3GPP TSG-RAN WG2 #117-e draftTdoc R2-2203572

Electronic meeting, Feb 21st – Mar 3rd, 2022

Agenda Item: 4.1

Source: Ericsson (Rapporteur)

Title: Report for [AT117-e][305][NBIOT R15] 2 HARQ processes and HARQ RTT timer

Document for: Discussion, Decision

# 1 Introduction

In RAN2#117-e, the following offline is allocated to discuss the issue presented in [R2-2203480](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_117-e/Docs/R2-2203480.zip) and the related CRs, i.e., [R2-2203486](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_117-e/Docs/R2-2203486.zip), [R2-2203495](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_117-e/Docs/R2-2203495.zip), and [R2-2203496](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_117-e/Docs/R2-2203496.zip).

* [AT117-e][305][NBIOT R15] 2 HARQ processes and HARQ RTT timer (Ericsson)

**Status**: Started

**Scope:** Discussion of whether correction is needed, and work on the CRs.

      **Intended outcome:** Report in R2-2203572, and revised CRs (if needed – Tdocs can be allocated if necessary).

      **Deadline:** Thursday 24th February 1200 UTC

In this document, we capture the comments from companies regarding the discussion document and the related CRs.

Contact information

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# 2 Discussion

## 2.1 Enabling 2 HARQ processes and DRX

When network enables 2 HARQ processes with the intention to schedule them in parallel, HARQ RTT timer configured for DRX may expire at different USS since NPUSCH transmissions end at different times. In this case the 1st HARQ process can be scheduled again during the earlier USS yet the 2nd HARQ process cannot be scheduled when DRX is enabled due to the restriction imposed by the definition of the HARQ RTT timer.

In Figure 1 below, one example of such is shown where non-anchor carrier is assumed so all subframes can be used for scheduling DL transmission, USS Rmax is 4 and G is 2, so the NPDCCH period is 8ms. HARQ 0 can be scheduled again in subframe 40, but since HARQ 1 RTT timer expires in the beginning of subframe 48 and this is already scheduled with NPDSCH transmision for HARQ 0, so only one HARQ process can be scheduled and the pattern will continue with single HARQ process if it happens that theer is more pending data in th DL to be transmitted.



Figure 1. DL *twoHARQ* scheduling pattern with DRX

**Q 2.1.1** Do you agree with the following observation? “When DRX is configured and the network enables scheduling two HARQ processes in parallel, HARQ RTT timers may expire at different USS which will lead to only one HARQ process to be scheduled thereon” Please elaborate your reply and comment especially if you do not agree.

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| **Company** | **Yes/No** | **Comments** |
| MediaTek | No | According to 36.321 5.7, for NB-IoT, when 2 HARQ processes was configured and PDCCH did not indicate multiple TBs, the *drx-InactivityTimer* will be started or restarted after a HARQ RTT Timer expires. And the *drx-InactivityTimer* will not be stopped after PDCCH indicates a transmission (DL, UL) in this case.For the c-HWase of Figure 1 of [1], if the *drx-InactivityTimer* was configured other than *0pp*, subframe 40 to subframe 43 are in Active Time, UE will monitor subframe 41 to subframe 43 for PDCCH even the HARQ 1 RTT timer has not expired yet, HARQ 1 process can be scheduled by NW in this period.Therefore, with the *drx-InactivityTimer* configured other than *0pp,* the observation does not hold. |
| Huawei, HiSilicon | No | We also think that the problem only exists for a specific configuration.  |
| Sequans | No | Agree with MediaTek. Making the required changes just for this single case is not justifiable. |
| Qualcomm | No | We have similar view as HW in that the problems exists for a specific configuration and the solution does not necessarily eliminate the problem for all configurations. |
| ZTE | No | We can agree that, when *twoHARQ* is configured, the HARQ RTT timers may expire at different USS which will lead to only one HARQ process to be scheduled. But we think this is the normal process, not problem. Per our understanding, even for only one HARQ process, with *deltaPDCCH* in the calculation for DRX timer, UE can only monitor NPDCCH (also network scheduling PDCCH) from the beginning of each search space. The UE cannot monitor NPDCCH at the middle of a search space, e.g., in partial search space. We think this is also applied to 2 HARQ processes case. E.g., DRX timer for each HARQ process runs independently. UE process for each HARQ process should follow the timer in this HARQ process.Even with the suggestions from Ericsson or MediaTek, e.g., to deliberately reset *deltaPDCCH* or to avoid *drx-InactivityTimer* configuration with 0pp, it just only make it possible for UE to monitor NPDCCH between subframe 41~43. But as UE cannot monitor NPDCCH in partial search space (network also would not schedule in partial search space), we think the solutions cannot achieve the expected results.  |
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**Summary – Q 2.1.1**

