**3GPP TSG RAN WG1 Meeting #102-e                     R1-200xxxx**

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

**Agenda Item: 7.2.2.2.3**

**Source: Moderator (Huawei)**

**Title: Feature lead summary#1 on NR-U HARQ**

**Document for: Discussion and Decision**

# Introduction

Corrections on NR-U HARQ have been submitted at RAN1#102 e-meeting. This first summary provides a list of submitted corrections and asks for companies’ views on the criticality of the proposed corrections.

Timeline:

* **Preparation phase: August 10th – 14th**
* Technical discussion: August 17th – 21st
* TP preparation: August 24th – 28th

The corrections proposed at RAN1#102 e-meeting are the following:

* **A (enhanced type 2 HARQ codebook): see section 2**
  + Issues not treated (not essential) or postponed from earlier meetings: A9(Q9), A16, A22
  + New: A23, A24
* **B (type 3 HARQ codebook): see section 3**
  + Issues not treated (not essential) or postponed from earlier meetings: B1, B4, B5, B8, B17
  + New: B14, B15, B16, B18
* **C (issues related to out-of-order HARQ): see section 4**
  + Issues postponed from earlier meetings: C3, C4
* **D (issues related to multi-PUSCH scheduling): see section 5**
  + New: D1, D2

Annex 7 contains a sub-section per issue including a more detailed summary of the proposals from the contributions to facilitate the discussion in preparation phase. **Companies’ feedback on the criticality, essentiality and priority of the issues in preparation phase will be collected in the Table of section 6.**

After initial collections of views, a proposal for discussion on essential corrections will be provided, e.g.:

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| **Proposed email discussions at August RAN1#102-e meeting** | |
| Email discussion #1 | Corrections on enhanced Type-2 HARQ-ACK codebook |
| Email discussion #2 | Corrections on Type-3 HARQ-ACK codebook |
| Email discussion #3 | Corrections related to multi-PUSCH scheduling |

# Corrections on enhanced Type-2 HARQ-ACK codebook

Corrections proposed on enhanced dynamic HARQ codebook

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| Issue | Description | Tdoc |
| A9 | Q9: can we clarify that a UE should ignore the NFI and DAI fields for the non-scheduled group in a DL DCI if q=0 for the number of requested PDSCH group(s) in that DCI? | R1-2005335 |
| A16 | What NFI value should a UE assume when the UE is provided with UL DAI (different than 4) for a PDSCH group that was not scheduled for the UE? | R1-2005907  R1-2005916  R1-2006302  R1-2006900 |
| A22 | Handling of codebooks with different priorities (URLLC) and enhanced dynamic HARQ codebook (NRU) when both are configured simultaneously | R1-2005602 |
| A23 | Whether there is a need to clarify that TS38.213 clause 9.1.3.1 (Type-2 HARQ-ACK codebook) applies only when *pdsch-HARQ-ACK-Codebook = dynamic* is configured to the UE **and** *pdsch-HARQ-ACK-Codebook = enhancedDynamic-r16* is **not** configured for a UE. | R1-2006022 |
| A24 | Correction for alignment of 38.212 with 38.331:   * replace pdsch-HARQ-ACK-Codebook = enhancedDynamic-r16 * by pdsch-HARQ-ACK-Codebook-r16 = enhancedDynamic | R1-2006555 |

# Corrections on Type-3 HARQ-ACK codebook

Corrections proposed on Type-3 HARQ-ACK codebook

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| Issue | Description | Tdoc |
| B1 | FFS on triggering Type-3 HARQ-ACK codebook feedback with a DCI that does not schedule a PDSCH and with CRS scrambled by CS-RNTI | R1-2005827  R1-2005907 |
| B4 (FFS) | Issue B4 was resolved at RAN1#100e, with one remaining FFS point.  FFS: Type-3 codebook with NDI where the UE has not yet obtained HARQ-ACK information for a TB corresponding to a scheduled PDSCH reception | R1-2005335  R1-2005602  R1-2005827  R1-2005845  R1-2005907  R1-2006022  R1-2006302 |
| B5 | nHARQ-ACK definition for power control with type-3 codebook is missing | R1-2006097 |
| B8 | If all the DCIs requesting one-shot feedback are missed, then UE and gNB are not aligned in the slot where the UE is supposed to report the type-3 codebook.  Case 1: if a collision with a PUCCH occasion for type2 (or type1) codebook happens, instead of reporting type3 codebook (as agreed) the UE will report type2 (or type1) codebook, resulting in mismatch with gNB’s expectation. In case of piggyback on PUSCH, this results in UL-SCH rate-matching issue.  Case 2: if there is no collision with a PUCCH occasion for type2 (or type1) codebook, if no PUSCH is transmitted in that slot then gNB does not receive any PUCCH, otherwise if a PUSCH is transmitted for reporting type2 (or type1) codebook then this results in UL-SCH rate-matching issue. | R1-2005907 |
| B14 | Potential ambiguity when CBG is configured for one cell in a PUCCH cell group and spatial bundling is also configured, whether CBG-based HARQ-ACK should be reported for all cells in the cell group or just for the one cell in Type-3 HARQ-ACK codebook. | R1-2005335 |
| B15 | Type-3 HARQ-ACK codebook size reduction | R1-2005602 |
| B16 | Whether a clarification is needed to explicitly exclude K1 value of “-1” in the determination of the Type-1 HARQ-ACK codebook association set, in case the UE is also configured with Type-3 codebook and NNK1 value. | R1-2006022 |
| B17 | DTX/NACK-to-ACK Error for one-shot feedback (used to be A20) | R1-2006022 |
| B18 | UCI multiplexing timeline based on a request for a Type-3 HARQ-ACK codebook report without scheduling a PDSCH | R1-2006022 |

# Corrections on Out-of-Order HARQ-ACK

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| Issue | Description | Tdoc |
| C3 | Out-of-Order issue for NNK1 involving DL SPS | R1-2005811  R1-2005845  R1-2005907  R1-2005916 |
| C4 | Out-of-Order issue with HARQ-ACK retransmission | R1-2005811 |

# Corrections on multi-PUSCH scheduling

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| Issue | Description | Tdoc |
| D1 | Ambiguity about which TDRA table applies for DCI format 0\_1 when multiple PUSCH scheduling is configured to the UE (TS38.214 Table 6.1.2.1.1-1A)  Correction to include *pusch-TimeDomainAllocationListForMultiPUSCH-r16* in Table 6.1.2.1.1-1A (Applicable PUSCH time domain resource allocation for DCI format 0\_1 in UE specific search space scrambled with C-RNTI, MCS-C-RNTI, CS-RNTI or SP-CSI-RNTI) | R1-2005335  R1-2006555 |
| D2 | Case where multiple PUSCHs are scheduled by a single DCI with CRC scrambled with CS-RNTI, and impact of signaling multiple NDI values on activation/release or re-transmission for UL CG | R1-2006765 |

# Companies’ views on RAN1#102-e proposed corrections

Companies are invited to fill-in the table below with their views on the criticality/essentiality of the issues. Companies’ views from RAN1#101bis-e are shown for past issues when there is no change in the contributions to RAN1#102-e. Companies are requested to update their views if needed.

