3GPP TSG RAN WG1 #108-e R1-220xxxx

e-Meeting, February 21st – 3rd March, 2022

Source: Moderator (ZTE)

Title: Summary of AI 8.4.3 for HARQ for NTN

Agenda Item: 8.4.3

**Document for: Discussion and Decision**

# **Introduction**

In RAN1#107e meeting, the Rel-17 NR-NTN has claimed to be completed. In this meeting for maintenance, companies’ views on the remaining issues are summarized with corresponding observations/proposals. Meanwhile, some TPs are proposed to fix the specification. Then, the summary of this AI is organized as below:

* Remaining issue on HARQ codebook
* SPS PDSCH
* Processing time for PDSCH with disabled HARQ process
* UE capability
* Others

Companies are encouraged to provide the inputs for corresponding topics in section 1/2/3 and 5.

# **Issue-1 Remaining issue on HARQ codebook**

## **DAI value for Type-2 codebook:**

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

This topic has been discussed in past meetings with different preferences among companies. In last meeting, the following proposal is recommended for decision without consensus:

*For the DCI of PDSCH with feedback-disabled HARQ processes, one of following options is supported:*

* *Option-1: the C-DAI and T-DAI are the same of the C-DAI and T-DAI of the most recent DCI of PDSCH with feedback-enabled processes, despite they are not incremented.* 
  + *For the codebook generation, the UE should use the DAI in DCI of feedback-disabled HARQ process to detect if a previous DCI of feedback-enabled HARQ processes has been missed. If so, the UE should chose the HARQ codebook size based on the DAI in DCI of the feedback-disabled HARQ process, and the feedback-enabled HARQ process detected to be missed should be NACK.*
  + *Up to the current PDCCH monitoring occasion, if all DCIs of PDSCH are associated with feedback disabled HARQ process, the value of C-DAI and T-DAI set to and*
* *Option-2: The C-DAI and T-DAI are ignored by the UE regardless of the value for Type 2 codebook generation.*

Regarding this topic, the corresponding views are summarized according to the inputs in this meeting:

* Option-1:
  + Supported by [OPPO, Spreadtrum, CMCC, Baicells, LGE]
* Option-1a: proposed by [Panasonic]
  + Option-1 with updates that “for DAI field in the DCI of PDSCH with feedback-disabled process, DAI indication when there are no DCI of PDSCH with feedback-enabled process before the reception of DCI of PDSCH with feedback-disabled process can be specified as [DAI 1,1 is indicated for (or )=0 and *Y*=0 is the simplest option i.e. just to describe "Y≥0 when DCI of PDSCH with feedback-disabled HARQ processes is enabled]”.
* Option-2:
  + Supported by [DCM (if no progress), CAICT, NEC, ZTE]
* Option-3: proposed by [QC]
  + For Type-2 codebook generation, UE *may* assume that the C-DAI and T-DAI of the DCI of PDSCH with feedback-disabled process is the same as the C\_DAI and T-DAI of the most recently transmitted DCI of PDSCH with feedback-enabled process by gNB.

From FL’s perspective, using the terminology as “*may*” is not helpful to address the concerns since the gNB’s implementation will be complicated with different assumption on UE’s behaviour. Considering the majority’s view, let’s try to conclude this topic with following proposal and corresponding updates/CR to the specification is left to editor:

**[Initial Proposal 1.1.1-1]**

For the DCI of PDSCH with feedback-disabled HARQ processes:

* The C-DAI and T-DAI are the same of the C-DAI and T-DAI of the most recent DCI of PDSCH with feedback-enabled processes, despite they are not incremented.
  + - For the codebook generation, the UE should use the DAI in DCI of feedback-disabled HARQ process to detect if a previous DCI of feedback-enabled HARQ processes has been missed. If so, the UE should chose the HARQ codebook size based on the DAI in DCI of the feedback-disabled HARQ process, and the feedback-enabled HARQ process detected to be missed should be NACK.
    - Up to the current PDCCH monitoring occasion, if all DCIs of PDSCH are associated with feedback disabled HARQ process, the value of C-DAI and T-DAI set to and

Please provide your views below：

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| **Company** | **Comments and Views** |
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## **Determination of PUCCH transmission power for Type-1 codebook:**

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

For Type-1 codebook, the following agreement has been made in RAN1#107e,

Agreement

For Type-1 HARQ codebook, the UE will consistently report NACK-only for the feedback-disabled HARQ process regardless of decoding results of corresponding PDSCH.

In this meeting, as pointed by [CAICT, Samsung], as the HARQ-ACK values for TBs with disabled HARQ-ACK reporting is known to the NTN (NACK), considering the UE’s power efficiency, it’s preferred to not count those TBs in the received TBs for determining the PUCCH transmission power.

From FL’s perspective, it’s reasonable to address this issue with consideration on the benefits to optimize the UE’s power efficiency. Then, companies are encouraged to share views on following proposal:

**[Initial Proposal 1.2.1-1]**

For Type-1 HARQ-ACK codebook, the pre-known NACK for PDSCH with the feedback-disabled HARQ process is excluded from HARQ-ACK bits when determining for PUCCH transmit power.

