वर्गीय आवश्यकताओं के लिए मानक

टी.ई.सी. २१०६०:२०२२

STANDARD FOR GENERIC REQUIREMENTS

TEC 21060:2022

जीनोडबी

gNodeB

ISO 9001:2015

दूरसंचार अभियांत्रिकी केंद्र

खुर्शीद लाल भवन, जनपथ, नई दिल्ली-110001, भारत

TELECOMMUNICATION ENGINEERING CENTRE

KHURSHID LAL BHAWAN, JANPATH, NEW DELHI–110001, INDIA

www.tec.gov.in

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FOREWORD

Telecommunication Engineering Centre (TEC) is the technical arm of Department of Telecommunications (DOT), Government of India. Its activities include:

- Framing of TEC Standards for Generic Requirements for a Product/Equipment, Standards for Interface Requirements for a Product/Equipment, Standards for Service Requirements & Standard document of TEC for Telecom Products and Services
- Formulation of Essential Requirements (ERs) under Mandatory Testing and Certification of Telecom Equipment (MTCTE)
- Field evaluation of Telecom Products and Systems
- Designation of Conformity Assessment Bodies (CABs)/Testing facilities
- Testing & Certification of Telecom products
- Adoption of Standards
- Support to DoT on technical/technology issues

For the purpose of testing, four Regional Telecom Engineering Centre's (RTECs) have been established which are located at New Delhi, Bangalore, Mumbai, and Kolkata.

ABSTRACT

This document contains the Standard for Generic Requirements (GR) of gNB for New Radio (NR) based mobile communication system for deployment in the Indian mobile communicationnetwork.

The document specifies Technical Requirements, General Requirements, Features and Functionality of the gNB for NR based mobile communication system.

This GR is applicable for both FDD and TDD modes of operation. For TDD both Mid Band and mmW is considered.

HISTORY SHEET

Sl. No.	Standard / document *No.*	*Title*	*Remarks*
1.	21060:2022	gNodeB	New GR
2.			

CONTENTS

REFERENCES

No.	TEC Standard No./3GPP/ Intl Standard/Government Order	Title/Document Name
1.	3GPP TR 21.905	“Vocabulary for 3GPP Specifications”
2.	3GPP TS 22.278	"Service requirements for the Evolved Packet System (EPS)"
3.	3GPP TS 38.306	"NR; User Equipment (UE) radio access capabilities "
4.	TEC 25588:2022 (3GPP TS 38.101)	"NR; User Equipment (UE) radio transmission and reception
5.	TEC 25591:2022 (3GPP TS 38.104)	NR; Base Station (BS) radio transmission and reception
6.	3GPP TS 38.141-1	NR; Base Station Conformance Testing Part 1: Conducted Conformance Testing
7.	3GPP TS 38.141-2	NR; Base Station Conformance Testing Part 2: Radiated Conformance Testing
8.	TEC 25608:2022 (3GPP TS 38.321)	NR; Medium Access Control (MAC) protocol specification
9.	TEC 25609:2022 (3GPP TS 38.322)	NR; Radio Link Control (RLC) protocol specification
10.	TEC 25610:2022 (3GPP TS 38.323)	NR; Packet Data Convergence Protocol (PDCP) specification
11.	TEC 25611:2022 (3GPP TS 38.331)	NR; Radio Resource Control (RRC) protocol specification
12.	TEC 25595:2022 (3GPP TS 38.201)	NR; physical layer; General description
13.	TEC 25597:2022 (3GPP TS 38.211)	NR; Physical Channels and modulation

14.	TEC 25598:2022 (3GPP TS 38.212)	NR; Multiplexing and Channel coding
15.	TEC 25599:2022 (3GPP TS 38.213)	NR; Physical Layer procedures for control
16.	TEC 25600:2022 (3GPP TS 38.214)	NR; Physical Layer procedures for data
17.	TEC 25601:2022 (3GPP TS 38.215)	NR; Physical Layer Measurements
18.	TEC 25602: 2022 (3GPP TS 38.300)	NR; NR and NG-RAN Overall Description; Stage 2".
19.	TEC 25615:2022 (3GPP TS 38.411)	NG-RAN; NG layer 1
20.	TEC 25631:2022 (3GPP TS 38.470)	NG-RAN; F1 general aspects and principles
21.	TEC 25632:2022 (3GPP TS 38.471)	NG-RAN; F1 layer 1
22.	TEC 25633:2022 (3GPP TS 38.472)	NG-RAN; F1 signalling transport
23.	TEC 25634:2022 (3GPP TS 38.473)	NG-RAN; F1 Application Protocol (F1AP)
24.	TEC 25635:2022 (3GPP TS 38.474)	NG-RAN; F1 data transport
25.	3GPP TS 38.475	NG-RAN; F1 interface user plane protocol
26.	TEC 25617:2022 (3GPP TS 38.413)	NG-RAN; NG Application Protocol (NGAP)
27.	TEC 25550:2022 (3GPP TS 36.420)	“X2 General aspects and principles”
28.	TEC 25623:2022 (3GPP TS 38.423)	NG-RAN; Xn Application protocol (XnAP)

29.	3GPP TS 38.171	NR; Requirements for support of Assisted Global Navigation Satellite System (A-GNSS)
30.	TEC 25604:2022 (3GPP TS 38.305)	NG Radio Access Network (NG-RAN); Stage 2 functional specification of User Equipment (UE) positioning in NG-RAN
31.	TEC 25626:2022 (3GPP TS 38.455)	NG-RAN; NR Positioning Protocol A (NRPPa)
32.	3GPP TS 33.117	Catalogue of general security assurance requirements
33.	3GPP TS 33.401	3GPP System Architecture Evolution (SAE); Security architecture
34.	TEC 25603:2022 (3GPP TS 38.304)	NR; User Equipment (UE) procedures in idle mode and in RRC Inactive state
35.	TEC 25594:2022 (3GPP TS 38.133)	NR; Requirements for support of radio resource management
36.	ISO-9001:2008	“Quality Management System – Requirement”.
37.	IS-41D & E	“Cellular Radio Telecommunications Intersystem Operations”
38.	CISPR 22 (2003)	“Limits and methods of measurement of radio disturbance characteristics of Information Technology Equipment”.
39.	EN55022	“Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment”
40.	IEC 60479-1 (1984)	“Effects of current on human beings: Part 1”
41.	IEC 60215 (1987)	“Safety requirements of radio transmitting equipment (for Radio equipment only)”
42.	IEC 62368	“Information technology equipment – Safety”
43.	IS 13252 part 1:2010	“Information Technology Equipment – Safety- Part 1: General Requirements”

44.	IEC 60950-1 {2005}	"Information Technology Equipment –Safety- Part 1: General Requirements"
45.	CISPR 22 (2008) OR CISPR 32 Class-A	Conducted and Radiated Emission
46.	IEC-61000	Electromagnetic Compatibility
47.	TEC 11016:2016	"Electromagnetic Compatibility Standard for Telecommunication Equipment"
48.	ITU-R SM.329	Unwanted emissions in the spurious domain
49.	Gazette Notification No. 18-10/2017-IP dated 29th August 2018	Public Procurement (Preference to Make in India) Order 2017 – Notification of Telecom Products, Services or Works - Regarding

Chapter 1

1.1 Scope

This document contains the Standard for Generic Requirements (GR) for New Radio (NR) based gNB for deployment in the Indian mobile communication network. The NG-RAN (Next Generation Radio Access Network) consists of gNBs, providing the NR (air interface) user plane (PDCP/RLC/MAC/PHY) and control plane (RRC) protocol terminations towards the UE.

