3GPP TSG RAN WG2 Meeting #115-e R2-21XXXXX

e-Meeting, 9th – 27th August, 2021

**Agenda item: 6.1.3.1**

**Source: Samsung**

**Title: Report of Offline 020: MAC II**

**Document for: Discussion and Decision**

# 1 Introduction

This document is a discussion report of the following offline discussion:

* [AT115-e][020][NR16] MAC II (Samsung)

 Scope: Take on-line outcome into account, Treat remaining aspects, determine agreeable parts and agree CRs Treat R2-2108257, R2-2107197, R2-2107610, R2-2108094, R2-2108095, R2-2108787, R2-2107735, R2-2107200, R2-2108283, R2-2108284, R2-2108285,

 Intended outcome: Report, Agreed CRs.

 Deadline: On-line first, Schedule 1

R2-2108257 Clarification of PUCCH resource in LCH-based Prioritization    Samsung    CR    Rel-16    38.321    16.5.0    1141    -    F    NR\_IIOT-Core

R2-2107197 Overlapping UCI and PUSCH    CATT    discussion    NR\_IIOT-Core

R2-2107610 UCI multiplexing and overlapped SR/PUSCH    Apple    CR    Rel-16    38.321    16.5.0    1132    -    F    NR\_newRAT-Core

[R2-2108094](file:///C%3A%5C3GPP%20meetings%5CRAN2%5C2021%5CTSGR2_115-e%5Cdocs%5CR2-2108094.zip) Corrections to retransmission of configured grant with empty buffer    Ericsson, MediaTek Inc.    discussion

R2-2108095 Corrections to retransmission of configured grant with empty buffer    Ericsson, MediaTek Inc.    CR    Rel-16    38.321    16.5.0    1136    -    F    NR\_IIOT-Core

[R2-2108787](file:///C%3A%5C3GPP%20meetings%5CRAN2%5C2021%5CTSGR2_115-e%5Cdocs%5CR2-2108787.zip) UCI on retransmission uplink grant    LG Electronics UK    discussion    TEI16

R2-2107735 Ignoring the retransmission grant overlapped with UCI    OPPO    discussion    Rel-16    TEI16

R2-2107200 Handling of pending empty PDUs after UCI multiplexing    CATT    discussion    NR\_IIOT-Core

[R2-2108283](file:///C%3A%5C3GPP%20meetings%5CRAN2%5C2021%5CTSGR2_115-e%5Cdocs%5CR2-2108283.zip) Autonomous Transmission of MAC PDU with only Padding or Periodic BSR    Nokia, Nokia Shanghai Bell    discussion    Rel-16    NR\_IIOT-Core

[R2-2108284](file:///C%3A%5C3GPP%20meetings%5CRAN2%5C2021%5CTSGR2_115-e%5Cdocs%5CR2-2108284.zip) Avoiding autonomous transmission of MAC PDU with only Padding BSR or unuseful Periodic BSR – Option 1    Nokia, Nokia Shanghai Bell    CR    Rel-16    38.321    16.5.0    1146    -    F    NR\_IIOT-Core

[R2-2108285](file:///C%3A%5C3GPP%20meetings%5CRAN2%5C2021%5CTSGR2_115-e%5Cdocs%5CR2-2108285.zip) Avoiding autonomous transmission of MAC PDU with only Padding BSR or unuseful Periodic BSR – Option 2    Nokia, Nokia Shanghai Bell    CR    Rel-16    38.321    16.5.0    1147    -    F    NR\_IIOT-Core

# 2 Contact Information

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# 3 Phase 1 Discussion

## 3.1 Issue #1: NOTE for the final PUCCH resource

R2-2108257 Clarification of PUCCH resource in LCH-based Prioritization    Samsung    CR    Rel-16    38.321    16.5.0    1141    -    F    NR\_IIOT-Core

R2-2107197 Overlapping UCI and PUSCH    CATT    discussion    NR\_IIOT-Core

R2-2107610 UCI multiplexing and overlapped SR/PUSCH    Apple    CR    Rel-16    38.321    16.5.0    1132    -    F    NR\_newRAT-Core

The contributions above propose to capture the last meeting’s RAN2 agreement as follows:

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| * We go with Understanding 1: MAC does not use knowledge of UCI multiplexing when MAC executes LCH based prioritization and deciding when to transmit SR (i.e. in the context of the cases listed in R2-2105781)
* [016] MAC CR is postponed (until R1 has made more progress).
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For careful checking for better TP, MAC CR has been postponed in the last meeting. In this meeting, three companies provided CRs, which all propose to have a NOTE in MAC specification.

