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Contents

Foreword

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1 Scope

The present document describes the overall architecture of the NG-RAN, including interfaces NG, Xn and F1 interfaces and their interaction with the radio interface.

2 References

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

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
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[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 38.300: "NR; Overall description; Stage-2".

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

[4] 3GPP TS 38.473: "NG-RAN; F1 application protocol (F1AP)".

[5] 3GPP TS 38.414: "NG-RAN; NG data transport".

[6] 3GPP TS 38.424: "NG-RAN; Xn data transport".

[7] 3GPP TS 38.474: "NG-RAN; F1 data transport".

[8] ITU-T Recommendation G.823 (2000-03): "The control of jitter and wander within digital networks which are based on the 2048 kbit/s hierarchy".

[9] ITU-T Recommendation G.824 (2000-03): "The control of jitter and wander within digital networks which are based on the 1544 kbit/s hierarchy".

[10] ITU-T Recommendation G.825 (2001-08): "The control of jitter and wander within digital networks which are based on the synchronous digital hierarchy (SDH)".

[11] ITU-T Recommendation G.8261/Y.1361 (2008-04): "Timing and Synchronization aspects in Packet networks".

[12] 3GPP TS 37.340: "NR; Multi-connectivity; Overall description; Stage-2".

[13] 3GPP TS 33.501: "Security Architecture and Procedures for 5G System".

[14] 3GPP TS 38.410: "NG-RAN; NG general aspect and principles".

[15] 3GPP TS 38.420: "NG-RAN; Xn general aspects and principles"

[16] 3GPP TS 38.470: "NG-RAN; F1 general aspects and principles".

[17] 3GPP TS 38.460: "NG-RAN; E1 general aspects and principles".

[18] 3GPP TS 33.210: "3G security; Network Domain Security (NDS); IP Network Layer Security".

[19] 3GPP TS 36.300: "Evolved Universal Terrestrial Radio Access (E-UTRA), Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2".

[20] 3GPP TS 32.422: "Trace control and configuration management".

[21] 3GPP TS 37.470: "Evolved Universal Terrestrial Radio Access Network (E-UTRAN) and NG-RAN; W1 general aspects and principles; Stage-2".

[22] 3GPP TS 38.340: "NR; Backhaul Adaptation Protocol (BAP) specification".

[23] 3GPP TS 38.331: "NR; Radio Resource Control (RRC) protocol specification".

[24] 3GPP TS 38.425: "NG-RAN; NR user plane Protocol".

[25] 3GPP TS 38.305: "NG Radio Access Network (NG-RAN); Stage 2 functional specification of User Equipment (UE) positioning in NG-RAN".

[26] 3GPP TS 38.472: "NG-RAN; F1 signalling transport".

[27] 3GPP TS 23.247: " Architectural enhancements for 5G multicast-broadcast services; Stage 2".

[28] 3GPP TS 36.401: "Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Architecture Description".

[29] IETF RFC 4555 (2006-06): "RFC IKEv2 Mobility and Multihoming Protocol (MOBIKE)".

[30] 3GPP TS 38.321 “NR; Medium Access Control (MAC) protocol specification”.

[31] 3GPP TS 37.320: "Radio measurement collection for Minimization of Drive Tests (MDT); Overall description; Stage 2".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] 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].

Associated QoS Flow: as defined in TS 23.247 [27].

Associated QoS flow information: Information encompassing: QoS flow QoS parameters for associated QoS flows and mapping information between mapped (unicast) QoS flows and associated QoS flows. The respective information is included in a way that non-supporting RAN nodes would not establish respective RAN resources irrespective the multicast session state.

Boundary IAB-node: an IAB-node with one RRC interface terminating at a different IAB-donor-CU than the F1 interface. This definition applies to partial migration, inter-donor redundancy and inter-donor RLF recovery.

Conditional Handover: as defined in TS 38.300 [2].

Conditional PSCell Addition: as defined in TS 37.340 [12].

Conditional PSCell Change: as defined in TS 37.340 [12].

