3GPP TSG RAN WG1 #110bis-e R1-220xxxx

e-meeting, e-meeting, Oct 10th – Aug 19th, 2022

Source: Moderator (ZTE)

Title: Summary of maintenance on HARQ for NR NTN

Agenda Item: 8.4

**Document for: Discussion and Decision**

# **Introduction**

In RAN1#107e meeting, the Rel-17 NR-NTN has claimed to be completed. In this meeting, the proposed issues are summarized as follows.

* Correction on determination of the number of HARQ-ACK information bits for NTN
* Correction on Type-2 HARQ-ACK codebook in PUSCH for NTN
* Editorial issues

Companies are encouraged to provide the inputs for corresponding topics.

# **Issue-1 • Correction on determination of the number of HARQ-ACK information bits for NTN**

## **Company view (Round-1)**

The following issue is agreed to be discussed based on the conclusion in [110bis-e-R17-NR-NTN-01]:

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| **Issue#** | **Issue** | **Recommendation from the moderator after 1st round of company comments** |
| 2-2 | **38.213- Correction on determination of the number of HARQ-ACK information bits for NTN:** | **Discuss over email in RAN1#110bis-e.**   8 companies (**Panasonic, Ericsson, Nokia, NSB, Qualcomm,  Samsung, Langbo, ZTE, DCM**) agree with the FL initial assessment and think it ok to discuss during the e-meeting.  1 company (**LG**) does not see the need to re-discuss this issue in maintenance phase. LG recalled this issue was discussed during WI phase, but it was not agreed.  Moderator’s view: Ok to discuss during RAN1#110bis-e.  **Moderator recommendation:** Discuss this issue over email in RAN1#110bis-e. |

For Type-2 HARQ-ACK codebook, as mentioned by [Langbo], DAI value is defined based on PDSCH receptions, excluding PDSCH receptions that provide only transport blocks for HARQ processes associated with disabled HARQ-ACK information. However, in current spec, the total number of DCI formats (i.e., ) used for calculating the number of HARQ-ACK information bits for PUCCH power control does not exclude the DCI formats scheduling PDSCH receptions without associated HARQ-ACK information. As a result, the UE may use an underestimated power to transmit PUCCH.

To resolve this issue, the following TP is proposed for TS 38.213:

**TP from Langbo:**

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| TS 38.213  \*\*\* Unchanged text is omitted \*\*\* 9.1.3.1 Type-2 HARQ-ACK codebook in physical uplink control channel If a UE is  - not provided *PDSCH-CodeBlockGroupTransmission* for any serving cell, or  - not provided *PDSCH-TimeDomainResourceAllocationListForMultiPDSCH* for any serving cell, or  - provided *PDSCH-TimeDomainResourceAllocationListForMultiPDSCH* and *numberOfHARQ-BundlingGroups* with for a serving cell  for PDSCH receptions scheduled by a DCI format that does not support CBG-based PDSCH receptions, or for SPS PDSCH reception, or for a DCI format having associated HARQ-ACK information without scheduling PDSCH reception, and if , the UE determines a number of HARQ-ACK information bits for obtaining a transmission power for a PUCCH, as described in clause 7.2.1, as    where  - is a number of serving cells where the UE is configured to receive unicast PDSCHs  - is a number of serving cells where the UE is configured to receive multicast PDSCHs for a G-RNTI or a G-CS-RNTI  - is a total number of G-RNTIs or G-CS-RNTIs configured to the UE  - is the number of PDCCH monitoring occasions for unicast DCI formats  - is the number of PDCCH monitoring occasions for multicast DCI formats with CRC scrambled by G-RNTI or G-CS-RNTI  - where the number of bits for the counter DAI field in unicast DCI formats  - where the number of bits for the counter DAI field in multicast DCI formats with CRC scrambled by G-RNTI or G-CS-RNTI  - if , is the value of the counter DAI in the last DCI format scheduling PDSCH reception or having associated HARQ-ACK information without scheduling PDSCH reception, that the UE detects within the PDCCH monitoring occasions.  - if , is the value of the counter DAI in the last multicast DCI format with G-RNTI , or G-CS-RNTI , scheduling PDSCH reception or having associated HARQ-ACK information without scheduling a PDSCH reception, that the UE detects within the PDCCH monitoring occasions  - if or if  - if the UE does not detect any DCI format that includes a total DAI field in a last PDCCH monitoring occasion within the or PDCCH monitoring occasions where the UE detects at least one DCI format scheduling PDSCH reception, or having associated HARQ-ACK information without scheduling PDSCH reception, for any serving cell , or , respectively, is the value of the counter DAI in a last DCI format the UE detects in the last PDCCH monitoring occasion  - if the UE detects at least one DCI format that includes a total DAI field in a last PDCCH monitoring occasion within the or , for G-RNTI or G-CS-RNTI , PDCCH monitoring occasions where the UE detects at least one DCI format scheduling PDSCH reception, or having associated HARQ-ACK information without scheduling PDSCH reception, for any serving cell , or , respectively, is the value of the total DAI in the at least one DCI format that includes a total DAI field  - or if the UE does not detect any DCI format scheduling PDSCH reception, or having associated HARQ-ACK information without scheduling PDSCH reception, for any serving cell in any of the or PDCCH monitoring occasions, respectively.  - or , for G-RNTI or G-CS-RNTI , is the total number of DCI formats scheduling PDSCH receptions providing transport blocks for HARQ processes with enabled HARQ-ACK information, or having associated HARQ-ACK information without scheduling a PDSCH reception, that the UE detects within the or PDCCH monitoring occasions, respectively, for serving cell . or if the UE does not detect any DCI format scheduling PDSCH reception providing a transport block for a HARQ process with enabled HARQ-ACK information, or having associated HARQ-ACK information without scheduling PDSCH reception, for serving cell in any of the or , respectively, PDCCH monitoring occasions.  \*\*\* Unchanged text is omitted \*\*\* |

From FL’s perspective, this issue is reasonable. In current spec, DCI formats scheduling PDSCH receptions will be counted in calculation of and thus the PDSCH with disabled feedback are also considered in determining HARQ-ACK information bits . That is, more HARQ-ACK information than expected will be used for PUCCH power control, which results in a mismatched transmission power. Hence, update on spec to only consider the PDSCHs with enabled feedback in power control is reasonable.

Then, following proposal is recommended:

**[Initial Proposal 1.1-1]**

Adopt the following TP (38.213, Section 9.1.3.1):

**Reason for change:**

DAI value is defined based on PDSCH receptions, excluding PDSCH receptions that provide only transport blocks for HARQ processes associated with disabled HARQ-ACK information if donwlinkHARQ-FeedbackDisabled is provided. The total number of DCI formats (i.e., ) used for calculating the number of HARQ-ACK information bits for PUCCH power control should also exclude the DCI formats scheduling PDSCH receptions without associated HARQ-ACK information.

**Summary of change:**

The DCI formats scheduling PDSCH receptions without associated HARQ-ACK information are excluded for the calculation of the total number of DCI formats (i.e., ) for PUCCH power.

**Consequences if not approved:**

The UE may use an underestimated power to transmit PUCCH.