Please provide your views below：

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| **Company** | **Comments and Views** |
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## **TP#1 for Type-2 codebook generation:**

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

As mentioned by [HW], for the case without the configuration of *HARQ-feedbackEnabling-disablingperHARQprocess,* the description regarding the pseudo-code for Type-2 HARQ-ACK codebook generationis missing in current spec and following TP is proposed:

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| * **TP#1 for Clause 9.1.3.1 of TS38.213**   ========================== Unchanged Text Omitted ==============================  while  if PDCCH monitoring occasion is before an active DL BWP change on serving cell or an active UL BWP change on the PCell and an active DL BWP change is not triggered in PDCCH monitoring occasion  ;  else  if *HARQ-feedbackEnabling-disablingperHARQprocess* is not provided and there is a PDSCH on serving cell associated with PDCCH in PDCCH monitoring occasion , or if *HARQ-feedbackEnabling-disablingperHARQprocess* is provided and there is a PDSCH providing a transport block for a HARQ process with enabled HARQ-ACK information on serving cell associated with PDCCH in PDCCH monitoring occasion , or there is a PDCCH providing a DCI format associated with HARQ-ACK information without scheduling PDSCH reception on serving cell  ============================ Unchanged Text Omitted ============================ |

From FL’s perspective, in the latest endorsed CR [R1-2112934], following update is proposed by editor.

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| ========================== Unchanged Text Omitted ==============================  if PDCCH monitoring occasion is before an active DL BWP change on serving cell or an active UL BWP change on the PCell and an active DL BWP change is not triggered in PDCCH monitoring occasion  ;  else  if there is a PDSCH providing a transport block for a HARQ process with enabled HARQ-ACK information on serving cell associated with PDCCH in PDCCH monitoring occasion , or there is a PDCCH indicating SPS PDSCH release or SCell dormancy on serving cell  ========================== Unchanged Text Omitted ============================== |

It can be noticed that the behaviour on HARQ-ACK information generation in **all cases with enabled HARQ-ACK information** is clearly defined, and no need to further highlight the “premise” based on the configurability of *HARQ-feedbackEnabling-disablingperHARQprocess*.

Then, the TP#1 is ***not*** needed. Companies are encouraged to share your views below:

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| **Company** | **Comments and Views** |
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## **TP#2 for C-/T-DAI of Type-2 codebook [L]:**

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

Regarding the description of description of C-/T-DAI value for Type-2 codebook, as mentioned by [OPPO, LGE], the definition of C-DAI/T-DAI is not updated to capture the previous agreement. Then, following two TPs are proposed:

**TP from LGE:**

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| 9.1.3.1 Type-2 HARQ-ACK codebook in physical uplink control channel  \*\*\* Unchanged text is omitted \*\*\*  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)~~ of PDSCH(s) providing a transport block for a HARQ process with enabled HARQ information, SPS PDSCH release or SCell dormancy indication associated with DCI formats 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.  Denote by the number of bits for the counter DAI and set . Denote by the value of the counter DAI in a DCI format scheduling ~~PDSCH~~ reception of PDSCH providing a transport block for a HARQ process with enabled HARQ information, SPS PDSCH release or SCell dormancy indication on serving cell in PDCCH monitoring occasion according to Table 9.1.3-1 or Table 9.1.3-1A. Denote by the value of the total DAI in a DCI format in PDCCH monitoring occasion according to Table 9.1.3-1. The UE assumes a same value of total DAI in all DCI formats that include a total DAI field in PDCCH monitoring occasion . A UE does not expect to multiplex, in a same Type-2 HARQ-ACK codebook, HARQ-ACK information that is in response to detection of DCI formats with different number of bits for the counter DAI field. |

