वर्गीय आवश्यकताओं के लिए मानक

टीईसी 21050:2019

(पूर्वसं: टीईसी/जीआर/डबल्यूएस/ईएनबी-001/01/मार्च-19)

STANDARD FOR GENERIC REQUIREMENTS

TEC 21050:2019

(Earlier No. TEC/GR/WS/ENB-001/01.March 2019)

ईनॉडबी

eNodeB

ISO 9001:2015

दूरसंचार अभियांत्रिकी केंद्र

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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 Centers (RTECs) have been established which are located at New Delhi, Bangalore, Mumbai, and Kolkata.

ABSTRACT

This document contains the Generic Requirements (GR) of eNodeB for Long Term Evolution (LTE) based mobile system defined by 3GPP and classified under 3GPP Specifications TS 36.104 as well as eNodeB for Small Size LTE based mobile system for deployment in the Indian mobile network. The document specifies Technical Requirements, General Requirements, Features and Functionality of the eNodeB for LTE based mobile system including Small Sized LTE based mobile systems, with its various derivatives including rural and disaster communications, Macro and Micro eNodeB as envisaged in Gazette Notification No. 18-10/2017-IP dated 29th August 2018. This document covers eNodeB, Home eNodeB and various applications including IOT, Public Safety and V2X. This GR is applicable for both FDD and TDD modes of operation.

HISTORY SHEET

Sl. No.	Standard/Document No.	Title	Remarks
1.	TEC/GR/WS/ENB-001/01/MAR-19	eNodeB	First Issue: March 2019
2.	TEC 21050:2019	Standard for Generic Requirements for eNodeB	Includes revised Numbering Scheme

Note:

1. The documents have been renumbered as per revised numbering scheme, kindly refer the Mapping-Listing Table pertaining to old and revised document number available on TEC website www.tec.gov.in/. In case of further clarification, please contact at email ID adgdoc.tec@gov.in

2. Inside the documents, General Requirements may be read as Standard for General Requirements, Interface Requirements as Standard for Interface Requirements, Several Requirements as Standard for General Requirements and Test Schedule & Test Procedure (TSTP) as TEC Test Guide.

CONTENTS

REFERENCES

S. No.	Document No.	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 36.306	"Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio access capabilities "
4)	3GPP TS 36.101	"Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception
5)	3GPP TS 36.104	"Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) radio transmission and reception ".
6)	3GPP TS 36.141	“Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) conformance testing”
7)	3GPP TS 36.321	"Evolved Universal Terrestrial Radio Access (E-UTRA); Medium Access Control (MAC) protocol specification".
8)	3GPP TS 36.322	"Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Link Control (RLC) protocol specification ".
9)	3GPP TS 36.323	"Evolved Universal Terrestrial Radio Access (E-UTRA); Packet Data

		Convergence Protocol (PDCP) specification ".
10)	3GPP TS 36.331	"Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification".
11)	3GPP TS 36.201	"Evolved Universal Terrestrial Radio Access (E-UTRA); LTE physical layer; General description ".
12)	3GPP TS 36.211	"Evolved Universal Terrestrial Radio Access (E-UTRA); Physical channels and modulation ".
13)	3GPP TS 36.212	"Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding ".
14)	3GPP TS 36.213	"Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures ".
15)	3GPP TS 36.214	"Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer; Measurements ".
16)	3GPP TS 36.300	"Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2".

17)	3GPP TS 36.133	"Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of radio resource management ".
18)	3GPP TS 36.411	"S1 Layer 1".
19)	3GPP TS 36.413	"S1Application protocol (S1AP) ".
20)	3GPP TS 36.420	“X2 General aspects and principles”
21)	3GPP TS 36.423	“X2 Application protocol (X2AP)”
22)	3GPP TS 23.401	“General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access”
23)	3GPP TS 32.511	“Telecommunication management; Automatic Neighbour Relation (ANR) management; Concepts and requirements”
24)	3GPP TS 23.216	“Single Radio Voice Call Continuity (SRVCC); Stage 2”
25)	3GPP TS 36.171	“Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for Support of Assisted Global Navigation Satellite System (A-GNSS)”
26)	3GPP TS 36.305	“Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Stage 2 functional specification of User Equipment (UE) positioning in E-UTRAN”.

27)	3GPP TS 36.455	"Evolved Universal Terrestrial Radio Access (E-UTRA); LTE Positioning Protocol A (LPPa)".
28)	3GPP TS 33.117	Catalogue of general security assurance requirements
29)	3GPP TS 33.401	3GPP System Architecture Evolution (SAE); Security architecture
30)	3GPP TS 36.133	Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of radio resource management
31)	ISO-9001:2008	"Quality Management System – Requirement".
32)	IS-41D & E	"Cellular Radio Telecommunications Intersystem Operations"
33)	CISPR 22 (2003)	"Limits and methods of measurement of radio disturbance characteristics of Information Technology Equipment".
34)	EN55022	"Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment"
35)	IEC 60479-1 (1984)	"Effects of current on human beings: Part 1"

36)	IEC 60215 (1987)	"Safety requirements of radio transmitting equipment (for Radio equipment only)"
37)	IEC-60950 (2001)	"Information technology equipment – Safety"
38)	IS 13252 part 1:2010	"Information Technology Equipment – Safety- Part 1: General Requirements"
39)	IEC 60950-1 {2005}	"Information Technology Equipment – Safety- Part 1: General Requirements"
40)	IEC 60215 (1987)	Safety requirements of radio transmitting equipments (for Radio equipments only)
41)	CISPR 22 (2008) OR CISPR 32 Class-A	Conducted and Radiated Emission
42)	IEC-61000	Electromagnetic Compatibility
43)	TEC/SD/DD/EMC-221/05/OCT-16	"Electromagnetic Compatibility Standard for Telecommunication Equipment"
44)	ITU-R SM.329	Unwanted emissions in the spurious domain
45)	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
46)	GR /WS /BSS-002/01. DEC. 2009	TEC GR of Small Size GSM Radio Sub System

1. INTRODUCTION

1.1 Scope

This document contains the Generic Requirements (GR) of Long Term Evolution (LTE) eNodeB defined by 3GPP upto Release-14 of 36 series for deployment in the Indian mobile network. The E-UTRAN (Evolved – Universal Terrestrial Radio Access Network) consists of eNodeBs, providing the E-UTRA (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 eNodeB System including Small Sized LTE based mobile systems, with its various derivatives including rural and disaster communications, Macro and Micro eNodeB as envisaged in Gazette Notification No. 18-10/2017-IP dated 29th August 2018.

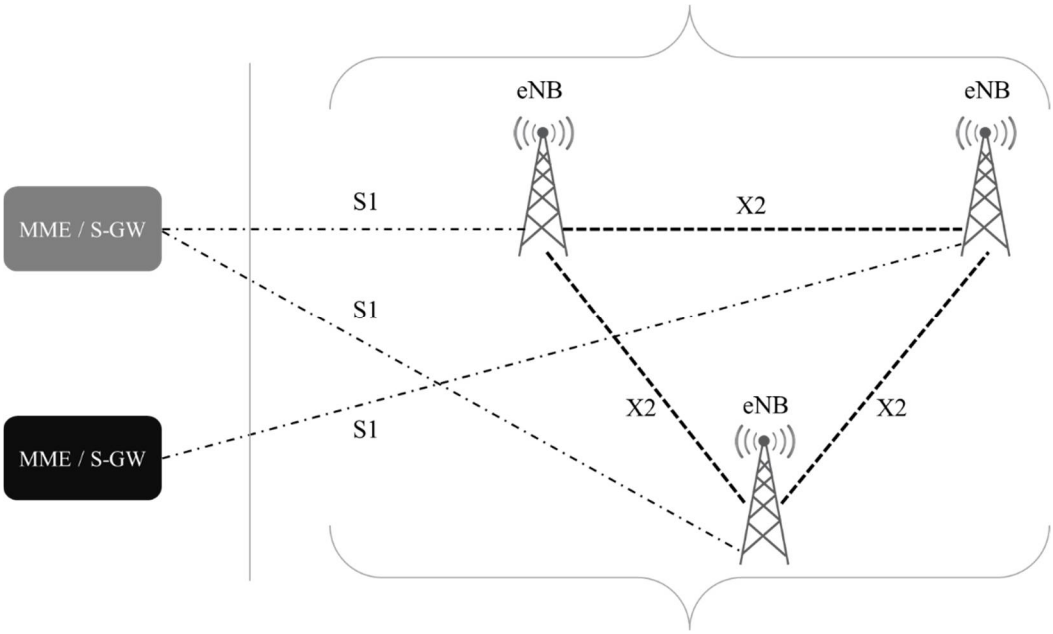
This document covers eNodeB, Home eNodeB and various applications including IOT, Public Safety and V2X

