in Specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.17_AC
2. Test Details	The dynamic range is specified as a measure of the capability of the receiver to receive a wanted signal in the presence of an interfering signal inside the received channel bandwidth. In this condition a throughput requirement shall be met for a specified reference measurement channel. The interfering signal for the dynamic range requirement is an AWGN signal.
3. Test Instruments Required	Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables, Optical Fiber Cable, Optical Transciever, RF Attenuator,Circulater,RF Combiner,Signal Generator for Wanted and Interfering AWGN Signal, 50Ω Termination, O-DU Emulator.
4. Test Setup	TEST SETUP 18
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 7.3.4.2 of 3GPP38.141-1
6. Test Limits	Test limits for the dynamic range level is as defined in Section 7.3.5 of 3GPP38.141-1
7. Expected Results	Dynamic range results should be with in specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.17_AD
2. Test Details	In-channel selectivity (ICS) is a measure of the receiver ability to receive a wanted signal at its assigned resource block locations in the presence of an interfering signal received at a larger power spectral density. In this condition a throughput requirement shall be met for a specified reference measurement channel. The interfering signal shall be an NR signal which is time aligned with the wanted signal.
3. Test Instruments Required	Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables, Optical Fiber Cable, Optical Transciever, RF Attenuator,RF Combiner,Signal Generator for Wanted and Interfering NR Signal, 50Ω Termination, O-DU Emulator.
4. Test Setup	TEST SETUP 18
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 7.8.4.2 of 3GPP38.141-1
6. Test Limits	Test limits for the In-channel selectivity is as defined in Section 7.8.5 of 3GPP38.141-1
7. Expected Results	In-channel selectivity results should be with in specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.17_AE
2. Test Details	The OTA RX spurious emission is the power of the emissions radiated from the antenna array from a receiver unit. Unless otherwise stated, all requirements are measured as mean power. The OTA receiver spurious emission limits for FR1 shall apply from 30 MHz to 12.75 GHz, excluding the frequency range from ΔfOBUE below the lowest frequency of each supported downlink operating band, up to ΔfOBUE above the highest frequency of each supported downlink operating band, where the ΔfOBUE is defined in subclause 6.7.1 of 3GPP38.141-2. For some operating bands, the upper limit of the spurious range might be higher than 12.75 GHz in order to comply with the 5th harmonic limit of the uplink operating band, as specified in ITU-R recommendation SM.329 [5]. For multi-band RIB the above exclusion applies for each supported operating band. The OTA receiver spurious emission limits for FR2 shall apply from 30 MHz to 2nd harmonic of the upper frequency edge of the uplink operating band, excluding the frequency range from ΔfOBUE below the lowest frequency of each supported downlink operating band, up to ΔfOBUE above the highest frequency of each supported downlink operating band, where the ΔfOBUE is defined in subclause 6.7.1 of 3GPP38.141-2. For a BS operating in FDD, OTA RX spurious emissions requirement do not apply as they are superseded by the OTA TX spurious emissions requirement. This is due to the fact that TX and RX spurious emissions cannot be distinguished in OTA domain. For a BS operating in TDD, the OTA RX spurious emissions requirement shall apply during the transmitter OFF period only. The metric used to capture OTA receiver spurious emissions is total radiated power (TRP), with the requirement defined at the RIB.

3. Test Instruments Required	Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables, Optical Fiber Cable, Optical Transciever, RF Attenuator,Tx Notch Filter, 50Ω Termination, O-DU Emulator, Antenna, Positioner, Test System Enclosure.
4. Test Setup	TEST SETUP 15
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 7.7.4.2 of 3GPP38.141-2
6. Test Limits	Limits as per section 7.7.5 of 3GPP38.141-2
7. Expected Results	OTA Rx Spurious emissions Should be with in specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.17_AF
2. Test Details	The OTA out-of-band blocking characteristics are a measure of the receiver unit ability to receive a wanted signal at the RIB at its assigned channel in the presence of an unwanted interferer. For the general OTA out-of-band blocking the requirement applies to the wanted signal for each supported polarization, under the assumption of polarization match. The interferer shall be polarization matched for in-band frequencies and the polarization maintained for out-of-band frequencies. The OTA in-band blocking characteristics is a measure of the receiver's ability to receive a OTA wanted signal at its assigned channel in the presence of an unwanted OTA interferer, which is an NR signal for in-band general blocking.
3. Test Instruments Required	Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables, Optical Fiber Cable, Optical Transciever, RF Attenuator,Circulater,RF Combiner,Signal Generator for Wanted and Interfering Signal, 50Ω Termination, O-DU Emulator, Antenna, Positioner, Test System Enclosure.
4. Test Setup	Test Setup 24 for OTA out-of-band blocking Test Setup 23 for OTA in-band blocking
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 7.5.2.4.2 (for in-band blocking) and 7.6.4.2 (for out-of-band blocking) of 3GPP38.141-2
6. Test Limits	Test limits for the OTA Blocking is as defined in Section 7.6.5(for out-of-band blocking) and 7.5.2.5(for in-band blocking) of 3GPP38.141-2

7. Expected Results	OTA Blocking results should be with in specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.17_AG
2. Test Details	Third and higher order mixing of the two interfering RF signals can produce an interfering signal in the band of the desired channel. Intermodulation response rejection is a measure of the capability of the receiver unit to receive a wanted signal on its assigned channel frequency in the presence of two interfering signals which have a specific frequency relationship to the wanted signal. The requirement is defined as a directional requirement at the RIB. The wanted and interfering signals apply to each supported polarization, under the assumption of polarization match.
3. Test Instruments Required	Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables, Optical Fiber Cable, Optical Transciever, RF Attenuator, RF Combiner,Signal Generator for Wanted,Interfering NR and Interfering CW Signal, 50Ω Termination, O-DU Emulator, Antenna, Positioner, Test System Enclosure.
4. Test Setup	Test Setup 25
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 7.8.4.2 of 3GPP38.141-2
6. Test Limits	Test limits for the OTA Rx Intermodulation is as defined in Section 7.8.5 of 3GPP38.141-2
7. Expected Results	OTA Rx Intermodulations results should be with in specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.17_AH
2. Test Details	OTA Adjacent channel selectivity (ACS) is a measure of the receiver's ability to receive an OTA wanted signal at its assigned channel frequency in the presence of an OTA adjacent channel signal with a specified centre frequency offset of the interfering signal to the band edge of a victim system. The wanted and interfering signals apply to each supported polarization, under the assumption of polarization match. The OTA narrowband blocking characteristics is a measure of the receiver's ability to receive a OTA wanted signal at its assigned channel at the antenna connector in the presence of an unwanted OTA interferer, which is an NR signal with one resource block.
3. Test Instruments Required	Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables, Optical Fiber Cable, Optical Transciever, RF Attenuator,Circulater,RF Combiner,Signal Generator for Wanted and Interfering Signal, 50Ω Termination, O-DU Emulator, Antenna, Positioner, Test System Enclosure.
4. Test Setup	Test Setup 22
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 7.5.1.4.2(OTA ACS) & 7.5.2.4.2(OTA Narrowband Blocking) of 3GPP38.141-2
6. Test Limits	Test limits for the OTA ACS & OTA Narrow Band Blocking is as defined in Section 7.5.1.5 and 7.5.2.5 respectively of 3GPP38.141-2

7. Expected Results	OTA ACS & OTA Narrow Band Blocking results should be with in specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.17_AI
2. Test Details	The OTA REFSENS requirement is a directional requirement and is intended to ensure the minimum OTA reference sensitivity level for a declared OTA REFSENS RoAoA. The OTA reference sensitivity power level EISREFSENS is the minimum mean power received at the RIB at which a reference performance requirement shall be met for a specified reference measurement channel. The OTA REFSENS EIS level declaration shall apply to each supported polarization, under the assumption of polarization match.
3. Test Instruments Required	Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables, Optical Fiber Cable, Optical Transciever, RF Attenuator, Signal Generator, 50Ω Termination, O-DU Emulator, Antenna, Positioner, Test System Enclosure.
4. Test Setup	Test Setup 21
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 7.3.4.2 of 3GPP38.141-2
6. Test Limits	Test limits for the OTA Reference sensitivity level is as defined in Section 7.3.5 of 3GPP38.141-2
7. Expected Results	OTA Reference sensitivity level results should be with in Specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.17_AJ
2. Test Details	The OTA dynamic range is a measure of the capability of the receiver unit to receive a wanted signal in the presence of an interfering signal inside the received BS channel bandwidth. The requirement shall apply at the RIB when the AoA of the incident wave of a received signal and the interfering signal are from the same direction and are within the OTA REFSENS RoAoA. The wanted and interfering signals apply to each supported polarization, under the assumption of polarization match.
3. Test Instruments Required	Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables, Optical Fiber Cable, Optical Transciever, RF Attenuator,Circulater,RF Combiner,Signal Generator for Wanted and Interfering AWGN Signal, 50Ω Termination, O-DU Emulator, Antenna, Positioner, Test System Enclosure.
4. Test Setup	Test Setup 22
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 7.4.4.2 of 3GPP38.141-2
6. Test Limits	Test limits for the OTA dynamic range level is as defined in Section 7.4.5 of 3GPP38.141-2
7. Expected Results	OTA Dynamic range results should be with in specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.17_AK
2. Test Details	OTA In-channel selectivity (ICS) is a measure of the receiver ability to receive a wanted signal at its assigned resource block locations in the presence of an interfering signal received at a larger power spectral density. In this condition a throughput requirement shall be met for a specified reference measurement channel. The interfering signal shall be an NR signal as specified in annex E in 3GPP 38.141-1 and shall be time aligned with the wanted signal.
3. Test Instruments Required	Power supply, Vector Spectrum analyzer, PC, LAN cable, Console cable, RF cables, Optical Fiber Cable, Optical Transciever, RF Attenuator,RF Combiner,Signal Generator for Wanted and Interfering NR Signal, 50Ω Termination, O-DU Emulator, Antenna, Positioner, Test System Enclosure.
4. Test Setup	Test Setup 26
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 7.9.4.2 of 3GPP38.141-2
6. Test Limits	Test limits for the OTA In-channel selectivity is as defined in Section 7.9.5 of 3GPP38.141-1
7. Expected Results	OTA In-channel selectivity results should be with in specified Test Limits.

1. Test No.	**GR_TSTP_1.2.4.1.18_A**
2. Test Details	Rated output power (Prated,c), of the base station is the mean power level per carrier for BS operating in single carrier, multi-carrier, or carrier aggregation configurations that the manufacturer has declared to be available at the antenna connector during the transmitter ON period
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, Reference clock generator.
4. Test Setup	Test Setup 27
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 6.2.4.2 of 3GPP36.141
6. Test Limits	≤ Declared BS Power ± 0.7 dB, f ≤ 3.0GHz ≤ Declared BS Power ± 1.0 dB, 3.0GHz < f ≤ 4.2GHz
7. Expected Results	Declared BS Power must be with in Test limits

1. Test No.	GR_TSTP_1.2.4.1.18_B
2. Test Details	The RE power control dynamic range is the difference between the power of an RE and the average RE power for a BS at maximum output power for a specified reference condition.
3. Test Instruments Required	Same as GR_TSTP_1.2.4.1.18_F
4. Test Setup	Same as GR_TSTP_1.2.4.1.18_F
5. Test Procedure	GR_TSTP_1.2.4.1.18_F NOTE: No specific test or test requirements are defined for RE Power control dynamic range. The Error Vector Magnitude test, provides sufficient test coverage for this requirement.
6. Test Limits	Same as GR_TSTP_1.2.4.1.18_F
7. Expected Results	Same as GR_TSTP_1.2.4.1.18_F

<table>
<tr><td>1. Test No.</td><td>GR_TSTP_1.2.4.1.18_C</td></tr>
<tr><td>2. Test Details</td><td>The total power dynamic range is the difference between the maximum and the minimum transmit power of an OFDM symbol for a specified reference condition.
NOTE: The upper limit of the dynamic range is the OFDM symbol power for a BS at maximum output power. The lower limit of the dynamic range is the OFDM symbol power for a BS when one resource block is transmitted. The OFDM symbol shall carry PDSCH and not contain RS, PBCH or synchronization signals.</td></tr>
<tr><td>3. Test Instruments

Required</td><td>Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, Reference clock generator.</td></tr>
<tr><td>4. Test Setup</td><td>Test Setup 27</td></tr>
<tr><td>5. Test Procedure</td><td>1. Make the setup as shown in Test Setup
2. Follow the procedure given in section 6.3.2.4.2 of 3GPP36.141</td></tr>
<tr><td>6. Test Limits</td><td>The downlink (DL) total power dynamic range for each E-UTRA carrier shall be larger than or equal to the level in Table Below:
<table>
<tr><th>E-UTRA
channel bandwidth (MHz)</th><th>Total power dynamic range (dB)</th></tr>
<tr><td>5</td><td>13.5</td></tr>
<tr><td>10</td><td>16.5</td></tr>
<tr><td>15</td><td>18.3</td></tr>
<tr><td>20</td><td>19.6</td></tr>
</table></td></tr>
</table>

7. Expected Results	The total power dynamic range should be with in Specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.18_D
2. Test Details	Transmitter OFF power is defined as the mean power measured over 70 us filtered with a square filter of bandwidth equal to the transmission bandwidth configuration of the BS centred on the assigned channel frequency during the transmitter OFF period. The purpose of this test is to verify the E-UTRA BS transmitter OFF power is within the limit of the minimum requirement.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, Reference clock generator.
4. Test Setup	Test Setup 28
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 6.4.2.4.2 of 3GPP36.141
6. Test Limits	Mean power spectral density shall be < -83dBm/MHz for f ≤ 3.0GHz < -82.5dBm/MHz for 3.0GHz < f ≤ 4.2GHz.
7. Expected Results	Transmitter OFF power Should be with in specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.18_E
2. Test Details	Frequency error is the measure of the difference between the actual BS transmit frequency and the assigned frequency. The same source shall be used for RF frequency and data clock generation.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, Reference clock generator.
4. Test Setup	Test setup 27
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 6.5.1.4 of 3GPP36.141
6. Test Limits	The modulated carrier frequency of each E-UTRA carrier configured by the BS shall be accurate to within the accuracy range given in Table Below observed over a period of one subframe (1ms).
7. Expected Results	Frequency error Should be with in specified Test Limits.

BS class	Accuracy
Wide Area BS	± (0.05 ppm + 12 Hz)
Medium Range BS	± (0.1 ppm + 12 Hz)
Local Area BS	± (0.1 ppm + 12 Hz)
Home BS	± (0.25 ppm + 12 Hz)

1. Test No.	GR_TSTP_1.2.4.1.18_F
2. Test Details	The Error Vector Magnitude is a measure of the difference between the ideal symbols and the measured symbols after the equalization. This difference is called the error vector. The EVM result is defined as the square root of the ratio of the mean error vector power to the mean reference power expressed in percentage.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, Reference clock generator.
4. Test Setup	Test Setup 27
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 6.5.2.4.2 of 3GPP36.141
6. Test Limits	The EVM of each E-UTRA carrier for different modulation schemes on PDSCH shall be less than the limits in table:
7. Expected Results	Error Vector Magnitude Should be with in specified Test Limits

Modulation scheme for PDSCH	Required EVM [%]
QPSK	18.5 %
16QAM	13.5 %
64QAM	9 %
256QAM	4.5%
NOTE: The EVM requirement for 256QAM applies to Home BS, Local Area BS and Medium Range BS.	

1. Test No.	GR_TSTP_1.2.4.1.18_G
2. Test Details	Frames of the LTE signals present at the BS transmitter antenna port(s) are not perfectly aligned in time. In relation to each other, the RF signals present at the BS transmitter antenna port(s) experience certain timing differences. For a specific set of signals/transmitter configuration/transmission mode, time alignment error (TAE) is defined as the largest timing difference between any two signals.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, Reference clock generator, hybrid coupler.
4. Test Setup	Test Setup 29
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 6.5.3.4.2 of 3GPP36.141
6. Test Limits	TAE shall not exceed: 1. 90 ns for MIMO or TX diversity transmissions, at each carrier frequency. 2. 155 ns for intra-band contiguous carrier aggregation, with or without MIMO or TX diversity. 3. 285 ns for intra-band non-contiguous carrier aggregation, with or without MIMO or TX diversity. 4. 285 ns for inter-band carrier aggregation, with or without MIMO or TX diversity.

7. Expected Results	TAE Should be with in specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.18_H
2. Test Details	For E-UTRA, DL RS power is the resource element power of Downlink Reference Symbol. The absolute DL RS power is indicated on the DL-SCH. The absolute accuracy is defined as the maximum deviation between the DL RS power indicated on the DL-SCH and the DL RS power of each E-UTRA carrier at the BS antenna connector
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, Reference clock generator.
4. Test Setup	Test Setup 27
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 6.5.4.4.2 of 3GPP36.141
6. Test Limits	DL RS power of each E-UTRA carrier shall be: within ± 2.9 dB of the DL RS power indicated on the DL-SCH for carrier frequency f ≤ 3.0 GHz within ± 3.2 dB of the DL RS power indicated on the DL-SCH for carrier frequency 3.0GHz < f ≤ 4.2GHz.
7. Expected Results	DL RS Power Should be with in specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.18_I
2. Test Details	The occupied bandwidth is the width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to 0.5% of the total mean transmitted power. The requirement applies during the transmitter ON period.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, Reference clock generator.
4. Test Setup	Test Setup 27
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 6.6.1.4.2 of 3GPP36.141 for vendor specified channel bandwidths.
6. Test Limits	Test limits for the Occupied BW is as defined in Section 5.6 of 3GPP36.141.
7. Expected Results	Occupied BW Should be with in specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.18_J
2. Test Details	Adjacent Channel Leakage Power Ratio (ACLR) is the ratio of the filtered mean power centered on the assigned channel frequency to the filtered mean power centered on an adjacent channel frequency.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, Reference clock generator.
4. Test Setup	Test Setup 27
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 6.6.2.4.2 of 3GPP36.141
6. Test Limits	Test limits for the ACLR is < 44.2 dB
7. Expected Results	ACLR Should be with in specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.18_K
2. Test Details	Unless otherwise stated, the Operating band unwanted emission limits are defined from 10 MHz below the lowest frequency of each supported downlink operating band up to 10 MHz above the highest frequency of each supported downlink operating band.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, EF Attenuator, 50Ω Termination, Reference clock generator.
4. Test Setup	Test Setup 27
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 6.6.3.4.2 of 3GPP36.141
6. Test Limits	Test limits for the Operating band unwanted emission is as defined in Section 6.6.3.5 of 3GPP36.141
7. Expected Results	Operating band unwanted emission should be with in Specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.18_L
2. Test Details	Spurious emissions are emissions which are caused by unwanted transmitter effects such as harmonics emission, parasitic emission, inter modulation products and frequency conversion products, but exclude out of band emissions. This is measured at the base station antenna connector. The transmitter spurious emission limits apply from 9 kHz to 12.75 GHz, excluding the frequency range from 10 MHz below the lowest frequency of the downlink operating band up to 10 MHz above the highest frequency of the downlink operating band.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, Reference clock generator.
4. Test Setup	Test Setup 30
5. Test Procedure	7. a) Make the setup as shown in Test Setup 8. b) Follow the procedure given in section 6.6.4.4.2 of 3GPP36.141
6. Test Limits	Ref 3GPP TS 36.141 Table 6.6.4.5.2-1

BS Spurious emissions limits		
Frequency range	**Maximum Level**	**Measurement Bandwidth**
9 kHz ~ 150 kHz	-36dBm	1 kHz
150 kHz ~ 30MHz	-36dBm	10 kHz
30MHz ~ 1 GHz	-36dBm	100 kHz
1 GHz ~ 12.75 GHz	-30dBm	1MHz

7. Expected Results	Spurious emissions Should be with in specified Test Limits.

1. Test No.	**GR_TSTP_1.2.4.1.18_M**
2. Test Details	The transmit inter modulation requirement is a measure of the capability of the transmitter to inhibit the generation of signals in its nonlinear elements caused by presence of the wanted signal and an interfering signal reaching the transmitter via the antenna. The requirement applies during the transmitter ON period and the transmitter transient period. The transmit inter modulation level is the power of the inter modulation products when an EUTRA signal of channel bandwidth 5 MHz as an interfering signal is injected into an antenna connector at a mean power level of 30 dB lower than that of the mean power of the wanted signal.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, Reference clock generator, Circulator, Signal Generator with LTE software.
4. Test Setup	Test Setup 31
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 6.7.4.2 of 3GPP36.141
6. Test Limits	Test limits for the Transmitter intermodulation is as defined in Section 6.7.5 of 3GPP36.141