The document specifies Technical Requirements, General Requirements, Features and Functionality of the gNB System including NSA (Non-Stand Alone) and SA (Stand Alone) deployments.

This GR is applicable for either FDD or TDD or both.

Chapter 2

2 gNodeB

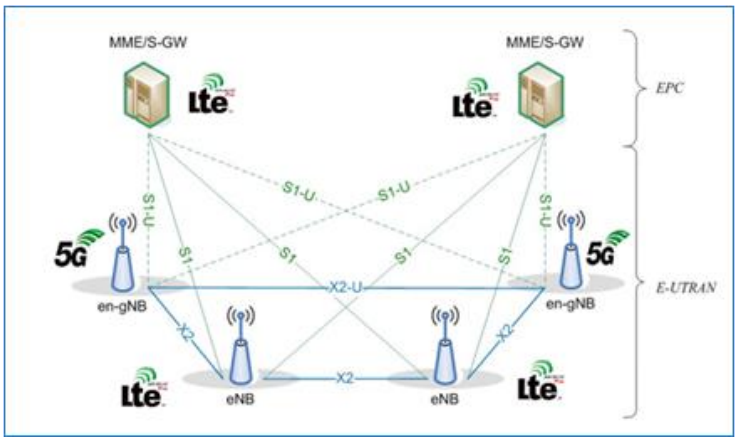
2.1 Product description

2.1.1 gNodeB (or gNB in short) is the NG-RAN node in the 5G network architecture that is responsible for radio transmission to and reception from UEs in one or more cells. The NG-RAN consists of gNB (serving NR devices using the NR user-plane and control-plane protocols) and ng-eNodeB (serving LTE devices using the LTE user-plane and control-plane protocols), providing the E-UTRA user plane (PDCP/RLC/MAC/PHY) and control plane (RRC) protocol terminations towards the UE. The gNB is connected to the 5G Core network by means of NG interface in standalone mode. The gNBs are also connected by means of the S1 interface to the EPC (Evolved Packet Core) in non-standalone mode. The gNBs may be interconnected with each other by means of the Xn interface in standalone mode and X2 interface in case of non-standalone mode..

2.1.2 As mentioned above, the NG-RAN can connect not only to a 5G Core Network but also to the EPC (LTE Core Network). As such, the following deployment options have been considered:

a. "Non-Stand Alone" (NSA)

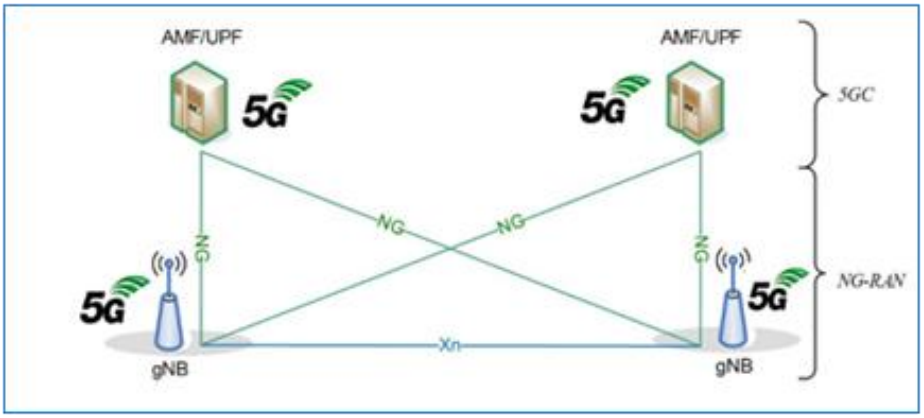
Non-Standalone architecture, where the 5G Radio Access Network (RAN) and its New Radio (NR) interface is used in conjunction with the existing LTE and EPC infrastructure Core Network (respectively 4G Radio and 4G Core). The NSA is also known as "E-UTRA-NR Dual Connectivity (EN-DC)".



The NSA offers dual connectivity, via both the 4G RAN (E-UTRA) and the 5G RAN (NR). It is thus also called "EN-DC", for "E-UTRA and NR Dual Connectivity". In EN-DC, the 4G's eNB is the Master Node (MN) while the 5G's en-gNB is the Secondary Node (SN).

b. "Stand-Alone" (SA)

Standalone architecture, where the NR is connected to the 5G Core Network. The NR base station (logical node "gNB") connects with each other via the Xn interface, and the Access Network (called the "NG-RAN for SA architecture") connects to the 5GC network using the NG interface.



2.1.3 The gNB (or en-gNB) is responsible for all radio-related functions to and from UEs in one or several cells, for example radio resource management, admission control, connection establishment, routing of user-plane data to the UPF and control-plane

information to the AMF, and quality-of-service (QoS) flow management. It is important to note that a gNB is a logical node and not a physical implementation.

(Note: One common implementation of a gNB is a three-sector site, where a base station is handling transmissions in three cells, although other implementations can be found as well, such as one baseband processing unit (Consisting of central unit/CU, distributed unit/DU or both) to which several remote radio units (Remote Radio Head/RRH) or Active Array Unit/AAU) are connected.)

2.1.4 The gNB design can be based on a distributed architecture or integrated architecture. This GR defines gNB functionality independent of implementation architecture.

i) Integrated Architecture: Integrated architecture consists of single unit implementing all necessary functions of baseband subsystem and radio subsystem.

ii) Distributed Architecture: The distributed architecture comprised of baseband unit (BBU) collocated with gNB Layer 2, Layer 3 functionality or split into DU and CU functionality and Remote radio head (RRH) connected via a CPRI/eCPRI or OBSAI interface or another interface. This also covers centralized/cloud RAN (C-RAN)/ vRAN/ O-RAN based architecture.

2.2 Interfaces

2.2.1 Uu interface: The interface between the gNB and the device is known as the Uu interface. The scenario of a device connected to two cells is known as dual connectivity and is an important concept for NSA. In Option 3 NSA, the NR based secondary cell only handles user plane traffic and the control and user plane signalling is done through the LTE eNodeB.

