**3GPP TSG-RAN2 Meeting #126 *R2-2405932***

**Fukuoka, Japan, May 20th – May 24th, 2024**

**Agenda Item 7.5.3.2**

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| *CR-Form-v12.3* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.323** | **CR** | **0139** | **rev** | **-** | **Current version:** | **18.1.0** |  |
|  | | | | | | | | |
| *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:*** | PDCP SN gap reporting | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | LG Electronics Inc. (Rapporteur) | | | | | | | | | |
| ***Source to TSG:*** | RAN2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_XR\_enh-Core | | | | |  | ***Date:*** | | | 2024-05-21 |
|  |  | | | |  | |  | | |  |
| ***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-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)  Rel-20 (Release 20)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | PDCP SN gap reporting is missing. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | PDCP SN gap reporting is introduced. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | PDCP SN gap reporting is not supported. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 5.2.2.1, 5.2.2.2, 5.X.1, 5.X.2, 6.1.2, 6.2.3.X, 6.3.8, 6.3.X, 6.3.Y | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | | **Y** |  | Other core specifications | | | | TS/TR 38.300 CR 0860  TS/TR 38.331 CR 4700 | | |
| ***affected:*** | |  | **X** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

### 5.2.2 Receive operation

#### 5.2.2.1 Actions when a PDCP Data PDU is received from lower layers

In this clause, following definitions are used:

- HFN(State Variable): the HFN part (i.e. the number of most significant bits equal to HFN length) of the State Variable;

- SN(State Variable): the SN part (i.e. the number of least significant bits equal to PDCP SN length) of the State Variable;

- RCVD\_SN: the PDCP SN of the received PDCP Data PDU, included in the PDU header;

- RCVD\_HFN: the HFN of the received PDCP Data PDU, calculated by the receiving PDCP entity;

- RCVD\_COUNT: the COUNT of the received PDCP Data PDU = [RCVD\_HFN, RCVD\_SN].

At reception of a PDCP Data PDU from lower layers, the receiving PDCP entity shall determine the COUNT value of the received PDCP Data PDU, i.e. RCVD\_COUNT, as follows:

- if RCVD\_SN < SN(RX\_DELIV) – Window\_Size:

- RCVD\_HFN = HFN(RX\_DELIV) + 1.

- else if RCVD\_SN >= SN(RX\_DELIV) + Window\_Size:

- RCVD\_HFN = HFN(RX\_DELIV) – 1.

- else:

- RCVD\_HFN = HFN(RX\_DELIV);

- RCVD\_COUNT = [RCVD\_HFN, RCVD\_SN].

After determining the COUNT value of the received PDCP Data PDU = RCVD\_COUNT, the receiving PDCP entity shall:

- perform deciphering and integrity verification of the PDCP Data PDU using COUNT = RCVD\_COUNT;

- if integrity verification fails:

- indicate the integrity verification failure to upper layer;

- discard the PDCP Data PDU and consider it as not received;

- if RCVD\_COUNT < RX\_DELIV; or

- if the PDCP Data PDU with COUNT = RCVD\_COUNT has been received before:

- discard the PDCP Data PDU;

If the received PDCP Data PDU with COUNT value = RCVD\_COUNT is not discarded above, the receiving PDCP entity shall:

- store the resulting PDCP SDU in the reception buffer;

- if RCVD\_COUNT >= RX\_NEXT:

- update RX\_NEXT to RCVD\_COUNT + 1.

- if *outOfOrderDelivery* is configured:

- deliver the resulting PDCP SDU to upper layers after performing header decompression using EHC.

- if RCVD\_COUNT = RX\_DELIV:

- deliver to upper layers in ascending order of the associated COUNT value after performing header decompression, if not decompressed before;

- all stored PDCP SDU(s) with consecutively associated COUNT value(s) starting from COUNT = RX\_DELIV, where consecutively associated COUNT value(s) include COUNT value(s) of both the stored PDCP SDU(s) and PDCP SDU(s) which are considered as discarded as specified in clause 5.X.2;

- update RX\_DELIV to the COUNT value of the first PDCP SDU which has not been delivered to upper layers and is not considered as discarded as specified in clause 5.X.2, with COUNT value > RX\_DELIV;

- if *t-Reordering* is running, and if RX\_DELIV >= RX\_REORD:

- stop and reset *t-Reordering*.

- if *t-Reordering* is not running (includes the case when *t-Reordering* is stopped due to actions above), and RX\_DELIV < RX\_NEXT:

- update RX\_REORD to RX\_NEXT;

- start *t-Reordering*.

#### 5.2.2.2 Actions when a *t-Reordering* expires

When *t-Reordering* expires, the receiving PDCP entity shall:

- deliver to upper layers in ascending order of the associated COUNT value after performing header decompression, if not decompressed before:

- all stored PDCP SDU(s) with associated COUNT value(s) < RX\_REORD;

- all stored PDCP SDU(s) with consecutively associated COUNT value(s) starting from RX\_REORD, where consecutively associated COUNT value(s) include COUNT value(s) of both the stored PDCP SDU(s) and PDCP SDU(s) which are considered as discarded as specified in clause 5.X.2;

- update RX\_DELIV to the COUNT value of the first PDCP SDU which has not been delivered to upper layers and is not considered as discarded as specified in clause 5.X.2, with COUNT value >= RX\_REORD;

- if RX\_DELIV < RX\_NEXT:

- update RX\_REORD to RX\_NEXT;

- start *t-Reordering*.

