3GPP TSG-RAN WG2 Meeting #125 Tdoc R2-24xxxxx

Athens, Greece, February 26th - March 1st, 2024

Source: Ericsson (rapporteur)

Title: [POST125][017][XR] PDCP report

Agenda item: 7.5.3.3

Document for: Discussion, Decision

# 1 Introduction

This contribution intends to provide a report for the post meeting discussion as below:

* [POST125][017][XR] PDCP report (Ericsson)

 Intended outcome: Start with joint paper proposal to get further inputs from companies that haven’t yet provided their views, suggest and review the TP.

 Deadline: Long

This email discussion will be organized in two phases. In the 1st phase, we will collect company views on the leftover joint proposals from [2]. In the 2nd phase, based on the outcome of the 1st phase, we will provide a set of proposals and corresponding TPs for perusal and further comments.

The deadline for providing company views are as follows:

|  |  |
| --- | --- |
| 1st Phase  | 22nd March 2024, 10 UTC |
| 2nd Phase  | 29th March 2024, 10 UTC |

# 2 List of Joint Proposals

The following are the agreements from the RAN2#125 meeting [18]:

**Agreements**

1. To define a mechanism for PDCP Transmitter to report to PDCP Receiver about the gap on the PDCP SN (i.e., transmitting PDCP entity can inform the receiving PDCP entity about the discarded SDUs).

2 To agree that the usage of a PDCP SN gap report is under network control (i.e. network configures UE whether/when PDCP SN gap report can be used). The UE should report only if there gaps (i.e. if the UE does re-association and there are not gaps, the UE is not required to transmit).

3 Define a new UE capability to indicate the support of PDCP SN Gap reporting.

The intended outcome as stated above is to get further input from companies on these joint proposals. Further, also gather company inputs on the related TPs. The proposals from the joint contribution [2] are as shown below, given that P1/P2 and part of P4 have already been agreed, we will focus on the other set of proposals.

***Proposal 1.*** *To define a mechanism for PDCP Transmitter to report to PDCP Receiver about the gap on the PDCP SN (i.e., transmitting PDCP entity can inform the receiving PDCP entity about the discarded SDUs).*

***Proposal 2.*** *To agree that the usage of a PDCP SN gap report is under network control (i.e. network configures UE whether/when PDCP SN gap report can be used).*

***Proposal 2.1.*** *To confirm that the usage of a PDCP SN gap reporting is dependent or applicable only when outOfOrderDelivery is not configured.*

***Proposal 3.*** *To agree on PDCP control PDU approach for transmitter to provide PDCP SN Gap reporting to receiver.*

***Proposal 3.1.*** *To discuss whether to enable PDCP SN Gap reporting via: option (A.1) bitmap kind of information, or option (A.2) range kind of information.*

***Proposal 3.2.*** *To discuss whether/which rules needs to be defined in PDCP transmitter entity to trigger PDCP SDU discard report considering e.g. (1) the PDCP entity discards SDU(s) which have not been transmitted (for UM DRBs) or acknowledged (for AM DRBs), due to the expiry of PDCP discard timer; and (2) there is a buffered SDU associated with an SN higher than the SN of the discarded SDU(s), as well as, related TPs included in R2-2401420, R2-2400748 and R2-2313923.*

***Proposal 3.3.*** *To consider the related TPs included in R2-2401420, R2-2400748 and R2-2313923.*

***Proposal 4.*** *To discuss whether to define a new UE capability to indicate the support of PDCP SN Gap reporting. If so, to discuss whether UE supporting PDCP SN Gap reporting shall also support pdu-SetDiscard-r18 and/or psi-BasedDiscard-r18.*

# 3 Discussion

## 3.1 PDCP SN Gap Reporting for *OutofOrderDelivery*

*that the usage of a PDCP SN gap reporting is dependent or applicable only when outOfOrderDelivery is not configured.*

This is a straightforward proposal where if the UE is configured with *OutofOrderDelivery*, then the reordering delays are not applicable. But would be good to confirm company’s views on this proposal.

**Is the PDCP SN gap reporting applicable only when outOfOrderDelivery is not configured?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| LGE | Yes |  |
| Futurewei | –  | Agree that reordering delay isn’t a concern when OOD is configured. However, we may need to study the following case as well:It is known that peak data rate of XR video (at least DL) can be as high as 150 Mbps, which translates into 12500 1500-byte SDUs per second. When PDU Set transmissions are uninterrupted, 12-bit PDCP SN can very well handle the HFN derivation for this case. However, if PSI-based SDU discard with a non-zero discardTimerForLowImportance is configured and the congestion causes the transmitter to consecutively discard more than 1/6 of a second of video PDUs, a PDCP SN gap greater than 2048 is created at the receiving PDCP entity, which may cause HFN desynchronization, when a next PDU Set (a high-importance one) is transmitted and received. In this case, if the transmitting PDCP entity reports the SN gap, the receiving PDCP entity updates its RX\_DELIV before deriving HFN for the next received PDU and hence avoids HFN desynchronization. The transmitting PDCP entity doesn’t have to report the SN gap each time SDU discarding occurs. It just needs to report when the size of the contiguous SN gap becomes very close to the size of one half of the PDCP SN space.The alternative is to configure 18-bit PDCP SN, but with a price of one extra byte of overhead for every PDCP data PDU constantly, i.e., even when there is no congestion. |
| Xiaomi | Yes | As for issues mentioned by Futurewei, we think 18-bit PDCP SN can resolve the potential issue. Considering that 1500-byte typical PDCP SDU size (as mentioned by Futurewei), the overhead of 1 byte is only 1/1500 = 0.067%, which is negligible. |
| CATT | Yes | In case outOfOrderDelivery is configured, the receiving PDCP entity shall deliver the resulting PDCP SDU to upper layers after performing header decompression using EHC. There is no PDCP SN gap issue needs to be handled under that case. |
| Huawei, HiSilicon | Yes |  |
| Apple | Yes |  |
| Ericsson | Yes |  |
| Intel | Yes |  |
| HONOR | Yes | When OutofOrderDelivery is configured for receiving side, once the PDCP SDU is successfully received from lower layer, it will forward to upper layer without any re-ordering delay. Thus no extra mechnism is needed in such case. |
| Lenovo | Yes |  |
| Fujitsu | See comment | Agree with the intention. We think the current outOfOrderDelivery configuration is used for delivery of downlink data. For uplink data, it’s up to the network implementation whether in-order delivery is needed. PDCP SN reporting can be used for both DL and UL. For DL, if outOfOrderDelivery is not configured, UE will expect to receive PDCP SN report from network. For UL, it may be better to define a new configuration to indicate whether UE should enable PDCP SN reporting. |
| ZTE | Yes |  |
| Nokia | Yes |  |
| Qualcomm | Yes |  |
| Samsung | Yes |  |
| OPPO | Yes |  |
| ITRI | Yes |  |
| Canon | No | Discard notification can be also valuable for PSER /PER calculation at receiving side as discarded PDU shall not be included in the error rate calculation. |
| TCL | -See comment | Even with out-of-order delivery configured, the RX reordering window continues to operate, and reporting the gap in PDCP SN may still be necessary in this scenario. |
| Sony | Yes |  |
| CMCC  | Yes |  |
| MediaTek | Yes | Agree with CATT. |
|  |  |  |

##### Rapporteur Summary (OOD):

Almost all companies agree that the PDCP SN gap reporting is not required when *outOfOrderDelivery* is configured. 3 companies have not provided their preference with their comments relating to HFN desynchronization when using a 12-bit PDCP SN, PDCP SN reporting can be used for both DL and UL and that the Rx reordering window continues to operate thereby the reporting of the gap in PDCP SNs may still be necessary. One company also disagrees, they comment that the discard notification can also be valuable for PSER/PER calculation at the receiving side as discarded PDUs shall not be included in the error rate calculation.

As described in the discussion section, since the PDCP Rx entity can deliver to the upper layers in out-of-order, the reordering delays are not applicable. In addition, as the PDCP SN gap reporting is primarily to avoid this delay, it would be reasonable to consider the PDCP SN gap reporting when outOfOrderDelivery is not configured. Hence, the following proposal:

1. **PDCP SN gap reporting is applicable only when outOfOrderDelivery is not configured.**

## 3.2 PDCP Control PDU for PDCP SN Gap Reporting

*On PDCP control PDU approach for transmitter to provide PDCP SN Gap reporting to receiver.*

[3][5][8][9][12][13][14][15] believe a new PDCP Control PDU is the simplest way to perform the PDCP SN gap reporting as the headers of the PDCP data PDU are not impacted [3] and, that it was agreed to not introduce in-band marking in Rel-18 XR [15]. Further, as detailed in [9], using the headers of the data PDU could result in a unwarranted size of the PDCP data PDU and due to preprocessing of the header, any changes would require manipulation of the already processed PDCP PDU header resulting in implementation complexities.

[6] on the other hand, suggests that the control PDU is poorly suited for this type of notification as in-band reception can inform the receiver as soon as possible hence, using the header of the data PDU.

So, based on the majority view, we would like to check company’s views on the use of a new PDCP control PDU to perform the PDCP SN gap reporting as a baseline.

**As the baseline, should a new PDCP Control PDU be used for PDCP SN gap reporting?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| LGE | No | Using a header-only PDU (i.e. PDU without payload) is simple with following reasons:* PDCP Control PDU can be transmitted only after all the buffered data are transmitted. There is no PDCP Control PDU prioritization rule in current specification. Thus, there is no real benefit to use PDCP Control PDU.
* Header-only PDU does not change any state variable handling in Rx operation. On the other hand, with PDCP Control PDU, a new state variable handling operation should be introduced in Rx side.

Futurewei>> we respectfully disagree with this bullet. The whole purpose of providing the SN gap report st o enable the receiving PDCP entity to update ist state variable such as RX\_DELIV when needed, so that: 1) HFN desynchronization can be avoided 2) any PDCP SDUs after the old RX\_DELIV and having been received and stored in the reordering buffer can be delivered to upper layer and the receiving window can slide forward, like what happens after the re-ordering timer expires today. Even if header-based approach is adopted, we expect that state variable handling in the data PDU Rx operation is still needed, potentially complicating the existing data PDU Rx operation significantly. On the other hand, if using PDCP control PDU, the control PDU Rx operation described in [1], [8], and [15] are very similar st o data PDU Rx operation today.[LGE] You seem to misunderstand the header-only PDU. It is different from Data PDU header indication described in [6].The header-only PDU contains only SN without any payload. As the SNs are attached to each PDCP PDU, the RX operation is same as legacy, i.e. the RX state variables are updated based on the SN of the header-only PDU. The change is simple, e.g. just adding a text “**if SN gap would occur due to discard of a PDCP SDU, the PDCP entity discards the payload of the PDCP PDU instead of discarding the PDCP SDU**”.The Control PDU solution requires additional handling of RX state variables based on the Control PDU, and thus it complicates the RX operation.* The Tx operation with header-only PDU is simple. When a PDCP report is triggered, the UE just removes the payload from the discardTimer-expired PDUs.

Futurewei>> we respectfully disagree with this bullet. It will significantly complicate the data PDU Tx and Rx operations when all details are considered. Please see point #3 in our analysis below.[LGE] Still you seem to misunderstand the header-only PDU. There is no change in Tx and Rx operation with header-only PDU.* If the header-only PDU is used, further discussion such as 3.2.1 and 3.2.2 are not needed.
 |
| Futurewei | Yes | There are a number of issues with PDCP data PDU header based approaches, as follows:1. Using PDCP data PDU header to report the SN gap is slower than using PDCP control PDU because the PDCP data PDU is submitted st o RLC entity in-sequence while the PDCP control PDU is prioritized over any PDCP data PDUs that has not been submitted st o RLC entity yet, according st o following text from 38.323:

[LGE] PDCP Control PDU is prioritized over PDCP Data PDU in PDCP entity, but it is not prioritized in RLC entity. The SN gap reporting is triggered when PDCP SDUs are discarded in the RLC entity and following PDCP SDUs are stored in the RLC buffer. Thus, the PDCP Control PDU can be transmitted only after all PDCP SDUs stored in the RLC buffer are transmitted.And, the PDCP control PDU can be generated and submitted st o RLC as soon as the transmitting PDCP entity, after having discarded some low-importance PDU Set(s), determines that the next PDU Set is a high-importance one, i.e., as soon as the first PDCP SDU st o high-importance PDU Set arrives. But if using PDCP data PDU header, one st o wait until the first PDCP SDU st o high-importance PDU Set has finished the header compression, integrity protection, and cyphering, and all PDCP data PDUs queued before it have been cleared. 1. According to [6], the SN gap is reported by inserting the number of contiguous SNs being discarded immedicately prior st o PDCP SN st o current PDCP data PDU. First, as we described in our response to Q3.1, consecutively discarding more than 1/6 of a second of video PDUs may cause HFN desynchronization if 12-bit PDCP SN is configured. If the COUNT value st o current PDCP data PDU cannot be correctly reconstructed in the first place, the discarded COUNT values cannot be correctly indicated either with the number of consecutively discarded SNs. Secondly, even without HFN desynchronization, design in [6] works only if the discarded PDCP SNs are always contiguous. However, the LS (R2-2400088) we just received from SA4 indicates that packets may arrive out of order. E.g., a base layer PDU Set (persumably with high-importance) and a spatial enhancement layer PDU Set (persumably with low-importance) generated from a same video picture may arrive at the gNB out-of-order and interleaved and hence their COUNT values may be interleaved. When the spatial enhancement layer PDU Set is discarded due to PSI based discarding under congestion, there is no guarantee that the discarded PDCP SNs are always contiguous.

[LGE] Header-only PDU is different from Data PDU header indication described in [6]. Such problem does not occur in header-only PDU.1. Since the SN gap report is not always present in the PDCP data PDUs, there must be an indication bit in every PDCP data PDU header to indicate the presence or absence st o SN gap report. But because discarding may occur after the integrity protection and cyphering has been done, this presence bit (as well as the inserted SN gap report) must be excluded from the computation of integrity protection and cyphering, and the receiving PDCP entity must mask this presence bit when performing decyphering and integrity verification. If the SN gap report is inserted as a new field in the PDCP header, not as a trailer st o PDU (i.e., after the MAC-I field), the receiving PDCP entity also needs to remove the SN gap report before performing decyphering and integrity verification. All these extra steps significantly complicate the data PDU Tx and Rx operations.

[LGE] Header-only PDU is different from Data PDU header indication described in [6]. Such problem does not occur in header-only PDU.On the other hand, if PDCP control PDU is used, the control PDU Rx operations described in [1], [8], and [15] are very similar st o data PDU Rx operation today. Except the triggers, the control PDU Tx operations described in [8] and [15] are very similar st o Status Report Tx operation today. The data PDU Tx operations remain completely intact and the data PDU Rx operations almost remain intact, as described in [8] and [15]. Hence, we support using PDCP control PDU to report SN gap. |
| Xiaomi | Yes |  |
| CATT | Yes | We see the similarity between SN gap reporting and status reporting, it is preferred to reuse a new PDCP Control PDU for PDCP SN gap reporting. |
| Huawei, HiSilicon | Yes | As mentioned by the rapporteur, using UP packets to carry this information would violate previous agreements which were made to avoid substantial impacts to UP processing and implementation, so this is not a proper way to handle this. In addition st o reasons introduced by the rapporteur, we think control PDU should be used because:1. This is control data so using user packet header is not appropriate.
2. For C-PDU we can easily inherit the design from PDCP SR.