**TP from OPPO:**

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| ----------------------------------------Start of TP 38.213 V17.0.0 section 9.1.3 ---------------------------------------------  9.1.3.1 Type-2 HARQ-ACK codebook in physical uplink control channel  <Unchanged parts are omitted>  The set of PDCCH monitoring occasions for DCI formats scheduling PDSCH receptions or PDSCH receptions with enabled HARQ-ACK information if *HARQ-feedbackEnabling-disablingperHARQprocess* is provided, or having associated HARQ-ACK information without scheduling PDSCH reception, is defined as the union of PDCCH monitoring occasions across active DL BWPs of configured serving cells. PDCCH monitoring occasions are indexed in an ascending order of their start times. The cardinality of the set of PDCCH monitoring occasions defines a total number of PDCCH monitoring occasions.  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 or PDSCH receptions with enabled HARQ-ACK information if *HARQ-feedbackEnabling-disablingperHARQprocess* is provided, or HARQ-ACK information bits that are not in response for PDSCH receptions, associated with the DCI formats 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) or PDSCH reception(s) with enabled HARQ-ACK information if *HARQ-feedbackEnabling-disablingperHARQprocess* is provided, or HARQ-ACK information that does not correspond to PDSCH receptions, associated with DCI formats 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.  Denote by the number of bits for the counter DAI and set . Denote by the value of the counter DAI in a DCI format scheduling PDSCH reception or PDSCH receptions with enabled HARQ-ACK information if *HARQ-feedbackEnabling-disablingperHARQprocess* is provided, or having associated HARQ-ACK information without scheduling PDSCH reception, on serving cell in PDCCH monitoring occasion according to Table 9.1.3-1 or Table 9.1.3-1A. Denote by the value of the total DAI in a DCI format in PDCCH monitoring occasion according to Table 9.1.3-1. The UE assumes a same value of total DAI in all DCI formats that include a total DAI field in PDCCH monitoring occasion . A UE does not expect to multiplex, in a same Type-2 HARQ-ACK codebook, HARQ-ACK information that is in response to detection of DCI formats with different number of bits for the counter DAI field.  <Unchanged parts are omitted>  **Table 9.1.3-1: Value of counter DAI for and of total DAI**   |  |  |  | | --- | --- | --- | | **DAI MSB, LSB** | **or** | **Number of {serving cell, PDCCH monitoring occasion}-pair(s) in which PDSCH transmission(s) associated with PDCCH or PDSCH transmission(s) associated with PDCCH with enabled HARQ-ACK information if *HARQ-feedbackEnabling-disablingperHARQprocess* is provided or PDCCH generating a HARQ-ACK information bit without scheduling a PDSCH reception or providing TCI state update is present, denoted as and** | | 0,0 | 1 |  | | 0,1 | 2 |  | | 1,0 | 3 |  | | 1,1 | 4 |  |   **Table 9.1.3-1A: Value of counter DAI for**   |  |  |  | | --- | --- | --- | | **DAI** |  | **Number of {serving cell, PDCCH monitoring occasion}-pair(s) in which PDSCH transmission(s) associated with PDCCH or PDSCH transmission(s) associated with PDCCH with enabled HARQ-ACK information if *HARQ-feedbackEnabling-disablingperHARQprocess* is provided or PDCCH generating a HARQ-ACK information bit without scheduling a PDSCH reception or providing TCI state update is present, denoted as and** | | 0 | 1 |  | | 1 | 2 |  |   9.1.3.2 Type-2 HARQ-ACK codebook in physical uplink shared channel  If a UE would multiplex HARQ-ACK information in a PUSCH transmission that is not scheduled by a DCI format or is scheduled by a DCI format that does not include a DAI field, then  - if the UE has not received any PDCCH within the monitoring occasions for DCI formats scheduling PDSCH receptions or PDSCH receptions with enabled HARQ-ACK information if *HARQ-feedbackEnabling-disablingperHARQprocess* is provided, or providing a DCI format having associated HARQ-ACK information without scheduling a 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 in the PUSCH transmission;  - else, the UE generates the HARQ-ACK codebook as described in clause 9.1.3.1, except that *harq-ACK-SpatialBundlingPUCCH* is replaced by *harq-ACK-SpatialBundlingPUSCH*.  If a UE multiplexes HARQ-ACK information in a PUSCH transmission that is scheduled by a DCI format that includes a DAI field, the UE generates the HARQ-ACK codebook as described in clause 9.1.3.1, with the following modifications:  - For the pseudo-code for the HARQ-ACK codebook generation in clause 9.1.3.1, after the completion of the and loops, the UE sets where is the value of the DAI field according to Table 9.1.3-2  - For the case of first and second HARQ-ACK sub-codebooks, the DCI format includes a first DAI field corresponding to the first HARQ-ACK sub-codebook and a second DAI field corresponding to the second HARQ-ACK sub-codebook  *- harq-ACK-SpatialBundlingPUCCH* is replaced by *harq-ACK-SpatialBundlingPUSCH*.  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 PDCCH with DCI format scheduling PDSCH receptions or PDSCH receptions with enabled HARQ-ACK information if *HARQ-feedbackEnabling-disablingperHARQprocess* is provided, 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 PDCCH with DCI format scheduling PDSCH reception or PDSCH receptions with enabled HARQ-ACK information if *HARQ-feedbackEnabling-disablingperHARQprocess* is provided, 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.  **Table 9.1.3-2: Value of DAI**   |  |  |  | | --- | --- | --- | | **DAI MSB, LSB** |  | **Number of {serving cell, PDCCH monitoring occasion}-pair(s) in which PDSCH transmission(s) associated with PDCCH or PDSCH transmission(s) associated with PDCCH with enabled HARQ-ACK information if *HARQ-feedbackEnabling-disablingperHARQprocess* is provided or PDCCH indicating SPS PDSCH release or providing TCI state update or DCI format 1\_1 indicating SCell dormancy is present, denoted as and** | | 0,0 | 1 |  | | 0,1 | 2 |  | | 1,0 | 3 |  | | 1,1 | 4 |  |   ----------------------------------------End of TP 38.213 V17.0.0 section 9.1.3 --------------------------------------------- |

From FL’s perspective, although the updates of the description for C-/T-DAI for Type-2 codebook are needed, the detailed changes can be handled by the editor **once the issue in section 1.1 has been addressed**. Then, the TP#2 is ***not*** recommended and can be left to editor’s updates along with the decision with relevant issue.

Companies are encouraged to share your views below if there is concern.

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| **Company** | **Comments and Views** |
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# **Issue-2 SPS PDSCH**

In last meeting, following agreement has been achieved regarding the SPS transmission:

Agreement

HARQ feedback for SPS activation may be additionally enabled by the network by RRC configuration.