7. Expected Results	Transmitter intermodulation Spurious emissions should be with in specified Test Limits.

<table>
<tr><td>1. Test No.</td><td>GR_TSTP_1.2.4.1.18_N</td></tr>
<tr><td>2. Test Details</td><td>The spurious emissions power is the power of emissions generated or amplified in a receiver that appear at the BS receiver antenna connector. The requirements apply to all BS with separate RX and TX antenna ports.</td></tr>
<tr><td>3. Test Instruments Required</td><td>Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, Reference clock generator.</td></tr>
<tr><td>4. Test Setup</td><td>Test Setup 30</td></tr>
<tr><td>5. Test Procedure</td><td>1. Make the setup as shown in Test Setup
2. Follow the procedure given in section 7.7 of 3GPP36.141</td></tr>
<tr><td>6. Test Limits</td><td>Limits as per section 7.7.5 of 3GPP36.141
Table 7.7-1: General spurious emission test requirement
<table>
<tr><th>Frequency range</th><th>Maximum level</th><th>Measurement Bandwidth</th><th>Note</th></tr>
<tr><td>30MHz - 1 GHz</td><td>-57 dBm</td><td>100 kHz</td><td></td></tr>
<tr><td>1 GHz - 12.75 GHz</td><td>-47 dBm</td><td>1 MHz</td><td></td></tr>
<tr><td>12.75 GHz - 5th harmonic of the upper frequency edge of the UL operating band in GHz</td><td>-47 dBm</td><td>1 MHz</td><td>Applies only for Bands 22, 42 and 43.</td></tr>
<tr><td colspan="4">NOTE: The frequency range between 2.5 * $BW_{Channel}$ below the first carrier frequency and 2.5 * $BW_{Channel}$ above the last carrier frequency transmitted by the BS, where $BW_{Channel}$ is the channel bandwidth according to Table 5.6-1, may be excluded from the requirement. However, frequencies that are more than 10 MHz below the lowest frequency of the BS downlink operating band or more than 10 MHz above the highest frequency of the BS downlink operating band (see Table 5.5-1) shall not be excluded from the requirement.</td></tr>
</table></td></tr>
<tr><td>7. Expected Results</td><td>Spurious emissions Should be with in specified Test Limits.</td></tr>
</table>

1. Test No.	GR_TSTP_1.2.4.1.18_O
2. Test Details	The blocking characteristics is a measure of the receiver ability to receive a wanted signal at its assigned channel in the presence of an unwanted interferer, which are either a 1.4MHz, 3MHz or 5MHz EUTRA signal for in-band blocking or a CW signal for out-of-band blocking. The test stresses the ability of the BS receiver to withstand high-level interference from unwanted signals at specified frequency offsets without undue degradation of its sensitivity.
3. Test Instruments Required	Power supply, Signal Generator, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, Reference clock generator, Combiner, Circulator.
4. Test Setup	Test Setup 32
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 7.6.4.2 of 3GPP36.141
6. Test Limits	Test limits for the Blocking is as defined in Section 7.6.5 of 3GPP36.141
7. Expected Results	Blocking results should be with in specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.18_P
2. Test Details	Third and higher order mixing of the two interfering RF signals can produce an interfering signal in the band of the desired channel. Inter modulation response rejection is a measure of the capability of the receiver to receive a wanted signal on its assigned channel frequency in the presence of two interfering signals which have a specific frequency relationship to the wanted signal. Interfering signals shall be a CW signal and an EUTRA signal.
3. Test Instruments Required	Power supply, Signal Generators with LTE software, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, Reference clock generator, Combiner, Circulator.
4. Test Setup	Test Setup 33
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 7.8.4.2 of 3GPP36.141
6. Test Limits	Test limits for the Rx Intermodulation is as defined in Section 7.8.5 of 3GPP36.141
7. Expected Results	Rx Intermodulations results should be with in specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.18_Q
2. Test Details	Adjacent channel selectivity (ACS) is a measure of the receiver's ability to receive a wanted signal at its assigned channel frequency in the presence of an adjacent channel signal with a specified center frequency offset of the interfering signal to the band edge of a victim system.
3. Test Instruments Required	Power supply, Signal Generators with LTE software, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, Reference clock generator, Combiner, Circulator.
4. Test Setup	Test Setup 32
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 7.5.4.2 & 7.5.4.3 of 3GPP36.141
6. Test Limits	Test limits for the ACS & Narrow Band Blocking is as defined in Section 7.5.5 of 3GPP36.141
7. Expected Results	ACS & Narrow Band Blocking results should be with in specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.18_R
2. Test Details	The reference sensitivity power level PREFSENS is the minimum mean power received at the antenna connector at which a throughput requirement shall be met for a specified reference measurement channel.
3. Test Instruments Required	Power supply, Signal Generators with LTE software, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, Reference clock generator, Combiner, Circulator.
4. Test Setup	Test Setup 32
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 7.2.4.2 of 3GPP36.141
6. Test Limits	Test limits for the Reference sensitivity level is as defined in Section 7.2.5 of 3GPP36.141
7. Expected Results	Reference sensitivity level results should be with in Specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.18_S
2. Test Details	The dynamic range is specified as a measure of the capability of the receiver to receive a wanted signal in the presence of an interfering signal inside the received channel bandwidth. In this condition a throughput requirement shall be met for a specified reference measurement channel. The interfering signal for the dynamic range requirement is an AWGN signal.
3. Test Instruments Required	Power supply, Signal Generators with LTE software & AWGN, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, Reference clock generator, Combiner, Circulator.
4. Test Setup	Test Setup 32
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 7.3.4.2 of 3GPP36.141
6. Test Limits	Test limits for the dynamic range level is as defined in Section 7.3.5 of 3GPP36.141
7. Expected Results	Dynamic range results should be with in specified Test Limits.

1. Test No.	GR_TSTP_1.2.4.1.18_T
2. Test Details	In-channel selectivity (ICS) is a measure of the receiver ability to receive a wanted signal at its assigned resource block locations in the presence of an interfering signal received at a larger power spectral density. In this condition a throughput requirement shall be met for a specified reference measurement channel.
3. Test Instruments Required	Power supply, Signal Generators with LTE software, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, Reference clock generator, Combiner, Circulator.
4. Test Setup	Test Setup 32
5. Test Procedure	1. Make the setup as shown in Test Setup 2. Follow the procedure given in section 7.4.4.2 of 3GPP36.141
6. Test Limits	Test limits for the In-channel selectivity is as defined in Section 7.4.5 of 3GPP36.141
7. Expected Results	In-channel selectivity results should be with in specified Test Limits.

1. Test No	**GR_TSTP_ 1.2.4.2.7**
2. Test Details	To Verify that the O-DU shall support CTI to a TN to control UL bandwidth allocation to TUs for UL LLS traffic on shared point-to-multipoint transport network (TN is a PON OLT or DOCSIS CMTS, TU is a PON ONU or DOCSIS Cable Modem).
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 7
5. Test Procedure	1. Bring O-DU, TN (OLT/CMTS) and TUs (ONU/Cable Modem) to operational state. 2. Establish uplink LLS traffic from multiple TUs simultaneously using UE/UE simulator. 3. From O-DU, configure CTI-based UL bandwidth control policies for TUs. 4. Observe whether TN applies bandwidth allocation changes as instructed by O-DU and whether traffic throughput adjusts accordingly.
6. Test Limits	NA
7. Expected Results	The O-DU shall successfully control UL bandwidth allocation to TUs via CTI on a shared TN, and traffic distribution shall follow O-DU scheduling instructions without major alarms or service disruption.

1. Test No	**GR_TSTP_ 1.2.4.2.9**
2. Test Details	To Verify that For Layer 1 acceleration, look-aside or inline configuration shall be supported.
3. Test Instruments Required	ORAN gNodeB (CU/DU), 5GC/5GC Emulator, Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 7
5. Test Procedure	1. Bring CU, DU and RU to operational state and establish UE connectivity. 2. From OAM / Console, configure L1 acceleration mode (look-aside or inline). 3. Trigger uplink and downlink traffic to load DU Layer-1 processing. 4. Monitor DU processor load, L1 accelerator utilization and service KPIs to confirm correct engagement of the configured acceleration mode.
6. Test Limits	NA
7. Expected Results	The O-DU shall support Layer-1 acceleration in both look-aside or inline configuration modes and shall apply the selected mode without service degradation or major alarms.

1. Test No	**GR_TSTP_ 1.2.4.2.13**
2. Test Details	To Verify that O-DU may support intra gNodeB-O-DU Carrier Aggregation: CA between 2 cells belonging to 2 different O-DUs on the same gNodeB.
3. Test Instruments Required	O-CU, O-DU, O-RU, UE (or UE simulator), 5G Core (or core simulator), Wireshark analyzer, traffic generator (e.g., iPerf), management PC, switch/router and network cables.
4. Test Setup	Test Setup 3
5. Test Procedure	1. Configure gNodeB with 2 component carrier for CA support. 2. Bring up the gNodeB into an Operationally Enabled state. 3. Confirm cells are active and broadcasting SIBs for both carriers. 4. Power on the UE and initiate the UE registration procedure. 5. Confirm successful RRC connection setup. 6. Initiate required amount of traffic to trigger data on both Pcell and Scell as part of carrier aggregation. 7. Confirm that UE attaches to the primary cell and then The Secondary Cell (SCell) is added for additional user-plane capacity
6. Test Limits	UE should be capable of supporting Carrier Aggregation
7. Expected Results	Measure throughput to confirm that both CCs are contributing to the data session. Also confirm that combined data throughput of CA

1. Test No	**GR_TSTP_ 1.2.4.2.14**
2. Test Details	To Verify that O-DU may have routing capabilities to support in-site connection to other/legacy equipment.
3. Test Instruments Required	O-CU, O-DU, O-RU, UE (or UE simulator), 5G Core (or core simulator), Network Packet Analyzer, Traffic generator (e.g., iPerf), management PC, switch/router and network cables.
4. Test Setup	TEST SETUP 1
5. Test Procedures	1. Enable routing capabilities on the O-DU. 2. Connect other/legacy equipment to the O-DU's network. 3. Send test traffic to Communicate from other/legacy equipment to O-DU. 4. Verify that O-DU is routing traffic to and from other/legacy equipment. 5. Verify end-to-end connectivity between other/legacy equipment . 6. Verify that communication through protocol analyzer.
6. Test Limits	NA
7. Expected Results	The O-DU successfully routes traffic to and from other/legacy equipment.

1. Test No	**GR_TSTP_ 1.2.4.2.15**
2. Test Details	To Verify that O-DU shall support DHCP server to allow O-RU bring-up and IP configuration in a more secure way.
3. Test Instruments Required	O-RU, O-DU, O-CU, 5G Core Network, UE or UE Simulator, Protocol Analyzer , Managed Switch/Router, RF Cables, DHCP Server.
4. Test Setup	Test setup-01
5. Test Procedure	1. Power on the O-RU and connect it to the O-DU network. 2.Verify O-RU sends DHCP Discover to the O-DU. 3. Check O-DU DHCP server responds with DHCP Offer 4. Confirm O-RU sends DHCP Request. 5. Verify O-DU completes with DHCP Acknowledge 6. Check O-RU configures with assigned IP and connects to O-DU. 7. configure gNodeB and bring up to operational state. 8. Initiate UE registration and perform data transfer. 9. Verify that 5G symbol and data traffic is seen at UE, .
6. Test Limits	NA
7. Expected Results	The O-RU successfully receives an IP address and network configuration from the O-DU's DHCP server. All DHCP message exchanges—Discover, Offer, Request, and Acknowledge—are completed as expected, with the O-RU configuring itself with the assigned IP

1. Test No	**GR_TSTP_ 1.2.4.2.16**
2. Test Details	To Verify that in order to enhance URLLC capabilities, 5G NR O-DUs shall support the existence of non-slot scheduling.
3. Test Instruments Required	O-CU, O-DU, O-RU, UE (or UE simulator), 5G Core (or core simulator), Network Packets Analyzer, Traffic generator (e.g., iPerf), management PC, switch/router and network cables.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Enable non-slot scheduling on the O-DU 2. Bring up gNodeB in operational state 3. Initiate data traffic from the UE to the O-DU. 4. Observe scheduling patterns to confirm non-slot scheduling is applied. 5. Verify KPIs related to URLLC functionalities.
6. Test Limits	UE should support URLLC capability
7. Expected Results	The O-DU uses non-slot scheduling to enhance URLLC performance, dynamically allocating resources outside standard slot intervals.

1. Test No	**GR_TSTP_ 1.2.4.2.17**
2. Test Details	To Verify that O-DUs may be able to support connectivity to multiple O-CUs for resilience.
3. Test Instruments Required	O-CU, O-DU, O-RU, UE (or UE simulator), 5G Core (or core simulator), Network Packet Analyzer, Traffic generator (e.g., iPerf), management PC, switch/router and network cables.
4. Test Setup	Test Setup 8
5. Test Procedure	1. Ensure gNodeB is configured with relevant configuration. 2. Establish an initial active connection between O-DU and O-CU in containerized environment. 3. Simulate failure on O-CU and ensure that failure is handled. 4. Verify that there is no disruption in data transmission.
6. Test Limits	NA
7. Expected Results	GnodeB shall support O-CU resilience towards O-DU incase of O-CU failure.

1. Test No	**GR_TSTP_ 1.2.4.2.18**
2. Test Details	To Verify that DU shall support at least one of the following synchronization options: - 1. GNSS (GPS or NAVIC) (to be specified by vendor) 2. IEEE 1588 V2 3. Sync E Frequency and Phase Synchronization shall be supported with at least 1 hr hold over mode in case of frequency and phase synchronization loss.
3. Test Instruments Required	ORAN gNodeB, 5GC/5GC Emulator, Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	**Test Procedure for GNSS/ IEEE 1588 V2/ SynchE:** 1. Prepare setup as per Test setup. 2.Connect a GNSS to the gNodeB O-DU. 3. Configure the GNSS and ORAN gNodeB O-DU appropriately. ORAN gNodeB should recover timing from GNSS. 4. Verify the synchronization status **Test procedure to verify hold over mode:** 1. Activate the primary synchronization source (GNSS, IEEE 1588 V2, or SyncE) on the O-DU. 2. Disconnect or disable the primary synchronization source to simulate sync loss. 3. Verify that the O-DU enters holdover mode, maintaining frequency and phase as precisely as possible. 4. Reconnect the primary synchronization source and observe the DU's re-locking to the external sync source. 5. Verify that the DU restores accurate synchronization upon re-connection.
6. Test Limits	NA

7. Expected Results	The O-DU should successfully achieve synchronization with at least one of the specified options (GNSS, IEEE 1588 V2, or SyncE) and maintain accurate frequency and phase synchronization under normal conditions.

1. Test No	GR_TSTP_ 1.2.4.2.19_A
2. Test Details	To Verify that O-DU shall perform the below RLC and MAC functions as under – 1.2.4.2.19.1 Radio Link Control (RLC) RLC shall be responsible for segmentation and retransmission handling. The RLC shall provide services to the PDCP in the form of RLC channels. There shall be one RLC entity per RLC channel (and hence per radio bearer) configured for a device. Segmentation/ Concatenation: RLC layer shall support segmentation and concatenation to adapt the payload to the transport block size. 1.2.4.2.19.2 Medium Access Control (MAC) The MAC shall handle hybrid-ARQ retransmissions, and dynamic resource allocation (scheduling) and scheduling-related functions. The system shall support: b. Contention based Random Access (RA) procedure.
3. Test Instruments Required	Power supply, Packet Analyzer, O-CU, O-DU, O-RU, UE (Commercial UE / UE simulator), 5G Core Network / Core Network Simulator), traffic generator , management PC, Cables and accessories
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Bring gNodeB in operationally enabled state. 2. Perform UE registration. 3. Ensure gNodeB is loaded with correct configurations(RLC AM / RLC UM mode). 4. Perform UL and DL data transfer. **Segmentation:** 1. Check gNodeB O-DU RLC receives transmission opportunity from gNodeB O-DU MAC for data transmission. 2. Verify that gNodeB O-DU RLC segments the available gNodeB O-DU RLC SDU's , if RLC SDU's have size larger than Transport Block Size which is received via transmission opportunity from gNodeB O-DU MAC. 3. Verify RLC segmentation with the help of RLC PDU header(SN ,SI

	and SO field). Re-transmission: 1. During Downlink data transfer, check UE sends RLC status report to gNodeB having NACK_SN field which implies loss of data packets. 2. Based on the transmission opportunity from MAC received from gNodeB O-DU MAC, gNodeB O-DU RLC will re-transmit the NACK/lost data packets to UE. 3. Check gNodeB O-DU RLC sends the SDU's to upper layer gNodeB O-DU PDCP. Hybrid-ARQ retransmissions: 1. Check gNodeB O-DU MAC is assigning harq process id for every DL and UL data PDU. 2. Verify NDI is toggling for every new data transmission (when ACK is received from UE). 3. Verify RV is updating during data re-transmission(when NACK is received from UE). Dynamic resource allocation: 1.During data transfer, check gNodeB O-DU MAC is allocating Resources dynamically based on the radio channel conditions. Contention based Random Access (RA) procedure: 1. Check RACH related parameters from SIB1 to initiate the random-access procedure. 2. Check UE send message -1 (Random Access Request) to gNodeB. 3. Check gNodeB sends message-2 (Random Access Response) to UE. 4. Verify that UE send message-3 (RRC Setup Request message) to gNodeB. 5. Check gNodeB sends message-4 (UE Contention Resolution) to UE.
6. Test Limits	NA
7. Expected Results	gNodeB O-DU RLC Layer shall support segmentation and re- transmission functionality. gNodeB O-DU MAC Layer shall support HARQ and Contention based Random Access (RA) functionality and Dynamic resource allocation can be seen based on

	demand.

1. Test No	**GR_TSTP_ 1.2.4.2.19_B**

2. Test Details	To Verify that O-DU shall perform the below MAC functions as under – 1.2.4.2.19.2 Medium Access Control (MAC) The MAC shall handle multiplexing and de-multiplexing of logical channels and dynamic resource allocation (scheduling) and scheduling-related functions. The MAC shall provide services to the RLC in the form of logical channels.
3. Test Instruments Required	Power supply, Packet Analyzer, O-CU, O-DU, O-RU, UE (Commercial UE / UE simulator), 5G Core Network / Core Network Simulator), traffic generator , management PC, Cables and accessories
4. Test Setup	Test Setup 2
5. Test Procedure	1. Bring gNodeB in operationally enabled state. 2. Ensure gNodeB is loaded with correct configurations. 3. Perform multiple UE registration. 4. Configure 2 data radio bearers per UE. 5. Perform UL and DL data transfer. 6. During Downlink data transfer, verify gNodeB O-DU MAC is performing multiplexing of MAC SDUs from one or different logical channels to form transport blocks (TB) and sending to Physical Layer. 7. During Uplink data transfer, verify gNodeB O-DU MAC is performing De-multiplexing of transport blocks (TB) into MAC SDUs and sending to gNodeB O-DU RLC. 8. Verify gNodeB O-DU MAC is providing services (MAC SDUs) to the gNodeB O-DU RLC.
6. Test Limits	NA
7. Expected Results	gNodeB O-DU MAC Layer shall support multiplexing and de-multiplexing and providing services to upper layer functionality.

1. Test No	**GR_TSTP_ 1.2.4.2.19_C**
2. Test Details	To Verify that O-DU shall perform the below MAC functions as under – 1.2.4.2.19.2 Medium Access Control (MAC) Discontinuous Reception (DRX) to enable reasonable UE battery consumption
3. Test Instruments Required	Power supply, Packet Analyzer, O-CU, O-DU, O-RU, UE (Commercial UE / UE simulator), 5G Core Network / Core Network Simulator), traffic generator , management PC, Cables and accessories
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Bring gNodeB in operationally enabled state. 2. Perform UE registration. 3. Ensure gNodeB is loaded with correct configurations (DRX related parameters in O-DU). 4. Perform UL and DL data transfer. 5. During idle mode, check the UE/UESIM is not actively transmitting or receiving data but remains reachable for paging messages from the network. 6. Check O-DU is able to handle paging occasions based on O-CU configurations.
6. Test Limits	NA
7. Expected Results	gNodeB O-DU MAC Layer shall support Discontinuous Reception (DRX) functionality.