2.2.2 Xn interface: Connecting gNBs to each other, is mainly used to support dual connectivity and lossless active-state mobility between cells by means of packet forwarding. It may also be used for multi-cell Radio Resource Management (RRM) functions.

2.2.3 F1 interface (As per tenderer requirement): There is also a standardized way to split the gNB into two parts, a central unit (gNB-CU) and one or more distributed units (gNB-DU) using the F1 interface. In case of a split gNB, the RRC, PDCP, and SDAP protocols, described in more detail later, reside in the gNB-CU and the remaining protocol entities (RLC, MAC, PHY) in the gNB-DU.

2.3 gNB classes

3GPP Specification (TS 38.104) defines the following gNB classes

1. Wide Area Base Station
2. Medium Range Base Station
3. Local Area Base Station

Each class of gNB has different requirements in terms of output power, transmitter characteristics and receiver performance.

BS Class	Derivation from	Pout	Type	No of RRC connected users
Wide Area BS	Macro cell scenario	>38dBm(BS type 1-C, 1-H) >47dBm (BS type 1-O)	Type 1: Macro	For FR1: >=600 UE per cell (For FR2 >=200 UE per cell)
Medium Range BS	Micro cell scenario	≤38 dBm (BS type 1-C, 1-H) <47dBm (BS type 1-O)	Type 2: Micro	>=32 UE per cell
Local Area BS	Pico cell scenario	≤24 dBm (BS type 1-C, 1-H) <33dBm (BS type 1-O)	Type 3: Pico	>=8 UE per cell

2.4 F1 interface - Split between DU and CU

(As per tenderer requirement)

The interface is between gNB-CU and gNB-DU. It is also separated into F1-C and F1-U based on control plane and user plane functionalities.

2.4.1 Functions:

-F1 interface defines inter-connection of a gNB-CU and a gNB-DU supplied by different manufacturers.

-It supports control plane and user plane separation.

-It separates Radio Network Layer and Transport Network Layer.

-F1 interface enables exchange of UE associated information and non-UE associated information.

Chapter 3

3 Functional Requirements:

These Software functionalities requirements are applicable and cover for Low-band (NSA/SA), Mid-band (NSA/SA) and High-band (NSA/SA), until explicitly highlighted.

3.1 Radio Resource Control/ Radio Resource Management (RRC/RRM) Functionality

i) Cell control and MME/AMF support: ng-eNB/gNB owns and controls the radio resources of its own cell or cells. Cell resources as requested by and granted to MME/AMFs shall be provided in an ordered fashion.

ii) Measurements and reporting: The gNB shall support Event-triggered measurement reporting.

iii) The gNB shall support System Information Broadcast (SIB).

iv) RRC messages shall be transmitted to the device using signalling radio bearers (SRBs) including SRB0, SRB1and SRB2. additionally support SRB3 when UE in (NG)EN-DC or NR-DC.

v) gNB shall support RRC_IDLE, RRC_CONNECTED, and RRC_INACTIVE states.

3.2 Service Data Adaptation Protocol (SDAP) for SA

i) QoS Bearers: SDAP shall be responsible for mapping QoS bearers to radio bearers according to their quality-of-service requirements.

ii) If the gNB is connected to the EPC (as in NSA), the SDAP is not required.

3.3 Packet Data Convergence Protocol (PDCP)

i) Control and User Plane security: gNB shall support integrity protection and ciphering of RRC signalling.

ii) RoHC shall be supported.

iii) PDCP shall also handle retransmissions, in-sequence delivery, and duplicate removal in the case of handover.

iv) For 5G NSA deployment: The gNB shall store one-to-one mapping between data radio bearers and S1 bearers to create the binding between a data radio bearer and an S1 bearer in both the uplink and downlink to enable Quality of Service (QoS) enforcement.

v) The gNB shall perform data recovery.

vi) For dual connectivity with split bearers, PDCP can provide routing and duplication. Duplication and transmission from different cells can be used to provide diversity for services requiring very high reliability. There is one PDCP entity per radio bearer configured for a device. (As per tenderer requirement)

3.4 Radio Link Control (RLC)

i) 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.

ii) Segmentation/Concatenation: RLC layer shall support segmentation and concatenation to adapt the payload to the transport block size.

3.5 Medium Access Control (MAC)

i) MAC shall handle multiplexing of logical channels, hybrid-ARQ retransmissions, and dynamic resource allocation (scheduling) and scheduling-related functions.

ii) The MAC shall provide services to the RLC in the form of logical channels.

iii) From the physical layer, the MAC layer shall use the services in the form of transport channels. The gNB shall support link adaptation and power control.

iv) The gNB shall support Contention based Random Access (RA) procedure.

3.6 Physical layer

i) gNB shall support OFDM modulation in both DL and UL. When DFT-precoding is used, uplink transmissions are restricted to a single layer per UE only while uplink transmissions with multiple layers per UE are possible with OFDM.

ii) gNB shall support DFT-s-OFDM with pi/2 BPSK filtering (LMLC) in Uplink. (As per tenderer requirement)

iii) gNB shall support Synchronization Signal Block (SSB).

iv) The gNB shall support the following physical channel types:

   a. Physical Downlink Shared Channel (PDSCH) : Main physical channel used for unicast data transmission, but also for transmission of, for example, paging information, random-access response messages, and delivery of parts of the system information.

   b. Physical Broadcast Channel (PBCH): Carries system information, required by the device to access the network.

   c. Physical Downlink Control Channel (PDCCH): Used for downlink control information, mainly scheduling decisions, required for reception of PDSCH, and for scheduling grants enabling transmission on the PUSCH.

   d. Physical Uplink Shared Channel (PUSCH): the uplink counterpart to the PDSCH. There is at most one PUSCH per uplink component carrier per device.

   e. Physical Uplink Control Channel (PUCCH): Used by the device to send hybrid-ARQ acknowledgments, indicating to the gNB whether the downlink transport block(s) was successfully received or not, to send channel-state reports and for requesting resources to transmit uplink data upon.

   f. Physical Random-Access Channel (PRACH): Used for random access. The gNB shall support Contention based and Contention free Random Access (CBRA, CFRA) procedure.

v) The gNB shall support UL Power Allocation for data channels. The gNB shall support both the open-loop power control and the closed-loop power control of the UE. (As per tenderer requirement)

vi) The gNB shall be able to communicate timing advance value to UE.

vii) The gNB shall support DL Power Allocation for data channels.

viii) The gNB shall support DL Power setting for data channels.

ix) The gNB shall support DL Power setting for signalling and control channels.

x) The gNB shall support Normal cyclic prefix.

xi) The gNB shall support Uplink and downlink demodulation reference signal.

xii) The gNB shall support UL & DL Link Adaptation.

xiii) The gNB shall support Short Buffer Status Report (BSR) and Long BSR.

xiv) Support for Discontinuous Reception (DRX) to enable reasonable UE battery consumption.

xv) The gNB shall support at least one Static TDD Mode with single Bandwidth Part.