* If enabled, UE reports ACK/NACK for the first SPS PDSCH after activation, regardless of whether HARQ feedback is enabled or disabled corresponding to the first SPS PDSCH after activation
* Otherwise, UE follows configuration of HARQ feedback enabled/disabled corresponding to the first SPS PDSCH after activation,
  + FFS between Alt1 and Alt2
    - [Alt-1: UE follows the per-process configuration of HARQ feedback enabled/disabled for the associated HARQ process
    - Alt-2: UE follows the feedback-enabled/disabled configuration of the SPS PDSCH]

## **Configuration of feedback-disabling for SPS:**

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

Regarding the remaining issue mentioned above, the key point is related to the approach to disable the HARQ feedback in SPS case. The corresponding views are summarized according to the inputs in this meeting:

* Option-1: The feedback for the HARQ process associated to SPS PDSCH can be disabled by RRC configuration per HARQ process (corresponding to the Alt-1 in the agreement achieved in RAN1#107e)
  + Supported by [CMCC, Samsung, ZTE, OPPO, CATT, Nokia, IDC, Ericsson, LGE]
* Option-2: The feedback for the HARQ process associated to SPS PDSCH can be disabled by RRC configuration per SPS configuration (corresponding to the Alt-2 in the agreement achieved in RAN1#107e)
  + Supported by [Huawei, DCM, vivo, Spreadtrum, Panasonic, Apple, CMCC, CAICT, Baicells, NEC]

From FL’s perspective, although benefits regarding the scheduling may be achieved by introducing different configurability on the feedback disabling for the HARA process used by SPS (e.g., whether the feedback disabling of one TB should be configured depends on service requirements and the associated HARQ processes of one SPS config are related to the specific configuration parameters of the SPS config, thus, it’s complicated to ensure the same configuration by the per-process configuration and the per-process configuration will be restricted), it’s workable keep the same configuration. Meanwhile, in RAN2 #116bis-e, it has been agreed that it is up to network implementation to ensure proper configuration of HARQ feedback (enabled/disabled) for HARQ processes is used by an SPS configuration, which is based on Alt-1 without specification impact. The decision has been made since Alt-2 requires higher gNB implementation complexity as well as specification impacts. Given that RAN2 has already made the agreement after extensive discussion, it is better not to repeat the same discussion in RAN1

Agreements online:

1. It is up to network implementation to ensure proper configuration of HARQ feedback (i.e. enabled or disabled) for HARQ processes used by an SPS configuration (no Stage 3 specification impact). FFS if a note in Stage 2 is needed
2. It is up to network implementation to ensure proper configuration of HARQ mode for HARQ processes used by a CG configuration (no Stage 3 specification impact). FFS if a note in Stage 2 is needed
3. For HARQ process(es) configured with HARQ Mode B, blind retransmission relies on UE being in DRX Active Time via other means (i.e. drx-RetransmissionTimerUL is not started).
4. For HARQ process(es) configured with disabled HARQ feedback, blind retransmission relies on UE being in DRX Active Time via other means (i.e. drx-RetransmissionTimerDL is not started).

RAN2 understanding:

1. RAN2 understanding is that: in general, all HARQ processes used by an SPS configuration are configured with the same HARQ feedback enabled/disabled state. No specification impact.
2. RAN2 understanding is that: in general, all HARQ processes used by a CG configuration are configured with the same HARQ state (e.g. A or B). No specification impact

It follows from these RAN2 agreements that there is no need (nor intention from RAN2) to introduce feedback-enabled/disabled configuration specifically for SPS PDSCH, since the per-HARQ-process configuration can be used. Therefore, Alt-2 is not applicable.

Then, following proposal is recommended:

**[Initial Proposal 2.1.1-1]**

If HARQ feedback for SPS activation is not additionally enabled by the network by RRC configuration,

* UE follows the per-process configuration of HARQ feedback enabled/disabled for the associated HARQ process corresponding to the first SPS PDSCH.

Note: The feedback of the HARQ process associated to SPS PDSCH is assumed to be disabled by RRC configuration per HARQ process as dynamic grant.

Companies are encouraged to share your views below:

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| **Company** | **Comments and Views** |
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## **Processing time for SPS**

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

As highlighted by [DCM] that the updates on the processing time based on the RAN1#105e agreement should also be applicable for SPS case except the initial one with activation since there is no corresponding PDCCH as shown below. Then, it’s preferred to update the agreement with red color so that any SPS PDSCH reception is included.



**Proposal & TP from DCM:**

* *Update the RAN1#105-e agreement and apply the following TP.*
  + *Confirm the previous working assumption for X = T\_proc,1 where X is defined from the end of the reception of the last PDSCH or slot-aggregated PDSCH for a given HARQ process with disabled feedback to the start of the PDCCH carrying the DCI scheduling another PDSCH or set of slot-aggregated PDSCH or the PDSCH without corresponding PDCCH for the given HARQ process.*

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| 38.214 V17.0.0  **5.1 UE procedure for receiving the physical downlink shared channel**  ...  ... When HARQ feedback for the HARQ process ID is not disabled, 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, TS 38.213]. For HARQ-ACK subject to HARQ-ACK deferral described in Clause 9.2.5.4 of [6 TS 38.213], the expected transmission of HARQ-ACK corresponds to the expected transmission HARQ-ACK in a first slot. When HARQ feedback for the HARQ process ID is disabled, the UE is not expected to receive another PDCCH carrying a DCI scheduling a PDSCH or set of slot-aggregated PDSCH scheduled for the given HARQ process or to receive another PDSCH without corresponding PDCCH scheduled for the given HARQ process that starts until Tproc,1 after the end of the reception of the last PDSCH or slot-aggregated PDSCH for that HARQ process. ...  ... |

From FL’s perspective, it’s reasonable to apply the same principle for both DG and SPS regarding the processing time and the proposal/TP from DCM is also agreeable.