R2-2108257 (Samsung)

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| 5.4.1 and 5.4.4 (Same NOTE)NOTE Y: If the MAC entity is configured with *lch-basedPrioritization,* the MAC entity does not consider UCI multiplexing in the physical layer when determining whether the PUSCH duration of an uplink grant overlaps with the PUCCH resource for the SR transmission. |

R2-2107197 (CATT)

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| 5.4.1NOTE X: If the MAC entity is configured with *lch-basedPrioritization*, the MAC entity does not take the UCI multiplexing in the physical layer into account when determining whether the PUSCH duration of an uplink grant overlaps with the PUCCH resource for an SR transmission.5.4.4NOTE Y: If the MAC entity is configured with *lch-basedPrioritization*, the MAC entity does not take the UCI multiplexing in the physical layer into account when determining whether the PUCCH resource for the SR transmission occasion overlaps with the PUSCH duration of an uplink grant and whether the physical layer can signal the SR on one valid PUCCH resource for SR. |

R2-2107610 (Apple)

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| 5.4.1NOTE 8: If the MAC entity is configured with *lch-basedPrioritization* and the PUCCH resource with an SR transmission overlaps with other UCI(s) according to the procedure specified in TS 38.213 [6] clause 9.2.5, the MAC entity determines a prioritized SR transmission for the PUCCH resource with an SR transmission that is configured by RRC.5.4.4NOTE 5: If the MAC entity is configured with *lch-basedPrioritization* and the PUCCH resource for the SR transmission occasion for the pending SR overlaps with other UCI(s) according to the procedure specified in TS 38.213 [6] clause 9.2.5, the MAC entity determines a prioritized SR transmission for the valid PUCCH resource for SR that is configured by RRC. |

Since only detail of TP is different and there was no objection to have a NOTE during the RAN#114-e offline discussion, the rapporteur would suggest to agree to have NOTEs for 5.4.1 and 5.4.4, as proposed by those CRs. The rapporteur would start the discussion with compromise TP considering all three CRs.

**Q1) Do companies agree to have the following NOTE for subclause 5.4.1 UL Grand Reception?**

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| NOTE X: If the MAC entity is configured with *lch-basedPrioritization*, the MAC entity does not take the UCI multiplexing according to the procedure specified in TS 38.213 [6] into account when determining whether the PUSCH duration of an uplink grant overlaps with the PUCCH resource for an SR transmission. |
| **Company** | **Yes/No** | **Comment (or any suggestion)** |
| Ericsson | Yes |  |
| Nokia | Yes |  |
| MediaTek | Yes | Minor wording suggestion to remove ‘the’, as below:*…the MAC entity does not take ~~the~~ UCI multiplexing according to the procedure specified in TS 38.213…* |
| Lenovo | Yes | Agree with MTK’s improved wording |
| ZTE | Yes | Agree with MTK’s improved wording |
| CATT | Yes | OK with MTK’s wording |
| Apple | Yes | OK with MTK’s wording |
| OPPO | Yes | OK with MTK’s suggestion. |
| Huawei, HiSilicon | No | We should respect the previous RAN2 agreement to avoid back-and-forth changes until RAN1 has made more progress based on RAN2 LS. No need for a hurry. |
| Qualcomm | Yes | Agree, plus MTK’s suggestion |
| vivo | No | As RAN2 has agreed to remove the condition (i.e. if the MAC entity is not configured with *lch-basedPrioritization*) in this meeting, we think we can have the MAC CR without waiting for RAN1 progress. So, we are fine to introduce a NOTE. However, we think the proposed wording is not so precious. It is not so clear whether the MAC does not consider UCI multiplexing on PUSCH or multiplexing on PUCCH or both. Instead, we think the basic intention is that the MAC entity can only be aware of the PUCCH-SR resource configured by*SchedulingRequestResourceId*. Thus, we propose the following,**If the MAC entity is configured with *lch-basedPrioritization*, the PUCCH resource for the SR transmission is referred to as the PUCCH resource configured by *SchedulingRequestResourceId* when determining whether the PUSCH duration of an uplink grant overlaps with the PUCCH resource for the SR transmission.** |
| Fujitsu | Yes | OK with MTK’s wording. Having sayd that, it makes sense to wait for RAN1 progress. |
| LG | Yes | It seems not essential but we can follow majority view. |
| Intel | Yes | OK with MTK’s wording. |
| Xiaomi | Yes |  |
| Sequans | Yes | Agree with MTK's wording. |

