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1 Scope

The present document provides an overview and overall description of the NG-RAN and focuses on the radio interface protocol architecture of NR connected to 5GC (E-UTRA connected to 5GC is covered in the 36 series). Details of the radio interface protocols are specified in companion specifications of the 38 series.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

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- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 36.300: "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2".

[3] 3GPP TS 23.501: "System Architecture for the 5G System; Stage 2".

[4] 3GPP TS 38.401: "NG-RAN; Architecture description".

[5] 3GPP TS 33.501: "Security Architecture and Procedures for 5G System".

[6] 3GPP TS 38.321: "NR; Medium Access Control (MAC) protocol specification".

[7] 3GPP TS 38.322: "NR; Radio Link Control (RLC) protocol specification".

[8] 3GPP TS 38.323: "NR; Packet Data Convergence Protocol (PDCP) specification".

[9] 3GPP TS 37.324: " E-UTRA and NR; Service Data Protocol (SDAP) specification".

[10] 3GPP TS 38.304: "NR; User Equipment (UE) procedures in Idle mode and RRC Inactive state".

[11] 3GPP TS 38.306: "NR; User Equipment (UE) radio access capabilities".

[12] 3GPP TS 38.331: "NR; Radio Resource Control (RRC); Protocol specification".

[13] 3GPP TS 38.133: "NR; Requirements for support of radio resource management".

[14] 3GPP TS 22.168: "Earthquake and Tsunami Warning System (ETWS) requirements; Stage 1".

[15] 3GPP TS 22.268: "Public Warning System (PWS) Requirements".

[16] 3GPP TS 38.410: "NG-RAN; NG general aspects and principles".

[17] 3GPP TS 38.420: "NG-RAN; Xn general aspects and principles".

[18] 3GPP TS 38.101-1: "NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone".

[19] 3GPP TS 22.261: "Service requirements for next generation new services and markets".

[20] 3GPP TS 38.202: "NR; Physical layer services provided by the physical layer"

[21] 3GPP TS 37.340: "NR; Multi-connectivity; Overall description; Stage-2".

[22] 3GPP TS 23.502: "Procedures for the 5G System; Stage 2".

[23] IETF RFC 4960 (2007-09): "Stream Control Transmission Protocol".

[24] 3GPP TS 26.114: "Technical Specification Group Services and System Aspects; IP Multimedia Subsystem (IMS); Multimedia Telephony; Media handling and interaction".

[25] Void.

[26] 3GPP TS 38.413: "NG-RAN; NG Application Protocol (NGAP)".

[27] IETF RFC 3168 (09/2001): "The Addition of Explicit Congestion Notification (ECN) to IP".

[28] 3GPP TS 24.501: "NR; Non-Access-Stratum (NAS) protocol for 5G System (5GS)".

[29] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification".

[30] 3GPP TS 38.415: "NG-RAN; PDU Session User Plane Protocol".

[31] 3GPP TS 38.340: "NR; Backhaul Adaptation Protocol (BAP) specification".

[32] 3GPP TS 38.470: "NG-RAN; F1 application protocol (F1AP) ".

[33] 3GPP TS 38.425: "NG-RAN; NR user plane protocol".

[34] 3GPP TS 23.216: "Single Radio Voice Call Continuity (SRVCC); Stage 2".

[35] 3GPP TS 38.101-2: "User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone".

[36] 3GPP TS 38.101-3: "User Equipment (UE) radio transmission and reception; Part 3: Range 1 and Range 2 Interworking operation with other radios".

[37] 3GPP TS 37.213: "Physical layer procedures for shared spectrum channel access".

[38] 3GPP TS 38.213: "NR; Physical layer procedures for control".

[39] 3GPP TS 22.104 "Service requirements for cyber-physical control applications in vertical domains".

[40] 3GPP TS 23.287: "Architecture enhancements for 5G System (5GS) to support Vehicle-to-Everything (V2X) services".