Then, following proposal is recommended:

**[Initial Proposal 2.2.1-1]**

* *Update the RAN1#105-e agreement and apply the following TP.*
  + *Confirm the previous working assumption for X = T\_proc,1 where X is defined from the end of the reception of the last PDSCH or slot-aggregated PDSCH for a given HARQ process with disabled feedback to the start of the PDCCH carrying the DCI scheduling another PDSCH or set of slot-aggregated PDSCH or the PDSCH without corresponding PDCCH for the given HARQ process.*

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| ----------------------------------------Start of TP 38.214 V17.0.0 section 5.1 ---------------------------------------------  <Unchanged parts are omitted>  **5.1 UE procedure for receiving the physical downlink shared channel**  <Unchanged parts are omitted>  When HARQ feedback for the HARQ process ID is not disabled, 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, TS 38.213]. For HARQ-ACK subject to HARQ-ACK deferral described in Clause 9.2.5.4 of [6 TS 38.213], the expected transmission of HARQ-ACK corresponds to the expected transmission HARQ-ACK in a first slot. When HARQ feedback for the HARQ process ID is disabled, the UE is not expected to receive another PDCCH carrying a DCI scheduling a PDSCH or set of slot-aggregated PDSCH scheduled for the given HARQ process or to receive another PDSCH without corresponding PDCCH scheduled for the given HARQ process that starts until Tproc,1 after the end of the reception of the last PDSCH or slot-aggregated PDSCH for that HARQ process.  <Unchanged parts are omitted>  ----------------------------------------End of TP 38.214 V17.0.0 section 5.1 --------------------------------------------- |

Companies are encouraged to share your views below:

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| **Company** | **Comments and Views** |
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## **Scheduling restriction for SPS**

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

As mentioned by [OPPO], since the ACK/NACK is always reported for this case if additional signaling is used to enable the feedback for 1st SPS PDSCH, the scheduling restriction for the first SPS PDSCH should follow the procedure with HARQ feedback as shown in Figure 1.



From FL’s perspective, the proposed changes are reasonable and it’s recommended to agree the changes.

Then, following proposal is recommended:

**[Initial Proposal 2.3.1-1]**

Adopt the following TP (38.214, Section 5.1):

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| ----------------------------------------Start of TP 38.214 V17.0.0 section 5.1 ---------------------------------------------  <Unchanged parts are omitted>  5.1 UE procedure for receiving the physical downlink shared channel  <Unchanged parts are 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. When the UE is scheduled with multiple PDSCHs by a DCI, HARQ process ID indicated by this DCI applies to the first PDSCH not overlapping with a UL symbol indicated by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated* if provided, HARQ process ID is then incremented by 1 for each subsequent PDSCH(s) in the scheduled order, with modulo operation of *nrofHARQ-ProcessesForPDSCH* applied. HARQ process ID is not incremented for PDSCH(s) not received if at least one of the symbols indicated by the indexed row of the used resource allocation table in the slot overlaps with a UL symbol indicated by *tdd-UL-DL-ConfigurationCommon* or *tdd-UL-DL-ConfigurationDedicated* if provided. 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. When HARQ feedback for the HARQ process ID is not disabled, or for the HARQ process associated with the first SPS PDSCH when *HARQ-feedbackEnablingforSPSactive* is provided, 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, TS 38.213]. For HARQ-ACK subject to HARQ-ACK deferral described in Clause 9.2.5.4 of [6 TS 38.213], the expected transmission of HARQ-ACK corresponds to the expected transmission HARQ-ACK in a first slot.  <Unchanged parts are omitted>  ----------------------------------------Start of TP 38.214 V17.0.0 section 5.1 --------------------------------------------- |

Please provide your views below：

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| **Company** | **Comments and Views** |
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# **Issue-3 Processing time for PDSCH with disabled HARQ process**

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

As highlighted by [Xiaomi], in current spec, the determination of T\_proc,1 is related to the value of N1, which is affected by three subcarrier spacing values, i.e., subcarrier spacing of thePDCCH scheduling the PDSCH, the subcarrier spacing of the scheduled PDSCH, and the subcarrier spacing of the uplink channel with which the HARQ-ACK is to be transmitted. When HARQ feedback is disabled, there is no subcarrier spacing of the uplink channel with which the HARQ-ACK is to be transmitted, therefore, updates on the specification is needed with ***following***TP*.*

