**3GPP TSG-RAN WG2 Meeting #128 *DRAFT*\_R2-24xxxx**

**Orlando, USA, Nov. 18th – 22nd, 2024**

**Agenda Item: 6.1.2.1**

**Source: CATT**

**Title: Report of [AT128][006][UP] NTN and one shot feedback (CATT)**

**Document for: Discussion and Decision**

1. Introduction

This contribution reports the progress of the following offline discussion:

* **[AT128][006][UP] NTN and on shot feedback (CATT)**

 Intended outcome: discuss how to capture it in a BC way and agree to CR (if agreable)

 Deadline: Thursday

1. Discussion

## 2.1 Disc Point 1: Which MAC change alternative is preferred?

Currently, there are four alternative ways for the MAC change on the table, regarding the handling of *HARQ-RTT-TimerDL-NTN*.

* **Alternative A** (proposed by Qualcomm during online discussion)

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| When DRX is configured, the MAC entity shall:[...]1> if a DRX group is in Active Time:2> monitor the PDCCH on the Serving Cells in this DRX group as specified in TS 38.213 [6];2> if the PDCCH indicates a DL transmission; or2> if the PDCCH indicates a one-shot HARQ feedback as specified in clause 9.1.4 of TS 38.213 [6]; or2> if the PDCCH indicates a retransmission of HARQ feedback as specified in clause 9.1.5 of TS 38.213 [6]:3> if this Serving Cell is configured with *downlinkHARQ-FeedbackDisabled*:4> if at least one of the corresponding HARQ process(es) is configured with HARQ feedback enabled:5> set *HARQ-RTT-TimerDL-NTN* for the corresponding HARQ process equal to *drx-HARQ-RTT-TimerDL* plus the latest available UE-gNB RTT value;5> if the PDCCH indicates a one-shot HARQ feedback:6> start or restart the *HARQ-RTT-TimerDL-NTN* for the corresponding HARQ process(es) whose HARQ feedback is enabled and reported in the first symbol after the end of the corresponding transmission carrying the DL HARQ feedback.5> else:6> start the *HARQ-RTT-TimerDL-NTN* for the corresponding HARQ process in the first symbol after the end of the corresponding transmission carrying the DL HARQ feedback.3> else:4> start or restart the *drx-HARQ-RTT-TimerDL* for the corresponding HARQ process(es) whose HARQ feedback is reported in the first symbol after the end of the corresponding transmission carrying the DL HARQ feedback.NOTE 3: When HARQ feedback is postponed by PDSCH-to-HARQ\_feedback timing indicating an inapplicable k1 value, as specified in TS 38.213 [6], the corresponding transmission opportunity to send the DL HARQ feedback is indicated in a later PDCCH requesting the HARQ-ACK feedback.[...] |

* **Alternative B** (proposed by CATT in R2-2409605 [1])

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| When DRX is configured, the MAC entity shall:[...]1> if a DRX group is in Active Time:2> monitor the PDCCH on the Serving Cells in this DRX group as specified in TS 38.213 [6];2> if the PDCCH indicates a DL transmission; or2> if the PDCCH indicates a one-shot HARQ feedback as specified in clause 9.1.4 of TS 38.213 [6]; or2> if the PDCCH indicates a retransmission of HARQ feedback as specified in clause 9.1.5 of TS 38.213 [6]:3> if this Serving Cell is configured with *downlinkHARQ-FeedbackDisabled*:4> if at least one of the corresponding HARQ process(es) is configured with HARQ feedback enabled:5> set *HARQ-RTT-TimerDL-NTN* for the corresponding HARQ process equal to *drx-HARQ-RTT-TimerDL* plus the latest available UE-gNB RTT value;5> start or restart the *HARQ-RTT-TimerDL-NTN* for the corresponding HARQ process(es) whose HARQ feedback is enabled and reported in the first symbol after the end of the corresponding transmission carrying the DL HARQ feedback.3> else:4> start or restart the *drx-HARQ-RTT-TimerDL* for the corresponding HARQ process(es) whose HARQ feedback is reported in the first symbol after the end of the corresponding transmission carrying the DL HARQ feedback.NOTE 3: When HARQ feedback is postponed by PDSCH-to-HARQ\_feedback timing indicating an inapplicable k1 value, as specified in TS 38.213 [6], the corresponding transmission opportunity to send the DL HARQ feedback is indicated in a later PDCCH requesting the HARQ-ACK feedback.[...] |