This GR is applicable for both FDD and TDD modes of operation

2. eNodeB

2.1 Description

eNodeB is the RAN node in the network architecture that is responsible for radio transmission to and reception from UEs in one or more cells. The E-UTRAN consists of eNodeBs, providing the E-UTRA user plane (PDCP/RLC/MAC/PHY) and control plane (RRC) protocol terminations towards the UE. The eNodeBs are interconnected with each other by means of the X2 interface. The eNodeBs are also connected by means of the S1 interface to the EPC (Evolved Packet Core), more specifically to the MME (Mobility Management Entity) by means of the S1-MME and to the Serving Gateway (S-GW) by means of the S1-U. The S1 interface supports a many-to-many relation between MMEs / Serving Gateways and eNodeBs.



The eNodeB design can be based on a distributed architecture or integrated architecture

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

- Distributed Architecture: The distributed architecture comprised of baseband unit (BBU) collocated with eNodeB Layer 2, Layer 3 functionality and Remote radio head (RRH) connected via a CPRI or OBSAI interface or another interface. This also covers centralised/cloud RAN (C-RAN) based architecture

This GR defines eNodeB functionality independent of implementation architecture.

2.2 eNodeB Classes

2.2.1 3GPP Specification (TS 36.104) define the following eNodeB classes

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

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

Clause	**BS Class**	**Derivation from**	**PRAT**
1	Wide Area BS	Macro cell scenario	(NOTE)
2	Medium Range BS	Micro cell scenario	≤38 dBm
3	Local Area BS	Pico cell scenario	≤24 dBm
NOTE: There is no upper limit for the rated output power of the wide area base station			

Rated output power, PRAT 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.

The limits/ levels for antennae (BS) emissions for general public exposure shall be as prescribed by the licensor from time to time.

The maximum power radiation shall be regulated by latest DoT guidelines/ instructions/ licensing conditions

2.2.2 Depending upon applicability in Indian scenario, the requirements have further been categorised as under (Refer The Gazette of India Notification No. 18-10/2017-IP dated 29th August 2018)

2.2.2.1 **Category 1**: LTE based mobile systems, with its various derivatives including rural and disaster communications, Macro and Micro eNodeB

2.2.2.2 **Category 2**: Small Size LTE based mobile systems with its various derivatives including Rural and Disaster communication, Macro and Micro eNodeB

Small Size LTE based mobile systems (Category 2) has been envisaged for Indian scenario with the key objective of power efficient (low power consumption) and eco-friendly solution, which can address the requirements in terms of coverage, capacity, quality with ease of maintenance. The prime requirement of the solution is to provide mobile services in unconnected, remote and rural areas with diverse clutter/ terrain, capacity and coverage needs as well as easy deployability at shortest possible timeframe. Small Size eNodeB system is characterized as below:

a. eNodeB - Low power consumption

b. Enclosure -

   i. For outdoor - IP65 compliant

   ii. For indoor - IP20 or higher

c. Typical configuration & Maximum RF Transmit power (Output Power) and Maximum power consumption (per sector):

   i. Macro Cell - up to 2 x 10W -250W

   ii. Micro Cell - up to 2 x 5W – 130W, 2 x 2W – 75W, 2 x 1W – 60W

   iii. Pico Cell - up to 2 x 250 mW – 40W

The limits/ levels for antennae (BS) emissions for general public exposure shall be as prescribed by the licensor from time to time.

Note : The Tendering Authority/ Purchaser may decide among Category 1 or Category 2 type eNodeB depending upon specific deployment in urban/ rural areas as per requirements.

2.3 Functional Requirements

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

2.3.1.1 Cell control and MME support: eNodeB owns and controls the radio resources of its own cell or cells. Cell resources as requested by and granted to MMEs shall be in an ordered fashion.

2.3.1.2 Measurements and reporting: The eNodeB shall support Event-triggered measurement reporting.

2.3.1.3 The eNodeB shall support System Information Broadcast (SIB).

2.3.1.4 The eNodeB shall support Signalling Radio Bearer (SRB), including SRB0, SRB1, and SRB2.

2.3.2 Packet Data Convergence Protocol (PDCP)

2.3.2.1 Control and User Plane security: eNodeB shall support the ciphering of user plane data over the radio interface and integrity protection of RRC signaling.

2.3.2.2 The eNodeB 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.

2.3.3 Radio Link Control (RLC)

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

2.3.4 Medium Access Control / Layer -1 (MAC/L1)

2.3.4.1 Shared Channel handling: eNodeB shall be able to handle the shared and random access channels used for signaling and initial access.

2.3.4.2 eNodeB shall support HARQ functionality

2.3.4.3 eNodeB shall support dynamic resource allocation (Scheduling)

2.3.4.4 Multiplexing and Mapping: The eNodeB shall be support mapping of logical channels onto transport channels.

2.3.4.5 Physical layer functionality: eNodeB shall support scrambling, Tx diversity, and OFDM modulation.

2.3.4.6 The eNodeB shall support Contention based and Contention free Random Access (RA) procedure.

2.3.4.7 The eNodeB shall support DL Power Allocation for data channels.

2.3.4.8 eNodeB shall support Downlink power allocation parameters, such PDSCH-to-RS ratios

2.3.4.9 The eNodeB shall support DL Power setting for signalling and control channels.

2.3.4.10 The eNodeB shall support both the open-loop power control and the closed-loop power control of the UE.

2.3.4.11 The eNodeB shall support Normal cyclic prefix. Optionally for Macro scenarios, Extended Cyclic prefix may be supported (Applicable to Category 1 eNodeB only).

2.3.4.12 The eNodeB shall support Uplink demodulation reference signal

2.3.4.13 Radio Bearer (RB) combinations dynamic mapping to Physical Resource Block (PRB).

2.3.4.14 The eNodeB shall support UL & DL Link Adaptation.

2.3.4.15 Uplink-Downlink frame configuration for TDD defined by 3GPP as Configuration-1 & Configuration-2 shall be supported. Optionally eNodeB shall support all the configurations.

2.3.4.16 The transmission modes viz: open loop, closed loop for spatial multiplexing and Transmit diversity etc. shall be supported.

2.3.4.17 The eNodeB shall support Short Buffer Status Report (BSR) and Long BSR.

2.3.4.18 The eNodeB shall support Random Access Preamble burst format 0 (FDD/TDD) and 4(TDD).

2.3.4.19 The eNodeB shall support Cell-specific reference signal.

2.3.4.20 The eNodeB shall support frequency selective scheduling (FSS) in Downlink

2.3.4.21 The eNodeB shall support Interference aware and channel aware frequency selective scheduling on PUSCH using Sounding Reference Signals (SRS)

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

2.3.5 S1 Interface

The S1 interface is specified at the boundary between the EPC and the E-UTRAN. From the S1 perspective, the E-UTRAN access point is an eNodeB, and the EPC access point is either the control plane MME logical node or the user plane S-GW logical node. Two types of S1 interfaces are thus defined at the boundary depending on the EPC access point: S1-MME towards an MME and S1-U towards an S- GW.

