# वर्गीय आवश्यकताओं के लिए मानक

# टी.ई.सी २१०७०:२०२६

**STANDARD FOR GENERIC REQUIREMENTS**

**TEC 21070:2026**

## 5जी एनएसए के लिए ईनोडबी

**eNodeB for 5G NSA**

ISO 9001:2015



**दूरसंचार अभियांत्रिकी केंद्र**

**खुर्शीदलाल भवन, जनपथ, नई दिल्ली - ११०००१, भारत**

**TELECOMMUNICATION ENGINEERING CENTRE**

**KHURSHIDLAL BHAWAN, JANPATH, NEW DELHI–110001, INDIA**

**www.tec.gov.in**

## FOREWORD

Telecommunication Engineering Centre (TEC) functions under Department of Telecommunications (DOT), Government of India. Its activities include:

- Issue of Standards for Generic Requirements (GR), Interface Requirements (IR) and Service Requirements (SR) as well as Test guides for Telecom Products and Services;
- Issue of Technical regulations in the form of essential Requirements (ER);
- Field evaluation of products and Systems;
- National Fundamental Plans;
- Support to DOT on technology issues;
- Testing & Certification of Telecom products; and
- Designation of Conformance Assessment Bodies (CABs) for testing. 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 is the Standard for Generic Requirements (GR) of the eNodeB for Long Term Evolution (LTE) based mobile system suitable for 5G NSA (Non-Stand alone) deployment in the Indian mobile communication networks.

It specifies Technical Requirements, General Requirements, Features

and Functionality of the eNodeB for LTE based mobile system and covers eNodeB, Home eNodeB and various applications including IOT, Public Safety and V2X, which is applicable for both FDD and TDD modes of operation.

## CONVENTIONS

In this document, requirements are classified as follows:

- The keywords "shall" or “is/are required to” indicate a requirement or requirements, which must be mandatorily complied and from which no deviation is permitted, if conformance to this document is to be claimed; and
- The keywords “optional” or “may” indicate an optional requirement, which is permissible for exclusion from mandatory compliance, unless the said requirement is claimed to be complied by the vendor. These terms are not intended to imply that the vendor's implementation must provide the option; it means the vendor may optionally provide the feature and still claim conformance with this document.

**"Type Approval/ Technology Approval/ Certificate of Approval Requirements":**

1. Field trial for at least 3 weeks;
2. Demonstration/ submission of test reports (from TEC designated lab) for prescribed tests against all mandatory requirements;
3. Demonstration/ submission of test reports (from TEC designated lab) for prescribed tests against such optional requirements, if any, which are offered by the vendor voluntarily; and
4. Submission of required undertaking in respect of remaining prescribed tests, which are "optional and not offered voluntarily" or "Not Applicable".

## CONTENTS


| *Clause** | *Particulars* | *Page No.* |
|---|---|---|
| History Sheet | | 10 |
| References | | 11 |
| 1. | INTRODUCTION | 17 |
| 1.1 | Scope | 17 |
| 2. | eNodeB | 18 |
| 2.1 | Description | 18 |
| 2.2 | eNodeB Classes | 19 |
| 2.3 | Functional Requirements | 21 |
| 2.4 | Dimensioning Requirements: | 44 |
| 3. | HOME ENODEB (VOICE AND DATA) | 45 |
| 3.1 | Basic Functional Requirements | 46 |
| 3.2 | Synchronization | 46 |
| 3.3 | System Specification: Refer section 2.3.38 | 46 |
| 4. | IOT | 47 |
| 4.1 | Basic Functional requirements | 47 |
| 4.2 | Specific Requirements | 47 |
| 5. | PUBLIC SAFETY | 49 |
| 5.1 | Basic Functional Requirements | 49 |
| 5.2 | Advanced Functionality (Optional feature) | 49 |
| 6. | V2X | 51 |
| 6.1 | Functional Requirements | 51 |
| 7. | GENERAL REQUIREMENTS | 52 |
| 7.1 | General | 52 |

7.2 Support of Multiple Equipment Vendors as per tender requirement ..... 52
7.3 Hardware ..... 52
7.4 Processors ..... 52
7.5 Input-Output devices ..... 53
7.6 Power Requirements ..... 53
7.7 Equipment Practice ..... 54
7.8 Quality Requirements ..... 55
7.9 Software ..... 55
7.10 Software Maintenance ..... 56
7.11 eNode B DoS (Denial of Service) Attack Protection ..... 56
8. OPERATIONAL, RELIABILITY, QUALITY, EMI/ EMC, SAFETY REQUIREMENTS ..... 57
8.1 System Radio Operating Environments ..... 57
8.2 Operation & Maintenance ..... 58
8.3 System and Network Management ..... 59
8.4 Diagnostic capability ..... 59
8.5 Environmental Test Conditions: ..... 59
8.6 Qualitative Requirements (QR) ..... 60
8.7 eNodeB Safety Requirements ..... 60
8.8 eNodeB Electromagnetic Compatibility (EMC) ..... 60
9. 3GPP RELEASE 15 FEATURES ..... 65
9.1 "Non-Stand Alone" (NSA) ..... 65
9.2 NB-IOT related features ..... 66
9.3 Enhancements on LTE-Based Cellular V2X Services (Optional – depending on specific use case deployment) ..... 66
9.4 UE Positioning Accuracy Enhancements for LTE (Optional – As per tenderer requirement depending on use case deployment) ..... 66
9.5 eNodeB shall support high power UE (power class 2) for EN-DC ..... 67

9.6 eNodeB shall support LTE emergency call handling with NR standalone (Emergency call support with EPS Fallback) ..... 67

9.7 eNodeB shall support TM8 downlink single-user MIMO on TDD SCell for LTE massive – MIMO. (Applicable for massive MIMO deployment) ..... 67