**Q2) Do companies agree to have the following NOTE for subclause 5.4.4 Scheduling Request?**

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| NOTE Y: If the MAC entity is configured with *lch-basedPrioritization*, the MAC entity does not take the UCI multiplexing according to the procedure specified in TS 38.213 [6] into account when determining whether the PUCCH resource for the valid SR transmission occasion overlaps with the PUSCH duration of an uplink grant. |
| **Company** | **Yes/No** | **Comment (or any suggestion)** |
| Ericsson | Yes |  |
| Nokia | Yes |  |
| MediaTek | Yes | Same wording suggestion as Q1 |
| Lenovo | Yes |  |
| ZTE | Yes | Agree with MTK’s improved wording |
| CATT | Yes but | The relevant text for the scheduling request is:

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| 3>  if the MAC entity is configured with *lch-basedPrioritization*, and the PUCCH resource for the SR transmission occasion does not overlap with an uplink grant received in a Random Access Response nor with a transmission of MSGA payload, and the PUCCH resource for the SR transmission occasion for the pending SR triggered as specified in clause 5.4.5 overlaps with any other UL-SCH resource(s), and the physical layer can signal the SR on one valid PUCCH resource for SR, and the priority of the logical channel that triggered SR is higher than the priority of the uplink grant(s) for any UL-SCH resource(s) where the uplink grant was not already de-prioritized, and the priority of the uplink grant is determined as specified in clause 5.4.1; or |

We think both yellow and green texts should be covered by the Note, hence suggest the following improvement (on top of MTK’s):NOTE Y: If the MAC entity is configured with *lch-basedPrioritization*, the MAC entity does not take ~~the~~ UCI multiplexing according to the procedure specified in TS 38.213 [6] into account when determining whether the PUCCH resource for the valid SR transmission occasion can be signalled by the physical layer and overlaps with the PUSCH duration of an uplink grant. |
| Apple | Yes (see comment) | We are fine with the wording proposed by the rapporteur, but we would suggest using ‘valid PUCCH’ instead of ‘valid SR’ to align with other parts in 5.4.4. In addition, the NOTE should account for the case for MSGA payload. NOTE Y: If the MAC entity is configured with *lch-basedPrioritization*, the MAC entity does not take ~~the~~ UCI multiplexing according to the procedure specified in TS 38.213 [6] into account when determining whether the valid PUCCH resource for the ~~valid~~ SR transmission occasion overlaps with the PUSCH duration of an uplink grant or with the PUSCH duration of a MSGA payload. |
| OPPO | Yes | Maybe it is better to put “valid” before “PUCCH resource”, as MAC always does. |
| Huawei, HiSilicon | No | See comments to Q1 |
| Qualcomm | Yes | We are fine with the suggestion by Apple |
| vivo | No | Similar view to Q1, we propose the following,**If the MAC entity is configured with *lch-basedPrioritization*, the PUCCH resource for the SR transmission is referred to as the PUCCH resource configured by *SchedulingRequestResourceId* when determining whether the PUSCH duration of an uplink grant overlaps with the PUCCH resource for the SR transmission.** |
| Fujitsu | Yes | OK with CATT+Apple wording |
| LG | Yes | It seems not essential but we can follow majority view. |
| Intel | Yes | Agree with wording improvements suggested by Apple. |
| Xiaomi | Yes |  |
| Sequans | Yes |  |

< Summary >

## 3.2 Issue #2: Retransmission resource for a skipped CG

[R2-2108094](file:///C%3A%5C3GPP%20meetings%5CRAN2%5C2021%5CTSGR2_115-e%5Cdocs%5CR2-2108094.zip) Corrections to retransmission of configured grant with empty buffer    Ericsson, MediaTek Inc.    discussion

R2-2108095 Corrections to retransmission of configured grant with empty buffer    Ericsson, MediaTek Inc.    CR    Rel-16    38.321    16.5.0    1136    -    F    NR\_IIOT-Core

[R2-2108787](file:///C%3A%5C3GPP%20meetings%5CRAN2%5C2021%5CTSGR2_115-e%5Cdocs%5CR2-2108787.zip) UCI on retransmission uplink grant    LG Electronics UK    discussion    TEI16

R2-2107735 Ignoring the retransmission grant overlapped with UCI    OPPO    discussion    Rel-16    TEI16

[R2-2108094, R2-2108095] points out that MAC specification does not follow a RAN1 agreement on UL skipping. As shown in the figure below, a problematic scenario is

* CG is skipped due to the absence of pending data and UCI. HARQ buffer is flushed.
* gNB mis-detects the skipped CG. (i.e. false alarm/false positive)
* gNB allocates a retransmission grant by CS-RNTI for the skipped CG. The PUSCH duration of the retransmission grant overlaps with UCI. This UCI should be multiplexed in the PUSCH. However, the current MAC specification ignores the retransmission grant.



