**3GPP TSG RAN WG1 Meeting #102-e                     R1-20xxxxx**

**e-Meeting,** **August 17th – 28th, 2020**

**Agenda Item: 7.2.2.2.3**

**Source: Moderator (Huawei)**

**Title: Feature lead summary#1 on 102-e-NR-unlic-NRU-HARQ-01**

**Document for: Discussion and Decision**

# Introduction

This document provides a summary of issue B18 for type-3 HARQ-ACK codebook maintenance [1], and will be used to collect comments on the proposal for correction submitted at RAN1#102-e.

[102-e-NR-unlic-NRU-HARQ-01] Email discussion/approval on the following from R1-2006983 until 8/20; if necessary, endorse associated TPs by 8/26 – David (Huawei)

* Correction on Type-3 HARQ-ACK codebook (issue B18): Clarification of UCI multiplexing timeline based on a request for a Type-3 HARQ-ACK codebook report without scheduling a PDSCH in the UE procedure for reporting multiple UCI types.

Companies are invited to provide their comments on the TP in [2] using the table in section 2.

# Discussion on issue B18

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| **Company** | **Summary of proposals and comments** |
| OPPO [2] | Proposal 5: Adopt TP4 for UCI multiplexing timeline based on DCI triggering one-shot feedback.  --------------------Start of TP 4 38.213 V16.2.0 section 9.2.5 ----------------------------  9.2.5 UE procedure for reporting multiple UCI types  <Unchanged parts are omitted>  If a UE would transmit multiple overlapping PUCCHs in a slot or overlapping PUCCH(s) and PUSCH(s) in a slot and, when applicable as described in Clauses 9.2.5.1 and 9.2.5.2, the UE is configured to multiplex different UCI types in one PUCCH, and at least one of the multiple overlapping PUCCHs or PUSCHs is in response to a DCI format detection by the UE, the UE multiplexes all corresponding UCI types if the following conditions are met. If one of the PUCCH transmissions or PUSCH transmissions is in response to a DCI format detection by the UE, the UE expects that the first symbol  of the earliest PUCCH or PUSCH, among a group overlapping PUCCHs and PUSCHs in the slot, satisfies the following timeline conditions  -  is not before a symbol with CP starting after after a last symbol of any corresponding PDSCH, is given by maximum of where for the i-th PDSCH with corresponding HARQ-ACK transmission on a PUCCH which is in the group of overlapping PUCCHs and PUSCHs, , is selected for the i-th PDSCH following [6, TS 38.214], is selected based on the UE PDSCH processing capability of the i-th PDSCH and SCS configuration , where corresponds to the smallest SCS configuration among the SCS configurations used for the PDCCH scheduling the i-th PDSCH (if any), the i-th PDSCH, the PUCCH with corresponding HARQ-ACK transmission for i-th PDSCH, and all PUSCHs in the group of overlapping PUCCHs and PUSCHs.  -  is not before a symbol with CP starting after after a last symbol of any corresponding SPS PDSCH release or of a DCI format 1\_1 indicating SCell dormancy as described in Clause 10.3 or a request for a Type-3 HARQ-ACK codebook report. is given by maximum of where for the i-th PDCCH providing the SPS PDSCH release or the DCI format 1\_1 or the request for a Type-3 HARQ-ACK codebook report with corresponding HARQ-ACK transmission on a PUCCH which is in the group of overlapping PUCCHs and PUSCHs, , is described in Clause 10.2 and is selected based on the UE PDSCH processing capability of the i-th SPS PDSCH release or the DCI format 1\_1 or the request for a Type-3 HARQ-ACK codebook report and SCS configuration , where corresponds to the smallest SCS configuration among the SCS configurations used for the PDCCH providing the i-th SPS PDSCH release or the DCI format 1\_1 or a request for a Type-3 HARQ-ACK codebook report, the PUCCH with corresponding HARQ-ACK transmission for i-th SPS PDSCH release or the DCI format 1\_1 or the request for a Type-3 HARQ-ACK codebook report, and all PUSCHs in the group of overlapping PUCCHs and PUSCHs.  - if there is no aperiodic CSI report multiplexed in a PUSCH in the group of overlapping PUCCHs and PUSCHs,  is not before a symbol with CP starting after after a last symbol of  - any PDCCH with the DCI format scheduling an overlapping PUSCH, and  - any PDCCH scheduling a PDSCH or SPS PDSCH release or a request for a Type-3 HARQ-ACK codebook report with corresponding HARQ-ACK information in an overlapping PUCCH in the slot  If there is at least one PUSCH in the group of overlapping PUCCHs and PUSCHs, is given by maximum of where for the i-th PUSCH which is in the group of overlapping PUCCHs and PUSCHs, , , and are selected for the i-th PUSCH following [6, TS 38.214], is selected based on the UE PUSCH processing capability of the i-th PUSCH and SCS configuration , where  corresponds to the smallest SCS configuration among the SCS configurations used for the PDCCH scheduling the i-th PUSCH (if any), the PDCCHs scheduling the PDSCHs or a request for a Type-3 HARQ-ACK codebook report with corresponding HARQ-ACK transmission on a PUCCH which is in the group of overlapping PUCCHs/PUSCHs, and all PUSCHs in the group of overlapping PUCCHs and PUSCHs.  If there is no PUSCH in the group of overlapping PUCCHs and PUSCHs, is given by maximum of where for the i-th PDSCH with corresponding HARQ-ACK transmission on a PUCCH which is in the group of overlapping PUCCHs, , is selected based on the UE PUSCH processing capability of the PUCCH serving cell if configured.   is selected based on the UE PUSCH processing capability 1, if PUSCH processing capability is not configured for the PUCCH serving cell. is selected based on the smallest SCS configuration between the SCS configuration used for the PDCCH scheduling the i-th PDSCH or a request for a Type-3 HARQ-ACK codebook report (if any) with corresponding HARQ-ACK transmission on a PUCCH which is in the group of overlapping PUCCHs, and the SCS configuration for the PUCCH serving cell.  - if there is an aperiodic CSI report multiplexed in a PUSCH in the group of overlapping PUCCHs and PUSCHs,  is not before a symbol with CP starting after after a last symbol of  - any PDCCH with the DCI format scheduling an overlapping PUSCH, and  - any PDCCH scheduling a PDSCH, or SPS PDSCH release, or providing a DCI format 1\_1 indicating SCell dormancy or a request for a Type-3 HARQ-ACK codebook report with corresponding HARQ-ACK information in an overlapping PUCCH in the slot  where corresponds to the smallest SCS configuration among the SCS configuration of the PDCCHs, the smallest SCS configuration for the group of the overlapping PUSCHs, and the smallest SCS configuration of CSI-RS associated with the DCI format scheduling the PUSCH with the multiplexed aperiodic CSI report, and for , for and for  - , , , , , and are defined in [6, TS 38.214], and and are defined in [4, TS 38.211].  ---------------------End of TP 4 38.213 V16.2.0 section 9.2.5 ---------------------------- |
| Views expressed during the preparation phase of RAN#102-e | QC (it should be added at least in some parts since DCI requesting Type 3 w/o scheduling PDSCH uses same timeline as SPS release, i.e., it should be treated same as SPS release / Scell dormancy in multiplexing timeline procedures)  Sharp (better to say “or a request for a Type-3 HARQ-ACK codebook report without scheduling a PDSCH”, reflecting the agreement achieved in RAN1 #100b-e)  Nokia (agree with Sharp) , ZTE, Samsung, LG (agree with Sharp), vivo (agree with Sharp), Huawei, OPPO |
| Ericsson | Agree with Sharp, the changes should be limited to “Type-3 HARQ-ACK codebook report without scheduling a PDSCH” |
| LG | Agree with Sharp and Ericsson, only the case of “Type-3 HARQ-ACK codebook report without scheduling a PDSCH” should be added. |
