**3GPP TSG RAN WG1 Meeting #105-e R1-210xxxx**

e-Meeting, May 19-27, 2021

**Agenda Item: 7.2.2**

**Source: Moderator (Huawei)**

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

**Document for: Discussion and Decision**

# Introduction

Corrections on NR-U HARQ have been submitted at RAN1#105 e-meeting. This first summary asks for companies’ views on the criticality of the proposed corrections during the preparation phase (May 14-18), including whether discussion is needed for clarification before we can determine whether an issue is critical or essential.

# Preparation phase

The corrections proposed in 5 Tdocs to RAN1#105 are summarized in the table below.

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| **Issue #** | **Issue summary** | **Contributions** |
| HARQ1 | **Issue: text in TS38.300 limits re-transmission of HARQ-ACK feedback with enhanced type-2 codebook and type-3 codebook to shared spectrum access, whereas FGs 10-15/10-16 are applicable to licensed bands as well.**  --------------- Text Proposal TP#1 for 38.300, Section 5.2.5.4 ----------------------  \*\*\* Unchanged text omitted \*\*\* 5.2.5.4 HARQ Asynchronous Incremental Redundancy Hybrid ARQ is supported. The gNB provides the UE with the HARQ-ACK feedback timing either dynamically in the DCI or semi-statically in an RRC configuration. Retransmission of HARQ-ACK feedback is supported by using enhanced dynamic codebook and/or one-shot triggering of HARQ-ACK transmission for all configured CCs and HARQ processes in the PUCCH group.  The UE may be configured to receive code block group based transmissions where retransmissions may be scheduled to carry a sub-set of all the code blocks of a TB.  \*\*\* Unchanged text omitted \*\*\*  ------------------------------------ End Text Proposal --------------------------------- | R1-2104458 |
| HARQ2 | **Issue: enhanced dynamic HARQ-ACK codebook cannot be configured by *pdsch-HARQ-ACK-Codebook-secondaryPUCCHgroup-r16***  Proposal 1: Discuss and decide which solution to be adopted for the relationship between *pdsch-HARQ-ACK-Codebook-r16* and *pdsch-HARQ-ACK-Codebook-secondaryPUCCHgroup-r16*   * Solution 1: If *pdsch-HARQ-ACK-Codebook-r16* and *pdsch-HARQ-ACK-Codebook-secondaryPUCCHgroup-r16* are configured simultaneously, enhanced dynamic HARQ-ACK codebook is applied to primary PUCCH group, and semi-static or dynamic HARQ-ACK codebook configured by *pdsch-HARQ-ACK-Codebook-secondaryPUCCHgroup* is applied to secondary PUCCH group. * Solution 2: If *pdsch-HARQ-ACK-Codebook-r16* is configured, the same RRC configuration *pdsch-HARQ-ACK-Codebook-r16* is applied to both primary PUCCH group and secondary PUCCH group if two PUCCH groups are configured regardless of whether *pdsch-HARQ-ACK-Codebook-secondaryPUCCHgroup-r16* is configured or not.   Proposal 2: If solution 1 is adopted, endorse TP1 and TP2 [in R1-2104476] for TS 38.212 and TS 38.213 respectively. Otherwise if solution 2 is adopted, send an LS to RAN2 to inform the conclusion*.* | R1-2104476 |
| HARQ3 | **Issue: potential inconsistency between RAN1 and RAN2 specifications about when a UE is expected to monitor a DCI scheduling re-transmission for a PDSCH that was scheduled with a NNK1 value.**  **Discussion in R1-2104764** (more details to be found in R1-2104764)  ***Observation 1: Based on RAN2 specification, if a NNK1 is indicated for one HARQ process, UE can immediately monitor the DCI for retransmission.***  Excerpt from RAN2 TS 38.321 clause 5.7 Discontinuous Reception (DRX):  3> if the PDSCH-to-HARQ\_feedback timing indicate a non-numerical k1 value as specified in TS 38.213 [6]:  4> start the *drx-RetransmissionTimerDL* in the first symbol after the PDSCH transmission for the corresponding HARQ process.  ***Observation 2: Based on RAN1 specification, the HARQ process cannot be rescheduled before the transmission of previous HARQ-ACK corresponding to the same HARQ process.***  Excerpt from RAN1 TS38.214:  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].  ***Proposal: Adopt TP for the scheduling order of the PDSCH with NNK1 in RAN1 specification.***  ------------------------ Start of TP 38.214 V16.5.0 section 5.1----------------------  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. 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 a first PDSCH for that HARQ process, where the timing is given by Clause 9.2.3 of [6], except for a PDSCH-to-HARQ\_feedback timing indicator field providing an inapplicable value for the first PDSCH. 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 assigned to be transmitted on a resource ending before the start of a different resource for the HARQ-ACK 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 *subslotLengthForPUCCH* if provided, and the HARQ-ACK for the two PDSCHs are associated with the HARQ-ACK codebook of the same priority.  <Unchanged parts are omitted>  ------------------------ End of TP 38.214 V16.5.0 section 5.1------------------------  **Discussion in R1-2105461**  Issue: when the actual HARQ-ACK feedback timing is not provided further by gNB, whether there is occupation restriction for the HARQ process or not should be clarified   * **Option 1**: An applicable HARQ-ACK feedback timing should be provided later for the HARQ process with NNK1 by gNB, otherwise the HARQ process would be suspended without any further PDSCH reception allowed. In other words, the HARQ process can only be scheduled or configured with any new PDSCH reception after the applicable HARQ-ACK feedback timing is provided. * **Option 2**: An applicable HARQ-ACK feedback timing may not be provided for the HARQ process with NNK1 by gNB before a new PDSCH reception for the HARQ process is scheduled or configured. If no applicable timing is provided before the new PDSCH reception, there may be some limitations for the timing of the new PDSCH reception, e.g., it should be received after a time offset from the ending time of the PDSCH reception with NNK1. The time offset may be specified or configured by considering PDSCH decoding time, or N1, etc. Otherwise, the HARQ process can only be scheduled or configured with any new PDSCH reception after the latest provided applicable HARQ-ACK feedback timing, if any.   ***Proposal 4: When a HARQ process is scheduled with a PDSCH reception with NNK1, and the actual HARQ-ACK feedback timing is not provided, whether there is occupation restriction for the HARQ process or not should be clarified.*** | R1-2104764  R1-2105461 |
| HARQ4 | **NFI and DAI for the non-scheduled group when q=0**  *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*  **NFI assumption for UL DAI when no DL DCI is detected**  *Proposal 3: No assumption for NFI is needed for a UL DAI different than 4 for a PDSCH group that was not scheduled for the UE.* | R1-2105461 |
| HARQ5 | **Issue: correct the use of a RRC parameter in TS38.212**  ------------------------------Start text proposal---------------------------------  7.3.1.2.2 Format 1\_1  ……  - Downlink assignment index – number of bits as defined in the following  - 6 bits if more than one serving cell are configured in the DL and the higher layer parameter *nfi-TotalDAI-Included=true ~~= enable~~*. The 4 MSB bits are the counter DAI and the total DAI for the scheduled PDSCH group, and the 2 LSB bits are the total DAI for the non-scheduled PDSCH group.  - 4 bits if only one serving cell are configured in the DL and the higher layer parameter *nfi-TotalDAI-Included=true ~~= enable~~.* The 2 MSB bits are the counter DAI for the scheduled PDSCH group, and the 2 LSB bits are the total DAI for the non-scheduled PDSCH group;  - 4 bits if more than one serving cell are configured in the DL, the higher layer parameter *pdsch-HARQ-ACK-Codebook=dynamic* or *pdsch-HARQ-ACK-Codebook-r16= enhancedDynamic*, and *nfi-TotalDAI-Included~~=true~~* is not configured, where the 2 MSB bits are the counter DAI and the 2 LSB bits are the total DAI;  - 4 bits if one serving cell is configured in the DL, and the higher layer parameter *pdsch-HARQ-ACK-Codebook=dynamic*, and 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*, where the 2 MSB bits are the counter DAI and the 2 LSB bits are the total DAI;  - 2 bits if only one serving cell is configured in the DL, the higher layer parameter *pdsch-HARQ-ACK-Codebook=dynamic* or *pdsch-HARQ-ACK-Codebook-r16=enhancedDynamic*, and *nfi-TotalDAI-Included~~=true~~* is not configured, when the UE is not configured with *coresetPoolIndex* or the value of *coresetPoolIndex* is the same for all CORESETs if *coresetPoolIndex* is provided or the UE is not configured with *ackNackFeedbackMode = joint*, where the 2 bits are the counter DAI;  - 0 bits otherwise.  --------------------------End text proposal------------------------------- | R1-2105461 |
| HARQ6 | **Issue: correct the use of a RRC parameter in in TS38.213**    According to NR Rel-15, the PDSCH HARQ-ACK codebook could be either semi-static or dynamic by pdsch-HARQ-ACK-Codebook, as following:  pdsch-HARQ-ACK-Codebook ENUMERATED {semiStatic, dynamic},  tpc-SRS-RNTI RNTI-Value OPTIONAL, -- Need R  An enhanced dynamic codebook for PDSCH is designed for Rel-16 NR-U by pdsch-HARQ-ACK-Codebook-r16, as following:  pdsch-HARQ-ACK-Codebook-r16 ENUMERATED {enhancedDynamic} OPTIONAL, -- Need R  **Correction proposed for TS28.213 clause 9.1.3:**  if the UE is provided *pdsch-HARQ-ACK-Codebook-r16*, the UE receives the second DCI format later than the slot for HARQ-ACK information in response to a SPS PDSCH reception received after the PDSCH scheduled by the first DCI format, and the second DCI format indicates a HARQ-ACK information report for a same PDSCH group index as indicated by the first DCI format as described in Clause 9.1.3.3. | R1-2105753 |

**Feedback Form**

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| **Company** | **Comment** |
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# References

[R1-2104458](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_105\Docs\R1-2104458.zip) Corrections related to HARQ Ericsson

[R1-2104476](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_105\Docs\R1-2104476.zip) Discussion on enhanced dynamic HARQ-ACK codebook for secondary PUCCH group CATT

[R1-2104764](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_105\Docs\R1-2104764.zip) Discussion on the remaining issues of HARQ enhancements OPPO

[R1-2105461](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_105\Docs\R1-2105461.zip) Maintenance on HARQ operation for NR-U vivo

[R1-2105753](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_105\Docs\R1-2105753.zip) Correction of higher layer parameter name for NR-U ITRI