The E-UTRAN may thus have several S1access points towards the EPC. As a minimum, each S1 access point (in E-UTRAN or EPC) shall independently fulfil the requirements of the relevant S1 specifications (3GPP TS 36.41x series).

S1 is a logical interface.

There may be multiple S1-MME logical interfaces towards the EPC from any one eNodeB. The selection of the S1-MME interface is then determined by the NAS Node Selection Function.

There may be multiple S1-U logical interfaces towards the EPC from any one eNodeB. The selection of the S1-U interface is done within the EPC and signalled to the eNodeB by the MME.

2.3.5.1 Functions of S1 Interface:

a. S1 UE context management function.

b. E-RAB management functions.

c. S1 link management function.

d. GTP-U tunnels management function.

e. S1 Signaling link management function.

f. Mobility functions for UEs in LTE_Active.

g. Intra-LTE handover.

h. Inter-3GPP RAT handover.

i. Paging function.

j. S1 interface management function.

k. Security function.

l. Service and network access function

    a. Core network signalling data transfer function

    b. Delivery of Warning messages

m. Location reporting function.

n. MME Selection with MME Load re-balancing & Overload Indication Management.

o. The S1-U interface shall be Ethernet

2.3.6 X2 Interface

The interface allowing interconnecting eNodeBs with each other is referred to as the X2 interface. The X2 interface shall support the exchange of signalling information between two eNodeBs, in addition the interface shall support the forwarding of PDUs to the respective tunnel endpoints. From a logical standpoint, the X2 is a point-to-point interface between two eNodeBs within the E-UTRAN

2.3.6.1 Functions of the X2 interface - The list of functions on the X2 interface shall include the following:

a. Intra LTE-Access-System Mobility Support for UE in LTE_ACTIVE.

b. Context transfer from source eNodeB to target eNodeB.

c. Control of user plane tunnels between source eNodeB and target eNodeB.

d. Handover cancellation.

e. General X2 management and error handling functions.

f. Error indication.

g. The X2 interface shall support Ethernet

2.3.6.2 It shall be mandatory that the X2 interface implementation with reference to intercell Coordination for Interference Mitigation (ICIC), mobility robustness and mobility load balancing as per applicable category be shared with the Purchaser to allow interworking with other vendors eNodeB and/or small cell.

2.3.7 Uu Interface

The Uu interface is the radio interface between the mobile and the radio access network. The protocol stack has two planes: the user plane carries the data streams of interest to the user, while the control plane carries the network's signaling messages.

2.3.7.1 Functions of the Uu interface:

a. RACH access.

b. RRC Connection Establishment procedure.

c. RRC Connection Re-establishment procedure.

d. Mobility Control through RRC Connection Reconfiguration.

e. Measurement Event Reporting.

2.3.8 Power Requirements

2.3.8.1 eNodeB shall support DC / AC power supply

2.3.8.2 eNodeB with DC power Supply

a. eNodeB shall support nominal voltage -48V (-40 to -60 V) DC supply voltage

b. Protection on Power Input Ports

c. Reverse Polarity protection at the DC input

d. Over voltage protection at the DC input

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

f. In case AC option, the required AC to DC converter shall be provided by the supplier.

2.3.8.3 eNodeB with AC power supply

eNodeB shall have in-built/external AC to DC converter module, which shall support nominal voltage as per IS 12360:1988 (as amended from time to time)

2.3.9 Operation & Maintenance

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

2.3.9.2 eNodeB shall support at least one of the following interfaces towards EMS / OMC

a. XML

b. TR.069

c. SNMP

2.3.9.3 The eNodeB control software shall interact with various hardware / software entities of the eNodeB and provide the health status/Alarms of the entire system on the EMS / OMC.

2.3.9.4 The eNodeB shall support remote Software/firmware updates via the EMS / OMC.

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

2.3.9.6 The system shall maintain a system log and core dump logs.

2.3.9.7 The eNodeB should support both local and remote software upgrade.

2.3.9.8 The eNodeB shall support alarms, events to EMS / OMC for visual indicators of status and fault.

2.3.9.9 The eNodeB shall have reboot / restart capability.

2.3.9.10 eNodeB shall support built-in power-on diagnostics and system monitoring capabilities to detect hardware failures.

2.3.9.11 The eNodeB should support Local Maintenance Ports for any debugging and troubleshooting.

2.3.9.12 The system shall provide the count for the total number of UEs connected to the eNodeB.

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

2.3.9.14 The eNodeB shall have the ability to detect and report any hardware fault within the equipment.

2.3.9.15 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.

2.3.10 Ethernet Transport features

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

2.3.10.2 The eNodeB shall be able to flexibly map traffic onto one or more VLANs.

2.3.11 IP Transport

2.3.11.1 Both IPV4 and IPV6 (dual stack) shall be supported on all Ethernet transport interfaces in compliance with IETF RFC 4213.

2.3.12 QoS in The Transport Layer

2.3.12.1 The eNodeB shall comply with the IETF DiffServe architecture as defined in IETF RFC2475 and shall support the DSCP interpretation of the TOS field in the IPv4 header as defined in IETF RFC2474.

2.3.12.2 The eNodeB shall support the use of the Ethernet Priority Code Point (PCP) field as defined in IEEE802.1Q-2005 section 9.

2.3.12.3 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.

2.3.12.4 The DSCP for S1-U and X2-U are configurable by operator.

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

2.3.12.6 Layer 2 QoS marking shall be supported when the backbone network supporting the eNodeB is a layer 2 switched network

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

2.3.13 eNodeB Synchronization

The solution shall support end-to-end synchronization solutions to maintain call quality and traffic throughput.

2.3.13.1 eNodeB shall support at least one of the following synchronization options

a. GPS

b. IEEE 1588 V2

c. SyncE

d. IRNSS timing source

2.3.13.2 eNodeB for Wide Area BS TDD systems shall support a phase accuracy as specified below

Cell Type	**Cell Radius**	**Requirement**
Small cell	≤ 3Km	≤ 3 µs
Large Cell	> 3Km	≤ 10 µs

2.3.13.3 eNodeB shall support at least 48 hr hold over mode in case of frequency synchronization loss and at least 6 hr hold over mode in case of Phase synchronization loss.

2.3.14 Security IPsec in Transport

2.3.14.1 System shall support IPSEC and key management (e.g. IKEv2 or pre-shared key) for the backhaul transport.

2.3.15 Transmission Modes, MIMO requirements & Modulation Schemes

Category 1 Specification

1. DL TM Modes: TM 1 – TM 4. (TM5 to TM10 optional) – to be specified by the tendering authority
2. DL SU MIMO
3. DL MU-MIMO (optional)
4. DL MIMO Layers: 2X2,4X2, 4X4,
5. Optional upgradability (AAS) which has large array of antenna elements i.e. more than 4 Tx Rx antenna elements e.g. 8T8R, 12T12R, 16T16R 32T32R, 64T64R MIMO
6. UL TM Modes: TM 1 – TM 2
7. UL Rx Diversity: 2X, 4X
8. UL-MIMO 2x2, 4x4
9. Optional FD-MIMO or Massive MIMO upgradability
10. The AAS system shall support dynamic switching of transmission modes of TM7/8 to TM3 or TM4 based on radio conditions and UE support.
11. DL modulation Schemes: BPSK, QPSK, 16 QAM, 64 QAM, 256 QAM
12. UL Modulation Schemes: BPSK, QPSK, 16 QAM, 64 QAM

Category 2 Specification

1. DL TM Modes: TM1 – TM4
2. DL SU MIMO

3. DL MIMO Layers: 2X2
4. UL TM Modes: TM1
5. UL Rx Diversity: 2X
6. DL modulation Schemes: BPSK, QPSK, 16 QAM, 64 QAM
7. UL modulation Schemes: BPSK, QPSK, 16 QAM

