**3GPP TSG-RAN WG2 Meeting #116bis ElectronicR2-220xxxx**

**Elbonia, 17 – 25 January 2022**

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| *CR-Form-v12.1* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.300** | **CR** | **xxxx** | **rev** | **-** | **Current version:** | **16.8.0** |  |
|  | | | | | | | | |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network | **X** | Core Network |  |

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| ***Title:*** | Introduction of the support for UDC in NR | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | CATT, CMCC, Huawei, HiSilicon, MediaTek, Ericsson, China Unicom, China Telecom, OPPO, ZTE, Samsung, Apple, Nokia, Nokia Shanghai Bell | | | | | | | | | |
| ***Source to TSG:*** | R2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_UDC-Core | | | | |  | ***Date:*** | | | 2021-12 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-17 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-15 (Release 15) Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | In Rel-17, NR UDC is introduced. Therefore corresponding descriptions should be added in the stage 2 TS. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | 1. Add abbreviation of UDC; 2. Add UDC function in PDCP; 3. Change the figures to include UDC in uplink compression. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | NR UDC function is missing from the Rel-17 stage 2 descriptions. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 3.1, 4.2, 6.1, 6.4.1, 9.2.3.1 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | | TS 38.323 CR  TS 38.331 CR  TS 38.306 CR  TS 37.340 CR | | |
| ***affected:*** | |  | **X** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

*First Change*

## 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

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

UDC Uplink Data Compression

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

*Next change*

## 4.2 Functional Split

The **gNB** and ng-eNB host the following functions:

- Functions for Radio Resource Management: Radio Bearer Control, Radio Admission Control, Connection Mobility Control, Dynamic allocation of resources to UEs in both uplink and downlink (scheduling);

- IP and Ethernet header compression, uplink data decompression, encryption and integrity protection of data;

- Selection of an AMF at UE attachment when no routing to an AMF can be determined from the information provided by the UE;

- Routing of User Plane data towards UPF(s);

- Routing of Control Plane information towards AMF;

- Connection setup and release;

- Scheduling and transmission of paging messages;

- Scheduling and transmission of system broadcast information (originated from the AMF or OAM);

- Measurement and measurement reporting configuration for mobility and scheduling;

- Transport level packet marking in the uplink;

- Session Management;

- Support of Network Slicing;

- QoS Flow management and mapping to data radio bearers;

- Support of UEs in RRC\_INACTIVE state;

- Distribution function for NAS messages;

- Radio access network sharing;

- Dual Connectivity;

- Tight interworking between NR and E-UTRA;

- Maintain security and radio configuration for User Plane CIoT 5GS Optimisation, as defined in TS 23.501 [3] (ng-eNB only).

NOTE 1: BL UE or UE in enhanced coverage is only supported by ng-eNB, see TS 36.300 [2].

NOTE 2: NB-IoT UE is only supported by ng-eNB, see TS 36.300 [2].

The **AMF** hosts the following main functions (see TS 23.501 [3]):

- NAS signalling termination;

- NAS signalling security;

- AS Security control;

- Inter CN node signalling for mobility between 3GPP access networks;

- Idle mode UE Reachability (including control and execution of paging retransmission);

- Registration Area management;

- Support of intra-system and inter-system mobility;

- Access Authentication;

- Access Authorization including check of roaming rights;

- Mobility management control (subscription and policies);

- Support of Network Slicing;

- SMF selection.

- Selection of CIoT 5GS optimisations;

The **UPF** hosts the following main functions (see TS 23.501 [3]):

- Anchor point for Intra-/Inter-RAT mobility (when applicable);

- External PDU session point of interconnect to Data Network;

- Packet routing & forwarding;

- Packet inspection and User plane part of Policy rule enforcement;

- Traffic usage reporting;

- Uplink classifier to support routing traffic flows to a data network;

- Branching point to support multi-homed PDU session;

- QoS handling for user plane, e.g. packet filtering, gating, UL/DL rate enforcement;

- Uplink Traffic verification (SDF to QoS flow mapping);

- Downlink packet buffering and downlink data notification triggering.

