**3GPP TSG-RAN2 Meeting #123 R2-230xxxx**

**Toulouse, France , 21 – 25 August, 2023**

**Agenda item: 7.5.1**

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.323** | **CR** | **NUM** | **rev** | **-** | **Current version:** | **17.5.0** |  |
|  | | | | | | | | |
| *For* [***HELP***](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 XR to PDCP | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | LG Electronics Inc. | | | | | | | | | |
| ***Source to TSG:*** | RAN2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_XR\_enh-Core | | | | |  | ***Date:*** | | | 2023-08-21 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-18 |
|  | *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-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | Following agreements need to be introduced. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Following changes are implemented. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | PDCP spec cannot support XR feature. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | To be filled later | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | | TS/TR ... 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:*** | |  | | | | | | | | |

====================================CHAGNE BEGIN====================================

# 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.

- 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 38.300: "NG Radio Access Network; Overall description".

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

[4] 3GPP TS 38.321: "NR Medium Access Control (MAC) protocol specification".

[5] 3GPP TS 38.322: "NR Radio Link Control (RLC) protocol specification".

[6] 3GPP TS 33.501: "Security Architecture and Procedures for 5G System ".

[7] IETF RFC 5795: "The RObust Header Compression (ROHC) Framework".

[8] IETF RFC 3095: "RObust Header Compression (ROHC): Framework and four profiles: RTP, UDP, ESP and uncompressed".

[9] IETF RFC 4815: "RObust Header Compression (ROHC): Corrections and Clarifications to RFC 3095".

[10] IETF RFC 6846: "RObust Header Compression (ROHC): A Profile for TCP/IP (ROHC-TCP)".

[11] IETF RFC 5225: "RObust Header Compression (ROHC) Version 2: Profiles for RTP, UDP, IP, ESP and UDP Lite".

[12] 3GPP TS 36.321: "Evolved Universal Terrestrial Radio Access (E-UTRA) Medium Access Control (MAC) protocol specification".

[13] 3GPP TS 23.287: "Architecture enhancements for 5G System (5GS) to support Vehicle-to-Everything (V2X) services".

[14] 3GPP TS 33.536: "Security Aspect of 3GPP Support for Advanced V2X Services".

[15] IEEE Standard 802.3™-2018: "Ethernet".

[16] 3GPP TS 24.587: "Vehicle-to-Everything (V2X) services in 5G System (5GS), Stage 3".

[17] 3GPP TS 33.401: "3GPP System Architecture Evolution (SAE); Security Architecture".

[18] 3GPP TS 23.304: "Proximity based Services (ProSe) in the 5G System (5GS)".

[19] IETF RFC 1951: "DEFLATE Compressed Data Format Specification version 1.3".

[20] IETF RFC 3485: "The Session Initiation Protocol (SIP) and Session Description Protocol (SDP) Static Dictionary for Signaling Compression (SigComp)".

[21] IETF RFC 1979: "PPP Deflate Protocol".

[22] 3GPP TS 38.351: "NR; Sidelink Relay Adaptation Protocol (SRAP) Specification".

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

## 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].

**AM DRB**:a data radio bearer which utilizes RLC AM.

**AM MRB:** an MRB associated with at least one AM RLC bearer for PTP transmission.

**Broadcast MRB**: a radio bearer configured for MBS broadcast delivery.

**DAPS bearer**:a bearer whose radio protocols are located in both the source gNB and the target gNB during DAPS handover to use both source gNB and target gNB resources.

**MBS Radio Bearer:** a radio bearer that is configured for MBS delivery.

**Multicast MRB:** a radio bearer configured for MBS multicast delivery.

**Non-split bearer**: a bearer whose radio protocols are located in either the MgNB or the SgNB to use MgNB or SgNB resource, respectively.

**NR sidelink communication**: AS functionality enabling at least V2X communication as defined in TS 23.287 [13] and ProSe communication (including ProSe non-Relay and UE-to-Network Relay communication) as defined in TS 23.304 [18], between two or more nearby UEs, using NR technology but not traversing any network node.

**NR sidelink discovery**: AS functionality enabling ProSe non-Relay Discovery and ProSe UE-to-Network Relay discovery for Proximity based Services as defined in TS 23.304 [18] between two or more nearby UEs, using NR technology but not traversing any network node.

