3GPP RAN WG2 Meeting #115e R2-2108883

eMeeting August 9th – 27th, 2021

Agenda Item: 8.10.2.2

Source: InterDigital (summary rapporteur)

Title: [DRAFT] Summary of [AT115-e][101][NTN] Other MAC aspects

Document for: Discussion, Decision

# Introduction

This document continues discussion on agenda item 8.10.2.2 – Other MAC aspects as per the following:

* [AT115-e][101][NTN] Other MAC aspects (InterDigital)

Scope: Continue the discussion on a revision of p1-p6 and p8 from R2-2109031

Final intended outcome: Summary of the offline discussion with e.g.:

* List of proposals for agreement (if any)
* List of proposals for further discussion
* List of proposals that should not be pursued (if any)

The following deadlines have been provided:

* Final deadline (for companies' feedback): **Thursday 2021-08-19 1600 UTC**
* Final deadline (for rapporteur's summary in R2-2108883): **Thursday 2021-08-19 2200 UTC**

The following guidance has been further provided by session chair:

*Proposals marked "for agreement" in R2-2108883 not challenged until* ***Friday 2021-08-20 1000*** *will be declared as agreed via email by the session chair (for the rest the discussion will further continue offline until the CB session in Week2).*

A summary of discussion topics based on company contribution to RAN2#115e is provided in [Pre115e][101][NTN] (R2-2109031). Companies are encouraged to review this document for relevant background.

# UL HARQ retransmission and LCP

## UL HARQ retransmission state: definition and indication

In RAN2#113bis-e, it was agreed to avoid NTN UE in HARQ stalling state, the NW can continuously schedule UE using one or a combination of scheduling strategies including: without HARQ retransmissions, with blind retransmissions, or with HARQ retransmissions based on UL decoding result.

Due to the different scheduling strategies, HARQ processes with different delay/reliability attributes may coexist. For example, HARQ retransmissions based on UL decoding result may take one or more RTTs to complete retransmisson, possibly causing excessive delay. Transmissions without HARQ retransmission risks packet loss if the data was not successfully decoded and higher-layer retransmissions (e.g. RLC) are not available.

In RAN2#113bis-e, RAN2 confirmed that in NTN if the UE is in DRX Active Time for any reason, the UE should monitor the PDCCH regardless of whether *drx-HARQ-RTT-TimerUL* is running or not. This allows UE to receive an UL retransmission grant blindly (i.e not based on UL decoding result) while UE is in DRX Active Time for other reasons (as long as RAN1 restrictions are satisfied). Blind retransmission can provide additional reliability via retransmission, but is also beneficial from a latency perspective as retransmission grant is received before the UL decoding result (i.e. less that one RTT).

For UE to know: 1) reliability/delay characteristics of a HARQ process at time of LCP; and 2) proper *drx-HARQ-RTT-TimerUL* behaviour, a large majority of companies support semi-static configuration of an UL HARQ retransmission state per HARQ process. To ensure that high-reliability data and low latency data are suitably mapped, two HARQ retransmission states may be defined.

**Question 1: Do you agree the following UL HARQ retransmission states are defined and optionally configured per HARQ process?:**