1. Test No	**GR_TSTP_ 1.2.4.2.19_D**
2. Test Details	To Verify that O-DU shall perform the below MAC functions as under – 1.2.4.2.19.2 Medium Access Control (MAC) Short Buffer Status Report (BSR) and Long BSR
3. Test Instruments Required	Power supply, Packet Analyzer, O-CU, O-DU, O-RU, UE (Commercial UE / UE simulator), 5G Core Network / Core Network Simulator), traffic generator , management PC, Cables and accessories
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Bring gNodeB in operationally enabled state. 2. Perform UE registration. 3. Ensure gNodeB is loaded with correct configurations. 4. Perform UL and DL data transfer. 5. Verify the BSR config in cell Group Config. 6. Verify that MAC allocates RBs and TBsize equivalent to bytes reported by UE through BSR. 7. Verify relevant LCID's for Short BSR and Long BSR.
6. Test Limits	NA
7. Expected Results	gNodeB O-DU MAC Layer shall support Short Buffer Status Report (BSR) and Long BSR functionality.

1. Test No	**GR_TSTP_ 1.2.4.2.19_E**
2. Test Details	To Verify that O-DU shall perform the below MAC functions as under – 1.2.4.2.19.2 Medium Access Control (MAC) From the physical layer, the MAC layer shall use the services in the form of transport channels. The system shall support: a. Link adaptation and power control
3. Test Instruments Required	Power supply, Packet Analyzer, O-CU, O-DU, O-RU, UE (Commercial UE / UE simulator), 5G Core Network / Core Network Simulator), traffic generator , management PC, Cables and accessories
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Bring gNodeB in operationally enabled state. 2. Perform UE registration. 3. Enable Link adaptation and power control related parameters in O-DU. 4. Perform UL and DL data transfer. 5. Verify gNodeB O-DU MAC is scheduling PDSCH with various DL MCS correctly as per channel conditions. 6. Verify gNodeB O-DU MAC is scheduling PUSCH with various UL MCS correctly as per channel conditions. 7. For Closed Loop Power Control, verify that gNodeB O-DU MAC is sending TPC commad to UE. 8. For Open Loop Power Control, Verify that power related parameters sent by gNodeB in SIB-1 message. Also, verify that UE computes power based on SIB-1 power parameters and sends RACH message to gNodeB.
6. Test Limits	NA
7. Expected Results	gNodeB O-DU MAC Layer shall support Link adaptation and power control and usage of services from Physical layer functionality.

1. Test No	**GR_TSTP_ 1.2.4.2.20**

2. Test Details	To Verify that O-DU may support artificial traffic generation to fill a percentage of Physical Resource Block according to ETSI ES 202 706-1 in order to measure power consumption for different traffic load levels
	• Operator shall set the percentage of PRB to be filled
	• Operator shall choose between below two options:
	    • PDSCH is equally distributed over time within the 10ms radio frame
	    • PDSCH load is concentrated in time, but use the full bandwidth.

3. Test Instruments Required	ORAN ORAN gNodeB, 5GC/5GC Emulator, Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 7
5. Test Procedure	1. Bring CU, DU and RU to operationally enabled state and establish UE session(s). 2. From OAM/Console, enable artificial traffic generation feature and configure PRB load percentage. 3. Select option (a) equal distribution across 10 ms frame or option (b) concentrated PDSCH load over full bandwidth. 4. Run traffic and verify PRB utilization through O-DU counters. 5. Measure power consumption against PRB load configuration.
6. Test Limits	NA
7. Expected Results	The O-DU shall successfully generate artificial traffic for the configured PRB percentage and distribution mode without service impact, and the power consumption shall vary with traffic load levels as expected without major alarms.

1. Test No	**GR_TSTP_ 1.2.4.4.3**
2. Test Details	To Verify that the O-CU may support O-CU-CP and O-CU-UP nodes only if its Control and User part is deployed in split configuration.
3. Test Instruments Required	O-CU, O-DU, O-RU, UE (or UE simulator), 5G Core (or core simulator), Network Packet Analyzer, Traffic generator (e.g., iPerf), management PC, switch/router and network cables.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Ensure O-CU-CP and O-CU-UP nodes are correctly deployed in split configuration. 2.Bring gNodeB in operationally enabled state. 3. Verify communication between O-CU-CP, O-CU-UP, and the corresponding RAN components 4.verify control and user plane data during UE registration. 5. Verify that O-CU-CP is handling control messages and O-CU-UP is handling UE related traffic. 6. Confirm that both control and user plane functionalities are operational.
6. Test Limits	NA
7. Expected Results	The O-CU successfully supports both O-CU-CP and O-CU-UP nodes when deployed in a split configuration. Verify the communication between O-CU-CP and O-CU-UP Verify control and user part functionality

1. Test No	**GR_TSTP_ 1.2.4.4.4**
2. Test Details	To Verify that gNodeB O-CU and O-vCU may support geo-redundancy mechanism in case of centralized deployment
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	gNodeB O-CU, O-vCU, Network Management Tool.
5. Test Procedure	1.Both the O-CU and O-vCU are operational in both sites, with active connections to the corresponding O-DUs and other network elements 2. Simulate traffic and normal operation in one site (primary). secondary site (backup) can take over the operational duties of the O-CU and O-vCU without interruption in the event of a failure 3. Failure Simulation 4. Data Synchronization Check
6. Test Limits	NA
7. Expected Results	The gNodeB O-CU and O-vCU should successfully support a geo-redundancy mechanism in a centralized deployment. In the event of a failure at the primary site, the secondary site should seamlessly take over all operational responsibilities without service disruption

1. Test No	**GR_TSTP_ 1.2.4.4.5**
2. Test Details	To Verify that O-CU-CPs shall be able to support connectivity to multiple O-CU-UPs
3. Test Instruments Required	O-CU, O-DU, O-RU, UE (or UE simulator), 5G Core (or core simulator), Network Packet Analyzer, Traffic generator (e.g., iPerf), management PC, switch/router and network cables.
4. Test Setup	Test Setup 9
. Test Procedure	1.Ensure gNodeB OCU is loaded with correct configurations 2.Bringup gNodeB to operationally enabled state. 3. verify that O-CU-CP comes up with multiple O-CU-Ups. 4. Verify that atleast one UE performs UE registration in each cell. 5. Verify Downlink and Uplink data transfer from each UE using multiple O-CU-UP.
6. Test Limits	NA
7. Expected Results	O-CU-CP supports connectivity to multiple O-CU-UP functionality

1. Test No	**GR_TSTP_ 1.2.4.4.6.1**
2. Test Details	To Verify that QoS requirements as under: ▪ 5QI (5G QoS Identifiers) for NR-Standalone mode as per 3GPP TS 23.501 Table 5.7.4-1. ▪ Multiple data radio bearers (DRBs). ▪ Dynamic addition and deletion of dedicated bearers. ▪ Both UE initiated as well as Network Initiated dedicated bearer creation. ▪ Prioritization of traffic in downlink as per the QCI/ 5QI priority value.
3. Test Instruments Required	O-CU, O-DU, O-RU, UE (or UE simulator), 5G Core (or core simulator), Network Packet Analyzer, Traffic generator (e.g., iPerf), management PC, switch/router and network cables.
4. Test Setup	Test Setup 2
5. Test Procedure	1.Ensure gNodeB is loaded with correct configurations. 2.Bring the gNodeB to the operational Enabled state. 3.Perform Multi-UE registration. 4.Perform voice call, video call, iperf data and youtube streaming. 5.During voice call initiation, verify that the gNodeB supports dynamic addition of dedicated bearers. 6.Ensure that dedicated bearers are released upon call termination. 7. verify that 5QI priorities are getting handled for the bearers.
6. Test Limits	N/A
7. Expected Results	gNodeB shall supprt multiple radio bearers. gNodeB shall support dynamic addition and deletion of radio bearers during voice call, video call, iperf data and youtube steaming. gNodeB shall support Prioritization of traffic as per 5QI priority.

1. Test No	GR_TSTP_1.2.4.4.6.2_A
2. Test Details	To Verify that Voice over NR (VoNR) support as under: -The O-CU shall support Voice over NR (VoNR) functionality, including: ▪ Basic Voice over NR, which provides traffic functions and protocol procedures for establishing, maintaining, and releasing a voice call in NR; ▪ Voice over NR calls, which allow the handling of voice traffic directly
3. Test Instruments Required	O-CU, O-DU, O-RU, UE (or UE simulator), 5G Core (or core simulator), Network Packet Analyzer, Traffic generator (e.g., iPerf), management PC, switch/router and network cables.
4. Test Setup	Test Setup 2
5. Test Procedure	1.Bringup gNodeB (O-CU, O-DU , O-RU) to operationally enabled state. 2. Perform 2 UE Registrations and initiate Voice call between UEs . 3. Verify that all VoNR based messages are seen over protocol analyzer. 4. Verify successful voice call between 2 UEs.
6. Test Limits	
7. Expected Results	OCU supports Voice over NR functionality through Successful voice call between 2UEs.

1. Test No	GR_TSTP_1.2.4.4.6.2_B
2. Test Details	To Verify that Voice over NR (VoNR) support as under: -The O-CU shall support Voice over NR (VoNR) functionality, including: ▪ Intra frequency handover for voice services
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	Test Setup 3
5. Test Procedure	1.Bringup gNodeB (O-CU, O-DU , O-RU) to operationally enabled state. 2. Perform 2 UE Registrations and initiate Voice call between UEs . 3. Verify that all VoNR based messages are seen over protocol analyzer. 4. Verify successful voice call between 2 UEs. 5. Move the UE from one cell to other cell during voice call. 6.Verify that UE successfully does handover from one cell to another cell. 7.Verify that voice call is consistent during handover .
6. Test Limits	NA
7. Expected Results	OCU supports VoNR functionality during intra-frequency handover.

1. Test No	**GR_TSTP_1.2.4.4.6.2_C**
2. Test Details	To Verify that Voice over NR (VoNR) support as under: -The O-CU shall support Voice over NR (VoNR) functionality, including: ▪ IP header compression.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	Test Setup 2
5. Test Procedure	1. Bringup gNodeB (O-CU, O-DU , O-RU) to operationally enabled state with relevant RoHC configuration . 2. Perform 2 UE Registrations and initiate Voice call between UEs . 3. Verify that all VoNR based messages are seen over protocol analyzer. 4. Verify that header compression is happening through logs during voice call.
6. Test Limits	NA
7. Expected Results	O-CU supports VoNR functionality with header compression.

1. Test No	GR_TSTP_1.2.4.4.6.3_A
2. Test Details	To Verify that Radio Resource Control/ Radio Resource Management (RRC/ RRM) Cell control and AMF support: NG-RAN owns and controls the radio resources of its own cell or cells. Cell resources as requested by and granted to AMF shall be provided in an ordered fashion.
3. Test Instruments Required	O-CU, O-DU, O-RU, UE (or UE simulator), 5G Core (or core simulator), Network Packet Analyzer, Traffic generator (e.g., iPerf), management PC, switch/router and network cables.
4. Test Setup	TEST SETUP 1
5. Test Procedure	5. Ensure gNodeB is loaded with correct configurations. 6. Bring the gNodeB to the operational Enabled state 7. Preform single UE registration. 8. Verify that resource requested by UE is granted by AMF . 9. Verify that AMF sends the initial context setup request. 10. Transfer UL/DL data
6. Test Limits	NA
7. Expected Results	gNodeB should support Radio Resource Control/ Radio Resource Management (RRC/ RRM). gNodeB should support cell control and inter working with the AMF functionalities.

1. Test No	**GR_TSTP_1.2.4.4.6.3_B**
2. Test Details	To Verify that Radio Resource Control/ Radio Resource Management (RRC/ RRM) RRC messages shall be transmitted to the device using signalling radio bearers (SRBs) including SRB0, SRB1and SRB2.
3. Test Instruments Required	O-CU, O-DU, O-RU, UE (or UE simulator), 5G Core (or core simulator), Network Packet Analyzer, Traffic generator (e.g., iPerf), management PC, switch/router and network cables.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Confirm that SRB0, SRB1, and SRB2 are properly configured in the network. 2. Establish an RRC connection between gNodeB O-CU and UE. 3. Send various RRC messages from the O-CU to UE using SRB0, SRB1, and SRB2. 4. Perform UE registration. 5. Capture and analyze the RRC messages transmitted over the designated SRBs. 6. Confirm that UE successfully receives all RRC messages sent via the appropriate SRBs.
6. Test Limits	NA
7. Expected Results	gNodeB O-CU support transmission of signaling messages using the signaling radio bearers (SRB0, SRB1, and SRB2).

1. Test No	**GR_TSTP_1.2.4.4.6.3_C**
2. Test Details	To Verify that Radio Resource Control/ Radio Resource Management (RRC/ RRM) The O-RAN shall support: i. Event-triggered measurement reporting; ii. System Information Broadcast (SIB); and iii. RRC_IDLE, RRC_CONNECTED, and RRC_INACTIVE states.
3. Test Instruments Required	O-CU, O-DU, O-RU, UE (or UE simulator), 5G Core (or core simulator), Network Packet Analyzer, Traffic generator (e.g., iPerf), management PC, switch/router and network cables.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Ensure gNodeB is loaded with correct configurations. 2. Configure the gNodeB to monitor specific measurement events 3. Bring the gNodeB to the operational Enabled state. 4. Initiate a broadcast of SIBs from gNodeB O-CU to UE. 5. Verify RRC RRC_IDLE state. 6. Perform UE registration, Verify the RRC_CONNECTED state. 7. verify that UE sends appropriate measurement report to gNodeB. 8. verify that after inactivity timer expiry, RRC state becomes RRC_INACTIVE.
6. Test Limits	NA
7. Expected Results	The gNodeB O-CU support RRC/RRM functionalities, including event-triggered measurement reporting, System Information Broadcast (SIB), and the management of RRC states (RRC_IDLE, RRC_CONNECTED, RRC_INACTIVE).

1. Test No	**GR_TSTP_ 1.2.4.4.6.4**
2. Test Details	To Verify that Service Data Adaptation Protocol (SDAP) SDAP shall be responsible for mapping Quality-of-Service (QoS) bearers to radio bearers according to their QoS requirements.
3. Test Instruments Required	O-RU, O-DU, O-CU, 5G Core Network, UE or UE Simulator, Protocol Analyzer , Managed Switch/Router, RF Cables, DHCP Server.
4. Test Setup	TEST SETUP 01
5. Test Procedure	1. Configure the pdu session with QoS Flow and mapped to DRB and make the gNodeB in operational state. 2.Perform the UE Registration procedure 3. Run the DL/UL data 4. verify PDU session with QFIs is successful. 5. Verify The QoS Flow mapped to DRB
6. Test Limits	NA
7. Expected Results	The QoS Flow mapped to DRB. UE attached and Running UL/DL data on the DRBS successfully.

1. Test No	**GR_TSTP_1.2.4.4.6.5_A1**
2. Test Details	To Verify that Packet Data Convergence Protocol (PDCP) a) The O-CU shall support; integrity protection and ciphering of RRC signalling;
3. Test Instruments Required	O-RU, O-DU, O-CU, 5G Core Network, UE or UE Simulator, Protocol Analyzer , Managed Switch/Router, RF Cables
4. Test Setup	TEST SETUP 1
5. Test Procedure	3. Bring gNodeB in operationally enabled state. 4. Perform UE registration. 5. Verify that O-CU sends Security Mode Command message with relevant Integrity and ciphering algorithm. 6. Verify that UE responds with Security Mode Complete message.
6. Test Limits	UE shall support required ciphering and integrity algorithm.
7. Expected Results	The gNodeB shall support ciphering and integrity protection procedures on radio interface.

1. Test No	**GR_TSTP_1.2.4.4.6.5_A2**
2. Test Details	To Verify that Packet Data Convergence Protocol (PDCP) a) The O-CU shall support; RoHC;
3. Test Instruments Required	O-CU, O-DU, O-RU, UE (or UE simulator), 5G Core (or core simulator), Network Packet Analyzer, Traffic generator (e.g., iPerf), management PC, switch/router and network cables.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Bring gNodeB in operationally enabled state. 2. Perform UE registration. 3. Initiate VoNR call or perform data test 4. Verify that UDP/TCP/RTP Packets are header compressed as per the configured ROHC Profile. 5. Verify through UE logs that RoHC is used
6. Test Limits	NA
7. Expected Results	gNodeB shall use RoHC during VoNR call or data test.

1. Test No	GR_TSTP_1.2.4.4.6.5_A3
2. Test Details	To Verify that Packet Data Convergence Protocol (PDCP) a) The O-CU shall support; data recovery
3. Test Instruments Required	O-CU, O-DU, O-RU, UE (or UE simulator), 5G Core (or core simulator), Network Packet Analyzer, Traffic generator (e.g., iPerf), management PC, switch/router and network cables.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Bring gNodeB to an operationally enabled state in SA mode. 2. Perform UE registration and establish a data session. 3. Trigger RRC Reestablishment from UE. 4. Observe PDCP and RLC logs or network analyzer captures to verify data recovery mechanisms.
6. Test Limits	
7. Expected Results	The O-CU shall support data recovery functionalities.

1. Test No	**GR_TSTP_1.2.4.4.6.5_A4**
2. Test Details	To Verify that Packet Data Convergence Protocol (PDCP) a) The O-CU shall support; ciphering of DRBs
3. Test Instruments Required	O-RU, O-DU, O-CU, 5G Core Network, UE or UE Simulator, Protocol Analyzer , Managed Switch/Router, RF Cables
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Bring gNodeB in operationally enabled state. 2. Perform UE registration and data transfer. 3. Verify that O-CU sends Security Mode Command message with relevant Integrity and ciphering algorithm. 4. Verify that UE responds with Security Mode Complete message. 5. Verify that the data is ciphered.
6. Test Limits	NA
7. Expected Results	The gNodeB shall support ciphering procedures on DRBs.

1. Test No	GR_TSTP_1.2.4.4.6.5_B
2. Test Details	To Verify that Packet Data Convergence Protocol (PDCP) b) PDCP shall also handle retransmissions, in-sequence delivery, and duplicate removal in the case of handover.
3. Test Instruments Required	O-CU, O-DU, O-RU, UE (or UE simulator), 5G Core (or core simulator), Network Packet Analyzer, Traffic generator (e.g., iPerf), management PC, switch/router and network cables.
4. Test Setup	Test Setup 3
5. Test Procedure	1. Bring gNodeB in operationally enabled state. 2. Perform UE registration and data transfer. 3. Move UE from one cell to another cell to trigger in handover while data transfer is in progress. 4. Capture the logs on gNodeB and UE sides. 5. Verify the PDCP behavior for re-transmission, in-sequence delivery, and duplicate removal post-handover.
6. Test Limits	NA
7. Expected Results	The gNodeB shall support re-transmission, in-sequence delivery, and duplicate removal functionality during handover .

1. Test No	**GR_TSTP_1.2.4.5.1**
2. Test Details	To Verify that O-CU/O-DU Shall have support of 1.2.4.5.1.1 IPv6 protocol 1.2.4.5.1.2 IPv4 (Optional)
3. Test Instruments Required	O-CU, O-DU, RU, UE (or UE simulator), 5G Core (or core simulator), Wireshark analyzer, traffic generator (e.g., iPerf), management PC, switch/router and network cables.
4. Test Setup	TEST SETUP 7
5. Test Procedure	1. Configure **IPv6 addresses** on O-DU, O-CU, Core, and their interfaces. 2. Start the setup and verify all links are operational. 3. Power on the UE, perform attach, initiate data transfer (e.g., iperf), and capture traffic. 4. Verify **IPv6 packets** in network protocol analyzer and logs. a. Optionally for IPV4, perform bellow steps - 5. configure **IPv4 addresses** on O-DU, O-CU, Core, and their interfaces. 6. Start the setup and verify all links are operational. 7. Repeat UE attach and data transfer; verify **IPv4 traffic** in network protocol analyzer captures.
6. Test Limits	NA
7. Expected Results	**O-CU/O-DU shall have support of IPv6 protocol and IPv4 protocol (optional)**

1. Test No	**GR_TSTP_1.2.4.5.2**
2. Test Details	To Verify that O-CU/O-DU shall allow SFP ports from 3rd party.
3. Test Instruments Required	O-CU, O-DU, O-RU, UE (or UE simulator), 5G Core (or core simulator), Wireshark analyzer, traffic generator (e.g., iPerf), management PC, switch/router, required SFP modules from two different vendor, and network cables.
4. Test Setup	TEST SETUP 1
5. Test Procedure	5. Configure O-**RU**, **O-DU**, **O-CU**, and **Core Network**, including all their interfaces,Insert **SFP from Vendor 1** between **O-DU and RU** (fronthaul link) and insert **SFP from Vendor 2** between **O-CU and Core Network** (backhaul link). 6. Start the setup and ensure **all links (RU ↔ O-DU, O-DU ↔ O-CU, O-CU ↔ Core)** are operational. 7. Power on the **UE** and perform **initial attach/registration**. After successful attach, initiate **data transfer** 8. **Verify UE attach and data transfer through logs and** network protocol analyzer captures. 9. Verify logs for SFP detection status. Confirm no compatibility issues of SFP during data transfer.
6. Test Limits	NA
7. Expected Results	O-CU/O-DU allow SFP ports from 3rd parties.