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| **Issue** | **Description** | **Critical/essential** | **Non-critical/non-essential** |
| A9 | Q9: can we clarify that a UE should ignore the NFI and DAI fields for the non-scheduled group in a DL DCI if q=0 for the number of requested PDSCH group(s) in that DCI?  Or to clarify whether NFI for group 0 (provided in a DCI format 1\_1 scheduling group 1 with q=0) should count towards determining how to report HARQ-ACK feedback for PDSCH scheduled by DCI format 1\_0? | QC (Ok to clarify), vivo | Sharp (the issue is not clear).  Ericsson (the pseudo code as it is now works as intended. But if majority of the companies want to add the clarification, it is fine.)  Samsung, LG, Huawei (if q=0, UE will only report the first HARQ-ACK information, it does not matter whether UE ignore the fields or not) |
| A16 | What NFI value should a UE assume when the UE is provided with UL DAI (different than 4) for a PDSCH group that was not scheduled for the UE? | Nokia, NSB, LG, Ericsson, Samsung | Sharp, ZTE, OPPO, Lenovo, Motorola Mobility, vivo, Huawei |
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| A22 | Handling of codebooks with different priorities (URLLC) and enhanced dynamic HARQ codebook (NRU) when both are configured simultaneously | ZTE (it is not clear if this is within the scope of Rel-17 URLLC, we are fine to handle it either way) | Sharp (better to be handled in Rel-17 AI for URLLC unlicensed)  Nokia; This was postponed to REL-17 and removed from REL-17 AI by plenary 😊  Lenovo (Suggest in R17 URLLC in unlicensed spectrum), Motorola Mobility, LG, vivo, Huawei |
| A23 | Whether there is a need to clarify that TS38.213 clause 9.1.3.1 (Type-2 HARQ-ACK codebook) applies only when *pdsch-HARQ-ACK-Codebook = dynamic* is configured to the UE **and** *pdsch-HARQ-ACK-Codebook = enhancedDynamic-r16* is **not** configured for a UE. | Huawei (ok to clarify) | Sharp (enhanced dynamic codebook generation also indirectly uses clause 9.1.3.1 by referring it in clause 9.1.3.3)  Nokia (we think this is already clear) , ZTE, Lenovo, Motorola Mobility, LG, vivo |
| A24 | Correction for alignment of 38.212 with 38.331:   * replace pdsch-HARQ-ACK-Codebook = enhancedDynamic-r16   by pdsch-HARQ-ACK-Codebook-r16 = enhancedDynamic | QC (editorial, using correct RRC name is preferred) , Sharp (This correction could be completed with minor effort and time), Ericsson (seems straight forward), Nokia, ZTE, Lenovo, Motorola Mobility, Samsung, LG, vivo, Huawei |  |
| B1 | FFS on triggering Type-3 HARQ-ACK codebook feedback with a DCI that does not schedule a PDSCH and with CRS scrambled by CS-RNTI | MTK, Sharp, Nokia, NSB (This not about optimization, this is about intentionally removing functionality from the specification), Intel, ZTE, Samsung, Lenovo, Motorola Mobility | QC (Given that this is already possible with C-RNTI, MCS-C-RNTI, the issue is not critical and specification is complete), LG (agree with QC that C-RNTI and MCS-C-RNTI are enough (not restrictive) for the purpose of Type-3 CB triggering), OPPO, Ericsson (seems like an optimization), vivo, Huawei (optimization) |
| B4 | FFS: Type-3 codebook with NDI where the UE has not yet obtained HARQ-ACK information for a TB corresponding to a scheduled PDSCH reception | Sharp, Intel, LG, OPPO, Ericsson | Nokia, NSB, QC (optimization), Lenovo (can be resolved by gNB implementation), Motorola Mobility, Samsung, vivo, Huawei |
| B5 | nHARQ-ACK definition for power control with type-3 codebook is missing | Intel, Samsung | Sharp, Nokia, NSB, ZTE, vivo, LG, QC, Ericsson, Huawei |
| B8 | If all the DCIs requesting one-shot feedback are missed, then UE and gNB are not aligned in the slot where the UE is supposed to report the type-3 codebook.  Case 1: if a collision with a PUCCH occasion for type2 (or type1) codebook happens, instead of reporting type3 codebook (as agreed) the UE will report type2 (or type1) codebook, resulting in mismatch with gNB’s expectation. In case of piggyback on PUSCH, this results in UL-SCH rate-matching issue.  Case 2: if there is no collision with a PUCCH occasion for type2 (or type1) codebook, if no PUSCH is transmitted in that slot then gNB does not receive any PUCCH, otherwise if a PUSCH is transmitted for reporting type2 (or type1) codebook then this results in UL-SCH rate-matching issue. | Nokia, NSB | QC (this is not specific to PUSCH as the same scenario is applicable to PUCCH. The issue can be avoided by sending multiple DCIs requesting Type-3), Sharp, Intel, ZTE, Lenovo, Motorola Mobility, vivo, OPPO, Ericsson, Samsung, Huawei |
| B14 | Potential ambiguity when CBG is configured for one cell in a PUCCH cell group and spatial bundling is also configured, whether CBG-based HARQ-ACK should be reported for all cells in the cell group or just for the one cell in Type-3 HARQ-ACK codebook. | Sharp, vivo (new parameter pdsch-HARQ-ACK-OneShotFeedbackCBG-r16 is configured per PUCCH group, which is same as spatial bundling, however, maxCodeBlockGroupsPerTransportBlock is configured per serving cell. Then, how to understand the agreement made in the last e-meeting) | QC (misconfiguration handling: can be avoided if network does not configure both CBG-based and spatial bundling for a CC at the same time), LG (agree with QC that no simultaneous configuration of CBG and spatial bundling was already Rel-15 conclusion), Huawei (in clause 9.1.4, the is set per cell, and in the pseudo-code it is clear that the HARQ-ACK information is generated cell by cell, there is no ambiguity)，Nokia (Our understanding is that proposal is to preclude spatial bundling only if also CBG feedback is configured to be present in TYPE-3 CB, so perhaps would be good to clarify what is the issue here. 😊) |
| B15 | Type-3 HARQ-ACK codebook size reduction |  | QC (optimization; Also, proposal may add issue wrt codebook size), Ericsson, ZTE, Lenovo, Motorola Mobility, Samsung, LG, vivo, Huawei (optimization) |
| B16 | Whether a clarification is needed to explicitly exclude K1 value of “-1” in the determination of the Type-1 HARQ-ACK codebook association set, in case the UE is also configured with Type-3 codebook and NNK1 value. |  | QC (it is obvious that HARQ-Ack for future PDSCHs is not reported, and also “-1” is called “not applicable” in current spec), Sharp , Ericsson , Nokia, Lenovo, Motorola Mobility, Samsung, LG, vivo, Huawei |
| B17 | DTX/NACK-to-ACK Error for one-shot feedback (used to be A20)  Proposal 3 (R1-2006022): If a PDSCH for a given HARQ process is received, the UE skips another PDSCH for a given HARQ process until after the end of the successful transmission of HARQ-ACK for that HARQ process. | OPPO | MTK, Sharp, Nokia, NSB, Intel, ZTE, Lenovo, Motorola Mobility, vivo, LG, Ericsson, QC, Samsung, Huawei |
| B18 | UCI multiplexing timeline based on a request for a Type-3 HARQ-ACK codebook report without scheduling a PDSCH | 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 |  |
| C3 | Out-of-Order issue for NNK1 involving DL SPS | Nokia (it should be at least concluded that this is OOO and UE may drop all involved PUCCH transmissions) | QC (Issue was discussed at length in previous meeting, and there was no conclusion) , Sharp , Ericsson, ZTE. Samsung, LG, vivo, Huawei |
| C4 | Out-of-Order issue with HARQ-ACK retransmission | Sharp, Huawei (current specs would leave HARQ ReTx as an OOO case, thus network cannot be sure of the correct UE behavior) | QC (optimization), Ericsson , Nokia (we do not understand why re-tx, initial tx and inapplicable NN-K1 should be treated differently) , ZTE, LG, vivo |
| D1 | Ambiguity about which TDRA table applies for DCI format 0\_1 when multiple PUSCH scheduling is configured to the UE (TS38.214 Table 6.1.2.1.1-1A)  Correction to include *pusch-TimeDomainAllocationListForMultiPUSCH-r16* in Table 6.1.2.1.1-1A (Applicable PUSCH time domain resource allocation for DCI format 0\_1 in UE specific search space scrambled with C-RNTI, MCS-C-RNTI, CS-RNTI or SP-CSI-RNTI) | QC (table should be corrected), Sharp, Ericsson, Nokia, ZTE, Lenovo, Motorola Mobility, Samsung, LG, vivo, Huawei |  |
| D2 | Case where multiple PUSCHs are scheduled by a single DCI with CRC scrambled with CS-RNTI, and impact of signaling multiple NDI values on activation/release or re-transmission for UL CG | QC (discussions are needed to clarify the behavior), Sharp, Ericsson , ZTE, Huawei (could be discussed under CG agenda) | Nokia (this topic should be handled in CG AI first, they should agree whether it is allowed to activate CG with multi-PUSCH TDRA), Samsung (share same view with Nokia), LG (agree with Nokia), vivo(agree with Nokia) |