9.8 eNodeB should support handover from EN-DC to NR SA to reduce interruptions of data flows/voice during session transition from an LTE cell to an NR cell (Optional - As per tenderer requirement depending on use case deployment) ..... 67

10. 3GPP RELEASE 16 FEATURES ..... 68

10.1 Additional enhancements for NB-IoT (Optional – As per tenderer requirement depending on use case deployment) ..... 68

10.2 Additional MTC enhancements for LTE (Optional – As per tenderer requirement depending on use case deployment) ..... 69

10.3 High power UE (power class 2) for EN-DC (1 LTE TDD band + 1 NR TDD band)( Applicable for TDD Deployment) ..... 69

10.4 LTE-NR enhancements (Optional) ..... 69

10.5 Mobility enhancement in E-UTRAN (Optional – As per tenderer requirement) ..... 70

10.6 DL MIMO efficiency enhancements for LTE (Optional – As per tenderer requirement) ..... 70

10.7 eNodeB should support LTE uplink RRC message segmentation ..... 70

11. INFORMATION FOR THE PROCURER OF PRODUCT ..... 71

## HISTORY SHEET

| *S.No.* | *GR No.* | *Title* | *Remarks* |
|---|---|---|---|
| 1. | TEC 21070:2023 | Standard for Generic Requirement for eNodeB for 5G NSA | New GR |
| 2. | TEC 21070:2026 | Standard for Generic Requirement for eNodeB for 5G NSA | Revised |

## 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)** | TEC 25534:2022 (3GPP TS 36.306) | "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio access capabilities " |
| **4)** | TEC 25516:2022 (3GPP TS 36.101 | "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception |
| **5)** | TEC 25517:2022 (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 37.141 | Digital cellular telecommunications system (Phase 2+) (GSM); Universal Mobile Telecommunications System (UMTS); LTE; E-UTRA, UTRA and GSM/EDGE; Multi-Standard Radio (MSR) Base Station (BS) conformance testing |

| | | |
|---|---|---|
| **8)** | 3GPP TS 37.145-1 | Universal Mobile Telecommunications System (UMTS); LTE; Active Antenna System (AAS) Base Station (BS) conformance testing; Part 1: conducted conformance testing |
| **9)** | TEC 25537:2022 (3GPP TS 36.321) | "Evolved Universal Terrestrial Radio Access (E-UTRA); Medium Access Control (MAC) protocol specification". |
| **10)** | TEC 25538:2022 (3GPP TS 36.322) | "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Link Control (RLC) protocol specification ". |
| **11)** | TEC 25539:2022 (3GPP TS 36.323) | "Evolved Universal Terrestrial Radio Access (E-UTRA); Packet Data Convergence Protocol (PDCP) specification ". |
| **12)** | TEC 25540:2022 (3GPP TS 36.331) | "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification". |
| **13)** | TEC 25524:2022 (3GPP TS 36.201) | "Evolved Universal Terrestrial Radio Access (E-UTRA); LTE physical layer; General description ". |
| **14)** | TEC 25525:2022 (3GPP TS 36.211) | "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical channels and modulation ". |
| **15)** | TEC 25526:2022 (3GPP | "Evolved Universal Terrestrial Radio |

| | | |
|---|---|---|
| | TS 36.212) | Access (E-UTRA); Multiplexing and channel coding ". |
| **16)** | TEC 25527:2022 (3GPP TS 36.213) | "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures ". |
| **17)** | TEC 25528:2022 (3GPP TS 36.214) | "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer; Measurements ". |
| **18)** | TEC 25530:2022 (3GPP TS 36.300) | "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2". |
| **19)** | TEC 25523:2022 (3GPP TS 36.133) | "Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of radio resource management ". |
| **20)** | TEC 25546:2022 (3GPP TS 36.411) | "S1 Layer 1". |
| **21)** | TEC 25548:2022 (3GPP TS 36.413) | "S1Application protocol (S1AP) ". |
| **22)** | TEC 25550:2022 (3GPP TS 36.420) | “X2 General aspects and principles” |
| **23)** | TEC 25553:2022 (3GPP TS 36.423) | “X2 Application protocol (X2AP)” |

| | | |
|---|---|---|
| **24)** | 3GPP TS 23.401 | "General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access" |
| **25)** | 3GPP TS 32.511 | "Telecommunication management; Automatic Neighbour Relation (ANR) management; Concepts and requirements" |
| **26)** | 3GPP TS 23.216 | "Single Radio Voice Call Continuity (SRVCC); Stage 2" |
| **27)** | 3GPP TS 36.171 | "Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for Support of Assisted Global Navigation Satellite System (A-GNSS)" |
| **28)** | TEC 25553:2022 (3GPP TS 36.305) | "Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Stage 2 functional specification of User Equipment (UE) positioning in E-UTRAN". |
| **29)** | TEC 25562:2022 (3GPP TS 36.455) | "Evolved Universal Terrestrial Radio Access (E-UTRA); LTE Positioning Protocol A (LPPa)". |
| **30)** | 3GPP TS 33.117 | Catalogue of general security assurance requirements |
| **31)** | 3GPP TS 33.401 | 3GPP System Architecture Evolution |

| | | |
|---|---|---|
| | | (SAE);<br>Security architecture |
| **32)** | TEC 25523:2022 (3GPP TS 36.133) | Evolved Universal Terrestrial Radio Access (E-UTRA);<br>Requirements for support of radio resource management |
| **33)** | ISO-9001:2008 | "Quality Management System – Requirement". |
| **34)** | IS-41D & E | "Cellular Radio Telecommunications Intersystem Operations" |
| **35)** | CISPR 22 (2003) | "Limits and methods of measurement of radio disturbance characteristics of Information Technology Equipment". |
| **36)** | EN55022 | "Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment" |
| **37)** | IEC 60479-1 (1984) | "Effects of current on human beings: Part 1" |
| **38)** | IEC 60215 (1987) | "Safety requirements of radio transmitting equipment (for Radio equipment only)" |
| **39)** | IEC-60950 (2001) | "Information technology equipment – Safety" |
| **40)** | IS 13252 part 1:2010 | "Information Technology Equipment – |