[R2-2108094, R2-2108095 (Ericsson, MediaTek)] propose to allow the initial transmission for UL grant addressed to CS-RNTI, if the HARQ buffer is empty, as follows. This is also to align the operations between the dynamic grant and the configured grant. For retransmission of a dynamic grant, the same problem due to the gNB false positive occurs, but the MAC spec treats it as a new transmission.

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| For each uplink grant, the HARQ entity shall:1> identify the HARQ process associated with this grant, and for each identified HARQ process:2> if the received grant was not addressed to a Temporary C-RNTI on PDCCH, and the NDI provided in the associated HARQ information has been toggled compared to the value in the previous transmission of this TB of this HARQ process; or2> if the uplink grant was received on PDCCH for the C-RNTI and the HARQ buffer of the identified process is empty; or2> if the uplink grant received on PDCCH was addressed to CS-RNTI and if the HARQ buffer of the identified process is empty; or… (omitted)2> if the uplink grant is part of a bundle of the configured uplink grant, and may be used for initial transmission according to clause 6.1.2.3 of TS 38.214 [7], and if no MAC PDU has been obtained for this bundle:… (omitted)3> else if the MAC entity is not configured with *lch-basedPrioritization*; or3> if this uplink grant is a prioritized uplink grant:4> obtain the MAC PDU to transmit from the Multiplexing and assembly entity, if any;3> if a MAC PDU to transmit has been obtained:4> if the uplink grant is not a configured grant configured with *autonomousTx*; or4> if the uplink grant is a prioritized uplink grant:5> deliver the MAC PDU and the uplink grant and the HARQ information of the TB to the identified HARQ process;5> instruct the identified HARQ process to trigger a new transmission;…2> else (i.e. retransmission):3> if the uplink grant received on PDCCH was addressed to CS-RNTI and if the HARQ buffer of the identified process is empty; or3> if the uplink grant is part of a bundle and if no MAC PDU has been obtained for this bundle; or3> if the uplink grant is part of a bundle of the configured uplink grant, and the PUSCH duration of the uplink grant overlaps with an uplink grant received in a Random Access Response (i.e. MAC RAR or fallbackRAR) or an uplink grant determined as specified in clause 5.1.2a for MSGA payload for this Serving Cell; or:3> if the MAC entity is not configured with *lch-basedPrioritization* and this uplink grant is part of a bundle of the configured uplink grant, and the PUSCH duration of the uplink grant overlaps with a PUSCH duration of another uplink grant received on the PDCCH; or:3> if the MAC entity is configured with *lch-basedPrioritization* and this uplink grant is not a prioritized uplink grant:4> ignore the uplink grant.3> else:4> deliver the uplink grant and the HARQ information (redundancy version) of the TB to the identified HARQ process;4> instruct the identified HARQ process to trigger a retransmission;… |

On the other hand, [R2-2108787] and [R2-2107735] propose to keep the current text.

R2-2108787 (LG Electronics)

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| **Proposal 1.** The dynamic uplink grant received for retransmission of skipped initial transmission shall be ignored as today, i.e., it is not to be used for UCI transmission even though UCI is overlapped with this invalid retransmission uplink grant. |

R2-2107735 (OPPO)

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| Proposal 2 RAN2 agrees to keep the current spec, i.e. ignore the retransmission grant whose PUSCH is overlapped with UCI if no MAC PDU has already been obtained for the corresponding HARQ process when Rel-16 LCH based prioritization is not configured and Rel-16 PUSCH skipping is enabled. |

**Q3) Do companies agree to allow the initial transmission for UL grant addressed to CS-RNTI, if the HARQ buffer is empty?**

* **Yes, the MAC entity shall treat the retransmission grant as the initial transmission.**
* **No, the MAC entity shall ignore the retransmission grant as today.**