| QC | Same view as Sharp/Ericsson/LG. With respect to the TP, we think anywhere in this section that SPS release timeline is mentioned, “or a request for a Type-3 HARQ-Ack codebook report without scheduling PDSCH” should be also added. However, there are instances in the above TP that SPS release timeline is not there but Type-3 HARQ-Ack w/o PDSCH scheduling timeline is added, e.g.,  “the PDCCHs scheduling the PDSCHs or a request for a Type-3 HARQ-ACK codebook report with”  Even though these instances are not technically incorrect, it creates inconsistency, and questions will be asked later as to why only Type-3 HARQ-Ack w/o PDSCH scheduling is mentioned while SPS release is not mentioned. There seem to be already some inconsistency wrt SPS release vs Scell dormancy being mentioned in this Section (but not sure if in this agenda item, whether we should try to fix those or not). |
| FL summary #1 | Thank you all for the feedback. We will not try to fix all inconsistencies unrelated to HARQ in clause 9.2.5 but let’s avoid introducing more inconsistencies, as pointed out by Qualcomm. In the proposed TP there is one instance fixing a missing “the DCI format 1\_1” which I think we can keep. So here is an updated possible TP for UCI multiplexing timeline based on DCI triggering one-shot feedback without scheduling a PDSCH. The revisions marks are against TP4 from [2].  --------------------Start of TP 38.213 V16.2.0 section 9.2.5 ----------------------------  9.2.5 UE procedure for reporting multiple UCI types  <Unchanged parts are omitted>  If a UE would transmit multiple overlapping PUCCHs in a slot or overlapping PUCCH(s) and PUSCH(s) in a slot and, when applicable as described in Clauses 9.2.5.1 and 9.2.5.2, the UE is configured to multiplex different UCI types in one PUCCH, and at least one of the multiple overlapping PUCCHs or PUSCHs is in response to a DCI format detection by the UE, the UE multiplexes all corresponding UCI types if the following conditions are met. If one of the PUCCH transmissions or PUSCH transmissions is in response to a DCI format detection by the UE, the UE expects that the first symbol  of the earliest PUCCH or PUSCH, among a group overlapping PUCCHs and PUSCHs in the slot, satisfies the following timeline conditions  -  is not before a symbol with CP starting after after a last symbol of any corresponding PDSCH, is given by maximum of where for the i-th PDSCH with corresponding HARQ-ACK transmission on a PUCCH which is in the group of overlapping PUCCHs and PUSCHs, , is selected for the i-th PDSCH following [6, TS 38.214], is selected based on the UE PDSCH processing capability of the i-th PDSCH and SCS configuration , where corresponds to the smallest SCS configuration among the SCS configurations used for the PDCCH scheduling the i-th PDSCH (if any), the i-th PDSCH, the PUCCH with corresponding HARQ-ACK transmission for i-th PDSCH, and all PUSCHs in the group of overlapping PUCCHs and PUSCHs.  -  is not before a symbol with CP starting after after a last symbol of any corresponding SPS PDSCH release or of a DCI format 1\_1 indicating SCell dormancy as described in Clause 10.3 or a request for a Type-3 HARQ-ACK codebook report without scheduling PDSCH. is given by maximum of where for the i-th PDCCH providing the SPS PDSCH release or the DCI format 1\_1 or the request for a Type-3 HARQ-ACK codebook report with corresponding HARQ-ACK transmission on a PUCCH which is in the group of overlapping PUCCHs and PUSCHs, , is described in Clause 10.2 and is selected based on the UE PDSCH processing capability of the i-th SPS PDSCH release or the DCI format 1\_1 or the request for a Type-3 HARQ-ACK codebook report and SCS configuration , where corresponds to the smallest SCS configuration among the SCS configurations used for the PDCCH providing the i-th SPS PDSCH release or the DCI format 1\_1 or the request for a Type-3 HARQ-ACK codebook report, the PUCCH with corresponding HARQ-ACK transmission for i-th SPS PDSCH release or the DCI format 1\_1 or the request for a Type-3 HARQ-ACK codebook report, and all PUSCHs in the group of overlapping PUCCHs and PUSCHs.  - if there is no aperiodic CSI report multiplexed in a PUSCH in the group of overlapping PUCCHs and PUSCHs,  is not before a symbol with CP starting after after a last symbol of  - any PDCCH with the DCI format scheduling an overlapping PUSCH, and  - any PDCCH scheduling a PDSCH or SPS PDSCH release or a request for a Type-3 HARQ-ACK codebook report without scheduling PDSCH with corresponding HARQ-ACK information in an overlapping PUCCH in the slot  If there is at least one PUSCH in the group of overlapping PUCCHs and PUSCHs, is given by maximum of where for the i-th PUSCH which is in the group of overlapping PUCCHs and PUSCHs, , , and are selected for the i-th PUSCH following [6, TS 38.214], is selected based on the UE PUSCH processing capability of the i-th PUSCH and SCS configuration , where corresponds to the smallest SCS configuration among the SCS configurations used for the PDCCH scheduling the i-th PUSCH (if any), the PDCCHs scheduling the PDSCHs with corresponding HARQ-ACK transmission on a PUCCH which is in the group of overlapping PUCCHs/PUSCHs, and all PUSCHs in the group of overlapping PUCCHs and PUSCHs.  If there is no PUSCH in the group of overlapping PUCCHs and PUSCHs, is given by maximum of where for the i-th PDSCH with corresponding HARQ-ACK transmission on a PUCCH which is in the group of overlapping PUCCHs, , is selected based on the UE PUSCH processing capability of the PUCCH serving cell if configured.   is selected based on the UE PUSCH processing capability 1, if PUSCH processing capability is not configured for the PUCCH serving cell. is selected based on the smallest SCS configuration between the SCS configuration used for the PDCCH scheduling the i-th PDSCH (if any) with corresponding HARQ-ACK transmission on a PUCCH which is in the group of overlapping PUCCHs, and the SCS configuration for the PUCCH serving cell.  - if there is an aperiodic CSI report multiplexed in a PUSCH in the group of overlapping PUCCHs and PUSCHs,  is not before a symbol with CP starting after after a last symbol of  - any PDCCH with the DCI format scheduling an overlapping PUSCH, and  - any PDCCH scheduling a PDSCH, or SPS PDSCH release, or providing a DCI format 1\_1 indicating SCell dormancy or a request for a Type-3 HARQ-ACK codebook report without scheduling PDSCH with corresponding HARQ-ACK information in an overlapping PUCCH in the slot  where corresponds to the smallest SCS configuration among the SCS configuration of the PDCCHs, the smallest SCS configuration for the group of the overlapping PUSCHs, and the smallest SCS configuration of CSI-RS associated with the DCI format scheduling the PUSCH with the multiplexed aperiodic CSI report, and for , for and for  - , , , , , and are defined in [6, TS 38.214], and and are defined in [4, TS 38.211].  ---------------------End of TP 38.213 V16.2.0 section 9.2.5 ---------------------------- |
| Samsung | Sorry for joining the discussion quite late.  If I understand correctly, in the existing spec, it firstly says ‘a DCI format 1\_1 indicating SCell dormancy as described in Clause 10.3’, then, it says ‘the DCI format 1\_1’ which means the DCI format 1\_1 indicating SCell dormancy, not a DCI format 1\_1 for other purpose.  Then, if we follow this logic, now, we revise the spec as “a DCI format 1\_1 indicating SCell dormancy as described in Clause 10.3 or a request for a Type-3 HARQ-ACK codebook report without scheduling PDSCH”, then, ‘the DCI format 1\_1’ is for SCcell dormancy or request for type-3 HARQ-ACK w/o PDSCH. So, there is no need to add “or the request for a Type-3 HARQ-ACK codebook report” after ‘the DCI format 1\_1’. The corresponding revision on top of David’s TP is as follows,  …  -  is not before a symbol with CP starting after after a last symbol of any corresponding SPS PDSCH release or of a DCI format 1\_1 indicating SCell dormancy as described in Clause 10.3 or a request for a Type-3 HARQ-ACK codebook report without scheduling PDSCH. is given by maximum of where for the i-th PDCCH providing the SPS PDSCH release or the DCI format 1\_1 ~~or the request for a Type-3 HARQ-ACK