[LGE] You seem to misunderstand the header-only PDU. It is different from Data PDU header indication described in [6]. The header-only PDU does not contain any control data but only contains SN without any payload. As the SNs are attached to each PDCP PDU, the RX operation is same as legacy, i.e. the RX state variables are updated based on the SN of the header-only PDU. To reply to LGE’s comments:* Priority of C-PDU: this is up to UE implementaiton so a smart UE would send it as soon as possible.

[LGE] In PDCP specification, it is specified that the Control PDU is prioritized over Data PDCP. But, in RLC, there is no such prioritization specified. The RLC does not differentiate the contents of RLC SDUs, and only transmits in the receiving order, i.e. first-in-first-out.* We do not see how the solution can work without changing state variables at the receiver side. The whole point st o solution st o avoid reoredring delay and avoid window stalling. Hence updating the variables is necessary.

[LGE] You seem to misunderstand the header-only PDU. It is different from Data PDU header indication described in [6]. Updating the state variable is definitely necessary. With header-only PDU, the RX state variables are updated same as legacy.* Of course we need to discuss how the discarded SNs are provided for both solutions, so we are not sure about the last point from LGE
* If the intention st o send all discarded PDUs with just an SN number, then we are concerned about the delay of providing this information as well as ist overhead.
 |
| Apple | Yes | To notify the receiver which SDUs are discarded, we think it is more generalized and straightforward to report a bitmap. Since the existing PDCP control PDUs already have fields based on bitmap structures, we believe a new control PDU reusing such bitmap structure for discarding notification seems to be a simpler approach. |
| Ericsson | See comments | From a specification standpoint, we believe that the header-only PDU looks like a reasonable solution as described by LGE. Even with the header-only solution, the state variables (RX\_NEXT and RX\_DELIV) would need to be updated, I assume what LGE meant by “no change“ is that the state variables update would be based on the current receive operation as described in Section 5.2.2 with the addition of handling the header-only PDU with zero data size. From an implementation standpoint also we think the header-only PDU is a good solution and as the reception is in-band (i.e., no prioritization needed) this has least impact on implementation. Even for the case when the PDCP PDUs are preprocessed, since the headers are not ciphered, the RLC can peek into the SNs of the PDUs to perform the removal of the data part of the PDU and retain the header. The specification impact would be restricted to a new section for e.g., 5.2.2.4 and something like the following:5.2.2.4          Actions when <discard indication header-only> is receivedWhen a <discard indication header-only> is received, the receiving PDCP entity shall:-    perform actions in 5.2.2.1 for an PDCP Data PDU with the assumed SN as indicated in the < received header-only > and assumed empty payload. Methods for decompression, deciphering and delivery don’t apply to this PDU.For FWs comment on the the transmission as the first PDCP PDU, it should be noted that the current PDCP SR is sent only in cases of reestablishment/data recovery. However, the PDCP SN gap reporting is under steady state conditions.For HWs comment, we believe this has least impact to UP processing/implementation.  |
| Intel | Yes | We have slightly preference to use a new PDCP Control PDU not to impact PDCP Data headers of any kind of traffic and because it is unclear whether the discarded PDUs will always be in sequence. Said this, if there is a large support to use PDCP Data header, we could accept it with the understanding that the Tx might need to flag the SN skipped multiple times if those SNs are not allocated sequencially.  |
| HONOR | Yes | We prefer using PDCP control PDU which is similar to current PDCP status report. |
| Lenovo | Yes with comment | We would be also open for the header-only solution suggested by LGE. We also think that specification impact would be reasonably low, since the “normal” receiving operation could be used.  |
| Fujitsu | Yes | No matter a control PDU-based or data PDU-based approach is used, the receiving operation on SN report will be similar. However, data PDU with the header indication will affect normal data PDU receiving operation, which increases the receiver complexity. |
| ZTE | Yes with comment | Our preference is for control PDU based solution, but we are also open to the header-only solution suggested by LGE.  |
| Nokia | Yes with comment | Also open to header-only solution. |
| Qualcomm | Yes | We have a slight preference for a new PDCP Control PDU, as header-only solution has more impact on UE implementation. |
| Samsung | Yes | We think a Control PDU is better suited as the discard information primarily can be consisting of one or two sets of first discarded SDU SN and number of consecutively discarded SDUs (depending on discardTimer expiry and/or discardTimerLowImportance expiry causing discard). Incorporating such information to a header-only data PDU has significant impact.  |
| OPPO | Yes | As what we want is to provide the status information to the peer entity, the most straightforward way is to introduce a new control PDU using a bitmap structure. |
| ITRI | Yes with comment | Our preference is PDCP control PDU similar to current PDCP status report based on bitmap structures, but we are also open to the header-only solution.  |
| Canon | Yes | To keep the legacy PDCP data PDU unchanged |
| TCL | Yes |  |
| Sony | See comment | We have sympathy for header only solution.  |
| CMCC | Yes | We think the new PDCP Control PDU is the simplest way, since it is similar to the PDCP status report. |
| MediaTek | Yes | Agree with CATT. |
|  |  |  |

##### Rapporteur Summary (Control PDU or header only):

From the companies who provided their views, 14 of them agreed that the PDCP control PDU should be used as the baseline, while 5 of them agreed with comments, two companies did not provide a preference and one company disagreed.

For a new control PDU, the view from most companies is that this is the more general and straightforward way to perform such indications as this information is a part of control data. In addition, views equate the similarity of this new PDCP SN gap reporting to the existing PDCP status report hence, the ease of implementation.

The other option proposed is to use a header-only PDU (i.e., PDU without payload) with the advantages listed as this is received in-band i.e., prioritization and timely delivery is not an issue, retain the *current* receiver behaviour for the state variable handling and in addition, this has least specification impact. Further, 6 or more companies have also alluded to being open to adopting this option.

Given that there is no clear majority, as the companies who agreed to a new control PDU are also open to the header-only solution, we make the following proposals:

1. **New PDCP Control PDU is used to perform the PDCP SN gap reporting.**
2. **Header-only PDCP data PDU is used to perform the PDCP SN gap reporting.**

### 3.2.1 Indication of Discarded PDCP SNs

*whether to enable PDCP SN Gap reporting via: option (A.1) bitmap kind of information, or option (A.2) range kind of information*

From the contributions, [3][5][8][12][13] alluded to a bitmap-based indication. On the other hand, a couple of other companies prefer the range indication. With [14] mentioning that discarding PDUs in blocks as an entire PDU-set can result in 100 PDUs being discarded if a single PDU is dropped. In [12], suggests three different indications i.e., bitmap-based, two COUNTs and first discard Count + number of SDUs.

Drawing from the options in [12] and based on our understanding of the requirements, at the PDCP Rx entity, it should be sufficient to consider all SNs in the reordering window SN >= RX\_DELIV AND < RX\_NEXT as discarded based on the PDCP SN gap report. In which case, RX\_DELIV would be set to the next non-delivered SN (not discarded) and RX\_NEXT would be set to the COUNT value of the indicated SN in the PDCP SN gap report. Further, it would be sufficient to indicate using a single SN in the PDCP SN gap report. Furthermore, this would also have minimal specification impact and in terms of overhead, the simple mechanism has a fixed length and at most two octets i.e., low overhead.

**For the new PDCP Control PDU, do companies think a simple mechanism of “considering all SNs in the reordering window (i.e., >= RX\_DELIV AND < RX\_NEXT) as discarded by using a single SN in the PDCP Control PDU” is sufficient?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| LGE | Comment | Note that if header-only PDU is used, this discussion is not needed.But, if PDCP Control PDU is used, the triggering event should be discussed first.If SN Gap reporting is triggered when SDUs are discarded discontinuously, FMC + BITMAP is desirable.But, if SN Gap reporting is triggered when SDUs are discarded continuously, only a single value (i.e. highest COUNT among discarded SDUs) is sufficient.However, we think SN Gap reporting is not beneficial when SDUs are discarded continuously, as explained in R2-2401863. Thus, if PDCP Control PDU is used, FMC + BITMAP is better. |
| Futurewei | No | First, SNs in the reordering window may include both SNs discarded and SNs not discarded yet (e.g., an earlier low-importance PDU Set is discarded while a later high-importance PDU Set isn’t). We shouldn’t throw the baby out with the bathwater. SDUs stored and after the RX\_DELIV should be delivered to upper layer, similar to the expiry of reordering timer today. [Ericsson] To clarify, with this report, the Rx entity does not discard all PDUs in the reordering queue, it only discards the ones which have not been received yet. The rest (already received) it can submit to the upper layers. Secondly, there may be less impact to the data PDU Rx operation by treating the discarded PDUs “as if received and delivered to upper layers“ than treating them “as discarded“. E.g., when updating RX\_DELIV, no change is needed if the discarded PDUs are treated “as if received and delivered to upper layers“.Third, as a part of the control PDU RX operation, 1) RX\_DELIV should be updated when condition is met, to prevent HFN desynchronization due to consecutive discarding; 2) RX\_NEXT should be updated when condition is met, to move the receiving window forward; 3) RX\_REORD should be updated according to the updated RX\_DELIV and RX\_NEXT. All three steps are very similar to (if not the same as) the existing behaviours in the data RX operation. |
| Xiaomi | No | Multiple QoS flows can be mapped to a single DRB. Discarding a PDU set in one QoS flow should not impact other QoS flows mapped in the same DRB. Therefore we think such mechanism impacts the performance of other QoS flows. It would be straightforward to reuse existing PDCP status report (with a bitmap) to indicate the discarded PDCP COUNTS. |
| CATT | No | It is possible that more than one PDU Sets are discarded and their SNs are not continuous, hence, bitmap method is more proper. |
| Huawei | No | As commented by LGE, the proposed mechanism does not work in all scenarios. We should have a possibility to indicate the discarded PDUs even if they are not consecutive and for this a bitmap is most suitable. One example where discontinous discard can easily happen is when PSI-based discarding is enabled. Furthermore, with bitmpa approach, we can simply reuse the design from PDCP SR, which makes specification and implementation simpler. |
| Apple | No | When discarding happens, not necessarily all SDUs in the reordering window are being discarded. Such approach is not able to support the cases where some SDUs within the window are discarded while some others are not discarded. |
| Ericsson | Yes | With the assumption that for XR traffic, if all the PDUs within the PDU set are “associated“, discarding one of the PDUs would result in all of them being discarded. Hence, at the Rx entity, all PDUs (yet to be received) within the range of >=RX\_DELIV and < RX\_NEXT would have been discarded at the Tx entity even if one of them were discarded. It is also most appropriate that the PDU sets are transmitted in order unless the jitter associated is really large, but this is unlikely. The specification impact would also be limited to something like the following (similar to the header-only PDU case):5.2.2.4          Actions when <discard indication control PDU> is receivedWhen a <discard indication control PDU> is received, the receiving PDCP entity shall:-    perform actions in 5.2.2.1 for an PDCP Data PDU with the assumed SN as indicated in the < received control PDU > and assumed empty payload. Methods for decompression, deciphering and delivery don’t apply to this PDU.For FWs comment, with this indication, the Rx entity should only discard the PDUs not yet received and submit the rest (i.e., already in the reordering queue) to the upper layers. Further, this is also applicable for discontinguous discarding, the Tx entity can always indicate the highest SN > RX\_DELIV.  |
| Intel | See comment | This approach would require that SN assigned/discarded are allocated in sequence or that a control PDU is sent for each set of in-sequence PDCP SN that is discarded. It is indeed a simple approach and might be sufficient although it is unclear whether this approach is enough considering the different range of XR applications (i.e., PDUs may not always be discarded in sequence ). On summary, maybe it is ok as a first step/enhancement. |
| HONOR | No | Considering PDU set discard and PSI based discard, PDCP discard may happen for more than one SDU and inconsecutively. Only one SN in PDCP control PDU can not be sufficient for such cases. |
| Lenovo | No | This approach only works in certain conditions. But we also don’t think that all SDUs in the reordering window need to be necessarily discarded. Such approach is not able to support the cases where some SDUs within the window are discarded while some others are not discarded. |
| Fujitsu | No | A single SN may not be enough. A PDU Set may be discarded, e.g., due to its low importance, while some earlier PDU Sets may still be waiting for transmission. In this case, these earlier PDU Sets should not be considered as discarded. |
| ZTE | No | As explained by others, this doesn’t work in all scenarios.  |
| Nokia | No | Agree with LGE. |
| Qualcomm | No | Agree with the comments by others |
| Samsung | No | Non-contaguous discard can happen due to PSI based SDU discard being enabled.  |
| OPPO | No | Agree with others, it would be possible that the discarded PDUs are not continuous, thus, bitmap is useful. |
| ITRI | No | Agree with LGE.  |
| Canon | No | It seems similar to the range indication. Range indication does not work when PDU Sets are interleaved (discontinous discard) so using a single SN indication does not work either |
| TCL | No |  |
| Sony | No |  |
| CMCC | No | Agree with LGE. |
| MediaTek | No | Agree with Futurewei, the mechanism with “single SN“ might discard too many SDUs. |
|  |  |  |

##### Rapporteur Summary (Type of Indication):

Only one company has agreed with this option, while two companies have not provided their preference. In principle, this solution is like the header-only solution where the control PDU carrying a single SN can be used to indicate the discarded SDUs less than the single SN indicated in the PDCP SN gap report.

At the PDCP Rx entity, this would only apply to the PDUs which are yet to be received (i.e., lower bounded by RX\_DELIV). This kind of reporting is also applicable for discontinuous discarding, as pointed out by one company, the requirement for discontinues discarding is that the control PDU would need to be transmitted in-sequence. This is a simple approach with small specification impact. The other rational is that since PDUs discarded would always belong to one PDU set, discarding one PDU in the PDU set would result in all the others also being discarded. Further, since it is most appropriate that the PDU sets are transmitted in order, therefore, all the PDUs (yet to be received) within the range of >=RX\_DELIV and < RX\_NEXT would need to be discarded.

As there is no support for this option, a proposal is not provided.

For the bitmap indication, the PDCP Tx entity needs to compile the report on the first discarded SN and each discarded SN within the window into a bitmap. The PDCP Rx entity then delivers all stored SDUs from the COUNT = RX\_DELIV except the SDUs which are not considered discarded and then the state variables need to be updated accordingly. This is not beneficial for PDUs discarded within a PDU sets. [12] also calculates the overhead for the bitmap indication for a maximum data packet size (140625 bytes) is at most 16 bytes with a variable length. The same is applicable for the range indication in terms of the processing required at the PDCP Tx and Rx entity.

Considering the aspect of complexity and in the interest of introducing a solution with minimal spec impact during the maintenance of Rel-18, we would like companies to provide their inputs on whether such complex indications as bitmap or range is necessary as opposed to using the simple mechanism described above.