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| ----------------------------------------Start of TP TS 38.214 v17.0.0 section 5.3 ---------------------------------------------  \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* Unchanged omitted \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*  If the first uplink symbol of the PUCCH which carries the HARQ-ACK information, as defined by the assigned HARQ-ACK timing *K1* and Koffset, if configured, and the PUCCH resource to be used and including the effect of the timing advance, starts no earlier than at symbol *L1*, where *L1* is defined as the next uplink symbol with its CP starting after  after the end of the last symbol of the PDSCH carrying the TB being acknowledged, then the UE shall provide a valid HARQ-ACK message.  *-* When the PDSCH carried by HARQ feedback-enabled HARQ process, *N1* is based on *µ* of table 5.3-1 and table 5.3-2 for UE processing capability 1 and 2 respectively, where *µ* corresponds to the one of (*µPDCCH*, *µPDSCH*, *µUL*) resulting with the largest *Tproc,1*, where the *µPDCCH* corresponds to the subcarrier spacing of the PDCCH scheduling the PDSCH, the *µPDSCH* corresponds to the subcarrier spacing of the scheduled PDSCH, and *µUL* corresponds to the subcarrier spacing of the uplink channel with which the HARQ-ACK is to be transmitted, and κ is defined in clause 4.1 of [4, TS 38.211]. When the PDSCH carried by HARQ feedback-disabled HARQ process, *N1* is based on *µ* of table 5.3-1 and table 5.3-2 for UE processing capability 1 and 2 respectively, where *µ* corresponds to the one of (*µPDCCH*, *µPDSCH*,*~~µ~~~~UL~~*) resulting with the largest *Tproc,1*, where the *µPDCCH* corresponds to the subcarrier spacing of the PDCCH scheduling the PDSCH, the *µPDSCH* corresponds to the subcarrier spacing of the scheduled PDSCH.  \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* Unchanged omitted \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*  ----------------------------------------End of TP TS 38.214 v17.0.0 section 5.3 --------------------------------------------- |

However, from FL’s perspective, since we have achieved the following agreement in last meeting.

Agreement

The bit-fields related to the HARQ-ACK feedback (i.e., PRI, PUSCH-to-HARQ\_feedback timing, DAI) are unchanged for the DCI of PDSCH with feedback-disabled HARQ process in Rel-17 with the same interpretation from UE as for feedback-enabled HARQ process

* Note: The interpretation regarding the DAI for Type-2 codebook is up to the progress of codebook design.

Meanwhile, as captured in latest spec (copied below, R1-2112934):

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| 9.2.3 UE procedure for reporting HARQ-ACK  In this clause, for the purpose of determining a PUCCH resource for a PUCCH transmission in a slot using a PUCCH resource indicator field in a DCI format that schedules a PDSCH reception, and for the purpose of determining the slot for the PUCCH transmission, a UE is assumed to generate HARQ-ACK information regardless of whether or not the PDSCH reception provides a transport block for a HARQ process with disabled HARQ-ACK information as indicated by *HARQ-feedbackEnabling-disablingperHARQprocess*, if provided. The UE determines a number of HARQ-ACK information bits as described in clauses 9.1 through 9.1.5 and a corresponding set of PUCCH resources as described in clause 9.2.1. |

The determination of PUCCH resource for HARQ-ACK can still following the legacy procedure regardless of whether or not the PDSCH reception provides a TB for a HARQ process with disabled HARQ-ACK information. Then, the legacy behavior to determine the value of T\_proc,1, can still be applicable and **no further clarification is needed**.

Please provide your views below：

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| **Company** | **Comments and Views** |
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# **Issue 5 UE capability [Closed]**

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

As highlighted by [DCM] that the supports of 32 HARQ processes is for NTN and B52.6 GHz. The updates on the spec to cover both cases are preferred with following TP.

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| 38.214 V17.0.0  **5.1 UE procedure for receiving the physical downlink shared channel**  For downlink, a maximum of 16 HARQ processes per cell are supported by the UE, or subject to UE capability, a maximum of 32 HARQ processes per cell for the cases of μ = 5 and μ = 6 or for the cases of communications via satellite/HAPS or with ATG gNB as specified in [8, TS 38.101-X]. The number of processes the UE may assume will at most be used for the downlink is configured to the UE for each cell separately by higher layer parameter *nrofHARQ-ProcessesForPDSCH*, and when no configuration is provided the UE may assume a default number of 8 processes.  ...  **6.1 UE procedure for transmitting the physical uplink shared channel**  ...  For uplink, 16 HARQ processes per cell are supported by the UE, or subject to UE capability, a maximum of 32 HARQ processes per cell for the cases of μ = 5 or μ = 6 or for the cases of communications via satellite/HAPS or with ATG gNB as specified in [8, TS 38.101-X]. |

Meanwhile, [Xiaomi] emphasizes that extending the support of 32 HARQ process to other feature ground is not preferred.

[Samsung] also prefer to enable the 32 HARQ process without increasing UE soft buffer size with following approach.

* *Option 1. gNB informs a maximum TBS and UE reports its capability for a number of HARQ processes.*
* *Option 2. UE reports separate capabilities for a number of predefined pairs of {maximum number of HARQ processes, maximum TBS}.*

In addition, since a UE is also aware of its soft buffer status and would be beneficial for the UE to request HARQ-ACK disabling for HARQ processes. The UE can use the *UEAssistanceInformation* to request a number of HARQ processes for HARQ-ACK disabling/enabling. The UE may also report its soft buffer size to the gNB as part of the UE capability information.

From FL’s perspective, all UE capability related discussion can be handled in the [108-e-R17-UE-features-NR-NTN-01]/ [108-e-R17-UE-features-32HARQ].