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| **Company** | **Yes/No** | **Comments (optional)** |
| Ericsson | Yes | We would like to point out that the operation of configured grant was copied from the LTE spec, which would make sense in the case of non-adaptive retransmission with PHICH but not anymore in NR. In addition to what the rapporteur has summarized, this is to align the operation in the case of a retransmission of the dynamic grant. We have added this with change marks in the above.  |
| Nokia | No | UL grant addressed to CS-RNTI has only been designed for retransmission rather than initial transmission or UCI multiplexing. Receiving such an UL grant when there is no data in the buffer is obviously an error case. If the NW intends to schedule new transmission, it would have used UL grant addressed to C-RNTI. |
| MediaTek | Yes | Agree with Ericsson. As highlighted in R2-2108094, false alarm/false positive cannot be considered as a corner case. If we keep the current text, we do not fulfil the expected UE behaviour that RAN1 asked us to implement. |
| Lenovo | Yes | We have same view as Ericsson/Mediatek. We think that the proposed behaviour is inline with what RAN1 had in mind. |
| ZTE | No | From NW perspective, if false alarm/false positive is really a case which shall be improved, the current mechanism is better and no enhancement is needed. For example, if NW mis-detect the skipped CG occasion as not skipped, then NW schedule a retransmission for this CG occasion, if NW cannot receive anything for the retransmission , this result can provide the feedback to NW what the situation is and NW can adjust detection threshold or remove the UL skipping feature. Assuming that we have this enhancement, NW cannot be aware of the mis-detection.In addition, we have a careful attitude on the non-alignment between UE and NW on one transmission (i.e NW presume the transmission is re-transmission while UE perform actually a new transmission) |
| CATT | Yes | With this solution, the network has no misunderstanding and can perform HARQ combination since the initial transmission is skipped anyways. Besides, this is beneficial to resource utilization. |
| Apple | No | We agree it seems logical to consider both DG and CG in the same way. In regard to the highlighted green part in R2-2108094, actually the retransmission branch under “2> else (i.e. retransmission)” should cover all cases of non-toggled NDI. This seems in line with the RAN2 assumptions per the early email discussions for Rel-15 (refer to the email discussion entitled “General corrections on NR MAC specification (also subject to [100#20])” from Jan 2018), but it will be good to clarify the understanding.Ericsson v18: Agree that the retransmission branch under “2> else (i.e., retransmission)” is supposed to cover all cases of non-toggled NDI (i.e., retransmission), but the green text indicates that if NDI is not toggled with empty buffer, then it is a new transmission. NDI has been used for other purposes and one cannot simply interpret NDI toggled or not as initial- or re-transmission. In our understanding, to treat the retransmission grant as the initial transmission mainly addresses a corner (error) case at the gNB. We would appreciate if the scenario does not need to get mitigated at the expense of UE implementation complexity. Ericsson v18: We understand the concern for UE implementation complexity and propose this alignment solution between DG and CG. As pointed out by other companies in the last meeting the proposed update may cause a confusion on Tx/ReTx modelling. Besides it looks strange to apply the same condition (see the yellow part in R2-2108094 and the newly added part in R2-2108095) for both initial Tx and ReTx. Ericsson v18: We can remove the blue part, see comments to OPPO below.Lastly, the potential impact to RAN1 specification may need to be evaluated. In the RAN1 specification, if repetition is configured for a configured grant transmission, say [0 3 0 3] for redundancy versions for 4 repetitions, an initial transmission of a transport block can start from the position of the first “0” or the second “0”, but not from the slot associated with redundancy version “3”. If the proposal in R2-2108094/5 is agreed, then the RAN1 specification should also be updated as the change can lead to a configured grant starting at redundancy version “3”. Ericsson v18: The CR is only related with the retransmission of a CG. For initial transmission of a CG, it is covered by the below text2> if the uplink grant is part of a bundle of the configured uplink grant, and may be used for initial transmission according to clause 6.1.2.3 of TS 38.214 [7], and if no MAC PDU has been obtained for this bundle:Apple v21: From UE perspective essentially it is still an initial transmission, and it may have an impact on RAN1. If we also remove the blue part in the retransmission branch, it is all the more a change to the design. The scenario would happen for a configured grant if L2 did not have data available at InitialTx while there was also no overlapping UCI, such that the InitialTx gets skipped as part of the normal UL skipping procedure in MAC. Thus MAC does not create a MAC PDU for the UL grant, and no TB is delivered to PHY. In this case the gNB should detect that nothing was received in uplink for the PUSCH and typically, not request a HARQ retransmission.Considering the complexity vs benefit we think it is better to contain the impact by not adopting this change to avoid complication at the late stage of Rel-16.  |
| OPPO | No | Agree with Nokia and ZTE. In addition, UL grant addressed to CS-RNTI is designed for the retransmission. If the MAC treats the such retransmission grant as the initial transmission and generates MAC PDU for this grant, it may introduce the confusion on TX/ReTX modelling. Ericsson v18: The CR models it as Tx, the same as retransmission of a dynamic grant.OPPO v22: If so, it means the original design of CS-RNTI is changed. Sometimes the UE needs consider CS-RNTI scheduling as a new transmission. From the UE perspective, it may introduce the backward compatibility issue. R15 UE and R16 UE needs to have different actions, i.e. ignore or try to generate a MAC PDU. Actually, it requires R16 UE to change its implementation from what it already has for R15. Also, there may be some issue on soft combination, i.e. the gNB may consider to perform soft combination for the MAC PDU associated with CS-RNTI scheduling grant, because the gNB considers it is a retransmission, but it is actually a new MAC PDU.By the way, one question for R2-2108095: If the green one is added, does it mean the blue one is useless?Ericsson v18: Yes.For each uplink grant, the HARQ entity shall:1> identify the HARQ process associated with this grant, and for each identified HARQ process:2> if the received grant was not addressed to a Temporary C-RNTI on PDCCH, and the NDI provided in the associated HARQ information has been toggled compared to the value in the previous transmission of this TB of this HARQ process; or2> if the uplink grant was received on PDCCH for the C-RNTI and the HARQ buffer of the identified process is empty; or2> if the uplink grant received on PDCCH was addressed to CS-RNTI and if the HARQ buffer of the identified process is empty; or… (omitted)2> else (i.e. retransmission):3> if the uplink grant received on PDCCH was addressed to CS-RNTI and if the HARQ buffer of the identified process is empty; or |
| Huawei, HiSilicon | No | Agree with Nokia. The proposal in 8094/8095 was discussed as one candidate solution to address the issue of deprioritized data in Rel-16 IIOT, but was not accepted finally due to the reason mentioned by Nokia. We should not re-open the discussions unless critical issue is identified. Otherwise, it is no good to just repeat discussions. |
| Qualcomm | No | We share the same view as Nokia and ZTE |
| vivo | No | We share a similar view with Nokia and Huawei. We don’t think this correction is needed for Rel-16 considering that there is no bug in the current spec.  |
| Fujitsu | No | Similar view with Nokia that PDCCH addressed to the CS-RNTI with NDI=1 is only received when there is data in the HARQ buffer. The discussed case is when there is no data in the HARQ buffer, so that the UE would regard it as an error case. |
| LG | No | Retransmission grant for the empty buffer is a false NW scheduling. Using this grant for other purpose is certainly an optimization, which may lead further complex UE behaviour in NDI management. In the beginning of LTE, it has been discussed whether to use SPS C-RNTI for initial transmission but RAN2 agreed to use SPS C-RNTI solely for retransmission without NDI check because NDI management could be complicated when two RNTIs (C-RNTI and SPS C-RNTI) schedules the same HARQ process while there is a possibility that one can be missing. This is a longtime principle and we don’t see much value to change it just for CSI report. |
| Intel | No | We agree with Apple’s impact analysis on bundling operation. We prefer not to make the change at the late stage of Rel-16. |
| Xiaomi | No | We agree with Nokia that this is an error case. |
| Sequans | No | Similar view as Nokia |