2.3.16 LTE QoS Requirements

a. The eNodeB shall support all nine Quality of Service Class Identifiers (QCIs)

b. The eNodeB shall support multiple data radio bearers (DRBs).

c. The eNodeB shall support dynamic addition and deletion of dedicated bearers.

d. The eNodeB shall support both UE initiated as well as Network Initiated dedicated bearer creation.

e. The eNodeB scheduler shall support prioritization of traffic in downlink as per the QCI priority value

f. The eNodeB shall consider ARP (Allocation and Retention Priority) parameters of priority level, the pre-emption capability and the pre-emption vulnerability during bearer establishment

2.3.17 LTE QoS Requirements Advanced (Applicable for Category 1)

a. The eNodeB shall support Extended QCI which enables the operator to define and configure new Quality of Service Class Identifier (QCIs) in addition to the existing standardized QCIs (0-9). This will further enable the operator to more flexibly differentiate between bearers or service flows from a Quality of Service (QoS) perspective

b. The inactivity timer for RRC and NAS (that makes the connection to be released) should be configurable by the operator for each QCI (standard and extended)

c. The eNodeB shall support mapping of QCIs to DSCP bits and marking the Egress IP Packets for different QCIs as per the configured mapping. This is important for end-to-end QoS in uplink.

d. The eNodeB shall support the pre-scheduling of resources to UEs (access grants) even if not required, which can be activated if certain load thresholds are reached.

2.3.18 Mobility control

a. The eNodeB shall be able to control the mobility for terminals in active state.

b. The eNodeB shall support Cell reselection procedures. Cell Re-selection based on:

   i. Broadcast priority indication

   ii. Broadcast cell-specific reselection parameters

   iii. Broadcast cell-specific blacklists

   iv. Access class baring parameters

c. The eNodeB shall support Inter PLMN reselection

d. The eNodeB shall support “connection re-establishment” procedure.

e. The system shall support following types of Inter eNodeB handover:

   i. Intra frequency

   ii. Inter frequency: same band

   iii. Inter frequency: different band

   iv. Over X2

   v. Over S1

   vi. Intra MME and SGW

   vii. Inter MME

viii. Inter MME and SGW

ix. Inter SGW

x. Inter mode (TDD / FDD)

f. The eNodeB shall support interworking between FDD and TDD, including session continuity. (applicable only when eNodeB supports both options of FDD & TDD)

g. The system shall support data forwarding at Intra-LTE handover, both over X2 and S1 interfaces.

h. The eNodeB shall support PS Handover to WCDMA based on Coverage

i. The eNodeB shall support UTRAN/ GERAN session release with redirect information

2.3.19 Mobility Requirements Advanced

a. The eNodeB shall support Load control mechanisms that provides overload protection for cells with a highly loaded air interface, by throttling incoming handovers and initial accesses in the cell

b. The eNodeB shall support load based Handover to GERAN/UTRAN/E-UTRAN

2.3.20 CSFB Support

The eNodeB shall support CS Fallback to UTRAN and GERAN as primary CS service for traditional voice traffic if IP Multimedia Subsystem (IMS) for Voice over IP (VoIP) services are not available.

2.3.21 Advanced CSFB

If CSFB is opted for voice services, the eNodeB shall be able to handle Emergency Calls during CS Fallback. The eNodeB should offer the operator the possibility to apply separate priorities for CS Fallback for emergency calls as compared to CS Fallback for ordinary voice calls.

2.3.22 Carrier Aggregation (Applicable for Category 1)

a. The eNodeB shall support LTE-FDD Carrier Aggregation (CA) upto 5 Component Carriers. The tendering authority shall indicate the component carriers

b. The eNodeB shall support Inter-Band CA between various standardized FDD bands (not applicable for TDD system)

c. The eNodeB shall support Intra-Band contiguous and non-contiguous CA

d. The eNodeB shall support CA between FDD and TDD (applicable only when eNodeB supports both options of FDD & TDD)

e. The eNodeB shall support Carrier Aggregation band combinations which are specific to India and already standardized

f. The eNodeB shall support Uplink Carrier Aggregation

g. The eNodeB shall support Dynamic selection of Secondary frequency when having multiple cell carriers for CA

h. The eNodeB shall consider CA users during Load Balancing to avoid losing CA capabilities and to avoid congestion because of CA activation

i. It should be possible to aggregate carriers where different Transmission Modes (TM) are used in the aggregated cells

2.3.23 eMBMS (Applicable to Category-1 only and optional)

a. The MCE shall be supported logically within the eNodeB and should support all associated interfaces: M2, M3 and M1

b. The eNodeB shall support Multicast Channel (MCH) and associated Physical Multicast Channel (PMCH)

c. The eNodeB shall support extended cyclic prefix

d. The eNodeB shall support Multimedia Broadcast/Multicast Service over Multimedia Broadcast Single Frequency Network (MBSFN)

e. The eNodeB shall support SIB13. MBSFN control channel information and MBSFN Area specification are specified by SIB13

f. The eNodeB shall support up to 3 MBSFN Areas in the same location

g. The eNodeB shall support SIB16 which contains information related to GPS time and Coordinated Universal Time (UTC). The UE may use the time information for numerous purposes, e.g. to synchronize the UE clock (to determine MBMS session start/ stop)

h. eMBMS should be supported in case of multiple carriers also, which means operator can choose to broadcast service on one of the carriers or both carriers simultaneously. The eNodeB shall support SIB15 which is broadcasted by RAN and it enables all cells to provide MBMS SAIs for the current frequency and also for neighboring frequencies where MBMS is provided

i. The eNodeB shall be able to support unicast traffic and eMBMS services simultaneously. Unicast traffic should not be affected by eMBMS traffic and vice versa.

j. The seamless mobility for eMBMS shall be supported in both RRC_IDLE state as well as RRC_CONNECTED state

2.3.24 Location Services Support

The system shall support Cell ID Based Location Support where the cell ID for a specific UE is transferred to MME upon request

2.3.25 Location Services Advanced:

eNodeB shall support any one of the following positioning methods

a. The eNodeB shall support location determination based on Enhanced Cell ID (ECID) by providing the following information

   i. Geographical coordinates of its serving eNB

   ii. Additional UE and radio resource measurements

b. The eNodeB shall support the OTDOA

i. The eNodeB can optionally support Positioning Reference Signal (PRS) to improve the accuracy and performance of the OTDOA methods for location determination by UE

2.3.26 Interference Mitigation Requirements

a. The eNodeB shall support Interference Rejection Combining in its PHY layer receiver for improved performance in interference limited scenarios. (Applicable to Category 1 only)

b. eNodeB shall support maximum-ratio combining (MRC), a method of diversity combining in which the signals from each channel are added together, the gain of each channel is made proportional to the RMS signal level and inversely proportional to the mean square noise level in that channel.

c. The eNodeB shall support coordinated scheduling in downlink &uplink between all cells of the same logical eNodeB whereby interference between neighbour cells is minimized via scheduling of resources in a dynamic and coordinated way.