* **Alternative C** (proposed by LG in R2-2410720/R2-2410721 [2][3])

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| When DRX is configured, the MAC entity shall:[...]1> if a DRX group is in Active Time:2> monitor the PDCCH on the Serving Cells in this DRX group as specified in TS 38.213 [6];2> if the PDCCH indicates a DL transmission; or2> if the PDCCH indicates a one-shot HARQ feedback as specified in clause 9.1.4 of TS 38.213 [6]; or2> if the PDCCH indicates a retransmission of HARQ feedback as specified in clause 9.1.5 of TS 38.213 [6]:3> if this Serving Cell is configured with *downlinkHARQ-FeedbackDisabled*:4> if the corresponding HARQ process(es) is configured with HARQ feedback enabled:5> set *HARQ-RTT-TimerDL-NTN* for the corresponding HARQ process(es) equal to *drx-HARQ-RTT-TimerDL* plus the latest available UE-gNB RTT value;5> start or restart the *HARQ-RTT-TimerDL-NTN* for the corresponding HARQ process(es) whose HARQ feedback is reported in the first symbol after the end of the corresponding transmission carrying the DL HARQ feedback.3> else:4> start or restart the *drx-HARQ-RTT-TimerDL* for the corresponding HARQ process(es) whose HARQ feedback is reported in the first symbol after the end of the corresponding transmission carrying the DL HARQ feedback.NOTE 3: When HARQ feedback is postponed by PDSCH-to-HARQ\_feedback timing indicating an inapplicable k1 value, as specified in TS 38.213 [6], the corresponding transmission opportunity to send the DL HARQ feedback is indicated in a later PDCCH requesting the HARQ-ACK feedback.[...] |

* **Alternative D** (proposed by Sharp in R2-2410879 [4])

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| When DRX is configured, the MAC entity shall:[...]1> if a DRX group is in Active Time:2> monitor the PDCCH on the Serving Cells in this DRX group as specified in TS 38.213 [6];2> if the PDCCH indicates a DL transmission; or2> if the PDCCH indicates a one-shot HARQ feedback as specified in clause 9.1.4 of TS 38.213 [6]; or2> if the PDCCH indicates a retransmission of HARQ feedback as specified in clause 9.1.5 of TS 38.213 [6]:3> if this Serving Cell is configured with *downlinkHARQ-FeedbackDisabled*:4> if the corresponding HARQ process(es) whose HARQ feedback is reported is configured with HARQ feedback enabled:5> set *HARQ-RTT-TimerDL-NTN* for the corresponding HARQ process(es) equal to *drx-HARQ-RTT-TimerDL* plus the latest available UE-gNB RTT value;5> start or restart the *HARQ-RTT-TimerDL-NTN* for the corresponding HARQ process(es) whose HARQ feedback is reported in the first symbol after the end of the corresponding transmission carrying the DL HARQ feedback.3> else:4> start or restart the *drx-HARQ-RTT-TimerDL* for the corresponding HARQ process(es) whose HARQ feedback is reported in the first symbol after the end of the corresponding transmission carrying the DL HARQ feedback.NOTE 3: When HARQ feedback is postponed by PDSCH-to-HARQ\_feedback timing indicating an inapplicable k1 value, as specified in TS 38.213 [6], the corresponding transmission opportunity to send the DL HARQ feedback is indicated in a later PDCCH requesting the HARQ-ACK feedback.[...] |

Note that during the online discussion, Qualcomm suggested to separate the handling of *HARQ-RTT-TimerDL-NTN* for the one-shot HARQ feedback case and for the other cases into difference branches, so as to avoid the impacts on the existing *HARQ-RTT-TimerDL-NTN* operation procedure for the cases other than one-shot HARQ feedback. This is how the Alternative A above comes.

Rapporteur thinks the suggestion from Qualcomm is decent, and thus Alternative A can be followed. Also, from readability perspective, such separation on different cases looks more reader friendly to track different handling for different cases, even with comparatively bigger Spec change than other alternatives. So Rapporteur suggests to go with Alternative A.

### **[Question 1]** Can companies accept Alternative A above for the MAC Spec change?

DISCUSSION

- Qualcomm: there are three conditions within the upper level conditions, so not impacting legacy behaviour is important.