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| ----------------------------------------Start of TP 38.213 V17.3.0 section 9.1.3.1 ---------------------------------------------  **9.1.3.1 Type-2 HARQ-ACK codebook in physical uplink control channel**  <Unchanged parts are omitted>  If a UE is  - not provided *PDSCH-CodeBlockGroupTransmission* for any serving cell, or  - not provided *PDSCH-TimeDomainResourceAllocationListForMultiPDSCH* for any serving cell, or  - provided *PDSCH-TimeDomainResourceAllocationListForMultiPDSCH* and *numberOfHARQ-BundlingGroups* with for a serving cell  for PDSCH receptions scheduled by a DCI format that does not support CBG-based PDSCH receptions, or for SPS PDSCH reception, or for a DCI format having associated HARQ-ACK information without scheduling PDSCH reception, and if , the UE determines a number of HARQ-ACK information bits for obtaining a transmission power for a PUCCH, as described in clause 7.2.1, as    where  - is a number of serving cells where the UE is configured to receive unicast PDSCHs  - is a number of serving cells where the UE is configured to receive multicast PDSCHs for a G-RNTI or a G-CS-RNTI  - is a total number of G-RNTIs or G-CS-RNTIs configured to the UE  - is the number of PDCCH monitoring occasions for unicast DCI formats  - is the number of PDCCH monitoring occasions for multicast DCI formats with CRC scrambled by G-RNTI or G-CS-RNTI  - where the number of bits for the counter DAI field in unicast DCI formats  - where the number of bits for the counter DAI field in multicast DCI formats with CRC scrambled by G-RNTI or G-CS-RNTI  - if , is the value of the counter DAI in the last DCI format scheduling PDSCH reception or having associated HARQ-ACK information without scheduling PDSCH reception, that the UE detects within the PDCCH monitoring occasions.  - if , is the value of the counter DAI in the last multicast DCI format with G-RNTI , or G-CS-RNTI , scheduling PDSCH reception or having associated HARQ-ACK information without scheduling a PDSCH reception, that the UE detects within the PDCCH monitoring occasions  - if or if  - if the UE does not detect any DCI format that includes a total DAI field in a last PDCCH monitoring occasion within the or PDCCH monitoring occasions where the UE detects at least one DCI format scheduling PDSCH reception, or having associated HARQ-ACK information without scheduling PDSCH reception, for any serving cell , or , respectively, is the value of the counter DAI in a last DCI format the UE detects in the last PDCCH monitoring occasion  - if the UE detects at least one DCI format that includes a total DAI field in a last PDCCH monitoring occasion within the or , for G-RNTI or G-CS-RNTI , PDCCH monitoring occasions where the UE detects at least one DCI format scheduling PDSCH reception, or having associated HARQ-ACK information without scheduling PDSCH reception, for any serving cell , or , respectively, is the value of the total DAI in the at least one DCI format that includes a total DAI field  - or if the UE does not detect any DCI format scheduling PDSCH reception, or having associated HARQ-ACK information without scheduling PDSCH reception, for any serving cell in any of the or PDCCH monitoring occasions, respectively.  - or , for G-RNTI or G-CS-RNTI , is the total number of DCI formats scheduling PDSCH receptions providing a transport block for a HARQ process with enabled HARQ-ACK information, or having associated HARQ-ACK information without scheduling a PDSCH reception, that the UE detects within the or PDCCH monitoring occasions, respectively, for serving cell . or if the UE does not detect any DCI format scheduling PDSCH reception providing a transport block for a HARQ process with enabled HARQ-ACK information, or having associated HARQ-ACK information without scheduling PDSCH reception, for serving cell in any of the or , respectively, PDCCH monitoring occasions.  <Unchanged parts are omitted>  ----------------------------------------End of TP 38.213 V17.3.0 section 9.1.3.1 --------------------------------------------- |

Companies are encouraged to share your views. If there are any concerns, updates on top of existing TP are appreciated.

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| **Company** | **Comments and Views** |
| OPPO | support |
| DCM | OK |
| Samsung | OK. Suggest to combine with the next CR into a single CR especially since it is the same simple issue. |
| Langbo | Support |

# **Issue-2 • • Correction on Type-2 HARQ-ACK codebook in PUSCH for NTN**

## **Company view (Round-1)**

The following issue is agreed to be discussed based on the conclusion in [110bis-e-R17-NR-NTN-01]:

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| **Issue#** | **Issue** | **Recommendation from the moderator after 1st round of company comments** |
| 2-3 | **38.213- Correction on Type-2 HARQ-ACK codebook in PUSCH for NTN.** | **Discuss over email in RAN1#110bis-e.**  8 companies (**Ericsson, Nokia, NSB, Qualcomm,  Samsung, Langbo, ZTE, DCM, Panasonic**) agree with the FL initial assessment and think it ok to discuss during this e-meeting.  **Moderator recommendation:** Discuss this issue over email in RAN1#110bis-e. |

