**3GPP TSG RAN WG1#117 R1-24zzzzz**

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

Source: Moderator (Nokia)

Title: [117-Pre-R18-NR] Summary of UCI on Msg3 PUSCH

Agenda Item: 7

Release: Release 18

WI code: NR\_newRAT-Core, TEI18

Document for: Discussion and Decision

# Introduction

RAN1#116 discussed a clarification text proposal [[R1-2400950](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_116/Docs/R1-2400950.zip)] for the specification to clearly state that UCI should not be multiplexed on Msg3 PUSCH. The discussion summary is recorded in [[R1-2401691](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_116/Docs/R1-2401691.zip)].

RAN1#116 made the following agreement:

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| **Agreement**  TP in R1-2400950 is agreed for Release 18 in principle. Final CR to be submitted after additional relevant issues are discussed in future meetings. |

RAN1#116bis continued the discussion, but did not have the time to converge to a CR text that would have been agreeable to all parties. The discussion summary is recorded in [[R1-2403722](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_116b/Docs/R1-2403722.zip)].

6 contributions were submitted to RAN1#117, the table below summarizes the proposals made in the submitted documents:

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| Ref | Summary of proposals |
| ZTE [1] | **Proposal 1:** RAN1 should focus on whether/how to address the original concerned case, i.e., PUCCH without repetition vs Msg3 without repetition.  **Observation 1:** Prioritizing Msg3 PUSCH and dropping PUCCH cannot offer clear benefits to NW compared to undefined UE behavior.  **Observation 2:** On one hand, a UE may not be able to support all the new specified UE behaviors for different collision cases involving Msg3. On the other hand, PRACH partitioning is only way for UE capability reporting for CBRA procedure and huge spec efforts are expected.  **Proposal 2:** If a Msg3 PUSCH (re)transmission overlaps with a PUCCH, a UE does not multiplex UCI on Msg3 PUSCH and it is up to UE to transmit either Msg3 PUSCH or the PUCCH. |
| Apple [2] | **Proposal 1:** If a Msg3 PUSCH scheduled by a RAR UL grant or a DCI with CRC scrambled by TC-RNTI overlaps with a PUCCH, it is up to UE to transmit either Msg3 PUSCH or the PUCCH. UE does not multiplex UCI on Msg3 PUSCH.  **Proposal 2:** Whether UCI can be multiplexed on another candidate PUSCH or not, is left to UE implementation. |
| Nokia, CATT, Ericsson [3, 4] | **Proposal:** Agree to the draft CR [4] starting from Rel-18 adding the following statement to TS38.213 clause 9:   * If a Msg3 PUSCH (re)transmission overlaps with a PUCCH, the UE does not multiplex UCI on Msg3 PUSCH and it is up to the UE to transmit either Msg3 PUSCH or the PUCCH. |
| Huawei [5] | **Proposal 1**: If a Msg3 PUSCH (re)transmission overlaps with a PUCCH, UE does not multiplex UCI on Msg3 PUSCH and it is up to UE to transmit either Msg3 PUSCH or the PUCCH.  **Proposal 2:** If a Msg3 PUSCH (re)transmission overlaps with a PUSCH, UE transmits Msg3 PUSCH and drop the PUSCH.  **Proposal 3:** In order to resolve the overlapping of Msg3 PUSCH and PUCCH or another PUSCH, the TP in Appendix is adopted in TS 38.213 [copied below].  If a Msg3 PUSCH (re)transmission overlaps with a PUCCH, UE does not multiplex UCI on Msg3 PUSCH and it is up to UE to transmit either Msg3 PUSCH or the PUCCH.  If a Msg3 PUSCH (re)transmission overlaps with a PUSCH, UE transmits Msg3 PUSCH and drop the PUSCH. |
| Samsung [6] | Draft CR proposing the following addition to clause 9 of TS 38.213:  If a UE would transmit a Msg3 PUSCH and a PUCCH that overlap and would not transmit other PUSCH that overlaps with the PUCCH, the UE does not multiplex UCI on the Msg3 PUSCH and it is up to UE to transmit either the Msg3 PUSCH or the PUCCH. |