**For the new PDCP Control PDU, do companies believe it is necessary to use a bitmap or range indication over the simple mechanism described above?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments (bitmap or range) |
| LGE | Comment | It should be discussed first in which case the SN Gap reporting is triggered. |
| Futurewei | Yes | Bitmap is more flexible and bullet-proof. Although it may incur more overhead, those extreme cases are relatively rare. Range incurs less overhead but works only if the discarded SNs are contiguous, which cannot be guaranteed according to the SA4 LS (R2-2400088). We may be OK to support both mechanisms. But if only one is to be specified, we prefer the bitmap to ensure that all cases can be covered. |
| Xiaomi | Yes for bitmap | As bitmap approach can reuse existing PDCP status report, we think the specification impact is minimal. |
| CATT | Yes for bitmap | During the maintenance of Rel-18, we think the bitmap manner is more easy and acceptable to reach consensus. |
| Huawei, HiSilicon | Yes for bitmap | Bitmap should be used, as mentioned above. |
| Apple | Yes for bitmap | As commented previously, we think it is more generalized and straightforward to report a bitmap for discarding notification, which also allows us to reuse the existing control PDU structure. |
| Ericsson | See comments | Prefer the single SN or the header-only indication as we believe it has least impact on the specification. Futurewei>> We wonder whether the single SN in the header-only approach has assumed that the discarded SNs are always contiguous, while SA4 LS (R2-2400088) indicates that packets may arrive out of order. We wonder how the single SN in the header-only approach would work in the scenario illustrated below, where packets of PDU Sets have arrived interleaved and the low-importance PDU Set is discarded due to a non-zero shorter discard timer value: |
| Intel | Maybe | In general, we are open on the actual mechanism used as long as it provides the optimum/required means for PDCP TX to inform RX of the SN gap.Bitmap approach is aligned to PCPC Status Report although it might not be ideal with a PDU Set containing a large number of PDUs. Range approach is aligned to RLC Status Report and could allow reporting of multiple ranges of SNs.On other hand, we also acknowledge that the discarded of PDUs belonging to one PDU Set may have sequential SNs and so a simpler indication may be sufficient. Considering the limited time that we have to conclude on the details of the solution, we suggest enabling the one with the largest support (i.e., bitmap approach). If there is equal support for the options, as an alternative to consider defining two approaches dependent on UE support and network configuration (e.g., PDCP Control PDU with bitmap approach, or PDCP Data PDU where , one of the reserve bits indicates that SNs up to this one are discarded). |
| HONOR | Yes for bitmap | If we consider inconsecuitve SDU discard, bitmap method has relative low overhead compared to COUNT+range. |
| Lenovo |  | We are open on the detailed mechanism to be used. Some range indication may be sufficient.  |
| Fujitsu | Yes for range | Range indication may have less signaling overhead than the bitmap indication considering PDU Set discard very likely have continuous SN. |
| ZTE | Yes for bitmap | We prefer bitmap solution which is similar to the existing mechanism for PDCP control SR.  |
| Nokia | Yes (both) | For the discard of PDUs in sequence, range is more attractive. If PDUs of a PDU set happen to be interleaved with other PDUs, bitmap is more attractive. |
| Qualcomm | Yes for bitmap | Either approach can work. We have a slight preference for bitmap as it is more flexible and also more in line with the format of the status report |
| Samsung | Yes for range | For discard signalling, only relevant information is the indication for discarded SDUs SN and it is not similar to bitmap in SR as the bits not set to 1 (not yet discarded SDUs) do not convey any real action to receiver. That is, not yet discarded SDUs are still subject to discard. Then, it is preferable to only limit the discard information for the discarded SDUs (i.e. one or more sets of FDC and range of SDUs). Moreover, with range approach, transmitting PDCP entity would be required to send discard information only once for a given PDCP SDU to the receiving PDCP entity, whereas, bitmap may cause repetition and/or update of discard of a given PDCP SDU in two different discard signalling. This causes additonal processing for receiving PDCP entity. |
| OPPO | Yes for bitmap | Bitmap is more proper for the case where SDUs are discarded discontinuously. This way is similar to the existing mechanism for PDCP control PDU. |
| ITRI | Yes for bitmap | We prefer reusing the bitmap solution.  |
| Canon | Yes for bitmap | We shall use the bitmap indication to support PDU Set interleaving. |
| TCL | Yes, see comment | We agree with Nokia's proposal and suggest introducing a 1-bit indicator to distinguish between bitmap and range solutions. |
| Sony | See comment | We agree with Ericsson comment |
| CMCC | Yes for bitmap | The bitmap indication is more suitable for the case that the discarded SDUs are not continuous. |
| MediaTek | Yes | Both are feasible, bitmap seems get more supprot, we are fine to follow majority. |
|  |  |  |

##### Rapporteur Summary (bitmap/range):

Many companies agree that the bitmap indication should be used if a new control PDU is defined for the PDCP SN gap reporting as this would support both cases of continuous/interleaved discarding and follows the design principles of the current PDCP SR reporting. While a couple of companies argue that range indication should be used from an overhead perspective. Further, three companies did not provide their preference as they would like to first conclude on the type of indication i.e., header-only data PDU or a new control PDU. But assuming that a new PDCP control PDU is needed, we make the following proposal:

1. **If P2 is agreed, a bitmap indication is used for the PDCP SN gap reporting.**

### 3.2.2 Usage of SN or COUNT

This was not discussed in detail during the previous meetings. [15] mentions that COUNT should be used as indication for the first discarded SDU and by reusing the design of the PDCP SR, there would not be too much work.

As explained in [9], the PDCP SN gap reporting is a different type of signaling i.e., originating at the PDCP Tx entity and this is used to indicate to the PDCP Rx entity to not wait for certain SN(s) in cases where the SN >= RX\_DELIV AND < RX\_NEXT. Given that the PDCP Tx entity and PDCP Rx entity are synchronized (i.e., operating under steady state conditions), it is sufficient to include the SN in the new PDCP control PDU as the Rx entity derives the corresponding HFN by operating on the received SNs. On the contrary, the current PDCP SR is used under conditions of reestablishment or data recovery i.e., the PDCP Tx entity and PDCP Rx entity have lost synchronization. Therefore, we would like companies to comment on this aspect.

**For the new PDCP Control PDU, do companies have a preference in using SN or COUNT for indicating discarded PDCP SDUs?**

|  |  |  |
| --- | --- | --- |
| Company | SN or COUNT | Comments |
| LGE | COUNT | But, it is not urgent, and thus can be discussed later. |
| Futurewei | COUNT | We think 12-bit PDCP SN is efficient in term of signaling overhead and sufficient for uniquely identifying XR video packets for the highest data rate (150 Mbps) within a period about 166 ms, which is much longer than the PDB/PSDB of XR video traffic. However, as we described in our response to Q3.1, HFN desynchronization may occur when consecutively discarding more than 166 ms of video data of a video stream with 150 Mbps data rate.To overcome that, 18-bit PDCP SN can be configured but with a price of one extra byte in PDCP header for every single PDCP data PDU, e.g., 12500 extra bytes per second for a video stream of 150 Mbps data rate. In comparison, sending the full COUNT value in the SN gap report, but doing so only occasionally, is far more economic. |
| Xiaomi | COUNT | We prefer to use COUNT to avoid any ambiguity. Also with COUNT, we can reuse PDCP Status Report as much as possible. |
| CATT | COUNT | Same view as Xiaomi. |
| Huawei, HiSilicon | COUNT | We think we can reuse PDCP SR principles as much as possible, but we do not have a strong view here in case we would like to save some overhead. However, we think we need to make a decision already to have complete CRs for the next meeting. |
| Apple | COUNT | It is simpler to just follow the existing status report design, by having a field indicates the COUNT value of the first discarde PDCP SDU in the discarding notification. |
| Ericsson | See comments  | The solution for indication should be decided first, the details can be worked out later.  |
| Intel | SN < COUNT | Both can work but we agree with the explanation provided by [9]. |
| HONOR | COUNT | If we go with bitmap method, only one COUNT/SN is needed in each PDCP SN Gap report, thus we should use COUNT to avoid potential ambiguity. |
| Lenovo | COUNT |  |
| Fujitsu | COUNT |  |
| ZTE | COUNT |  |
| Nokia | COUNT |  |
| Qualcomm | COUNT | We are fine with either COUNT or SN. Both can be made to work. We have a slight preference for COUNT because it is more in line with the current format of status report.  |
| Samsung | COUNT |  |
| OPPO | See comments | We see either SN or COUNT can work, but COUNT is preferred to avoid any ambiguity. |
| ITRI | COUNT |  |
| Canon | COUNT | Similar to PDCP status report |
| TCL | SN | We are OK to either using COUNT or SN, with a preference for SN due to its lower overhead. |
| Sony |  | We are ok with either option |
| CMCC | COUNT | reuse the same way as the PDCP status report. |
| MediaTek | COUNT | Simialr to PDCP Status Report. |
|  |  |  |

##### Rapporteur Summary (COUNT vs SN):

Mostly all companies prefer the COUNT indication as this is again reusing the design of the existing PDCP status report, while a couple of companies have indicated the use of SNs. However, most companies also point out that both COUNT and SNs do indeed work with the advantage of an overhead reduction when using SNs. Like in the proposal above, assuming that a new PDCP control PDU is needed, we make the following proposal:

1. **If P2 is agreed, use the COUNT value to indicate the first missing SN.**

## 3.3 Triggering of the PDCP SN Gap Report

*whether/which rules needs to be defined in PDCP transmitter entity to trigger PDCP SDU discard report considering e.g. (1) the PDCP entity discards SDU(s) which have not been transmitted (for UM DRBs) or acknowledged (for AM DRBs), due to the expiry of PDCP discard timer; and (2) there is a buffered SDU associated with an SN higher than the SN of the discarded SDU(s), as well as, related TPs included in R2-2401420, R2-2400748 and R2-2313923*.

In [15], when the SDUs are discarded in the PDCP buffer and at the tail of the buffer, the Tx entity could perform (re-)association of the SNs to the SDUs that arrive later. This has already been covered in the agreement and such (re-)association is up to implementation.

[15] also details the scenario where the PDCP Tx entity can trigger the report based on the conditions in the proposal above. In our understanding, the underlying trigger is the same in both cases, in the RLC buffer, if there are PDCP PDUs not transmitted in UM DRBs or acknowledged in AM DRBs and in the PDCP buffer, if the corresponding SDU associated with a lower SN is discarded (due to the expiry of the discard timer) whilst a SDU associated with a higher SN is buffered, this would trigger the PDCP SN gap report. In essence, the discarding of lower SNs (in the presence of higher SNs) in the PDCP buffer will create gaps in SNs. The dependence on the RLC status of the PDCP PDUs is a precursor for discard but not the trigger for the PDCP SN gap report nor will it affect the gap in the PDCP SNs.

Therefore, the trigger at the PDCP Tx entity is basically an “arbitration” of whether the discard will create a gap at the PDCP Rx entity. Hence, we comebine the two triggering conditions and would like to check company’s views on the same.

**Do companies agree that the PDCP Tx entity triggers the PDCP SN gap report when there is a buffered SDU associated with an SN higher than the SN of the discarded SDU(s) (discarded due to expiry of the discard timer) and these SDU(s) have not been transmitted (for UM DRBs) or acknowledged (for AM DRBs)?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| LGE | No | Even for AM DRBs, the condition should be same as UM DRBs, i.e. “these SDU(s) have not been transmitted“. The “not acknodwledged“ SDU includes SDUs already transmitted. In AM RLC, once a segment is transmitted, the AM RLC entity will keep retransmitting the SDU. Thus, there is no need to report SN Gap. |
| Futurewei | –  | 1. OK with the part of “**when there is a buffered SDU associated with an SN higher than the SN of the discarded SDU(s)**“. Agree with LGE on the part of “not been transmitted“ for both UMD and AMD. In addition, this is the trigger when OOD isn‘t configured.
2. We also need to consider a trigger when OOD is configured and the size of a contiguous SN gap is getting close to one half of the PDCP SN space, to prevent HFN desynchronization.
 |
| Xiaomi | No | Agree with LGE that we should use the same condition “these SDU(s) have not been transmitted“ for both AM and UM. |
| CATT | No | Same view as LG. |
| Huawei, HiSilicon | Yes | For AM, we need to also indicate those PDUs which have been transmitted but not acknowledged yet, because these PDUs are outdated already and the Rx PDCP entity can move the receiving window and not wait for the RLC retransmissions of such PDUs, to speed up the delivery of the subsequent PDUs. Otherwise, we are delaying the delivery of data by waiting for RLC retransmissions which are useless in this situation. |
| Apple | No | We should use the same condition for both AM and UM. In principle, the trigger condition would be fulfilled whenever the transmitter introduces an SN gap due to SDU discarding (from the perspective of the PDCP receiver). A discard notification may be sent when a) these SDU(s) have not been transmitted and b) there is a PDCP SDU already associated with an SN higher than the SN of the discarded SDU(s).  |
| Ericsson | Yes for the higher SN in the queue | As explained in the discussion, the trigger is related to when the PDCP Tx entity expects a SN gap at the Rx entity. This is most likely when there is a higher SN in the queue and lower SNs are discarded. For AM, it would be easier to keep the not transmitted condition.  |
| Intel | Yes |  |
| HONOR | Yes | For AM DRBs, we see some benefits if also send the nofication for discarded SDUs transmitted but not acknowledged. Since the PDCP re-ordering window could also be forwarded in advance in some cases. Besides, it is better to keep PDCP independent based on its current discard operation. |
| Lenovo |  | Agree with Ericsson comment |
| Fujitsu | No | Discard due to discardTimer is a legacy behavior which does not need to trigger a PDCP SN report, otherwise the report will be too frequent. We think that the PDCP SN report is better to be triggered by PDU Set discard/PSI-based discard and there is a buffered SDU associated with an SN higher than the SN of the discarded SDU(s) and these SDU(s) have not been transmitted. |
| ZTE | Yes | In general the condition seems fine. But, we don’t think the addtional restriction “and these SDU(s) have not been transmitted (for UM DRBs) or acknowledged (for AM DRBs)“ is needed.  |
| Nokia | ~ | Agree with Ericsson |
| Qualcomm | No | Agree with LGE |
| Samsung | No | Same view as LGE |
| OPPO | No | Agree with LGE |
| ITRI |  | Agree with Ericsson  |
| Canon | No | PDCP Tx entity shall report SN gap when discard timer elapses. |
| TCL | No | Agree with LGE |
| Sony |  | Agree with Ericsson |
| MediaTek | No | Agree with LGE |
|  |  |  |

##### Rapporteur Summary (Triggering of PDCP SN gap report):

Most companies seem to be fine with the trigger when a higher SN is in the queue and lower SNs are discarded. For the AM DRBs, the requirement that SDU(s) have not yet been acknowledged is questioned by a lot of companies and they would prefer to keep the same handling for RLC UM and RLC AM case i.e., not transmitted yet.

One company points out that those PDUs which have been transmitted but not acknowledged yet are outdated already and the Rx PDCP entity can move its receiving window not waiting for the RLC retransmissions of such PDUs. However, if packets that have been transmitted but not acknowledged are discarded at the PDCP Tx entity, the handling of the corresponding RLC procedures is unclear and could result in more specification impact. Given the limited time and the priority to focus on more pressing issues, our suggestion is to keep the same condition for RLC UM and RLC AM DRBs i.e., SDU(s) have not been transmitted for UM/AM DRBs.

1. **PDCP Tx entity triggers the PDCP SN gap report when there is a buffered SDU associated with an SN higher than the SN of the discarded SDU(s) (due to expiry of the discard timer) and these SDU(s) have not been transmitted for UM DRBs and AM DRBs.**

## 3.4 New UE-capability for PDCP SN Gap Reporting and Other Discarding Capabilities

To discuss whether to define a new UE capability to indicate the support of PDCP SN Gap reporting. If so, to discuss whether UE supporting PDCP SN Gap reporting shall also support pdu-SetDiscard-r18 and/or psi-BasedDiscard-r18.

The highlighted part of the proposal was not discussed during the meeting. Dependencies between discard capabilities was brought up during the coordination of the summary paper [2], specifically around the question if capability to do PDU Set discard would also mandate the capability to do PDCP SN gap reporting. Earlier discussion around PDCP SN gap reporting has raised the concern that there may be more discards happen when utilizing PDU Set discarding. Hence, we would like companies to provide their views on the relationship between PDCP SN gap reporting and other discarding capabilities.