3.6.1 NR Physical Layers – Low Band(LB)(<1GHz)

i) The gNB shall support Cell Carrier Bandwidth of 5 MHz, 10 MHz, 15 MHz, 20 MHz on Low-Band.

ii) The gNB shall support 15 kHz subcarrier spacing on Low-Band.

iii) The gNB shall support Modulation schemes up to 256 QAM in downlink and uplink on Low-Band.

3.6.2 NR Physical Layers – Mid Band (MB)(1GHz- 6GHz)

i) The gNB shall support 15kHz, 30 kHz and/ or 60 kHz subcarrier spacing on Mid-Band.

ii) The gNB shall support Cell Carrier Bandwidth from a sub set of 5, 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100MHz on Mid-Band. (Subject to valid combinations of SCS , Cell Carrier Bandwidth and cyclic prefix as specified by 3GPP)

iii) The gNB shall support Modulation schemes up to 256 QAM in downlink and uplink on Mid-Band.

3.6.3 NR Physical Layers – High Band (HB)(24 GHz-52.5GHz)

i) The gNB shall support 60kHz and 120 kHz subcarrier spacing on High-Band.

ii) The gNB shall support Cell Carrier Bandwidth from a sub set of 50, 100, 200, 400MHz on High-Band. (Subject to valid combinations of SCS, Cell Carrier Bandwidth and cyclic prefix as specified by 3GPP)

iii) The gNB shall support Modulation schemes up to 64 QAM in downlink and uplink on High-Band.

3.7 Interfaces:

3.7.1 Interface between RAN and Device/ UE

i) gNB shall support Uu interface towards Device/UE.

3.7.2 Interface between RAN and Core

i) NR Standalone Deployment: The gNB is connected to the 5G Core Network (5GC) through the NG interface.

ii) NR Non-Standalone (EN-DC) Deployment: The gNB is connected to the EPC through the S1 interface.

3.7.3 Interface between RAN and other RAN

i) NR Standalone Deployment: The interconnection of gNBs is managed over the Xn interface.

ii) NR Non-Standalone (EN-DC) Deployment: The interconnection of gNBs with eNodeBs is managed over the X2 interface.

3.8 Synchronization

i) The gNB shall support Frequency Synchronization.

ii) The gNB shall support Time and Phase Synchronization.

iii) The gNB shall support at least one of following synchronization option

a. GNSS (GPS or NAVIC) (to be specified by tenderer)

b. IEEE 1588 V2

c. Sync E

iv) The gNB shall support at least 48 hr hold over mode in case of frequency synchronization loss and at least 1 hr hold over mode in case of phase synchronization loss.

3.9 MIMO requirements & Modulation Schemes

(The tenderer may specify specific sub-clauses as per their requirements)

i) The gNB shall support up to 4 DL MIMO layers in Low Band (as per tenderer requirement depending on deployment scenario)

ii) The gNB shall support Downlink Single-User MIMO in Mid Band. The minimum configuration of Downlink Single-User MIMO may be specified by the tenderer.

iii) The gNB shall support Downlink Multi-User MIMO in Mid Band to support minimum 8 layers;(applicable if tenderer requires 32T32R or higher)

iv) The gNB shall support Uplink Multi-User MIMO in Mid Band to support minimum 4-layer UL MU-MIMO for PUSCH transmission; (applicable if tenderer requires 32T32R or higher)

v) The gNB shall support DL modulation schemes: BPSK, QPSK, 16QAM, 64QAM and 256QAM

vi) The gNB shall support UL modulation schemes: π/2-BPSK (As per tenderer requirement), QPSK, 16QAM, 64QAM and 256QAM (Low/Mid band)

3.10 5G QoS Requirements

i) The gNB shall support Quality-of-Service Class Identifiers (QCIs) for NR-NSA mode (EN-DC mode).

ii) The gNB shall support 5QI (5G QoS Identifiers) for NR-Standalone mode as per 3GPP TS 23.501 Table 5.7.4-1.

iii) The gNB shall support multiple data radio bearers (DRBs).

iv) The gNB shall support dynamic addition and deletion of dedicated bearers.

v) The gNB shall support both UE initiated as well as Network Initiated dedicated bearer creation.

vi) The gNB scheduler shall support prioritization of traffic in downlink as per the QCI/5QI priority value.

3.11 Mobility control

i) Idle mode mobility (Re-selection):

a. The gNB shall support NR intra-frequency cell re-selection.

b. The gNB shall support NR inter-frequency cell re-selection.

c. The gNB shall support IRAT inter-frequency cell re-selection towards EUTRAN. (As per tenderer requirement in view of deployment)

ii) Connected mode mobility (Handover):

a. The gNB shall support Connected mode mobility within NR frequency (Intra-frequency Handover).

b. The gNB shall support Connected mode mobility within or between gNB (Inter-frequency Handover including same band and different band).

c. The gNB shall support Connected mode mobility towards E-UTRAN in the form of release with redirection towards E-UTRAN frequency (only applicable to SA). (As per tenderer requirement in view of deployment)

d. The gNB shall support interworking between FR1/FR2, including session continuity.

e. The gNB shall support PS Handover to LTE for SA mode (In NSA Mobility control is governed by anchor LTE cell). (As per tenderer requirement in view of deployment)

f. The gNB shall support inter technology handover i.e; FDD to TDD and vice versa.

g. The gNB shall support X2(NSA) or Xn(SA) handover.

h. The gNB shall support S1(NSA) or NG(SA) handover.

iii) The gNB shall support access class barring parameters

iv) The gNB shall support inter PLMN reselection

v) The gNB shall support “Connection re-establishment” procedure.

vi) The system shall support data forwarding at intra-LTE/NR handover, both over X2/ Xn and S1 interfaces based on NSA or SA.

3.12 Fallback Support

[For NSA mode, LTE anchor controls the voice call as normal LTE procedure]

(As per tenderer requirement in view of deployment)

i) The gNB shall support VoNR to VoLTE handover for Standalone mode.

ii) The gNB shall support EPS Fallback from NR to LTE for IMS Voice in Standalone mode.

iii) If the NR-Standalone RAN is not able to provide voice services, then initiated or received voice calls shall be supported by moving the UE from NR RAN to LTE RAN to provide a seamless voice service.

iv) The gNB shall support measurement-based release with redirection and measurement-based handover, to perform EPS fallback from NR to LTE for voice service in Standalone mode.

v) If EPS fallback is opted for voice services, the gNB shall be able to handle Emergency Calls during Fallback. The gNB shall offer the operator the possibility to

apply separate priorities for Fallback of emergency calls as compared to Fallback for ordinary voice calls in Standalone mode.