# References

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| [1] | [R1-2404229](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_117/Docs/R1-2404229.zip) | Discussion on UCI multiplexing in Msg3 PUSCH | ZTE |
| [2] | [R1-2404269](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_117/Docs/R1-2404269.zip) | Views on multiplexing UCI on MSG3 PUSCH | Apple |
| [3] | [R1-2404479](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_117/Docs/R1-2404479.zip) | On not multiplexing UCI on MSG3 PUSCH | Nokia, CATT, Ericsson |
| [4] | [R1-2404480](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_117/Docs/R1-2404480.zip) | Clarification on not multiplexing UCI on MSG3 PUSCH | Nokia, CATT, Ericsson |
| [5] | [R1-2404945](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_117/Docs/R1-2404945.zip) | Discussion on overlapping issues related to Msg3 | Huawei, HiSilicon |
| [6] | [R1-2404954](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_117/Docs/R1-2404954.zip) | Draft CR for overlapping between msg3 PUSCH and PUCCH | Samsung |

# Contacts

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# Discussion

## Moderator summary

The proposals can be split into parts

1. How to capture the fact that UCI is not be multiplexed to Msg3 PUSCH

ZTE, Nokia/CATT/Ericsson and Huawei:

* + If a Msg3 PUSCH (re)transmission overlaps with a PUCCH, [a/the] UE does not multiplex UCI on Msg3 PUSCH […]

Apple

* + If a Msg3 PUSCH scheduled by a RAR UL grant or a DCI with CRC scrambled by TC-RNTI overlaps with a PUCCH, […]. UE does not multiplex UCI on Msg3 PUSCH

Samsung

* + If a UE would transmit a Msg3 PUSCH and a PUCCH that overlap and would not transmit other PUSCH that overlaps with the PUCCH, the UE does not multiplex UCI on the Msg3 PUSCH

1. Prioritization of PUCCH and Msg3 PUSCH

ZTE, Nokia/CATT/Ericsson, Apple

* + … it is up to [the] UE to transmit either Msg3 PUSCH or the PUCCH.

Samsung makes no statement, which effectively leaves the UE the freedom to decide which of the two it transmits

1. What to do with the UCI that was not multiplexed on Msg3 PUSCH if there are other overlapping PUSCHs

ZTE, Nokia/CATT/Ericsson and Huawei: No statement, which can be understood to leave it undefined whether the UCI is dropped or multiplexed to another overlapping PUSCH

Apple explicitly proposes that “Whether UCI can be multiplexed on another candidate PUSCH or not, is left to UE implementation.”.

Samsung clarified offline that the intention was to leave it up to the UE

1. What to do with other PUSCHs overlapping with Msg3 PUSCH

Huawei: Drop the PUSCHs that overlap with Msg3 PUSCH

## Moderator proposals

**Discussion point #1: Agree on which wording to take as the core text for UCI not to be multiplexed on Msg3**

* + - **Alt1:** If a Msg3 PUSCH (re)transmission overlaps with a PUCCH, the UE does not multiplex UCI on the Msg3 PUSCH.
    - **Alt2:** If a Msg3 PUSCH scheduled by a RAR UL grant or a DCI with CRC scrambled by TC-RNTI overlaps with a PUCCH, the UE does not multiplex UCI on the Msg3 PUSCH.
    - **Alt3:** If a UE would transmit a Msg3 PUSCH and a PUCCH that overlap, the UE does not multiplex UCI on the Msg3 PUSCH.

**Moderator’s proposal #1: suggest adopting Alt3 as it is grammatically more fluent, but any one of the three will get the job done.**

**Discussion point #2: Prioritization of PUCCH and Msg3 PUSCH, agree on one of the following:**

* + - **Alt1: In addition to the text under point #1, add to the specification an explicit statement:** It is up to the UE to transmit either the Msg3 PUSCH or the PUCCH.
    - **Alt2: Add a note to the chair’s notes and CR cover page:** If a Msg3 PUSCH (re)transmission overlaps with a PUCCH, it is up to the UE to transmit either the Msg3 PUSCH or the PUCCH.
    - **Alt3: Do nothing**