# Annex – Details about the proposed corrections

## Issue A9

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| A9 | Q9: can we clarify that a UE should ignore the NFI and DAI fields for the non-scheduled group in a DL DCI if q=0 for the number of requested PDSCH group(s) in that DCI? |

FL analysis: A9(Q9) was discussed extensively at RAN1#100bis-e, and there was no consensus to provide a TP. The notes from the discussion in R1-2002923 are copied below:

***Q9: can we clarify that a UE should ignore the NFI and DAI fields for the non-scheduled group in a DL DCI if q=0 for the number of requested PDSCH group(s) in that DCI?***

*Yes: Nokia, Sharp, MediaTek, LG, vivo, OPPO, Ericsson, Lenovo, Intel*

*No: ZTE, Samsung, Qualcomm*

*FL summary: several companies answering yes or no mentioned that this could be left to UE implementation as it doesn’t seem to affect the specified behavior. A correction related to Q9 does not seem critical.*

*A possible conclusion is that this clarification from Q9 is not needed.*

*Q9: 7 companies accepted that no clarification is needed, 2 companies preferred a clarification. No conclusion is provided for Q9.*

FL proposal: no further discussion on A9(Q9) at RAN1#102e

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| **Company** | **Summary of proposals** |
| vivo  (R1-2005335) | Proposal 1: For enhanced dynamic codebook, UE should ignore the NFI and DAI fields for the non-scheduled group in a DL DCI with q=0, and assume that the DL DCI does not include or provide an NFI for the non-scheduled group. |
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## Issue A16

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| A16 | What NFI value should a UE assume when the UE is provided with UL DAI (different than 4) for a PDSCH group that was not scheduled for the UE? |

FL analysis: similar issue and proposals were discussed in WI phase. 3 companies indicated that this issue is not critical at RAN1#101bis-e. The 4 companies contributing on this issue at RAN1#102e are proposing 4 different solutions to fix this ambiguous case.

FL proposal: no discussion at RAN1#102e

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| **Company** | **Summary of proposals** |
| Ericsson  (R1-2005916) | Proposal 2: If a UE is scheduled a PUSCH transmission by DCI format 0\_1 having a DAI field value for a PDSCH group index ,and the UE has not detected any DCI format scheduling PDSCH receptions for the PDSCH group index, and the UE has not detected any DCI format with a request for HARQ-ACK information for the PDSCH group index, the UE generates HARQ-ACK information for the PDSCH group as described in Clause 9.1.3.1 by setting and, after the completion of the and loops for the pseudo-code for the HARQ-ACK codebook generation in Clause 9.1.3.1, setting . |
| LG  (R1-2006302) | For an example, in case configured with T-DAI for both two PDSCH groups, if the first group 0 is not scheduled (while the first T-DAI indicated by UL DCI is not equal to 4), the UE assumption is needed for the NFI value (e.g., whether it is toggled) corresponding to the first group 0, in order to generate the HARQ-ACK payload corresponding to the first group 0.  For another example, in case configured with T-DAI for only one PDSCH group, if no PDSCH is scheduled in the UE side (while the T-DAI in UL DCI is not equal to 4), the UE assumption is needed for the NFI value corresponding to the first group 0.  Proposal #1 (R1-2006302): For the case when a PDSCH group is not scheduled at UE side and the PDSCH group corresponds to the T-DAI in UL grant DCI, one of the following alternatives is adopted.  - Alt 1: NFI value for the PDSCH group is assumed to be toggled (or non-toggled) from the latest value.  - Alt 2: NFI (for the PDSCH group) is signaled via the UL DCI (as for DL DCI). |
| Nokia  (R1-2005907) | Proposal 2: If UE receives DCI format 0\_1 with while the UE has not detected any DCI scheduling PDSCH for the PDSCH group, and the UE has not detected any DCI requesting HARQ-ACK information for the PDSCH group, UE toggles the NFI if UL DAI is smaller than the latest received T-DAI.  **TP for TS38.213:** 9.1.3.3 Type-2 HARQ-ACK codebook grouping and HARQ-ACK retransmission <unchanged text omitted >  If a UE is scheduled a PUSCH transmission by DCI format 0\_1 having a DAI field value for a PDSCH group index, and the UE has not detected any DCI format scheduling PDSCH receptions for the PDSCH group index, and the UE has not detected any DCI format with a request for HARQ-ACK information for the PDSCH group index, the UE does not multiplex HARQ-ACK information in the PUSCH transmission for the PDSCH group index.  If a UE is scheduled a PUSCH transmission by DCI format 0\_1 having a DAI field value for a PDSCH group index *k*, and the UE has not detected any DCI format scheduling PDSCH receptions for the PDSCH group index, and the UE has not detected any DCI format with a request for HARQ-ACK information for the PDSCH group index, and , where is the latest value used in previous HARQ information transmission for the PDSCH group, UE togglesvalue for the PDSCH group before the generation of the HARQ information for the PDSCH group.  If a UE detects DCI formats with respective PDSCH-to-HARQ\_feedback timing field values indicating a same PUCCH transmission occasion and none of the DCI formats that the UE detects after a last PUCCH transmission occasion for includes a New\_Feedback indicator field for , and at least one of the DCI formats is DCI format 1\_0, the UE generates HARQ-ACK information only for PDSCH receptions scheduled by detections of DCI format 1\_0, as described in Clause 9.1.3.1 or 9.1.3.2 for multiplexing in the PUCCH transmission occasion.  <unchanged text omitted > |
| Google  (R1-2006900) | **Text proposal #1 for 38.213**  9.1.3.3 Type-2 HARQ-ACK codebook grouping and HARQ-ACK retransmission  *\*\*\* Unchanged text is omitted \*\*\**  If a UE is scheduled a PUSCH transmission by DCI format 0\_1 having a DAI field value for a PDSCH group index, and the UE has not detected any DCI format scheduling PDSCH receptions for the PDSCH group index, and the UE has not detected any DCI format with a request for HARQ-ACK information for the PDSCH group index, the UE multiplex HARQ-ACK information in the PUSCH transmission for the PDSCH group index as .  \*\*\* Unchanged text is omitted \*\*\* |
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## Issue A22

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| A22 | Handling of codebooks with different priorities (URLLC) and enhanced dynamic HARQ codebook (NRU) when both are configured simultaneously |  |

FL analysis: there was no consensus to harmonize the URLLC and NRU HARQ codebook configurations in Rel-16 at RAN1#101bis-e. RAN TSG #88e did not include this task as an objective of the Rel-17 IIoT/URLLC WI.