| | | |
|---|---|---|
| | | Safety- Part 1: General Requirements" |
| **41)** | IEC 60950-1 {2005} | "Information Technology Equipment – Safety- Part 1: General Requirements" |
| **42)** | IEC 60215 (1987) | Safety requirements of radio transmitting equipments (for Radio equipments only) |
| **43)** | CISPR 22 (2008) OR<br>CISPR 32 Class-A | Conducted and Radiated Emission |
| **44)** | IEC-61000 | Electromagnetic Compatibility |
| **45)** | TEC/SD/DD/EMC-221/05/OCT-16 | "Electromagnetic Compatibility Standard for Telecommunication Equipment" |
| **46)** | ITU-R SM.329 | Unwanted emissions in the spurious domain |
| **47)** | Gazette Notification No. 18-10/2017-IP dated 29th August 2018 | Public Procurement (Preference to Make in India) Order 2017 – Notification of Telecom Products,<br>Services or Works - Regarding |

# 1. INTRODUCTION

## 1.1 Scope

This document contains the Generic Requirements (GR) of Long Term Evolution (LTE) eNodeB suitable for 5G NSA (Non Standalone) 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.

This document specifies Technical Requirements, General Requirements, Features and Functionality of the eNodeB System.

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

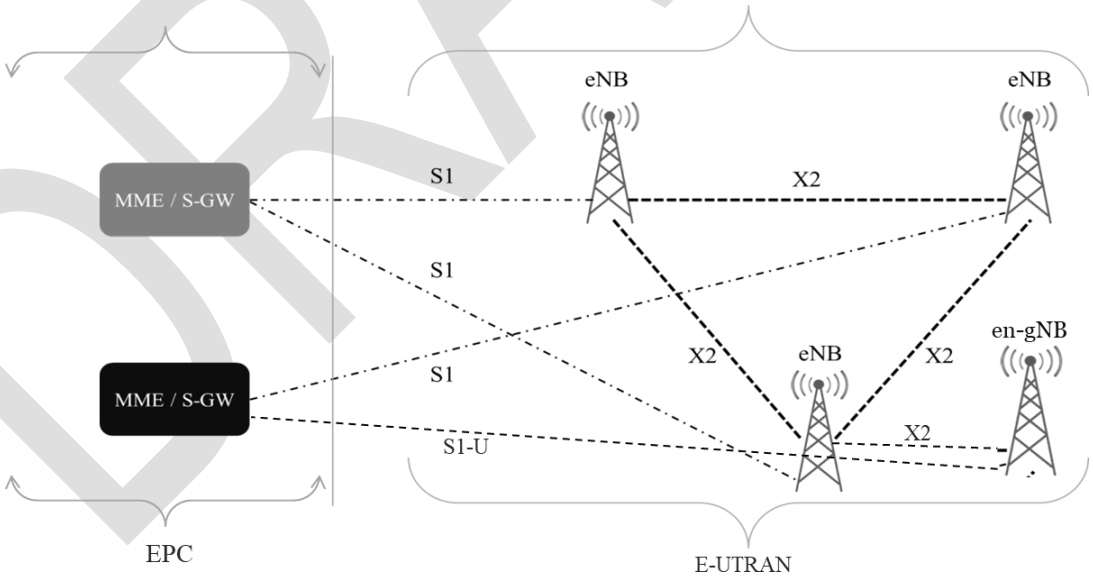
This document is applicable for both FDD and TDD modes of operation.

# 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.

In 5G NSA EN-DC mode, eNodeB has the capability to connect to en-gNB through X2 interface. In EN-DC, the 4G's eNodeB is the Master Node (MN) while the 5G's en- gNB is the Secondary Node (SN).



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 or split into DU and CU functionality and Remote radio head (RRH)/ ORU connected via a CPRI/e-CPRI or OBSAI interface or another standardized interface. This also covers centralised/cloud RAN (C-RAN)/ vRAN/ O-RAN/ based architecture .

This Standard for 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

## 2.3 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

a. Event-triggered measurement reporting and

b. NR measurements and reporting for EN-DC operation.

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.

2.3.2.3 eNodeB shall support NSA radio protocol user plane architecture for EN-DC operation.

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.

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.

2.3.4.23 The eNodeB shall support QoS aware scheduling in Downlink and Uplink.

2.3.4.24 LTE-LAA / eLAA Enhancements

a. eNodeB may support Licensed Assisted Access (LAA).
b. eNodeB may support enhanced LAA (eLAA) for uplink operation in unlicensed spectrum.
c. eNodeB may support Listen Before Talk (LBT) mechanism.

2.3.4.25 Support for SPS (Semi Persistent Scheduling) and TTI (Transmission Time Interval) Bundling to enable efficient VoLTE calls.

2.3.4.26 eNodeB shall support LTE-NR coexistence mechanisms for NSA deployment.

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
    1. Core network signalling data transfer function
    2. 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

2.3.5.2 eNodeB shall support interoperability with EPC networks implementing Control and User Plane Separation (CUPS) architecture.

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

h. Support for ENDC procedures (like ENDC X2 Setup, EN-DC X2 Setup, EN-DC Cell Activation, E-UTRA - NR Cell Resource Coordination, EN-DC X2 Removal)

i. Idle mode and connected mode mobility support between eNodeB and 5G (Depending on 5G NSA architecture option as specified by tenderer).

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 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.

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

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

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

2.3.7.5 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).

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

2.3.7.7 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.

2.3.8 Ethernet Transport features

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

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

2.3.9 IP Transport

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

2.3.10 QoS in The Transport Layer

2.3.10.1 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.