- Sharp: all solutions do not impact legacy/non-one-shot case. LG’s version is mostly copied-pasted from R17 behaviour. All Alternatives B/C/D mostly come from the legacy. Whether HARQ feedback re- transmission is supported in NTN is not unclear.

- Sharp: Need to discuss whether one-shot feedback and HARQ feedback transmission are both supported. They think this should be the case.

- CATT: seems majority share the same understanding.

- LG: Even if we have no separation like in Alt.A, the UE receiving PDCCH scheduling only DL TX will not go into the restart branch.

 - ZTE: With or w/o separation, UE behjaviour is the same. Can leave with having two conditions for one-shot and retransmission HARQ Feedback, and having the separation.

 - vivo: Agree with QC/ZTE that the change only applies to the two conditions of retx HARQ FB and one-shot FB.

- Sharp: restart operation also applies to the condition “2> if the PDCCH indicates a DL transmission”, because of one-shot FB performed in the past.

- Nokia: share the view of Sharp. But can live with just two conditions.

- Ericsson: Share the view from Sharp.

- CATT: Seems majority can accept the revised Alternative A.

CONCLUSION

**=> The offline discussion concludes the below Revised Alternative A**

* **Revised Alternative A** (concluded during offline discussion)

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| When DRX is configured, the MAC entity shall:[...]1> if a DRX group is in Active Time:2> monitor the PDCCH on the Serving Cells in this DRX group as specified in TS 38.213 [6];2> if the PDCCH indicates a DL transmission; or2> if the PDCCH indicates a one-shot HARQ feedback as specified in clause 9.1.4 of TS 38.213 [6]; or2> if the PDCCH indicates a retransmission of HARQ feedback as specified in clause 9.1.5 of TS 38.213 [6]:3> if this Serving Cell is configured with *downlinkHARQ-FeedbackDisabled*:4> if at least one of the corresponding HARQ process(es) is configured with HARQ feedback enabled:5> set *HARQ-RTT-TimerDL-NTN* for the corresponding HARQ process(es) equal to *drx-HARQ-RTT-TimerDL* plus the latest available UE-gNB RTT value;5> if the UE is configured with one-shot HARQ Feedback:6> start or restart the *HARQ-RTT-TimerDL-NTN* for the corresponding HARQ process(es) whose HARQ feedback is enabled and reported in the first symbol after the end of the corresponding transmission carrying the DL HARQ feedback.5> else:6> start the *HARQ-RTT-TimerDL-NTN* for the corresponding HARQ process in the first symbol after the end of the corresponding transmission carrying the DL HARQ feedback.3> else:4> start or restart the *drx-HARQ-RTT-TimerDL* for the corresponding HARQ process(es) whose HARQ feedback is reported in the first symbol after the end of the corresponding transmission carrying the DL HARQ feedback.NOTE 3: When HARQ feedback is postponed by PDSCH-to-HARQ\_feedback timing indicating an inapplicable k1 value, as specified in TS 38.213 [6], the corresponding transmission opportunity to send the DL HARQ feedback is indicated in a later PDCCH requesting the HARQ-ACK feedback.[...] |

## 2.2 Disc Point 2: How to make the change BC?

Strictly speaking, the existing procedure for *HARQ-RTT-TimerDL-NTN* handling is not correct in the case of one-shot HARQ Feedback, meaning that the UE implementation based on the current MAC spec (if any) cannot behave correctly in this case.

Then after we introduce the MAC correction, there is the backward compatible issue that the new gNB implemented based on the CR including this MAC correction may configure and indicate one-shot HARQ feedback to an “old” UE implemented based on the existing MAC spec., in which case the UE behaves mistakenly for the *HARQ-RTT-TimerDL-NTN* handling. This makes the change functional NBC.

The way to avoid such functional NBC issue that Rapporteur can think of is to introduce a new UE capability, for the new gNB to distinguish whether a UE is a new UE implementing this MAC change, or an old UE not implementing this MAC change, so as to determine whether to configure/indicate the UE to perform one-shot HARQ feedback and corresponding *HARQ-RTT-TimerDL-NTN* handling in NR NTN.

### **[Question 2]** Are companies OK to introduce a new UE capability, to make the MAC change BC? Or any other suggestion to make the change BC?