**Do companies think that there should be any dependencies between the UE capability to support PDCP SN Gap reporting and support pdu-SetDiscard-r18/psi-BasedDiscard-r18?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| LGE | Yes | As explained in our paper (R2-2401863), the SN Gap reporting is beneficial only when RLC SDUs stored in RLC Tx buffer are discarded discontinuously. This case happens in following conditions:* pdu-SetDiscard is configured
* PDU sets arrive at PDCP buffer with interleaving
* Lots of PDCP SDUs are pre-processed and stored in RLC Tx buffer
* RLC SDUs are not transmitted until the discard timer expires

For other cases (i.e. continuous discard case), SN re-association or relying on t-Reordering is sufficient. Thus, the SN Gap reporting should be used only when pdu-SetDiscard is configured. |
| Futurewei | Yes and No | pdu-SetDiscard-r18 and psi-BasedDiscard-r18 indicates UE’s capability of discarding UL packets. So, UE’s capability of sending PDCP SN Gap report on the UL can be dependent on pdu-SetDiscard-r18 and psi-BasedDiscard-r18. However, UE’s capability of receiving PDCP SN Gap report and responding to it (such as updating RX\_DELIV accordingly) should be independent from pdu-SetDiscard-r18 or psi-BasedDiscard-r18. In a CU-DU split gNB architecture, for security reason, the CU cannot reuse a discarded COUNT value on another SDU if the discarded PDCP PDU has been submitted to the RLC entity. So, if the CU discards consecutive PDCP PDUs spanning one half of the PDCP SN space or more, the transmitting PDCP entity in the CU may send a PDCP SN Gap report to the receiving PDCP entity in the UE, if knowing the UE is capable of receiving PDCP SN Gap report, to avoid HFN desynchronization. |
| Xiaomi | No strong view. | If we want to define the dependency, it might be sufficient to specify that a UE supporting PDCP SN gap reporting shall also support *pdu-SetDiscard-r18*. |
| CATT | Yes | Agree with LG, the SN Gap reporting should be used only when pdu-SetDiscard is configured. |
| Huawei, HiSilicon | No | SN gap reporting can be used also when PDU set discarding is not enabled, i.e. for normal discarding operation. PDCP specifications does not even have to distinguish these two cases and the transmitter/receiver behaviour can be exactly the same in both cases. Hence, there is no need to introduce any capability inter-dependencies and it can be a network decision whether to configure it together with PDU Set discarding or also in other cases. |
| Apple | Comment | Ok to have such a prerequisite. Moreover, if the UE supports a re-adjustment of the reordering window due to PDCP discard then a PDCP transmitter may use the Discard Notification in downlink as well. The gNB may only use that if the UE supports the SN gap reporting (which implies a) bi-directional operation and b) that the capability for SN gap reporting encompasses the receiver behavior too). |
| Ericsson | No | We dont agree with LG that this feature is only beneficial when PDU Set discarding is used. As HW point out there is no real dependencies between the features, they work independently of each other and thus there is no need to introduce any artifical dependency. It should be left up to network to decide which features it want to be configured together. |
| Intel | No | It was possible that PDCP SN gap occurs even before Rel-18 discard enhancements as stated in the following note captured in TS 38.323.NOTE 2: 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.Therefore we have slight preference to define this functionality without any dependencies. At most, we wonder whether RAN2 should discuss whether a UE supporting *pdu-SetDiscard-r18* (or *psi-BasedDiscard-r18*) shall always support PDCP SN Gap. If so, PDCP SN Gap feature can be supported by itself but if a UE supports *pdu-SetDiscard-r18* (or *psi-BasedDiscard-r18*), this UE shall always support PDCP SN Gap feature. |
| HONOR | Yes | The PDCP SN Gap reporting capability shoud be based on UE supporting either pdu-SetDiscard-r18 or psi-BasedDiscard-r18, ie if UE only support legacy PDCP discard, the PDCP SN Gap reporting should not be supported. |
| Fujitsu | Yes | UE capability to support PDCP SN Gap reporting should support pdu-SetDiscard-r18 or psi-BasedDiscard-r18. This capability is only for UL PDCP SN reporting. |
| ZTE | No strong view | We are okay to keep this as an independent capability.  |
| Nokia | Yes | UE supporting pdu-SetDiscard-r18 or psi-BasedDiscard-r18 shall also support SN-Gap reporting.Discontinuous discarding becomes possible also with PSI-based discarding, when discard timers of successive SDUs have different durations. |
| Qualcomm | No | We can’t agree with the view that the association between the two features shall be mandated. First, gap reporting does not need to depend on the support for XR PDU set. Second, if a UE supports PDU set discard or PSI based discard, it does not need to implement gap indication if it always assigns PDCP SN in the very last moment (hence there is no gap). |
| Samsung | No | There seems no real dependency between these features, so it is preferable to leave this to network configuration. |
| OPPO | No | We do not see tight-dependency in-between. |
| ITRI | No strong view | There is no explicit dependency between these capabilities.  |
| Canon | Yes |  |
| TCL | Yes | We believe that PDU Set Discard and SN-Gap reporting are related, and suggest that the UE can utilize pdu-SetDiscard-r18 to indicate its support for SN-Gap reporting. |
| Sony | No strong view | We think these could be independent |
| CMCC | No | We do not see dependency between these features.  |
| MediaTek | No | It can be no dependency between PDCP SN Gap reporting and pdu-SetDiscard-r18/psi-BasedDiscard-r18 as Futurewei indicated above. |
|  |  |  |

##### Rapporteur Summary (Relationship with other Capabilities):

8 companies think there should be no dependencies, 7 companies think there should be dependencies and 5 companies have no strong view. 1 company thinks that there can only be dependency in UL ability to send the indication but not the UE capability of receiving the indication.

The argument from the YES side is the indication is only useful together with PDU Set discarding and thus they should be mandated to always be used together. On the NO side there are arguments that the indication can be useful also in other scenarios when PDU Set discard is not used, that it is up to network configuration what features to be used together, also that the SN gap could happen even before PDU Set discard was introduced and that smart UE implementations may avoid making gaps happen. There was even raised concern that dependent capability may not work in all cases.

Overall, there seems to be a slight preference to not support the dependency in the capabilities. Thus, the rapporteur proposal is as follows:

1. **No dependencies are to be introduced between the UE capability to support PDCP SN gap reporting and support pdu-SetDiscard-r18/psi-BasedDiscard-r18.**

## 3.5 Receiver Behaviour

In [15], the behaviour is described for when the PDCP SN gap report is received at the PDCP Rx entity. For the upper bound of the reordering window, if RX\_NEXT is not larger than the max COUNT indicated as discarded, it should be updated to the max COUNT + 1 and for the lower bound, if the RX\_DELIV corresponds to an SDU which has been discarded, the receiving PDCP entity shall deliver subsequent received SNs consecutively and skip the discarded SNs and update RX\_DELIV to the COUNT which has not been discarded or delivered.

As a baseline, we would like to get company views on the receiver behaviour up on receiving the PDCP SN gap report.

**Do companies agree that RX\_DELIV and RX\_NEXT should be updated at the PDCP Rx entity when the PDCP SN gap report is received?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Futurewei | Yes | [8] and [15] describe essentially the same behavior for RX\_NEXT update.In [8], because discarded SDUs are treated as if “delivered to upper layers”, the RX\_DELIV update procedure is slightly simpler than [15], including less impact to the legacy data PDU RX operation.In addition, RX\_REORD should be updated according to the updated RX\_DELIV and RX\_NEXT, like what is done today after the expiry of reordering timer. |
| Xiaomi | Yes with comments | Our understanding is that PDCP state variables (RX\_DELIV, RX\_NEXT, RE\_REORD) might be updated (following the principle as in TS 38.323 clause 5.2.2.1) if discarded SDUs are treated as delivered to upper layers. Which state variable is update depends on receiver state and discarded SDUs.  |
| CATT | Yes | The push window + t\_reording mechanism can work appropriately with RX\_DELIV and RX\_NEXT updation at the PDCP Rx entity when the PDCP SN gap report is received. |
| Huawei, HiSilicon | Yes | For the mechanism to work, we need to clarify how the variables need to be updated at the receiver upon obtaining the discarding report. |
| Apple | Yes with comments | Following reception of a discard indication the receiver treats the last PDU before and the first PDU after the range of discarded SNs as in-sequence. This implies that the receiver updates RX\_DELIV (if t-reordering is not running) and RX\_REORD (if t-Reordering is running). RX\_NEXT can be updated based on RCVD\_COUNT, so perhaps nothing much is needed for RX\_NEXT. |
| Ericsson | Yes, see comments | To answer the question at face-value, we believe the status variables at the Rx would need to be updated. But depending on the solution, it would be possible to re-use the existing receiver operation section in the spec for e.g., when using the header-only PDU or single-SN indication.  |
| Intel | Yes |  |
| HONOR | Yes | RX\_DELIV and RX\_NEXT could be updated accordingly if the PDCP SN Gap report is received based on current principle in TS38.323. And considering inconsecutive discard, for each time the above varibale need to be updated, it should check with the previous recived SN Gap report to forward the window further. |
| Lenovo | Yes |  |
| Fujitsu | Yes | How to update the state variables depends on the PDCP SN report information and the relation of the reported SN number compared with the current state variables. The detailed RX operation may be discussed in next meeting based on contributions. |
| ZTE | Yes | This will be needed for the control PDU based solution but not needed (i.e. no changes) for header only solution proposed above.  |
| Nokia | Yes |  |
| Qualcomm | Yes |  |
| Samsung | Yes, see comment | We understand PDCP state variables (RX\_DELIV, RX\_NEXT, RE\_REORD) should be updated based on discard information. In addition, receiving PDCP entity can be benefitted by “considering” each of the discarded SDU included in the discard information as if already received. |
| LGE | Yes |  |
| OPPO | Yes, see Comments | Similar view as Samsung. |
| ITRI | Yes |  |
| Canon | Yes |  |
| TCL | Yes |  |
| Sony | Yes |  |
| MediaTek | Yes |  |
|  |  |  |

##### Rapporteur Summary (Receiver behaviour):

All companies agree that the receiver state variables (RX\_DELIV, RX\_NEXT) need to be updated upon reception of the PDCP SN gap report. Some companies also point out that for the header only solution, no changes are required to the current receiver operation whilst if using a new control PDU, the receiver operation needs to be updated.

1. **The receiver state variables (RX\_DELIV, RX\_NEXT) are updated upon the reception of the PDCP SN gap report.**

# 1st Phase Summary

Based on company’s views and the rapporteur comments above, we make the following draft proposals:

**Proposal 1 PDCP SN gap reporting is applicable only when outOfOrderDelivery is not configured.**

**Proposal 2 New PDCP Control PDU is used to perform the PDCP SN gap reporting.**

**Proposal 3 Header-only PDCP data PDU is used to perform the PDCP SN gap reporting.**

**Proposal 4 If P2 is agreed, a bitmap indication is used for the PDCP SN gap reporting.**

**Proposal 5 If P2 is agreed, use the COUNT value to indicate the first missing SN.**

**Proposal 6 PDCP Tx entity triggers the PDCP SN gap report when there is a buffered SDU associated with an SN higher than the SN of the discarded SDU(s) (due to expiry of the discard timer) and these SDU(s) have not been transmitted for UM DRBs and AM DRBs.**

**Proposal 7 No dependencies are to be introduced between the UE capability to support PDCP SN gap reporting and support pdu-SetDiscard-r18/psi-BasedDiscard-r18.**

**Proposal 8 The receiver state variables (RX\_DELIV, RX\_NEXT) are updated upon the reception of the PDCP SN gap report.**

Please provide your comments on the proposals below:

|  |  |
| --- | --- |
| Company | Comment |
| LGE | P7 needs more discussion. We don’t think SN gap reporting is needed when PDU set discard is not configured.P8 is only relevant for PDCP Control PDU solution. For header-only PDU solution, it is natural to update state variables following the legacy procedure. Thus, please add “If P2 is agreed” in front. |
| Apple | For P2 and P3, we don’t think it is a good idea to have two contradictory proposals in the summary. One single proposal with two options may be more appropriate.On the other hand, we are already in Rel-18 Maintenance Phase so it is less desirable to have open-ended proposals. Given vast support of Bitmap and COUNT, we tend to think RAN2 can try to first agree on Control PDU at least as a working assumption, i.e. Focus on P2. |
| Nokia | P2 & P3: would be good to clarify that it is either.P6: to avoid excessive complexity, the “not transmitted” should mean not submitted by PDCP to lower layer. “Transmitted by lower layer” is not known by CU-UP for AM DRBs and does not prevent COUNT re-use in downlink. |
| Qualcomm | Agree with Apple and Nokia that only one proposal is needed. Given that* + - 1. There are 14 companies for P2 and only 6 for P3;
			2. The current spec does not prohibit a transimitter from sending a header-only data PDU;

We’d like to suggest removing P3. |
| Huawei, HiSilicon | We agree with other companies that we only need a single solutions for this issue and considering the solution maturity and views expressed in the e-mail discussion, we think we should proceed with C-PDU based approach. The header-only solution has an impact on both PDCP and RLC specifications, impacts the processing of the SDUs/PDUs in both PDCP and RLC layers and introduces additional cross-layer interactions. It is also associated with higher overhead as we need to send headers at the PDCP, RLC and MAC layers for each discarded PDU. Furthermore this solution is not as simple as it may appear initially and there seem to be multiple points that we would have to continue discussing while we already are in the maintenance phase for this WI, e.g. handling of integrity protection or handling of the header-only PDU at the receiving PDCP entity. Considering the lack of clear benefits over the other alternative, we think it is not worth trying to address these issues. |
| Fujitsu | For **P2 and P3**, agree with QC that P2 is clear mojority so we we suggest removing P3.For **P6,** we think if the condition in P6 is used for triggering the SN gap report, there is a very high chance that it will trigger the report too frequently. Consider SDU discard may happen in slightly different time for different SDUs as shown in the following figure, the SN Gap report will be triggered every time an SDU is discarded, which is a very inefficient design and has a lot of overhead/radio resource consumption. There can be different approaches to prevent this frequent trigger, e.g., only PDU Set discard can trigger the SN gap reporting, etc. We propose to add an FFS to P6:**Proposal 6 PDCP Tx entity triggers the PDCP SN gap report when there is a buffered SDU associated with an SN higher than the SN of the discarded SDU(s) (due to expiry of the discard timer) and these SDU(s) have not been transmitted for UM DRBs and AM DRBs. FFS on how to avoid frequent triggering of PDCP SN gap report.** |
| Xiaomi | Regarding P2 and P3, we agree with other companies that we only need to specify one option. And given that most companies support P2, we propose to remove P3. |
| TCL | We agree with Qualcomm to adopt P2 and remove P3. P2 is supported by the majority of companies, while P3 is not. Additionally, P3 may introduce significant header overhead. As for P7, we concur with LGE and suggest further discussion. |
| OPPO | We only need to specify one mechanism related to either P2 or P3. As P2 has more support, we suggest focusing on this mechanism and related TP. |

# Conclusion

Based on further comments from companies, the following are the list of final proposals:

<Common>

**Proposal 1                 PDCP SN gap reporting is applicable only when *outOfOrderDelivery* is not configured.**

**Proposal 2                 PDCP Tx entity triggers the PDCP SN gap report when there is a buffered SDU associated with an SN higher than the SN of the discarded SDU(s) (due to expiry of the discard timer) and these SDU(s) have not been submitted to lower layers (for e.g., RLC layer). FFS on how to avoid frequent signaling.**

**Proposal 3                No dependencies are to be introduced between the UE capability to support PDCP SN gap reporting and support pdu-SetDiscard-r18/psi-BasedDiscard-r18.**

<Type of Indication>

**Proposal 4                To perform the PDCP SN gap reporting, downselect between:**

* **New PDCP Control PDU**
* **Header-only PDCP data PDU**

<Header-only PDU indication>

**Proposal 5                For the header-only PDCP data PDU, integrity protection/verification is not applicable when the PDCP entity of the DRB is configured with *integrityprotection*.**

<Control PDU Indication>

**Proposal 6                For the new control PDU, a bitmap indication is used for the PDCP SN gap reporting.**

**Proposal 7                For the new control PDU, use the COUNT value to indicate the first missing SN.**

**Proposal 8               For the new control PDU, the receiver state variables (RX\_DELIV, RX\_NEXT) are updated upon the reception of the PDCP SN gap report.**

# 4 Related TPs (Phase 2)

The following are the set of TPs based on the outcome of the above discussion and taking the TP from [8][15] for a new PDCP control PDU as baseline. As the decision on the use of PDCP control PDU or header-only indication is still to be decided, we provide two sets of TPs to cover both solutions (section 4.1 for the header-only indication, section 4.2 for the new control PDU indication). However, there are also other changes based on the agreements and independent of both solutions, we also cover those aspects in section 4.3.