**Moderator’s proposal #2: Adopt Alt2, or if that is not agreeable fall bac to Alt1.**

**Discussion point #3: What to do with UCI if there is another PUSCH, agree on one of the following:**

* + - **Alt1: If Alt1 of discussion point #2 is agreed, add to it:** It is up to the UE to transmit either the Msg3 PUSCH or the PUCCH, if the UE would not transmit another PUSCH that overlaps with the PUCCH.
    - **Alt2: If Alt2 of discussion point #2 is agreed, add to it:** If a Msg3 PUSCH (re)transmission overlaps with a PUCCH, it is up to the UE to transmit either the Msg3 PUSCH or the PUCCH, if the UE would not transmit another PUSCH that overlaps with the PUCCH.
    - **Alt3: Add a note to the chair’s notes and CR cover page:** If a Msg3 PUSCH (re)transmission overlaps with a PUCCH and with another PUSCH(s), it is up to the UE whether to multiplex the UCI on (one of) the other PUSCH(s)
    - **Alt4: Do nothing**

**Moderator’s proposal #3: Adopt the alternative that corresponds to the alternative chosen for point #2, or if not possible to agree, do nothing.**

**Discussion point #4: Msg3 PUSCH overlapping with another PUSCH**

* + - **Alt1: Add to the specification an explicit statement:** If a Msg3 PUSCH (re)transmission overlaps with another PUSCH, the UE transmits the Msg3 PUSCH and drops the other PUSCH.
    - **Alt2: Add a note to the chair’s notes and CR cover page:** If a Msg3 PUSCH (re)transmission overlaps with another PUSCH, the UE transmits the Msg3 PUSCH and it may drop the other PUSCH.
    - **Alt3: Do nothing**

**Moderator’s proposal #4: See if Alt1 or Alt2 is agreeable, and if not, do nothing.**

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| Company | Comments |
| CATT | For Moderator’s proposal #1, we do not have a strong preference among the three alternatives. However, Alt 3 is not quite clear in terms of whether Msg3 PUSCH retransmission is included or not.  For Moderator’s proposal #2 and #3, we are open to discuss whether to capture in spec or chair notes.  For Moderator’s proposal #4, we have a preference on Alt 3. For Alt 1 and Alt 2, at least it should be clarified that it is for PUSCH transmissions on the same cell. For Alt 2, it is not quite clear how UE could transmit Msg3 PUSCH w/o dropping other overlapping PUSCH on the same cell. |
| MTK | Moderator’s proposal #1: Alt 1 or Alt 2 are fine to us.  Moderator’s proposal #2: Support  Moderator’s proposal #3: We prefer Alt 3 followed by Alt 2. Both are fine to us.  Moderator’s proposal #4: We are fine with Alt 1/2 by specifying that this is for the same cell. |
| Huawei, HiSilicon | Moderator’s proposal #2: We prefer to transmit Msg3 PUSCH rather than depending on UE selection, for moving forward, we are fine with moderator’s proposal.  Moderator’s proposal #3: We prefer Alt.4, if spec or chair note specifies nothing, there is no clear requirements on UE implementation, but it is still possible for gNB to make some appropriate configurations/scheduling that make UE implementation as it expects. Thus, it may be not necessarily explicit saying up to UE whether to multiplex or not.  Moderator’s proposal #4: We are open to hear companies’ views, right now slightly prefer Alt.2. |
| ZTE | Moderator’s proposal #2: Prefer Alt 1 and also ok with Alt 2.  Moderator’s proposal #3: Prefer Alt 4. No matter whether there is another overlapping PUSCH, it is still up to UE to transmit PUCCH or Msg3, and depending on the UE implementation of which channel to transmit, it may end up with different UE behaviors. As we analyzed in our contribution, in any case, NW needs to do some special handling, e.g., blind decoding, if such collision happens. So, we can leave to implementation.  Moderator’s proposal #4: Alt 3 at least for the same cell case. Again, similar to Msg3 vs PUCCH, even we prioritize Msg3 PUSCH as the UE behavior, NW still needs to do, e.g., blind decoding, because NW does not know which UE is transmitting Msg3. So, concluding on a certain UE behavior makes no difference from NW side compared to undefined UE behavior. |
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