3.13 Voice over NR (VoNR)

(As per tenderer requirement in view of deployment)

i) The gNB shall support Voice over NR (VoNR) functionality for Standalone mode (.

ii) The gNB shall support Basic Voice over NR, which provides traffic functions and protocol procedures for establishing, maintaining, and releasing a voice call in NR Standalone mode.

iii) The gNB shall support Voice over NR calls, which allow the handling of voice traffic directly in NR RAN instead of EPS Fallback to LTE for Standalone mode.

iv) The gNB shall support intra frequency handover for voice services to be maintained in NR RAN for Standalone mode.

v) The gNB shall support IP header compression

3.14 Carrier Aggregation

(Optional – The tenderer may specify specific sub-clauses as per their requirements)

i) The System shall support LTE-NR Downlink Carrier Aggregation for EN-DC mode.

ii) The System shall support LTE-NR Uplink Carrier Aggregation for EN-DC mode.

iii) The gNB shall support NR DL Carrier Aggregation up to 2CC for Low-Band and Mid-Bands.

iv) The gNB shall support up to 8CC DL Carrier Aggregation for High Bands, as per tendering authority requirements

v) The gNB shall support Inter-Band CA between various standardized FDD bands (not applicable for TDD system)

vi) The gNB shall support Intra-Band contiguous and non-contiguous CA

vii) The gNB shall support CA between FDD and TDD

viii) The gNB shall support Carrier Aggregation combinations for 3CC

a. 1xFDD+2xTDD with FDD or TDD as PCell

b. 2xFDD+ 1xTDD with FDD or TDD as PCell

c. 3xFDD with FDD as PCell

ix) The gNB shall support Uplink Carrier Aggregation

x) The gNB shall support Dynamic selection of Secondary frequency when having multiple cell carriers for CA

xi) The gNB shall consider CA users during Load Balancing to avoid losing CA capabilities and to avoid congestion because of CA activation.

3.15 Dual Connectivity

(As per tenderer requirement in view of deployment)

i) The system shall support LTE-NR Dual Connectivity to enable support for EN-DC in the gNB

ii) The gNB shall support UE to be served simultaneously by multiple component carriers from 2 cell groups (Master eNodeB and Secondary gNB) scheduling resources independently for NR-NSA mode.

iii) Band combinations for end-to-end performance, standardization and ecosystem may be as per tenderer requirements.

iv) System shall support periodic NR search thereby providing the UE multiple chances to establish EN-DC connection.

v) EN-DC-Triggered Handover at incoming handover may be as per tenderer requirements.

vi) Carrier aggregation features available to achieve high capacity may be as per tenderer requirements.

vii) The LTE-NR Dual Connectivity system shall support addition, modification, and release of resources allocated in the Secondary Node for the EN-DC-capable UE.

3.16 Location Based Services

i) System shall support Location Services for NR Standalone mode.

ii) System shall support receiving a positioning request for a specific device from the AMF for NR Standalone mode.

3.17 Energy Efficiency & Power Savings

(Optional – The tenderer may specify specific sub-clauses as per their requirements)

i) gNB shall be power efficient and implement power saving functionality

ii) The gNB shall support Energy Metering to provide a standardized way to observe power consumption and energy consumption measurements on a node or parts of a node.

iii) The gNB shall support Micro Sleep Transmission, which reduces energy consumption by turning off certain radio hardware components when there is no traffic.

iv) The gNB shall support discontinuous transmission (DTX) on downlink to save energy during low traffic.

v) The gNB shall automatically enables and disables the main power amplifier (PA) in the radio-unit (as per tenderer requirements)
The PA is turned off in the following cases:

a. When no PDSCH traffic is scheduled on a subframe

b. During symbols that do not carry mandatory information

vi) The system shall support decrease of UE battery consumption by typical traffic patterns and reduces the risk of overheating.

vii) The system shall support long cycle Discontinuous Reception (C-DRX)

3.18 Self-Organizing Network

i) System shall provide support for Autointegration.

ii) System shall provide support for Automatic Neighbour Relations or provide suitable API support for Automatic Neighbour Relations.

iii) System shall provide suitable API support for minimization of drive test in NSA mode of operation. (Optional - As per tenderer requirement)

iv) System shall provide support for autoconfiguration.

3.19 NR Public Warning System

i) The gNB shall support Public Warning System (PWS).

ii) The gNB shall supports the ETWS and CMAS (also known as WEA) cell broadcast functions.

3.20 RAN Slicing

(Applicable for SA except point vi) which is applicable for NSA) / (Optional – The tenderer may specify specific sub-clauses as per their requirements)

i) The gNB shall support network slices in NR RAN.

ii) The gNB shall support slice-aware Quality of Service (QoS) mapping framework and support QoS differentiation within a slice.

iii) The gNB shall support Slice-aware NG-based handover.

iv) The gNB shall support S-NSSAI (Single Network Slice Selection Assistance Information) of neighbouring gNB (received by the Xn interface) in order to avoid unnecessarily initiating NG-based handovers.

v) The RAN Slicing Framework feature enables the mapping of PDU sessions to resource partitions based on PLMN and S-NSSAI.

vi) For NSA mode: The EN-DC RAN Slicing extends QoS differentiation and dynamically sharing spectral resources to be applicable to EN-DC traffic.

3.21 RAN Sharing

(Optional – The tenderer may specify specific sub-clauses as per their requirements)

i) The gNB shall support MORAN (Multi-Operator RAN) functionality for both NR NSA and NR SA modes, which allows two operators to share the same Radio unit with dedicated spectrum per operator.

ii) The gNB shall support MOCN (Multi-Operator Core Network) functionality, which allows shared NR RAN with Spectrum sharing for NR Cell among up to 12 operators for NR-SA mode.

iii) The gNB shall support MOCN (Multi-Operator Core Network) functionality, which allows shared NR RAN with Spectrum sharing for NR Cell among up to 6 operators for NR-NSA (EN-DC) mode.

3.22 Satellite based backhaul system support

(Optional – The tenderer may specify as per their requirements)

3.23 Operating Frequency & Channel bandwidth

i) Operating frequency and Channel bandwidth shall be as per the applicable National Frequency Allocation Plan.

ii) The Base Station shall be capable of operating in at least one of the frequency bands as per the applicable National Frequency Allocation Plan.