**NR sidelink transmission**: any NR Sidelink-based transmission, including both transmission for NR sidelink discovery and transmission for NR sidelink communication.

**PDCP data volume**: the amount of data available for transmission in a PDCP entity.

**PDU Set**: one or more PDUs carrying the payload of one unit of information generated at the application level (e.g. frame(s) or video slice(s) etc for XR Services), as defined in TS 23.501 [xx].

**Split bearer**: in dual connectivity, a bearer whose radio protocols are located in both the MgNB and the SgNB to use both MgNB and SgNB resources.

**Split secondary RLC entity**: in dual connectivity, the RLC entity other than the primary RLC entity which is responsible for split bearer operation. If the PDCP entity is associated with two RLC entities, the split secondary RLC entity is the RLC entity other than the primary RLC entity. If the PDCP entity is associated with more than two RLC entities, the split secondary RLC entity is configured by upper layers.

**UM DRB**:a data radio bearer which utilizes RLC UM.

**UM MRB:** an MRB associated with only RLC UM.

## 3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] 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].

AM Acknowledged Mode

ARP Address Resolution Protocol

CID Context Identifier

DAPS Dual Active Protocol Stack

DRB Data Radio Bearer carrying user plane data

EHC Ethernet Header Compression

FIFO First In First Out

gNB NR Node B

HFN Hyper Frame Number

IETF Internet Engineering Task Force

IP Internet Protocol

MAC Medium Access Control

MAC-I Message Authentication Code for Integrity

MBS Multicast/Broadcast Services

MRB MBS Radio Bearer

MTCH MBS Traffic Channel

PDCP Packet Data Convergence Protocol

PDU Protocol Data Unit

PSI PDU Set Importance

RB Radio Bearer

RFC Request For Comments

RLC Radio Link Control

ROHC RObust Header Compression

RRC Radio Resource Control

RTP Real Time Protocol

SAP Service Access Point

SCCH Sidelink Control Channel

SDU Service Data Unit

SLRB Sidelink Radio Bearer carrying NR sidelink communication or NR sidelink discovery

SN Sequence Number

SRAP Sidelink Relay Adaptation Protocol

SRB Signalling Radio Bearer carrying control plane data

STCH Sidelink Traffic Channel

TCP Transmission Control Protocol

UDC Uplink Data Compression

UDP User Datagram Protocol

UE User Equipment

UM Unacknowledged Mode

U2N UE-to-Network

X-MAC Computed MAC-I

Editor's Notes: the need for new abbreviations are FFS.

## 4.4 Functions

The PDCP layer supports the following functions:

- 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 the EHC protocol;

- uplink data compression and decompression using the UDC protocol;

- ciphering and deciphering;

- integrity protection and integrity verification;

- timer based SDU discard;

- timer based PDU Set discard;

- PSI based PDU Set discard;

- for split bearers and DAPS bearer, routing;

- duplication;

- reordering and in-order delivery;

- out-of-order delivery;

- duplicate discarding.

## 5.3 SDU discard

When the successful delivery of a PDCP SDU is confirmed by PDCP status report, the transmitting PDCP entity shall discard the PDCP SDU along with the corresponding PDCP Data PDU.

When the *discardTimer* expires for a PDCP SDU, the transmitting PDCP entity shall:

- if *pdu-SetDiscard* is configured:

- discard all PDCP SDUs belonging to the PDU Set to which the PDCP SDU belongs along with the corresponding PDCP Data PDUs;

- else:

- discard the PDCP SDU along with the corresponding PDCP Data PDU.

When the [congestion] is indicated, [if *psi-BasedDiscard* is configured], the transmitting PDCP entity shall:

- [discard all PDCP SDUs belonging to the PDU Set whose PSI is less than a [threshold] along with the corresponding PDCP Data PDUs].

Editor's Notes: it is FFS how the congestion is indicated, exact mechanism of congestion discard, and until when this behaviour is applied.

If the corresponding PDCP Data PDU has already been submitted to lower layers, the discard is indicated to lower layers.

For SRBs, when upper layers request a PDCP SDU discard, the PDCP entity shall discard all stored PDCP SDUs and PDCP PDUs.

NOTE: Discarding a PDCP SDU already associated with a PDCP SN causes a SN gap in the transmitted PDCP Data PDUs, which increases PDCP reordering delay in the receiving PDCP entity. It is up to UE implementation how to minimize SN gap after SDU discard.