FL proposal: no discussion at RAN1#102e

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| **Company** | **Summary of proposals** |
| ZTE, Sanechips  (R1-2005602) | Proposal 1 (R1-2005602):   * For determine the feedback slot of the first PDSCH with inapplicable k1 value, the second DCI schedule PDSCH should be with a same priority index as the first PDSCH when two codebooks are configured. * Adopt TP#1 for the corresponding change in 38.213   < Start of text proposal for 38.213 [2]>  ================== Beginning of text proposal 1 ===================  9.1.3 Type-2 HARQ-ACK codebook determination  This clause applies if the UE is configured with *pdsch-HARQ-ACK-Codebook = dynamic* or with *pdsch-HARQ-ACK-Codebook = enhancedDynamic-r16*. Unless stated otherwise, a PDSCH-to-HARQ\_feedback timing indicator field provides an applicable value.  A UE does not expect to multiplex in a Type-2 HARQ-ACK codebook HARQ-ACK information that is in response to a detection of a DCI format that does not include a counter DAI field.  If a UE receives a first DCI format that the UE detects in a first PDCCH monitoring occasion and includes a PDSCH-to-HARQ\_feedback timing indicator field providing an inapplicable value from *dl-DataToUL-ACK*,  - if the UE detects a second DCI format, the UE multiplexes the corresponding HARQ-ACK information in a PUCCH or PUSCH transmission in a slot that is indicated by a value of a PDSCH-to-HARQ\_feedback timing indicator field in the second DCI format, where  - if the UE is not provided *pdsch-HARQ-ACK-Codebook = enhancedDynamic-r16*, the UE detects the second DCI format of the same priority index if provided by *pdsch-HARQ-ACK-Codebook-List* indicating two HARQ-ACK codebooks in any PDCCH monitoring occasion after the first one  - if the UE is provided *pdsch-HARQ-ACK-Codebook = enhancedDynamic-r16*, the UE detects the second DCI format in any PDCCH monitoring occasion after the first one, and the second DCI format indicates a HARQ-ACK information report for a same PDSCH group index and a same priority index if provided by *pdsch-HARQ-ACK-Codebook-List* indicating two HARQ-ACK codebooks as indicated by the first DCI format as described in Clause 9.1.3.3  - if the UE is provided *pdsch-HARQ-ACK-OneShotFeedback-r16*, the first DCI format does not indicate SPS PDSCH release or SCell dormancy, the UE detects the second DCI format in any PDCCH monitoring occasion after the first one, and the second DCI format includes a One-shot HARQ-ACK request field with value 1, the UE includes the HARQ-ACK information in a Type-3 HARQ-ACK codebook, as described in Clause 9.1.4.  - otherwise, the UE does not multiplex the corresponding HARQ-ACK information in a PUCCH or PUSCH transmission.  < End of text proposal 1>  Proposal 2 (R1-2005602): For enhanced dynamic codebook,   * The UL DAI in DCI format 0\_1 should indicate the DAI correspond to a HARQ-ACK codebook of higher priority when the UE is not configured with UL-TotalDAI-Included-r16. * Adopt TP#2 for the corresponding change in 38.213   < Start of text proposal for 38.213 [2]>  ================== Beginning of text proposal 2===================  9.1.3.3 Type-2 HARQ-ACK codebook grouping and HARQ-ACK retransmission  If the HARQ-ACK information is multiplexed in a PUSCH transmission, the HARQ-ACK information is determined as  - for multiplexing in PUCCH transmission occasion , if the PUSCH transmission is not scheduled by a DCI format or is scheduled by a DCI format that does not include a DCI field with value  - for multiplexing in PUCCH transmission occasion , if the PUSCH transmission is scheduled by a DCI format without *UL-TotalDAI-Included-r16* configured except that for PDSCH group , the DCI field with value in the DCI format is used for higher priority if provided by *pdsch-HARQ-ACK-Codebook-List* indicating two HARQ-ACK codebooks after the completion of the and loops for the pseudo-code for the HARQ-ACK codebook generation in Clause 9.1.3.1, and when the HARQ-ACK information multiplexed in the PUCCH transmission occasion does not include HARQ-ACK information for PDSCH group  - for multiplexing in PUCCH transmission occasion , if the PUSCH transmission is scheduled by a DCI format without *UL-TotalDAI-Included-r16* configured except that for PDSCH group , the DCI field with value in the DCI format is used for higher priority if provided by *pdsch-HARQ-ACK-Codebook-List* indicating two HARQ-ACK codebooks after the completion of the and loops for the pseudo-code for the HARQ-ACK codebook generation in Clause 9.1.3.1, and when the HARQ-ACK information multiplexed in the PUCCH transmission occasion includes HARQ-ACK information for PDSCH groups and  - for multiplexing in PUCCH transmission occasion , if the PUSCH transmission is scheduled by a DCI format without *UL-TotalDAI-Included-r16* configured except that for PDSCH group , the DCI field with value  in the DCI format is used for higher priority if provided by *pdsch-HARQ-ACK-Codebook-List* indicating two HARQ-ACK codebooks after the completion of the and loops for the pseudo-code for the HARQ-ACK codebook generation in Clause 9.1.3.1, and when the UE has not detected any DCI format scheduling PDSCH receptions, and the UE has not detected any DCI format with a request for HARQ-ACK information for any PDSCH group  - for multiplexing in PUCCH transmission occasion , if the PUSCH transmission is scheduled by a DCI format with *UL-TotalDAI-Included-r16* configured except that MSBs of the DCI field with value in the DCI format are used for PDSCH group , and LSBs of DCI field with value in the DCI format are used for PDSCH group , after the completion of the and loops for the pseudo-code for the HARQ-ACK codebook generation in Clause 9.1.3.1.  < End of text proposal 2> |
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## Issue A23

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| A23 | Whether there is a need to clarify that TS38.213 clause 9.1.3.1 (Type-2 HARQ-ACK codebook) applies only when *pdsch-HARQ-ACK-Codebook = dynamic* is configured to the UE **and** *pdsch-HARQ-ACK-Codebook = enhancedDynamic-r16* is **not** configured for a UE. |

FL proposal: determine in preparation phase whether this is an essential correction.