< Summary >

## 3.3 Issue #3: Retransmission of Padding BSR-only MAC PDU

R2-2107200 Handling of pending empty PDUs after UCI multiplexing    CATT    discussion    NR\_IIOT-Core

[R2-2108283](file:///C%3A%5C3GPP%20meetings%5CRAN2%5C2021%5CTSGR2_115-e%5Cdocs%5CR2-2108283.zip) Autonomous Transmission of MAC PDU with only Padding or Periodic BSR    Nokia, Nokia Shanghai Bell    discussion    Rel-16    NR\_IIOT-Core

[R2-2108284](file:///C%3A%5C3GPP%20meetings%5CRAN2%5C2021%5CTSGR2_115-e%5Cdocs%5CR2-2108284.zip) Avoiding autonomous transmission of MAC PDU with only Padding BSR or unuseful Periodic BSR – Option 1    Nokia, Nokia Shanghai Bell    CR    Rel-16    38.321    16.5.0    1146    -    F    NR\_IIOT-Core

[R2-2108285](file:///C%3A%5C3GPP%20meetings%5CRAN2%5C2021%5CTSGR2_115-e%5Cdocs%5CR2-2108285.zip) Avoiding autonomous transmission of MAC PDU with only Padding BSR or unuseful Periodic BSR – Option 2    Nokia, Nokia Shanghai Bell    CR    Rel-16    38.321    16.5.0    1147    -    F    NR\_IIOT-Core

[R2-2107200] and [R2-2108283] point out that MAC may generate a MAC PDU carrying UCI-only TB (or with BSR) for a configured grant, if there is no UL transmission for the CG and CG overlaps with one PUCCH carrying UCI. In case that *AutonomousTx* is configured (potentially CGRT is configured and potentially LBT failure occurs), padding-only MAC PDU (or BSR-only MAC PDU) may be retransmitted in the next CG occasion. It would negatively impact the latency performance. Moreover, the delayed BSR may be outdated.



[R2-2107200] and [R2-2108283] propose to have a mechanism to avoid autonomous transmission of padding-only MAC PDU. Also, there were some proposals for the similar issue in Relase-17 IIOT WI, i.e. [R2-2107896, R2-2108810]. The rapporteur would like to ask if companies would agree to resolve the issue.