Rapporteur would appreciate that the companies provide their comments for the TP in the form of word bubble comments and avoid changing the text directly.

# 4.1 Header-only based Indication

## 4.1.1 TP for TS 38.323

|  |
| --- |
| START OF CHANGE |

<Unmodified Parts Omitted>

5.2.2.X Actions when the header only PDCP Data PDU is received

When the header only PDCP Data PDU is received, the receiving entity shall:

* p**erform** the actions in clause 5.2.2.1 for a PDCP Data PDU with the assumed SN as indicated in the received header only PDCP Data PDU with an empty payload, and the corresponding PDCP Data PDU is considered as received. Methods for decompression, integrity verification and deciphering does not apply to this PDU. Storing in reception buffer and delivery to upper layers also does not apply to this SDU.

<Unmodified Parts Omitted>

|  |
| --- |
| NEXT CHANGE |

## 5.X Header only PDCP Data PDU

### 5.X.1 Transmit Operation

For AM and UM DRBs with *SNGapReportEnabled* configured [3], the transmitting PDCP entity shall trigger a header only PDCP Data PDU when:

* a PDCP SDU is discarded as specified in clause 5.3 and the PDCP SDU being discarded is associated with a COUNT value which has not been transmitted by lower layers; and
* there is at least one buffered SDU which is associated with a COUNT larger than COUNT of the discarded SDU.

If a header only PDCP Data PDU is triggered, the transmitting PDCP entity shall:

* remove the data part and MAC-I of the to-be-discarded PDCP Data PDU and submit the header only PDCP Data PDU for transmission entity as specified in clause 5.2.1 for Uu interface.

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| NEXT CHANGE |

<Unmodified Parts Omitted>

6.2.2.2 Data PDU for DRBs and MRBs with 12 bits PDCP SN

Figure 6.2.2.2-1 shows the format of the PDCP Data PDU with 12 bits PDCP SN. This format is applicable for UM DRBs, AM DRBs, UM MRBs and AM MRBs. For the header-only PDCP data PDU, the Data and MAC-I parts are not applicable.

<Unmodified Parts Omitted>

<Unmodified Parts Omitted>

6.2.2.3 Data PDU for DRBs and MRBs with 18 bits PDCP SN

Figure 6.2.2.3-1 shows the format of the PDCP Data PDU with 18 bits PDCP SN. This format is applicable for UM DRBs, AM DRBs, UM MRBs and AM MRBs. For the header-only PDCP data PDU, the Data and MAC-I parts are not applicable.

<Unmodified Parts Omitted>

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| --- |
| END OF CHANGE |

## 4.1.2 TP for TS 38.322

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| --- |
| START OF CHANGE |

~~5.4 SDU discard procedures~~

~~When indicated from upper layer (e.g. PDCP) to discard a particular RLC SDU, if~~ *~~SNGapReportEnabled~~* ~~is not configured [5], the transmitting side of an AM RLC entity or the transmitting UM RLC entity shall discard the indicated RLC SDU, if neither the RLC SDU nor a segment thereof has been submitted to the lower layers. If~~ *~~SNGapReportEnabled~~* ~~is configured [5], the transmitter side of an AM or the transmitting UM RLC entity replaces the corresponding RLC SDU by discarding the payload, if neither the RLC SDU nor a segment thereof has been submitted to the lower layers. The transmitting side of an AM RLC entity shall not introduce an RLC SN gap when discarding an RLC SDU.~~

|  |
| --- |
| END OF CHANGE |

# 4.2 New Control PDU based Indication

## 4.2.1 TP for TS 38.323

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| --- |
| START OF CHANGE |

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, with the exception of the PDCP SDUs which were considered as discarded 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, 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*.

|  |
| --- |
| NEXT CHANGE |

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, with the exception of the PDCP SDUs which were considered as discarded 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, with COUNT value >= RX\_REORD;

- if RX\_DELIV < RX\_NEXT:

- update RX\_REORD to RX\_NEXT;

- start *t-Reordering*.

|  |
| --- |
| NEXT CHANGE |

## 5.X SN Gap Report

### 5.X.1 Transmit Operation

For AM and UM DRBs with *SNGapReportEnabled* configured [3], the transmitting PDCP entity shall trigger a PDCP SN gap report when:

* PDCP SDUs are discarded as specified in clause 5.3 and at least one PDCP SDU being discarded is associated with a COUNT (or SN) value which have not been transmitted by lower layers; and
* there is at least one buffered SDU which is associated with a COUNT (or SN) larger than COUNT (or SN) of the discarded SDUs.

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

* compile a PDCP SN gap report:
	+ setting the FDC (or FDSN) field to the smallest COUNT/SN value among the COUNT (or SN) values associated with PDCP SDUs being discarded.
	+ if more than one PDCP SDUs are discarded:
		- allocating a Bitmap field of length in bits equal to the number of COUNTs (or SNs) 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 bitmap field as ‘0’ for all PDCP SDUs that have not been discarded;
		- setting in the bitmap field as ‘1’ for all PDCP SDUs that have been discarded.
	+ submit the PDCP discard report to lower layers as the first PDCP PDU for transmission via the transmitting PDCP entity as specified in clause 5.2.1 for Uu interface.

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 bitmap set to '1', or with the associated COUNT value equal to the value of FDC (or FDSN, with the corresponding COUNT value is determined based on section 5.2.2.1) field as discarded, and:

- if RX\_DELIV is larger than the maximum COUNT value associated with the discarded PDCP SDUs:

- ignore the PDCP SN gap report.

- if RX\_NEXT is smaller than or equal to the maximum COUNT value associated with the discarded PDCP SDUs:

- update RX\_NEXT to the maximum COUNT value associated with the discarded PDCP SDUs + 1.

- if RX\_DELIV is equal to any COUNT value associated with the discarded PDCP SDUs:

- 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;

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

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

- stop and reset *t-reordering*.

- if *t-reorderin*g 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*.

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| NEXT CHANGE |

6 Protocol data units, formats, and parameters

6.1 Protocol data units

6.1.1 Data PDU

The PDCP Data PDU is used to convey one or more of followings in addition to the PDU header:

- user plane data;

- control plane data;

- a MAC-I.

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

|  |
| --- |
| NEXT CHANGE |

6.2.3.X Control PDU for PDCP SDU discard report

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

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| D/C | PDU Type | R | R | R | R | Oct 1 |
| FDC  | Oct 2 |
| FDC (cont.) | Oct 3 |
| FDC (cont.) | Oct 4 |
| FDC (cont.) | Oct 5 |
| Discard Bitmap1 (optional) | Oct 6 |
| … | … |
| Discard BitmapN (optional) | Oct 6+N |

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

(OR)

6.2.3.X Control PDU for PDCP SDU discard report

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

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| D/C | PDU Type | FDSN | Oct 1 |
| FDSN (cont.)  | Oct 2 |
| L | R | FDSN (cont.) | Oct 3 |
| Discard Bitmap1 (optional) | Oct 4 |
| … | … |
| Discard BitmapN (optional) | Oct 4+N |

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

|  |
| --- |
| NEXT CHANGE |

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 |

|  |
| --- |
| NEXT CHANGE |

6.3.X FDC

Length: 32 bits

First Discarded COUNT. This field indicates the COUNT value of the first discarded PDCP SDU which has not been acknowledged (for AM DRBs) or transmitted (for UM DRBs).

(OR)

6.3.X FDSN

Length: 12 or 18 bits

First Discarded SN. This field indicates the SN value of the first discarded PDCP SDU which has not been transmitted (for AM and UM DRBs).

6.3.Y Discard Bitmap

Length: Variable. The length of the 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 Nth bit in the Bitmap is N, i.e., the bit position of the first bit in the Bitmap is 1.

**Table 6.3.Y-1 Discard Bitmap**

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

|  |
| --- |
| END OF CHANGES |

# 4.3 Common Parts

## 4.3.1 TP for TS 38.300

|  |
| --- |
| START OF CHANGE |

16.15.4.2.2 Discard

When the PSIHI is set 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, the gNB may use the PSI for PDU set discarding. For uplink, dedicated downlink signalling is used to request the UE to apply a shorter discard timer to *low importance* SDUs in PDCP.

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

After performing PDCP SDU discard, the transmitting PDCP entity may send a PDCP SN gap report to the receiving PDCP entity, and the receiving PDCP entity shall update the reordering window according to the information provided by the PDCP SN gap report, as specified in TS 38.323 [8]. The UE is configured by the gNB to send the PDCP SN gap report in the uplink.

(OR)

After performing PDCP SDU discard, the transmitting PDCP entity may send a header only PDCP data PDU to the receiving PDCP entity, and the receiving PDCP entity shall update the reordering window accordingly, as specified in TS 38.323 [8]. The UE is configured by the gNB to send the header only PDCP data PDU in the uplink.