## 5.6 Data volume calculation

For the purpose of MAC buffer status reporting, the transmitting PDCP entity shall consider the following as PDCP data volume:

- the PDCP SDUs for which no PDCP Data PDUs have been constructed;

- the PDCP Data PDUs that have not been submitted to lower layers;

- the PDCP Control PDUs;

- for AM DRBs, the PDCP SDUs to be retransmitted according to clause 5.1.2 and clause 5.13;

- for AM DRBs, the PDCP Data PDUs to be retransmitted according to clause 5.5.

[For the purpose of MAC delay status reporting, the transmitting PDCP entity shall consider the following as delay-critical PDCP data volume]:

- the PDCP SDUs for which the remaining *discardTimer* values are less than a [threshold].

Editor's Notes: it is a placeholder for new mechanism. Depending on further progress, the exact procedure and location of this text may need to be changed.

If the transmitting PDCP entity is associated with at least two RLC entities, when indicating the PDCP data volume to a MAC entity for BSR triggering and Buffer Size calculation (as specified in TS 38.321 [4] and TS 36.321 [12]), the transmitting PDCP entity shall:

- if the PDCP duplication is activated for the RB:

- indicate the PDCP data volume to the MAC entity associated with the primary RLC entity;

- indicate the PDCP data volume excluding the PDCP Control PDU to the MAC entity associated with the RLC entity other than the primary RLC entity activated for PDCP duplication;

- indicate the PDCP data volume as 0 to the MAC entity associated with RLC entity deactivated for PDCP duplication;

- else (i.e. the PDCP duplication is deactivated for the RB or the RB is a DAPS bearer):

- if the split secondary RLC entity is configured; and

- if the total amount of PDCP data volume and RLC data volume pending for initial transmission (as specified in TS 38.322 [5]) in the primary RLC entity and the split secondary RLC entity is equal to or larger than *ul-DataSplitThreshold*:

- indicate the PDCP data volume to both the MAC entity associated with the primary RLC entity and the MAC entity associated with the split secondary RLC entity;

- indicate the PDCP data volume as 0 to the MAC entity associated with RLC entity other than the primary RLC entity and the split secondary RLC entity;

- else, if the transmitting PDCP entity is associated with the DAPS bearer:

- if the uplink data switching has not been requested:

- indicate the PDCP data volume to the MAC entity associated with the source cell;

- else:

- indicate the PDCP data volume excluding the PDCP Control PDU for interspersed ROHC feedback associated with the source cell to the MAC entity associated with the target cell;

- indicate the PDCP data volume of PDCP Control PDU for interspersed ROHC feedback associated with the source cell to the MAC entity associated with the source cell;

- else:

- indicate the PDCP data volume to the MAC entity associated with the primary RLC entity;

- indicate the PDCP data volume as 0 to the MAC entity associated with the RLC entity other than the primary RLC entity.

====================================CHAGNE STOP====================================

# Annex A: RAN2 agreements related to PDCP

## RAN2#121

* 5. Introduce UL PDU Set Importance. How UE derives this will be handled in UE implementation.
* Can indicate that in RAN2 considers PDU set concept applicable to both UL and DL in LS to SA2.
* RAN2 thinks PSI can be useful for PDU set-based discard. RAN2 aims to introduce a mechanism to allow UE to handle discarding of packets with different PSI in case of congestion. FFS for other cases.
* Support of RLC bearer splitting should be limited to existing cases (e.g. PDCP duplication), no new XR-specific functionality.

## RAN2#121bis

* 2: PDU set discard is modelled using the existing PDCP discard timer for the uplink. The timer is in network control.

## RAN2#122

* 1: UE calculates the remaining time based on the PDCP discard timer value. FFS if UE reports one or multiple values. FFS how this is modelled in PDCP specification. FFS which UEs support this.
* When/if UE reports remaining time, the reference time for the remaining time is determined from the point of the first transmission of the information. FFS if intra-UE prioritization can impact this.
* 2: PDU-set discard indication for UL is configured using RRC to handle the PDU Set based discard functionality (i.e. whether UE discards all packets in PDU set when one PDU is discarded). The configuration is per PDCP entity.
* Network indicates UE to apply PSI-based XR discard mechanism via dedicated signalling.
* FFS how/whether to minimize additional UL signalling after this indication.
* FFS if the NW indication is a one-shot or also subsequent packets