**3GPP TSG-RAN WG2 Meeting #131 *R2-25xxxxx***

**Bengaluru, India, 25 – 29 August 2025**

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| *CR-Form-v12.3* |
| **CHANGE REQUEST** |
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|  |  | **CR** |  | **rev** | **1** | **Current version:** |  |  |
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| ***Proposed change affects:*** | UICC apps |  | ME | **x** | Radio Access Network | **x** | Core Network |  |

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|  |
| ***Title:***  | Introduction of XR Enhancements Phase 3 |
|  |  |
| ***Source to WG:*** | Nokia |
| ***Source to TSG:*** | R2 |
|  |  |
| ***Work item code:*** | NR\_XR\_Ph3-Core |  | ***Date:*** | 2025-08-25 |
|  |  |  |  |  |
| ***Category:*** |  |  | ***Release:*** | Rel-19 |
|  | *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 canbe 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-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19) Rel-20 (Release 20)* |
|  |  |
| ***Reason for change:*** | For the Phase 3 of XR Enhancements, the following was agreed:1. By SA2: provision of MMSID by 5GC;
2. By SA2: provision of TTNB and Burst Size in GTP-U header;
3. A multiple entry DSR to convey multiple pairs of amount of data buffered and shortest remaining time for that data;
4. In LCP, prioritisation of data with remaining time before discard going below a configured threshold;
5. A rate control mechanism to cope with congestion;
6. For RLC AM, new mechanisms to ensure timely RLC retransmissions and avoid unnecessery RLC retransmisions;
7. Measurement gap handling enhancement to enable transmission/reception in gaps/restrictions that are caused by RRM measurements;
8. End of Data Burst forwarding.
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| ***Summary of change:*** | New mechanims for the Phase 3 of XR Enhancements are introduced:1. The provision of MMSID by 5GC;
2. The provision of Burst Size and TTNB by 5GC;
3. Multiple Entry DSR;
4. Delay-aware LCP;
5. Rate control mechanism;
6. RLC AM enhancements;
7. Measurement gaps handling enhancements;
8. Clarification that the source gNB should forward the End of Data Burst Indication to target gNB during the data forwarding for handover. This enables the target gNB to push the UE back to sleep as early as possible.

A clean-up for QNC is also done. |
|  |  |
| ***Consequences if not approved:*** | The new mechanims agreed for the Phase 3 of XR Enhancements are not captured in the Stage 2. |
|  |  |
| ***Clauses affected:*** | 3.1, 12.1, 16.15 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** | **X** |  |  Other core specifications  | TS 38.321 CR 2102TS 38.322 CR 0065TS 38.323 CR 0149TS 38.331 CR 5395, 5403TS 38.306 CR 1321TS 37.483 CR 0171TS 38.413 CR 1282TS 38.423 CR 1269TS 38.473 CR 1485TS 38.415 CR 0056TS 38.425 CR 0156 |
| ***affected:*** |  | **X** |  Test specifications |  |
| ***(show related CRs)*** |  | **X** |  O&M Specifications |  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

*First Modified Subclause*

## 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

A2X Aircraft-to-Everything

A-CSI Aperiodic CSI

AGC Automatic Gain Control

AI Artificial Intelligence

AKA Authentication and Key Agreement

AMBR Aggregate Maximum Bit Rate

AMC Adaptive Modulation and Coding

AMF Access and Mobility Management Function

AR Augmented Reality

ARP Allocation and Retention Priority

ATG Air to Ground

BA Bandwidth Adaptation

BCCH Broadcast Control Channel

BCH Broadcast Channel

BFD Beam Failure Detection

BH Backhaul

BL Bandwidth reduced Low complexity

BPSK Binary Phase Shift Keying

BRID Broadcast Remote Identification

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

cellDTRX-RNTI Cell Discontinuous Transmission and Reception RNTI

CFR Common Frequency Resource

CFRA Contention Free Random Access

CG Configured Grant

CHO Conditional Handover

CIoT Cellular Internet of Things

CLI Cross Link interference

CMAS Commercial Mobile Alert Service

CORESET Control Resource Set

CP Cyclic Prefix

CPA Conditional PSCell Addition

CPC Conditional PSCell Change

DAA Detect And Avoid

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

DCR Direct Communication Request

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

DSR Delay Status Report

DTX Discontinuous Transmission

E-CID Enhanced Cell-ID (positioning method)