## 5.X SN gap report

### 5.X.1 Transmit operation

For UM DRBs and AM DRBs configured by upper layers to send a PDCP SN gap report in the uplink (*sn-GapReport* in TS 38.331 [3]), the transmitting PDCP entity shall trigger a PDCP SN gap report when:

- the PDCP SDU(s) are discarded as specified in clause 5.3; and

- there is at least one stored PDCP SDU(s) which is associated with a COUNT value larger than the COUNT value associated to the discarded PDCP SDU(s); and

- the discarded PDCP SDU(s) have not been submitted by RLC to lower layers.

If a PDCP SN gap report is triggered, the transmitting PDCP entity shall:

- compile a PDCP SN gap report as indicated below by:

- setting the FDC field to the smallest COUNT value among the COUNT values associated with the discarded PDCP SDU(s);

- if more than one PDCP SDUs are discarded:

- allocating a Discard Bitmap field of length in bits equal to the number of COUNT values from and not including the first discarded PDCP SDU up to and including the last discarded PDCP SDU, rounded up to the next multiple of 8, or up to and including a PDCP SDU for which the resulting PDCP Control PDU size is equal to 9000 bytes, whichever comes first;

- setting in the discard bitmap field as ‘0’ for all PDCP SDUs that have not been discarded;

- setting in the discard bitmap field as ‘1’ for all PDCP SDUs that have been discarded.

- submit the PDCP SN gap report to lower layers as specified in clause 5.2.1 for Uu interface.

NOTE X: It is up to UE implementation how to limit the frequency of PDCP SN gap reporting.

### 5.X.2 Receive operation

At reception of a PDCP SN gap report from lower layers, the receiving PDCP entity shall:

- consider each PDCP SDU, if any, with the bit in the discard bitmap set to ‘1’, or with the associated COUNT value equal to the value of FDC field as discarded:

- if RX\_DELIV is less than or equal to the largest COUNT value associated with the discarded PDCP SDUs:

- if RX\_NEXT <= COUNT value associated with the last discarded PDCP SDU indicated in the PDCP SN gap report:

- update RX\_NEXT to the largest COUNT value associated with the discarded PDCP SDU + 1;

- if RX\_DELIV is equal to any COUNT value associated with the discarded PDCP SDU(s):

- deliver to upper layers in ascending order of the associated COUNT value after performing header decompression, if not decompressed before:

- all stored PDCP SDU(s) with consecutively associated COUNT values starting from COUNT value(s) equal to RX\_DELIV + 1, where consecutively associated COUNT value(s) include COUNT value(s) of both the stored PDCP SDU(s) and PDCP SDU(s) which are considered as discarded;

- update RX\_DELIV to the COUNT value of the first PDCP SDU which has not been delivered to upper layers and is not considered as discarded, with COUNT value > RX\_DELIV;

- if *t-Reordering* is running, and if RX\_DELIV >= RX\_REORD:

- stop and reset *t-Reordering*;

- if *t-Reordering* is not running (includes the case when *t-Reordering* is stopped due to actions above), and RX\_DELIV < RX\_NEXT:

- update RX\_REORD to RX\_NEXT;

- start *t-Reordering*.

### 6.1.2 Control PDU

The PDCP Control PDU is used to convey one of followings in addition to the PDU header:

- a PDCP status report;

- an interspersed ROHC feedback;

- an EHC feedback;

- a UDC feedback;

- a PDCP SN gap report.

#### 6.2.3.X Control PDU for PDCP SN gap report

Figure 6.2.3.X-1 shows the format of the PDCP control PDU carrying the PDCP SN gap report. This format is applicable for UM DRBs and AM DRBs.



Figure 6.2.3.X-1: PDCP Control PDU format for PDCP SN gap report

### 6.3.8 PDU type

Length: 3 bits

This field indicates the type of control information included in the corresponding PDCP Control PDU.

Table 6.3.8-1: PDU type

|  |  |
| --- | --- |
| Bit | Description |
| 000 | PDCP status report |
| 001 | Interspersed ROHC feedback |
| 010 | EHC feedback |
| 011 | UDC feedback |
| 100 | PDCP SN gap report |
| 101-111 | Reserved |

### 6.3.X FDC

Length: 32 bits

First discarded COUNT. This field indicates the smallest COUNT value among the COUNT value(s) associated with the discarded PDCP SDU(s).

### 6.3.Y Discard Bitmap

Length: Variable. The length of the discard bitmap field can be 0.

This field indicates which SDUs are discarded and which SDUs are not discarded in the transmitting PDCP entity. The bit position of the Nth bit in the Discard Bitmap is N, i.e., the bit position of the first bit in the Discard Bitmap is 1.

Table 6.3.Y-1 Discard Bitmap

|  |  |
| --- | --- |
| Bit | Description |
| 0 | PDCP SDU with COUNT = (FDC + bit position) modulo 232 is not discarded. |
| 1 | PDCP SDU with COUNT = (FDC + bit position) modulo 232 is discarded. |