DAPS Handover: as defined in TS 38.300 [2].

eNB-CP: as defined in TS 36.401 [28].

eNB-UP: as defined in TS 36.401 [28].

en-gNB: as defined in TS 37.340 [12].

Early Data Forwarding: as defined in TS 38.300 [2].

F1-terminating IAB-donor of boundary IAB-node: Refers to the IAB-donor that terminates F1 for the boundary IAB-node.

gNB: as defined in TS 38.300 [2].

gNB Central Unit (gNB-CU): a logical node hosting RRC, SDAP and PDCP protocols of the gNB or RRC and PDCP protocols of the en-gNB that controls the operation of one or more gNB-DUs. The gNB-CU terminates the F1 interface connected with the gNB-DU.

gNB Distributed Unit (gNB-DU): a logical node hosting RLC, MAC and PHY layers of the gNB or en-gNB, and its operation is partly controlled by gNB-CU. One gNB-DU supports one or multiple cells. One cell is supported by only one gNB-DU. The gNB-DU terminates the F1 interface connected with the gNB-CU. For DC operation, the MgNB-DU designates the gNB-DU of an en-gNB or a gNB acting as master node, and the SgNB-DU designates the gNB-DU of an en-gNB or a gNB acting as secondary node.

gNB-CU-Control Plane (gNB-CU-CP): a logical node hosting the RRC and the control plane part of the PDCP protocol of the gNB-CU for an en-gNB or a gNB. The gNB-CU-CP terminates the E1 interface connected with the gNB-CU-UP and the F1-C interface connected with the gNB-DU. For DC operation, the MgNB-CU-CP designates the gNB-CU-CP of the gNB-CU for an en-gNB or a gNB acting as master node, and the SgNB-CU-CP designates the gNB-CU-CP of the gNB-CU for an en-gNB or a gNB acting as secondary node.

gNB-CU-User Plane (gNB-CU-UP): a logical node hosting the user plane part of the PDCP protocol of the gNB-CU for an en-gNB, and the user plane part of the PDCP protocol and the SDAP protocol of the gNB-CU for a gNB. The gNB-CU-UP terminates the E1 interface connected with the gNB-CU-CP and the F1-U interface connected with the gNB-DU. For DC operation, the MgNB-CU-UP designates the gNB-CU-UP of the gNB-CU for an en-gNB or a gNB acting as master node, and the the SgNB-CU-UP designates the gNB-CU-UP of the gNB-CU for an en-gNB or a gNB acting as secondary node.

IAB-node: as defined in TS 38.300 [2].

IAB-donor: as defined in TS 38.300 [2].

IAB-donor-CU: the gNB-CU of an IAB-donor, terminating the F1 interface towards IAB-nodes and IAB-donor-DU.

IAB-donor-DU: the gNB-DU of an IAB-donor, hosting the IAB BAP sublayer (as defined in TS 38.340 [22]), providing wireless backhaul to IAB-nodes.

IAB-DU: as defined in TS 38.300 [2].

IAB-MT: as defined in TS 38.300 [2].

IAB Topology: as defined in TS 38.300 [2].

Mapped QoS flows: Unicast QoS flows requested to be established, i.e. included in the legacy QoS flow lists in a way, that non-support RAN nodes would attempt to establish unicast QoS flows and supporting RAN nodes can identify them as mapped QoS flows based on the associated QoS information.

Master node: as defined in TS 37.340 [12].

Master gNB: see TS 37.340 [12].

MBS session resource: This term is used for specification of NG, Xn, F1 and E1 interfaces. It denotes NG-RAN interface and radio resources provided to support an MBS Session.

ng-eNB: as defined in TS 38.300 [2].

ng-eNB Central Unit (ng-eNB-CU): as defined in TS 37.470 [21].

ng-eNB Distributed Unit (ng-eNB-DU): as defined in TS 37.470 [21].

ng-eNB-CU-Control Plane (ng-eNB-CU-CP): a logical node hosting the RRC and the control plane part of the PDCP protocol of the ng-eNB-CU for an ng-eNB. The ng-eNB-CU-CP terminates the E1 interface connected with the ng-eNB-CU-UP and the W1-C interface connected with the ng-eNB-DU.

ng-eNB-CU-User Plane (ng-eNB-CU-UP): a logical node hosting the user plane part of the PDCP protocol and the SDAP protocol of the ng-eNB-CU for an ng-eNB. The ng-eNB-CU-UP terminates the E1 interface connected with the ng-eNB-CU-CP and the W1-U interface connected with the ng-eNB-DU.