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| **Company** | **Summary of proposals** |
| OPPO  R1-2006022 | Rel-15 RRC signaling *pdsch-HARQ-ACK-Codebook* is a mandatory parameter, and *pdsch-HARQ-ACK-Codebook-r16* is an optional parameter. Type-2 HARQ-ACK codebook is used when only *pdsch-HARQ-ACK-Codebook = dynamic* is configured to the UE.  Proposal 2 (R1-2006022): Type-2 HARQ-ACK codebook is used when only pdsch-HARQ-ACK-Codebook = dynamic is configured to the UE.  ------------------------- Start of TP 2 38.213 V16.2.0 section 9.1.3.1-----------------------  9.1.3.1 Type-2 HARQ-ACK codebook in physical uplink control channel  This clause applies if the UE is configured with *pdsch-HARQ-ACK-Codebook = dynamic* and not configured with *pdsch-HARQ-ACK-Codebook = enhancedDynamic-r16*.  A UE determines monitoring occasions for PDCCH with DCI format scheduling PDSCH receptions or SPS PDSCH release on an active DL BWP of a serving cell , as described in Clause 10.1, and for which the UE transmits HARQ-ACK information in a same PUCCH in slot  based on  <Unchanged parts are omitted>  --------------------- End of TP 2 38.213 V16.2.0 section 9.1.3.1----------------------------- |
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## Issue B1

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| B1 | FFS on triggering Type-3 HARQ-ACK codebook feedback with a DCI that does not schedule a PDSCH and with CRS scrambled by CS-RNTI |

FL analysis: this issue was proposed at RAN1#101bis-e and there was no consensus that this is a critical or essential correction. Updated companies views are requested.

FL proposal: no discussion at RAN1#102e

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| **Company** | **Summary of proposals** |
| Nokia  (R1-2005907) | R16 URLLC AI has made changes to validation of UL grant release, but DL SPS release remained unchanged and its validation is unified with validation of DCIs indicating dormancy and TYPE-3 trigger DCI but not scheduling PDSCH.  In our opinion, DCI Format 1\_1 scrambled by CS-RNTI shall be allowed to trigger TYPE-3 CB, particularly for DL SPS release. When HARQ process starvation occurs due to PUCCH LBT failure, gNB may stop DL SPS, pull HARQ-ACK with TYPE-3 CB and restart DL SPS afterwards. No additional specification effort is needed to support TYPE-3 CB trigger in DL SPS release, because processing timelines are the same for DL SPS release and TYPE-3 CB trigger and both DL SPS release and TYPE3 CB trigger will be validated based on “set to all '0's for FDRA Type 0 or for dynamicSwitch set to all '1's for FDRA Type 1”. In case FDRA is set “for dynamicSwitch set to all '0's for FDRA Type 0” UE would not validate DL SPS release, but it would transmit TYPE-3 CB.  Observation 1: *No additional specification effort is needed to support TYPE-3 CB trigger in DCI formant scrambled by CS-RNTI*   * *If FDRA is set to all '0's for FDRA Type 0 or for dynamicSwitch set to all '1's for FDRA Type 1, both TYPE-3 both TYPE-3 CB trigger and DL SPS release is validated* * *If FDRA is set for dynamicSwitch to all '0's for FDRA Type 0, UE would not validate DL SPS release, but it would validate TYPE-3 CB trigger*   Proposal 3: *Support DCI format 1\_1 scrambled by a CS-RNTI and triggering TYPE-3 CB by removing brackets from ~~[~~CS-RNTI~~]~~ in sub-clause 9.1.4 in TS 38.213* |
| Lenovo (R1-2005827) | *Proposal 1: Allow a DCI format with CRC scrambled by CS-RNTI for triggering Type-3 HARQ-ACK codebook.*  *Proposal 2: Include the below TP in TS38.213.*  ------------------------------< BEGIN TEXT PROPOSAL >---------------------------- 9.1.4 Type-3 HARQ-ACK codebook determination <unrelated part omitted>  If a UE detects a DCI format that includes a One-shot HARQ-ACK request field with value 1, the UE determines a PUCCH or a PUSCH to multiplex a Type-3 HARQ-ACK codebook for transmission in a slot as described in Clauses 9.2.3 and 9.2.5. The UE multiplexes only the Type-3 HARQ-ACK codebook in the PUCCH or the PUSCH for transmission in the slot.  If  - a UE detects a DCI format that includes a One-shot HARQ-ACK request field with value 1, and  - the CRC of the DCI is scrambled by a C-RNTI or CS-RNTI or an MCS-C-RNTI, and  - *resourceAllocation* = *resourceAllocationType0* and all bits of the frequency domain resource assignment field in the DCI format are equal to 0, or  - *resourceAllocation* = *resourceAllocationType1* and all bits of the frequency domain resource assignment field in the DCI format are equal to 1, or  - *resourceAllocation = dynamicSwitch* and all bits of the frequency domain resource assignment field in the DCI format are equal to 0 or 1  the DCI format provides a request for a Type-3 HARQ-ACK codebook report and does not schedule a PDSCH reception. The UE is expected to provide HARQ-ACK information in response to the request for the Type-3 HARQ-ACK codebook after symbols from the last symbol of a PDCCH providing the DCI format, where the value of for is provided in Clause 10.2 by replacing "SPS PDSCH release" with "DCI format".  If a UE multiplexes HARQ-ACK information in a PUSCH transmission, the UE generates the HARQ-ACK codebook as described in this Clause except that *harq-ACK-SpatialBundlingPUCCH* is replaced by *harq-ACK-SpatialBundlingPUSCH*.  ----------------------------------< END TEXT PROPOSAL >-------------------------------------- |
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## Issue B4 (remaining FFS)

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| B4 | Issue B4 was resolved at RAN1#100e, with one remaining FFS point.  FFS: Type-3 codebook with NDI where the UE has not yet obtained HARQ-ACK information for a TB corresponding to a scheduled PDSCH reception |

FL summary of companies’ proposals for the case where NDI is not configured to report in type-3 codebook:

* Nokia, vivo, Lenovo: handle cases without sufficient PDSCH processing time as in 38.213v16.1.0
  + Vivo: How to report HARQ-ACK for a HARQ process with a TB scheduled without sufficient processing time is up to UE implementation
  + Lenovo: UE does not expect to be scheduled a PDSCH without sufficient processing time for reporting corresponding HARQ-ACK feedback in a Type-3 HARQ-ACK codebook
  + Nokia: For the remaining case when gNB scheduled PDSCH without sufficient processing time before PUCCH carrying TYPE-3 CB is left up to implementation.
* Samsung (RAN1#100b-e), ZTE: generalize to more cases where UE reports NACK by default, including when UE already reported the information then detected another DCI (without sufficient processing time)
* OPPO, LG, Intel: report ACK or NACK based on NDI in DCI without sufficient PDSCH processing time

FL analysis: There is still a wide divergence in the proposals, no change of positions since the last RAN1 meeting. Several companies still do not see the need for further correction to resolve the FFS point. Two companies (Huawei, Ericsson) did no longer contribute on this issue.