1. Test No	**GR_TSTP_1.2.4.5.3**
2. Test Details	To Verify that O-DU/O-CU shall support containerization and containers deployment need to make an efficient use of IP addresses avoiding multiple IP addresses per single CNF with preference only 1 IP address per CNF.
3. Test Instruments Required	O-CU, O-DU, O-RU, UE (or UE simulator), 5G Core (or core simulator), Network Packet Analyzer, Traffic generator (e.g., iPerf), management PC, switch/router and network cables.
4. Test Setup	Test Setup 6
5. Test Procedure	1.Ensure gNodeB is loaded with correct configuration. 2. Bringup the gNodeB with atleast one of O-CU/O-DU in a containerized deployment. 3. Perform UE registration and data transfer . 4. Verify that every pod/ container where OCU/ODU modules are present have only 1 IP present.
6. Test Limits	
7. Expected Results	gNodeB shall support containerized deployment functionality and usage of single IP per O-CU/O-DU module.

1. Test No	**GR_TSTP_1.2.4.5.4**

2. Test Details	To Verify that O-DU/O-CU shall support Mid Haul or Back Haul ports as per capacity scenarios.
3. Test Instruments Required	O-CU, O-DU, O-RU, UE (or UE simulator), 5G Core (or core simulator), Network Packet Analyzer, Traffic generator (e.g., iPerf), management PC, switch/router and network cables.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Ensure gNodeB is loaded with correct configurations. 2. Bring the gNodeB to the operational Enabled state. 3. Perform UE registration and data transfer. 4. Verify that NG-U and F1-U data is handled through Mid-haul and Back haul Ports.
6. Test Limits	
7. Expected Results	gNodeB shall support NG-U and F1-U functionality through Mid-haul and Back haul Ports.

1. Test No	**GR_TSTP_1.2.4.5.5**
2. Test Details	To Verify that O-DU/O-CU shall support platform management through IPMI v2.0 Compliant (or later) or RedFish v1.6.0 Compliant (or later)..
3. Test Instruments Required	O-CU, O-DU, O-RU, UE (or UE simulator), 5G Core (or core simulator), Network Packet Analyzer, Traffic generator (e.g., iPerf), management PC, switch/router and network cables.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Access the platform management software (IPMI / REDFISH) . 2. Power on the ODU/OCU hosted physical system remotely with management software. 3. Bringup the OCU /ODU and perform UE registration. 4. Verify that OCU/ODU working properly during above procedure.
6. Test Limits	NA
7. Expected Results	System containing O-CU/O-DU shall support remote management of software using IPMI/REDFISH

1. Test No	**GR_TSTP_1.2.4.5.6**
2. Test Details	To Verify that O-CU/O-DU may support stateless implementation.
3. Test Instruments Required	O-RU, O-DU, O-CU, 5G Core Network, UE or UE Simulator, Protocol Analyzer , Managed Switch/Router, RF Cables
4. Test Setup	TEST SETUP 1
5. Test Procedure	5) Bring the gNodeB(O-CU, O-DU, O-RU) in operational state 6) Perform UE Registration 7) Perform data transfer 8) restart the O-CU and O-DU while UE is attached 9) Verify that UE again registers with gNodeB 10) verify that UE is able to send and receive the data packets successfully.
6. Test Limits	NA
7. Expected Results	gNodeB shall support support stateless implementation. Verify that No permanent session loss happens and UE re-attachment or context gets restored

1. Test No	**GR_TSTP_1.2.4.5.8**
2. Test Details	To Verify that O-DU/O-CU shall support of centralized retransmission in intra gNB-OCU/DU scenarios, i.e. the gNB-O-CU/DU can switch transmission of data traffic, as well as perform retransmission of undelivered PDCP PDUs, from a gNB-O-DU/CU affected by an outage to other available gNB-O-DUs/CUs
3. Test Instruments Required	O-CU, O-DU, O-RU, UE (or UE simulator), 5G Core (or core simulator), Network Packet Analyzer, Traffic generator (e.g., iPerf), management PC, switch/router and network cables.
4. Test Setup	TEST SETUP 7
5. Test Procedure	Connect 1 O-CU-CP with 1 O-DU with 1 O-CU-UP in containerized environment. Bring the nodes in operational state. Attach 1 UE and perform data transfer. Make the current serving O-CU-UP down and check that the data transfer happens through another instance of O-CU-UP.
6. Test Limits	
7. Expected Results	gNodeB shall support centralized retransmission in intra gNB-OCU/DU scenarios. Check that all PDCP SN are delivered to UE

1. Test No	**GR_TSTP_1.2.4.6.1_A1**
2. Test Details	To Verify that The F1 interface shall support: ▪ procedures to establish, maintain and release UE contexts, includinghandling of the radio bearers for the NG-RAN part of PDU sessions and for EUTRAN Radio Access Bearers;
3. Test Instruments Required	O-CU, O-DU, O-RU, UE (or UE simulator), 5G Core (or core simulator), Network Packet Analyzer, Traffic generator (e.g., iPerf), management PC, switch/router and network cables.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Bring the gNodeB (O-CU, O-DU, O-RU) in operational state 2. Verify successful communication between O-CU and O-DU through F1 interface. 3. Perform single UE registration. 4. Perform data transfer
6. Test Limits	NA
7. Expected Results	From the network analyzer tool, verify the F1 interface procedures related to establish, maintain and release UE contexts, including handling of the radio bearers for the NG-RAN part of PDU sessions and for EUTRAN Radio Access Bearers;

1. Test No	GR_TSTP_1.2.4.6.1_A2
2. Test Details	To Verify that The F1 interface shall support: ▪ procedures to establish, maintain and release BH RLC channels; (Optional)
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 7
5. Test Procedure	1. Bring O-CU and O-DU to operational state with F1 interface configured. 2. Attach UE and initiate data traffic so that BH RLC channels are established on the F1 interface. 3. Force a channel reconfiguration/maintain procedure using OAM/Console. 4. Release BH RLC channels and verify that user-plane traffic is correctly stopped or re-established as per configuration.
6. Test Limits	NA
7. Expected Results	The F1 interface shall support establishing, maintaining and releasing BH RLC channels without major alarms or service disruption.

1. Test No	GR_TSTP_1.2.4.6.1_A3
2. Test Details	To Verify that The F1 interface shall support: ▪ the separation of each UE on the protocol level for user specific signalling management;
3. Test Instruments Required	O-CU, O-DU, O-RU, UE (or UE simulator), 5G Core (or core simulator), Network Packet Analyzer, Traffic generator (e.g., iPerf), management PC, switch/router and network cables.
4. Test Setup	TEST SETUP 7
5. Test Procedure	1. Bring the gNodeB(O-CU, O-DU, O-RU) in operational state 2. Attach 2 UEs 3. Verify UE context related messages in F1 interface are handled separately for both Ues. 4. Perform data transfer
6. Test Limits	NA
7. Expected Results	From the network analyzer tool, verify the separation of each UE on the protocol level for user specific signalling management

1. Test No	GR_TSTP_1.2.4.6.1_A4
2. Test Details	To Verify that The F1 interface shall support: ▪ the separation of each IAB-MT on the protocol level for IAB-MTspecific signalling management; (Optional).
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 7
5. Test Procedure	1. Bring O-CU and O-DU to operational state with F1 interface configured. 2. Register multiple IAB-MT units and establish signalling sessions. 3. Trigger signalling and data exchange independently per IAB-MT via OAM/Console. 4. Verify that each IAB-MT maintains protocol-level signalling separation and no context overlap occurs.
6. Test Limits	NA
7. Expected Results	The F1 interface shall support protocol-level separation for each IAB-MT, ensuring independent signalling management without cross-impact or major alarms.

1. Test No	**GR_TSTP_1.2.4.6.1_A5**
2. Test Details	To Verify that The F1 interface shall support: ▪ transfer of RRC signalling messages between the UE and the gNBCU.
3. Test Instruments Required	O-CU, O-DU, O-RU, UE (or UE simulator), 5G Core (or core simulator), Network Packet Analyzer, Traffic generator (e.g., iPerf), management PC, switch/router and network cables.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Bringup gNodeB with OCU , ODU and ORU . 2. Perform UE registration. 3. Verify that RRC messages are seen through F1AP messages using protocol analyzer.
6. Test Limits	NA
7. Expected Results	gNodeB shall support RRC message transferred through F1AP messages

1. Test No	**GR_TSTP_1.2.4.6.1_A6**
2. Test Details	To Verify that The F1 interface shall support: ▪ Synchronization (S-Plane) Requirements of O-RAN.
3. Test Instruments Required	O-CU, O-DU, O-RU, UE (or UE simulator), 5G Core (or core simulator), Network Packet Analyzer, Traffic generator (e.g., iPerf), management PC, switch/router and network cables.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1.Connect O-CU, O-DU and O-RU modules with GNSS compatible PTP Aware switch. 2. Bringup gNodeB by bringing up OCU , ODU and ORU . 3. Verify that all Modules are in sync with PTP.
6. Test Limits	NA
7. Expected Results	gNodeB supports F1-Interface with S-plane functionality.

1. Test No	**GR_TSTP_1.2.4.7.1**
2. Test Details	To Verify that the key services of the SMO that provide support in O-RAN are: a. OAM interface to O-RAN Network Functions b. Non- RT RIC for RAN optimization c. O-Cloud Management, Orchestration and Workflow Management.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	• Use SMO northbound/southbound APIs or CLI to verify communication with O-RAN NFs (e.g., O-DU, O-RU). • Perform a basic GET status query (via NETCONF/RESTCONF or supported OAM interface). • Verify management functions like configuration, fault, performance, security, and software management: Confirm that the Non-RT RIC module within SMO is active and accessible via its APIs. • Deploy a test rApp or trigger a RAN optimization use case (e.g., policy configuration or AI-based recommendation). • Verify Non-RT RIC sends the policies to Near-RT RIC and that they are applied to the RAN nodes. • Check A1 interface communication between Non-RT RIC and Near-RT RIC. • Ensure policy or enrichment information is delivered.

	Verify O-Cloud Management, Orchestration & Workflow 6. O-Cloud Inventory: 1. Use SMO O-Cloud management APIs to list available compute, storage, and network resources. 2. Ensure the correct status and inventory details are returned. 7. Onboarding/Orchestration: 1. Deploy a test VNFM/VNF or rApp/xApp via SMO orchestration workflows. 2. Check if the deployment is successfully instantiated in O-Cloud. 8. Workflow Validation: 1. Trigger a simple workflow (e.g., scaling a function or starting/stopping a service). 2. Verify logs and events to ensure workflow execution is correct.
6. Test Limits	NA
7. Expected Results	SMO successfully exposes OAM interfaces, enables Non-RT RIC functions for RAN optimization, and supports O-Cloud management, orchestration, and workflow execution.

1. Test No	**GR_TSTP_1.2.4.7.2**
2. Test Details	To Verify that The SMO shall perform above services through four key interfaces to the O- RAN Elements a.A1 Interface between the Non-RT RIC in the SMO and the Near RT RIC Platform for RAN Optimization b. O1 Interface between the SMO and the O-RAN Network Functions for FCAPS support c. In the hybrid model, Open Fronthaul M-plane interface between SMO and O-RU for FCAPS support TEC Standard No. 21110:2024 31 d. O2 Interface between the SMO and the O-Cloud to provide platform resources and workload management
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	• Verify the following interfaces are implemented and configured: ◦ A1: SMO ↔ Near-RT RIC ◦ O1: SMO ↔ O-CU/O-DU ◦ M-Plane: SMO ↔ O-RU (for hybrid model) ◦ O2: SMO ↔ O-Cloud • A1 Interface Testing: ◦ Send RAN optimization policies from SMO (Non-RT RIC) to Near-RT RIC via A1 interface. ◦ Validate successful reception and application of policies. • O1 Interface Testing: ◦ Perform FCAPS operations (e.g., fault generation, performance metrics collection) on O-CU and O-DU via SMO. ◦ Confirm the correct flow of information through the O1

	interface. • M-Plane Interface Testing (Hybrid Model): ◦ Configure O-RU and trigger FCAPS interactions through the M-Plane interface. ◦ Validate communication between SMO and O-RU for configuration, fault, and performance monitoring. • O2 Interface Testing: ◦ Use SMO to manage resources on O-Cloud (e.g., create/delete workloads, scale functions). ◦ Verify platform resource orchestration and workload lifecycle management through O2. • Interface Integrity Checks: ◦ Monitor interface status, response latency, and error handling across all four interfaces.
6. Test Limits	NA
7. Expected Results	SMO establishes and utilizes the A1, O1, Open Fronthaul M-plane (in hybrid model), and O2 interfaces effectively to perform RAN optimization, FCAPS support, and O-Cloud resource and workload management as per O-RAN specifications.

1. Test No	**GR_TSTP_1.2.4.7.3_A**
2. Test Details	To Verify that SMO shall support FCAPS to O-RAN Network Functions a. The SMO shall provide support for O-RAN network function FCAPS via the O1 Interface
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	Verify Fault Management (F) 5. Simulate a fault on a network function (e.g., disable a port or create a test alarm) and check that SMO receives the alarm via O1 and logs it correctly. 6. Resolve the fault or clear the alarm and confirm the SMO updates the status. Verify Configuration Management (C) 1. Push Configuration: From SMO, change a configuration parameter on the O-RU/O-DU (e.g., update frequency or power parameters). Validate that the new configuration is successfully applied and reflected in the network element. Retrieve Configuration: Use the O1 interface to perform a GET configuration query from SMO to the NF. Confirm correct configuration details are returned. Verify Accounting Management (A) *(Optional in many O-RAN deployments)*

	1. If supported, retrieve usage records or session logs through O1. 2. Validate that SMO receives and records accounting-related data (e.g., resource utilization). Verify Performance Management (P) 1. Collect KPIs/PM Data: • Request performance counters or KPIs (e.g., throughput, latency) from a network function via O1. • Validate data correctness and timestamp. 2. PM Report Subscription: • Set up a periodic PM report via O1. • Verify that reports are sent at the configured intervals. Verify Security Management (S) 1. Access Control: • Validate that only authorized SMO users can access or modify configurations via O1. 2. Key/Certificate Management: • Check that SMO can retrieve or update security credentials/certificates for network functions. 3. Audit Logs: • Verify that all security-related events (e.g., login attempts, config changes) are logged.
6. Test Limits	NA
7. Expected Results	SMO successfully provides FCAPS support to O-RAN Network Functions through the O1 interface.

1. Test No	GR_TSTP_1.2.4.7.3_B
2. Test Details	To Verify that SMO shall support FCAPS to O-RAN Network Functions b. The following FCAPS functions defined in the O1 Specification shall be provided across the O1 interface :- i. Performance Management (PM) ii. Configuration Management (CM) iii. Fault Management (FM) iv. File Management v. Communication Surveillance (Heartbeat) vi. Trace vii. Physical Network Function (PNF) Discovery viii. PNF Software Management
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	i. Performance Management (PM) Subscribe to PM Counters: Configure SMO to subscribe to KPIs (e.g., throughput, latency) using O1. Verify periodic or on-demand PM reports are received. Validate PM Data: Ensure KPI values match expected performance metrics (cross-check with NF logs). ii. Configuration Management (CM) Push Configuration: Update a parameter (e.g., RF power, frequency) from SMO via O1. Verify the new configuration is applied on the NF.

	Retrieve Configuration: Query the NF configuration from SMO to ensure synchronization. iii. Fault Management (FM) Inject Fault: Simulate a fault condition on an NF (e.g., port down, process crash). Check if SMO receives and logs alarms through O1. Clear Fault: Resolve the issue and verify SMO updates alarm status. iv. File Management Upload/Download Files: Test file transfer from SMO to NF and vice versa (e.g., log files or configuration files). Integrity Check: Validate file integrity (checksum verification) after transfer. v. Communication Surveillance (Heartbeat) Heartbeat Monitoring: Ensure SMO receives regular heartbeat messages from the NF. Heartbeat Failure Detection: Simulate a heartbeat loss (e.g., disconnect NF). Confirm SMO detects the failure and triggers alarms. vi. Trace Activate Trace Session: Initiate a trace session via O1 (e.g., packet flow trace or call trace). Collect Trace Data: Validate that trace logs are captured and available in SMO. vii. Physical Network Function (PNF) Discovery PNF Onboarding:

	Bring a new PNF online. Verify SMO discovers it automatically via O1. Check Inventory: Ensure PNF details (ID, capabilities) are recorded in SMO inventory. viii. PNF Software Management Software Upgrade/Downgrade: Trigger software image upgrade for PNF from SMO via O1. Verify upgrade completion and status reports. Rollback/Validation: Test rollback functionality and confirm version consistency.
6. Test Limits	NA
7. Expected Results	SMO supports all listed FCAPS functions over the O1 interface as defined in the O1 Specification, including PM, CM, FM, File Management, Heartbeat monitoring, Trace, PNF Discovery, and PNF Software Management.

1. Test No	GR_TSTP_1.2.4.7.4
2. Test Details	To Verify that SMO shall provide the capability of managing the O-Clouds as well as providing support for the orchestration of platform and application elements and workflow management.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	Resource Management: • Validate that SMO can auto-discover and list O-Cloud resources (e.g., CPU, memory, network capacity). • Check that SMO collects metrics (e.g., utilization, health) for O-Cloud resources. • Trigger a test allocation or reservation of resources for a new VNF or CNF. • Verify that resource allocation is successfully completed and reflected in inventory. • On-boarding: • Upload and onboard a test application package (e.g., VNF/CNF descriptor or xApp/rApp). • Confirm onboarding is successful and appears in the SMO catalog. Instantiation/Deployment: • Deploy a test platform component (e.g., Kubernetes cluster or VNF instance) via SMO orchestration. • Verify deployment success using logs, API responses, and O-Cloud dashboards. • Scaling: • Trigger horizontal/vertical scaling of an application or platform component from SMO. • Confirm the scaling is correctly applied and updated in the SMO inventory. • Workflow Management

	• Create and Execute Workflow: • Define a test workflow (e.g., deployment of an application followed by configuration). • Trigger the workflow and verify step-by-step execution logs in SMO. Failure Handling: • Introduce a controlled failure in one workflow step. • Verify SMO's rollback or error handling capabilities. Custom Workflow Automation: • If available test SMO's capability to orchestrate multi-step tasks (e.g., VNF deploy → configuration → PM data collection).₩
6. Test Limits	NA
7. Expected Results	SMO successfully manages O-Cloud infrastructure and supports orchestration of platform and application elements, including workflow automation and lifecycle management.

1. Test No	**GR_TSTP_1.2.4.7.5**
2. Test Details	To Verify that the SMO shall be able to correlate ME telemetry to Infrastructure and Deployment telemetry to aggregate problems to a root cause and thus correlate a Managed Element to its deployment components
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1

5. Test Procedure	• Simulate a fault in a Managed Element (e.g., packet drop in O-DU).
	• Verify that:
	  ◦ The fault is reported via O1 to the SMO.
	  ◦ The SMO logs an alarm for the ME.
	• Ensure SMO collects:
	  ◦ Metrics/events from deployment layer (VNFM/K8s/Orchestrator).
	  ◦ Metrics/events from infrastructure layer (O-Cloud monitoring agents).
	• Validate that:
	  ◦ SMO correlates the ME fault with platform/infrastructure issues.
	  ◦ It identifies that the ME issue is caused by the underlying platform component or host.
	• If applicable check if similar alarms are grouped under one root issue/alarm.

6. Test Limits	NA
7. Expected Results	SMO accurately correlates Managed Element (ME) telemetry with infrastructure and deployment telemetry, enabling identification of root causes and linking MEs to their respective deployment components.

1. Test No	**GR_TSTP_1.2.4.7.6**
2. Test Details	To Verify that the O2 interface supports the management of the O-cloud infrastructure and the use of the O-cloud resources allocated to the RAN.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	Management: • Verify SMO sends O2IMS API call to retrieve compute / storage / network resource inventory. • Verify SMO receives periodic telemetry or can query on-demand, via subscription based methods or other methods. • Simulate Fault and verify fault alarm is visible in SMO via O2. O-Cloud Resource Usage: • Verify that resources are allocated to O-RAN VNF/CNF when requested for deployment. • Trigger lifecycle operations and verify that it is reported in SMO via O2.
6. Test Limits	NA
7. Expected Results	O2 interface successfully enables management of O-Cloud infrastructure and allows allocation and monitoring of O-Cloud resources used by the RAN.