3.24 Transmitter Specification (Conducted)

S. No	Parameter Name	TEC Standard No (3GPP Clause No)
01	Base station output power	TEC 25591:2022 (3GPP TS 38.104 Clause 6.2)
02	RE Power control dynamic range	TEC 25591:2022 (3GPP TS 38.104 Clause 6.3.2)
03	Total Power dynamic range	TEC 25591:2022 (3GPP TS 38.104 Clause 6.3.3)
04	Transmitter OFF power	TEC 25591:2022 (3GPP TS 38.104 Clause 6.4)
05	Frequency Error	TEC 25591:2022 (3GPP TS 38.104 Clause 6.5.1)
06	Error Vector Magnitude	TEC 25591:2022 (3GPP TS 38.104 Clause 6.5.2)
07	Time alignment error	TEC 25591:2022 (3GPP TS 38.104 Clause 6.5.3)
08	Occupied Bandwidth	TEC 25591:2022 (3GPP TS 38.104 Clause 6.6.2)
09	Adjacent Channel Leakage Power Ratio (ACLR)	TEC 25591:2022 (3GPP TS 38.104 Clause 6.6.3)
10	Operating band unwanted emissions	TEC 25591:2022 (3GPP TS 38.104 Clause 6.6.4)
11	Transmitter spurious emissions	TEC 25591:2022 (3GPP TS 38.104 Clause 6.6.5)
12	Transmitter Intermodulation	TEC 25591:2022 (3GPP TS 38.104 Clause 6.7)

3.25 Transmitter Specification (Radiated)

S No	Parameter	TEC Standard No (3GPP Clause No)
01	OTA Base Station Output Power	TEC 25591:2022 (3GPP TS 38.104 Clause 9.3)
02	OTA RE power control dynamic range	TEC 25591:2022 (3GPP TS 38.104 Clause 9.4.2)
03	OTA Total power dynamic range	TEC 25591:2022 (3GPP TS 38.104 Clause 9.4.3)
04	OTA Transmitter OFF Power	TEC 25591:2022 (3GPP TS 38.104 Clause 9.5)
05	OTA Frequency Error	TEC 25591:2022 (3GPP TS 38.104 Clause 9.6.1)
06	Error Vector Magnitude	TEC 25591:2022 (3GPP TS 38.104 Clause 9.6.2)
07	OTA Time alignment Error	TEC 25591:2022 (3GPP TS 38.104 Clause 9.6.3)
08	OTA Occupied Bandwidth	TEC 25591:2022 (3GPP TS 38.104 Clause 9.7.2)
09	OTA Adjacent Channel Leakage Power Ratio (ACLR)	TEC 25591:2022 (3GPP TS 38.104 Clause 9.7.3)
10	OTA Operating band unwanted emissions	TEC 25591:2022 (3GPP TS 38.104 Clause 9.7.4)
11	OTA Transmitter Spurious Emission	TEC 25591:2022 (3GPP TS 38.104 Clause 9.7.5)

3.26 Receiver Specification (Conducted)

S.No	Parameter	TEC Standard No (3GPP Clause No)
01	Receiver Spurious emissions	TEC 25591:2022 (3GPP TS 38.104 Clause 7.6)
02	Blocking	TEC 25591:2022 (3GPP TS 38.104 Clause 7.4.2 & 7.5)
03	Receiver intermodulation	TEC 25591:2022 (3GPP TS 38.104 Clause 7.7)
04	Adjacent Channel Selectivity (ACS) and narrow-band blocking	TEC 25591:2022 (3GPP TS 38.104 Clause 7.4.1)
05	Dynamic Range	TEC 25591:2022 (3GPP TS 38.104 Clause 7.3)
06	In-channel selectivity	TEC 25591:2022 (3GPP TS 38.104 Clause 7.8)
07	Reference sensitivity level	TEC 25591:2022 (3GPP TS 38.104 Clause 7.2)

3.27 Receiver Specification (Radiated)

S.No	Parameter Name	TEC Standard No (3GPP Clause No)
01	OTA Receiver Spurious Emissions	TEC 25591:2022 (3GPP TS 38.104 Clause 10.7)
02	OTA Blocking	TEC 25591:2022 (3GPP TS 10.5.2 & 10.6)
03	OTA Receiver Intermodulation	TEC 25591:2022 (3GPP TS 38.104 Clause 10.8)

04	OTA Adjacent channel selectivity	TEC 25591:2022 (3GPP TS 38.104 Clause 10.5.1)
05	OTA Dynamic Range	TEC 25591:2022 (3GPP TS 38.104 Clause 10.4)
06	OTA In- Channel Selectivity	TEC 25591:2022 (3GPP TS 38.104 Clause 10.9)
07	OTA Reference sensitivity level	TEC 25591:2022 (3GPP TS 38.104 Clause 10.3)

3.28 AAS

3.29 Power Requirements

i) gNB shall support DC power supply.

ii) gNB shall support nominal voltage of -48V DC supply voltage.

iii) Protection on Power Input Ports.

iv) Reverse Polarity at the DC input.

v) Over voltage protection at the DC input.

vi) DC input under voltage cut-off. Limit of under voltage shall be indicated by the vendor.

3.30 Operation & Maintenance

i) O&M Interface: The gNB shall include an O&M interface for debugging, troubleshooting and for providing fault, configuration and performance data to an O&M server (EMS). The O&M interface shall be Ethernet.

ii) gNB shall support at least one of the following interfaces towards EMS.

a. XML

b. TR.069
c. SNMP
d. CLI
e. NETCONF/YANG

iii) The gNB control software shall interact with various hardware / software entities of the gNB and provide the health status/Alarms of the entire system on the EMS.

iv) The gNB shall support remote Software/firmware updates via the EMS.

v) The gNB control software shall be responsible for logging and sending the log file on the network to a designated syslog server.

vi) The system shall maintain a system log and core dump logs.

vii) The gNB shall support both local and remote software upgrade.

viii) The gNB shall support alarms, events to OMC for visual indicators of status and fault.

ix) The gNB shall have reboot and shut-down capability.

x) The gNB shall support built-in power-on diagnostics and system monitoring capabilities to detect hardware failures.

xi) The gNB shall support Local Maintenance Ports for any debugging and troubleshooting.

xii) The system shall provide the count for the total number of UEs connected to the gNB.

xiii) The gNB shall be capable of providing the system configuration data to the Management Information Base (MIB) of the system (applicable with SNMP based management only).

xiv) The gNB shall have the ability to detect and report any hardware fault within the equipment.

xv) The system shall provide multiple level of recovery from software and hardware faults such that the impact on system operation shall be in accordance of the severity of the faults.

3.31 Transport features

i) IP Transport:

a. In case IPv4 is supported, the gNB hardware and software shall support IPv4 packet formats on all Ethernet transport interfaces in compliance with IETF RFC791.

b. In case IPv6 is supported, the gNB hardware shall support IPv6 packet formats on all Ethernet transport interfaces in compliance with IETF RFC2460.

ii) Ethernet Transport:

a. The gNB shall support the operator configurable use of VLANs compliant to IEEE802.1Q on any Ethernet interfaces.

b. The gNB shall be able to flexibly map traffic onto one or more VLANs. The default SA mapping shall be User (NG_u), Control (NG_C, Xn) and O&M (PTP, Sync, Management)

c. The transport QoS is managed at layer 3 with the DSCP field of IP packets and at layer 2 with the “PCP” bits in the Ethernet frames.

d. DSCP values that are supported in the gNodeB shall be indicated in the technical document supplied with the equipment.

e. Layer 2 QoS marking shall be supported when the backbone network supporting the gNodeB is a layer 2 switched network

f. DSCP-PCP mapping shall be configurable. Default DSCP-PCP to be provided.