NG-RAN node: as defined in TS 38.300 [2].

Non-F1-terminating IAB-donor of boundary IAB-node: Refers to the IAB-donor that has an RRC connection with the boundary node but does not terminate F1 with this boundary node.

PDU Session Resource: This term is used for specification of NG, Xn, and E1 interfaces. It denotes NG-RAN interface and radio resources provided to support a PDU Session.

Public Network Integrated NPN: as defined in TS 23.501 [3].

Secondary gNB: see TS 37.340 [12].

Stand-alone Non-Public Network: as defined in TS 23.501 [3].

U2N Relay UE: as defined in TS 38.300 [2].

U2N Remote UE: as defined in TS 38.300 [2].

3.2 Abbreviations

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] 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].

5GC	5G Core Network
AMF	Access and Mobility Management Function
AP	Application Protocol
AS	Access Stratum
BH	Backhaul
CAG	Closed Access Group
CHO	Conditional Handover
CLI	Cross-Link Interference
CM	Connection Management
CMAS	Commercial Mobile Alert Service
CPA	Conditional PSCell Addition
CPC	Conditional PSCell Change
DAPS	Dual Active Protocol Stack
EM	Element Manager
EN-DC	E-UTRA-NR Dual Connectivity
ETWS	Earthquake and Tsunami Warning System
F1-U	F1 User plane interface
F1-C	F1 Control plane interface
F1AP	F1 Application Protocol
FDD	Frequency Division Duplex
FTEID	Fully Qualified TEID
GTP-U	GPRS Tunnelling Protocol
IAB	Integrated Access and Backhaul
IP	Internet Protocol
L2	Layer-2
MBS	Multicast Broadcast Service
MCG	Master Cell Group
MDT	Minimization of Drive Tests
MN	Master Node
MgNB	Master gNB
MRB	MBS Radio Bearer
MRDC	Multi-Radio Dual Connectivity
NAS	Non-Access Stratum
NID	Network identifier
NPN	Non-Public Network
NSA	Non Standalone
OAM	Operation, Administration and Maintenance
PNI-NPN	Public Network Integrated Non-Public Network
PTP	Point to Point
PTM	Point to Multipoint
PWS	Public Warning System

QoE	Quality of Experience
QoS	Quality of Service
RET	Remote Electrical Tilting
RIM	Remote Interference Management
RIM-RS	Remote Interference Management Reference Signal
RNL	Radio Network Layer
RRC	Radio Resource Control
SA	Standalone
SAP	Service Access Point
SCG	Secondary Cell Group
SCTP	Stream Control Transmission Protocol
SFN	System Frame Number
SgNB	Secondary gNB
SM	Session Management
SMF	Session Management Function
SN	Secondary Node
SNPN	Stand-alone Non-Public Network
SRAP	Sidelink Relay Adaptation Protocol
TCE	Trace Collection Entity
TDD	Time Division Duplex
TDM	Time Division Multiplexing
TEID	Tunnel Endpoint Identifier
TMA	Tower Mounted Amplifier
TNL	Transport Network Layer
U2N	UE-to-Network

4 General principles

The general principles guiding the definition of NG-RAN architecture as well as the NG-RAN interfaces are the following:

- Logical separation of signalling and data transport networks.
- NG-RAN and 5GC functions are fully separated from transport functions. Addressing scheme used in NG-RAN and 5GC shall not be tied to the addressing schemes of transport functions. The fact that some NG-RAN or 5GC functions reside in the same equipment as some transport functions does not make the transport functions part of the NG-RAN or the 5GC.
- Mobility for an RRC connection is fully controlled by the NG-RAN.
- The NG-RAN interfaces are defined along the following principles:
  - The functional division across the interfaces have as few options as possible.
  - Interfaces are based on a logical model of the entity controlled through this interface.
  - One physical network element can implement multiple logical nodes.