FL proposal: no discussion at RAN1#102e

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| **Company** | **Summary of proposals** |
| Vivo  (R1-2005335) | Proposal 4: How to report HARQ-ACK for a HARQ process with a TB scheduled without sufficient processing time is up to UE implementation. |
| ZTE  (R1-2005602) | UE shall report NACK for the cases where the UE has not yet obtained HARQ-ACK information for a TB corresponding to a scheduled PDSCH reception  while  if UE has reported HARQ-ACK information for TB for HARQ process number on serving cell and has not subsequently detected a DCI format scheduling a PDSCH reception, or received a SPS PDSCH, with TB for HARQ process number on serving cell , or UE has not yet obtained HARQ-ACK information for a TB corresponding to a scheduled PDSCH reception        end if |
| OPPO  (R1-2006022) | To prepare the one-shot codebook, when UE has previously reported HARQ-ACK with a TB for a HARQ process number, if the UE has detected another DCI format scheduling a PDSCH with a TB for the same HARQ process number, and the UE does not have enough processing time for PDSCH decoding, the UE reports previously reported HARQ-ACK if the PDSCH is a retransmission; NACK, otherwise.  if UE has reported HARQ-ACK information for TB for HARQ process number on serving cell , and has not subsequently detected a DCI format scheduling a PDSCH reception, or received a SPS PDSCH, with TB for HARQ process number on serving cell  while        end while  end if  if UE has obtained HARQ-ACK information for TB for HARQ process number on serving cell corresponding to a PDSCH reception and has not reported the HARQ-ACK information corresponding to the PDSCH reception  while  = HARQ-ACK information bit for CBG of TB for HARQ process number of serving cell      end while  end if  if UE has reported HARQ-ACK information for TB for HARQ process number on serving cell , and has subsequently detected a DCI format scheduling a PDSCH reception with NDI not toggled with TB for HARQ process number on serving cell  while  = latest reported HARQ-ACK information bit for CBG of TB for HARQ process number of serving cell      end while  end if  if UE has reported HARQ-ACK information for TB for HARQ process number on serving cell , and has subsequently detected a DCI format scheduling a PDSCH reception with NDI toggled with TB for HARQ process number on serving cell  while        end while  end if |
| LG  (R1-2006302) | For one-shot HARQ-ACK codebook without NDI inclusion, following UE behaviour is to be specified for the cases where the UE has not yet obtained HARQ-ACK information for a TB corresponding to a scheduled PDSCH reception.  - HARQ-ACK is reset to NACK if the NDI value for the TB is toggled.  - HARQ-ACK is kept as previous report if the NDI value is not toggled |
| Intel  (R1-2005845) | For the case that DCI is detected but PDSCH is not decoded with sufficient processing time for one-shot feedback,  - Case 1: if the NDI in the latest detected DCI is NOT toggled, UE report actual HARQ-ACK for the HARQ process;  - Case 2: if the NDI in the latest detected DCI is toggled, UE reports NACK for the HARQ process  Text proposal for section 9.1.4 in 38.213-g10.  …  if UE has reported HARQ-ACK information for TB for HARQ process number on serving cell , and has not subsequently detected a DCI format scheduling a PDSCH reception with non-toggled NDI, or has not received a SPS PDSCH, with TB for HARQ process number on serving cell  while        end while  else  while  = HARQ-ACK information bit for CBG of TB for HARQ process number of serving cell      end while  end if  …  if UE has reported HARQ-ACK information for TB for HARQ process number on serving cell and has not subsequently detected a DCI format scheduling a PDSCH reception with non-toggled NDI, or has not received a SPS PDSCH, with TB for HARQ process number on serving cell  = NACK      else  = HARQ-ACK information bit for TB for HARQ process of serving cell      end if |
| Nokia  (R1-2005907) | Proposal 4: For the remaining case when gNB scheduled PDSCH without sufficient processing time before PUCCH carrying TYPE-3 CB is left up to implementation. |
| Lenovo  (R1-2005827) | Proposal 3: UE does not expect to be scheduled a PDSCH without sufficient processing time for reporting corresponding HARQ-ACK feedback in a Type-3 HARQ-ACK codebook |
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## Issue B5

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| B5 | nHARQ-ACK definition for power control with type-3 codebook is missing |

FL analysis: this proposal was considered non-critical at RAN1#100-e (the number of reported bits < 11 happens rarely and only for special configurations). Several companies still considered it as a corner case at RAN1#100b-e/101bis-e, even if the case is not specified. This time again just one company contributed on this issue.

FL proposal: no discussion at RAN1#102e

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| **Company** | **Summary of proposals** |
| Samsung  (R1-2006097) | Proposal 2: For one-shot HARQ-ACK feedback, if NDI is not configured, and if the number of UCI bits is smaller than or equal to 11 bits, the NACK bits for a HARQ process without PDSCH receiving after previous transmitted PUCCH occasion is not counted for the purpose of PUCCH power control. TP for TS 38.213:  **TS 38.213**  **9.1.4 Type-3 HARQ-ACK codebook determination**  ------------------ Unchanged part omitted ------------------------  If , and if the UE determines a number of HARQ-ACK information bits  for obtaining a transmission power for a PUCCH in PUCCH transmission occasion *i*, as described in Clause 7.2.1, aswhere  - is the number of transport blocks the UE receives after a previous transmitted PUCCH occasion *i-*1 for HARQ process ID *h* for serving cell  if *harq-ACK-SpatialBundlingPUCCH* and *pdsch-HARQ-ACK-OneShotFeedbackCBG-r16* are not provided, or the number of PDSCH receptions if *harq-ACK-SpatialBundlingPUCCH* is provided.  - is the number of CBGs the UE receives after a previous transmitted PUCCH occasion *i-*1 for HARQ process ID *h* for serving cell  if *PDSCH-CodeBlockGroupTransmission* and *pdsch-HARQ-ACK-OneShotFeedbackCBG-r16* is provided.  ------------------ Unchanged part omitted ------------------------ |
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## Issue B8

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| B8 | If all the DCIs requesting one-shot feedback are missed, then UE and gNB are not aligned in the slot where the UE is supposed to report the type-3 codebook.  Case 1: if a collision with a PUCCH occasion for type2 (or type1) codebook happens, instead of reporting type3 codebook (as agreed) the UE will report type2 (or type1) codebook, resulting in mismatch with gNB’s expectation. In case of piggyback on PUSCH, this results in UL-SCH rate-matching issue.  Case 2: if there is no collision with a PUCCH occasion for type2 (or type1) codebook, if no PUSCH is transmitted in that slot then gNB does not receive any PUCCH, otherwise if a PUSCH is transmitted for reporting type2 (or type1) codebook then this results in UL-SCH rate-matching issue. |

FL analysis: this issue was not considered critical by several companies at RAN1#100e/101e/101bis-2. This time again just one company contributed on this issue.

Proposal: no discussion at RAN1#102e

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| **Company** | **Summary of proposals** |
| Nokia  (R1-2005907) | Proposal 5: For UE with TYPE-2 CB and TYPE-3 CB configured:   * + When UE received UL-DAI=3 in PUSCH grant and hasn’t received any PDCCH for which HARQ-ACK is to be multiplexed in PUSCH, UE reports TYPE-3 CB   + UE multiplexes TYPE-3 CB on the PUSCH     - when UE receives DCI format 1\_1 with positive TYPE-3 CB trigger, or     - when UE receives UL-DAI=3 in PUSCH grant and hasn’t received DL DAI value for more than 2 PDCCH for which HARQ-ACK is to be reported in the corresponding PUCCH.   + Otherwise, UE multiplexes TYPE-2 CB on PUSCH according to UL-DAI received. |
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## Issue B14

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| B14 | Potential ambiguity when CBG is configured for one cell in a PUCCH cell group and spatial bundling is also configured, whether CBG-based HARQ-ACK should be reported for all cells in the cell group or just for the one cell in Type-3 HARQ-ACK codebook. |

FL proposal: determine in preparation phase whether this is an essential correction.