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| END OF CHANGE |

## 4.3.2 TP for TS 38.306

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| START OF CHANGE |

##### 4.2.2 General parameters

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Definitions for parameters | Per | M | FDD-TDD DIFF | **FR1-FR2**DIFF |
| ***accessStratumRelease***Indicates the access stratum release the UE supports as specified in TS 38.331 [9]. | UE | Yes | No | No |
| ***additionalBSR-Table-r18***Indicates whether the UE supports the BSR enhancements associated with the additional BSR table as specified in TS 38.321 [8] and TS 38.331 [9]. | UE | No | No | No |
| ***airToGroundNetwork-r18***Indicates whether the UE supports air to ground network access. If the UE indicates this capability the UE shall support the following ATG essential features, e.g., acquiring ATG cell specific SIBxx and ATG cell specific P-Max. | UE | No | No | FR1 only |
| ***crossCarrierSchedulingConfigurationRelease-r17***Indicates whether the UE supports using *crossCarrierSchedulingConfigRelease* to release the configurations configured by *crossCarrierSchedulingConfig*. | UE | No | No | No |
| ***delayBudgetReporting***Indicates whether the UE supports delay budget reporting as specified in TS 38.331 [9]. | UE | No | No | No |
| ***delayStatusReport-r18***Indicates whether the UE supports the delay status report of the buffered data as specified in TS 38.321 [8], TS 38.331 [9], TS 38.323 [16] and TS 38.322 [36]. | UE | No | No | No |
| ***disableCG-RetransmissionMonitoring-r18***Indicates whether the UE supports to disable monitoring for retransmissions corresponding to a *ConfiguredGrantConfig* as specified in TS 38.321 [8] and TS 38.331 [9]. | UE | No | No | No |
| ***dl-DedicatedMessageSegmentation-r16***Indicates whether the UE supports reception of segmented DL RRC messages. | UE | No | No | No |
| ***drx-Preference-r16***Indicates whether the UE supports providing its preference of a cell group on DRX parameters for power saving in RRC\_CONNECTED, as specified in TS 38.331 [9]. | UE | No | No | No |
| ***enhancedDRX-r18***Indicates whether the UE supports DRX enhancements including the support of non-integer DRX periodicity and addressing the SFN wrap around as specified in TS 38.331 [9] and TS 38.321 [8]. | UE | No | No | No |
| ***gNB-SideRTT-BasedPDC-r17***Indicates whether the UE supports gNB-side RTT-based PDC, as specified in TS 38.300 [28]. A UE supporting this feature shall also support *rtt-BasedPDC-CSI-RS-ForTracking-r17* and/or *rtt-BasedPDC-PRS-r17*. | UE | No | No | No |
| ***hardSatelliteSwitchResyncNTN-r18***Indicates whether UE supports hard satellite switch with re-sync, as specified in TS 38.331 [9].A UE supporting this feature shall also indicate the support of *nonTerrestrialNetwork-r17*.When UE supports this feature and does not support *softSatelliteSwitchResyncNTN-r18*, this UE is able to perform hard satellite switch with re-sync in a network supporting soft satellite switch with re-sync, as specified in TS 38.331 [9]. | UE | No | No | No |
| ***inactiveState***Indicates whether the UE supports RRC\_INACTIVE as specified in TS 38.331 [9]. This capability is not applicable to NCR-MT. | UE | Yes | No | No |
| ***inactiveStateNTN-r17***Indicates whether the UE supports RRC\_INACTIVE in NTN as specified in TS 38.331 [9]. It is mandated if the UE indicates the support of *nonTerrestrialNetwork-r17*. | UE | CY | No | No |
| ***inactiveStatePO-Determination-r17***Indicates whether the UE supports to use the same i\_s to determine PO in RRC\_INACTIVE state as in RRC\_IDLE state. | UE | No | No | No |
| ***inDeviceCoexInd-r16***Indicates whether the UE supports reporting of affected NR carrier frequencies in IDC assistance information as specified in TS 38.331 [9]. | UE | No | No | No |
| ***inDeviceCoexIndAutonomousDenial-r18***Indicates whether the UE supports IDC autonomous denial as specified in TS 38.331 [9]. A UE supporting this feature shall also support *inDeviceCoexInd-r16*. | UE | No | No | No |
| ***inDeviceCoexIndFDM-r18***Indicates whether the UE supports reporting of affected NR carrier frequency ranges in IDC assistance information as specified in TS 38.331 [9]. A UE supporting this feature shall also support *inDeviceCoexInd-r16*. | UE | No | No | No |
| ***inDeviceCoexIndTDM-r18***Indicates whether the UE supports reporting of IDC TDM assistance information as specified in TS 38.331 [9]. A UE supporting this feature shall also support *inDeviceCoexInd-r16*. | UE | No | No | No |
| ***maxBW-Preference-r16, maxBW-Preference-r17***Indicates whether the UE supports providing its preference of a cell group on the maximum aggregated bandwidth for power saving in RRC\_CONNECTED, as specified in TS 38.331 [9]. | UE | No | No | Yes(Incl FR2-2 DIFF) |
| ***maxCC-Preference-r16***Indicates whether the UE supports providing its preference of a cell group on the maximum number of secondary component carriers for power saving in RRC\_CONNECTED, as specified in TS 38.331 [9]. | UE | No | No | No |
| ***maxMIMO-LayerPreference-r16, maxMIMO-LayerPreference-r17***Indicates whether the UE supports providing its preference of a cell group on the maximum number of MIMO layers for power saving in RRC\_CONNECTED, as specified in TS 38.331 [9]. | UE | No | No | Yes(Incl FR2-2 DIFF) |
| ***maxMRB-Add-r17***Indicates the additional maximum number of MRBs that the UE supports for MBS multicast reception in RRC\_CONNECTED as specified in TS 38.331 [9].For the UE indicating support of *multicastInactive-r18*, this capability is also applicable to multicast reception in RRC\_INACTIVE, as specified in TS 38.331 [9]. | UE | No | No | No |
| ***mcgRLF-RecoveryViaSCG-r16***Indicates whether the UE supports recovery from MCG RLF via split SRB1 (if supported) and via SRB3 (if supported) as specified in TS 38.331[9]. | UE | No | No | No |
| ***minSchedulingOffsetPreference-r16***Indicates whether the UE supports providing its preference on the minimum scheduling offset for cross-slot scheduling of the cell group for power saving in RRC\_CONNECTED, as specified in TS 38.331 [9]. | UE | No | No | No |
| ***mpsPriorityIndication-r16***Indicates whether the UE supports *mpsPriorityIndication* on RRC release with redirect as defined in TS 38.331 [9]. | UE | No | No | No |
| ***mt-SDT-r18***Indicates whether the UE supports initiating MT-SDT procedure via random access procedure with 4-step RA type and if UE supports *twoStepRACH-r16*, with 2-step RA type, in response to the reception of MT-SDT indication in paging message, as specified in TS 38.331 [9]. | UE | No | No | No |
| ***mt-SDT-NTN-r18***Indicates whether the UE supports initiating MT-SDT procedure in NTN via random access procedure with 4-step RA type and if UE supports *twoStepRACH-r16* for NTN, with 2-step RA type, in response to the reception of MT-SDT indication in paging message, as specified in TS 38.331 [9]. | UE | No | No | No |
| ***multiRx-FR2-Preference-r18***Indicates whether the UE supports providing multi-Rx operation preference (i.e. not supporting simultaneous reception with different QCL-typeD) for FR2, as defined in TS 38.331 [9]. | UE | No | No | FR2 only |
| ***musim-CapabilityRestriction-r18***Indicates whether the UE supports providing MUSIM assistance information with temporary capability restriction and capability restriction indication (i.e., *musim-CapabilityRestrictionIndication*), as defined in TS 38.331 [9]. | UE | No | No | No |
| ***musim-GapPreference-r17***Indicates whether the UE supports providing MUSIM assistance information with MUSIM gap preference and related MUSIM gap configuration, as defined in TS 38.331 [9]. UE supporting this feature supports 3 periodic gaps and 1 aperiodic gap. | UE | No | No | No |
| ***musim-GapPriorityPreference-r18***Indicates whether the UE supports providing MUSIM assistance information with periodic MUSIM gap priority preference and related periodic MUSIM gap priority configuration, and its preference of keeping all collided MUSIM gaps, as defined in TS 38.331 [9]. A UE supporting this feature shall support *musim-GapPreference-r17.* | UE | No | No | No |
| ***musimLeaveConnected-r17***Indicates whether the UE supports providing MUSIM assistance information with indication of leaving RRC\_CONNECTED state as defined in TS 38.331 [9]. | UE | No | No | No |
| ***nonTerrestrialNetwork-r17***Indicates whether the UE supports NR NTN access. If the UE indicates this capability the UE shall support the following NTN essential features, e.g., timer extension in MAC/RLC/PDCP layers and RACH adaptation to handle long RTT, acquiring NTN specific SIB and more than one TAC per PLMN broadcast in one cell. | UE | No | No | No |
| ***ntn-ScenarioSupport-r17***Indicates whether the UE supports the NTN features in GSO scenario or NGSO scenario. If a UE does not include this field but includes *nonTerrestrialNetwork-r17*, the UE supports the NTN features for both GSO and NGSO scenarios, and also supports mobility between GSO and NGSO scenarios. | UE | No | No | No |
| ***onDemandSIB-Connected-r16***Indicates whether the UE supports the on-demand request procedure of SIB(s) or posSIB(s) while in RRC\_CONNECTED, as specified in TS 38.331 [9]. | UE | No | No | No |
| ***overheatingInd***Indicates whether the UE supports overheating assistance information. | UE | No | No | No |
| ***pei-SubgroupingSupportBandList-r17***Indicates whether the UE supports receiving paging early indication in DCI format 2\_7 as specified in TS 38.304 [21] for a list of frequency band. The UE shall support UEID based subgrouping for a frequency band if it indicates supporting of paging early indication reception for the frequency band. The set of OFDM symbols within a slot where UE can monitor the PEI PDCCH in Type 2A CSS is the same as the requirement for paging PDCCH in Type 2 CSS for IDLE and INACTIVE mode UEs. | UE | No | No | No |
| ***partialFR2-FallbackRX-Req***Indicates whether the UE meets only a partial set of the UE minimum receiver requirements for the eligible FR2 fallback band combinations as defined in Clause 4.2 of TS 38.101-2 [3] and Clause 4.2 of TS 38.101-3 [4]. If not indicated, the UE shall meet all the UE minimum receiver requirements for all the FR2 fallback combinations in TS 38.101-2 [3] and TS 38.101-3 [4]. The UE shall support configuration of any of the FR2 fallback band combinations regardless of the presence or the absence of this field. | UE | No | No | No |
| ***pdu-SetDiscard-r18***Indicates whether the UE supports PDU set based discard operation (i.e. *pdu-SetDiscard-r18* configuration, as specified in TS 38.331 [9]).UE supporting *pdu-SetDiscard-r18* shall also support the ability to identify PDU sets for UL XR traffic. | UE | No | No | No |
| ***psi-BasedDiscard-r18***Indicates whether the UEs supports PSI based discard (i.e. *discardTimerForLowImportance-r18* configuration, as specified in TS 38.331 [9]).UE supporting *psi-BasedDiscard-r18* shall also support the ability to identify PDU sets and PSI for UL XR traffic. | UE | No | No | No |
| ***ra-InsteadCG-SDT-r18***Indicates whether the UE supports the selection of RACH resources instead of configured grant type 1 resource when triggering resume for MO-SDT or MT-SDT and next configured grant type 1 resource is too far, as specified in TS 38.331 [9].A UE supporting this feature shall also indicate the support of *cg-SDT-r17,* or *mt-CG-SDT-r18.* | UE | No | No | No |
| ***ra-SDT-r17***Indicates whether the UE supports initiating MO-SDT procedure (i.e. transmission of data and/or signalling over allowed radio bearers in RRC\_INACTIVE state) via Random Access procedure (i.e., RA-SDT) with 4-step RA type and if UE supports *twoStepRACH-r16,* with 2-step RA type, as specified in TS 38.331 [9]. | UE | No | No | No |
| ***ra-SDT-NTN-r17***Indicates whether the UE supports initiating MO-SDT procedure (i.e. transmission of data and/or signalling over allowed radio bearers in RRC\_INACTIVE state) in NTN via Random Access procedure (i.e., RA-SDT) with 4-step RA type and if UE supports *twoStepRACH-r16* for NTN*,* with 2-step RA type, as specified in TS 38.331 [9]. A UE supporting this feature shall also indicate the support of *nonTerrestrialNetwork-r17*. | UE | No | No | No |
| ***redirectAtResumeByNAS-r16***Indicates whether the UE supports reception of *redirectedCarrierInfo* in an *RRCRelease* message in response to an *RRCResumeRequest* or *RRCResumeRequest1* which is triggered by the NAS layer, as specified in TS 38.331 [9]. | UE | No | No | No |
| ***reducedCP-Latency***Indicates whether the UE supports reduced control plane latency as defined in TS 38.331 [9] | UE | No | No | No |
| ***referenceTimeProvision-r16***Indicates whether the UE supports provision of referenceTimeInfo in *DLInformationTransfer* message and in SIB9 and reference time information preference indication via assistance information, as specified in TS 38.331 [9]. | UE | No | No | No |
| ***releasePreference-r16***Indicates whether the UE supports providing its preference assistance information to transition out of RRC\_CONNECTED for power saving, as specified in TS 38.331 [9]. | UE | No | No | No |
| ***requirementTypeIndication-r18***Indicates whether the UE supports network control of requirement applicability for UE supporting interBandMRDC-WithOverlapDL-Bands-r16. This field is only applicable to the UE indicating *interBandMRDC-WithOverlapDL-Bands-r16*.The UE supports this feature shall also indicate support of *interBandMRDC-WithOverlapDL-Bands-r16*. | UE | No | No | FR1 only |
| ***resumeAfterSDT-Release-r18***Indicates whether the UE supports immediate RRC connection resume procedure triggering after receiving *RRCRelease* message with a *resumeIndication* included during an ongoing SDT procedure, as specified in TS 38.331 [9].The UE indicating support of this feature shall also support any of *ra-SDT-r17*, *ra-SDT-NTN-r17*, *cg-SDT-r17*, *mt-SDT-r18, mt-SDT-NTN-r18* or *mt-CG-SDT-r18*. | UE | No | No | No |
| ***resumeWithStoredMCG-SCells-r16***Indicates whether the UE supports not deleting the stored MCG SCell configuration when initiating the resume procedure. | UE | No | No | No |
| ***resumeWithStoredSCG-r16***Indicates whether the UE supports not deleting the stored SCG configuration when initiating resume. The UE which indicates support for *resumeWithStoredSCG-r16* shall also indicate support for *resumeWithSCG-Config-r16*. | UE | No | No | No |
| ***resumeWithSCG-Config-r16***Indicates whether the UE supports (re-)configuration of an SCG during the resume procedure. | UE | No | No | No |
| ***sliceInfoforCellReselection-r17***Indicates whether the UE supports slice-based cell reselection information in SIB and on RRC release for slice-based cell reselection in RRC \_IDLE and RRC INACTIVE as defined in TS 38.304 [21]. | UE | No | No | No |
| ***splitSRB-WithOneUL-Path***Indicates whether the UE supports UL transmission via MCG path and DL reception via either MCG path or SCG path, as specified for the split SRB in TS 37.340 [7]. The UE shall not set the FDD/TDD specific fields for this capability (i.e. it shall not include this field in *UE-MRDC-CapabilityAddXDD-Mode*). | UE | No | No | No |
| ***softSatelliteSwitchResyncNTN-r18***Indicates whether UE supports soft satellite switch with re-sync, as specified in TS 38.331 [9].A UE supporting this feature shall also indicate support of *hardSatelliteSwitchResyncNTN-r18.* | UE | No | No | No |
| ***splitDRB-withUL-Both-MCG-SCG***Indicates whether the UE supports UL transmission via both MCG path and SCG path for the split DRB as specified in TS 37.340 [7]. The UE shall not set the FDD/TDD specific fields for this capability (i.e. it shall not include this field in *UE-MRDC-CapabilityAddXDD-Mode*). | UE | Yes | No | No |
| ***srb3***Indicates whether the UE supports SRB3 which is a direct SRB between the SN and the UE as specified in TS 37.340 [7]. The UE shall not set the FDD/TDD specific fields for this capability (i.e. it shall not include this field in *UE-MRDC-CapabilityAddXDD-Mode*). This field is not applied to NE-DC. | UE | Yes | No | No |
| ***srb-SDT-NTN-r17***Indicates whether the UE supports the usage of signalling radio bearer SRB2 for MO-SDT (over RA-SDT or CG-SDT) or MT-SDT (over RA or CG-SDT) in NTN, as specified in TS 38.331 [9].A UE supporting this feature shall also indicate support of *ra-SDT-NTN-r17*, *cg-SDT-r17*, *mt-SDT-NTN-r18* or *mt-CG-SDT-r18* in NTN bands. A UE supporting this feature shall also indicate the support of *nonTerrestrialNetwork-r17*. | UE | No | No | No |
| ***srb-SDT-r17***Indicates whether the UE supports the usage of signalling radio bearer SRB2 for MO-SDT (over RA-SDT or CG-SDT) or MT-SDT (over RA or CG-SDT), as specified in TS 38.331 [9].A UE supporting this feature shall also indicate support of *ra-SDT-r17 cg-SDT-r17*, *mt-SDT-r18* or *mt-CG-SDT-r18*. | UE | No | No | No |
| ***sdu-SNGapReport-r18***Indicates whether the UE supports the PDCP SN gap report as specified in TS 38.323 [16] and TS 38.331 [9]. | UE | No | No | No |
| ***ul-GapFR2-Pattern-r17***Indicates FR2 UL gap pattern(s) supported by the UE for NR SA, for NR-DC without FR2-FR2 band combination, for NE-DC, and for (NG)EN-DC, if UE supports a band in FR2. The leading / leftmost bit (bit 0) corresponds to the FR2 UL gap pattern 0, the next bit corresponds to the FR2 UL gap pattern 1, as specified in TS 38.133 [5] and so on. The UE shall set at least one of the bits to 1 for FR2 UL gap pattern 1 and 3, if the UE indicates support for *ul-GapFR2-r17* in an FR2 band. | UE | CY | No | FR2 only |
| ***ul-RRC-Segmentation-r16***Indicates whether the UE supports uplink RRC segmentation of *UECapabilityInformation* as specified in TS 38.331 [9]. | UE | No | No | No |
| ***ul-TrafficInfo-r18***Indicates whether UE supports sending UE assistance information with UL traffic information such as jitter range, burst arrival time, data burst periodicity and whether UE is able to identify PDU Set related information per UL QoS flow as specified in TS 38.331 [9]. | UE | No | No | No |

## 4.3.3 TP for TS 38.331

|  |
| --- |
| START OF CHANGE |

##### – *PDCP-Config*

The IE *PDCP-Config* is used to set the configurable PDCP parameters for signalling, MBS multicast and data radio bearers.

***PDCP-Config* information element**

-- ASN1START

-- TAG-PDCP-CONFIG-START

PDCP-Config ::= SEQUENCE {

 drb SEQUENCE {

 discardTimer ENUMERATED {ms10, ms20, ms30, ms40, ms50, ms60, ms75, ms100, ms150, ms200,

 ms250, ms300, ms500, ms750, ms1500, infinity} OPTIONAL, -- Cond Setup

 pdcp-SN-SizeUL ENUMERATED {len12bits, len18bits} OPTIONAL, -- Cond Setup1

 pdcp-SN-SizeDL ENUMERATED {len12bits, len18bits} OPTIONAL, -- Cond Setup2

 headerCompression CHOICE {

 notUsed NULL,

 rohc SEQUENCE {

 maxCID INTEGER (1..16383) DEFAULT 15,

 profiles SEQUENCE {

 profile0x0001 BOOLEAN,

 profile0x0002 BOOLEAN,

 profile0x0003 BOOLEAN,

 profile0x0004 BOOLEAN,

 profile0x0006 BOOLEAN,

 profile0x0101 BOOLEAN,

 profile0x0102 BOOLEAN,

 profile0x0103 BOOLEAN,

 profile0x0104 BOOLEAN

 },

 drb-ContinueROHC ENUMERATED { true } OPTIONAL -- Need N

 },

 uplinkOnlyROHC SEQUENCE {

 maxCID INTEGER (1..16383) DEFAULT 15,

 profiles SEQUENCE {

 profile0x0006 BOOLEAN

 },

 drb-ContinueROHC ENUMERATED { true } OPTIONAL -- Need N

 },

 ...