5 General architecture

5.1 General

The protocols over Uu and NG interfaces are divided into two structures:

- **User plane protocols**

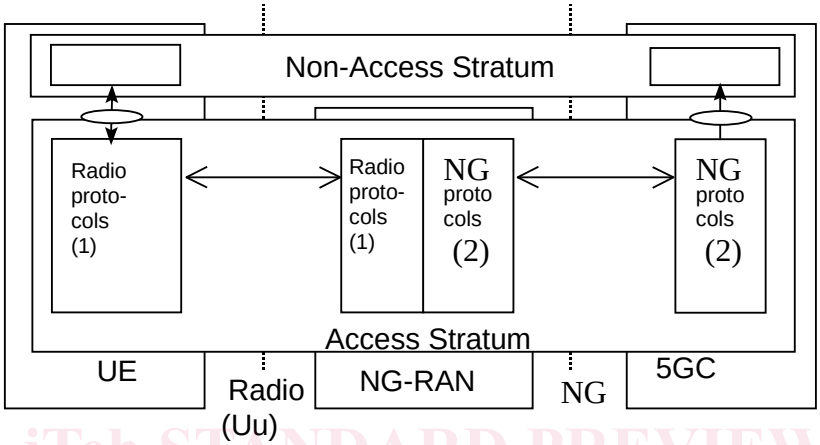
  These are the protocols implementing the actual PDU Session service, i.e. carrying user data through the access stratum.

- **Control plane protocols**

  These are the protocols for controlling the PDU Sessions and the connection between the UE and the network from different aspects (including requesting the service, controlling different transmission resources, handover etc.). Also a mechanism for transparent transfer of NAS messages is included.

5.2 User plane

The PDU Session Resource service is offered from SAP to SAP by the Access Stratum. Figure 5.2-1 shows the protocols on the Uu and the NG interfaces that linked together provide this PDU Session Resource service.

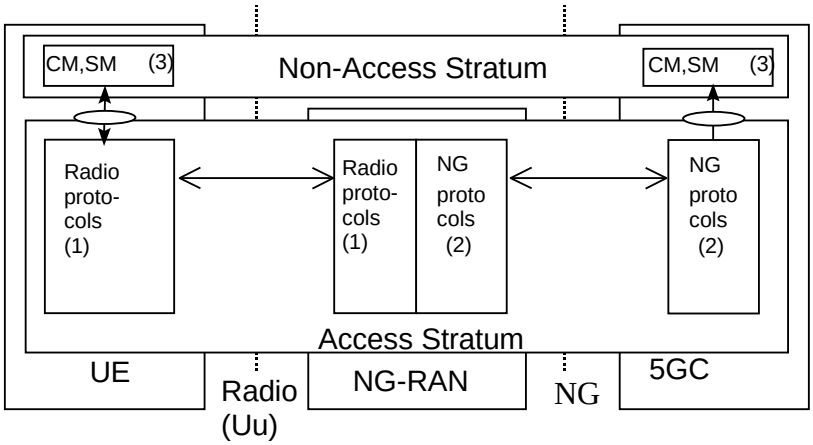


NOTE 1: The radio interface protocols are defined in TS 38.2xx and TS 38.3xx.
NOTE 2: The NG interface protocols are defined in TS 38.41x.

Figure 5.2-1: NG and Uu user plane

5.3 Control plane

Figure 5.3-1 shows the control plane (signalling) protocol stacks on NG and Uu interfaces.



NOTE 1: The radio interface protocols are defined in TS 38.2xx and TS 38.3xx.
NOTE 2: The protocol is defined in TS 38.41x. (Description of NG interface).
NOTE 3: CM, SM: This exemplifies a set of NAS control protocols between UE and 5GC. The evolution of the protocol architecture for these protocols is outside the scope of the present document.