The Session Management function (**SMF**) hosts the following main functions (see TS 23.501 [3]):

- Session Management;

- UE IP address allocation and management;

- Selection and control of UP function;

- Configures traffic steering at UPF to route traffic to proper destination;

- Control part of policy enforcement and QoS;

- Downlink Data Notification.

This is summarized on the figure below where yellow boxes depict the logical nodes and white boxes depict the main functions.



Figure 4.2-1: Functional Split between NG-RAN and 5GC

*Next Change*

## 6.1 Overview

The layer 2 of NR is split into the following sublayers: Medium Access Control (MAC), Radio Link Control (RLC), Packet Data Convergence Protocol (PDCP) and Service Data Adaptation Protocol (SDAP). The two figures below depict the Layer 2 architecture for downlink and uplink, where:

- The physical layer offers to the MAC sublayer transport channels;

- The MAC sublayer offers to the RLC sublayer logical channels;

- The RLC sublayer offers to the PDCP sublayer RLC channels;

- The PDCP sublayer offers to the SDAP sublayer radio bearers;

- The SDAP sublayer offers to 5GC QoS flows;

- *Comp.* refers to header compression or uplink data compression;

- *Segm.* refers to segmentation;

- Control channels (BCCH, PCCH are not depicted for clarity).

NOTE: The gNB may not be able to guarantee that a L2 buffer overflow will never occur. If such overflow occurs, the UE may discard packets in the L2 buffer.



Figure 6.1-1: Downlink Layer 2 Structure



Figure 6.1-2: Uplink Layer 2 Structure

Radio bearers are categorized into two groups: data radio bearers (DRB) for user plane data and signalling radio bearers (SRB) for control plane data.

For IAB, the Layer 2 of NR includes: MAC, RLC, Backhaul Adaptation Protocol (BAP), PDCP and optionally SDAP.

- The BAP sublayer supports routing across the IAB topology and traffic mapping to BH RLC channels for enforcement of traffic prioritization and QoS.

Figures 6.1-3 below depicts the Layer-2 architecture for downlink on the IAB-donor. Figure 6.1-4 and 6.1-5 depict the Layer-2 architecture for downlink and uplink on the IAB-node, where the BAP sublayer offers routing functionality and mapping to BH RLC channels.



Figure 6.1-3: DL L2-structure for user plane at IAB-donor



Figure 6.1-4: DL L2-structure at IAB-node



Figure 6.1-5: UL L2-structure at IAB-node

*Next Change*

### 6.4.1 Services and Functions

The main services and functions of the PDCP sublayer include:

- Transfer of data (user plane or control plane);

- Maintenance of PDCP SNs;

- Header compression and decompression using the ROHC protocol;

- Header compression and decompression using EHC protocol;

- Compression and decompression of uplink PDCP SDUs: DEFLATE based UDC only;

- Ciphering and deciphering;

- Integrity protection and integrity verification;

- Timer based SDU discard;

- For split bearers, routing;

- Duplication;

- Reordering and in-order delivery;

- Out-of-order delivery;

- Duplicate discarding.

Since PDCP does not allow COUNT to wrap around in DL and UL, it is up to the network to prevent it from happening (e.g. by using a release and add of the corresponding radio bearer or a full configuration).

*Next Change*

#### 9.2.3.1 Overview

Network controlled mobility applies to UEs in RRC\_CONNECTED and is categorized into two types of mobility: cell level mobility and beam level mobility.

**Cell Level Mobility** requires explicit RRC signalling to be triggered, i.e. handover. For inter-gNB handover, the signalling procedures consist of at least the following elemental components illustrated in Figure 9.2.3.1-1:



Figure 9.2.3.1-1: Inter-gNB handover procedures

1. The source gNB initiates handover and issues a HANDOVER REQUEST over the Xn interface.

2. The target gNB performs admission control and provides the new RRC configuration as part of the HANDOVER REQUEST ACKNOWLEDGE.