# **Others**

## **Restriction on the RV value [L]**

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

As highlighted by [QC], it has been agreed that HARQ processes with feedback disabled are still configured to allow blind retransmissions. Without HARQ-ACK feedbacks, however, DL scheduling of the HARQ process will be susceptible to errors without additional enhancements. An example is shown in Figure 3. In the figure, all transmissions are of the same HARQ process carrying different TBs. Suppose UE misses the PDCCH of the second PDSCH and HARQ feedback is disabled for the process, UE will understand the third PDSCH as a retransmission of the first PDSCH and miss the third PDSCH again. When HARQ feedback is enabled, the above scenario is unlikely to happen. Since network knows that the second PDSCH was missed, it will schedule the third PDSCH as a retransmission of the second PDSCH instead of a new transmission. Then, following approach is proposed:

*For DL HARQ processes with HARQ feedback disabled, initial transmissions shall use RV 0 and retransmissions shall not use RV 0.*



Figure 3. Example DL scheduling using NDI: Without HARQ feedback and if UE misses the PDCCH of second transmission, UE will understand the third transmission as a repetition of the first.

From FL’s perspective, without the assumption that the UE will conduct the LLR combination for the scheduling with feedback-disabled HARQ process, the gNB will avoid the scheduling with improper RV in the implementation (especially for same HARQ ID). Then, **no further enhancement and specification impact is expected**.

Please share your views on this proposal and potential way forward if there is concern.

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| **Company** | **Comments and Views** |
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## **Restriction on HARQ feedback disabling [L]**

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

In RAN1#102e meeting, following agreement has been achieved:

Agreement:

Enabling/disabling on HARQ feedback for downlink transmission should be at least configurable per HARQ process via UE specific RRC signaling

However, in current specification, some mechanisms, i.e., delivering MAC CE command, depend on the ACK-NACK feedback. To avoid the potential misalignment between gNB’s and UE’s behaviour, corresponding enhancements have been discussed in past meetings without consensus.

In this meeting, views to introduce the explicit restriction on HARQ disabling for the PDSCH carrying MAC CE(s) are highlighted by [CATT, IDC] with following proposal:

*RAN1 makes a conclusion that UE expects that MAC-CEs (except for the TAC command) are transmitted using HARQ processes with feedback enabled.*

From FL’s perspective, since this issue has been discussed in multiple meetings with diverse view, no further discussion on this aspect is recommended and proper scheduling of MAC CE with feedback-enabled HARQ process can be ensured by the gNB’s implementation.

Please share your views on this proposal and potential way forward if there is concern.

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| **Company** | **Comments and Views** |
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## **PUSCH scheduling restriction [L]**

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

[OPPO] also propose to define a minimum gap (e.g., T\_proc,2) between two PUSCHs of a HARQ process and clarify the PUSCH transmission constraint and PDSCH reception constraint for a given enabled UL and DL HARQ process, respectively.





However, according to the discussion in previous meeting, from FL’s perspective:

1. According to existing process, only HARQ feedback disabling for the DL transmission is agreed, no additional enhancement has been considered for UL transmission.

*Agreement:*

*Enabling/disabling on HARQ feedback for downlink transmission should be at least configurable per HARQ process via UE specific RRC signaling*

Agreement from RAN2#112e:

1. From RAN2 perspective, for dynamic grant, one possibility for "enabling"/"disabling" HARQ uplink retransmission at UE transmitter is without introducing an additional mechanism (i.e. gNB can send grant with NDI not toggled/toggled without waiting for decoding result of previous PUSCH transmission). FFS on the handling of RTT timers. Other solutions for enabling/disabling HARQ UL reTX are not precluded

Agreement:

1. For HARQ state B, FFS to run drx-RetransmissionTimerUL for blind UL retransmission

2. UE configured with an UL HARQ retransmission state (i.e. A or B) will always act as indicated in a grant/assignment provided during a valid occasion (i.e. subject to legacy restrictions in e.g. MAC and RAN1 specifications). (No RAN2 specification impact)

1. In the existing specification, w.r.t the PUSCH scheduling, followings are defined in 38.214:

*The UE is not expected to be scheduled to transmit another PUSCH by DCI format 0\_0, 0\_1 or 0\_2 scrambled by C-RNTI or MCS-C-RNTI for a given HARQ process until after the end of the expected transmission of the last PUSCH for that HARQ process.*

*If the first uplink symbol in the PUSCH allocation for a transport block, including the DM-RS, as defined by the slot offset K2 and the start and length indicator SLIV of the scheduling DCI and including the effect of the timing advance, is no earlier than at symbol L2, where* *L2 is defined as the next uplink symbol with its CP starting*  *after the end of the reception of the last symbol of the PDCCH carrying the DCI scheduling the PUSCH, then the UE shall transmit the transport block.*

Moreover, following conclusion has been achieved in RAN1#104e to further clarify the potential ambiguity on the scheduling part for legacy spec. And further discussion on other cases are still discussed parallel in this meeting.

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| **Conclusion**  For the sentence “The UE is not expected to be scheduled to transmit another PUSCH by DCI format 0\_0 or 0\_1 scrambled by C-RNTI or MCS-C-RNTI for a given HARQ process until after the end of the expected transmission of the last PUSCH for that HARQ process.” in TS 38.214 Clause 6.1,   * The common understanding is that the DCI is expected to be received after the end of the last PUSCH. |

Then, proponents are encouraged to have the offline discusses with other companies and we can come back to this topic if there is progress.

Please share your views if there is concern.