Figure 5.3-1: NG and Uu control plane

NOTE: Both the Radio protocols and the NG protocols contain a mechanism to transparently transfer NAS messages.

6 NG-RAN architecture

6.1 Overview

6.1.1 Overall Architecture of NG-RAN

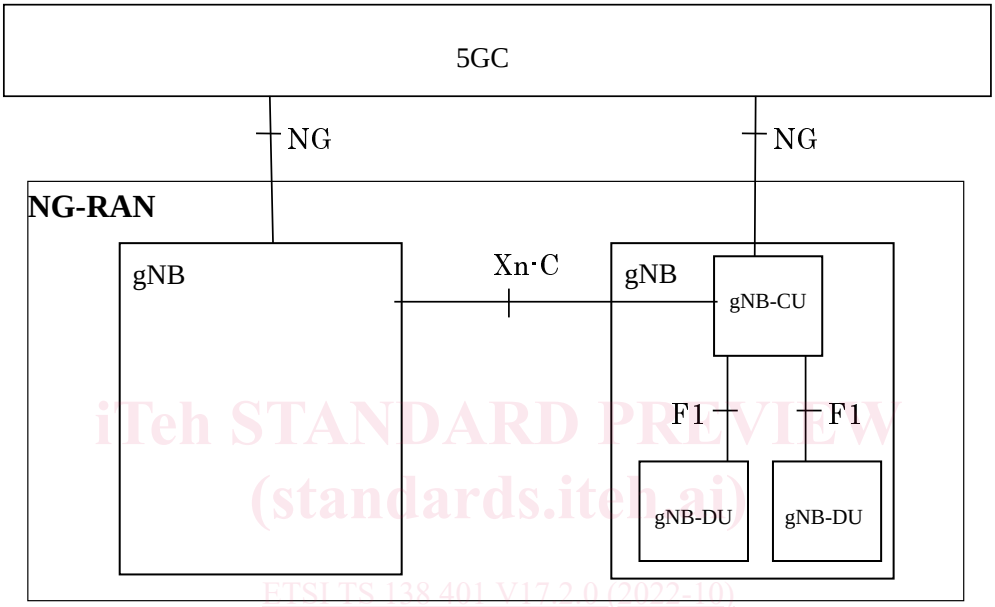


Figure 6.1-1: Overall architecture

The NG-RAN consists of a set of gNBs connected to the 5GC through the NG interface.

NOTE: As specified in TS 38.300 [2], NG-RAN could also consists of a set of ng-eNBs, an ng-eNB may consist of an ng-eNB-CU and one or more ng-eNB-DU(s). An ng-eNB-CU and an ng-eNB-DU is connected via W1 interface. The general principle described in this clause also applies to ng-eNB and W1 interface, if not explicitly specified otherwise.

An gNB can support FDD mode, TDD mode or dual mode operation.

gNBs can be interconnected through the Xn interface.

A gNB may consist of a gNB-CU and one or more gNB-DU(s). A gNB-CU and a gNB-DU is connected via F1 interface.

One gNB-DU is connected to only one gNB-CU.

NOTE: In case of network sharing with multiple cell ID broadcast, each Cell Identity associated with a subset of PLMNs corresponds to a gNB-DU and the gNB-CU it is connected to, i.e. the corresponding gNB-DUs share the same physical layer cell resources.

NOTE: For resiliency, a gNB-DU may be connected to multiple gNB-CUs by appropriate implementation.

NG, Xn and F1 are logical interfaces.

For NG-RAN, the NG and Xn-C interfaces for a gNB consisting of a gNB-CU and gNB-DUs, terminate in the gNB-CU. For EN-DC, the S1-U and X2-C interfaces for a gNB consisting of a gNB-CU and gNB-DUs, terminate in the gNB-CU. The gNB-CU and connected gNB-DUs are only visible to other gNBs and the 5GC as a gNB. A possible deployment scenario is described in Annex A.