As mentioned by [Langbo], in current spec, UE has to always multiplex HARQ-ACK information for PDSCH receptions with disabled HARQ-ACK information in PUSCH even if UL DAI value when the UE has received a PDCCH scheduling PDSCH receptions with disabled HARQ-ACK information. However, for Type-2 HARQ-ACK codebook, no HARQ-ACK will be provided for PDSCH if the corresponding HARQ is feedback disabled. Therefore, the condition for disabling multiplexing HARQ-ACK information in PUSCH should be updated.

To resolve this issue, the following TP is proposed for TS 38.213:

**TP from Langbo:**

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| TS 38.213  \*\*\* Unchanged text is omitted \*\*\* 9.1.3.2 Type-2 HARQ-ACK codebook in physical uplink shared channel \*\*\* Unchanged text is omitted \*\*\*  If a UE is not provided *PDSCH-CodeBlockGroupTransmission* and the UE is scheduled for a PUSCH transmission by DCI format that includes a DAI field with value and the UE has not received any PDCCH within the monitoring occasions for a DCI format scheduling PDSCH receptions providing transport blocks for HARQ processes with enabled HARQ-ACK information or having associated HARQ-ACK information without scheduling PDSCH receptions on any serving cell , and the UE does not have HARQ-ACK information in response to a SPS PDSCH reception to multiplex in the PUSCH as described in clause 9.1.3.1, the UE does not multiplex HARQ-ACK information in the PUSCH transmission.  If a UE is provided *PDSCH-CodeBlockGroupTransmission* and the UE is scheduled for a PUSCH transmission by DCI format that includes a DAI field with first value or with second value and the UE has not received any PDCCH within the monitoring occasions for a DCI format scheduling PDSCH reception providing a transport block for HARQ process with enabled HARQ-ACK information or having associated HARQ-ACK information without scheduling PDSCH reception on any serving cell , and the UE does not have HARQ-ACK information in response to a SPS PDSCH reception to multiplex in the PUSCH, as described in clause 9.1.3.1, the UE does not multiplex HARQ-ACK information for the first sub-codebook or for the second sub-codebook, respectively, in the PUSCH transmission.  \*\*\* Unchanged text is omitted \*\*\* |

From FL’s perspective, this issue is reasonable. For PDSCH receptions with disabled HARQ-ACK information, no HARQ-ACK will be transmitted in Type-2 HARQ codebook and UE should not multiplex HARQ-ACK in PUSCH transmission. Hence, the conditions for not multiplexing HARQ-ACK information in the PUSCH transmission should be updated.

Then the following TP is recommended.

**[Initial Proposal 2.1-1]**

Adopt the following TP (38.213, Section 9.1.3.2):

**Reason for change:**

UE has to always multiplex HARQ-ACK information for PDSCH receptions with disabled HARQ-ACK information in PUSCH even if UL DAI value when the UE has received a PDCCH scheduling PDSCH receptions with disabled HARQ-ACK information.

**Summary of change:**

Change the condition for disabling multiplexing HARQ-ACK information in PUSCH transmission in case UL DAI value by excluding the PDCCH scheduling PDSCH receptions with disabled HARQ-ACK information.

**Consequences if not approved:**

UL DAI value cannot disable the multiplexing of HARQ-ACK information for PDSCH receptions with disabled HARQ-ACK information in PUSCH.