 },

 integrityProtection ENUMERATED { enabled } OPTIONAL, -- Cond ConnectedTo5GC1

 statusReportRequired ENUMERATED { true } OPTIONAL, -- Cond Rlc-AM-UM

 outOfOrderDelivery ENUMERATED { true } OPTIONAL -- Need R

 } OPTIONAL, -- Cond DRB

 moreThanOneRLC SEQUENCE {

 primaryPath SEQUENCE {

 cellGroup CellGroupId OPTIONAL, -- Need R

 logicalChannel LogicalChannelIdentity OPTIONAL -- Need R

 },

 ul-DataSplitThreshold UL-DataSplitThreshold OPTIONAL, -- Cond SplitBearer

 pdcp-Duplication BOOLEAN OPTIONAL -- Need R

 } OPTIONAL, -- Cond MoreThanOneRLC

 t-Reordering ENUMERATED {

 ms0, ms1, ms2, ms4, ms5, ms8, ms10, ms15, ms20, ms30, ms40,

 ms50, ms60, ms80, ms100, ms120, ms140, ms160, ms180, ms200, ms220,

 ms240, ms260, ms280, ms300, ms500, ms750, ms1000, ms1250,

 ms1500, ms1750, ms2000, ms2250, ms2500, ms2750,

 ms3000, spare28, spare27, spare26, spare25, spare24,

 spare23, spare22, spare21, spare20,

 spare19, spare18, spare17, spare16, spare15, spare14,

 spare13, spare12, spare11, spare10, spare09,

 spare08, spare07, spare06, spare05, spare04, spare03,

 spare02, spare01 } OPTIONAL, -- Need S

 ...,

 [[

 cipheringDisabled ENUMERATED {true} OPTIONAL -- Cond ConnectedTo5GC

 ]],

 [[

 discardTimerExt-r16 SetupRelease { DiscardTimerExt-r16 } OPTIONAL, -- Cond DRB2

 moreThanTwoRLC-DRB-r16 SEQUENCE {

 splitSecondaryPath-r16 LogicalChannelIdentity OPTIONAL, -- Cond SplitBearer2

 duplicationState-r16 SEQUENCE (SIZE (3)) OF BOOLEAN OPTIONAL -- Need S

 } OPTIONAL, -- Cond MoreThanTwoRLC-DRB

 ethernetHeaderCompression-r16 SetupRelease { EthernetHeaderCompression-r16 } OPTIONAL -- Need M

 ]],

 [[

 survivalTimeStateSupport-r17 ENUMERATED {true} OPTIONAL, -- Cond Drb-Duplication

 uplinkDataCompression-r17 SetupRelease { UplinkDataCompression-r17 } OPTIONAL, -- Cond Rlc-AM

 discardTimerExt2-r17 SetupRelease { DiscardTimerExt2-r17 } OPTIONAL, -- Need M

 initialRX-DELIV-r17 BIT STRING (SIZE (32)) OPTIONAL -- Cond MRB-Initialization

 ]],

 [[

 pdu-SetDiscard-r18 ENUMERATED {true} OPTIONAL, -- Need R

 discardTimerForLowImportance-r18 SetupRelease { DiscardTimerForLowImportance-r18 } OPTIONAL, -- Cond DRB2

 primaryPathOnIndirectPath-r18 ENUMERATED {true} OPTIONAL -- Cond SplitBearerMP

 sn-GapReportEnabled-r18 ENUMERATED {true} OPTIONAL -- Need R

 ]],

}

EthernetHeaderCompression-r16 ::= SEQUENCE {

 ehc-Common-r16 SEQUENCE {

 ehc-CID-Length-r16 ENUMERATED { bits7, bits15 },

 ...

 },

 ehc-Downlink-r16 SEQUENCE {

 drb-ContinueEHC-DL-r16 ENUMERATED { true } OPTIONAL, -- Need N

 ...

 } OPTIONAL, -- Need M

 ehc-Uplink-r16 SEQUENCE {

 maxCID-EHC-UL-r16 INTEGER (1..32767),

 drb-ContinueEHC-UL-r16 ENUMERATED { true } OPTIONAL, -- Need N

 ...

 } OPTIONAL -- Need M

}

UL-DataSplitThreshold ::= ENUMERATED {

 b0, b100, b200, b400, b800, b1600, b3200, b6400, b12800, b25600, b51200, b102400, b204800,

 b409600, b819200, b1228800, b1638400, b2457600, b3276800, b4096000, b4915200, b5734400,

 b6553600, infinity, spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1}

DiscardTimerExt-r16 ::= ENUMERATED {ms0dot5, ms1, ms2, ms4, ms6, ms8, spare2, spare1}

DiscardTimerExt2-r17 ::= ENUMERATED {ms2000, spare3, spare2, spare1}

UplinkDataCompression-r17 ::= CHOICE {

 newSetup SEQUENCE {

 bufferSize-r17 ENUMERATED {kbyte2, kbyte4, kbyte8, spare1},

 dictionary-r17 ENUMERATED {sip-SDP, operator} OPTIONAL -- Need N

 },

 drb-ContinueUDC NULL

}

DiscardTimerForLowImportance-r18 ::= ENUMERATED {ms0, ms2, ms4, ms6, ms8, ms10, ms12, ms14, ms18, ms22, ms26, ms30, ms40, ms50, ms75, ms100}

-- TAG-PDCP-CONFIG-STOP

-- ASN1STOP

| ***PDCP-Config* field descriptions** |
| --- |
| ***cipheringDisabled***If included, ciphering is disabled for this DRB regardless of which ciphering algorithm is configured for the SRB/DRBs. The field may only be included if the UE is connected to 5GC. Otherwise the field is absent. The network configures all DRBs with the same PDU-session ID with same value for this field. The value for this field cannot be changed after the DRB is set up. |
| ***discardTimer***Value in ms of *discardTimer* specified in TS 38.323 [5]. Value *ms10* corresponds to 10 ms, value *ms20* corresponds to 20 ms and so on. The value for this field cannot be changed in case of reconfiguration with sync, if the bearer is configured as DAPS bearer. |
| ***discardTimerExt***Value in ms of *discardTimer* specified in TS 38.323 [5]. Value *ms0dot5* corresponds to 0.5 ms, value *ms1* corresponds to 1ms and so on. If this field is present, the field *discardTimer* is ignored and *discardTimerExt* is used instead. |
| ***discardTimerExt2***Value in ms of *discardTimerExt* specified in TS 38.323 [5]. Value *ms2000* corresponds to 2000 ms. If this field is present, the field *discardTimer* and *discardTimerExt* are ignored and *discardTimerExt2* is used instead. |
| ***discardTimerForLowImportance***Value in ms of d*iscardTimerForLowImportance* specified in TS 38.323 [5]. Value *ms0* corresponds to 0 ms, value *ms2* corresponds to 2 ms and so on. The value of this timer for a PDCP entity is always configured shorter than *discardTimer*, *discardTimerExt* or *discardTimerExt2*, whichever is used for the PDCP entity. |
| ***sn-GapReportEnabled*** Indicates whether the PDCP entity is configured to send a PDCP SN gap report in the uplink, as specified in TS 38.323 [5]. This field is only configured for DRBs. |
| ***drb-ContinueROHC***Indicates whether the PDCP entity continues or resets the ROHC header compression protocol during PDCP re-establishment, as specified in TS 38.323 [5]. This field is configured only in case of resuming an RRC connection or reconfiguration with sync, where the PDCP termination point is not changed and the *fullConfig* is not indicated. The network does not include the field if the bearer is configured as DAPS bearer. This field can be configured for both DRB and multicast MRB. |
| ***duplicationState***This field indicates the uplink PDCP duplication state for the associated RLC entities at the time of receiving this IE. If set to *true,* the PDCP duplication state is activated for the associated RLC entity. The index for the indication is determined by ascending order of logical channel ID of all RLC entities other than the primary RLC entityindicated by *primaryPath* in the order of MCG and SCG, as in clause 6.1.3.32 of TS 38.321 [3]. If the number of associated RLC entities other than the primary RLC entity is two, UE ignores the value in the largest index of this field. If the field is absent, the PDCP duplication states are deactivated for all associated RLC entities.  |
| ***ethernetHeaderCompression***This fields configures Ethernet Header Compression. This field can only be configured for a bi-directional DRB or a bi-directional multicast MRB. The network reconfigures *ethernetHeaderCompression* only upon reconfiguration involving PDCP re-establishment and with neither *drb-ContinueEHC-DL* nor *drb-ContinueEHC-UL* configured. Network only configures this field when *uplinkDataCompression* is not configured. |
| ***headerCompression***If rohc is configured, the UE shall apply the configured ROHC profile(s) in both uplink and downlink. If *uplinkOnlyROHC* is configured, the UE shall apply the configured ROHC profile(s) in uplink (there is no header compression in downlink). ROHC can be configured for any bearer type. ROHC and EHC can be both configured simultaneously for a DRB or a multicast MRB. The network reconfigures *headerCompression* only upon reconfiguration involving PDCP re-establishment or involving PDCP entity reconfiguration to configure DAPS bearer(s), and without any *drb-ContinueROHC*. Network configures *headerCompression* to *notUsed* when *outOfOrderDelivery* is configured. Network only configures this field when *uplinkDataCompression* is not configured. |
| ***initialRX-DELIV***Indicates the initial value of RX\_DELIV during PDCP window initialization for multicast MRB as specified in TS 38.323 [5]. |
| ***integrityProtection***Indicates whether or not integrity protection is configured for this radio bearer. The network configures all DRBs with the same PDU-session ID with same value for this field. The value for this field cannot be changed after the DRB is set up. |
| ***maxCID***Indicates the value of the MAX\_CID parameter as specified in TS 38.323 [5].The total value of MAX\_CIDs across all bearers for the UE should be less than or equal to the value of *maxNumberROHC-ContextSessions* parameter as indicated by the UE. |
| ***moreThanOneRLC***This field configures UL data transmission when more than one RLC entity is associated with the PDCP entity. This field is not present if the bearer is configured as DAPS bearer. |
| ***moreThanTwoRLC-DRB***This field configures UL data transmission when more than two RLC entities are associated with the PDCP entity for DRBs. |
| ***outOfOrderDelivery***Indicates whether or not *outOfOrderDelivery* specified in TS 38.323 [5] is configured. This field should be either always present or always absent, after the radio bearer is established. |
| ***pdcp-Duplication***Indicates whether or not uplink duplication status at the time of receiving this IE is configured and activated as specified in TS 38.323 [5]. The presence of this field indicates that duplication is configured. PDCP duplication is not configured for CA packet duplication of LTE RLC bearer. The value of this field, when the field is present, indicates the state of the duplication at the time of receiving this IE. If set to *true*, duplication is activated. The value of this field is always *true*, when configured for a SRB. For PDCP entity with more than two associated RLC entities for UL transmission, this field is always present. If the field *moreThanTwoRLC-DRB* is present, the value of this field is ignored and the state of the duplication is indicated by *duplicationState*. For PDCP entity with more than two associated RLC entities, only NR RLC bearer is supported. |
| ***pdcp-SN-SizeDL***PDCP sequence number size for downlink, 12 or 18 bits, as specified in TS 38.323 [5]. For SRBs only the value *len12bits* is applicable. The value for this field cannot be changed in case of reconfiguration with sync, if the bearer is configured as DAPS bearer. |
| ***pdcp-SN-SizeUL***PDCP sequence number size for uplink, 12 or 18 bits, as specified in TS 38.323 [5]. For SRBs only the value *len12bits* is applicable. The value for this field cannot be changed in case of reconfiguration with sync, if the bearer is configured as DAPS bearer. |
| ***pdu-SetDiscard***If set to true, the UE shall perform PDU set based discarding for this PDCP entity, as specified in TS 38.323 [5]. |
| ***primaryPath***Indicates the cell group ID and LCID of the primary RLC entity as specified in TS 38.323 [5], clause 5.2.1 for UL data transmission when more than one RLC entity is associated with the PDCP entity. In this version of the specification, only cell group ID corresponding to MCG is supported for SRBs, except for the split SRB2 of the IAB-MT, and except when the UE is required to set the *primaryPath* to refer to the SCG as specified in clause 5.7.3b.4. In this last case, if the network sends an *RRCReconfiguration* message (in NR-DC) or an EUTRA *RRCConnectionReconfiguration* message (in (NG)EN-DC) keeping SRB1 as split SRB, the network explicitly configures the *primaryPath* for the PDCP entity of SRB1 to refer to the MCG. In this version of the specification, only cell group ID corresponding to MCG is supported for DRBs when the SCG is deactivated. In MR-DC, the NW indicates *cellGroup* for split bearers using logical channels in different cell groups. The NW always indicates *logicalChannel* if CA based PDCP duplication is configured in the cell group indicated by *cellGroup* of this field. In MP, when the primay path is set to indirect path, the field *cellGroup* and *logicalChannel* are absent, and the field *primaryPathOnIndirectPath* is set to true. |
| ***primaryPathOnIndirectPath***Indicates that the primary RLC entity is on indirect path for DRB when MP is configured. |
| ***splitSecondaryPath***Indicates the LCID of the split secondary RLC entity as specified in TS 38.323 [5] for fallback to split bearer operation when UL data transmission with more than two RLC entities is associated with the PDCP entity. This RLC entity belongs to a cell group that is different from the cell group indicated by *cellGroup* in the field *primaryPath.* |
| ***statusReportRequired***For AM DRBs, AM MRBs and DAPS UM DRBs, indicates whether the DRB or the multicast MRB is configured to send a PDCP status report in the uplink, as specified in TS 38.323 [5]. For DAPS AM DRBs, it also indicates whether the DRB is configured to send a second PDCP status report in the uplink, as specified in TS 38.323 [5]. |
| ***survivalTimeStateSupport***Indicates whether the DRB associated with this PDCP entity has survival time state support. If this field is configured to be true, all associated RLC entities are activated for PDCP duplication upon reception of a retransmission grant addressed to CS-RNTI, as specified in TS 38.321 [3]. |
| ***t-Reordering***Value in ms of t-Reordering specified in TS 38.323 [5]. Value *ms0* corresponds to 0 ms, value *ms20* corresponds to 20 ms, value *ms40* corresponds to 40 ms, and so on. When the field is absent the UE applies the value *infinity*. The value for this field cannot be changed in case of reconfiguration with sync, if the bearer is configured as DAPS bearer. |
| ***ul-DataSplitThreshold***Parameter specified in TS 38.323 [5]. Value *b0* corresponds to 0 bytes, value *b100* corresponds to 100 bytes, value *b200* corresponds to 200 bytes, and so on. The network sets this field to *infinity* for UEs not supporting *splitDRB-withUL-Both-MCG-SCG* and when the SCG is deactivated. If the field is absent when the split bearer is configured for the radio bearer first time, then the default value *infinity* is applied. |
| ***uplinkDataCompression***Indicates the UDC configuration that the UE shall apply. Network does not configure *uplinkDataCompression* for a DRB, if *headerCompression* or *ethernetHeaderCompression* is already configured or *outOfOrderDelivery* or DAPS is configured for the DRB. The maximum number of DRBs where *uplinkDataCompression* can be applied is two. The network reconfigures *uplinkDataCompression* only upon reconfiguration involving PDCP re-establishment. If the field is set to *drb-ContinueUDC*, the PDCP entity continues the uplink data compression protocol during PDCP re-establishment, as specified in TS 38.323 [5]. The field is set to *drb-ContinueUDC* only in case of resuming an RRC connection or reconfiguration with sync, where the PDCP termination point is not changed and the *fullConfig* is not indicated. |

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| NEXT CHANGE |

##### – *UE-NR-Capability*

The IE *UE-NR-Capability* is used to convey the NR UE Radio Access Capability Parameters, see TS 38.306 [26].