EC Energy Cost

EHC Ethernet Header Compression

ePWS enhancements of Public Warning System

ETWS Earthquake and Tsunami Warning System

FS Feature Set

FSA ID Frequency Selection Area Identity

G-CS-RNTI Group Configured Scheduling RNTI

G-RNTI Group RNTI

GFBR Guaranteed Flow Bit Rate

GIN Group ID for Network selection

GNSS Global Navigation Satellite System

GSO Geosynchronous Orbit

H-SFN Hyper System Frame Number

HAPS High Altitude Platform Station

HRNN Human-Readable Network Name

HSDN High Speed Dedicated Network

IAB Integrated Access and Backhaul

IFRI Intra Frequency Reselection Indication

I-RNTI Inactive RNTI

INT-RNTI Interruption RNTI

KPAS Korean Public Alarm System

L2 Layer-2

L3 Layer-3

LBT Listen Before Talk

LDPC Low Density Parity Check

LEO Low Earth Orbit

LTM L1/L2 Triggered Mobility

MBS Multicast/Broadcast Services

MCE Measurement Collection Entity

MCCH MBS Control Channel

MDBV Maximum Data Burst Volume

MEO Medium Earth Orbit

MIB Master Information Block

MICO Mobile Initiated Connection Only

MFBR Maximum Flow Bit Rate

ML Machine Learning

MMSID Multi-modal Service ID

MMTEL Multimedia telephony

MNO Mobile Network Operator

MO-SDT Mobile Originated SDT

MP Multi-Path

MPE Maximum Permissible Exposure

MRB MBS Radio Bearer

MT Mobile Termination

MT-SDT Mobile Terminated SDT

MTCH MBS Traffic Channel

MTSI Multimedia Telephony Service for IMS

MU-MIMO Multi User MIMO

Multi-RTT Multi-Round Trip Time

MUSIM Multi-Universal Subscriber Identity Module

N3C Non-3GPP Connection

NB-IoT Narrow Band Internet of Things

NCD-SSB Non Cell Defining SSB

NCGI NR Cell Global Identifier

NCL Neighbour Cell List

NCR Neighbour Cell Relation

NCRT Neighbour Cell Relation Table

NES Network Energy Savings

NGAP NG Application Protocol

NGSO Non-Geosynchronous Orbit

NID Network Identifier

NPN Non-Public Network

NR NR Radio Access

NSAG Network Slice AS Group

NTN Non-Terrestrial Network

P-MPR Power Management Maximum Power Reduction

P-RNTI Paging RNTI

PCH Paging Channel

PCI Physical Cell Identifier

PDB Packet Delay Budget

PDC Propagation Delay Compensation

PDCCH Physical Downlink Control Channel

PDSCH Physical Downlink Shared Channel

PEI Paging Early Indication

PER Packet Error Rate

PH Paging Hyperframe

PLMN Public Land Mobile Network

PNI-NPN Public Network Integrated NPN

PO Paging Occasion

PQI PC5 5QI

PRACH Physical Random Access Channel

PRB Physical Resource Block

PRG Precoding Resource block Group

PRS Positioning Reference Signal

PS-RNTI Power Saving RNTI

PSDB PDU Set Delay Budget

PSER PDU Set Error Rate

PSI PDU Set Importance

PSIHI PDU Set Integrated Handling Information

PSS Primary Synchronisation Signal

PTM Point to Multipoint

PTP Point to Point

PTW Paging Time Window

PUCCH Physical Uplink Control Channel

PUSCH Physical Uplink Shared Channel

PWS Public Warning System

QAM Quadrature Amplitude Modulation

QFI QoS Flow ID

QMC QoE Measurement Collection

QoE Quality of Experience

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

RLM Radio Link Monitoring

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

RTT Round Trip Time

RVQoE RAN visible QoE

SCS SubCarrier Spacing

SD Slice Differentiator

SDAP Service Data Adaptation Protocol

SDT Small Data Transmission

SD-RSRP Sidelink Discovery RSRP

SFI-RNTI Slot Format Indication RNTI

SHR Successful Handover Report

SIB System Information Block

SI-RNTI System Information RNTI

SLA Service Level Agreement

SL-PRS Sidelink Positioning Reference Signal

SL-RSRP Sidelink RSRP

SMC Security Mode Command