1. **“High reliability HARQ process”: supports scheduling strategies “with HARQ retransmissions based on UL decoding result” and “with blind retransmissions”;**
2. **“Low-latency HARQ Process”: supports scheduling strategies “without HARQ retransmissions” and “with blind retransmissions”.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/Disagree** | **Additional comments** |
| Xiaomi | Disagree | We do not agree with the classification, the main differentiator should be delay rather than reliability, as delay is the motivation of introducing HARQ enable/disable. Reliability can be dynamically implemented based on gNB blind scheduling strategy without HARQ differentiation, similar to the current UL grant for IIOT/URLLC. Thus, we prefer the following classification:   1. High latency HARQ process: supports scheduling strategies “with HARQ retransmissions based on UL decoding result” 2. Low latency HARQ process: supports scheduling strategies “without HARQ retransmissions” and “with blind retransmissions” |
| CATT | Agree with comments | The blind retransmission can be used to increase reliability without bringing any delay, so the blind retransmission can be applied to HARQ process with requirement of “high reliability” or “low-latency”. Thus, we prefer the following description.  1. High latency HARQ process: supports scheduling strategies “with HARQ retransmissions based on UL decoding result”  2. Low latency HARQ process: supports scheduling strategies “without HARQ retransmissions”  The HARQ process in above two strategies can also be configured with blind retransmission. |
| Lenovo | Agree with comments | UL HARQ retransmission states are better to be aligned with whether UL HARQ retransmission enabled/disabled for less complexity. Therefore blind retransmission is better to be included in just one state. That is, for example, if “UL HARQ retransmission enabled” includes “HARQ retransmissions based on UL decoding result” and “blind retransmissions”, the “high reliability HARQ process” supports scheduling strategies “with HARQ retransmissions based on UL decoding result” and “with blind retransmissions”. |
| OPPO | Disagree | Agree with Xiaomi. From service delay’s perspective, HARQ retransmission based/not based on the previous PUSCH decoding result is quite different, while HARQ retransmission not based on the previous PUSCH decoding result (blind retransmission) and no retransmission has little difference since retransmissions don’t need to wait a RTT.  Hence, UE needs to distinguish HARQ retransmission schemes per HARQ process between the following options:  - HARQ with retransmissions based on the previous PUSCH decoding result  - HARQ with retransmissions NOT based on the previous PUSCH decoding result, including HARQ with blind retransmissions and no retransmission |
| vivo | Disagree | The HARQ retransmission state classification does not only impact the LCP restriction, but also impacts the handling of DRX related timers on each HARQ process. If we include the UL decoding-based HARQ retransmission and the blind retransmission in the same HARQ state, it is not clear how the *drx-HARQ-RTT-TimerUL* of the HARQ process configured with such HARQ state actually works, because the blind retransmission scheme requires the drx-HARQ-RTT-TimerUL *not to be started*, but the UL decoding-based HARQ retransmission requires the *drx-HARQ-RTT-TimerUL* to be started.  From the above perspective, we think the classification as below makes more sense:   * HARQ process state 1 (enabled HARQ): “with HARQ retransmissions based on UL decoding result” * HARQ process state 2 (disabled HARQ): “without HARQ retransmission” and “with blind retransmissions”   Regarding the specific name on those states, we still prefer using the “disabled/enabled” fashion, following the way that is already used for DL. Note that, with the classification above, we do not mean to exclude blind retransmissions from the “disabled HARQ”, but only want to say that it is not the adaptive HARQ retransmission scheme based on UL decoding result as usual. If some companies have concerns on this, maybe we can say “adaptive HARQ disabled” and “adaptive HARQ enabled”, with “adaptive” meaning “based on UL decoding result”. |
| Huawei, HiSilicon | Disagree | We wonder about the necessity of adding these new definitions.  Instead, we can simply categorize the HARQ processes based on the HARQ retransmission type, i.e., whether it can be retransmitted or not. |
| Samsung | Disagree | Based on the discussion up to now, we assume three kinds of HARQ process types for UL, i.e. HARQ retransmission based on UL decoding result, blind HARQ retransmissions and no HARQ retransmissions. Also we assume MAC will specify the UE behaviour for the corresponding HARQ process type (if it differentiates the UE behaviour). Based on the described assmption, we don’t understand i) why we need more like grouping consisting of multiple HARQ process types?, ii) why the UE needs to distinguish scheduling strategies? From the UE point of view, it just follows how HARQ process is configured with which HARQ process type and what HARQ process is scheduled in DCI. |
| Panasonic | Agree with Comments | For High Reliabiliy and High latency with HARQ retransmission based on UL decoding result and with blind retransmission,  For low low reliability and low latency with HARQ retransmission without HARQ retransmission and with blind retransmission.  Furthermore, we also need to consider service requirement in terms of throughput. For e.g high rate eMBB services , HARQ retransmission without HARQ retransmission and with blind retransmission.  Addtioanlly, we also agree with Huawei that UE is configfured with retransmission type per LCH i.e. whether it can be retransmitted or not |