**Q4) Do companies agree to have a mechanism to avoid autonomous transmission of a MAC PDU that includes only padding BSR or periodic BSR indicating no data, in Rel-16?**

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| **Company** | **Yes/No** | **Comments (optional)** |
| Ericsson | No | This is an optimization, and we don’t consider this correction as essential in Rel-16, in particular this late phase. * The feature of autonomous transmission was introduced in Rel-16 in the case that the network may not always send a re-transmission grant for the de-prioritized CG which may contain data. The motivation is not to “facilitate low latency transmission by recovering deprioritized MAC PDU that could be relatively delay-sensitive.”, but to recover the data. The data transmitted on CG is de-prioritized and thus it is assumed that it is for the best effort eMBB data but not the URLLC data.
* In Rel-16, even without the latest LS from RAN1 on UCI-multiplexing, the uplink grant may contain paddings due to aperiodic CSI request.
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| Nokia | Yes | We disagree with Ericsson that the intention of autonomous transmission is only for gNB to recover eMBB data. In fact, in IIoT use cases the UE may have to handle multiple URLLC traffic flows simultaneously (with some differences in their urgency level which can be reflected to LCH priorities), so **the CG configured with AutoTX can be delay-sensitive** even though it may not be the most urgent data the UE has to handle. For such cases, AutoTX provides some benefits of latency reduction as the MAC PDU can be transmitted autonomously without waiting for retransmission grant. For eMBB we can simply rely on SR/BSR procedures and dynamic grants, not necessarily CG with AutoTX. And even if the MAC PDU is for aperiodic CSI, the PHY can always convey the A-CSI on some other TBs once the original MAC PDU is deprioritized. What has been stored in the HARQ buffer by MAC does not include anything useful really.Therefore, we do not think it makes sense at all to transmit such MAC PDU autonomously and block new data that has much more value. Furthermore, the paddind/periodic BSR conveyed by this empty MAC PDU can be outdated and the gNB may erroneously treat this as the latest buffer information (because the gNB does not know exactly when this BSR is prepared), and the UE may also miss out the opportunity to update the BSR. This is especially undesirable for IIoT/URLLC use cases. |
| MediaTek | No | We do not see this as an essential correction for Rel-16. Also agree with Ericsson that this was already the case for aperiodic CSI requests. |
| Lenovo | Yes | We agree with Nokia, that such UCI-only TBs shall not delay other high priority new data, i.e. this is in particular unacceptable if the new data is some URLLC data or if there are some critical MAC CEs that need to be sent immediately. UCI contents multiplexed in this UCI-only TB may be no longer useful/valuable for the gNB, since the corresponding information such as HARQ-ACK or CSI may be already outdated or superseded.  |
| ZTE | No | For Rel-16, no need to have this kind of enhancement at this stage, this is a rare case. For Rel-17, we are open to it. |
| CATT | Yes | Since the only reason for transmitting this PUSCH initially was the multiplexed UCI, and there is no autonomous handling by the UE of the “lost” UCI from the initial transmission, then such UCI is no longer there in the PUSCH of the (autonomous) (re)transmission. Hence there is no point in attempting any (re)transmission of such empty and useless PDU.  |
| Apple | Yes | Agree to the problem and the solution approach (to flush the HARQ process or to stop the CGT/CGRT). Autonomous transmission/retransmission does not make sense for an empty MAC PDU. We are okay to add a fix in Rel-16, however, if most companies prefer to defer the solution to Rel-17 then that is acceptable to us as well. |
| OPPO | No | It is not an essential correction.  |
| Huawei, HiSilicon | No | We understand the intention however we think the correction is for a corner case in Rel-16. Even if RAN2 agreed to solve this issue, we don't think any solution is complete for the padding issue and can be agreeable since the case where lch-based prioritization is not configured is not applicable anyways. |
| Qualcomm | No | Agree with Ericsson |
| vivo | No | We share the same view with Ericsson and Huawei. |
| Fujitsu | No | We have sympathy with the case that the CG configured with AutoTX can be delay-sensitive. Having said that, the newly arrived data seems can be transmitted on SR/UL grant procedure. Alternatively, the newly arrived data can be transmitted by overprovisioned other CG resources. There is no problem with those solutions. |
| LG | No | (Proponent for Rel-17.) In Rel-16, it is not essential at this late stage. In Rel-17, it is worthwhile discussing how to serve low-latency data carefully by considering the UCI multiplexing.  |
| Intel | No | We don’t think this is an essential correction for Rel-16. |
| Xiaomi | No | We agree with Ericsson that this is an optimization which is not essential for Rel-16. |
| Sequans | No | Agree that it is not essential for Rel-16 |

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Assuming that companies agree to resolve the issue, RAN2 needs to decide the option. (Note that if companies disagree, then none of the solutions is needed.) Anyway, the following solutions were proposed:

R2-2108283, R2-2108284, R2-2108285 (Nokia)

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| **Proposal: RAN2 should discuss how to avoid autonomous transmission of a MAC PDU that includes only padding BSR or periodic BSR indicating no data, based on the following options:**1. **Flush this MAC PDU when it is deprioritized, so it will not be fetched for autonomous TX in the subsequent CG, if it only has padding or periodic BSR indicating no data (CR: R2-2108284)**
2. **Do not consider this MAC PDU as obtained for autonomous transmission in HARQ entity procedure, if it only has padding or periodic BSR indicating no data (CR: R2-2108285)**
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R2-2107200 (CATT)

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| **Proposal 1: MAC flushes the corresponding HARQ process after an empty MAC PDU aimed for an UCI-only TB has been delivered to PHY.** |

R2-2107896 (Lenovo)

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| **Proposal 4: UE flushes the HARQ buffer after the initial transmission (attempt) of an empty MAC PDU.**  |

R2-2108810 (LG Electronics)

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| **Proposal.** If retransmission of UCI-only MAC PDU needs to be de-prioritized, RAN2 discuss an option of *not starting configuredGrantTimer* and *cg-RetransmissionTimer* upon transmission of UCI-only MAC PDU.  |

**Q5) Assuming that RAN2 introduce a mechanism to avoid autonomous transmission of a MAC PDU that includes only padding BSR or periodic BSR indicating no data in Rel-16, which option is preferred?**

* **Option 1. Flush this MAC PDU when it is deprioritized, so it will not be fetched for autonomous TX in the subsequent CG, if it only has padding or periodic BSR indicating no data [R2-2108284].**
* **Option 2. Do not consider this MAC PDU as obtained for autonomous transmission in HARQ entity procedure, if it only has padding or periodic BSR indicating no data [R2-2108285].**
* **Option 3. MAC flushes the corresponding HARQ process after an empty MAC PDU aimed for an UCI-only TB has been delivered to PHY [R2-2107200].**
* **Option 4. UE flushes the HARQ buffer after the initial transmission (attempt) of an empty MAC PDU [R2-2107896].**
* **Option 5. If retransmission of UCI-only MAC PDU needs to be de-prioritized, the MAC entity does not start *configuredGrantTimer* and *cg-RetransmissionTimer* upon transmission of UCI-only MAC PDU [R2-2108810].**

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| **Company** | **Option** | **Comments (optional)** |
| Nokia | 1, (4), (5) | Option 1 is beneficial in term of complexity, because MAC anyway needs to check the MAC PDU content before deciding if it should be deprioritized. So the MAC can decide directly if this MAC PDU should be flushed upon its de-prioritization. We understand that Option 3 is more generic, but we generally think this problem is more undesirable for autoTX or autoReTX mechanisms where gNB may not be able to detect the MAC PDU, and the subsequent resources may be used by autoTX/ReTX that potentially blocks new data. So, we prefer to limit the special handling to these autonomous mechanisms only.Option 4 and Option 5 make sense when CG retransmission timer is configured in NR-U. |
| Lenovo | 4,5 |  |
| CATT | 3,4 | We see no difference between options 3 and 4. We believe this is the cleanest solution since there is no point in keeping the empty PDU in the HARQ buffer once it was used to transmit UCI. |
| Apple | 5, (4) | We prefer solution 5 over flushing the HARQ buffer as it aligns with other cases such as an uplink grant cancelled by CI-RNTI. Also, the change should apply regardless of whether lch-basedPrioritization is applied or not. |
| LG | 5+2 | We see no difference between 1, 3, and 4. They are all intended to flush the HARQ buffer storing the UCI-only TB. In these options, it is explained that if the HARQ buffer is empty, the condition for autonomous transmission would not be satisfied. However, ‘MAC PDU had already been obtained for this HARQ process’ seems not ask whether the HARQ buffer is currently empty or not. It only checks whether the MAC PDU had already been obtained for this HARQ process. Thus, if the UCI-only TB had already been obtained but flushed, then the condition seems to still be satisfied, and hence, triggering autonomous transmission. In this regards, we think option 2 is rather clearer than option 1/3/4. In addition, if the intention is to prevent retransmission of UCI-only TB, there is no reason to keep the *configuredGrantTimer* running, which has been started at transmission of UCI-only TB. It only results in unused CGs before the *configuredGrantTimer* expires. If there is no retransmission expected to the UCI-only TB, it would be better to allow next new transmission as soon as possible. Therefore, we think *configuredGrantTimer* should be stopped for UCI-only TB transmission.  |
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# 4 Phase-1 Conclusion