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| **Company** | **Summary of proposals** |
| vivo  (R1-2005335) | Proposal 2: For Type-3 codebook, when pdsch-HARQ-ACK-OneShotFeedbackCBG-r16 is provided for a PUCCH group, and maxCodeBlockGroupsPerTransportBlock is provided for a serving cell belonging to the PUCCH group, UE ignores spatial bundling related configuration, and reports CBG-based HARQ-ACK for each configured downlink codeword for the serving cell.  ----------------------------------Start text proposal 1--------------------------------------  9.1.4 Type-3 HARQ-ACK codebook determination  If a UE is provided *pdsch-HARQ-ACK-OneShotFeedback-r16*, the UE determines a Type-3 HARQ-ACK codebook according to the following procedure.  Set to the number of configured serving cells  Set to the value of *nrofHARQ-ProcessesForPDSCH* for serving cell , if provided; else, set  Set to the value of *maxNrofCodeWordsScheduledByDCI* for serving cell if *harq-ACK-SpatialBundlingPUCCH* is provided and , or if *harq-ACK-SpatialBundlingPUCCH* is not provided, or if *maxCodeBlockGroupsPerTransportBlock* is provided for serving cell and *pdsch-HARQ-ACK-OneShotFeedbackCBG-r16* is provided; else, set  Set to the number of HARQ-ACK information bits per TB for PDSCH receptions on serving cell as described in Clause 9.1.1 if *maxCodeBlockGroupsPerTransportBlock* is provided for serving cell and *pdsch-HARQ-ACK-OneShotFeedbackCBG-r16* is provided; else, set  Set if *pdsch-HARQ-ACK-OneShotFeedbackNDI-r16* is provided; else set  -------------------------------------End text proposal 1------------------------------------ |
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## Issue B15

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| B15 | Type-3 HARQ-ACK codebook size reduction |

FL analysis: this looks like an optimization, not an essential correction.

FL proposal: no discussion at RAN1#102e.

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| **Company** | **Summary of proposals** |
| ZTE, Sanechips  (R1-2005602) | Proposal 4: When a DCI format 1\_1 triggers one-shot feedback, methods to reduce the codebook size, such as only report the ACK/NACK for activated serving cells, or only contain the HARQ-ACK information that have the same priority can be considered. |
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## Issue B16

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| B16 | Whether a clarification is needed to explicitly exclude K1 value of “-1” in the determination of the Type-1 HARQ-ACK codebook association set, in case the UE is also configured with Type-3 codebook and NNK1 value. |

FL analysis: It is not clear that there is an ambiguity in the specifications.

FL proposal: determine in preparation phase whether this is an essential correction.

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| **Company** | **Summary of proposals** |
| OPPO  (R1-2006022) | Proposal 1: Type-1 HARQ-ACK codebook is determined based on the applicable value(s) of K1  ------------------- Start of TP 1 38.213 V16.2.0 section 9.1.2---------------------------  9.1.2.1 Type-1 HARQ-ACK codebook in physical uplink control channel  <Unchanged parts are omitted>  For a serving cell , an active DL BWP, and an active UL BWP, as described in Clause 12, the UE determines a set of occasions for candidate PDSCH receptions for which the UE can transmit corresponding HARQ-ACK information in a PUCCH in slot . If serving cell is deactivated, the UE uses as the active DL BWP for determining the set of occasions for candidate PDSCH receptions a DL BWP provided by *firstActiveDownlinkBWP-Id*. The determination is based:  a) on a set of slot timing values associated with the active UL BWP  a) If the UE is configured to monitor PDCCH for DCI format 1\_0 and is not configured to monitor PDCCH for either DCI format 1\_1 or DCI format 1\_2 on serving cell , is provided by the slot timing values {1, 2, 3, 4, 5, 6, 7, 8}  b) If the UE is configured to monitor PDCCH for DCI format 1\_1 and is not configured to monitor PDCCH for DCI format 1\_2 for serving cell , is the applicable value(s) provided by *dl-DataToUL-ACK*  c) If the UE is configured to monitor PDCCH for DCI format 1\_2 and is not configured to monitor PDCCH for DCI format 1\_1 for serving cell ,  is the applicable value(s) provided by *dl-DataToUL-ACK-ForDCIFormat1\_2*  d) If the UE is configured to monitor PDCCH for DCI format 1\_1 and DCI format 1\_2 for serving cell ,  is the applicable value(s) provided by the union of *dl-DataToUL-ACK* and *dl-DataToUL-ACK-ForDCIFormat1\_2*  b) on a set of row indexes of a table that is associated with the active DL BWP and defining respective sets of slot offsets , start and length indicators *SLIV*, and PDSCH mapping types for PDSCH reception as described in [6, TS 38.214], where the row indexes of the table are provided by the union of row indexes of time domain resource allocation tables for DCI formats the UE is configured to monitor PDCCH for serving cell  <Unchanged parts are omitted>  ----------------------- End of TP 1 38.213 V16.2.0 section 9.1.2--------------------------- |
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## Issue B17

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| B17 | DTX/NACK-to-ACK Error for one-shot feedback (used to be A20) |

FL analysis: 11 companies considered that this is not a critical issue at RAN1#101bis-e.

FL proposal: no discussion at RAN1#102e.

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| **Company** | **Summary of proposals** |
| OPPO  (R1-2006022) | Figure 1 (R1-2006022). DTX-to-ACK error for one-shot feedback  Proposal 3: If a PDSCH for a given HARQ process is received, the UE skips another PDSCH for a given HARQ process until after the end of the successful transmission of HARQ-ACK for that HARQ process. |
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## Issue B18

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| B18 | UCI multiplexing timeline based on a request for a Type-3 HARQ-ACK codebook report without scheduling a PDSCH |

FL analysis: It is not clear that there is an ambiguity in the specifications.

FL proposal: determine in preparation phase whether this is an essential correction.

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| **Company** | **Summary of proposals** |
| OPPO  (R1-2006022) | 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 ---------------------------- |
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## Issue C3

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| C3 | Out-of-Order issue for NNK1 involving DL SPS |

FL analysis: this issue was discussed at RAN1#101-e, where the following summary and proposed conclusion were provided:

Summary of discussions on issue C3 at RAN1#101-e: there is no consensus to agree on a TP for issue C3. Companies have different interpretations on whether the case described in R1-2004445 section 4 corresponding to an out-of-order condition for PDSCH-to-HARQ-Ack. When a UE is configured with DL SPS, similar cases may happen when a PDSCH is scheduled with NNK1 value, or when HARQ-ACK feedback re-transmission is requested. These cases may deserve further detailed analysis but it may not be possible to complete such analysis at RAN1#101-e. We could revisit this issue at RAN1#102-e.

Proposed conclusion at RAN1#101-e: potential issues on out-of-order PDSCH-to-HARQ-Ack in case of DL SPS, including the case of NNK1 value with Type-2 HARQ-ACK codebook, and the case of NNK1 value and/or HARQ-ACK feedback re-transmission with Enhanced Type-2 HARQ-ACK codebook, can be revisited at RAN1#102-e.

Based on the contributions submitted to RAN1#102e, it seems no correction is needed for issue C3.

FL proposal: No discussion at RAN1#102e on issue C3.