3.32 Security IPsec in Transport

i) gNB shall support IPSec using Encapsulating Security Payload (ESP) tunnel mode for node terminated traffic, which is compliant to RFC 4301, RFC 4303 and RFC 7296.

ii) gNB shall support IPSec solution where IKEv2 must be used as control and key exchange protocol.

iii) gNB shall support IKE initiator mode to initiate set up of IKE session.

iv) gNB shall support Anti-replay protection.

v) gNB shall support at least one of ESP encryption algorithm with 128- & 256-bit key length based on ciphers AES_GCM_16, AES-CBC and AES_GMAC.

vi) gNB shall support DPD (Dead Peer Detection) mechanism at IPsec that can send out DPD messages in case no ESP traffic ongoing.

vii) IPSec solution shall support IPv4 and IPv6.

Chapter 4

4 3GPP Release 16 features

The features are given in the following clauses. The tenderer may specify which features from this section need to be supported based on eco-system development and use cases.

4.1 NR-based access to unlicensed spectrum

4.2 2-step RACH for NR

4.3 UE Power Saving in NR

i) Power Saving Techniques in CONNECTED state

ii) Cross slot scheduling

iii) Maximum MIMO Layer Adaptation with characterisation of the Power saving impact of DRX adaptation

iv) Power Saving Techniques in idle/inactive state

4.4 Integrated access and backhaul for NR

4.5 Dual Connectivity (EN-DC) with 3 bands DL and 3 bands UL

4.6 NR mobility enhancements

4.7 Inter-band Carrier Aggregation

(a) Rel-16 NR inter-band CA/Dual Connectivity for 2 bands DL with x bands UL (x=1, 2)

(b) Rel-16 NR inter-band Carrier Aggregation for 3 bands DL with 1 band UL

4.8 Add support of NR DL 256QAM for frequency range 2 (FR2)

4.9 SON and MDT support

SON (Self-Organising Networks) and MDT (Minimization of Drive Tests) support for NR

4.10 Introduction of NR FDD bands with variable duplex and corresponding framework

4.11 Cross Link Interference handling and Remote Interference Management for NR

4.12 RF requirements for NR frequency range 1 (FR1)

4.13 NR RF requirement enhancements for frequency range 2

4.14 NR RRM enhancement

4.15 RRM requirement for CSI-RS based L3 measurement in NR

4.16 Enhancement on MIMO for NR (NR_eMIMO)

4.17 Rel-16 pi/2 BPSK

Chapter 5

5 Operational, Reliability, Quality, EMI/ EMC, Safety Requirements

5.1 System Radio Operating Environments

5.1.1. 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.

b. 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.

5.1.2. Relative UE speed

The targeted relative speed between the gNB and the mobile stations may 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 gNB and the mobile station may be up to 100 km/h.

5.2 System and Network Management

5.2.1 Facility shall be available for introduction of centralized maintenance control (OMC).

5.2.2 The maintenance spares supplied shall take into account the MTBF and MTTR

5.3 Diagnostic capability

5.3.1 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.

5.3.2 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.

5.4 Environmental Test Conditions:

a. Indoor gNB / Indoor BBU : Category A SD: QM-333

b. Outdoor gNB BBU & RRH : Category D SD: QM-333 and IP65

c. Antenna & Feeders : Category E as per SD: QM-333

5.5 Qualitative Requirements (QR)

5.5.1 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.

5.5.2 For a distributed gNB, the failure of any component/ sub-system in the system shall not result in the failure of complete system.

5.6 gNB Safety Requirements

Clause	Parameter	Standard
1.	The equipment shall conform to IS 13252 part 1:2010- "Information Technology Equipment – Safety- Part 1: General Requirements" [equivalent to IEC 60950-1 {2005} "Information Technology Equipment –Safety- Part 1: General Requirements"] OR IEC 62368-I:2014	IS 13252 part 1:2010 / IEC 60950-1 {2005} part 1; OR IEC 62368-I:2014
2.	IEC 60215 (1987) Safety requirements of radio transmitting equipment's (for Radio equipment's only)	IEC 60215 (1987)

5.7 gNB Electromagnetic Compatibility (EMC)

(These requirements shall be as per TEC Standard No. TEC11016:2016 as modified/ amended from time to time)

Clause	Parameter	Standard
1.	Conducted and Radiated Emission	CISPR 22 (2008) OR CISPR 32 Class-A
2.	Immunity to Electrostatic discharge: Contact discharge level 2 {± 4 kV}	IEC-61000-4-2

		Performance Criteria-B, Clause 9
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: 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	IEC 61000-4-3 (2010); Performance Criteria-A, Clause 9
5.	Immunity to fast transients (burst): Test Level 2: a) 1 kV for AC/DC power port b) 0. 5 kV for signal / control / data / telecom lines.	IEC 61000- 4- 4 {2012); Performance Criteria-B, Clause 9
6.	Immunity to surges: AC/DC ports a) 2 kV peak open circuit voltage for line to ground b) 1kV peak open circuit voltage for line to line	IEC 61000-4-5 (2014) Performance Criteria-B, Clause 9
7.	Immunity to surges: Telecom ports a) 2 kV peak open circuit voltage for line to ground coupling. b) 2 kV peak open circuit voltage for line-to-line coupling.	IEC 61000-4-5 (2014) Performance Criteria-C, Clause 9
8.	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.	
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):	IEC 61000-4-29(2000) a) Applicable Performance Criteria shall be B.

	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.	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.

Chapter 6

6 General Requirements

6.1 General

6.1.1 5G provides users a facility for high-speed data & voice. The system shall have facilities for automatic roaming, locating and updating mobile subscribers.

6.1.2 The operation of the equipment shall be in the frequency band allotted.

6.2 Support of Multiple Equipment Vendors as per tender requirement

6.2.1 The system shall support the possibility of using equipment and sub-systems of different vendors as per defined industry standards, wherever relevant.

6.3 Hardware

6.3.1 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.

6.3.2 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.

6.3.3 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.

6.4 Processors

6.4.1 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.

6.5 Input-Output devices

6.5.1 The communication facilities provided for exchange of information between the elements of 5G-RAN and the maintenance and operating personnel shall include facilities for a system test, control and alarm indication at OMC.

6.5.2 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.