3. The source gNB provides the RRC configuration to the UE by forwarding the *RRCReconfiguration* message received in the HANDOVER REQUEST ACKNOWLEDGE. The *RRCReconfiguration* message includes at least cell ID and all information required to access the target cell so that the UE can access the target cell without reading system information. For some cases, the information required for contention-based and contention-free random access can be included in the *RRCReconfiguration* message. The access information to the target cell may include beam specific information, if any.

4. The UE moves the RRC connection to the target gNB and replies with the *RRCReconfigurationComplete*.

NOTE 1: User Data can also be sent in step 4 if the grant allows.

In case of DAPS handover, the UE continues the downlink user data reception from the source gNB until releasing the source cell and continues the uplink user data transmission to the source gNB until successful random access procedure to the target gNB.

Only source and target PCell are used during DAPS handover. CA, DC, SUL, multi-TRP, EHC, CHO, UDC, NR sidelink configurations and V2X sidelink configurations are released by the source gNB before the handover command is sent to the UE and are not configured by the target gNB until the DAPS handover has completed (i.e. at earliest in the same message that releases the source PCell).

The handover mechanism triggered by RRC requires the UE at least to reset the MAC entity and re-establish RLC, except for DAPS handover, where upon reception of the handover command, the UE:

- Creates a MAC entity for target;

- Establishes the RLC entity and an associated DTCH logical channel for target for each DRB configured with DAPS;

- For each DRB configured with DAPS, reconfigures the PDCP entity with separate security and ROHC functions for source and target and associates them with the RLC entities configured by source and target respectively;

- Retains the rest of the source configurations until release of the source.

NOTE 2: Void.

NOTE 3: Void.

RRC managed handovers with and without PDCP entity re-establishment are both supported. For DRBs using RLC AM mode, PDCP can either be re-established together with a security key change or initiate a data recovery procedure without a key change. For DRBs using RLC UM mode, PDCP can either be re-established together with a security key change or remain as it is without a key change. For SRBs, PDCP can either remain as it is, discard its stored PDCP PDUs/SDUs without a key change or be re-established together with a security key change.

Data forwarding, in-sequence delivery and duplication avoidance at handover can be guaranteed when the target gNB uses the same DRB configuration as the source gNB.

Timer based handover failure procedure is supported in NR. RRC connection re-establishment procedure is used for recovering from handover failure except in certain CHO or DAPS handover scenarios:

- When DAPS handover fails, the UE falls back to the source cell configuration, resumes the connection with the source cell, and reports DAPS handover failure via the source without triggering RRC connection re-establishment if the source link has not been released.

- When initial CHO execution attempt fails or HO fails, the UE performs cell selection, and if the selected cell is a CHO candidate and if network configured the UE to try CHO after handover/CHO failure, then the UE attempts CHO execution once, otherwise re-establishment is performed.

DAPS handover for FR2 to FR2 case is not supported in this release of the specification.

The handover of the IAB-MT in SA mode follows the same procedure as described for the UE. After the backhaul has been established, the handover of the IAB-MT is part of the intra-CU topology adaptation procedure defined in TS 38.401 [4]. Modifications to the configuration of BAP sublayer and higher protocol layers above the BAP sublayer are described in TS 38.401 [4].

**Beam Level Mobility** does not require explicit RRC signalling to be triggered. The gNB provides via RRC signalling the UE with measurement configuration containing configurations of SSB/CSI resources and resource sets, reports and trigger states for triggering channel and interference measurements and reports. Beam Level Mobility is then dealt with at lower layers by means of physical layer and MAC layer control signalling, and RRC is not required to know which beam is being used at a given point in time.

SSB-based Beam Level Mobility is based on the SSB associated to the initial DL BWP and can only be configured for the initial DL BWPs and for DL BWPs containing the SSB associated to the initial DL BWP. For other DL BWPs, Beam Level Mobility can only be performed based on CSI-RS.

*End of Change*