DISCUSSION

- Rapporteur’s observation: People seem to be confident that on combination of “one-shot Feedback” and “HARQ Feedback enabled/disabled” are implemented. So there seems no new UE capability needed.

CONCLUSION

**=> No new UE capability is introduced.**

### **[Question 2a]** If companies agree with a new UE capability, do companies agree that this UE capability indicates “whether the UE supports *HARQ-RTT-TimerDL-NTN* handling when one-shot HARQ feedback is indicated in NR NTN”?

DISCUSSION

- No discussion is needed.

## 2.3 Disc Point 3: From which release to change?

Some companies want to start the change from Rel-18, but some others think it should be started from Rel-17. Note that from which release to change may also have something to do with the BC aspects discussed above, especially whether companies want to introduce a new UE capability additionally or to have the MAC change only.

### **[Question 3]** Based on companies’ input to above questions, should the changes (i.e. MAC change and UE capability change, if agreed) be introduced from Rel-17 or Rel-18?

DISCUSSION

- Rapporteur’s observation was as follows

* The majority seems to be OK to change from Rel-17;
* Some companies prefer changing from Rel-18 with a cover-page sentence saying that the CR is an essential correction for the implementation of the combination of “one-shot HARQ Feedback” and “HARQ feedback enabled/disabled” feature in NR NTN. They need more time to check.

CONCLUSION

**=> Further discuss online whether the correction is made from R18 (with an “essential correction” description in the cover page) or from Rel-17 (majority’s view).**

3. Conclusion

Based on the offline discussion conclusion in clause 2, the proposals from this offline discussion are given as follows:

**Proposal 1: RAN2 agrees the TP for TS 38.321 as follows:**

* **Revised Alternative A** (concluded during offline discussion)

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| When DRX is configured, the MAC entity shall:[...]1> if a DRX group is in Active Time:2> monitor the PDCCH on the Serving Cells in this DRX group as specified in TS 38.213 [6];2> if the PDCCH indicates a DL transmission; or2> if the PDCCH indicates a one-shot HARQ feedback as specified in clause 9.1.4 of TS 38.213 [6]; or2> if the PDCCH indicates a retransmission of HARQ feedback as specified in clause 9.1.5 of TS 38.213 [6]:3> if this Serving Cell is configured with *downlinkHARQ-FeedbackDisabled*:4> if at least one of the corresponding HARQ process(es) is configured with HARQ feedback enabled:5> set *HARQ-RTT-TimerDL-NTN* for the corresponding HARQ process(es) equal to *drx-HARQ-RTT-TimerDL* plus the latest available UE-gNB RTT value;5> if the UE is configured with one-shot HARQ Feedback:6> start or restart the *HARQ-RTT-TimerDL-NTN* for the corresponding HARQ process(es) whose HARQ feedback is enabled and reported in the first symbol after the end of the corresponding transmission carrying the DL HARQ feedback.5> else:6> start the *HARQ-RTT-TimerDL-NTN* for the corresponding HARQ process in the first symbol after the end of the corresponding transmission carrying the DL HARQ feedback.3> else:4> start or restart the *drx-HARQ-RTT-TimerDL* for the corresponding HARQ process(es) whose HARQ feedback is reported in the first symbol after the end of the corresponding transmission carrying the DL HARQ feedback.NOTE 3: When HARQ feedback is postponed by PDSCH-to-HARQ\_feedback timing indicating an inapplicable k1 value, as specified in TS 38.213 [6], the corresponding transmission opportunity to send the DL HARQ feedback is indicated in a later PDCCH requesting the HARQ-ACK feedback.[...] |

**Proposal 2: RAN2 discusses whether to introduce the agreed MAC change from Rel-17 or from Rel-18:**

* **If RAN2 agrees to introduce the change from Rel-17, agree the CRs in R2-24abcde and R2-24vwxyz;**
* **If RAN2 agrees to introduce the change from Rel-18, agree the CR in R2-24vwxyz.**

**Proposal 3: No new UE capability is introduced.**

4. Reference

1. R2-2409605 Discussion on remaining issues for one-shot HARQ Feedback in NR NTN CATT.
2. R2-2410720 Correction on drx HARQ RTT timer in NTN LG Electronics Inc.
3. R2-2410722 Correction on drx HARQ RTT timer in NTN LG Electronics Inc.
4. R2-2410879 NTN DRX Timer Handling and URLLC One-Shot HARQ Feedback Sharp

Appendix: Assistance info on RAN1 procedure [1]

Based on the RAN1 procedure in TS 38.213 (see below Table A.1), an example is shown in [1] and cited as follows. Note that based on RAN1 Spec, it is supported at least by RAN1 Spec that among the HARQ processes configured for one-shot HARQ feedback, only a portion of them are configured with HARQ feedback enabled (and thus need be further filtered out in the PHY as per the following green-marked step in Table A.1).