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

2.3.10.3 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.

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

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

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

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

2.3.11 eNodeB Synchronization

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

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

a. GPS

b. IEEE 1588 V2

c. SyncE

d. IRNSS timing source

2.3.11.2 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 |

2.3.11.3 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.

2.3.12 Security IPsec in Transport

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

2.3.12.2 eNodeB shall support User Plane Integrity Protection for LTE.

2.3.13 Transmission Modes, MIMO requirements & Modulation Schemes

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

2.3.13.1 The eNodeB shall support configuration of a single 4T4R radio unit as two independent 2T2R cells.

2.3.14 LTE QoS Requirements

a. The eNodeB shall support all nine basic Quality of Service Class Identifiers (QCIs) (1-9).
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

g. The eNodeB shall support Operator defined Quality of Service Class Identifiers (QCIs) (Optional – As per tenderer requirement)

2.3.15 LTE QoS Requirements Advanced

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. eNodeB shall support all QCI's of LTE to be supported GBR/Non-GBR, Dynamic addition and deletion of bearers Up to 4 Bearers per User

c. 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)

d. 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.

e. 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.

2.3.16 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

2.3.17 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-UTRANSeamless handover of UE's in the network. Handover interruption time upto 130ms

2.3.18 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.

2.3.19 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.

2.3.20 Carrier Aggregation

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 cellsThe eNodeB shall support the following Carrier Aggregation band combinations:

- Band 28 + Band 41 (FDD-TDD Inter-band CA, 2CC)
- Band 1 + Band 41 (FDD-TDD Inter-band CA, 2CC)

2.3.21 Band 28 + Band 1 (FDD-FDD Inter-band CA, 2CC)eMBMS (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

2.3.22 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

2.3.23 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

c. eNodeB shall support UE Positioning Accuracy Enhancements for LTE.

2.3.24 Interference Mitigation Requirements

a. The eNodeB shall support Interference Rejection Combining in its PHY layer receiver for improved performance in interference limited scenarios.

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.

2.3.25 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

e. eNodeB shall support advanced cell sleep mechanisms.

f. eNodeB shall support traffic adaptive transmission power optimization

g. eNodeB shall support enhanced MDT data collection and reporting capabilities.

2.3.26 SON Advanced requirements

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 enhanced 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

a. Inter site IFLB intersite source and target cell coordiation over X2 , A4/RRC redirection HO event for inter carrier support on load balancing

b. Control and user plane metrics , HO delay metrics , Missing neighbour detection for ANR , PCI conflict and confusion detection for SON

c. Remote interference cell detection on TDD for ducting mitigation and reporting high UL RSSI victim cells to SON

d. Configurable special sub frame ( SSF 7 to 5 ) during ducting.

e. CTR ( event failure traces ) and MDT trace log collection for trouble shooting and Drive less tuning

2.3.27 Coordinated Multi-Point (CoMP) (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

2.3.28 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 UM mode for GBR and interactive services; AM mode for non-GBR packet-switched sessions.

e. 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.

f. eNodeB shall support uplink-triggered VoLTE mobility
g. eNodeB shall support Enhanced VoLTE performance.
h. eNodeB shall support Enhanced Calling Name Service
i. eNodeB shall support full support for Semi-Persistent Scheduling (SPS) and TTI Bundling to ensure high-quality voice and HD-Voice Support Good MoS Score for Cell Center (>4) and Cell Edge (>3.5)

2.3.29 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
c. Cell broadcast feature to be supported

2.3.30 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.

2.3.31 Active RAN Sharing

2.3.31.1 MOCN

a. The eNodeB shall indicate the support of multiple operator
b. The eNodeB shall route operator specific traffic to its respective core network

2.3.31.2 The eNodeB shall support MORAN architecture enabling multiple operators to share the same RAN infrastructure while maintaining separate carrier frequencies and spectrum resources for each operator.

2.3.32 ePDCCH (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.

2.3.33 Overload handling

a. 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.

b. The eNodeB shall support overload and congestion control mechanisms including Access Class Barring (ACB), transport resource overload control, and priority handling for emergency calls and emergency paging.

2.3.34 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

2.3.35 System Specifications

| Clause | Parameter | Standard | Notes |
|---|---|---|---|
| 1 | Operating Frequency<br>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 | |

2.3.35.1 System Specification eNodeB

These specifications shall be applicable for

a. integrated eNodeB

b. Split / Distributed architecture eNodeB

c. MSR based eNodeB

d. eNodeB with Active Antenna System

2.3.35.2 Tx Specifications

a) Tx Specification for integrated eNodeB and Split/Distributed architecture eNodeB

| S.No | Parameter Name | Standard |
|---|---|---|
| 01 | Operating band unwanted emissions | 3GPP TS 36.141 Clause 6.6.3 |
| 02 | Adjacent Channel Leakage power Ratio (ACLR) | 3GPP TS 36.141 Clause 6.6.2 |
| 03 | Home BS output power for adjacent UTRA channel protection : Applicable to Home base Station only | 3GPP TS 36.141 Clause 6.2.6 |
| 04 | Home BS output power for adjacent E-UTRA channel protection: Applicable to Home base Station only | 3GPP TS 36.141 Clause 6.2.7 |
| 05 | Home BS output power for co-channel E-UTRA protection: Applicable to Home base | 3GPP TS 36.141 Clause 6.2.8 |

| | | |
|---|---|---|
| | Station only | |
| 06 | Transmitter spurious emissions | 3GPP TS 36.141 Clause 6.6.4 |
| 07 | Base station output power | 3GPP TS 36.141 Clause 6.2 |
| 08 | Transmitter intermodulation | 3GPP TS 36.141 Clause 6.7 |