[41] 3GPP TS 23.285: "Technical Specification Group Services and System Aspects; Architecture enhancements for V2X services".

[42] 3GPP TS 38.305: "NG Radio Access Network (NG-RAN); Stage 2 functional specification of User Equipment (UE) positioning in NG-RAN".

[43] 3GPP TS 37.355: "LTE Positioning Protocol (LPP)".

[44] 3GPP TS 29.002: "Mobile Application Part (MAP) specification".

[45] 3GPP TS 23.041: "Technical realization of Cell Broadcast Service (CBS)".

3 Abbreviations and Definitions

3.1 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1], in TS 36.300 [2] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1] and TS 36.300 [2].

5GC	5G Core Network
5GS	5G System
5QI	5G QoS Identifier
A-CSI	Aperiodic CSI
AKA	Authentication and Key Agreement
AMBR	Aggregate Maximum Bit Rate
AMC	Adaptive Modulation and Coding
AMF	Access and Mobility Management Function
ARP	Allocation and Retention Priority
BA	Bandwidth Adaptation
BCH	Broadcast Channel
BH	Backhaul
BL	Bandwidth reduced Low complexity
BPSK	Binary Phase Shift Keying
C-RNTI	Cell RNTI
CAG	Closed Access Group
CAPC	Channel Access Priority Class
CBRA	Contention Based Random Access
CCE	Control Channel Element
CD-SSB	Cell Defining SSB
CFRA	Contention Free Random Access
CHO	Conditional Handover
CIoT	Cellular Internet of Things
CLI	Cross Link interference
CMAS	Commercial Mobile Alert Service
CORESET	Control Resource Set
CP	Cyclic Prefix
CPC	Conditional PSCell Change
DAG	Directed Acyclic Graph
DAPS	Dual Active Protocol Stack
DFT	Discrete Fourier Transform
DCI	Downlink Control Information
DCP	DCI with CRC scrambled by PS-RNTI
DL-AoD	Downlink Angle-of-Departure
DL-SCH	Downlink Shared Channel
DL-TDOA	Downlink Time Difference Of Arrival
DMRS	Demodulation Reference Signal
DRX	Discontinuous Reception
E-CID	Enhanced Cell-ID (positioning method)
EHC	Ethernet Header Compression
ePWS	enhancements of Public Warning System
ETWS	Earthquake and Tsunami Warning System
FS	Feature Set
GFBR	Guaranteed Flow Bit Rate
HRNN	Human-Readable Network Name
IAB	Integrated Access and Backhaul
I-RNTI	Inactive RNTI
INT-RNTI	Interruption RNTI
KPAS	Korean Public Alarm System
LDPC	Low Density Parity Check
MDBV	Maximum Data Burst Volume
MIB	Master Information Block