SMF Session Management Function

SMTC SS/PBCH block Measurement Timing Configuration

S-NSSAI Single Network Slice Selection Assistance Information

SNPN Stand-alone Non-Public Network

SNPN ID Stand-alone Non-Public Network Identity

SpCell Special Cell

SPR Successful PSCell Addition/Change Report

SPS Semi-Persistent Scheduling

SR Scheduling Request

SRAP Sidelink Relay Adaptation Protocol

SRS Sounding Reference Signal

SRVCC Single Radio Voice Call Continuity

SS Synchronization Signal

SSB SS/PBCH block

SSS Secondary Synchronisation Signal

SSSG Search Space Set Group

SST Slice/Service Type

SU-MIMO Single User MIMO

SUL Supplementary Uplink

TA Timing Advance

TB Transport Block

TCE Trace Collection Entity

TN Terrestrial Network

TNL Transport Network Layer

TPC Transmit Power Control

TRP Transmit/Receive Point

TRS Tracking Reference Signal

TSS Timing Synchronization Status

U2N UE-to-Network

U2U UE-to-UE

UAV Uncrewed Aerial Vehicle

UCI Uplink Control Information

UDC Uplink Data Compression

UDM Unified Data Management

UE-Slice-MBR UE Slice Maximum Bit Rate

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

VR Virtual Reality

V2X Vehicle-to-Everything

Xn-C Xn-Control plane

Xn-U Xn-User plane

XnAP Xn Application Protocol

XR eXtended Reality

*Next Modified Subclause*

## 12.1 Overview

The **5G QoS model** is based on QoS Flows (see TS 23.501 [3]) and supports both QoS Flows that require guaranteed flow bit rate (GBR QoS Flows) and QoS Flows that do not require guaranteed flow bit rate (non-GBR QoS Flows). At NAS level (see TS 23.501 [3]), the QoS flow is thus the finest granularity of QoS differentiation in a PDU session. A QoS flow is identified within a PDU session by a QoS Flow ID (QFI) carried in an encapsulation header over NG-U.

The **QoS architecture** in NG-RAN, both for NR connected to 5GC and for E-UTRA connected to 5GC, is depicted in the Figure 12-1 and described in the following:

- For each UE, 5GC establishes one or more PDU Sessions;

- Except for NB-IoT, IAB-MT in SA mode, and NCR-MT, for each UE, the NG-RAN establishes at least one Data Radio Bearers (DRB) together with the PDU Session and additional DRB(s) for QoS flow(s) of that PDU session can be subsequently configured (it is up to NG-RAN when to do so);

- If NB-IoT UE supports NG-U data transfer, the NG-RAN may establish Data Radio Bearers (DRB) together with the PDU Session and one PDU session maps to only one DRB;

- The NG-RAN maps packets belonging to different PDU sessions to different DRBs;

- NAS level packet filters in the UE and in the 5GC associate UL and DL packets with QoS Flows;

- AS-level mapping rules in the UE and in the NG-RAN associate UL and DL QoS Flows with DRBs.



Figure 12-1: QoS architecture

NG-RAN and 5GC ensure quality of service (e.g. reliability and target delay) by mapping packets to appropriate QoS Flows and DRBs. Hence there is a 2-step mapping of IP-flows to QoS flows (NAS) and from QoS flows to DRBs (Access Stratum).

At **NAS level**, a QoS flow is characterised by a QoS profile provided by 5GC to NG-RAN and QoS rule(s) provided by 5GC to the UE. The QoS profile is used by NG-RAN to determine the treatment on the radio interface while the QoS rules dictates the mapping between uplink User Plane traffic and QoS flows to the UE. A QoS flow may either be GBR or Non-GBR depending on its profile. The QoS profile of a QoS flow contains QoS parameters, for instance (see TS 23.501 [3]):

- For each QoS flow:

- A 5G QoS Identifier (5QI);

- An Allocation and Retention Priority (ARP).