2.3.27 SON requirements

a. The eNodeB shall support self-configuration

b. The eNodeB SON shall support Automatic PCI planning

c. The eNodeB shall support Automatic Neighbour Relations (ANR) based on UE Measurement Report

d. The eNodeB shall support power saving functionality

2.3.28 SON Advanced requirements (Applicable to Category 1)

a. The eNodeB shall support PCI collision detection and resolution

b. The eNodeB SON shall support Automatic Root Sequence Index (RSI) allocation for PRACH planning

c. The eNodeB shall support automated configuration of best neighbor relations for Intra-RAT load management

d. It shall be possible to black list and exclude neighbors that have a low handover success rate, from the neighbor list

e. The eNodeB shall support Mobility Robustness Optimization (MRO) related to Too-early, Too-late or Handovers to Wrong Cell

f. The eNodeB shall support Mobility Load Balancing (MLB)

g. The system shall support soft lock of cells making it possible to take cells out of traffic with minimal impact on ongoing traffic

h. The eNodeB shall support Coverage and Capacity optimization features thus ensuring optimum tradeoff between coverage, capacity and quality as well as handling load imbalance

i. The eNodeB shall support Self-Healing procedures

j. The eNodeB shall have capability to supervise all cells. It should able to detect sleeping cells and supports self-healing by automatically trying to recover the suspected sleeping cells

k. The eNodeB shall support micro sleep in the Downlink enabling discontinuous transmission to save energy during low traffic. The TX in the eNodeB shall be able to mute transmission during empty OFDM symbols

l. The eNodeB shall be able to automatically reconfigure the antenna system from MIMO to SIMO mode and back based on traffic load in the eNodeB order to lower the power consumption

m. The system shall support advanced monitoring of the antenna system in order to be able to indicate problems related to the antenna system, e.g. mismatched antenna pair Rx diagrams, swapped or disconnected feeders and loss in RF path

n. The system shall support means to monitor the CPRI link quality

o. The eNodeB shall support Minimization of Drive Test feature

2.3.29 Coordinated Multi-Point (CoMP) (Applicable to Category-1 only and optional)

a. The eNodeB shall Support UL intra-site CoMP

b. The eNodeB shall Support DL intra-site CoMP

c. The eNodeB shall support at least one of the following methods:

i. Joint Transmission: When two or more Tx point, transmit on a same frequency in the same subframe

ii. Dynamic Transmission: When two or more Tx/Rx point ready to transmit but only scheduled from one Tx point in each subframe

2.3.30 VoLTE, ViLTE Support

a. The eNodeB shall support creation of dedicated bearers with the following QCIs for carrying different type of traffic associated with the VoLTE Service: QCI-5 for IMS Signaling, QCI-1 for Voice Traffic, QCI-2 for Video Traffic.

b. The eNodeB shall support RLC UM (Unacknowledged Mode) for services that tolerate a higher packet loss rate but require lower latency, e.g. VoLTE.

c. The eNodeB shall support Robust Header Compression (RoHC).

d. The eNodeB shall support Single Radio Voice Call Continuity (SRVCC) handover to UTRAN/ GERAN. Voice calls (VoLTE) that have been established over LTE shall be able to continue if the user moves away from LTE coverage to areas with only WCDMA/GSM coverage while still on a call.

2.3.31 PWS (Public Warning System)

a. PWS provides a service that allows the network to distribute warning messages on behalf of public authority

b. PWS enables the distribution of ETWS

2.3.32 eMPS

a. The eNodeB shall be capable of prioritization of calls (RRC establishment cause highPriorityAccess) by using dedicated resources in admission control during initial access

b. The eNodeB shall have capability to prioritize paging messages in overload situations based on a priority provided by the MME.

2.3.33 Active RAN Sharing

2.3.33.1 MOCN

a. The eNodeB shall indicate the support of multiple operator

b. The eNodeB shall route operator specific traffic to its respective core network

2.3.34 ePDCCH (Applicable for Category-1 only and optional)

The eNodeB shall support Enhanced PDCCH (ePDCCH) capability that enable support of UE specific control signaling. ePDCCH can therefore be used to increase amount of downlink PDCCH capacity since the ePDCCH resource can be scheduled to the UEs in addition to traditional PDCCH resources.

2.3.35 Overload handling

The eNodeB shall have the capability to support the S1-AP procedures (Overload Start and Overload Stop) that can be used to aid an MME in handling overload situations.

2.3.36 Features Specific to Category 2

a. Shall be all outdoor designed preferably pole/tower mounted (not applicable for eNodeB deployed indoor for in-building coverage)

b. eNodeB shall be power efficient and implement power saving functionality

c. Shall be minimum IP65 and shall not require any air-conditioning (not applicable for eNodeB deployed indoor for in-building coverage)

2.3.37 eNodeB shall support satellite based backhaul system with following characteristics (Optional Feature, to be decided by tendering authority)

a. Shall be able to support a round trip latency up to 800ms on the satellite backhaul (S1) interface

b. Shall be able to support packet jitter of up to 100ms on the satellite backhaul (S1) interface

2.3.38 System Specifications

Clause	**Parameter**	**Standard**	**Notes**
1	Operating Frequency The Base Station shall be capable of operating in at least one of the frequency bands as per the National Frequency Allocation Plan.	Applicable National Frequency Allocation Plan	
2	Channel bandwidth	Applicable National Frequency Allocation Plan	

2.3.38.1 System Specification eNodeB

The additional tolerance for all parameters defined below will be as per 3GPP TS 36.141

These specifications shall be applicable for

a. integrated eNodeB

b. Split / Distributed architecture eNodeB

c. MSR based eNodeB

d. eNodeB with Active Antenna System

2.3.38.2 Tx Specifications

a. Base station output power

Output power of the base station is the mean power of one carrier delivered to a load with resistance equal to the nominal load impedance of the transmitter.

Rated total output power of the base station is the mean power 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.

The rated output power of the BS shall be as specified as

Clause	**BS Class**	**PRAT**
1	Wide Area BS	(Note)
2	Medium Range BS	≤ 38 dBm
3	Local Area BS	≤ 24 dBm
4	Home BS	≤ 20 dBm (for one transmit antenna port) ≤ 17 dBm (for two transmit antenna ports) ≤ 14 dBm (for four transmit antenna ports) ≤ 11 dBm (for 8 transmit antenna ports)
NOTE: There is no upper limit for the rated output power of the wide area base station		

The maximum power radiation shall be regulated by latest DoT guidelines/ instructions/ licensing conditions.

The limits/ levels for antennae (BS) emissions for general public exposure shall be as prescribed by the licensor from time to time.

Rated output power, PRAT, 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

b. RE Power control dynamic range

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. RE Control dynamic range for LTE BS shall be as specified below for different Modulation schemes

Modulation Scheme used on the RE	**RE power Control Dynamic Range (dB)**	
	(Down)	**(Up)**
QPSK (PDCCH)	-6	+4
QPSK (PDSCH)	-6	+3
16QAM (PDSCH)	-3	+3
64QAM (PDSCH)	0	0
256QAM (PDSCH)	0	0

c. Total Power dynamic range

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. The requirement does not apply to Band 46.

The downlink (DL) total power dynamic range for each E-UTRA carrier shall be larger than or equal to the level as specified:

Clause	BS Class	Accuracy
1	Wide Area BS	± 0.05 ppm
2	Medium Range BS	± 0.1 ppm
3	Local Area BS	± 0.1 ppm
4	Home BS	± 0.25 ppm

LTE Channel Bandwidth (MHz)	Total power dynamic range (dB)
5	13.9
10	16.9
15	18.7
20	20

d. Transmitter OFF power

Transmitter OFF power is defined as the mean power measured over 70 µs 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 transmitter OFF power spectral density shall be less than -85dBm/MHz.

e. Frequency Error

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.

For E-UTRA, the modulated carrier frequency of each E-UTRA carrier configured by the BS shall be accurate to within the accuracy range given below:

f. Error Vector Magnitude

For E-UTRA, for all bandwidths, the EVM measurement shall be performed for each E-UTRA carrier over all allocated resource blocks and downlink subframes within 10ms measurement periods. The boundaries of the EVM measurement periods need not be aligned with radio frame boundaries. The EVM value is then calculated as the mean square root of the measured values.

The EVM of each E-UTRA carrier for different modulation schemes on PDSCH shall be better than the limits in table below:

Modulation Scheme for PDSCH	**Required EVM (%)**
QPSK	17.5%
16QAM	12.5%
64QAM	8%
256QAM	3.5%

g. Time alignment error

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.