b) Tx Specification for MSR based eNodeB

| S.No | Parameter Name | Standard |
|---|---|---|
| 01 | Operating band unwanted emissions | 3GPP TS 37.141 Clause 6.6.2 |
| 02 | Adjacent Channel Leakage power Ratio (ACLR) | 3GPP TS 37.141 Clause 6.6.4 |
| 03 | Transmitter spurious emissions | 3GPP TS 37.141 Clause 6.6.1 |
| 04 | Base station output power | 3GPP TS 37.141 Clause 6.2 |
| 05 | Transmitter intermodulation | 3GPP TS 37.141 Clause 6.7 |

c) Tx Specification for eNodeB with Active Antenna System

| S.No | Parameter Name | Standard |
|---|---|---|
| 01 | Operating band unwanted emissions | 3GPP TS 37.145-1 Clause 6.6.5 |
| 02 | Adjacent Channel Leakage power Ratio (ACLR) | 3GPP TS 37.145-1 Clause 6.6.3 |
| 03 | Transmitter spurious emissions | 3GPP TS 37.145-1 Clause 6.6.6 |
| 04 | Base station output power | 3GPP TS 37.145-1 Clause 6.2 |
| 05 | Transmitter intermodulation | 3GPP TS 37.145-1 Clause 6.7 |
| 06 | Spectrum emission mask | 3GPP TS 37.145-1 Clause 6.6.4 |

2.3.35.3 RX Specification

a) Rx Specification for integrated eNodeB and Split/Distributed architecture eNodeB

| S.No | Parameter Name | Standard |
|---|---|---|
| 01 | Receiver spurious emissions | 3GPP TS 36.141 Clause 7.7 |
| 02 | Blocking | 3GPP TS 36.141 Clause 7.6 |
| 03 | Receiver intermodulation | 3GPP TS 36.141 Clause 7.8 |

| | | |
|---|---|---|
| 04 | Adjacent Channel Selectivity (ACS) and narrow-band blocking | 3GPP TS 36.141 Clause 7.5 |
| 05 | Reference sensitivity level | 3GPP TS 36.141 Clause 7.2 |

b) Rx Specification for MSR based eNodeB

| S.No | Parameter Name | Standard |
|---|---|---|
| 01 | Receiver spurious emissions | 3GPP TS 37.141 Clause 7.6 |
| 02 | In-band selectivity and blocking | 3GPP TS 37.141 Clause 7.4 |
| 03 | Out-of-band blocking | 3GPP TS 37.141 Clause 7.5 |
| 04 | Receiver intermodulation | 3GPP TS 37.141 Clause 7.7 |
| 05 | In-band selectivity and blocking | 3GPP TS 37.141 Clause 7.4 |
| 06 | Reference sensitivity level | 3GPP TS 37.141 Clause 7.2 |

c) Rx Specification for eNodeB with Active Antenna System

| S.No | Parameter Name | Standard |
|---|---|---|
| 01 | Reference sensitivity level | 3GPP TS 37.145-1 Clause 7.2 |
| 02 | Adjacent channel selectivity and narrowband blocking | 3GPP TS 37.145-1 Clause 7.4 |
| 03 | Blocking | 3GPP TS 37.145-1 Clause 7.5 |
| 04 | Receiver spurious emissions | 3GPP TS 37.145-1 Clause 7.6 |
| 05 | Receiver intermodulation | 3GPP TS 37.145-1 Clause 7.7 |

## 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, which 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)<br>≤17 dBm (for two transmit antenna ports)<br>≤ 14 dBm (for four transmit antenna ports)<br>≤ 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

4.1.6 eNodeB should support deterministic latency optimization for industrial IoT applications.

4.1.7 eNodeB shall support optimized small data transmission procedures for massive IoT deployment.

4.1.8

## 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)

4.2.2.4 eNodeB shall support enhanced NB-IoT coverage extension mechanisms.

4.2.2.5 eNodeB shall support:

a. Support for multicast firmware update over NB-IoT.
b. Support for improved mobility for NB-IoT devices.
c. Support for connected mode mobility enhancements.

4.2.2.6

# 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 (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 MCX

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 MCX Users using Public Safety ProSe-enabled UEs as a direct communication between Ues

f. Support for Mission Critical QCI's at RAN QCI-65,66,69,70,71

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

5.2.4 Establish a stand-alone mobile LTE MCX 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 eNodeBeNodeB shall support enhanced MCPTT performance optimization

5.2.5 eNodeB shall support Enhancements to MC Video/ MC Data

5.2.6 eNodeB shall support sidelink relay enhancements for public safety communications

# 6. V2X

eNodeB can optionally provide V2X service.

## 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

6.1.8 eNodeB shall support enhanced sidelink resource allocation for vehicular communication

6.1.9 eNodeB shall support congestion control for LTE V2X communication

6.1.10 eNodeB shall support enhanced sidelink scheduling and resource allocation.

6.1.11

# 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.

7.1.3 eNodeB should support AI-assisted energy optimization mechanisms.

7.1.4 eNodeB shall support dynamic carrier shutdown during low traffic conditions.

## 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 Power Requirements

7.6.1 eNodeB shall support DC / AC power supply

7.6.2 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.

7.6.3 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)

**7.7 Equipment Practice**

7.7.1 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.

7.7.2 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.

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

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

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

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

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

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

**7.8 Quality Requirements**

7.8.1 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.

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

**7.9 Software**

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

7.9.2 The software shall include the following characteristics:

7.9.2.1 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.

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

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

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

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

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

**7.10 Software Maintenance**

7.10.1 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.

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

**7.11 eNode B DoS (Denial of Service) Attack Protection**

7.11.1 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 Operation & Maintenance

8.2.1 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.

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

a. XML

b. TR.069

c. SNMP

8.2.3 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.