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| ----------------------------------------Start of TP 38.213 V17.3.0 section 9.1.3.2 ---------------------------------------------  **9.1.3.2 Type-2 HARQ-ACK codebook in physical uplink shared channel**  <Unchanged parts are omitted>  If a UE is not provided *PDSCH-CodeBlockGroupTransmission* and the UE is scheduled for a PUSCH transmission by DCI format that includes a DAI field with value and the UE has not received any PDCCH within the monitoring occasions for a DCI format scheduling PDSCH receptions providing a transport block for a HARQ process with enabled HARQ-ACK information or having associated HARQ-ACK information without scheduling PDSCH receptions on any serving cell , and the UE does not have HARQ-ACK information in response to a SPS PDSCH reception to multiplex in the PUSCH as described in clause 9.1.3.1, the UE does not multiplex HARQ-ACK information in the PUSCH transmission.  If a UE is provided *PDSCH-CodeBlockGroupTransmission* and the UE is scheduled for a PUSCH transmission by DCI format that includes a DAI field with first value or with second value and the UE has not received any PDCCH within the monitoring occasions for a DCI format scheduling PDSCH reception providing a transport block for a HARQ process with enabled HARQ-ACK information or having associated HARQ-ACK information without scheduling PDSCH reception on any serving cell , and the UE does not have HARQ-ACK information in response to a SPS PDSCH reception to multiplex in the PUSCH, as described in clause 9.1.3.1, the UE does not multiplex HARQ-ACK information for the first sub-codebook or for the second sub-codebook, respectively, in the PUSCH transmission.  <Unchanged parts are omitted>  ----------------------------------------End of TP 38.213 V17.3.0 section 9.1.3.2 --------------------------------------------- |

Companies are encouraged to share your views. If there are any concerns, updates on top of existing TP are appreciated.

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| **Company** | **Comments and Views** |
| OPPO | support |
| DCM | OK |
| Samsung | OK. Suggest to combine with the previous CR into a single CR especially since it is the same simple issue. |
| Langbo | Support |

# **Editorial issues**

## **3.1 Company view (Round-1)**

The following issue is agreed to be discussed based on the conclusion in [110bis-e-R17-NR-NTN-01]:

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| **Issue#** | **Issue** | **Recommendation from the moderator after 1st round of company comments** |
| 2-1 | **38.213-Draft CR on the indication of downlink disabled HARQ feedback for NR NTN**: | **Discuss over email in RAN1#110bis-e.**  9 companies expressed views on this topic.  All companies agree with the FL assessment: This is an editorial issue that will be handled as editorial CRs/ alignment CR.  **Moderator recommendation:** Discuss this issue over email in RAN1#110bis-e. This is an editorial issue that will be handled as editorial CRs (to be communicated to the editors/chairs). |

As mentioned by [vivo], in TS 38.213 v17.3.0, there are several typos where the name of high layer parameter *donwlinkHARQ-FeedbackDisabled* is written as *donwlinkHARQ-FeedbackDisabled*, which should be corrected.

To handle this issue, the following TPs are proposed from vivo:

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| TS 38.213 9.1.3.1 Type-2 HARQ-ACK codebook in physical uplink control channel <Unchanged parts are omitted>  A value of the counter downlink assignment indicator (DAI) field in DCI formats denotes the accumulative number of {serving cell, PDCCH monitoring occasion}-pairs in which PDSCH receptions, excluding PDSCH receptions that provide only transport blocks for HARQ processes associated with disabled HARQ-ACK information if *downlinkHARQ-FeedbackDisabled* is provided, or HARQ-ACK information bits that are not in response for PDSCH receptions, associated with the DCI formats, excluding the SPS activation DCI, is present up to the current serving cell and current PDCCH monitoring occasion,  - first, if the UE indicates by *type2-HARQ-ACK-Codebook* support for more than one PDSCH reception on a serving cell that are scheduled from a same PDCCH monitoring occasion, in increasing order of the PDSCH reception starting time for the same {serving cell, PDCCH monitoring occasion} pair,  - second in ascending order of serving cell index, and  - third in ascending order of PDCCH monitoring occasion index , where .  If, for an active DL BWP of a serving cell, the UE is not provided *coresetPoolIndex* or is provided *coresetPoolIndex* with value 0 for one or more first CORESETs and is provided *coresetPoolIndex* with value 1 for one or more second CORESETs, and is provided *ackNackFeedbackMode* = *joint*, the value of the counter DAI is in the order of the first CORESETs and then the second CORESETs for a same serving cell index and a same PDCCH monitoring occasion index.  The value of the total DAI, when present [5, TS 38.212], in a DCI format denotes the total number of {serving cell, PDCCH monitoring occasion}-pair(s) in which PDSCH reception(s), excluding PDSCH receptions that provide only transport blocks for HARQ processes associated with disabled HARQ-ACK information if *downlinkHARQ-FeedbackDisabled* is provided, or HARQ-ACK information that does not correspond to PDSCH receptions, associated with DCI formats, excluding the SPS activation DCI, is present, up to the current PDCCH monitoring occasion and is updated from PDCCH monitoring occasion to PDCCH monitoring occasion. If, for an active DL BWP of a serving cell, the UE is not provided *coresetPoolIndex* or is provided *coresetPoolIndex* with value 0 for one or more first CORESETs and is provided *coresetPoolIndex* with value 1 for one or more second CORESETs, and is provided *ackNackFeedbackMode* = *joint*, the total DAI value counts the {serving cell, PDCCH monitoring occasion}-pair(s) for both the first CORESETs and the second CORESETs.  <Unchanged parts are omitted>  If a UE is configured to receive SPS PDSCH and the UE multiplexes HARQ-ACK information for one activated SPS PDSCH reception based on *downlinkHARQ-FeedbackDisabled* if provided [12, TS 38.331], including the ones associated with the corresponding activation DCI, in the PUCCH in slot , the UE generates one HARQ-ACK information bit associated with the SPS PDSCH reception and appends it to the HARQ-ACK information bits.  If a UE is configured to receive SPS PDSCH and the UE multiplexes HARQ-ACK information for multiple activated SPS PDSCH receptions, including the ones associated with the corresponding activation DCI and excluding the ones that provide only transport blocks for HARQ processes associated with disabled HARQ-ACK information if *downlinkHARQ-FeedbackDisabled* is provided, in the PUCCH in slot , the UE generates the HARQ-ACK information as described in clause 9.1.2 and appends it to the HARQ-ACK information bits.  <Unchanged parts are omitted> |

From FL’s perspective, the corrections are reasonable. But regarding the alignment of RRC parameter, it can be left to editor in the updated version. No further action is expected.

Companies are encouraged to share your views. If there are any concerns, updates on top of existing TP are appreciated.

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| **Company** | **Comments and Views** |
| OPPO | Agree with FL |
| DCM | Agree with FL |
| Samsung | Agree with FL |
| Langbo | Agree with FL |

# **Appendix**

1. R1-2208829 Discussion on remaining issue for NTN-NR OPPO
2. R1-2208830 Draft CR on interpretation SFN indicating epoch time OPPO
3. R1-2208886 Draft CR on the indication of downlink disabled HARQ feedback for NR NTN vivo
4. R1-2208993 Correction on determination of the number of HARQ-ACK information bits for NTN Langbo
5. R1-2208994 Correction on Type-2 HARQ-ACK codebook in PUSCH for NTN Langbo
6. R1-2209654 On the validity of assistance information for R17 NR NTN Ericsson
7. R1-2209823 Correction on timing relationship parameter for NR NTN Huawei, HiSilicon
8. R1-2210019 Remaining issues on solutions for NR to support NTN Lenovo
9. R1-2210045 Additional aspects of Rel-17 maintenance for NR over NTN Nokia, Nokia Shanghai Bell
10. R1-2210046 Draft CR for 38.211 to ensure correct interworking between open and closed loop TA Nokia, Nokia Shanghai Bell
11. R1-2210047 Draft CR for 38.213 to capture correct validity timer expiry behavior for UL synchronization Nokia, Nokia Shanghai Bell
12. R1-2210048 Draft CR for 38.213 to clarify calculation and application of timing advance values for common TA and UE specific TA Nokia, Nokia Shanghai Bell