6.5.3 Adequate number of man-machine interfaces shall be available.

6.5.4 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 5G-RAN. Special provision shall also be made for storage of failure event even when the system is unable to transmit an output message.

6.5.5 A suitable alarm and display system at OMC shall be provided for a continuous indication of the system status.

6.6 Equipment Practice

6.6.1 For a Distributed gNB, 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.

6.6.2 For a Distributed gNB, it shall be indicated whether printed board connectors are of edge-type or plug-and-socket 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.

6.6.3 All components and material used in the equipment shall be non-inflammable or in absence of it, self-extinguishable. They shall be fully tropicalised.

6.6.4 For a Distributed gNB, the method used for connection of permanent wiring outside the printed cards shall be indicated.

6.6.5 The buses, if any, shall be suitably protected against electrical and magnetic interference from neighbouring systems (like electromechanical systems, fluorescent tubes, motors, etc.).

6.6.6 For a Distributed gNB, the different plug-in cards shall have suitable mechanical safeguards to prevent damage due to accidental interchange of cards.

6.6.7 The requirement at the external interface against induced voltages and currents due to lightning, high power system, etc. shall be indicated.

6.6.8 The system shall provide for human isolation and protection from accidental high voltage power contact.

6.7 Quality Requirements

6.7.1 The components used shall be available from multiple sources with adequate qualification. Number of proprietary components used shall be minimum. List of such components shall be indicated.

6.7.2 All the equipment shall have a tropical finish and coated to protect against saline atmosphere.

6.8 Software

6.8.1 The software shall be written in a High-Level Language. The software shall be modular and structured.

6.8.2 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.

6.9 Software Maintenance

6.9.1 All software updates, for a period as specified, shall be supplied on continuing basis. These updates shall include new features and services and other maintenance updates.

6.9.2 Integration of software updates without posing any problem to the existing functionality shall be possible.

6.10 gNB DoS (Denial of Service) Attack Protection

6.10.1 The gNB shall provide the protection against DOS attack. The vendor shall describe how to protect against DOS attack in their system.

Chapter 7

7 INFORMATION FOR THE PROCURER OF PRODUCT

The procurer may specify the requirements of the following parameters in the various clauses of the GR indicated against each parameter given in below table (as per specific deployment/application requirements suitable for the procurer) Regarding 3GPP release 16 features, requirement of one or more of the 3GPP Release 16 Features as given in Clause 4 may be indicated by the procurer as per Table in clause 7.1.

Note: For type approval/ technology approval, the equipment vendor shall indicate product specific configuration/features being offered as per following tables.

#	Tendering parameter	Options
1.	gNB Standalone/ Non-Standalone Mode	Clause 2.1
2.	Implementation architecture	Clause 2.1
3.	F1 interface	Clause 2.2.3
4.	Band Support: FR1-; FR2 (with specific band details)	Clause 2.3
5.	TDD /FDD:	Clause 3.6
6.	Channel bandwidth	Clause 3.6
7.	Subcarrier spacing	Clause 3.6
8.	Number of beams supported	
9.	Transmission Modes, MIMO requirements & Modulation Schemes	Clause 3.9
10.	Carrier Aggregation	Clause 3.14

11.	Base Station Class	Clause 2.3
12.	Output Power of gNB	Clause 2.3
13.	Base Station Type	Clause 2.3
14.	Power Supply Option AC/DC	Clause 3.29
15.	Mobility with 5G NR SA	Clause 3.11
16.	AAS	Clause 3.28
17.	UE Speed	Clause 5.1.2

7.1 The tenderer may specify 3GPP release 16 features as per their requirement.

S. No.	Parameter	Option
1.	3GPP Release 16 features	from Clause 4
2.		
3.		
4.		

Abbreviations

For the purpose of this document the following abbreviations apply:

AAS	Active Antenna System
ACLR	Adjacent Channel Leakage Ratio
ACS	Adjacent Channel Selectivity
AMF	Access and Mobility Management Function
ARQ	Automatic Repeat Request
BPSK	Binary phase-shift keying
BS	Base Station
BW	Bandwidth
CA	Carrier Aggregation
CU	Centralized Unit
CN	Core Network
CPRI	Common Public Radio Interface
eCPRI	Enhanced CPRI
en-gNB	gNB that can connect with EPC
EN-DC	E-UTRAN New Radio – Dual Connectivity
DU	Distributed Unit
DOS	Denial of Service
C-DRX	Connected Mode Discontinuous Reception
2CC	Two Carrier Aggregation

3CC	Three Carrier Aggregation
DFT	Discrete Fourier Transformation
5GC	5G Core
DL	Downlink
DFT	Discrete Fourier transform
UL	Uplink
EPC	Evolved Packet Core
EMS	Element Management System
EVM	Error Vector Magnitude
F1-C	F1 Interface Control Plane
F1-U	F1 Interface User Plane
FDD	Frequency Division Duplex
GPS	Global Positioning System
HB	High Band
ICS	In-Channel Selectivity
IMS	IP Multimedia Subsystem
IOT	Internet Of Things
LTE	Long Term Evolution
LMLC	Low Mobility Large Cell
LB	Low Band
MAC	Medium Access Control

MB	Mid Band
MIMO	Multiple Input Multiple Output
MME	Mobility Management Entity
MTBF	Mean Time Between Failure
MTTR	Mean Time To Repair
NB-IOT	Narrow Band IOT
NR	New Radio
OBSAI	Open Base Station Architecture Initiative
OMC	Operations and Maintenance Controller
OTA	Over the Air
OFDM	Orthogonal frequency-division multiplexing
PDCCH	Physical Downlink Control Channel
PDSCH	Physical Downlink Shared Channel
PDCP	Packet Data Convergence Protocol
PHY	Physical Layer
PUSCH	Physical Uplink Shared Channel
PUCCH	Physical Uplink Control Channel
PWS	Public Warning System
QAM	Quadrature Amplitude Modulation
QCI	Qos Class Identifier
QOS	Quality Of Service
QPSK	Quadrature Phase-Shift Keying

RAN	Radio Access Network
RAT	Radio Access Technology
RF	Radio Frequency
RMS	Root Mean Square (value)
RRH	Remote Radio Head
RS	Reference Symbol
RX	Receiver
RLC	Radio Link Control
RRC	Radio Resource Control
SA	Standlone
NSA	Non-Standlone
SNMP	Simple Network Management Protocol
SCS	Subcarrier Spcaing
SDAP	Service Data Adaption Protocol
SON	Self-organizing networks
SSB	Synchronization Signal Block
S-NSSAI	Single Network Slice Selection Assistance Information
TA	Timing Advance
TDD	Time Division Duplex
TX	Transmitter
UE	User Equipment
UPF	User Plane Function
VLAN	Virtual Local Area Network
VoNR	Voice over NR

ViNR Video over NR

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