- In case of a GBR QoS flow only:

- Guaranteed Flow Bit Rate (GFBR) for both uplink and downlink;

- Maximum Flow Bit Rate (MFBR) for both uplink and downlink;

- Maximum Packet Loss Rate for both uplink and downlink;

- Delay Critical Resource Type;

- Notification Control.

NOTE: The Maximum Packet Loss Rate (UL, DL) is only provided for a GBR QoS flow belonging to voice media.

- In case of Non-GBR QoS only:

- Reflective QoS Attribute (RQA): the RQA, when included, indicates that some (not necessarily all) traffic carried on this QoS flow is subject to reflective quality of service (RQoS) at NAS;

- Additional QoS Flow Information.

The QoS parameter Notification Control indicates whether notifications are requested from the RAN when the GBR QoS can no longer (or again) be fulfilled for a QoS Flow, as specified in TS 23.501 [3]. If, for a given GBR QoS Flow, notification control is enabled and the RAN determines that the GBR QoS cannot be guaranteed, RAN shall send a notification towards SMF and keep the QoS Flow (i.e. while the NG-RAN is not delivering the requested GBR QoS for this QoS Flow), unless specific conditions at the NG-RAN require the release of the NG-RAN resources for this GBR QoS Flow, e.g. due to Radio link failure or RAN internal congestion. When applicable, NG-RAN sends a new notification, informing SMF that the GBR QoS can be guaranteed again.

If Alternative QoS parameters Sets are received with the Notification Control parameter, the NG-RAN may also include in the notification a reference corresponding to the QoS Parameter Set which it can currently fulfil as specified in TS 23.501 [3]. The target NG-RAN node may include in the notification control indication the reference to the QoS Parameter Set which it can currently fulfil over Xn to the source NG-RAN node during handover.

In addition, an Aggregate Maximum Bit Rate is associated to each PDU session (Session-AMBR), to each UE (UE-AMBR) and to each slice per UE (UE-Slice-MBR). The Session-AMBR limits the aggregate bit rate that can be expected to be provided across all Non-GBR QoS Flows for a specific PDU Session and is ensured by the UPF. The UE-AMBR limits the aggregate bit rate that can be expected to be provided across all Non-GBR QoS Flows of a UE and is ensured by the RAN (see clause 10.5.1). The UE-Slice-MBR limits the aggregate bit rate that can be expected to be provided across all GBR and Non-GBR QoS Flows corresponding to PDU Sessions of the UE for the same slice (S-NSSAI) as specified in TS 23.501 [3] and is ensured by the RAN (see clause 10.5.1).

The 5QI is associated to QoS characteristics giving guidelines for setting node specific parameters for each QoS Flow. Standardized or pre-configured 5G QoS characteristics are derived from the 5QI value and are not explicitly signalled. Signalled QoS characteristics are included as part of the QoS profile. The QoS characteristics consist for instance of (see TS 23.501 [3]):

- Priority level;

- Packet Delay Budget (including Core Network Packet Delay Budget);

- Packet Error Rate;

- Averaging window;

- Maximum Data Burst Volume.

At **Access Stratum** level, the data radio bearer (DRB) defines the packet treatment on the radio interface (Uu). A DRB serves packets with the same packet forwarding treatment. The QoS flow to DRB mapping by NG-RAN is based on QFI and the associated QoS profiles (i.e. QoS parameters and QoS characteristics). Separate DRBs may be established for QoS flows requiring different packet forwarding treatment, or several QoS Flows belonging to the same PDU session can be multiplexed in the same DRB.

In the uplink, the mapping of QoS Flows to DRBs is controlled by mapping rules which are signalled in two different ways:

- Reflective mapping: for each DRB, the UE monitors the QFI(s) of the downlink packets and applies the same mapping in the uplink; that is, for a DRB, the UE maps the uplink packets belonging to the QoS flows(s) corresponding to the QFI(s) and PDU Session observed in the downlink packets for that DRB. To enable this reflective mapping, the NG-RAN marks downlink packets over Uu with QFI.

- Explicit Configuration: QoS flow to DRB mapping rules can be explicitly signalled by RRC.