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

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

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

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

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

8.2.9 The eNodeB shall have reboot / restart capability.

8.2.10 Performance Monitoring and KPI Reporting

The eNodeB shall provide sufficient and suitable data to enable KPI monitoring for at least the following KPIs:

a. RRC connection setup success rate and drop rate
b. ERAB setup success rate and drop rate
c. VoLTE setup success rate and drop rate
d. DL and UL data volume
e. Intra-freq, Inter-freq and Inter-RAT Handover success rate
f. PRB utilization in DL and UL
g. Cell throughput DL and UL (average and peak)

h. Per QCI DL/UL volumes, DL/UL total packet count, Per QCI DL/UL lost packet count

**8.3 System and Network Management**

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

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

8.3.3 eNodeB shall support Common API Framework for 3GPP Northbound APIs.

8.3.4

**8.4 Diagnostic capability**

8.4.1 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.

8.4.2 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.

**8.5 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

## 8.6 Qualitative Requirements (QR)

8.6.1 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.

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

## 8.7 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"<br><br>[equivalent to IEC 60950-1 {2005} "Information Technology Equipment –Safety- Part 1: General Requirements"]<br>OR<br>IEC 62368-I:2014 | IS 13252 part 1:2010 / IEC 60950-1 {2005} part 1;<br><br>OR<br><br>IEC 62368-I:2014 |
| 2 | IEC 60215 (1987) Safety requirements of radio transmitting equipments (for Radio equipments only) | IEC 60215 (1987) |

## 8.8 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<br>CISPR 32<br>Class-A |
| 2 | Immunity to Electrostatic discharge: Contact discharge level 2 {± 4 kV} | IEC-61000-4-2<br>Performance Criteria-B, Clause 9 |
| 3 | Immunity to Electrostatic discharge: Air discharge level 3 {± 8 kV} | IEC-61000-4-2<br>Performance Criteria-B, Clause 9 |
| 4 | Immunity to radiated RF:<br>(a) Radio Frequency: 80 MHz to 1 GHz, Electromagnetic field: 3V/m<br>(b) Radio Frequency: 800 MHz to 960 MHz, Electromagnetic field: 10V/m<br>(c) Radio Frequency: 1.4 GHz to 6 GHz, Electromagnetic field: 10V/m | IEC 61000-4-3 (2010);<br>Performance Criteria-A, Clause 9 |
| 5 | Immunity to fast transients (burst): Test Level 2:<br>(a) 1 kV for AC/DC power port<br>(b) 0. 5 kV for signal / control / data / telecom lines. | IEC 61000- 4- 4 {2012);<br>Performance Criteria-B, Clause 9 |
| 6 | Immunity to surges: AC/DC ports | IEC 61000-4-5 |

| | | |
|---|---|---|
| | a. 2 kV peak open circuit voltage for line to ground<br>b. 1kV peak open circuit voltage for line to line | (2014)<br>Performance Criteria-B, Clause 9 |
| 7 | Immunity to surges: Telecom ports<br>(a) 2 kV peak open circuit voltage for line to ground coupling.<br>(b) 2 kV peak open circuit voltage for line to line coupling. | IEC 61000-4-5 (2014)<br>Performance Criteria-C, Clause 9 |
| 8 | Immunity to conducted disturbance induced by Radio frequency fields:<br>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)<br>Performance Criteria-A, Clause 9 |
| 9 | Immunity to voltage dips & short interruptions (applicable to only ac mains power input ports, if any):<br>Limits: -<br>(a) a voltage dip corresponding to a reduction of the supply voltage of 30% for 500ms (i.e. 70% supply voltage for 500ms)<br>(b) a voltage dip corresponding to a reduction of the supply voltage of 60% for 200ms; (i.e.40% supply voltage for 200ms)<br>(c) a voltage interruption corresponding to a reduction of supply voltage of > 95% for 5s. | IEC 61000-4-11 (2004):<br>a. Performance Criteria B for Reduction of Supply 30% for 500ms or Dip to reduction of 60% for 100ms<br>b. Performance Criteria C for Reduction of 60% for 200ms |

| | | |
|---|---|---|
| | (d) a voltage interruption corresponding to a reduction of supply voltage of >95% for 10ms. | c. Performance criteria C for Voltage Interruption>95% for 5 s<br><br>(Note: In case of Battery back-up performance criteria A is applicable).<br><br>d. Performance CriteriaB for Voltage Interruption >95% duration :10ms<br><br>(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):<br>a. Voltage Interruption with 0% of supply for 10ms.<br><br>b. Voltage Interruption with 0% of supply for 30ms, 100ms, 300ms and 1000ms. | IEC 61000-4-29(2000)<br>a. Applicable Performance Criteria shall be B.<br><br>b. Applicable Performance |

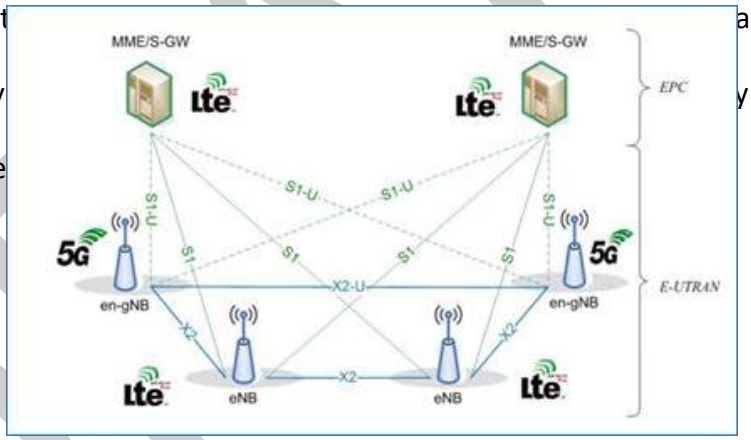
| | | |
|---|---|---|
| | c. Voltage dip corresponding to 40% & 70% of supply for 10ms, 30 ms.<br>d. Voltage dip corresponding to 40% & 70% of supply for 100ms, 300 ms and 1000 ms.<br>e. Voltage variations corresponding to 80% and 120%of supply for 100 ms to 10s as per Table 1c of IEC 61000-4-29. | Criteria shall be C.<br>c. Applicable Performance Criteria shall be B.<br>d. Applicable Performance Criteria shall be C.<br>e. Applicable Performance Criteria shall be B. |

# 9. 3GPP RELEASE 15 FEATURES

In 3GPP Release 15, support for 5G NR through dual connectivity (DC) using option 3 architecture – ENDC is there, where the eNodeB interworks with the en-gNB. Other features related to carrier aggregation, coding etc. have also been added. The features are given in detail in the following clauses. The tenderer may specify which features from this section need to be supported, apart from Clause 9.1 "Non-Stand Alone" (NSA) which has to be supported.