This requirement applies to frame timing in TX diversity, MIMO transmission, carrier aggregation and their combinations. 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.

i. For MIMO or TX diversity transmissions, at each carrier frequency, TAE shall not exceed 65 ns.

ii. For intra-band contiguous carrier aggregation, with or without MIMO or TX diversity, TAE shall not exceed 130ns.

iii. For intra-band non-contiguous carrier aggregation, with or without MIMO or TX diversity, TAE shall not exceed 260 ns.

iv. For inter-band carrier aggregation, with or without MIMO or TX diversity, TAE shall not exceed 260ns.

h. DL RS power

For LTE, DL RS power is the resource element power of the Downlink Reference Symbol.

For LTE, DL RS power of each E-UTRA carrier shall be within 2.1 dB of the DL RS power indicated on the DLSCH.

i. Occupied Bandwidth

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 0.5% of the total mean transmitted power.

The requirement applies during the transmitter ON period.

LTE Channel Bandwidths requirement is specified as 5MHz/10MHz/15MHz/20MHz for FDD and TDD systems

j. Adjacent Channel Leakage Power Ratio (ACLR)

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.

For Category A Wide Area BS, either the ACLR limits of 45 dB or the absolute limit of -13dBm/MHz shall apply, whichever is less stringent.

For Category B Wide Area BS, either the ACLR limits of 45 dB below or the absolute limit of -15dBm/MHz shall apply, whichever is less stringent.

For Medium Range BS, either the ACLR limits of 45 dB or the absolute limit of -25 dBm/MHz shall apply, whichever is less stringent.

For Local Area BS, either the ACLR limits of 45 dB or the absolute limit of -32dBm/MHz shall apply, whichever is less stringent.

For Home BS, either the ACLR limits of 45 dB or the absolute limit of -50dBm/MHz shall apply, whichever is less stringent.

For any exceptional requirement refer the Clause 6.6.2 of 3GPP TS36.141.

k. Operating band unwanted emissions

The requirements shall apply whatever the type of transmitter considered (single carrier or multi-carrier) and for all transmission modes foreseen by the manufacturer's specification.

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.

Depending upon Channel BW, Category B of BS (as defined in ITU-R SM.329) & Class of BS (as defined in clause 2.2.1), the requirement is specified and tabulated in the clause 6.6.3 of 3GPP TS36.141.

l. Transmitter spurious emissions

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. For BS capable of multi-band operation where multiple bands are mapped on the same antenna connector, this exclusion applies for each supported operating band. For BS capable of multi-band operation where multiple bands are mapped on separate antenna connectors, the single-band requirements apply and the multi-band exclusions and provisions are not applicable.

The requirements shall apply whatever the type of transmitter considered (single carrier or multi-carrier). It applies for all transmission modes foreseen by the manufacturer's specification. Unless otherwise stated, all requirements are measured as mean power (RMS).

Depending upon Category B of BS (as defined in ITU-R SM.329), the requirement is specified and tabulated hereunder:

Frequency Range	**Maximum Level for Category B (dBm)**	**Measurement BW**
9 kHz ~ 150 kHz	-36	1 kHz
150 kHz ~ 30 MHz	-36	10 kHz
30 MHz ~ 1 GHz	-36	100 kHz
1GHz ~ 12.75 GHz	-30	1 MHz

Some Exception to the requirement may be referred to clause 6.6.4 of 3GPP TS36.141.

m. Transmitter intermodulation

The transmit intermodulation requirement is a measure of the capability of the transmitter 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 via the antenna. The requirement applies during the transmitter ON period and the transmitter transient period.

For BS capable of multi-band operation where multiple bands are mapped on separate antenna connectors, the single band requirements apply regardless of the interfering signals position relative to the Inter RF Bandwidth gap.

The transmitter intermodulation level is the power of the intermodulation products when an E-UTRA signal of channel bandwidth 5 MHz as an interfering signal is injected into the antenna connector.

Depending upon the Interfering Signal Type, its level and frequency offset from the lower/upper edge of wanted signal, the BS shall meet the requirements specified in the clause 2.3.38.2k (Operating Band Unwanted Emissions)

2.3.38.3 RX Specification

a. Receiver spurious emissions

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. In this case for FDD BS the test shall be performed when both TX and RX are on, with the TX port terminated.

For TDD BS with common RX and TX antenna port the requirement applies during the Transmitter OFF period. For FDD BS with common RX and TX antenna port the transmitter spurious emission as specified in clause 6.6.4 is valid.

For BS capable of multi-band operation where multiple bands are mapped on separate antenna connectors, the single band requirements apply and the excluded frequency range is only applicable for the operating band supported on each antenna connector.

The requirements shall apply to BS that supports LTE operation.

The power of any spurious emission shall not exceed the levels in Table below:

Frequency Range	**Maximum Level (dBm)**	**Measurement BW**
30 MHz ~ 1 GHz	-57	100 kHz
1GHz ~ 12.75 GHz	-47	1 MHz

b. Blocking

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 is 5MHz LTE signal for in-band blocking or a CW signal for out-of-band blocking. The interfering signal shall be an LTE signal as specified in Annex C of 3GPP TS36.141.

For LTE, the throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel, with a wanted and an interfering signal coupled to BS antenna input using the parameters in Tables of clause 7.6 of 3GPP TS36.141.

c. Receiver intermodulation

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 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 E-UTRA signal as specified in Annex C of 3GPP TS36.141.

For E-UTRA, the throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel, with a wanted signal at the assigned channel frequency and two interfering signals coupled to the BS antenna input, with the conditions specified in Tables of clause 7.8.1 of 3GPP TS36.141.

d. Adjacent Channel Selectivity (ACS) and narrow-band blocking

Adjacent channel selectivity (ACS) is a measure of the receiver ability to receive a wanted signal at its assigned channel frequency in the presence of an adjacent channel signal with a specified centre frequency offset of the interfering signal to the band edge of a victim system. For LTE (in-band and/or guard band operation) BS, the interfering signal shall be an LTE signal as specified in Annex C of 3GPP TS36.141.

The throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel.

e. Reference sensitivity level

The reference sensitivity power level is the minimum mean power received at the antenna connector at which a throughput requirement shall be met for a specified reference measurement channel.

For LTE, the throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel as specified in Annex A.1 of 3GPP TS36.141 depending upon class of LTE BS.

LTE Channel BW (MHz)	**Reference Sensitivity Level (dBm)**			
	Wide Area BS	**Medium Area BS**	**Local Area BS**	**Home Area BS**
5	-101.5	-96.5	-93.5	-93.5
10	-101.5	-96.5	-93.5	-93.5
15	-101.5	-96.5	-93.5	-93.5
20	-101.5	-96.5	-93.5	-93.5

f. Dynamic range

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.

For E-UTRA, the throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel as specified in Annex A of 3GPP TS36.141 depending upon class of LTE BS, Wanted Signal Level, Interfering Signal Level and Interfering Signal Type as specified in the clause 7.3 of 3GPP TS36.141.

g. In-channel selectivity

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 E-UTRA signal as specified in Annex C and shall be time aligned with the wanted signal.

For E-UTRA, the throughput shall be ≥ 95% of the maximum throughput of the reference measurement channel as specified in Annex A of 3GPP TS36.141 depending upon class of LTE BS, Wanted Signal Level, Interfering Signal Level and Interfering Signal Type as specified in the clause 7.4 of 3GPP TS36.141.

2.4 Dimensioning Requirements:

2.4.1 eNB shall allow subscribers capacity to be pooled between all sectors. Baseband subscriber capacity shall be pooled over all sectors. (applicable to split architecture)

2.4.2 eNB shall be able to support at least 32 simultaneously scheduled subscribers (up to 8 users per TTI: 4 users in UL and 4 users in DL). A scheduled subscriber has data to be sent in the uplink or downlink and is queued in the scheduler.