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| **Company** | **Comments and Views** |
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## **PDSCCH scheduling restriction [L]**

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

As pointed by [Samsung], in Rel-16, a UE does not expect to receive a first PDCCH indicating a first PUCCH transmission with HARQ-ACK in a first slot and a second PDCCH, after the first PDCCH, indicating a second PUCCH transmission with HARQ-ACK in a second slot that is before the first slot. The Rel-16 “out-of-order” scheduling does not apply when a PDCCH is associated with a HARQ process having disabled HARQ-ACK report as there is no indication of a PUCCH transmission with HARQ-ACK (if PUCCH is transmitted, it would be due to another PDCCH associated with a HARQ process with enabled HARQ-ACK report). Therefore, only the PDSCH processing timeline constraint for is necessary. As pointed by [CATT], reuse the legacy “OOO” is still recommended.

From FL’s perspective, the following agreement has been achieved with corresponding updates in the spec (R1-2112934):

Agreement

The bit-fields related to the HARQ-ACK feedback (i.e., PRI, PUSCH-to-HARQ\_feedback timing, DAI) are unchanged for the DCI of PDSCH with feedback-disabled HARQ process in Rel-17 with the same interpretation from UE as for feedback-enabled HARQ process

* Note: The interpretation regarding the DAI for Type-2 codebook is up to the progress of codebook design.

|  |
| --- |
| 9.2.3 UE procedure for reporting HARQ-ACK  In this clause, for the purpose of determining a PUCCH resource for a PUCCH transmission in a slot using a PUCCH resource indicator field in a DCI format that schedules a PDSCH reception, and for the purpose of determining the slot for the PUCCH transmission, a UE is assumed to generate HARQ-ACK information regardless of whether or not the PDSCH reception provides a transport block for a HARQ process with disabled HARQ-ACK information as indicated by *HARQ-feedbackEnabling-disablingperHARQprocess*, if provided. The UE determines a number of HARQ-ACK information bits as described in clauses 9.1 through 9.1.5 and a corresponding set of PUCCH resources as described in clause 9.2.1. |

Then, the legacy behavior is still applicable without changes and **no further discussion** is needed on this issue.

Please share your views if there is concern.

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| **Company** | **Comments and Views** |
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## **Enhancement on the Type-2 feedback [Closed]**

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

As pointed by [QC], additional techniques for improved feedback efficiency is necessary for NTN. For dynamic codebook, this can be done by spatial bundling all the feedback bits so that only one bit is transmitted. If there is one or more PDSCH decoding failures, UE will provide a negative feedback and network will retransmit all the PDSCHs. To ensure a small probability of PDSCH retransmission, network can limit the number of PDSCHs before feedback is requested and slightly reduce the target BLER of PDSCH transmissions with following approach.

*For Type-2 HARQ codebook, support spatial bundling of all feedback bits in a codebook if the number of feedback bits without bundling is less than or equal to N.*

* *FFS: the value of N.*

From FL’s perspective, the proposed enhancement is not critical and only for performance optimization with additional spec impact. Then, in the maintenance phase, further discussion on this topic is not needed and this issue is **closed**.

## **Extension of aggregation factor [Closed]**

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

In this meeting, [CATT] prefer to extend the aggregation factor to 16 as one approach to improve the performance in NTN. Since the corresponding discussion to ensure the performance will be expected in Rel-18, as common understanding, no further discussion in Rel-17 is needed. Then, this issue is **closed**.

# **Proposals for discussion at GTW sessions**

# **Conclusion**

# **Appendix**

[R1-2200939](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2200939.zip) Maintenance on HARQ enhancement for NTN Huawei, HiSilicon

[R1-2201092](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2201092.zip) Remaining issues on HARQ enhancements for NR-NTN vivo

[R1-2201273](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2201273.zip) Discussion on remaining issue for HARQ enhancements OPPO

[R1-2201360](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2201360.zip) Remaining issues on HARQ operation enhancement for NTN CATT

[R1-2201478](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2201478.zip) Remaining issues on HARQ enhancements for NR NTN NTT DOCOMO, INC.

[R1-2201548](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2201548.zip) Discussion on enhancements on HARQ for NTN Spreadtrum Communications

[R1-2201633](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2201633.zip) HARQ enhancement for NTN Panasonic Corporation

[R1-2201647](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2201647.zip) Maintenance aspects related to HARQ for Rel-17 NR over NTN Nokia, Nokia Shanghai Bell

[R1-2201746](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2201746.zip) Remaining issues on HARQ enhancement for NTN InterDigital, Inc.

[R1-2201773](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2201773.zip) Remaining Issue of HARQ Enhancements for NR NTN Apple

[R1-2201806](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2201806.zip) On HARQ maintenance issues for NR NTN Ericsson Hungary Ltd

[R1-2201854](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2201854.zip) Remaining issues on enhancements on HARQ for NTN CMCC

[R1-2201923](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2201923.zip) Discussion on HARQ for NTN Xiaomi

[R1-2201960](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2201960.zip) Remaining issues on enhancements on HARQ to support NTN CAICT

[R1-2202013](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2202013.zip) Maintenance issues on HARQ aspects for NTN Samsung

[R1-2202139](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2202139.zip) Remaining issues on HARQ for NTN Qualcomm Incorporated

[R1-2202208](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2202208.zip) Remaining issues of HARQ for NR-NTN ZTE

[R1-2202242](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2202242.zip) Remaining issues on HARQ enhancement for NTN Baicells

[R1-2202287](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2202287.zip) Remaining issues on HARQ enhancements in NTN LG Electronics

[R1-2202362](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_108-e\Docs\R1-2202362.zip) Remaining issues on HARQ enhancements for NR NTN NEC