MICO	Mobile Initiated Connection Only
MFBR	Maximum Flow Bit Rate
MMTEL	Multimedia telephony
MNO	Mobile Network Operator
MPE	Maximum Permissible Exposure
MT	Mobile Termination
MU-MIMO	Multi User MIMO
Multi-RTT	Multi-Round Trip Time
NB-IoT	Narrow Band Internet of Things
NCGI	NR Cell Global Identifier
NCR	Neighbour Cell Relation
NCRT	Neighbour Cell Relation Table
NGAP	NG Application Protocol
NID	Network Identifier
NPN	Non-Public Network
NR	NR Radio Access
P-MPR	Power Management Maximum Power Reduction
P-RNTI	Paging RNTI
PCH	Paging Channel
PCI	Physical Cell Identifier
PDCCH	Physical Downlink Control Channel
PDSCH	Physical Downlink Shared Channel
PLMN	Public Land Mobile Network
PNI-NPN	Public Network Integrated NPN
PO	Paging Occasion
PRACH	Physical Random Access Channel
PRB	Physical Resource Block
PRG	Precoding Resource block Group
PS-RNTI	Power Saving RNTI
PSS	Primary Synchronisation Signal
PUCCH	Physical Uplink Control Channel
PUSCH	Physical Uplink Shared Channel
PWS	Public Warning System
QAM	Quadrature Amplitude Modulation
QFI	QoS Flow ID
QPSK	Quadrature Phase Shift Keying
RA	Random Access
RA-RNTI	Random Access RNTI
RACH	Random Access Channel
RANAC	RAN-based Notification Area Code
REG	Resource Element Group
RIM	Remote Interference Management
RMSI	Remaining Minimum SI
RNA	RAN-based Notification Area
RNAU	RAN-based Notification Area Update
RNTI	Radio Network Temporary Identifier
RQA	Reflective QoS Attribute
RQoS	Reflective Quality of Service
RS	Reference Signal
RSRP	Reference Signal Received Power
RSRQ	Reference Signal Received Quality
RSSI	Received Signal Strength Indicator
RSTD	Reference Signal Time Difference
SCS	SubCarrier Spacing
SD	Slice Differentiator
SDAP	Service Data Adaptation Protocol
SFI-RNTI	Slot Format Indication RNTI
SIB	System Information Block
SI-RNTI	System Information RNTI
SLA	Service Level Agreement
SMC	Security Mode Command
SMF	Session Management Function

S-NSSAI	Single Network Slice Selection Assistance Information
SNPN	Stand-alone Non-Public Network
SNPN ID	Stand-alone Non-Public Network Identity
SPS	Semi-Persistent Scheduling
SR	Scheduling Request
SRS	Sounding Reference Signal
SRVCC	Single Radio Voice Call Continuity
SS	Synchronization Signal
SSB	SS/PBCH block
SSS	Secondary Synchronisation Signal
SST	Slice/Service Type
SU-MIMO	Single User MIMO
SUL	Supplementary Uplink
TA	Timing Advance
TPC	Transmit Power Control
TRP	Transmit/Receive Point
UCI	Uplink Control Information
UL-AoA	Uplink Angles of Arrival
UL-RTOA	Uplink Relative Time of Arrival
UL-SCH	Uplink Shared Channel
UPF	User Plane Function
URLLC	Ultra-Reliable and Low Latency Communications
V2X	Vehicle-to-Everything
Xn-C	Xn-Control plane
Xn-U	Xn-User plane
XnAP	Xn Application Protocol

3.2 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1], in TS 36.300 [2] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1] and TS 36.300 [2].

BH RLC channel: an RLC channel between two nodes, which is used to transport backhaul packets**.**

CAG Cell: a PLMN cell broadcasting at least one Closed Access Group identity.

CAG Member Cell: for a UE, a CAG cell broadcasting the identity of the selected PLMN, registered PLMN or equivalent PLMN, and for that PLMN, a CAG identifier belonging to the Allowed CAG list of the UE for that PLMN.

CAG-only cell: a CAG cell that is only available for normal service for CAG UEs.

Cell-Defining SSB: an SSB with an RMSI associated.

Child node: IAB-DU's and IAB-donor-DU's next hop neighbour node; the child node is also an IAB-node.

Conditional Handover (CHO): a handover procedure that is executed only when execution condition(s) are met.

CORESET#0: the control resource set for at least SIB1 scheduling, can be configured either via MIB or via dedicated RRC signalling.

DAPS Handover: a handover procedure that maintains the source gNB connection after reception of RRC message for handover and until releasing the source cell after successful random access to the target gNB.

Downstream: Direction toward child node or UE in IAB-topology.

Early Data Forwarding: data forwarding that is initiated before the UE executes the handover.

gNB: node providing NR user plane and control plane protocol terminations towards the UE, and connected via the NG interface to the 5GC.

IAB-donor: gNB that provides network access to UEs via a network of backhaul and access links.

IAB-donor-CU: as defined in TS 38.401 [4].