2.4.3 eNB shall be able to support at least 32 simultaneously connected subscribers. Required number of RRC connected subscriber shall be indicated by the tenderer

2.4.4 eNB shall be able to support Omni and multi-sector configurations

2.4.5 eNB shall provide VLAN separation for O&M and X2/S1 traffic. Two separate VLANs on a common physical interface

2.4.6 For coverage target RSRP shall be as -110dBm. However, it may be reviewed in tender requirement.

3. HOME ENODEB (VOICE AND DATA)

Home eNodeBs can be used in residential and enterprise deployments.

This category maps to the “Home Base Station” category as defined in 3GPP Specification (TS 36.104)

#	BS Class	Derivation from	PRAT	#Minimum Subscribers
1	Home BS	Femto Cell Scenario	≤ 20 dBm (for one transmit antenna port) ≤17 dBm (for two transmit antenna ports) ≤ 14 dBm (for four transmit antenna ports) ≤ 11 dBm (for 8 transmit antenna ports)	8

3.1 Basic Functional Requirements

3.1.1 The system shall support self-configuration functionality

3.1.2 The system may support LIPA functionality

3.1.3 The system shall support mutual authentication with the core network

3.1.4 The system shall support secure IPSEC communication with core network if communicating over an insecure link

3.1.5 The system shall provide location information to satisfy various security, regulatory and operational requirements

3.2 Synchronization

3.2.1 eNodeB for Home BS TDD systems shall support a phase accuracy in 3GPP TS 36.133 as specified below

Cell Type	Propagation Distance	Requirement
Small cell	≤ 500 m	≤ 3 µs
Large Cell	> 500 m	≤ 1.33 + $T_{propagation}$ µs

3.3 System Specification: Refer section 2.3.38

4. IOT

eNodeB can optionally provide IOT service using the LTE-M and/or NB-IOT functionality

4.1 Basic Functional requirements

4.1.1 The system shall support eDRX function in idle mode to provide energy efficiency.

4.1.2 The system shall support PSM (Power Save Mode) to provide energy efficiency

4.1.3 The system shall support “Attach without PDN” allows the UE to be attached without having a Default PDN connection established. SMS is available to UE that has attached without PDN connection

4.1.4 The system shall support control plane optimization to transport user data within signaling on the access network until the MME

4.1.5 The system shall support user plane optimisation to transfer on the user plane data without the need for using the Service Request procedure to establish the Access Stratum (AS) when the user is in ECM-IDLE mode

4.2 Specific Requirements

4.2.1 LTE-M Requirements

4.2.1.1 The system shall support Cat M1 capability of operating in bandwidth of 1.4 MHz (6 PRBs), a single antenna, half-duplex and full duplex operation and lower peak rate

4.2.1.2 The system shall support Cat M capability in LTE eNodeB in co-existence with existing functionality

4.2.1.3 The system shall support coverage enhancements mode A.

4.2.2 NB-IOT Requirements

4.2.2.1 The system shall support at least one of the NB-IOT deployment modes defined in 3GPP: in-band, guard-band and stand-alone

4.2.2.2 The system shall support Half Duplex FDD UE (Applicable to FDD system only)

4.2.2.3 The system shall support narrow band physical uplink channel on single-tone (15 kHz or 3.75 kHz) or multi-tone (n*15 kHz, n up to 12)

5. PUBLIC SAFETY

eNodeB shall support public safety service.

5.1 Basic Functional Requirements

5.1.1 The system shall support PWS as defined in section 2.3.31

5.2 Advanced Functionality (Applicable to Category-1 only and Optional feature)

5.2.1 The eNodeB shall support ProSe/D2D for public safety using the PC5 side link channel and/or E-UTRA air interface

a. The system shall support discovery

b. The system shall support one to one communication

c. The system shall support one to many communications

d. The system shall support group communication

e. The system shall support broadcast communication to all ProSe capable UEs within the transmission range

f. The system shall support relay functionality where a given ProSe capable UEs acts as a communication relay for one or more UEs

g. The system shall support in-network coverage, partial in-network coverage and out of coverage scenarios

h. The system shall support both scheduled and autonomous resource allocation modes

5.2.2 The eNodeB shall support MCPTT

a. The system shall support access control mechanisms: Access Class Barring, Service Specific Access Control, Access control for CSFB, Extended Access Class barring

b. The system shall support ARP (Allocation and Retention Priority) parameters of priority level, the pre-emption capability and the pre-emption vulnerability during bearer establishment

c. The system shall support QOS based scheduling

d. The system shall support on network operation using either dedicated EPS bearers or MBMS bearers

e. The system shall support off network operation using ProSe Discovery and the ProSe Communication path for MCPTT Users using Public Safety ProSe-enabled UEs as a direct communication between UEs

5.2.3 The system shall support IOPS (Isolated E-UTRAN Operation for Public Safety)

Establish a stand-alone mobile LTE MCPTT network to provide local PTT communication and data coverage without backhaul connection to the centralized macro core. IOPS assumes that local EPC function is co-sited with eNodeB

6. V2X

eNodeB can optionally provide V2X service (applicable to Category 1 only)

6.1 Functional Requirements

6.1.1 The system shall support ProSe/D2D for V2X using the PC5 side link channel or E-UTRA air interface

6.1.2 The system shall support discovery

6.1.3 The system shall support one to one communication

6.1.4 The system shall support in-network coverage scenario

6.1.5 The system shall support 4 DMRS symbols per sub frame on the PC5 interface

6.1.6 The system shall support one Tx-Rx turnaround symbol at the end of each subframe on the PC5 interface

6.1.7 The system shall support deployment configuration 1 and/or deployment configuration 2 for resource scheduling and interference management

7. GENERAL REQUIREMENTS

7.1 General

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

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

7.2 Support of Multiple Equipment Vendors as per tender requirement

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

7.3 Hardware

7.3.1 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.

7.3.2 Design precautions shall be taken to minimise 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.

7.3.3 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.

7.4 Processors

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.

7.5 Input-Output devices

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

7.5.2 Input / output terminals shall be capable of transmitting/ receiving characters of a subset of the ITU-T No.5 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.

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

7.5.4 If provision is made for monitoring from a remote terminal, it shall be ensured that the data links conform to the ITU-T Recommendations 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 LTE-RAN. Special provision shall also be made for storage of failure event even when the system is unable to transmit an output message.

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

7.6 Equipment Practice

7.6.1 For a Distributed eNodeB, 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.

7.6.2 For a Distributed eNodeB, 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.

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

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

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

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

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

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

7.7 Quality Requirements

7.7.1 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.

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

7.8 Software

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

7.8.2 The software shall include the following characteristics:

7.8.2.1 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.

7.8.2.2 The functional modularity of the software shall permit introduction of changes wherever necessary with least impact on other modules.

7.8.2.3 It shall be open-ended to allow addition of new features.

7.8.2.4 Adequate flexibility shall be available to easily adopt changes in service features & facilities and technological evolution in hardware.

7.8.2.5 The design shall be such that propagation of software faults is contained.

7.8.2.6 Test programs shall include fault tracing for detection and localization of system faults.

7.9 Software Maintenance

7.9.1 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.

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

7.10 eNode B DoS (Denial of Service) Attack Protection

7.10.1 The eNode shall provide the protection against DOS attack.

The vendor shall describe how to protect against DOS attack in their system.

8. OPERATIONAL, RELIABILITY, QUALITY, EMI/ EMC, SAFETY REQUIREMENTS

8.1 System Radio Operating Environments

8.1.1 System supervision

8.1.1.1 Provision shall be made for continuous testing of the system to allow both system qualities check and fault indication as a fault arises.

8.1.1.2 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.