codebook report~~ with corresponding HARQ-ACK transmission on a PUCCH which is in the group of overlapping PUCCHs and PUSCHs, , is described in Clause 10.2 and is selected based on the UE PDSCH processing capability of the i-th SPS PDSCH release or the DCI format 1\_1 ~~or the request for a Type-3 HARQ-ACK codebook report~~ and SCS configuration , where corresponds to the smallest SCS configuration among the SCS configurations used for the PDCCH providing the i-th SPS PDSCH release or the DCI format 1\_1 ~~or the request for a Type-3 HARQ-ACK codebook report~~, the PUCCH with corresponding HARQ-ACK transmission for i-th SPS PDSCH release or the DCI format 1\_1 ~~or the request for a Type-3 HARQ-ACK codebook report~~, and all PUSCHs in the group of overlapping PUCCHs and PUSCHs. |
| Intel | We support FL’s latest proposal with revision by Samsung. Since type-3 HARQ-ACK codebook can only be triggered by DCI 1\_1, it is enough to just mention ‘the DCI format 1\_1’. |
| Lenovo, Motorola Mobility | We are OK with Samsung’s revision. It makes the spec clear and simple. |
| vivo | We support FL’s latest proposal with revision by Samsung. |
| FL summary #2 | Thanks for the suggestion. Nokia also made a similar comment by email.  To summarize, the draft TP would now look as below (revisions marks against the current specs will be fixed once the draft TP is stable).  --------------------Start of TP 38.213 V16.2.0 section 9.2.5 ----------------------------  9.2.5 UE procedure for reporting multiple UCI types  <Unchanged parts are omitted>  If a UE would transmit multiple overlapping PUCCHs in a slot or overlapping PUCCH(s) and PUSCH(s) in a slot and, when applicable as described in Clauses 9.2.5.1 and 9.2.5.2, the UE is configured to multiplex different UCI types in one PUCCH, and at least one of the multiple overlapping PUCCHs or PUSCHs is in response to a DCI format detection by the UE, the UE multiplexes all corresponding UCI types if the following conditions are met. 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If there is no PUSCH in the group of overlapping PUCCHs and PUSCHs, is given by maximum of where for the i-th PDSCH with corresponding HARQ-ACK transmission on a PUCCH which is in the group of overlapping PUCCHs, , is selected based on the UE PUSCH processing capability of the PUCCH serving cell if configured.   is selected based on the UE PUSCH processing capability 1, if PUSCH processing capability is not configured for the PUCCH serving cell. is selected based on the smallest SCS configuration between the SCS configuration used for the PDCCH scheduling the i-th PDSCH (if any) with corresponding HARQ-ACK transmission on a PUCCH which is in the group of overlapping PUCCHs, and the SCS configuration for the PUCCH serving cell.  - if there is an aperiodic CSI report multiplexed in a PUSCH in the group of overlapping PUCCHs and PUSCHs,  is not before a symbol with CP starting after after a last symbol of  - any PDCCH with the DCI format scheduling an overlapping PUSCH, and  - any PDCCH scheduling a PDSCH, or SPS PDSCH release, or providing a DCI format 1\_1 indicating SCell dormancy or a DCI format 1\_1 indicating a request for a Type-3 HARQ-ACK codebook report without scheduling PDSCH with corresponding HARQ-ACK information in an overlapping PUCCH in the slot  where corresponds to the smallest SCS configuration among the SCS configuration of the PDCCHs, the smallest SCS configuration for the group of the overlapping PUSCHs, and the smallest SCS configuration of CSI-RS associated with the DCI format scheduling the PUSCH with the multiplexed aperiodic CSI report, and for , for and for  - , , , , , and are defined in [6, TS 38.214], and and are defined in [4, TS 38.211].  ---------------------End of TP 38.213 V16.2.0 section 9.2.5 ---------------------------- |

# References

1. R1-2006983 Feature lead summary#1 on NR-U HARQ maintenance at RAN1#102-e
2. R1-2006022 Discussion on the remaining issues of HARQ enhancements OPPO