| LG | Agree with comments | We are not sure whether “without HARQ retransmission” is needed. Considering the requirement of reliability in NTN, “without HARQ retransmission” is not useful. Thus, we prefer the following description.  1. HARQ process for non-delay sensitive service: supports scheduling strategies “with HARQ retransmissions based on UL decoding result” and “blind retransmission”.  2. HARQ process for delay-sensitive service: supports scheduling strategies “blind retransmission” but “with HARQ retransmissions based on UL decoding result” is not supported. |
| Ericsson | Disagree | We agree with the intention of this question: to optionally have two states defined per UL HARQ proccess.  The state “**“2 Low-latency HARQ Process”: supports scheduling strategies “without HARQ retransmissions” and “with blind retransmissions”**” can also be used with HARQ retx based on UL decoding result, if   * gNB decides to, and * the HARQ process has not been reused, and * the UE is in Active Time when the grant arrives at the UE.   Therefore we suggest to use “state A” and “state B” for now. The naming is not ideal, but we may leave to running RRC and MAC spec editors to come up with better names until next meeting, if agreed.  These two states are applicable to dynamic grants, and not to CG (if this is an issue for any company – I suggest to agree to the proposal for dynamic grants and add “(FFS if applicable for configured grants)”).  We propose:  **Proposal 1**: For dynamic grants, the network can optionally configure a UL HARQ retransmission state per HARQ process:  State A: all types of retransmissions can be expected.  State B: all types of retransmissions can be expected, but retx based on UL decoding result is less likely. |
| Apple | Disagree | We prefer this to be delay based as Vivo have already commented about. Reliability was never the use case and latency was the primary reason for even discussing this change back from the SI phase. |
| ZTE | Disagree | It seems that companies have different understanding on the transmission scheme to be supported, which actually has no specs impact since UE will just follow the NDI indication indicated by NW to do the transmission. Therefore to spare us from discussing the transmission scheme options, we propose following compromised solution:   * Two HARQ process groups can be configured by NW. And each HARQ process can be associated to one of the two HARQ process group. * Mapping between LCH and HARQ process group can be configured by RRC signaling. * It is up to NW implementation to determine how to use the HARQ process group |
| Qualcomm | Agree with comments. | For the sake of progress, can we forget “blind retransmission” for now? Lets discuss it later.  So in addition to what ZTE mentioned, we can have simple two HARQ process groups as follows.  1. Group 1 (regardless whatever we call it :High reliability or high latency or HARQ process state): supports scheduling strategies “with HARQ retransmissions based on UL decoding result”  2. Group 2: supports scheduling strategies “without HARQ retransmissions” ~~and “with blind retransmissions~~” |
| Spreadtrum | Agree with comments | The critical intention of introducing UL HARQ retransmission enabled/disabled type is latency, not reliability. Actually, gNB could increase the reliability via blind retransmission for these two types of HARQ process. |
| Nokia | Agree with comments | We agree with the intention to define UL retransmission states to facilitate new LCP restriction and different DRX RTT timer configuration for different retransmission states.  We share the view of Xiaomi, OPPO, vivo, Apple and Spreadtrum, the latency is the key aspect for NTN to classify the UL retransmssion schemes while the reliability may depend on network implementation (e.g. via link adaptation). So, we support classification of HARQ retransmission schemes as below:   * HARQ process state 1: UL retransmission scheme “with HARQ retransmissions based on UL decoding result” * HARQ process state 2: UL retransmission scheme “without HARQ retransmission” and “with blind retransmissions” |
| Intel | Not sure | It is not clear whether UL HARQ retransmission states needs to be explicitly defined in specification. The key aspect is that the relation/mapping is clearly captured.  For the discussion purpose, we would be ok to categorize scheduling strategies although some clarification is needed.  However, we need to discuss how this UL retransmission state/scheduling strategy affect the exact UE beahvior/operation and then, we can discuss whether/how to categorize/define the HARQ process. If there is no need for the UE to know scheduling strategies at all (because the UE can just map certain logical channel to a certain HARQ process), simply we don’t need to define UL HARQ retransmission states. Alternatively, we may just need to define HARQ retransmission state 1 and 2 instead of defining the scheduling strategy. |
| ETRI | Disagree | We do not see the necessity of new definition. Latency and reliability could be depend on the scheduling operation. |
| MediaTek | Disagree | The naming should be more generic and should not imply that the network scheduling strategy will be restricted (as commented by Ericsson, all types of scheduling strategies are supported for both types), please see our responses for Q3 and Q4 below. For the moment, we can go with Ericsson’s, Qualcomm’s, or Nokia’s suggestions (State A/B or Group A/B). We can discuss the exact naming later or leave it to the spec editors. |
| Sequans | Disagree | We don't think we need such definitions. "State" is wording doesn't seem appropriate. It's more a "type" or "mode" that will be configured by RRC. We don't say that RLC AM or UM are states of RLC.  We have a similar understanding as ZTE on the overall functionality. |