***UE-NR-Capability* information element**

-- ASN1START

-- TAG-UE-NR-CAPABILITY-START

UE-NR-Capability ::= SEQUENCE {

 accessStratumRelease AccessStratumRelease,

 pdcp-Parameters PDCP-Parameters,

 rlc-Parameters RLC-Parameters OPTIONAL,

 mac-Parameters MAC-Parameters OPTIONAL,

 phy-Parameters Phy-Parameters,

 rf-Parameters RF-Parameters,

 measAndMobParameters MeasAndMobParameters OPTIONAL,

 fdd-Add-UE-NR-Capabilities UE-NR-CapabilityAddXDD-Mode OPTIONAL,

 tdd-Add-UE-NR-Capabilities UE-NR-CapabilityAddXDD-Mode OPTIONAL,

 fr1-Add-UE-NR-Capabilities UE-NR-CapabilityAddFRX-Mode OPTIONAL,

 fr2-Add-UE-NR-Capabilities UE-NR-CapabilityAddFRX-Mode OPTIONAL,

 featureSets FeatureSets OPTIONAL,

 featureSetCombinations SEQUENCE (SIZE (1..maxFeatureSetCombinations)) OF FeatureSetCombination OPTIONAL,

 lateNonCriticalExtension OCTET STRING (CONTAINING UE-NR-Capability-v15c0) OPTIONAL,

 nonCriticalExtension UE-NR-Capability-v1530 OPTIONAL

}

-- Regular non-critical Rel-15 extensions:

UE-NR-Capability-v1530 ::= SEQUENCE {

 fdd-Add-UE-NR-Capabilities-v1530 UE-NR-CapabilityAddXDD-Mode-v1530 OPTIONAL,

 tdd-Add-UE-NR-Capabilities-v1530 UE-NR-CapabilityAddXDD-Mode-v1530 OPTIONAL,

 dummy ENUMERATED {supported} OPTIONAL,

 interRAT-Parameters InterRAT-Parameters OPTIONAL,

 inactiveState ENUMERATED {supported} OPTIONAL,

 delayBudgetReporting ENUMERATED {supported} OPTIONAL,

 nonCriticalExtension UE-NR-Capability-v1540 OPTIONAL

}

UE-NR-Capability-v1540 ::= SEQUENCE {

 sdap-Parameters SDAP-Parameters OPTIONAL,

 overheatingInd ENUMERATED {supported} OPTIONAL,

 ims-Parameters IMS-Parameters OPTIONAL,

 fr1-Add-UE-NR-Capabilities-v1540 UE-NR-CapabilityAddFRX-Mode-v1540 OPTIONAL,

 fr2-Add-UE-NR-Capabilities-v1540 UE-NR-CapabilityAddFRX-Mode-v1540 OPTIONAL,

 fr1-fr2-Add-UE-NR-Capabilities UE-NR-CapabilityAddFRX-Mode OPTIONAL,

 nonCriticalExtension UE-NR-Capability-v1550 OPTIONAL

}

UE-NR-Capability-v1550 ::= SEQUENCE {

 reducedCP-Latency ENUMERATED {supported} OPTIONAL,

 nonCriticalExtension UE-NR-Capability-v1560 OPTIONAL

}

UE-NR-Capability-v1560 ::= SEQUENCE {

 nrdc-Parameters NRDC-Parameters OPTIONAL,

 receivedFilters OCTET STRING (CONTAINING UECapabilityEnquiry-v1560-IEs) OPTIONAL,

 nonCriticalExtension UE-NR-Capability-v1570 OPTIONAL

}

UE-NR-Capability-v1570 ::= SEQUENCE {

 nrdc-Parameters-v1570 NRDC-Parameters-v1570 OPTIONAL,

 nonCriticalExtension UE-NR-Capability-v1610 OPTIONAL

}

-- Late non-critical Rel-15 extensions:

UE-NR-Capability-v15c0 ::= SEQUENCE {

 nrdc-Parameters-v15c0 NRDC-Parameters-v15c0 OPTIONAL,

 partialFR2-FallbackRX-Req ENUMERATED {true} OPTIONAL,

 nonCriticalExtension UE-NR-Capability-v15g0 OPTIONAL

}

UE-NR-Capability-v15g0 ::= SEQUENCE {

 rf-Parameters-v15g0 RF-Parameters-v15g0 OPTIONAL,

 nonCriticalExtension UE-NR-Capability-v15j0 OPTIONAL

}

UE-NR-Capability-v15j0 ::= SEQUENCE {

 -- Following field is only for REL-15 late non-critical extensions

 lateNonCriticalExtension OCTET STRING OPTIONAL,

 nonCriticalExtension UE-NR-Capability-v16a0 OPTIONAL

}

-- Regular non-critical Rel-16 extensions:

UE-NR-Capability-v1610 ::= SEQUENCE {

 inDeviceCoexInd-r16 ENUMERATED {supported} OPTIONAL,

 dl-DedicatedMessageSegmentation-r16 ENUMERATED {supported} OPTIONAL,

 nrdc-Parameters-v1610 NRDC-Parameters-v1610 OPTIONAL,

 powSav-Parameters-r16 PowSav-Parameters-r16 OPTIONAL,

 fr1-Add-UE-NR-Capabilities-v1610 UE-NR-CapabilityAddFRX-Mode-v1610 OPTIONAL,

 fr2-Add-UE-NR-Capabilities-v1610 UE-NR-CapabilityAddFRX-Mode-v1610 OPTIONAL,

 bh-RLF-Indication-r16 ENUMERATED {supported} OPTIONAL,

 directSN-AdditionFirstRRC-IAB-r16 ENUMERATED {supported} OPTIONAL,

 bap-Parameters-r16 BAP-Parameters-r16 OPTIONAL,

 referenceTimeProvision-r16 ENUMERATED {supported} OPTIONAL,

 sidelinkParameters-r16 SidelinkParameters-r16 OPTIONAL,

 highSpeedParameters-r16 HighSpeedParameters-r16 OPTIONAL,

 mac-Parameters-v1610 MAC-Parameters-v1610 OPTIONAL,

 mcgRLF-RecoveryViaSCG-r16 ENUMERATED {supported} OPTIONAL,

 resumeWithStoredMCG-SCells-r16 ENUMERATED {supported} OPTIONAL,

 resumeWithStoredSCG-r16 ENUMERATED {supported} OPTIONAL,

 resumeWithSCG-Config-r16 ENUMERATED {supported} OPTIONAL,

 ue-BasedPerfMeas-Parameters-r16 UE-BasedPerfMeas-Parameters-r16 OPTIONAL,

 son-Parameters-r16 SON-Parameters-r16 OPTIONAL,

 onDemandSIB-Connected-r16 ENUMERATED {supported} OPTIONAL,

 nonCriticalExtension UE-NR-Capability-v1640 OPTIONAL

}

UE-NR-Capability-v1640 ::= SEQUENCE {

 redirectAtResumeByNAS-r16 ENUMERATED {supported} OPTIONAL,

 phy-ParametersSharedSpectrumChAccess-r16 Phy-ParametersSharedSpectrumChAccess-r16 OPTIONAL,

 nonCriticalExtension UE-NR-Capability-v1650 OPTIONAL

}

UE-NR-Capability-v1650 ::= SEQUENCE {

 mpsPriorityIndication-r16 ENUMERATED {supported} OPTIONAL,

 highSpeedParameters-v1650 HighSpeedParameters-v1650 OPTIONAL,

 nonCriticalExtension UE-NR-Capability-v1690 OPTIONAL

}

UE-NR-Capability-v1690 ::= SEQUENCE {

 ul-RRC-Segmentation-r16 ENUMERATED {supported} OPTIONAL,

 nonCriticalExtension UE-NR-Capability-v1700 OPTIONAL

}

-- Late non-critical extensions from Rel-16 onwards:

UE-NR-Capability-v16a0 ::= SEQUENCE {

 phy-Parameters-v16a0 Phy-Parameters-v16a0 OPTIONAL,

 rf-Parameters-v16a0 RF-Parameters-v16a0 OPTIONAL,

 nonCriticalExtension UE-NR-Capability-v16c0 OPTIONAL

}

UE-NR-Capability-v16c0 ::= SEQUENCE {

 rf-Parameters-v16c0 RF-Parameters-v16c0 OPTIONAL,

 nonCriticalExtension UE-NR-Capability-v16d0 OPTIONAL

}

UE-NR-Capability-v16d0 ::= SEQUENCE {

 featureSets-v16d0 FeatureSets-v16d0 OPTIONAL,

 nonCriticalExtension SEQUENCE {} OPTIONAL

}

-- Regular non-critical Rel-17 extensions:

UE-NR-Capability-v1700 ::= SEQUENCE {

 inactiveStatePO-Determination-r17 ENUMERATED {supported} OPTIONAL,

 highSpeedParameters-v1700 HighSpeedParameters-v1700 OPTIONAL,

 powSav-Parameters-v1700 PowSav-Parameters-v1700 OPTIONAL,

 mac-Parameters-v1700 MAC-Parameters-v1700 OPTIONAL,

 ims-Parameters-v1700 IMS-Parameters-v1700 OPTIONAL,

 measAndMobParameters-v1700 MeasAndMobParameters-v1700,

 appLayerMeasParameters-r17 AppLayerMeasParameters-r17 OPTIONAL,

 redCapParameters-r17 RedCapParameters-r17 OPTIONAL,

 ra-SDT-r17 ENUMERATED {supported} OPTIONAL,

 srb-SDT-r17 ENUMERATED {supported} OPTIONAL,

 gNB-SideRTT-BasedPDC-r17 ENUMERATED {supported} OPTIONAL,

 bh-RLF-DetectionRecovery-Indication-r17 ENUMERATED {supported} OPTIONAL,

 nrdc-Parameters-v1700 NRDC-Parameters-v1700 OPTIONAL,

 bap-Parameters-v1700 BAP-Parameters-v1700 OPTIONAL,

 musim-GapPreference-r17 ENUMERATED {supported} OPTIONAL,

 musimLeaveConnected-r17 ENUMERATED {supported} OPTIONAL,

 mbs-Parameters-r17 MBS-Parameters-r17,

 nonTerrestrialNetwork-r17 ENUMERATED {supported} OPTIONAL,

 ntn-ScenarioSupport-r17 ENUMERATED {gso, ngso} OPTIONAL,

 sliceInfoforCellReselection-r17 ENUMERATED {supported} OPTIONAL,

 ue-RadioPagingInfo-r17 UE-RadioPagingInfo-r17 OPTIONAL,

 -- R4 17-2 UL gap pattern for Tx power management

 ul-GapFR2-Pattern-r17 BIT STRING (SIZE (4)) OPTIONAL,

 ntn-Parameters-r17 NTN-Parameters-r17 OPTIONAL,

 nonCriticalExtension UE-NR-Capability-v1740 OPTIONAL

}

UE-NR-Capability-v1740 ::= SEQUENCE {

 redCapParameters-v1740 RedCapParameters-v1740,

 nonCriticalExtension UE-NR-Capability-v1750 OPTIONAL

}

UE-NR-Capability-v1750 ::= SEQUENCE {

 crossCarrierSchedulingConfigurationRelease-r17 ENUMERATED {supported} OPTIONAL,

 nonCriticalExtension UE-NR-Capability-v1800 OPTIONAL

}

-- Regular non-critical Rel-18 extensions:

UE-NR-Capability-v1800 ::= SEQUENCE {

 airToGroundNetwork-r18 ENUMERATED {supported} OPTIONAL,

 eRedCapParameters-r18 ERedCapParameters-r18 OPTIONAL,

 ncr-Parameters-r18 NCR-Parameters-r18 OPTIONAL,

 softSatelliteSwitchResyncNTN-r18 ENUMERATED {supported} OPTIONAL,

 hardSatelliteSwitchResyncNTN-r18 ENUMERATED {supported} OPTIONAL,

 mt-SDT-r18 ENUMERATED {supported} OPTIONAL,

 mt-SDT-NTN-r18 ENUMERATED {supported} OPTIONAL,

 inDeviceCoexIndAutonomousDenial-r18 ENUMERATED {supported} OPTIONAL,

 inDeviceCoexIndFDM-r18 ENUMERATED {supported} OPTIONAL,

 inDeviceCoexIndTDM-r18 ENUMERATED {supported} OPTIONAL,

 musim-GapPriorityPreference-r18 ENUMERATED {supported} OPTIONAL,

 musim-CapabilityRestriction-r18 ENUMERATED {supported} OPTIONAL,

 multiRx-FR2-Preference-r18 ENUMERATED {supported} OPTIONAL,

 ra-InsteadCG-SDT-r18 ENUMERATED {supported} OPTIONAL,

 resumeAfterSDT-Release-r18 ENUMERATED {supported} OPTIONAL,

 additionalBSR-Table-r18 ENUMERATED {supported} OPTIONAL,

 delayStatusReport-r18 ENUMERATED {supported} OPTIONAL,

 disableCG-RetransmissionMonitoring-r18 ENUMERATED {supported} OPTIONAL,

 enhancedDRX-r18 ENUMERATED {supported} OPTIONAL,

 pdu-SetDiscard-r18 ENUMERATED {supported} OPTIONAL,

 psi-BasedDiscard-r18 ENUMERATED {supported} OPTIONAL,

 ul-TrafficInfo-r18 ENUMERATED {supported} OPTIONAL,

 aerialParameters-r18 AerialParameters-r18 OPTIONAL,Up

 nonCriticalExtension UE-NR-Capability-v1810 OPTIONAL

}

UE-NR-Capability-v1810 ::= SEQUENCE {

 sdu-SNGapReport—r18 ENUMERATED {supported} OPTIONAL,

 nonCriticalExtension SEQUENCE {} OPTIONAL

}

UE-NR-CapabilityAddXDD-Mode ::= SEQUENCE {

 phy-ParametersXDD-Diff Phy-ParametersXDD-Diff OPTIONAL,

 mac-ParametersXDD-Diff MAC-ParametersXDD-Diff OPTIONAL,

 measAndMobParametersXDD-Diff MeasAndMobParametersXDD-Diff OPTIONAL

}

UE-NR-CapabilityAddXDD-Mode-v1530 ::= SEQUENCE {

 eutra-ParametersXDD-Diff EUTRA-ParametersXDD-Diff

}

UE-NR-CapabilityAddFRX-Mode ::= SEQUENCE {

 phy-ParametersFRX-Diff Phy-ParametersFRX-Diff OPTIONAL,

 measAndMobParametersFRX-Diff MeasAndMobParametersFRX-Diff OPTIONAL

}

UE-NR-CapabilityAddFRX-Mode-v1540 ::= SEQUENCE {

 ims-ParametersFRX-Diff IMS-ParametersFRX-Diff OPTIONAL

}

UE-NR-CapabilityAddFRX-Mode-v1610 ::= SEQUENCE {

 powSav-ParametersFRX-Diff-r16 PowSav-ParametersFRX-Diff-r16 OPTIONAL,

 mac-ParametersFRX-Diff-r16 MAC-ParametersFRX-Diff-r16 OPTIONAL

}

BAP-Parameters-r16 ::= SEQUENCE {

 flowControlBH-RLC-ChannelBased-r16 ENUMERATED {supported} OPTIONAL,

 flowControlRouting-ID-Based-r16 ENUMERATED {supported} OPTIONAL

}

BAP-Parameters-v1700 ::= SEQUENCE {

 bapHeaderRewriting-Rerouting-r17 ENUMERATED {supported} OPTIONAL,

 bapHeaderRewriting-Routing-r17 ENUMERATED {supported} OPTIONAL

}

MBS-Parameters-r17 ::= SEQUENCE {

 maxMRB-Add-r17 INTEGER (1..16) OPTIONAL

}

-- TAG-UE-NR-CAPABILITY-STOP

-- ASN1STOP

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| ***UE-NR-Capability* field descriptions** |
| ***featureSetCombinations***A list of *FeatureSetCombination:s* for *supportedBandCombinationList* in *UE-NR-Capability*. The *FeatureSetDownlink:s* and *FeatureSetUplink:s* referred to from these *FeatureSetCombination:s* are defined in the *featureSets* list in *UE-NR-Capability*. |

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| ***UE-NR-Capability-v1540 field descriptions*** |
| ***fr1-fr2-Add-UE-NR-Capabilities***This instance of *UE-NR-CapabilityAddFRX-Mode* does not include any other fields than *csi-RS-IM-ReceptionForFeedback*/ *csi-RS-ProcFrameworkForSRS*/ *csi-ReportFramework*. |

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| END OF CHANGE |

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