1. Test No	**GR_TSTP_1.2.4.7.7**
2. Test Details	To Verify that SMO shall provide the following functionalities: - a. Discovery and administration of O-Cloud Resources b. Scale-In, Scale-Out for O-Cloud c. FCAPS (PM, CM, FM, Communication Surveillance) of O-Cloud d. Software Management of Cloud Platform e. Create, Delete Deployments and Associated Allocated O-Cloud Resources f. Scale-In, Scale-Out Deployments and Allocated O-Cloud Resources g. FCAPS (PM, FM) of Deployments and Allocated O-Cloud Resources h. Software Management of Deployments
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	• Verify that SMO can discover, inventory, and manage O-Cloud compute, storage, and network resources. • Check SMO's ability to monitor performance, apply configurations, detect faults, and track connectivity of O-Cloud components. • Verify that SMO can upgrade, patch, and rollback cloud platform software with audit logging. • Test deployment creation and deletion with proper allocation and release of O-Cloud resources. • Confirm that SMO can scale deployed services and their associated O-Cloud resources on demand. • Ensure SMO provides monitoring and fault detection for running deployments and linked resources. • Validate that SMO can manage deployment software

	upgrades and rollbacks efficiently.
6. Test Limits	NA
7. Expected Results	SMO successfully performs all listed functions, including discovery, administration, scaling, FCAPS support, software management, and lifecycle operations (create/delete/scale) for both O-Cloud resources and their associated deployments.

1. Test No	**GR_TSTP_1.2.4.8.1**
2. Test Details	To Verify that Non-Real Time RAN Intelligent Controller (Non-RT RIC) is the functionality internal to the SMO in O-RAN architecture that provides the A1 interface to the Near-Real Time RIC.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	• Ensure the SMO platform is successfully onboarded and operational. • Verify that the SMO GUI includes an option to access the Non-RT RIC interface. • Launch the Non-RT RIC GUI from within the SMO interface and confirm accessibility. • Check the configuration of the Near-RT RIC to ensure that the A1 interface target (IP/hostname) points correctly to the SMO. • Confirm the ability to view and create A1 policies intended for the Near-RT RICs from the Non-RT RIC GUI. • Validate that the SMO (via the Non-RT RIC) is capable of processing A1 interface requests.
6. Test Limits	NA
7. Expected Results	1. Should be able to view Non-RT RIC application and view the configured Near-RT RICs and A1 Policies 2. Near-RT RIC receives and acknowledges policy. 3. Policy is accepted and acted upon.

1. Test No	**GR_TSTP_1.2.4.8.3**
2. Test Details	To Verify that Non-RT RIC shall support intelligent RAN optimization by providing policy based guidance, ML model management and enrichment information to the Near RT RIC Platform function so that the RAN can optimize..
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Confirm that Near-RT RIC is reachable from the Non-RT RIC Framework 2. Upload/Register ML Model 3. Create A1-Policy 4. Configure additional attributes/Enrichment information. 5. Ensure policy guidance/Model inference/ EI jobs configured are sent to Near RT RIC via A1 interface 6. Verify if policy is Enforced
6. Test Limits	NA
7. Expected Results	• Non-RT RIC receives metrics and can adjust policies or models accordingly.

1. Test No	**GR_TSTP_1.2.4.8.4**
2. Test Details	To Verify that the Non-RT RIC framework shall support functionality to register services along with their service producers and Data Producers (including rApps) to register their DME types production capabilities, if such functionality is not supported in the SMO framework.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Verify that the Non-RT RIC has been successfully onboarded in the SMO. 2. Validate that service producers can be registered along with their supported DME type capabilities. 3. Confirm that data producers can also be registered with their declared DME type capabilities.
6. Test Limits	NA
7. Expected Results	Shall be able to view the list of Registered Service Producers and Data Producers with the DME types supported

1. Test No	**GR_TSTP_1.2.4.8.5**
2. Test Details	To Verify that the Non-RT RIC framework shall support functionality to allow service consumers to discover services and data Consumers (including rApps) to discover and register available DME types they consume, if such functionality is not supported in the SMO framework.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Verify that the Non-RT RIC is successfully onboarded within the SMO. 2. Ensure at least one service producer and one data producer are registered in the system. 3. Confirm that service consumers can retrieve and view the list of available services. 4. Validate that the Non-RT RIC GUI displays the registered DME types and associated data producer information. 5. Verify that data consumers are able to register for the available DME types
6. Test Limits	NA
7. Expected Results	1. Service Consumer shall be able to view the list of authorized Services. 2. Data Consumer shall be able to receive the registered DME Type when available.

1. Test No	**GR_TSTP_1.2.4.8.6**
2. Test Details	To Verify that the Non-RT RIC framework shall support functionality to allow service consumers to subscribe/unsubscribe notifications about newly registered/updated/deregistered services and Data Consumers (including rApps) to subscribe/request instances of registered DME types for consumption if such functionality is not supported in SMO
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Confirm that the Non-RT RIC is deployed with functional Service Registry and DME Registry (or equivalent components). 2. Ensure at least one rApp is deployed and capable of subscribing to available services and DME types. 3. Verify that at least one DME type is registered and accessible within the registry. 4. Validate that a service consumer can successfully send subscribe and unsubscribe requests to the Non-RT RIC's service registry notification interface. 5. Confirm that a data consumer is able to send subscription requests for instances of a specific DME type.
6. Test Limits	NA
7. Expected Results	1. Service Consumer should receive notification about New service registration, Service updates,Service deregistration. 2. Service Consumer should not receive any service notifications after sending unsubscribe request. 3. Data consumer successfully receives instance information and optionally data streams

1. Test No	**GR_TSTP_1.2.4.8.7**
2. Test Details	To Verify that the Non-RT RIC framework shall support functionality to notify subscribed service consumers about newly registered/updated/deregistered services
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Ensure that the Non-RT RIC is onboarded with an active Service Registry component. 2. Verify that one or more service consumers are deployed and able to receive service registry event notifications. 3. Initiate a subscription request from the service consumer to the Non-RT RIC's service registry for event notifications.
6. Test Limits	NA
7. Expected Results	Service Consumers should receive notifications about newly registered/updated/deregistered services

1. Test No	**GR_TSTP_1.2.4.8.8**
2. Test Details	To Verify that the Non-RT RIC framework shall support functionality to authenticate and authorize service consumers to access services
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Verify that the Non-RT RIC framework displays the list of service consumers requesting onboarding. 2. Confirm that the system allows authentication of the service consumer requests. 3. Ensure that authorization is granted to service consumers only for the specific DME types they have requested access to.
6. Test Limits	NA
7. Expected Results	Shall be able to view the Authentication/Authorization status change of the Service Consumer

1. Test No	**GR_TSTP_1.2.4.8.9**
2. Test Details	To Verify that the Non-RT RIC framework shall support functionality to send messages to and receive messages from the Near RT RIC Platform via the A1 interface.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Verify that the configured Near-RT RICs are reachable from the Non-RT RIC. 2. Confirm that the list of configured Near-RT RICs is viewable in the system. 3. Ensure that the system receives message updates related to the configured policies.
6. Test Limits	NA
7. Expected Results	Shall be able to get the policies status and update messages in case of the policy is not enforced.

1. Test No	**GR_TSTP_1.2.4.8.10**
2. Test Details	To Verify that the Non-RT RIC framework shall support functionality to allow Data Producers (including rApps) to offer instances of registered DME types for collection and storage, if such functionality is not supported in the SMO framework
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Verify that the Non-RT RIC platform includes a Data Management Service (DMS) or equivalent component. 2. Confirm that the SMO does not manage DME offerings directly. 3. Ensure that Data Producers can register DME types with the Non-RT RIC. 4. Validate that Data Producers can send instances of the registered DME types to the Non-RT RIC
6. Test Limits	NA
7. Expected Results	1. Registered DME type appears in Non-RT RIC. 2. DME instance is stored in the Non-RT RIC data store 3. Shall be able to access the Stored DME instance.

1. Test No	**GR_TSTP_1.2.4.8.11**
2. Test Details	To Verify that the Non-RT RIC framework shall support functionality to train AI/ML models and allow service consumers to store and retrieve these trained AI/ML models, if such functionality is not supported in the SMO framework.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Verify that the Non-RT RIC platform is deployed with support for an ML pipeline and integrated storage system. 2. Ensure the Non-RT RIC is capable of training AI/ML models. 3. Validate that the trained models can be stored in the designated storage system. 4. Confirm that a Service Consumer can retrieve the stored AI/ML model from the Non-RT RIC.
6. Test Limits	NA
7. Expected Results	1. Trained Model is saved with unique ID/version. 2. Non-RT RIC returns the model artifact with associated meta data

1. Test No	**GR_TSTP_1.2.4.8.12**
2. Test Details	To Verify that the Non-RT RIC framework shall support functionality to monitor the performance for deployed AI/ML models in runtime, if such functionality is not supported in the SMO framework.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Verify that the Non-RT RIC platform includes capabilities for monitoring and logging ML model activity. 2. Upload and deploy a pre-trained AI/ML model through the Non-RT RIC interface. 3. From a Data Consumer, initiate multiple inference requests using the deployed model. 4. Ensure the Non-RT RIC captures real-time or near real-time performance metrics during inference operations. 5. Confirm that collected metrics are stored in a time-series database or telemetry system for further analysis.
6. Test Limits	NA
7. Expected Results	1. Non-RT RIC collects metrics in real-time or near real-time. 2. Metrics are stored in a time-series DB or telemetry system.

1. Test No	GR_TSTP_1.2.4.8.13
2. Test Details	To Verify that the Non-RT RIC framework shall support functionality to collect external enrichment information from external enrichment information sources
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Verify that the Non-RT RIC is successfully onboarded and has connectivity to external enrichment information sources. 2. Configure or register the external enrichment sources within the Non-RT RIC framework. 3. Trigger the collection of enrichment data using the Non-RT RIC interface or appropriate API.
6. Test Limits	NA
7. Expected Results	1. External enrichment information is collected accurately and completely. 2. Collected data is stored and available within the framework for further processing.

1. Test No	**GR_TSTP_1.2.4.8.14**
2. Test Details	To Verify that the Non-RT RIC framework shall support functionality to retrieve trained ML models (and metadata) from external AI/ML service providers also
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Verify that the Non-RT RIC has connectivity to external AI/ML service providers. 2. Initiate a request from the Non-RT RIC to fetch the list of available trained ML models along with their metadata from the external provider.
6. Test Limits	NA
7. Expected Results	1. Non-RT RIC framework successfully connects to the external AI/ML service provider. 2.Trained ML models and their metadata are correctly retrieved and stored.

1. Test No	**GR_TSTP_1.2.4.8.15**
2. Test Details	To Verify that the Non-RT RIC framework shall support functionality to allow external sources to inject RAN intents, suspend/resume/check rApps, and configure/check/initiate/suspend/resume/terminate AI/ML training processes.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 7
5. Test Procedure	1. Bring Non-RT RIC, SMO, O-CU, O-DU and O-RU to operational state and establish UE connectivity. 2. From an external source / management console, inject RAN intents into the Non-RT RIC framework. 3. Initiate, suspend, resume and check execution status of rApps through Non-RT RIC. 4. Configure and run AI/ML training; then suspend, resume and terminate training processes. 5. Verify that service continues normally during all lifecycle operations.
6. Test Limits	NA
7. Expected Results	The Non-RT RIC framework shall allow external intent injection and rApp/AI-ML lifecycle control without service degradation or major alarms.

1. Test No	**GR_TSTP_1.2.4.8.16**
2. Test Details	To Verify that the Non-RT RIC framework shall support functionality to consolidate the alarm information from multiple managed entities, if such functionality is not supported in the SMO framework
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Verify that the Managed Entities are properly configured and accessible from the Non-RT RIC framework. 2. Set up the Non-RT RIC to receive alarms directly from the specified Managed Entities.
6. Test Limits	NA
7. Expected Results	Non-RT RIC receives alarms from managed entities.

1. Test No	**GR_TSTP_1.2.4.8.17**
2. Test Details	To Verify that The Non-RT RIC framework may have the capability to identify the potentially applicable Near RT RIC Platform(s) for A1 policy creation if the Near RT RIC Platform identifier is absent in the create A1 policy request received from the rApp
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Ensure that the Non-RT RIC framework is deployed and functioning correctly 2. Confirm that one or more Near-RT RIC platforms are registered and can be discovered by the Non-RT RIC 3. From the rApp, initiate an A1 Policy creation request without specifying the Near-RT RIC platform identifier in the request
6. Test Limits	NA
7. Expected Results	1. Non-RT RIC successfully maps the policy request to the correct Near-RT RIC platform and delivers. 2. The Policy is acknowledged by the selected Near-RT RIC.

1. Test No	**GR_TSTP_1.2.4.8.18**
2. Test Details	To Verify that the Non-RT RIC framework shall support the functionality to collect trace data, from multiple managed entities and analytical data from the Near RT RIC Platform, if such functionality is not supported in the SMO framework
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Verify that the Non-RT RIC framework is deployed and functioning properly 2. Ensure multiple managed entities (e.g., gNBs, CUs, DUs) are active and can generate trace data 3. Set up trace interfaces on managed entities to stream trace data to the Non-RT RIC 4. Activate trace collection functionality in the Non-RT RIC 5. Confirm at least one Near-RT RIC platform is deployed and provides analytics APIs 6. Enable analytics generation features on the Near-RT RIC 7. Configure the Non-RT RIC to either subscribe to or pull analytics data
6. Test Limits	NA
7. Expected Results	1. Non-RT RIC receives and logs trace data from all configured entities. 2. Non-RT RIC is consuming analytical data from Near-RT RIC platform.

1. Test No	**GR_TSTP_1.2.4.8.19**
2. Test Details	To Verify that the Non-RT RIC framework shall support functionality to allow Data Consumers (including rApps) to consume Deployment and Infrastructure Telemetry metrics collected by the O2- related functions.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Ensure the Non-RT RIC is deployed and running, with one or more data consumers registered and active 2. Verify that the O2 interface is integrated and set up to gather telemetry data from the O-Cloud or orchestrator 3. Confirm that the SMO and O2 components are operational and delivering telemetry to the Non-RT RIC 4. Validate that the necessary telemetry subscription mechanisms (e.g., push or pull) are supported and functional
6. Test Limits	1. Non-RT RIC is deployed and operational and one or more data consumers are deployed and registered with the Non-RT RIC 2. O2 interface is integrated and configured to collect telemetry data (from O-Cloud or orchestrator) 3. SMO and O2-related components are available and providing telemetry to Non-RT RIC 4. Required telemetry subscription models (e.g., push/pull) are supported
7. Expected Results	1. Telemetry data is successfully received and processed by the Non-RT RIC from O2 functions. 2. rApp successfully queries and receives telemetry data from Non-RT RIC. 3. rApp is notified of telemetry changes/events in real time

1. Test No	**GR_TSTP_1.2.4.8.20**
2. Test Details	To Verify that the Non-RT RIC framework shall support functionality that allows managing the configuration, if such functionality is not supported in the SMO framework. Similarly, Non-RT RIC framework shall support functionality that allows obtaining, from an rApp, information about that rApp's performance, fault information related to that rApp, logging information reported by the rApp and to store log information received from rApps, if such functionality is not supported in the SMO framework.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Ensure Non-RT RIC and rApps are deployed and functioning correctly. 2. Initiate a configuration create, read, update, or delete (CRUD) request targeting a managed entity or RIC component via the Non-RT RIC. 3. Verify that rApps transmit performance data, fault information, and log entries to the Non-RT RIC. 4. Simulate or verify the occurrence of a fault scenario within the rApp. 5. Trigger or validate performance-related activity within the rApp.
6. Test Limits	NA
7. Expected Results	1. Configuration is accepted, stored, and applied. 2. Check that Non-RT RIC receives and stores: Performance metrics, Fault information and Log entries

1. Test No	**GR_TSTP_1.2.4.9.1**
2. Test Details	To Verify that Near RT RIC Platform platform shall provide a database that stores an upto-date RAN information, history of time-varying network state, as well as configurations related to E2 Nodes, Cells, Bearers, Flows, UEs, etc
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Ensure that Near RT RIC is up and Running 2. Add E2 node to Near RT RIC 3. Observe the the current state of E2 Node in Near RT RIC with timestamps 4. Modify the state of the E2 Node 5. Observe whether the new state of the E2 Node is reflected in Near RT ROC with timestamps. 6. Choose a configuration parameter of E2 node which is visible in Near RT RIC. 7. Change the configuration parameter in E2 node. 8. Observe whether the new configuration of the E2 Node is reflected in Near RT ROC with timestamps.
6. Test Limits	NA
7. Expected Results	All the changes shall be visible in Near RT RIC with proper timestamp.

1. Test No	**GR_TSTP_1.2.4.9.2**
2. Test Details	To Verify that Near RT RIC architecture shall also support WG3.RICARCH functional requirements from 5.1.2 (xApp requirements) and 5.1.3 (near-RT RIC API requirements)
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Ensure that the Near-RT RIC is operational. 2. Add an E2 Node to the Near-RT RIC. 3. Deploy and start an xApp in the Near-RT RIC. 4. Verify that the xApp receives E2 Node information from the Near-RT RIC. 5. Confirm that the xApp is successfully registered with the E2 Node.
6. Test Limits	NA
7. Expected Results	1. The xApp shall be able to get the E2 node related information from Near RT RIC. 2. xApp shall be able to register itself with E2 Node.

1. Test No	**GR_TSTP_1.2.4.9.3**
2. Test Details	To Verify that Near RT RIC Platform shall provide AI/ML tools that support for data pipelining, training
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Ensure that the Near-RT RIC is up and operational. 2. Add an E2 Node to the Near-RT RIC. 3. Deploy and start an xApp on the Near-RT RIC to execute a specific use case. 4. Deploy a second xApp that gathers data from the first xApp and supplies it for AI/ML training.
6. Test Limits	NA
7. Expected Results	The second xApp shall be able to collect and provide data from AI/ML training.

1. Test No	**GR_TSTP_1.2.4.9.4**
2. Test Details	To Verify that Near RT RIC Platform shall provide a messaging infrastructure
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Ensure that the Near RT RIC is up and running. 2. Add E2 Node to Near RT RIC. 3. Start an xApp in the Near RT RIC. 4. Verify that the message from xApp is reaching E2 via Near RT RIC internal infrastructure such as Message Router.
6. Test Limits	NA
7. Expected Results	It shall be able to view the logs of messaging infrastructure for E2 Node addition and starting of xApp.

1. Test No	**GR_TSTP_1.2.4.9.5**
2. Test Details	To Verify that Near RT RIC Platform shall provide logging, tracing and metrics collected from Near RT RIC Platform platform and xApps toward SMO.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Ensure the Near-RT RIC is operational. 2. Add an E2 Node to the Near-RT RIC. 3. Launch an xApp in the Near-RT RIC to implement a specific use case. 4. Establish a connection between the SMO, the Near-RT RIC, and the corresponding E2 Node. 5. Retrieve data from the Near-RT RIC into the SMO. 6. Verify the logs , tracing information and metrics collected.
6. Test Limits	NA
7. Expected Results	Near RT RIC shall be able to provide notifications and data related to E2 Node and xApp.

1. Test No	**GR_TSTP_1.2.4.9.6**
2. Test Details	To Verify that Near RT RIC Platform shall provide security functions
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Verify that the communication link between the Near-RT RIC and the E2 Node is secured. 2. Verify that the connection between the Near-RT RIC and the SMO is established securely.
6. Test Limits	NA
7. Expected Results	The connectivity shall be secured.

1. Test No	**GR_TSTP_1.2.4.9.7**
2. Test Details	To Verify that Near RT RIC Platform shall provide security functions Near RT RIC Platform shall support resolution of potential conflicts or overlaps of controls from xApps toward an E2 node.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Ensure the Near-RT RIC is up and running. 2. Integrate an E2 Node with the Near-RT RIC. 3. Deploy and start an xApp in the Near-RT RIC that addresses a specific use case. 4. Initiate a control command from the first xApp. 5. Deploy and start a second xApp in the Near-RT RIC targeting a similar use case. 6. Initiate control commands from the second xApp. 7. If the second xApp commands are in conflict with first xApp , Near RT RIC should stop the execution of second xApp
6. Test Limits	NA
7. Expected Results	Near RT RIC shall stop the second xApp from sending control commands toward E2 Node.