For DL, HARQ feedback is enabled/disabled in Rel-17, but HARQ processes remain configured. The criteria and decision to enable/disable HARQ feedback is under network control and is signalled to the UE via RRC in a semi-static manner. If UL HARQ retransmission state is configured, A similar agreement may also apply.

**Question 2:** **If “agree” to Question 3, do you agree** **UL HARQ retransmission state configuration is semi-static, signalled via RRC, and the decision and criteria to configure UL HARQ retransmission for a HARQ process is under network control?**

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| **Company** | **Agree/Disagree** | **Additional comments** |
| Xiaomi | Yes | Semi-static manner via RRC is enough |
| CATT | Yes | semi-static manner is more better. |
| Lenovo | Yes | Semi-static manner via RRC is sufficient. |
| OPPO |  | We are ok with semi-static configuration via RRC, but we don’t agree to the classification in Q1. |
| vivo | Yes with comment | First, we are fine to have the RRC-configured HARQ retransmission state per HARQ process.  On top of that, we still want to try the possibility of the DCI-based solution, as the RRC-based solution may still suffer from HARQ stalling issue sometimes, e.g. when the HARQ processes of one HARQ state are fully occupied, further scheduling with this HARQ state may not be able to be scheduled onto the HARQ process of the other HARQ state and thus have to wait. We think this issue was raised by some companies also in their contributions and would like RAN2 to consider the necessity to treat this issue. If the main concern is the PHY impact, maybe an LS can be sent to enquire RAN1’s preference first. |
| Huawei, HiSilicon | Agree | Though we answered no to adding the new definitions, we are supportive of signalling the HARQ retransmission state configuration in a semi-static manner via RRC, and that it is up to network control. |
| Samsung | Yes, but see comments. | We understand the intention, but Q2 is written based on the assumption Q1 is agreed. If Q1 is not agreed, the wording “UL HARQ retransmission state” needs to be updated. |
| Panasonic | Agree | Semi-static signalling is sufficient. |
| LG | Agree | Semi-static manner via RRC is enough |
| Ericsson | Agree |  |
| Apple | Agree | Semi-static RRC configuration is sufficient. |
| ZTE | Yes | Per our comment in Q1, RRC signalling can be used. |
| Qualcomm | Yes with comments | RRC confgiguration is sufficient. However, could we say up to network configuration?  This means how a LCH is mapped to which HARQ process group is up to network configuration. |
| Spreadtrum | Agree | Semi-static RRC configuration is enough. |
| Nokia | Agree |  |
| Intel | not sure | We need to first discuss what different UE operation is expected before discussing configuration. |
| ETRI | Agree |  |
| MediaTek | Agree, but | Agree on semi-static configuration via RRC, but this should not be dependent on Q1. |
| Sequans | Agree but | Same view as MediaTek. We should not use "state" for a configuration parameter. |

Assuming a HARQ process may be configured with an UL HARQ retransmission state which supports a subset of scheduling strategies (exact supported strategies are pending on outcome to Q3), UE should expect that for UL grants assigned to that HARQ process network will schedule according to those strategies. However, UE may receive a grant with an unexpected NDI value (e.g. for a high reliability HARQ process, NDI indicating new transmission before UE-gNB RTT, or for low-latency HARQ process NDI indicating retransmission after UE-gNB RTT). In this case, UE behaviour is to be determined.

**Question 3:** **If a HARQ process is configured with an UL HARQ retransmission state and UE receives grant with an unexpected NDI value (e.g. for a high reliability HARQ process, NDI indicating new transmission before UE-gNB RTT), what is preferred UE behaviour?**

1. **UE shall** **act as indicated in the grant/assignment (as in legacy);**
2. **UE shall ignore UL grant;**
3. **Other, please describe**