## 9.1 "Non-Stand Alone" (NSA)

Non-Standalone architecture, where the 5G Radio Access Network (AN) and its New Radio (NR) interface is used in conjunction with the existing LTE and EPC infrastructure Core Network (respect as "E-UTRA-NR Dual Connectivity y implemented for NR-NSA mode




(Source: 3GPP TS 38.104)

[1] Option 3 includes Option 3a, Option 3x, as specified by the tenderer.

The NSA offers dual connectivity, via both the 4G RAN (E-UTRA) and the 5G AN (NR). It is thus also called "EN-DC", for "E-UTRAN 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).

i) Support for ENDC procedures (like ENDC X2 Setup, EN-DC X2 Setup, EN-DC Cell Activation, E-UTRA - NR Cell Resource Coordination, EN-DC X2 Removal)

ii) eNodeB Shall support idle mode and connected mode mobility towards 5G on S1 or X2 interface.

**9.2 NB-IOT related features**

9.2.1. Mobile Originating Early Data Transmission (MO-EDT)

9.2.2. Wake-Up Signalling (WUS)

**9.3 Enhancements on LTE-Based Cellular V2X Services (Optional – depending on specific use case deployment)**

9.3.1 Shall support carrier aggregation (upto 8 PC5 carriers).

9.3.2 Shall support 64QAM.

**9.4 UE Positioning Accuracy Enhancements for LTE (Optional – As per tenderer requirement depending on use case deployment)**

9.4.1 Support for a new UE GNSS carrier phase measurement

9.4.2 RTK (Real Time Kinematic) GNSS (Global Navigation Satellite System) requires three additional technical enhancements:

i. the UE measures the carrier phase (in addition to the code phase) of each satellite signal

ii. one or more reference receivers (also called reference stations) in the vicinity of the UE, each with precisely known position, measures the code and carrier phase measurements of the same GNSS signals observed by the UE

iii. Raw measurements from these reference receivers (also called corrections data) need to be communicated to the UE

9.4.3 The E-SMLC supports transport of corrections/positioning assistance data from E-SMLC to the eNB using the LPPa protocol.

**9.5 eNodeB shall support high power UE (power class 2) for EN-DC**

**9.6 eNodeB shall support LTE emergency call handling with NR standalone (Emergency call support with EPS Fallback)**

**9.7 eNodeB shall support TM8 downlink single-user MIMO on TDD SCell for LTE massive – MIMO. (Applicable for massive MIMO deployment)**

**9.8 eNodeB may support shortened TTI and reduced processing time enhancements for LTE.**

**9.9 eNodeB should support handover from EN-DC to NR SA to reduce interruptions of data flows/voice during session transition from an LTE cell to an NR cell (Optional - As per tenderer requirement depending on use case deployment)**

**9.10 The eNodeB shall support Secondary Cell Group (SCG) failure detection and recovery procedures for EN-DC operation.**

**9.11 The eNodeB shall support Split Signalling Radio Bearer (SRB3) operation for EN-DC.**

**9.12 The eNodeB may support PDCP duplication for EN-DC to improve reliability and**

**latency performance.**

**9.13 The eNodeB shall support NR measurement configuration, reporting and event handling for EN-DC mobility.**

**9.14 eNodeB may support enhanced LTE features for aerial vehicle connectivity.**

**9.15 eNodeB shall support EPC enhancements to support 5G New Radio via Dual Connectivity.**

## 10. 3GPP RELEASE 16 FEATURES

Features related to NB-IOT, MTC, Dual Connectivity etc. have been specified. The features are given in detail in the following clauses. The tenderer may specify which features from this section need to be supported.

**10.1 Additional enhancements for NB-IoT (Optional – As per tenderer requirement depending on use case deployment)**

a. Increased spectral efficiency for NBIoT transmissions and reduced energy consumption for NB-IoT devices enabled by:

i. Enhanced mobile-terminated early-data transmission, which can be used by idle mode UE to receive a small amount of data without having to transition to connected mode.

ii. UE-group wake-up signaling by means of which the network can wake up a configurable group of UEs, thereby reducing power consumption for the UEs. Up to 8 groups may be configured per wake-up-signal resource.

iii. Uplink transmission using preconfigured resources in idle mode, allowing the device to avoid time-consuming randomaccess procedures.

iv. Multi-transport-block scheduling in both the downlink and uplink transmission directions.

v. Reducing the control-signaling overhead.

vi. Enhanced downlink-quality reporting from the device in both idle and connected mode,

vii. Enabling improved link adaptation.

viii. Mobility enhancements by means of new system information to assist idle-mode inter-RAT cell selection for NB-IoT to and from LTE, LTE-MTC and GERAN.