1. Test No	**GR_TSTP_1.2.4.9.8**
2. Test Details	To Verify that Near RT RIC Platform shall communicate with xApp(s) via Near RT RIC Platform APIs
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Ensure that the Near RT RIC is up and running. 2. Add E2 Node to Near RT RIC. 3. Start an xApp in the Near RT RIC. 4. verify the logs from xApp if it is using APIs of Near RT RIC
6. Test Limits	NA
7. Expected Results	Logs shall be observed displaying the communication between xApp and the other modules of Near RT RIC Platform.

1. Test No	**GR_TSTP_1.2.4.9.9**
2. Test Details	To Verify that Near RT RIC Platform shall register the Near RT RIC Platform APIs it produces.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Ensure that the Near RT RIC is up and running. 2. Add E2 Node to Near RT RIC. 3. Start an xApp in the Near RT RIC. 4. Verify that Near RT RIC platform is able to register its APIs (verify in logs)
6. Test Limits	NA
7. Expected Results	The xApp shall have the details of the registered APIs .

1. Test No	**GR_TSTP_1.2.4.9.10**
2. Test Details	To Verify that Near RT RIC Platform shall be capable of discovering the Near RT RIC Platform APIs it consumes..
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Ensure that the Near RT RIC is up and running. 2. Add E2 Node to Near RT RIC. 3. Start an xApp in the Near RT RIC. 4. xApps should able to discover the APIs Near RT RIC platform produces (verify in logs)
6. Test Limits	NA
7. Expected Results	UI shall display the APIs consumed by the Near RT RIC Platform.

1. Test No	**GR_TSTP_1.2.4.9.11**
2. Test Details	To Verify that Near RT RIC Platform shall provide means to resolve compatibility clashes between xApps and the Near RT RIC Platform services they access
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Ensure that the Near RT RIC is up and running. 2. Add E2 Node to Near RT RIC. 3. Start two xApps in the Near RT RIC with two different use cases but need for sharing data. 4. Verify that the Near RT RIC has a capability to start/stop/onboard/deboard xApp as a means to resolve compatibility clashes.
6. Test Limits	NA
7. Expected Results	The two xApps shall be able to share data between them.

1. Test No	**GR_TSTP_1.2.4.9.12**
2. Test Details	To Verify that Near RT RIC Platform shall support subscription merging from multiple xApps to avoid unnecessary network load.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Ensure that the Near RT RIC is up and running. 2. Add E2 Node to Near RT RIC. 3. Start two xApps in the Near RT RIC with two different use cases . 4. The two xApps shall register with same E2 node and shall subscribe for same data . 5. Verify that both xApps get same data at same time (verify logs)
6. Test Limits	NA
7. Expected Results	E2 node shall send data to only Near RT RIC platform. Near RT RIC shall distribute the data to both the xApps.

1. Test No	GR_TSTP_1.2.4.9.13
2. Test Details	To Verify that Near RT RIC Platform shall provide an O1 interface..
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Ensure that the Near RT RIC is up and running. 2. Add E2 Node to Near RT RIC. 3. SMO should be integrated with Near RT RIC. 4. Send get request from SMO to Near RT RIC using O1. 5. Verify SMO logs
6. Test Limits	NA
7. Expected Results	SMO shall be able to get data from Near RT RIC through O1 interface.

1. Test No	**GR_TSTP_1.2.4.9.14**
2. Test Details	To Verify that Near RT RIC Platform shall be able to route A1 policy management messages to the registered xApps based on A1 policy type and operator policies
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Ensure that the Near RT RIC is up and running. 2. Add E2 Node to Near RT RIC. 3. Non RT RIC shall be integrated with Near RT RIC. 4. Send request from Non RT RIC to Near RT RIC over A1. 5. Verify logs at Near RT RIC
6. Test Limits	NA
7. Expected Results	Non RT RIC shall be able to send command to Near RT RIC through A1 interface.

1. Test No	**GR_TSTP_1.2.4.9.15**
2. Test Details	To Verify that Near RT RIC Platform shall control access of A1-EI types for xApps based on operator policies.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Ensure that the Near RT RIC is up and running. 2. Add E2 Node to Near RT RIC. 3. Non RT RIC shall be integrated with Near RT RIC. 4. Send A1-EI request from Non RT RIC to Near RT RIC. 5. Verify logs at Near RT RIC
6. Test Limits	NA
7. Expected Results	Non RT RIC shall be able to send command to Near RT RIC through A1 interface.

1. Test No	**GR_TSTP_1.2.4.9.16**
2. Test Details	To Verify that Near RT RIC Platform shall provide APIs enabling the hosting of 3rd party xApps and xApps from the Near RT RIC Platform platform vendor.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Ensure that the Near RT RIC is up and running. 2. Add E2 Node to Near RT RIC. 3. Open xApp on boarding page and deploy 3rd party xApp, start the xAPP. 4. verify that the xApp deployed is able to communicate with E2 node.
6. Test Limits	NA
7. Expected Results	Document with API details and integration steps shall be available.

1. Test No	**GR_TSTP_1.2.4.9.17**
2. Test Details	To Verify that Near RT RIC Platform APIs shall support the Near RT RIC Platform control loop of execution time from 10 milliseconds to 1 second.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Ensure that the Near RT RIC is up and running. 2. Add E2 Node to Near RT RIC. 3. Ensure that E2 node is sending some fault information to Near RT RIC . 3. verify that Near RT RIC is sending command to rectify fault within 10 millisecond to 1 second time.
6. Test Limits	NA
7. Expected Results	Control loop shall be executed within 10 milliseconds to 1 second.

1. Test No	GR_TSTP_1.2.4.9.18
2. Test Details	To Verify that Near RT RIC Platform shall provide APIs decoupled from specific implementation solutions, including a Shared Data Layer (SDL) that works as an overlay for underlying databases and enables simplified data access.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	NA
5. Test Procedure	1. verify that document shall be available explaining the Architecture and API of the Near RT RIC .
6. Test Limits	NA
7. Expected Results	Document shall provide details of Shared Data Layer (SDL) and it's working mechanism.

1. Test No	**GR_TSTP_1.2.4.9.19**
2. Test Details	To Verify that Near RT RIC Platform shall provide an API repository/registry for the services provided by the Near RT RIC Platform platform and/or xApps.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Ensure that the Near RT RIC is up and running. 2. Add E2 Node to Near RT RIC. 3. Start an xApp in the Near RT RIC. 4. Verify that Near RT RIC platform is able to register its APIs (verify in logs) 5. xApps should able to discover the APIs Near RT RIC platform produces (verify in logs)
6. Test Limits	NA
7. Expected Results	UI shall provide details of API repository/registry for the services provided by the Near RT RIC Platform platform and/or xApps.

1. Test No	**GR_TSTP_1.2.4.9.20**
2. Test Details	To Verify that Near RT RIC Platform APIs shall provide means for xApps to discover the published APIs based on the xApps' needs
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Ensure that the Near RT RIC is up and running. 2. Add E2 Node to Near RT RIC. 3. Start an xApp in the Near RT RIC. 4. xApps should able to discover the APIs Near RT RIC platform produces (verify in logs)
6. Test Limits	NA
7. Expected Results	UI shall provide details of the published APIs.

1. Test No	**GR_TSTP_1.2.4.9.21**
2. Test Details	To Verify that Near RT RIC Platform APIs shall provide means to restrict xApps from discovering some published APIs based on configured policies.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Ensure that the Near RT RIC is up and running. 2. Add E2 Node to Near RT RIC. 3. Configure API policies such that it is visible to only one xApp. 4. Start two xApps in the Near RT RIC (one with API visibility and other without). 5. Verify that Near RT RIC platform is able to register its APIs (verify in logs) 6. Verify that one xApp is able to discover published API where as second xApp does not discover the published APIs.
6. Test Limits	NA
7. Expected Results	UI shall provide details of the published APIs. These details shall not contain the blocked APIs.

1. Test No	**GR_TSTP_1.2.4.9.22**
2. Test Details	To Verify that Near RT RIC Platform shall provide APIs enabling all xApps to directly use the information elements of E2SMs with which they are associated.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Ensure that the Near RT RIC is up and running. 2. Add E2 Node to Near RT RIC. 3. Start an xApp in the Near RT RIC. 4. Verify that Near RT RIC platform is able to register its APIs (verify in logs) 5. xApps should able to discover the APIs Near RT RIC platform produces and get the information elements of E2SMs (verify in logs)
6. Test Limits	NA
7. Expected Results	UI shall provide details of E2SMs with which xApp is associated.

1. Test No	**GR_TSTP_1.2.4.9.23**
2. Test Details	To Verify that Near RT RIC Platform shall provide APIs aiming to simplify the development of xApps and enable rapid innovation.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	NA
5. Test Procedure	Verify that Near RT RIC API document provideds details of the APIs so that it simplify the development of xApp.
6. Test Limits	NA
7. Expected Results	Document shall contains stepwise details of using the APIs needed for integration of xApp with Near RT RIC.

1. Test No	**GR_TSTP_1.2.4.9.24**
2. Test Details	To Verify that Near RT RIC Platform shall provide Near RT RIC Platform APIs supporting xApp development in multiple programming languages (e.g. C, C++, Python, Go).
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	NA
5. Test Procedure	Verify that Near RT RIC API document provideds details of the APIs along with programming languages so that it simplify the development of xApp.
6. Test Limits	NA
7. Expected Results	Document shall contains stepwise details of using the APIs needed for integration of xApp with Near RT RIC

1. Test No	**GR_TSTP_1.2.4.9.25**
2. Test Details	To Verify that Near RT RIC Platform APIs shall support xApp subscription management based on operators' policies. An xApp may be restricted to interface with only a subset of E2 Nodes by such policies. Near RT RIC Platform shall be responsible for routing messages between this xApp and the subset of E2 Nodes.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Ensure that the Near RT RIC is up and running. 2. Add E2 Node to Near RT RIC. 3. Start an xApp in the Near RT RIC. 4. verify that xApp is having access to only subset of E2 nodes.
6. Test Limits	NA
7. Expected Results	UI shall provide details of the subscribed xApps. It shall also display the E2 Nodes with whom it has subscribed.

1. Test No	**GR_TSTP_1.2.4.10.1**
2. Test Details	To Verify that The O-Cloud services shall provide the ability to discover what event types the cloud instance supports. The minimal list of supported event types shall be: a. Inventory Change b. Configuration Change c. Fault Events d. Performance Reporting e. Heartbeat f. Shall support O2 interface.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 7
5. Test Procedure	1. Bring the O-Cloud and connected RAN NFs (O-CU / O-DU / O-RU) into operational state. 2. Connect the management client / external system to the O-Cloud via the O2 interface. 3. Discover the list of supported event types through O2 interface capabilities. 4. Subscribe and trigger each available event type (Inventory Change, Configuration Change, Fault, Performance Reporting, Heartbeat). 5. Verify that all subscribed event notifications are received correctly without service disruption.
6. Test Limits	NA
7. Expected Results	The O-Cloud shall support O2 interface and allow discovery of supported event types. Event notifications for Inventory Change, Configuration Change, Fault, Performance Reporting and Heartbeat shall be received correctly without major alarms or service impact.

1. Test No	**GR_TSTP_1.2.4.10.2**
2. Test Details	To Verify that the O-Cloud shall support O2 interface towards SMO
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 7
5. Test Procedure	1. Bring O-Cloud and SMO to operational state. 2. Establish O2 interface connectivity between O-Cloud and SMO. 3. From SMO, query O-Cloud via O2 interface to retrieve capabilities / resource information. 4. Verify execution of management operations (e.g., resource query, lifecycle or telemetry configuration) over O2 interface.
6. Test Limits	NA
7. Expected Results	The O-Cloud shall support O2 interface towards SMO and allow successful exchange of O2 management messages without service disruption or major alarms.

1. Test No	**GR_TSTP_1.2.4.10.3**
2. Test Details	To Verify that the O-Cloud shall be able to make all Configuration Data and any external changes to it available to the SMO.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 7
5. Test Procedure	1. Bring O-Cloud and SMO to operational state. 2. Establish O2 interface between O-Cloud and SMO. 3. From SMO, query O-Cloud for configuration data (initial configuration). 4. Apply a configuration change externally on O-Cloud (e.g., compute/storage/network resource change or host configuration update). 5. Verify that the changed configuration data becomes available to SMO through the O2 interface.
6. Test Limits	NA
7. Expected Results	The O-Cloud shall provide configuration data to the SMO and reflect any external changes to that configuration without service degradation or major alarms.

1. Test No	**GR_TSTP_1.2.4.10.4**
2. Test Details	To Verify that O-Cloud telemetry shall minimally consist of Fault, Performance, and Configuration Data
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 7
5. Test Procedure	1. Bring O-Cloud and SMO to operational state. 2. Establish O2 interface connectivity between O-Cloud and SMO. 3. From SMO, subscribe to O-Cloud telemetry. 4. Validate that telemetry reports contain at least Fault, Performance and Configuration data categories.
6. Test Limits	NA
7. Expected Results	O-Cloud telemetry shall minimally include Fault, Performance and Configuration data and shall expose them successfully to SMO without service disruption or major alarms.

1. Test No	**GR_TSTP_1.2.4.10.5**
2. Test Details	To Verify that the O-Cloud shall be able to report telemetry of NF deployment relative to those identified in the deployment descriptor.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 7
5. Test Procedure	1. Bring O-Cloud and SMO to operational state. 2. Deploy NFs based on a deployment descriptor and validate completion. 3. From SMO, subscribe to telemetry notifications from O-Cloud via O2 interface. 4. Verify that telemetry reports reflect NF deployment status and resource allocation as defined in the deployment descriptor.
6. Test Limits	NA
7. Expected Results	The O-Cloud shall correctly report telemetry of NF deployment consistent with the deployment descriptor without service disruption or major alarms.

1. Test No	**GR_TSTP_1.2.4.10.6**
2. Test Details	To Verify that the O-Cloud shall be able to report Cloud Infrastructure Resource telemetry and is a major functionality of the O-Cloud represented by the DMS. NF function will have its own requirement.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 7
5. Test Procedure	1. Bring O-Cloud and SMO into operational state. 2. Establish O2 interface connectivity. 3. From SMO, subscribe to Cloud Infrastructure Resource telemetry exposed by O-Cloud. 4. Trigger infrastructure load changes (e.g., VM/container start/stop or resource allocation change). 5. Verify that telemetry reported through O-Cloud reflects the resource status change correctly.
6. Test Limits	NA
7. Expected Results	O-Cloud shall correctly report Cloud Infrastructure Resource telemetry to SMO without service degradation or major alarms.

1. Test No	**GR_TSTP_1.2.4.10.7**
2. Test Details	To Verify that the O-Cloud shall provide the collection and reporting of performance information of O-Cloud resources and notify this information
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 7
5. Test Procedure	1. Bring O-Cloud and SMO into operational state. 2. Establish O2 interface connectivity between O-Cloud and SMO. 3. From SMO, subscribe to O-Cloud performance telemetry reporting. 4. Trigger performance variations (e.g., workload/resource utilization changes) in O-Cloud. 5. Verify that O-Cloud collects and notifies performance telemetry to SMO corresponding to the resource status.
6. Test Limits	NA
7. Expected Results	O-Cloud shall collect and report performance information of O-Cloud resources and notify this information to SMO without service degradation or major alarms.

1. Test No	**GR_TSTP_1.2.4.10.8**
2. Test Details	To Verify that O-Cloud shall expose the type of performance information that can be collected for the allocated O-Cloud resource(s) and type of O-Cloud resource, for which the performance information can be collected.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 7
5. Test Procedure	1. Bring O-Cloud and SMO into operational state. 2. Establish O2 interface connectivity between O-Cloud and SMO. 3. From SMO, query O-Cloud for supported performance information types per O-Cloud resource. 4. Validate that O-Cloud exposes the list of performance metrics and the resource types to which each metric applies.
6. Test Limits	NA
7. Expected Results	O-Cloud shall expose the type of performance information that can be collected and the associated O-Cloud resource types without service disruption or major alarms.

1. Test No	**GR_TSTP_1.2.4.10.9**
2. Test Details	To Verify that O-Cloud shall provide the collection and notification of fault information for O-Cloud resources.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 7
5. Test Procedure	1. Bring O-Cloud and SMO to operational state. 2. Establish O2 interface connectivity between O-Cloud and SMO. 3. From SMO, subscribe to fault telemetry notifications from O-Cloud. 4. Trigger a fault condition on O-Cloud resources (for example, resource unavailability, node fail, storage/network threshold breach, VM/container crash). 5. Verify that the corresponding fault information is collected and notified by O-Cloud to SMO
6. Test Limits	NA
7. Expected Results	O-Cloud shall provide collection and notification of fault information for O-Cloud resources without service degradation or major alarms.

1. Test No	**GR_TSTP_1.2.4.10.10**
2. Test Details	To Verify that to support the deployments, O-Cloud Provisioning will need to provide several functionalities. There shall be initial support for the following: a. Affinity, Anti-Affinity, Quorum Diversity Rules b. Capacity Query c. Availability Query d. Managed O-Cloud Noe Clusters and Logical Clouds.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 7
5. Test Procedure	1. Bring O-Cloud and SMO into operational state. 2. Establish O2 interface connectivity between O-Cloud and SMO. 3. From SMO, query O-Cloud provisioning capabilities for: – Affinity / Anti-Affinity / Quorum Diversity Rules – Capacity Query – Availability Query – Node Cluster / Logical Cloud Management 4. Execute provisioning operations and validate that O-Cloud responds with the provisioned resources, rule constraints and topology as requested
6. Test Limits	NA
7. Expected Results	O-Cloud shall support provisioning operations including Affinity, Anti-Affinity, Quorum Diversity Rules, Capacity Query, Availability Query and management of O-Cloud Node Clusters and Logical Clouds without service degradation or major alarms.

1. Test No	**GR_TSTP_1.2.4.10.11**
2. Test Details	To Verify that O-Cloud shall provide Add, Delete, Update and Query Software Images of O-RAN Cloudified Network Function to O-Cloud repository
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 7
5. Test Procedure	1. Bring O-Cloud and SMO into operational state. 2. Establish O2 interface connectivity between SMO and O-Cloud. 3. From SMO, add a software image to the O-Cloud repository and verify successful upload. 4. Query the O-Cloud repository to confirm presence of the added image. 5. Update an existing software image and verify updated metadata/descriptor. 6. Delete a software image from the repository and verify removal.
6. Test Limits	NA
7. Expected Results	O-Cloud shall support Add, Delete, Update and Query operations for software images of O-RAN Cloudified Network Functions in the O-Cloud repository without service degradation or major alarms.

1. Test No	**GR_TSTP_1.2.4.10.12**
2. Test Details	To Verify that O-Cloud shall provide Software Image properties information of O-RAN Cloudified Network Function
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 7
5. Test Procedure	1. Bring O-Cloud and SMO into operational state. 2. Establish O2 interface connectivity between O-Cloud and SMO. 3. From SMO, query the O-Cloud repository for Software Image properties of an O-RAN Cloudified Network Function. 4. Validate that the response includes all expected Software Image properties such as version, vendor, checksum, format, dependencies and supported deployment profile.
6. Test Limits	NA
7. Expected Results	O-Cloud shall successfully provide Software Image properties information of O-RAN Cloudified Network Functions to SMO without service disruption or major alarms.

1. Test No	**GR_TSTP_1.2.4.10.13**
2. Test Details	To Verify that In O-RAN the O-Cloud Life Cycle Management shall provide the following capabilities: a. Deploy b. Registration c. Scale
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 7
5. Test Procedure	1. Bring O-Cloud and SMO into operational state and establish the O2 interface. 2. From SMO, initiate deployment of an O-RAN Cloudified Network Function using O-Cloud LCM. 3. Verify successful **deployment** completion and **registration** of the deployed NF in O-Cloud/SMO inventory. 4. Trigger **scaling** of the deployed NF (up/down) via SMO using O-Cloud LCM. 5. Confirm that the scaling action is executed and that service remains operational.
6. Test Limits	NA
7. Expected Results	O-Cloud Life Cycle Management shall support Deploy, Registration and Scale capabilities for O-RAN Cloudified Network Functions without service degradation or major alarms.

1. Test No	**GR_TSTP_1.2.4.11.1**
2. Test Details	To Verify that O-RAN OAM Architecture shall support the interaction between the Service Management and Orchestration Framework and the O-Cloud through O2 interface to perform virtualized resource orchestration.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	• Verify SMO can successfully discover and communicate with the O-Cloud over the O2 interface. • Use SMO to trigger orchestration operations (e.g., VM or container instantiation, network setup) on the O-Cloud. • Confirm that the O-Cloud correctly provisions and configures the requested resources. • Ensure the O2 interface reports status, success/failure, and lifecycle events back to the SMO. • Trigger scale-in/scale-out or deletion of resources and validate updates on both SMO and O-Cloud sides. • Verify that O2 interactions and resource orchestration events are logged and traceable from both systems.
6. Test Limits	NA
7. Expected Results	The O-RAN OAM architecture enables successful interaction between the SMO framework and the O-Cloud via the O2 interface, allowing effective orchestration of virtualized resources.