The UE always applies the latest update of the mapping rules regardless of whether it is performed via reflecting mapping or explicit configuration.

When a QoS flow to DRB mapping rule is updated, the UE sends an end marker on the old bearer.

In the downlink, the QFI is signalled by NG-RAN over Uu for the purpose of RQoS and if neither NG-RAN, nor the NAS (as indicated by the RQA) intend to use reflective mapping for the QoS flow(s) carried in a DRB, no QFI is signalled for that DRB over Uu. In the uplink, NG-RAN can configure the UE to signal QFI over Uu.

For each PDU session, a default DRB may be configured: if an incoming UL packet matches neither an RRC configured nor a reflective mapping rule, the UE then maps that packet to the default DRB of the PDU session. For non-GBR QoS flows, the 5GC may send to the NG-RAN the Additional QoS Flow Information parameter associated with certain QoS flows to indicate that traffic is likely to appear more often on them compared to other non-GBR QoS flows established on the same PDU session.

Within each PDU session, it is up to NG-RAN how to map multiple QoS flows to a DRB. The NG-RAN may map a GBR flow and a non-GBR flow, or more than one GBR flow to the same DRB, but mechanisms to optimise these cases are not within the scope of standardization.

*Next Modified Subclause*

## 16.15 eXtended Reality Services

### 16.15.1 General

This clause describes the functionalities for the support of eXtended Reality (XR) services that require high data rate and low latency communications. An overview of XR services is available in TR 38.835 [57], while the service requirements are documented in TS 22.261 [19]. Please note however that some of those functionalities need not be limited to the provision of XR services.

### 16.15.2 Awareness

XR-Awareness relies on QoS flows, PDU Sets, Data Bursts and traffic assistance information (see TS 23.501 [3]).

The following **PDU Set QoS Parameters** may be provided by the SMF to the gNB as part of the QoS profile of the QoS flow:

- PDU Set Delay Budget (PSDB): as defined in TS 23.501 [3], upper bound for the duration between the reception time of the first PDU (at the UPF for DL, at the UE for UL) and the time when all PDUs of a PDU Set have been successfully received (at the UE in DL, at the UPF in UL). When available, supersedes the PDB of the QoS flow.

- PDU Set Error Rate (PSER): as defined in TS 23.501 [3], upper bound for a rate of non-congestion related PDU Set losses between RAN and the UE. When available, it supersedes the PER of the QoS flow.

NOTE 1: In this release, a PDU set is considered as successfully delivered only when all PDUs of a PDU Set are delivered successfully.

- PDU Set Integrated Handling Information (PSIHI): indicates whether all PDUs of the PDU Set are needed for the usage of PDU Set by application layer, as defined in TS 23.501 [3].

NOTE 2: For a given QoS flow, the PDU Set QoS parameters are common for all PDU Sets but can be different for UL and DL.

The PDU Set based handling can be enabled based on the PDU Set QoS Parameters, or based on the DL PDU Set Information Marking Support Indication received from SMF.

During the Xn-handover preparation procedure, the source gNB sends the stored PDU Set QoS Parameters as part of the QoS profile to the target NG-RAN node. For NG handover, the AMF provides the PDU Set QoS parameters to the target gNB by means of the NGAP HANDOVER REQUEST message.

The UPF can identify PDUs that belong to PDU Sets, and may indicate to the gNB the following **PDU Set Information** in the GTP-U header:

- PDU Set Sequence Number;

- Indication of End PDU of the PDU Set;

- PDU Sequence Number within a PDU Set;

- PDU Set Size in bytes;

- PDU Set Importance (PSI), which identifies the relative importance of a PDU Set compared to other PDU Sets within the same QoS Flow.

NOTE: PDU Set Information can be provided without PDU Set QoS Parameters.

5GC may provide XR traffic assistance information to gNB through NG AP TSC Assistance Information (TSCAI) as specified in clause 5.37.8 of TS 23.501[3] (for both GBR and non-GBR QoS flows):

- UL and/or DL Periodicity;

- N6 Jitter Information (i.e. between UPF and Data Network) associated with the DL Periodicity.

This assistance information can be used by the gNB to configure DRX to enable better UE power saving.