**10.2 Additional MTC enhancements for LTE (Optional – As per tenderer requirement depending on use case deployment)**

10.2.1 eMTC Shall support IOT through lower device complexity and provides extended coverage.

a. Increased spectral efficiency for massive MTC transmissions and reduced energy consumption for massive-MTC devices, enabled by:

i. Enhanced mobile-terminated early-data transmission, which can be used by idle-mode UEs to receive a small amount of data without having to transition to connected mode.

ii. UE-group wake-up signaling allowing the network to wake up a configurable group of UEs (instead of all UEs), thereby reducing UE energy consumption

iii. Enhanced downlink-quality reporting from the UE in both idle and connected mode, enabling improved link

**10.3 High power UE (power class 2) for EN-DC (1 LTE TDD band + 1 NR TDD band)( Applicable for TDD Deployment)**

**10.4 LTE-NR enhancements (Optional)**

10.4.1 Support for Master Cell Group (MCG)' Secondary Cell Group (SCG) and split bearer with serving cells in same frequency range

10.4.2 Early measurement reporting from neighbor and serving cells to reduce the delay when setting up dual connectivity and/or carrier aggregation.

10.4.3 Shall support Efficient and low-latency serving-cell configuration/activation/setup by minimizing the signaling overhead and latency needed for cell setup and cell activation

**10.5 Mobility enhancement in E-UTRAN (Optional – As per tenderer requirement)**

10.5.1 Shall support DAPS (Dual active protocol stack).

**10.6 DL MIMO efficiency enhancements for LTE (Optional – As per tenderer requirement)**

10.6.1 Shall support SRS transmission to improve SRS Capacity as well as Extended SRS coverage.

10.6.2 Shall support Virtual Cell ID.

**10.7 eNodeB should support LTE uplink RRC message segmentation**

**10.8 eNodeB shall support Dual Connectivity (EN-DC) with up to 3 downlink bands and 3 uplink bands.**

**10.9 eNodeB shall support NR mobility enhancements for EN-DC operation.**

**10.10 eNodeB shall support LTE-NR dual connectivity enhancements and carrier aggregation enhancements.**

## 11. 3GPP RELEASE 17 FEATURES

Release-17 introduces further enhancements for LTE evolution in support of 5G deployment, EN-DC operation, mobility, positioning, IoT and network efficiency. The tenderer may specify which features from this section need to be supported.

a. **EN-DC and NR Carrier Aggregation Enhancements (Optional)**
b. **eNodeB may support intra-band non-collocated EN-DC/NR-CA deployment.**
c. **eNodeB may support enhanced EN-DC procedures for efficient operation with NR Carrier Aggregation.**
d. **eNodeB may support improved mobility procedures for EN-DC deployments involving NR Carrier Aggregation.**

**11.1 LTE-NR Coexistence Enhancements (Optional)**

a. **eNodeB may support enhanced LTE-NR coexistence mechanisms for NSA deployment.**
b. **eNodeB may support efficient spectrum utilization between LTE and NR carriers.**
c. **eNodeB may support enhanced NR Dynamic Spectrum Sharing (DSS).**

**11.2 Mobility Enhancements for E-UTRAN and EN-DC (Optional)**

a. **eNodeB may support improved mobility robustness between E-UTRAN and NG-RAN.**
b. **eNodeB may support direct data forwarding between NG-RAN and E-UTRAN nodes during inter-system mobility.**
c. **eNodeB may support enhanced handover procedures for LTE-NR dual connectivity deployments.**

**11.3 MDT and SON Enhancements for NR and EN-DC**

**11.4 eNodeB may support enhanced positioning assistance for LTE and LTE-NR deployments.**

**11.5 eNodeB may support enhanced LTE/NR Multi-SIM operation.**

**12.**

## 13. 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 **Error! Reference s ource not found.** or Home eNodeB (Clause 3) |
| 2 | eNodeB Architecture | Clause 2.3.35.1<br>integrated eNodeB,<br>split architecture eNodeB, MSR based eNodeB,<br>eNodeB with Active Antenna System |
| 3 | Output Power of eNodeB | Clause 2.2.1<br>The maximum power radiation shall be regulated by latest DoT guidelines/ instructions/ licensing conditions. |
| 4 | Power Supply Option AC/DC | Clause 7.6 |

| | | |
|---|---|---|
| 5 | Transmission Modes, MIMO requirements & Modulation Schemes | Clause 2.3.13 |
| 6 | Number of Maximum component carriers | Clause 2.3.20 |
| 7 | eMBMS Requirement | Clause 2.3.21 |
| 8 | COMP Requirement | Clause 2.3.27 |
| 9 | ePDCCH Requirement | Clause 2.3.32 |
| 10 | Satellite Backhaul Requirement | Clause 2.3.34 |
| 11 | Operation Frequency | Clause 2.3.35<br>FDD bands chosen from 1, 3, 5, 8,28<br>TDD bands chosen 40 and 41<br>NB-IOT as per policy guidelines |
| 12 | Channel bandwidth | Clause 2.3.35<br>FDD chosen from 1.4, 3, 5, 10, 15, 20 MHz<br>TDD chosen from 1.4, 3, 5, 10, 15, 20 MHz |
| 13 | Option of TDD/FDD or both | Clause 2.3.35<br>Clause 2.3.18 (f), 2.3.22(b&d) |
| 14 | Service | IOT -- Clause 4 V2X<br>--Clause 5 |

| | | |
|---|---|---|
| 15 | UE speed | Clause 8.1.2<br>Optional requirement of<br>• High speed vehicular (up to 120 km/h)<br>• High Speed train (up to 300 km/h) |
| 16 | 3GPP Release 15 features | Clause 9 – Clauses to be supported are to be specified |
| 17 | 3GPP Release 16 features | Clause 10 – Clauses to be supported are to be specified |

## ABBREVIATIONS

For the purpose of this document the following abbreviations apply:

| | |
|---|---|
| AAS | Adaptive Antenna System Adjacent |
| ACLR | 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 |
| CPRI | Common Public Radio Interface |
| 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 |
| ECID | Enhanced Cell ID |
| 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 |
| MCS | Modulation and Coding Scheme |
| MCX | Mission Critical Services |
| 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 |

**======== End of the document ========**