1. Test No	**GR_TSTP_1.2.4.11.2**
2. Test Details	To Verify that O-RAN OAM Architecture shall support the capability for the Service Management and Orchestration Framework to consume the provisioning management service exposed by the MnF of each O-RAN NF, regardless of whether the NF is implemented as PNF or VNF, through the O1 interface except O-RU.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	• Validate O1 interface connectivity between the SMO and each target NF (PNF and VNF). • From SMO, send provisioning management requests (e.g., configuration retrieval or update) to each NF's MnF via the O1 interface. • Confirm that each NF responds correctly to the provisioning requests and applies the configuration where applicable. • Ensure the SMO receives accurate status, acknowledgment, or result of the provisioning action from each NF. • Ensure that no provisioning request is made to O-RUs and verify that SMO does not attempt such interaction via O1 for O-RUs. • Review logs from both SMO and NFs to confirm successful interaction and provisioning lifecycle completion.
6. Test Limits	NA
7. Expected Results	The O-RAN OAM architecture supports the SMO in consuming the provisioning management services exposed by the MnF of each O-RAN Network Function (excluding O-RU), via the O1 interface, irrespective of whether the NF is a PNF or VNF.

1. Test No	**GR_TSTP_1.2.4.11.3**
2. Test Details	To Verify that O-RAN OAM Architecture shall support creation, modification and termination of VNFs in an O-RAN network by the Service Management and Orchestration Framework
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	• Trigger the creation of a VNF from SMO using a pre-defined VNFD. Verify that the VNF is successfully instantiated in the O-Cloud environment. • Perform a configuration change on the deployed VNF (e.g., scaling, parameter update) through the SMO. Confirm the VNF reflects updated configuration. • Use SMO to gracefully terminate the VNF instance. Validate that all related resources are released in the O-Cloud. • Check orchestration logs, events, and status reports in SMO and O-Cloud to ensure successful execution of each operation. • Ensure no residual resources remain post-termination and that system state is consistent.
6. Test Limits	NA
7. Expected Results	The O-RAN OAM Architecture enables the SMO to successfully create, modify, and terminate VNFs within the O-RAN network, demonstrating full lifecycle management capabilities.

1. Test No	**GR_TSTP_1.2.4.11.4**
2. Test Details	To Verify that O-RAN OAM Architecture shall support registration and inventory of newly activated VNFs and PNFs by the Service Management and Orchestration Framework.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	• Use the SMO or orchestrator to instantiate a new VNF. Verify that it automatically registers with SMO and appears in the inventory. • Simulate PNF power-on or deployment. Confirm that it initiates registration with SMO via the O1 interface and is recorded in the inventory. • Check that both VNFs and PNFs are correctly listed in the SMO inventory with appropriate metadata (type, ID, location, status, etc.). • Compare registered items against expected deployments to ensure inventory completeness and accuracy. • Review SMO logs to confirm successful registration messages and database update events for each new NF.
6. Test Limits	NA
7. Expected Results	The O-RAN OAM Architecture allows the SMO to register and maintain an up-to-date inventory of newly activated VNFs and PNFs, ensuring accurate tracking and management of network functions.

1. Test No	**GR_TSTP_1.2.4.11.5**
2. Test Details	To Verify that O-RAN OAM Architecture shall support collection of status change and other indications from VNFs and PNFs by the Service Management and Orchestration Framework
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	• Simulate an operational status change (e.g., from "active" to "degraded") in the VNF and verify that the SMO receives the correct indication. • Simulate a state change (e.g., port failure or reboot) in the PNF. Ensure the SMO collects and logs the indication. • Confirm that the SMO records all status changes and indications from both VNFs and PNFs accurately via O1. • Ensure the SMO triggers any configured workflows or alarms based on the collected indications. • Validate the completeness and correctness of the logs and ensure that no indications were missed.
6. Test Limits	NA
7. Expected Results	The O-RAN OAM Architecture enables the SMO to successfully receive and process status change notifications and other operational indications from VNFs and PNFs in real time.

1. Test No	**GR_TSTP_1.2.4.11.6**
2. Test Details	To Verify that O-RAN OAM Architecture shall support configuration of VNFs and PNFs by the Service Management and Orchestration Framework, including, for example, addressing information needed to allow them to connect to each other
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	• Use the SMO to provision basic configuration settings to VNFs and PNFs, including IP addressing and interface parameters. • Configure routing or addressing info (e.g., next-hop IPs, VLANs, subnets) that enable VNFs and PNFs to connect with each other. • Query the VNFs and PNFs to confirm that the configuration changes were successfully applied. • Initiate a test communication (e.g., ping or control-plane message) between the VNF and PNF to confirm interconnection is successful. • Ensure that SMO receives acknowledgement of successful configuration from the NFs and logs are updated.
6. Test Limits	NA
7. Expected Results	The SMO is able to configure VNFs and PNFs via the O-RAN OAM Architecture, including setting addressing and connectivity parameters, ensuring successful communication between network functions.

1. Test No	**GR_TSTP_1.2.4.11.7**
2. Test Details	To Verify that O-RAN OAM Architecture shall support management of PM jobs/PM data collection/storage/query/statistical reports from MnFs of O-RAN NFs.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	• Use the SMO to configure and activate a PM job targeting specific MnFs with required metrics, intervals, and thresholds. • Trigger or wait for periodic PM reports from MnFs to be sent via O1 interface and confirm successful data ingestion into SMO. • Check that collected PM data is correctly stored in the SMO's performance data repository. • Use the SMO interface or API to query historical PM data based on time range, metrics, and NFs. • Validate that the SMO can generate aggregated/statistical reports (e.g., averages, trends, KPIs) from the collected PM data. • Cross-check a subset of PM data from MnF with the stored data to ensure accuracy and completeness.
6. Test Limits	NA
7. Expected Results	The SMO successfully manages Performance Management (PM) jobs, including initiation, data collection, storage, querying, and generation of statistical reports from the Managed Functions (MnFs) of O-RAN Network Functions (NFs).

1. Test No	**GR_TSTP_1.2.4.11.8**
2. Test Details	To Verify that O-RAN OAM Architecture shall support operation logging, operation authority and management of O-RAN NFs.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	• Access the SMO using an account with defined operation roles. • Trigger basic NF operations (e.g., configuration update, fault reset, PM job creation) via the SMO interface. • Attempt operations with users of different privilege levels and validate that unauthorized actions are blocked. • Access SMO's operation logs to verify that all management actions are recorded with user ID, timestamp, and action details. • Confirm the logs reflect actual operations performed and any denied actions are also logged for audit purposes. • Confirm that SMO can perform and track NF management operations (e.g., service start/stop, config changes) correctly.
6. Test Limits	NA
7. Expected Results	The O-RAN OAM Architecture enables proper logging of operations, enforces operation-level authority controls, and provides effective management capabilities for O-RAN Network Functions (NFs).

1. Test No	**GR_TSTP_1.2.4.11.9**
2. Test Details	To Verify that O-RAN OAM Architecture shall support management of O-DU, O-CU, ORU and other hardware components
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	• Verify that SMO can discover and register O-DU, O-CU, O-RU via the O1 interface. • Fetch and verify hardware details (model, version, serial number) from SMO for each component. • Perform basic configuration operations (e.g., IP update, time sync settings) on each hardware component from SMO. • Check the health and operational status of each component from SMO, ensuring real-time monitoring works. • Simulate hardware faults (e.g., disconnect O-RU) and verify fault detection and logging in SMO. • Ensure SMO can collect and display PM data from each hardware component. • Execute firmware/software update or reboot of a component via SMO and confirm completion and status.
6. Test Limits	NA
7. Expected Results	The O-RAN OAM Architecture successfully supports the management of O-DU, O-CU, O-RU, and other associated hardware components, enabling configuration, monitoring, and control functionalities.

1. Test No	**GR_TSTP_1.2.4.11.10**
2. Test Details	To Verify that O-RAN OAM Architecture and interfaces shall support network slicing, where an instance of O-RAN NF may be associated with one or more slices.
3. Test Instruments Required	O-CU, O-DU, O-RU, UE (or UE simulator), 5G Core (or core simulator), Network Packet Analyzer, Traffic generator (e.g., iPerf), management PC, switch/router and network cables.
4. Test Setup	
5. Test Procedure	1. Configure OAM with CU and DU parameters 2. Configure OAM with Two Network Slice parameters 3. Bring gNB up with the help of OAM 3. Verify in the log that the Cell is configured with given Slice parameters 4. Verify UE attach is working
6. Test Limits	Not Applicable
7. Expected Results	1. UE attach successfully 2. Network slice ids verified in Log

1. Test No	**GR_TSTP_1.2.4.11.11**
2. Test Details	To Verify that O-RAN OAM Architecture may support O1 interface to the MnF of each O-RAN NF (with the exception of the RU) even if the MnF is deployed behind a NAT.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	• From the SMO, verify it can reach the MnF endpoints using the NAT-exposed IP or reverse channel. • Initiate the O1 interface communication from SMO to MnFs behind NAT using supported protocols (e.g., NETCONF, RESTCONF). • Perform a basic configuration operation and request a status report via the O1 interface to validate full bidirectional communication. • Check for latency, session drops, and retries due to NAT translation. • Modify NAT mappings (e.g., timeout or IP change) and verify the O1 session can recover or re-establish. • Execute a subset of FCAPS functions (e.g., PM data collection, fault notification) and verify data delivery to the SMO through NAT. • Collect logs and ensure there are no blocked or dropped messages due to NAT-related issues.
6. Test Limits	NA
7. Expected Results	The O-RAN OAM Architecture supports communication over the O1 interface to the MnF of each O-RAN NF (excluding the RU), even when the MnF is deployed behind a NAT, ensuring proper management and monitoring capabilities.

1. Test No	**GR_TSTP_1.2.4.11.12**
2. Test Details	To Verify that the O-RAN OAM architecture shall support the capability of the Service Management and Orchestration (SMO) framework to discover the RAN FCAPS-related management capabilities of the O-RAN MnF that terminates the O1 interface or NF that terminates the Open fronthaul Mplane interface.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	• SMO sends a discovery request over the O1 or M-plane interface to each connected MnF or NF. • Each MnF/NF responds with its supported FCAPS functionalities (e.g., supports PM, FM, etc.). • Ensure the response aligns with O-RAN-specified information models (e.g., Yang models for O1). • Validate that SMO correctly logs and categorizes the FCAPS features of each MnF/NF. • Compare the discovered data with known capability expectations for the specific MnF/NF. • Trigger a capability change (e.g., enabling PM on a device), and verify the SMO receives and reflects this update. • Generate a fault event from a connected NF and confirm that SMO recognizes the FM capability in action. • Confirm SMO accurately reflects current FCAPS capabilities for all NFs/MnFs connected via O1 or M-plane.
6. Test Limits	NA
7. Expected Results	The SMO successfully discovers the RAN FCAPS-related management capabilities of the O-RAN MnF or NF that terminates the O1 or Open Fronthaul M-plane interface, as supported by the O-RAN OAM architecture.

1. Test No	**GR_TSTP_1.2.4.12.1**
2. Test Details	To Verify that O-RAN OAM Architecture shall support the introduction of new and more cost-effective technologies into the RAN through open, standard interfaces.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	• Prepare a new RAN component (e.g., a cost-effective O-RU or DU) supporting O-RAN standard interfaces (O1, Open Fronthaul, etc.). • Onboard the new component to the SMO using standard procedures defined in O-RAN specifications. • Validate the SMO's ability to: ◦ Discover the new component. ◦ Establish connectivity through open interfaces. ◦ Manage the component via O1 or M-Plane interfaces. • Verify FCAPS operations (fault, configuration, performance monitoring, etc.) are possible on the new component. • Check interoperability with existing O-RAN components via standard interfaces (e.g., new O-RU works with existing O-DU). • Record system logs and verify no proprietary dependencies are needed for integration.
6. Test Limits	NA
7. Expected Results	O-RAN OAM Architecture allows integration of new and cost-effective technologies into the RAN using open, standardized interfaces, ensuring interoperability and vendor flexibility.

1. Test No	**GR_TSTP_1.2.4.12.2**
2. Test Details	To Verify that O-RAN OAM Architecture shall support virtualization of RAN components, allowing operators use of common, off-the-shelf hardware implementations
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	• Initiate deployment of virtualized RAN components from the SMO to the O-Cloud over the O2 interface. • Verify resource allocation and orchestration of the VNFs on off-the-shelf hardware. • Confirm registration of VNFs with the SMO via the O1 interface. • Execute basic FCAPS operations on virtualized components to validate full OAM capability. • Monitor performance and stability to ensure the virtualized RAN behaves equivalently to traditional implementations. • Validate scalability by simulating scale-out/in operations on the virtualized components. • Check interoperability between virtualized and physical RAN components if present. • Log and evaluate results, ensuring virtualization is functional using non-proprietary, COTS hardware.
6. Test Limits	NA
7. Expected Results	O-RAN OAM Architecture supports virtualization of RAN components, enabling deployment on common off-the-shelf (COTS) hardware, promoting flexibility, scalability, and cost-efficiency for network operators.

1. Test No	**GR_TSTP_1.2.4.12.3**
2. Test Details	To Verify that O-RAN OAM Architecture shall support use of Analytics and Artificial Intelligence/Machine Learning to improve network efficiency and performance and reduce operations costs.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	• Start data collection from RAN components (e.g., KPIs, PM data, alarms) through O1 interface. • Feed collected telemetry into the Non-RT RIC for analysis. • Run ML inference or analytics jobs within an rApp to identify optimization opportunities or performance anomalies. • Generate AI/ML-based policy guidance in the Non-RT RIC and send it to the Near-RT RIC via the A1 interface. • Observe the implementation of policies in the RAN nodes and evaluate network performance impact (e.g., throughput, latency). • Validate reduced manual intervention or auto-remediation actions triggered by the AI/ML pipeline. • Check logs and system KPIs to confirm efficiency gains and cost reduction indicators. • Document results and validate against expected behavior.
6. Test Limits	NA
7. Expected Results	O-RAN OAM Architecture supports integration of Analytics and AI/ML frameworks to enable intelligent automation, enhance network performance, optimize resource utilization, and reduce operational costs.

1. Test No	**GR_TSTP_1.2.4.12.4**
2. Test Details	To Verify that O-RAN entities emitting alarms to the SMO shall provide an Alarm Dictionary with the product delivery that is delivered to the SMO at onboarding for O-RAN NFs, xApps and rApps or at registration for OCloud entities and the same shall be updated when the entity emitting the alarm supports a new alarm definition, the information associated with the alarm definition changes or the entity no longer supports an alarm definition.
3. Test Instruments Required	O-CU, O-DU, O-RU, UE (or UE simulator), 5G Core (or core simulator), Network Packet Analyzer, Traffic generator (e.g., iPerf), management PC, switch/router and network cables.
4. Test Setup	TEST SETUP 7
5. Test Procedure	1. Establish Netconf connection between gNB and SMO over O1 interface 2. Verify connection status at SMO 3. SMO invoke GET_CONFIG RPC to get the Alarm Dictionary from gNB 4. SMO display the Alarm Dictionary on the GUI
6. Test Limits	Not Applicable
7. Expected Results	1. Operator shall be able to view the Alarm Dictionary supported by gNB on the SMO GUI

1. Test No	**GR_TSTP_1.2.4.12.5**
2. Test Details	To Verify that the SMO shall maintain the association between an entity version onboarded from a product delivery and its alarm dictionary
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	• Onboard version 1.0 of the O-RAN entity to the SMO along with its alarm dictionary. • Verify that the SMO correctly stores and associates the alarm dictionary with version 1.0 of the entity. • Onboard version 1.1 of the same entity with a modified or extended alarm dictionary. • Validate that the SMO maintains separate associations • Query the SMO for alarm dictionary data for each onboarded version and ensure the correct dictionary is returned. • Optionally, simulate an alarm from both versions and confirm the SMO maps each to the correct version-specific dictionary.
6. Test Limits	NA
7. Expected Results	The SMO maintains a correct and consistent association between each onboarded entity version and its corresponding alarm dictionary, ensuring accurate alarm interpretation and management.

1. Test No	**GR_TSTP_1.2.4.12.6**
2. Test Details	To Verify that the Alarm Dictionary shall be delivered following the schema to be defined in the IM/DM specification.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	• Retrieve the latest version of the Information Model/Data Model (IM/DM) specification that defines the required schema for the Alarm Dictionary. • Acquire the Alarm Dictionary delivered by the O-RAN entity (e.g., O-RAN NF, xApp, rApp, O-Cloud entity) during onboarding or registration. • Use a schema validation tool or parser to verify that the structure and content of the Alarm Dictionary conform to the schema defined in the IM/DM specification. • Check that all mandatory fields specified in the schema (e.g., alarm ID, severity, probable cause, description) are present and correctly formatted in the Alarm Dictionary. • Record any deviations, errors, or warnings generated during schema validation. • Document the validation results, including pass/fail status and any issues found. • If the Alarm Dictionary does not comply with the schema, report the discrepancies to the responsible development or integration team.
6. Test Limits	NA
7. Expected Results	The Alarm Dictionary is successfully delivered in a format that fully complies with the schema defined in the Information Model/Data Model (IM/DM) specification, with all required fields and structure correctly implemented.

1. Test No	**GR_TSTP_1.2.4.12.7**
2. Test Details	To Verify that the O-RAN OAM Architecture shall support security of interactions between the components of an O-RAN network.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 1
5. Test Procedure	• Initiate secure communication between O-RAN components (e.g., SMO and O-DU via O1, SMO and O-Cloud via O2). • Verify encryption by inspecting message headers or traffic using packet capture tools (e.g., Wireshark). • Attempt unauthorized access or simulate a man-in-the-middle (MITM) scenario and confirm it is detected/prevented. • Check that mutual authentication (e.g., using certificates) is enforced at the interfaces. • Validate role-based access control (RBAC) is in effect during API or CLI operations. • Inspect security logs for evidence of secure session establishment, access denial, or threat detection. • Confirm that security policies comply with O-RAN Alliance specifications and organizational security standards.
6. Test Limits	NA
7. Expected Results	All interactions between O-RAN components are secured using authentication, authorization, encryption, and integrity protection as defined in O-RAN security specifications.

1. Test No	**GR_TSTP_1.2.5.1**
2. Test Details	To Verify that the supplier/manufacturer shall conform to ISO 9001:2015 certifications. A quality plan describing the quality assurance system followed by the manufacturer shall be required to be submitted.
3. Test Instruments Required	NA
4. Test Setup	NA
5. Test Procedure	No test required. Supplier/Manufacturer to provide ISO 9001 certification details and Quality Plan.
6. Test Limits	NA
7. Expected Results	Supplier/Manufacturer to provide ISO 9001 certification and Quality Plan

1. Test No	GR_TSTP_1.2.5.2
2. Test Details	To Verify that for O-RAN, the failure of any component/ sub-system in the system may not result in the failure of complete system.
3. Test Instruments Required	NA
4. Test Setup	NA
5. Test Procedure	Details of compliance to be submitted by supplier.
6. Test Limits	NA
7. Expected Results	Distributed eNodeB has suitable provisions.

1. Test No	GR_TSTP_1.2.6_A1
2. Test Details	EMI/EMC Requirements: Conducted and Radiated Emission- CISPR 32 Class-A
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	NA
5. Test Procedure	O-RAN to be tested in accordance with the test procedure of relevant standards. Testing to be done at certified lab.
6. Test Limits	NA
7. Expected Results	Test certificate/reports from any certified lab should be submitted.

1. Test No	GR_TSTP_1.2.6_A2
2. Test Details	EMI/EMC Requirements: Immunity to Electrostatic discharge: Contact discharge level 2 {± 4 kV}- IEC-61000-4-2 Performance Criteria-B, Clause 9
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	NA
5. Test Procedure	O-RAN to be tested in accordance with the test procedure of relevant standards. Testing to be done at certified lab.
6. Test Limits	NA
7. Expected Results	Test certificate/reports from any certified lab should be submitted.