**Table A.1: One-shot HARQ feedback procedure in TS 38.213**

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| 9.1.4 Type-3 HARQ-ACK codebook determination If a UE is provided *pdsch-HARQ-ACK-OneShotFeedback* or *pdsch-HARQ-ACK-EnhType3ToAddModList*, the UE determines $\tilde{o}\_{0}^{ACK},\tilde{o}\_{1}^{ACK},…,\tilde{o}\_{O\_{ACK}−1}^{ACK}$ HARQ-ACK information bits, for a total number of $O\_{ACK}$ HARQ-ACK information bits, of a Type-3 HARQ-ACK codebook according to the following procedure. If the UE is provided *pdsch-HARQ-ACK-EnhType3ToAddModList* and a DCI format scheduling PDSCH reception and triggering the Type-3 HARQ-ACK codebook includes an enhanced Type 3 codebook indicator field that provides a value for *pdsch-HARQ-ACK-EnhType3Index*, the UE determines a size of a set of indicated serving cells $N\_{cells}^{DL,ind}$ and a size of a set of indicated HARQ process numbers $N\_{HARQ,c}^{DL,ind}$ for each indicated serving cell and each indicated HARQ process number from the entry in *pdsch-HARQ-ACK-EnhType3ToAddModList* corresponding to the *pdsch-HARQ-ACK-EnhType3Index* value. Each bit from MSB to LSB provided by *perCC* corresponds to a serving cell in ascending order of serving cell index, where value ‘1’ or value ‘0’ indicate HARQ-ACK for the corresponding serving cell is included or not included in the Type 3 HARQ-ACK codebook, respectively. Each bit string provided by *perHARQ* corresponds to a serving cell in ascending order of serving cell index, and each bit from MSB to LSB within a bit string corresponds to a HARQ process number on a corresponding serving cell in ascending order of HARQ process number, where value ‘1’ or value ‘0’ indicate HARQ-ACK for the corresponding HARQ process number on the corresponding serving cell is included or not included in the Type 3 HARQ-ACK codebook, respectively. If the DCI format does not include the enhanced Type 3 codebook indicator field, the *pdsch-HARQ-ACK-EnhType3Index* value is zero.[…]Set $NDI\_{HARQ}=0$ if *pdsch-HARQ-ACK-OneShotFeedbackNDI* or *pdsch-HARQ-ACK-EnhType3NDI* is provided; else set $NDI\_{HARQ}=1$.Set $c=0$ – serving cell index in the set of serving cellsSet $ℎ=0$ – HARQ process number index in the set of numbers of HARQ processesSet $t=0$ – TB indexSet $g=0$ – CBG indexSet $j=0$while $c<N\_{cells}^{DL}$while $ℎ<N\_{HARQ,c}^{DL}$if *downlinkHARQ-FeedbackDisabled* is not provided, or is provided and indicates enabled HARQ-ACK information for $ℎ$, or *harq-feedbackEnablingforSPSactive* is provided and enabled and $ℎ$ corresponds to a transport block in a first SPS PDSCH reception after an activation of SPS PDSCH receptionsif $NDI\_{HARQ}=0$if $N\_{HARQ−ACK,c}^{CBG/TB,max}>0$while $t<N\_{TB,c}^{DL}$while $g<N\_{HARQ−ACK,c}^{CBG/TB,max}$$\tilde{o}\_{j}^{ACK}$= HARQ-ACK information bit for CBG $g$ of TB $t$ for HARQ process number index $ℎ$ in the set of numbers of HARQ processes of serving cell $c$, if any; else, $\tilde{o}\_{j}^{ACK}=0$$j=j+1$ $g=g+1$ end while[…]end while$ℎ=0$ $c=c+1$ end while[…] |