TBD

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**Q 2.1.2** Do you agree that the observation above in Q 2.1.1 also apply to UL? Please elaborate your reply and comment especially if you do not agree.

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| **Company** | **Yes/No** | **Comments** |
| ZTE | No | It seems same situation for UL.  |
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**Summary – Q 2.1.2**

TBD

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## 2.2 Solutions and the related CRs

To address the issue observed in R2-2203480 for DL transmission using 2 HARQ processes, the following solution has been proposed:

“In case network enables scheduling two HARQ processes in parallel and the corresponding HARQ RTT Timers respectively expire at different UE specific search spaces, *deltaPDCCH* is reset for the HARQ RTT Timer corresponding to the DL HARQ process for which HARQ feedback transmission ends last.”

**Q 2.2.1** Do you agree with the proposal? Please elaborate your reply and comment especially if you do not agree or have an alternative solution in mind.

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| **Company** | **Yes/No** | **Comments** |
| MediaTek | No | Since with the *drx-InactivityTimer* configured other than *0pp* HARQ 1 process can be scheduled. The proposal seems not that necessary. |
| ZTE | No | As mentioned in **Q 2.1.1**, with the understang that UE cannot monitor NPDCCH at the middle of a search space, e.g., in partial search space, we think the problem does not exist and the suggested solutions are not needed (also useless). |
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**Summary – Q 2.2.1**

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To address the issue observed in R2-2203480 for UL transmission using 2 HARQ processes, the following solution has been proposed:

“In case network enables scheduling two HARQ processes in parallel and the corresponding UL HARQ RTT Timers respectively expire at different UE specific search spaces, *deltaPDCCH* is reset for the UL HARQ RTT Timer corresponding to the UL HARQ process for which PUSCH transmission ends last.”

**Q 2.2.2** Do you agree with the proposal? Please elaborate your reply and comment especially if you do not agree or have an alternative solution in mind.

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| **Company** | **Yes/No** | **Comments** |
| Mediatek | No | Since with the *drx-InactivityTimer* configured other than *0pp* HARQ 1 process can be scheduled. The proposal seems not that necessary. |
| ZTE | No |  |
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**Summary – Q 2.2.2**

TBD

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**Q 2.2.3** Do you have any comments regarding the CRs?

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| **Company** | **Comments** |
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**Summary – Q 2.2.3**

TBD

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# 3 Conclusion

Based on the discussion above the following proposals have been made:

[Proposal 1 ???](#_Toc96381973)

[Proposal 2 ???](#_Toc96381974)

[Proposal 3 ???](#_Toc96381975)

[Proposal 4 ???](#_Toc96381976)

[Proposal 5 ???](#_Toc96381977)

# References

1. [R2-2203480](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_117-e/Docs/R2-2203480.zip) Discussion on enabling 2 HARQ processes and HARQ RTT timer in NB-IoT Ericsson

1. [R2-2203486](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_117-e/Docs/R2-2203486.zip) Clarification on CDRX and two HARQ interaction for NB-IoT Ericsson

1. [R2-2203495](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_117-e/Docs/R2-2203495.zip) Clarification on CDRX and two HARQ interaction for NB-IoT Ericsson

1. [R2-2203496](http://ftp.3gpp.org/tsg_ran/WG2_RL2/TSGR2_117-e/Docs/R2-2203496.zip) Clarification on CDRX and two HARQ interaction for NB-IoT Ericsson