1. Test No	GR_TSTP_1.2.6_A3
2. Test Details	EMI/EMC Requirements: Immunity to Electrostatic discharge: Air discharge level 3 {± 8 kV}-IEC-61000-4-2 Performance Criteria-B, Clause 9
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	NA
5. Test Procedure	O-RAN to be tested in accordance with the test procedure of relevant standards. Testing to be done at certified lab.
6. Test Limits	NA
7. Expected Results	Test certificate/reports from any certified lab should be submitted.

1. Test No	GR_TSTP_1.2.6_A4
2. Test Details	EMI/EMC Requirements: Immunity to radiated RF: -IEC 61000-4-3 (2010); Performance Criteria-A, Clause 9 a) Radio Frequency: 80 MHz to 1 GHz, Electromagnetic field: 3V/m b) Radio Frequency: 800 MHz to 960 MHz, Electromagnetic field: 10V/m c) Radio Frequency: 1.4 GHz to 6 GHz, Electromagnetic field: 10V/m
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	NA
5. Test Procedure	O-RAN to be tested in accordance with the test procedure of relevant standards. Testing to be done at certified lab.
6. Test Limits	NA
7. Expected Results	Test certificate/reports from any certified lab should be submitted.

1. Test No	**GR_TSTP_1.2.6_A5**
2. Test Details	EMI/EMC Requirements: Immunity to fast transients (burst): Test Level 2:- IEC 61000- 4- 4 {2012); Performance Criteria-B, Clause 9 a) Immunity to fast transients (burst): Test Level 2: b) 0. 5 kV for signal / control / data / telecom lines
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	NA
5. Test Procedure	O-RAN to be tested in accordance with the test procedure of relevant standards. Testing to be done at certified lab.
6. Test Limits	NA
7. Expected Results	Test certificate/reports from any certified lab should be submitted.

1. Test No	GR_TSTP_1.2.6_A6
2. Test Details	EMI/EMC Requirements: Immunity to surges: AC/DC ports: - IEC 61000-4-5 (2014) Performance Criteria-B, Clause 9 a)2 kV peak open circuit voltage for line to ground b)1kV peak open circuit voltage for line to line
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	NA
5. Test Procedure	O-RAN to be tested in accordance with the test procedure of relevant standards. Testing to be done at certified lab.
6. Test Limits	NA
7. Expected Results	Test certificate/reports from any certified lab should be submitted.

1. Test No	GR_TSTP_1.2.6_A7
2. Test Details	EMI/EMC Requirements: Immunity to surges: Telecom ports: IEC 61000-4-5 (2014) Performance Criteria-C, Clause 9 a) 2 kV peak open circuit voltage for line to ground coupling. b) 2 kV peak open circuit voltage for line-to-line coupling
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	NA
5. Test Procedure	O-RAN to be tested in accordance with the test procedure of relevant standards. Testing to be done at certified lab.
6. Test Limits	NA
7. Expected Results	Test certificate/reports from any certified lab should be submitted.

1. Test No	**GR_TSTP_1.2.6_A8**
2. Test Details	EMI/EMC Requirements: Immunity to conducted disturbance induced by Radio frequency fields:- IEC 61000-4-6 (2013) Performance Criteria-A, Clause 9 Under the test level 2 {3 V r.m.s.} in the frequency range 150 kHz-80 MHz for AC / DC lines and Signal /Control/telecom lines.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	NA
5. Test Procedure	O-RAN to be tested in accordance with the test procedure of relevant standards. Testing to be done at certified lab.
6. Test Limits	NA
7. Expected Results	Test certificate/reports from any certified lab should be submitted.

1. Test No	**GR_TSTP_1.2.6_A9**
2. Test Details	EMI/EMC Requirements: Immunity to voltage dips & short interruptions (applicable to only ac mains power input ports, if any): Limits: a) a voltage dip corresponding to a reduction of the supply voltage of 30% for 500ms (i.e., 70% supply voltage for 500ms) b) a voltage dip corresponding to a reduction of the supply voltage of 60% for 200ms; (i.e.,40% supply voltage for 200ms) c) a voltage interruption corresponding to a reduction of supply voltage of > 95% for 5s d) a voltage interruption corresponding to a reduction of supply voltage of >95% for 10ms. IEC 61000-4-11 (2004): a) Performance Criteria B for Reduction of Supply 30% for 500ms or Dip to reduction of 60% for 100ms b) Performance Criteria C for Reduction of 60% for 200ms c) Performance criteria C for Voltage Interruption>95% for 5 s (Note: In case of Battery back-up performance criteria A is applicable). d) Performance Criteria B for Voltage Interruption >95% duration :10ms (Note: In case of Battery back-up Performance Criteria A is applicable for above conditions.)
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	
5. Test Procedure	O-RAN to be tested in accordance with the test procedure of relevant standards. Testing to be done at certified lab.
6. Test Limits	NA

7. Expected Results	Test certificate/reports from any certified lab should be submitted.

1. Test No	GR_TSTP_1.2.6_A10
2. Test Details	EMI/EMC Requirements: Immunity to voltage dips & short interruptions (applicable to only DC power input ports, if any): a) Voltage Interruption with 0% of supply for 10ms. b) Voltage Interruption with 0% of supply for 30ms, 100ms, 300ms and 1000ms. c) Voltage dip corresponding to 40% & 70% of supply for 10ms, 30 ms. d) Voltage dip corresponding to 40% & 70% of supply for 100ms, 300 ms and 1000 ms. e) Voltage variations corresponding to 80% and 120%of supply for 100 ms to 10s as per Table 1c of IEC 61000-4-29. IEC 61000-4-29(2000) f) Applicable Performance Criteria shall be B. g) Applicable Performance Criteria shall be C. h) Applicable Performance Criteria shall be B. i) Applicable Performance Criteria shall be C. j) Applicable Performance Criteria shall be B.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	NA
5. Test Procedure	O-RAN to be tested in accordance with the test procedure of relevant standards. Testing to be done at certified lab.
6. Test Limits	NA
7. Expected Results	Test certificate/reports from any certified lab should be submitted.

1. Test No	GR_TSTP_1.2.7
2. Test Details	Safety Requirements The equipment shall conform to relevant safety requirements as per (IS/IEC 62368- 1:2018 or Latest & IS 10437: 2019/IEC 60215: 2016) as prescribed under Table no. 1 of the TEC document 'SAFETY REQUIREMENTS OF TELECOMMUNICATION EQUIPMENT": TEC10009: 2024. These requirements are applicable for purposely built hardware or a physical entity only.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	NA
5. Test Procedure	O-RAN to be tested in accordance with the test procedure of relevant standards. Testing to be done at certified lab.
6. Test Limits	NA
7. Expected Results	Test certificate/reports from any certified lab should be submitted.

1. Test No	GR_TSTP_1.2.8.1
2. Test Details	To verify that the System supervision a. Provision shall be made for continuous testing of the system to allow both system qualities check and fault indication as a fault arises. In case a fault is detected requiring reloading of the program, this shall be carried out automatically. In case of manual re-loading, it shall be possible to stop and start at any particular point in the program.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 7
5. Test Procedure	1. Simulate a process crash at O-RAN by using appropriate command. Check that the O-RAN is able to recover by itself. 2. In case where the auto recovery cannot be done, check that O-RAN gives a provision to stop at a point while boot up, make the required changes and then again start the bootup process. This is a case of provision of recovery by manual intervention if the system cannot recover from a fault by itself
6. Test Limits	NA
7. Expected Results	System shall be able to recover from faults automatically. If unable to do so, manual loading is supported.

1. Test No	GR_TSTP_1.2.8.2
2. Test Details	To verify that Relative UE Speed The targeted relative speed between the O-RU and the mobile stations shall be chosen from the following categories: (Applicable for Low/Mid band) a. Stationary (0 km/h) b. Pedestrian (up to 10 km/h) c. Vehicular: 10 km/h to 120 km/h d. High speed vehicular: 120 km/h to 500 km/h For High band, the targeted relative speed between the O-RAN and the mobile station shall be up to 100 km/h.
3. Test Instruments Required	O-CU, O-DU, O-RU, UE (or UE simulator), 5G Core (or core simulator), Network Packet Analyzer, Traffic generator (e.g., iPerf), management PC, switch/router and network cables.
4. Test Setup	TEST SETUP 1
5. Test Procedure	1. Attach UE 2. Run Iperf Application to Download data 3. Verify that UE is able to receive data while Stationary. 4. Verify that UE is able to receive data at pedestrian speed . 5. Verify that UE is able to receive data while moving at vehicular speeds.
6. Test Limits	NA
7. Expected Results	gNodeB supports uplink and downlink traffic at differential UE speeds.

1. Test No	GR_TSTP_1.2.9.1
2. Test Details	To verify that Availability a. The facility shall be available for introduction of centralized Operation and Maintenance Control (OMC). The maintenance spares supplies shall take in to account the MTBF and MTTR.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 7
5. Test Procedure	1. Connect multiple eNodeBs with the EMS. 2. Check that operations and maintenance tasks can be performed for each eNodeB via OMC. 3. Operations carried out on one eNodeB are mutually exclusive 4. Check that alarms for different eNodeBs are reflected at the OMC. They are identifiable for each eNodeB by a unique field. 5. Also verify that the eNodeBs are accessible by OMC client and operations and maintenance activities can be done remotely. Spare calculations factoring MTBF and MTTR values shall be provided by supplier. No test required.
6. Test Limits	NA
7. Expected Results	System shall provide facility for introduction of centralized maintenance control (OMC). Spares calculation is provided.

1. Test No	GR_TSTP_1.2.9.2
2. Test Details	To verify that Diagnostic Capability a. The diagnostic capability of the system shall be such as to minimize the human efforts required. The diagnostic programs which are normally resident in the on-line program shall be indicated. Details of the off-line diagnostic programs shall be given. The procedure for invoking such programs shall be described. The procedure for consulting fault dictionary for diagnostic programs shall be made available. The system shall provide facility for automatic restart under severe fault conditions. Where automatic restart fails to restore system sanity, facility shall be provided for manual restart of the system.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 7
5. Test Procedure	Execute the diagnostic test at O-RAN. Verify that test execution is successful and a valid report is generated
6. Test Limits	NA
7. Expected Results	Diagnostic report generated successfully.

1. Test No	GR_TSTP_1.2.9.3
2. Test Details	Environmental Test Conditions: a. Indoor entity (such as CU, DU, RIC, SMO): Category A SD: QM-333 b. Outdoor entity (such as O-RU): Category D SD: QM-333 and IP65 c. Antenna & Feeders: Category E as per SD: QM-333
3. Test Instruments Required	ORAN gNodeB, 5GC/5GC Emulator, Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	NA
5. Test Procedure	1. Check indoor O-RAN as per QM-333 standard Category A. 2. Check outdoor O-RAN, BBU & RRH as per QM-333 standard category D and for IP65. 3. Check Antenna & Feeders as per QM-333 standard category E. 4. Test can be performed in Factory or in any certified Lab.
6. Test Limits	NA
7. Expected Results	Test certificate/report to be attached with compliance to the respective requirements.

1. Test No	GR_TSTP_1.2.10.2.2
2. Test Details	To verify that Design precautions shall be taken to minimize the possibility of equipment damage arising from the insertion of an electronic package into the wrong connector or the removal of any package from any connector
3. Test Instruments Required	NA
4. Test Setup	NA
5. Test Procedure	This requirement is applicable to O-RAN implementations with field removable electronic packages/modules 1. Check from physical construction if there is any electronic package(s) which is to be inserted/removed on O-RAN during site installation. 2. On such electronic package(s): a. Check if there is a possibility of inserting it into any other connector of system. b. Check by removing the electronic package from the connector, if any impact to system functionality not dependent on that electronic package.
6. Test Limits	NA
7. Expected Results	No equipment damage shall arise due to insertion of an electronic package into wrong connector. No equipment damage shall arise due to removal of any package from any connector.

1. Test No	GR_TSTP_1.2.10.2.3
2. Test Details	The system hardware shall not pose any problem, due to changes in date and time caused by events such as changeover of leap year etc., in the normal functioning of the system.
3. Test Instruments Required	ORAN gNodeB, 5GC/5GC Emulator, RF cables and attenuators, PC, UE/UE simulator, Network Performance Measurement Tool (such as iPerf), Wireshark Network Protocol Analyser.
4. Test Setup	NA
5. Test Procedure	1. Change the date and time at ORAN gNodeB such that the year given is a leap year. 2. There should not be any impact on hardware on changing the date and time. 3. Perform UE attach. 4. Verify that the attach is successful.
6. Test Limits	NA
7. Expected Results	There should be no impact at ORAN gNodeB when the date is changed to a year which is a leap year.

1. Test No	**GR_TSTP_1.2.10.3.1**
2. Test Details	To verify that Provision shall be made to prevent the loss/alteration of memory contents due to power failures, improper operating procedures and the procedure for restoring the system to its normal state, etc
3. Test Instruments Required	ORAN gNodeB, 5GC/5GC Emulator, RF cables and attenuators, PC, UE/UE simulator, Network Performance Measurement Tool (such as iPerf), Wireshark Network Protocol Analyser.
4. Test Setup	TEST SETUP 7
5. Test Procedure	**Prevention of loss/alteration of contents:** The vendor to specify data/files that are present on persistent storage. 1. Bring O-RAN in operationally enabled state 2. Verify vendor specified data/files 3. Perform UE attach 4. Switch-off the power supply 5. Wait for 1 minute 6. Switch on the power supply 7. Bring O-RAN gNodeB in operationally enabled state 8. Verify that vendor specified data/files are intact 9. Perform UE attach **System restoration procedure after following improper operating procedure:** The vendor to specify procedure to restore the system 1. Delete some critical data/file or modify data (as per vendor specified procedure) that take O-RAN in inconsistent state. 2. Bring O-RAN gNodeB in operationally enabled state. The procedure shall fail. 3. Now follow vendor specified restoration procedure 4. Bring O-RAN gNodeB in operationally enabled state 5. Perform UE attach
6. Test Limits	NA

7. Expected Results	The specified file/data shall not be altered/lost at power-off. The O-RAN gNodeB shall come to normal state and attach shall be successful.

1. Test No	GR_TSTP_1.2.10.4.1
2. Test Details	To verify that system shall provide facilities for system test, control and alarm indication at OMC.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 7
5. Test Procedure	1. Trigger diagnostics tests for O-RAN. Verify the test reports at OMC/EMS/Command line. 2. Lock the O-RAN through OMC/EMS (i.e. Make the O-RAN out of service from OMC). Verify that the relevant alarms are raised. 3. Make some changes in the O-RAN configuration through OMC/EMS. 4. Unlock the O-RAN through OMC/EMS (i.e. Make the O-RAN in service from OMC/EMS). Verify that the relevant alarms are raised.
6. Test Limits	NA
7. Expected Results	The O-RAN shall successfully execute vendor specified diagnostic procedure. The O-RAN shall indicate alarms to OMC/EMC for vendor specified events. The O-RAN shall allow configuration of vendor specified parameters through OMC/EMS.

1. Test No	GR_TSTP_1.2.10.4.2
2. Test Details	To verify that Input / output terminals shall be capable of transmitting/ receiving characters of a subset of the ITU-T T.50 alphabet. The printing/display device shall print/display different graphic symbols for the digit zero and the capital letter O. The input/output terminal shall have the English Keyboard.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 7
5. Test Procedure	1. Input/output terminals will refer to the serial console for accessing the O-RAN as well as the OMC client for operations and management of O-RAN through EMS. 2. Check that the serial console/OMC client shall have the English keyboard.
6. Test Limits	NA
7. Expected Results	Input / output terminals shall be capable of transmitting/ receiving characters of a subset of the ITU-T No.5 alphabet

1. Test No	**GR_TSTP_1.2.10.4.3**
2. Test Details	To verify that Adequate number of man-machine interfaces shall be available.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 7
5. Test Procedure	Check that the system provides adequate number of MMI. It could be via a serial port / OMC client through which the operations and management can be carried out for O-RAN
6. Test Limits	NA
7. Expected Results	System shall support adequate number of man machine interfaces.

1. Test No	**GR_TSTP_1.2.10.4.4**
2. Test Details	To verify that If provision is made for monitoring from a remote terminal, it shall be ensured that the data links conform to the ITU-T Recommendation Q.513. Care shall be taken that the reliability of the data links towards remote terminal does not, in any way, affect the reliability of the O-RAN. Special provision shall also be made for storage of failure event even when the system is unable to transmit an output message.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 7
5. Test Procedure	1. Break the ethernet connectivity between the O-RAN and the OMC. 2. Check that the un-reachability status of the O-RAN is updated at the OMC. 3. Also check that the O-RAN operations are not affected. In case some alarms are raised in this time, they are stored at O-RAN.
6. Test Limits	NA
7. Expected Results	Reliability of the data links towards remote terminals shall not impact the reliability of the O-RAN
1. Test No	**GR_TSTP_1.2.10.4.5**
2. Test Details	To verify that a suitable alarm and display system at OMC shall be provided for a continuous indication of the system status.
3. Test Instruments Required	Power supply, Spectrum analyzer, PC, LAN cable, Console cable, RF cables, BNC cables, RF Attenuator, 50Ω Termination, gNB/DU Emulator / RAN Tester, Reference clock generator.
4. Test Setup	TEST SETUP 7

5. Test Procedure	1. This is a generic clause. Verify that the OMC gives you a provision to check the alarms as and when they are raised 2. It should basically provide you with the complete view of the system status. The alarm view should be clear enough to get a clear picture of the system status.
6. Test Limits	NA
7. Expected Results	Alarm and display system is present at OMC.

1. Test No	GR_TSTP_1.2.10.5.7
2. Test Details	To verify that the requirement at the external interface against induced voltages and currents due to lightning, high power system, etc. shall be indicated.
3. Test Instruments Required	NA
4. Test Setup	NA
5. Test Procedure	No test required. Supplier to indicate (list) the external interfaces which will need external/additional protection mechanism, when induced voltages and currents (due to lightning, high power system, etc) exceed limits applied in TEC Standard No. TEC11016:2016
6. Test Limits	NA
7. Expected Results	List of external interfaces is provided by supplier.

1. Test No	GR_TSTP_1.2.10.5.8
2. Test Details	To verify that the system shall provide for human isolation and protection from accidental high voltage power contact.
3. Test Instruments Required	NA
4. Test Setup	NA
5. Test Procedure	No test required. Compliance shall be achieved based on the test report against TEC document 'SAFETY REQUIREMENTS OF TELECOMMUNICATION EQUIPMENT": TEC10009: 2024
6. Test Limits	NA
7. Expected Results	System complies with the safety and protection requirements.

1. Test No	GR_TSTP_1.2.10.9.1
2. Test Details	To verify that the O-RAN shall provide the protection against DOS attack. The vendor shall describe how to protect against DOS attack in their system.
3. Test Instruments Required	O-RU, O-DU, O-CU, 5G Core Network, UE or UE Simulator, Protocol Analyzer , Managed Switch/Router, RF Cables.
4. Test Setup	Test Setup 01
5. Test Procedure	1. Bring up the gNodeB in Operational state 2. Simulate the DOS attack and gNodeB should be able to handle the same 3. verify from logs that gNodeB is able to protect against DOS attack
6. Test Limits	NA
7. Expected Results	The O-RAN system should be able to detect the DOS attack and handle it.

1. Test No	GR_TSTP_1.2.10.9.2_A
2. Test Details	To verify that the different O-RAN components such as O-RU, O-CU, O-DU, RIC, SMO etc. shall comply Management Protocols mutual authentication requirements mentioned in the applicable Indian Telecommunication Security Assurance Requirements (ITSAR) as and when notified by National Centre for communication Security (NCCS).
3. Test Instruments Required	O-RU, O-DU, O-CU, 5G Core Network, UE or UE Simulator, Protocol Analyzer , Managed Switch/Router, RF Cables.
4. Test Setup	Test Setup 01
5. Test Procedure	1. Install SSH on all the servers of O-RAN Components 2. Verify the Authentication mechanisms have been configured on servers 3. Trigger the communication between servers having legitimate authentication credential. 4. Trigger the communication between servers which do not have a legitimate authentication credential.
6. Test Limits	NA
7. Expected Results	Mutual authentication is successful for the legitimate servers and and communication between them is established. Mutual authentication is failed for the server which does not have legitimate credentials.

J. Summary of Test Results:

GR/IR No.__________ TSTP No.__

Equipment name & Model No.____________________

Clause No.	Compliance (Complied /Not Complied / Submitted/Not Submitted / Not Applicable)	Remarks / Test Report Annexure No.

[Add as per requirement]

Date:

Place:

Signature & Name of TEC testing Officer /

*Signature of Applicant / Authorized Signatory

* Section J as given above is also to be submitted by the Applicant/ Authorised signatoryas part of in-house test results along with Form-A. The Authorised signatory shall be the same as the one for Form 'A'.