8.1.2 Relative UE speed

The targeted relative speed between the eNB and the mobile stations may be chosen from the following categories

a. Stationary (0 km/h)

b. Pedestrian (up to 10 km/h)

c. Typical vehicular (up to 100 km/h)

d. High speed vehicular (up to 120 km/h) – If required as per tender

e. High Speed train (up to 300 km/h) – If required as per tender

8.2 System and Network Management

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

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

8.3 Diagnostic capability

8.3.1 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.

8.3.2 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.

8.4 Environmental Test Conditions:

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

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

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

8.5 Qualitative Requirements (QR)

8.5.1 The supplier/manufacturer shall conform to ISO 9001:2008 certifications. A quality plan describing the quality assurance system followed by the manufacturer shall be required to be submitted.

8.5.2 For a Distributed eNodeB, the failure of any component/sub-system in the system shall not result in the failure of complete system.

8.6 eNodeB 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 equipments (for Radio equipments only)	IEC 60215 (1987)

8.7 eNodeB Electromagnetic Compatibility (EMC)

(These requirements shall be as per TEC Standard No. TEC/SD/DD/EMC-221/05.OCT-16 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:	IEC 61000- 4- 4 {2012);

	(a) 1 kV for AC/DC power port (b) 0. 5 kV for signal / control / data / telecom lines.	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: 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.	IEC 61000-4-6 (2013) Performance Criteria-A, Clause 9
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)	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) 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.	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. 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.	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.

9. INFORMATION FOR THE PROCURER OF PRODUCT

The procurer may specify the requirements of the following parameters out of the various values indicated in the various clauses of the GR indicated against each parameter below (as per specific deployment/application requirements suitable for the procurer's business plan)

Note: The equipment vendor shall indicate product specific configuration being offered for the type approval:

#	Tendering parameter	Options
1	eNodeB Category	Clause 2.2.2 or Home eNodeB (Clause 3)
2	eNodeB Architecture	Clause 2.3.38.1 integrated eNodeB, split architecture eNodeB, MSR based eNodeB, eNodeB with Active Antenna System
3	Output Power of eNodeB	Clause 2.2.1 (for Category 1) & 2.2.2.2 (for Category 2) to be specified The maximum power radiation shall be regulated by latest DoT guidelines/ instructions/ licensing conditions.
4	Power Supply Option AC/DC	Clause 2.3.8

5	Transmission Modes, MIMO requirements & Modulation Schemes	Clause 2.3.15
6	Number of Maximum component carriers	Clause 2.3.22
7	eMBMS Requirement	Clause 2.3.23
8	COMP Requirement	Clause 2.3.29
9	ePDCCH Requirement	Clause 2.3.34
10	Satellite Backhaul Requirement	Clause 2.3.37
11	Operation Frequency	Clause 2.3.38 FDD bands chosen from 1, 3, 5, 8,28 TDD bands chosen 40 and 41 NB-IOT as per policy guidelines
12	Channel bandwidth	Clause 2.3.38 FDD chosen from 1.4, 3, 5, 10, 15, 20 MHz TDD chosen from 1.4, 3, 5, 10, 15, 20 MHz
13	Option of TDD/FDD or both	Clause 2.3.38 Clause 2.3.18 (f), 2.3.22(b&d)
14	Service	IOT -- Clause 4 V2X --Clause 5

15	UE speed	Clause 8.1.2 Optional requirement of • High speed vehicular (up to 120 km/h) • High Speed train (up to 300 km/h)

ABBREVIATIONS

For the purpose of this document the following abbreviations apply:

AAS	Adaptive Antenna System
ACLR	Adjacent Channel Leakage Ratio
ACK	Acknowledgement (in HARQ protocols)
ACS	Adjacent Channel Selectivity
A-GPS	Assisted GPS
ANR	Automatic Neighbour Relation
APN	Access Point Name
ARP	Allocation and Retention Priority
AWGN	Additive White Gaussian Noise
BS	Base Station
CA	Carrier Aggregation
CMIP	Common Management Information Protocol
CoMP	Co-ordinated Multi-Point
CP	Cyclic prefix
CRC	Cyclic Redundancy Check
CSFB	Circuit Switched FallBack
CSG	Closed Subscriber Group
CW	Continuous Wave
D2D	Device to Device
DC	Direct Current
DFT	Discrete Fourier Transformation

DMRS	DeModulation Reference Signal
DSCP	Differential Service Code Point
DTX	Discontinuons Transmission
DwPTS	Downlink part of the special subframe (for TDD operation)
EARFCN	E-UTRA Absolute Radio Frequency Channel Number
eMPS	Enhanced Multimedia Priority Service
EMS	Element Management System
EPA	Extended Pedestrian A model
EPC	Evolved Packet Core
E-RAB	E-UTRAN Radio Access Bearer
ETU	Extended Typical Urban model
ETWS	Earthquake and Tsunami Warning System
E-UTRA	Evolved UTRA
E-UTRAN	Evolved UTRAN
EVA	Extended Vehicular A model
EVM	Error Vector Magnitude
FDD	Frequency Division Duplex
FD-MIMO	Full Dimension MIMO
FFT	Fast Fourier Transformation
FRC	Fixed Reference Channel
GP	Guard Period (for TDD operation)
GPS	Global Positioning System
GUI	Graphical User Interface
HARQ	Hybrid Automatic Repeat Request

HSS	Home Subscriber Server
ICIC	Inter-Cell Interference Co-ordination
ICS	In-Channel Selectivity
IMS	IP Multimedia Subsystem
IOPS	Isolated E-UTRAN Operation for Public Safety
IOT	Internet Of Things
ITU R	Radio communication Sector of the ITU
KPI	Key Performance Indicator
LNA	Low Noise Amplifier
LTE	Long Term Evolution
LTE-U	LTE – Unlicensed
LAA	License Assisted Access
LWA	Localized Wireless Access
MAC	Medium Access Control
MCPTT	Mission Critical Push To Talk
MCS	Modulation and Coding Scheme
MIMO	Multiple Input Multiple Output
MIB	Management Information Base
MLB	Mobility Load Balancing
MME	Mobility Management Entity
MRO	Mobility Robustness Optimization
MTBF	Mean Time Between Failure
MTTR	Mean Time To Repair
MORAN	Multi Operator RAN

MOCN	Multi Operator Core Network
NB-IOT	Narrow Band IOT
OFDM	Orthogonal Frequency Division Multiplex
OMC	Operations and Maintenance Controller
OOB	Out-of-band
OTDOA	Observed Time Difference Of Arrival
PA	Power Amplifier
PBCH	Physical Broadcast Channel
PCP	Priority Code Point
PCRF	Policy and Charging Rules Function
PDCCH	Physical Downlink Control Channel
PDN	Packet Data Network
PDSCH	Physical Downlink Shared Channel
PHY	PHYsical layer
PUSCH	Physical Uplink Shared Channel
PUCCH	Physical Uplink Control Channel
PRACH	Physical Random Access Channel
ProSe	Proximity Service
PRS	Position Reference Signal
PSM	Power Save Mode
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
RB	Resource Block
RE	Resource Element
RF	Radio Frequency
RMS	Root Mean Square (value)
RoHC	Robust Header Compression
RRH	Remote Radio Head
RS	Reference Symbol
RSRP	Reference Signal Received Power
RSI	Root Sequence Index
RX	Receiver
RLC	Radio Link Control
RRC	Radio Resource Control
SIMO	Single Input Multiple Output
SNR	Signal-to-Noise Ratio
SNMP	Simple Network Management Protocol
SON	Self Organising Network
SPV	Solar Photovoltaic Cell
SRVCC	Single Radio Voice Call Continuity
TA	Timing Advance
TDD	Time Division Duplex
TOS	Type of Service

TX	Transmitter
UE	User Equipment
UTRA	Universal Terrestrial Radio Access
UTRAN	Universal Terrestrial Radio Access Network
V2X	Vehicle to anything
VLAN	Virtual Local Area Network
VoLTE	Voice over LTE
ViLTE	Video over LTE

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