In addition, 5GC may provide the following information through NG-U as specified in clause 5.37.5.2 of TS 23.501[3]:

- Indication of End of Data Burst in the GTP-U header of the last PDU in downlink: this information can be used by the gNB to push the UE back to sleep when possible.

- Indication of Data Burst Size in the GTP-U header of the first PDUs of the data burst in downlink: this information can be used by the gNB to assist radio resource management.

- Indication of Time To Next Burst in the GTP-U header in downlink: this information represents the interval between the transmission of the last PDU in the current data burst and the first PDU of the next data burst, and can be used by the gNB to assist scheduling in downlink.

During the data forwarding for handover, the source gNB provides the Indication of End of Data Burst, Indication of Data Burst Size, and Time to Next Burst received from the UPF to target gNB in case one or more PDUs of the data burst is forwarded to target gNB.

Finally, 5GC may provide the Multi-modal Service ID (MMSID) to NG-RAN, as part of the QoS parameters of the QoS flow, when establishing and/or updating the corresponding QoS Flows. It is up to the gNB’s implementation to use this information for multi-modality service.

In the uplink, the UE needs to be able to identify PDU Sets and Data Bursts dynamically, including PSI. How this is done is left up to UE implementation but when possible for a QoS flow, this is indicated to the gNB via UE Assistance Information.

### 16.15.3 Power Saving

Most XR video frame rates (15, 30, 45, 60, 72, 90 and 120 fps) correspond to periodicities that are not an integer (66.66, 33.33, 22.22, 16.66, 13.88, 11.11 and 8.33 ms respectively). The gNB may configure a DRX cycle expressed in rational numbers so that the DRX cycle matches those periodicities, e.g. for the traffic with a frame rate of 60 fps, the network may configure the UE with a DRX cycle of 50/3 ms.

Configured grants may be configured without the need for the UE to wake up to monitor possible grants for UL retransmissions of configured grants, thus increasing the number of power saving opportunities for the UE.

### 16.15.4 Capacity

#### 16.15.4.1 Physical Layer Enhancements

The following enhancements for configured grant-based PUSCH transmission are introduced:

- Support of multiple CG PUSCH transmission occasions within a single period of a CG configuration;

- Indication of unused CG PUSCH occasion(s) of a CG configuration with Uplink Control Information multiplexed in CG PUSCH transmission of the CG configuration.

#### 16.15.4.2 Layer 2 Enhancements

##### 16.15.4.2.1 Assistance Information

In order to enhance the scheduling of uplink resources for XR, the following improvements are introduced:

- One additional buffer size table to reduce the quantisation errors in BSR and DSR (defined below) reporting (e.g. for high bit rates):

- Whether, for an LCG, the new table can be used in addition to the regular one is configured by the gNB;

- When the new table is configured for an LCG, it is used whenever the amount of the buffered data of that LCG to be reported is within the range of the new table, otherwise the regular table is used.

- Delay Status Report (DSR) of buffered data via a dedicated MAC CE:

- Triggered for an LCH when the remaining time before discard of any buffered PDCP SDU goes below a configured threshold (threshold configured per LCG by the gNB);

- When triggered for an LCH, reports for each threshold configured, the buffer size and the shortest remaining time before discard of buffered PDCP SDUs associated to this threshold.

- Reporting of uplink assistance information (jitter range, burst arrival time, UL data burst periodicity, possibility for the UE to identify PDU sets and/or PSI) per QoS flow by the UE via UE Assistance Information. In case target gNB receives the burst arrival time from source gNB during the handover preparation procedure, the target gNB may use it by considering the SFN offset of the source gNB.

##### 16.15.4.2.2 Discard

When the PSIHI indicates that all PDUs of the PDU Set are needed for a QoS flow, as soon as one PDU of a PDU set is known to be lost, the remaining PDUs of that PDU Set can be considered as no longer needed by the application and may be subject to discard operation at the transmitter to free up radio resources.

NOTE 1: It cannot always be assumed that the remaining PDUs are not useful and can safely be discarded. Also, in case of Forward Error Correction (FEC), active discarding of PDUs when assuming that a large enough number of packets have already been transmitted for FEC to recover without the remaining PDUs is not recommended as it might trigger an increase of FEC packets.