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| **Company** | **Summary of proposals** |
| Huawei (R1-2005811) | Observation 1: Issue C3 is an out of order issue for PDSCH-to-HARQ-ACK, which should follow rules defined for OOO in TS38.214 section 5.1.  Proposal 1: No correction is needed for issue C3. |
| Intel (R1-2005845) | Proposal 2:  - If there is a previous PDSCH for which HARQ-ACK transmission timing is not determined until UE receives a SPS PDSCH, UE expects the HARQ-ACK timing for the previous PDSCH is no latter than the PUCCH configured for the HARQ-ACK transmission of the SPS PDSCH.  - No TP is needed |
| Nokia (R1-2005907) | Proposal-1: If RAN1 cannot find a consensus that PDSCH received with NN-K1 value does not violate the OOO HARQ clause in TS38.214, consider introducing a behavior where if UE has at least one PDSCH with inapplicable K1 value in the buffer and receives DL SPS PDSCH, then UE reports HARQ-ACK for the DL SPS only according to the applicable value of the second DCI. |
| Ericsson (R1-2005916) | Our understanding of the rel-15 behaviour is that the UE is not expected to send out of order HARQ. If the UE misses PDCCH for PDSCH2, the UE is not expected to include the feedback in PUCCH2 when there is another PDSCH (SPS PDSCH) that points to an earlier PUCCH (PUCCH1). Hence, the error should not propagate to the second PUCCH.  In fact, if the missed PDCCH indicated a PUCCH that is earlier in time than PUCCH 1, the proposed solution will yield to erroneous codebook in PUCCH1. In our view, there is no need to do any changes to the specification to cover those cases.  Proposal 1: No specification changes are needed to handle C3 issue |
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## Issue C4

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| C4 | Out-of-Order issue with HARQ-ACK retransmission |

FL analysis: a single company contributed on a potential OOO issue due to a HARQ-ACK retransmission (not involving DL SPS PDSCH).

FL proposal: determine in preparation phase whether this is an essential correction.

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| **Company** | **Summary of proposals** |
| Huawei  (R1-2005811) | Proposal 2 (R1-2005811): HARQ-ACK retransmission should not be considered as OOO.  **TP#1 for TS 38.214 Clause 5.1**  ==================== Unchanged part omitted ====================  A UE shall upon detection of a PDCCH with a configured DCI format 1\_0, 1\_1 or 1\_2 decode the corresponding PDSCHs as indicated by that DCI. For any HARQ process ID(s) in a given scheduled cell, the UE is not expected to receive a PDSCH that overlaps in time with another PDSCH. The UE is not expected to receive another PDSCH for a given HARQ process until after the end of the expected transmission of HARQ-ACK for that HARQ process, where the timing is given by Clause 9.2.3 of [6]. In a given scheduled cell, the UE is not expected to receive a first PDSCH and a second PDSCH, starting later than the first PDSCH, with its corresponding HARQ-ACK initially assigned to be transmitted on a resource ending before the start of a different resource for the HARQ-ACK initially assigned to be transmitted for the first PDSCH, where the two resources are in different slots for the associated HARQ-ACK transmissions, each slot is composed of symbols [4] or a number of symbols indicated by *subslotLength-ForPUCCH* if provided, and the HARQ-ACK for the two PDSCHs are associated with the HARQ-ACK codebook of the same priority. In a given scheduled cell, the UE is not expected to receive a first PDSCH, and a second PDSCH, starting later than the first PDSCH, with its corresponding HARQ-ACK initially assigned to be transmitted on a resource ending before the start of a different resource for the HARQ-ACK initially assigned to be transmitted for the first PDSCH if the HARQ-ACK for the two PDSCHs are associated with HARQ-ACK codebooks of different priorities. For any two HARQ process IDs in a given scheduled cell, if the UE is scheduled to start receiving a first PDSCH starting in symbol *j* by a PDCCH ending in symbol *i*, the UE is not expected to be scheduled to receive a PDSCH starting earlier than the end of the first PDSCH with a PDCCH that ends later than symbol *i*. In a given scheduled cell, for any PDSCH corresponding to SI-RNTI, the UE is not expected to decode a re-transmission of an earlier PDSCH with a starting symbol less than *N* symbols after the last symbol of that PDSCH, where the value of *N* depends on the PDSCH subcarrier spacing configuration *μ,* with *N*=13 for *μ*=0, *N*=13 for *μ*=1, *N*=20 for *μ*=2, and *N*=24 for *μ*=3.  ================== Unchanged part omitted ==================== |
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## Issue D1

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| D1 | Correction to include *pusch-TimeDomainAllocationListForMultiPUSCH-r16* in TS38.214 Table 6.1.2.1.1-1A (Applicable PUSCH time domain resource allocation for DCI format 0\_1 in UE specific search space scrambled with C-RNTI, MCS-C-RNTI, CS-RNTI or SP-CSI-RNTI) |

FL analysis: *pusch-TimeDomainAllocationListForMultiPUSCH-r16* seems to be missing from Table 6.1.2.1.1-1A.

FL proposal: determine in preparation phase whether this is an essential correction.

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| **Company** | **Summary of proposals** |
| Vivo  (R1-2005335) | TP for 38.214 Table 6.1.2.1.1-1A |
| Sharp  (R1-2006555) | TP1 for 38.214 Table 6.1.2.1.1-1A + TP2 for 38.212 clause 7.3.1.1.2 |
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## Issue D2

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| D2 | Case where multiple PUSCHs are scheduled by a single DCI with CRC scrambled with CS-RNTI, and impact of signaling multiple NDI values on activation/release or re-transmission for UL CG |

FL analysis: issue D2 seems to be an ambiguity in the specifications.

FL proposal: determine in preparation phase whether this is an essential correction.

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| **Company** | **Summary of proposals** |
| Qualcomm  (R1-2006765) | Proposal 1: If DCI with CRC scrambled with CS-RNTI schedules more than one PUSCH, it is not expected that the multiple bits of the NDI field are set to different values.   * + It should be decided if all the bits of the NDI field being set to 0 is supported or not (corresponding to ULCG activation / release).   + It should be allowed that all the bits of the NDI field being set to 1 (corresponding to scheduling retransmissions of multiple PUSCHs whose initial transmissions were on ULCG resources). |
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# References

1. R1-2005335 Remaining issues on HARQ operation for NR-U vivo
2. R1-2005602 Remaining issues on the HARQ for NR-U ZTE, Sanechips
3. R1-2005811 Maintenance on HARQ-ACK enhancement Huawei, HiSilicon
4. R1-2005827 Text proposals for HARQ enhancement for NR-U Lenovo, Motorola Mobility
5. R1-2005845 Enhancements to HARQ for NR-unlicensed Intel Corporation
6. R1-2005907 Remaining issues on NR-U HARQ scheduling and feedback Nokia, Nokia Shanghai Bell
7. R1-2005916 HARQ enhancement Ericsson
8. R1-2006022 Discussion on the remaining issues of HARQ enhancements OPPO
9. R1-2006097 HARQ enhancement for NR-U Samsung
10. R1-2006302 Remaining issues of HARQ procedure for NR-U LG Electronics
11. R1-2006555 Remaining issues and corrections on HARQ enhancement for NR-U Sharp
12. R1-2006765 TP for Enhancements to Scheduling and HARQ Operation for NR-U Qualcomm Incorporated
13. R1-2006900 Text proposal for enhanced dynamic HARQ procedures Google, Inc