In uplink, the UE may be configured with PDU Set based discard operation for a specific DRB. When configured, the UE discards all packets in a PDU set when one PDU belonging to this PDU set is discarded due to discard timer expiry.

The gNB may perform downlink PDU Set discarding based on implementation by taking at least PSDB, PSI, PSIHI parameters into account.

In case of congestion, for downlink, the gNB may perform PDCP SDU discarding based on PSI. For uplink, dedicated downlink signalling is used to request the UE to apply a shorter discard timer to PDCP SDUs belonging to *low importance* PDU Sets in PDCP.

NOTE 2: How PDU Sets are identified as *low importance* is left up to UE implementation. When a PSI is available, it can be used according to the guidelines specified in TS 26.522 [58].

The transmitting PDCP entity can inform the receiving one of gaps in the sequence of transmitted PDCP SN, resulting from PDCP SDU discard, via a PDCP control PDU.

##### 16.15.4.2.X Logical Channel Priority Adjustment

An LCH may be configured to apply an additional priority when any of its buffered PDCP SDU(s) has a remaining time before discard falling below a configured threshold.

##### 16.15.4.2.Y RLC Retransmissions

For operation of RLC AM, the following improvements are introduced:

- To avoid unnecessary RLC retransmissions:

- On the transmitter side, when the RLC entity receives a discard indication for an SDU from PDCP, it stops any further transmission or retransmission of that SDU and its corresponding segment(s) if any;

- On the receiver side, a complete PDU detected as missing can be discarded after a configured duration, and positively acknowledged through a status report.

- To ensure timely RLC retransmissions, on the transmitter side, when the remaining time before discard of an RLC SDU:

- Falls below a configured retransmission threshold, a retransmission of this RLC SDU may be triggered; and/or

- Falls below a configured polling threshold, polling is triggered.

##### 16.15.4.2.Z Uplink Rate Control

To enable faster adaptation of the uplink source rate (e.g. to handle to uplink congestion), an uplink physical-layer bit rate available to a QoS flow can be suggested by the gNB via a downlink MAC CE, and the UE can also request a desired one via an uplink MAC CE.

NOTE: The bit rate is linked to the QoS flow regardless of how many cell groups are configured.

The 5GC may provide the gNB the information indicating that the QoS Flow allows rate adaptation in the uplink direction. During the Xn-based handover preparation procedure, the source gNB will forward this information for the QoS flow to the target gNB, which allows target gNB to perform uplink rate control.

### 16.15.5 Non-Homogeneous support of PDU set based handling in NG-RAN

During a handover from a gNB supporting PDU Set based handling to another gNB, the source gNB signals the PDU Set Information over Xn-U if the target node has signalled the support of PDU Set based handling in the Xn Handover Request Acknowledge message.

During a handover, transition from RRC\_INACTIVE to RRC\_CONNECTED or RRC re-establishment from a gNB not supporting PDU Set based handling to a gNB supporting PDU Set based handling, the target/new serving gNB may indicate the support of PDU Set based handling to the SMF during the Path Switch Request procedure or Handover Resource Allocation procedure (in case of NG handover), the SMF will act as specified in TS 23.501[3]. If the indication is absent, the SMF infers that PDU Set based handling is not supported by the target/new serving gNB node, then the SMF will act as specified in TS 23.501[3].

During a handover, transition from RRC\_INACTIVE to RRC\_CONNECTED or RRC re-establishment from a gNB node not supporting PDU Set based handling to a gNB node supporting PDU Set based handling, the target/new serving gNB node may receive unmarked PDU(s) (i.e. PDU(s) without PDU Set Information Container) forwarded from the source/last serving gNB, node and marked PDU(s) (i.e. PDU(s) with PDU Set Information Container) from UPF, how the target/new serving gNB node handles the marked and unmarked PDUs for the same QoS flow is up to implementation.

### 16.15.Y Measurement Gaps

To enable the transmission and reception during some of the measurements gaps configured for RRM measurements, a measurement gap occasion may be cancelled via DCI.

In addition, the UE may provide, via UE Assistance information, a recommended gap occasion cancellation ratio per measurement gap configuration.

*End of Changes*