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| **Company** | **Supported Option(s)** | **Additional comments** |
| Xiaomi | Option 1 | No need to change |
| CATT | Option 1 | The scheduling strategies is based on network implementation, if the above scenario in Q3 is happened, the UE should act as indicated in the grant/assihnment. |
| Lenovo | Option 1 | No spec change needed. |
| OPPO | Option 1 | UE simply follows the indication of NW. It’s up to NW to manage the scheduling. |
| vivo | 1 | The UE needs to follow the NDI value of each UL scheduling as in the legacy. At the same time, however, the UE can only handle the DRX related timers based on the originally configured HARQ state on the relevant HARQ process. |
| Huawei, HiSilicon | Option 3 | Reasonable NW implementation can avoid the issue. Even if it appears, it can be left to UE implementation. |
| Samsung | Option1 and see comments. | To us, scheduling (or scheduling strategy) is up to the gNB. From an UE point of view, we don’t see real need to differentiate the UE behaviour between HARQ retransmission based on UL decoding result and blind HARQ retransmission. The UE just follows whatever indicated by DCI. Also note Q3 is also written based on the assumption Q1 is agreed. If Q1 is not agreed, the wording “UL HARQ retransmission state” needs to be updated. |
| Panasonic | Opttion 1 | UE can simply follow the instraction from NW as legacy. |
| LG | Option 1 |  |
| Ericsson | 1 | There is no “unexpected NDI value” in legacy and we shall not break legacy behaviour by adding that.  There can always be a state mismatch between UE and gNB for example a DCI decoding error in UE, HARQ feedback decoding error in gNB, DRX state mismatch between UE and gNB making the UE mis a grant/assignment, a timing issue (maybe Koffset is not large enough) or other reasons.  The UE shall always follow what a received grant/assignment indicates (as specified in legacy specification), any other behaviour would make a state mismatch worse. |
| Apple | Option 1 | Same view as mentioned by some of the other colleagues. |
| ZTE | Option 1 | UE simply follows the indication of NW. It’s up to NW to manage the scheduling. |
| Qulcomm | Option 3 | This is simply means disabling HARQ retransmission even for the case of HARQ retransmission enabled. This is what we want to avoid from day one.  We agree with HW the reasonable network implementation should avoid this. We do not need to specify this. How we capture it is same as current definition below.  - *drx-HARQ-RTT-TimerDL* (per DL HARQ process except for the broadcast process): the minimum duration before a DL assignment for HARQ retransmission is expected by the MAC entity; |
| Spreadtrum | Option 1 | It’s up to gNB to schedule the uplink transmission. If UE ignore the UL grant, it means UE is out of control of gNB. |
| Nokia | Option1 | In any case, UE shall follow the DCI grant for retransmission instead of the the UL retransmission state. It is NW implementation to guarantee the alignment between DCI grant and RRC indicated retx state. |
| Intel | Option 1 | No need to change |
| ETRI | Option 1 | The UE just needs to follow the network instructions. |
| MediaTek | Option 1 | The configuration (for UL HARQ retransmission) does not restrict the network behaviour. These scenarios (e.g. “unexpected” NDI) will not be considered as an error/exception case by the UE, as in legacy. |
| Sequans | Option 1 | No special handling needed. |

In RAN2#114e, a compromise proposal was suggested by the vice chair which allows both semi-staitc configuration of HARQ process(es) and legacy behaviour via configuration. In [AT114-e][103][NTN] Other MAC aspects: Phase 2, this proposal (as is or minor modifications) were acceptable to 15/17 companies. Rapporteur therefore suggests a similar proposal which allows both semi-statically configured UL HARQ retransmission and the option to schedule as per legacy behaviour.

**Question 4:** **Do you agree if a HARQ process is not configured with an UL HARQ retransmission state, the network may schedule according to any scheme (i.e. as in legacy)?**

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| **Company** | **Agree/Disagree** | **Additional comments** |
| Xiaomi | Agree | Legacy behaviour applies |
| CATT | Agree |  |
| Lenovo | Agree | No spec change needed. |
| OPPO | Agree |  |
| vivo |  | If the HARQ retransmission state is not configured for a HARQ process, it means that all the per HARQ process operations are done based on the legacy behaviour, e.g. starting HARQ RTT timer with the per DRX group configured value, and starting retransmission timer after RTT timer’s expiry. Therefore, the NW can schedule in a legacy way without being impacted by this newly introduced feature. Regarding whether to use any scheme, it is up to NW implementation. |
| Huawei, HiSilicon | Agree |  |
| Samsung | Agree, but see comments. | We understand the intention, but Q4 is written based on the assumption Q1 is agreed. If Q1 is not agreed, the wording “UL HARQ retransmission state” needs to be updated. |
| Panasonic | Agree |  |
| LG | Agree |  |
| Ericsson | Agree |  |
| Apple | Agree |  |
| ZTE | Agree |  |
| Qualcomm | Disagree | Agree with revision:  **if a HARQ process is not configured with an UL HARQ retransmission state, legacy behaviour applies.** |
| Spreadtrum | Agree |  |
| Nokia | Agree |  |
| Intel | Agree |  |
| ETRI | Agree |  |
| MediaTek | Agree, and | Even if a HARQ process is configured with UL HARQ retransmission state, the network can still schedule the UE according to any scheme. |
| Sequans | Agree but | Same comment as Samsung. |

## Details of new mapping restriction

From the agreement in RAN2#115e, it is currently FFS how an LCH is mapped to one or more HARQ process(es):

*For dynamic grants, each LCH can optionally be semi statically configured (by RRC) to be mapped to one or more HARQ processes (FFS if it's possible to map to more than one HARQ process/ process type. FFS on mapping method). If there is no RRC configuration for this, this mapping has no effect (legacy behaviour applies).*

In general there are two methods proposed to map LCH to one or more HARQ process(es): directly to a HARQ process, or indirectly via mapping to an UL HARQ retransmission state. A simplified example of each can be seen below:



**Figure 1:** Possible mapping rules for new mapping restriction (simplified).

In Option 1, an LCH is mapped directly to one or more HARQ process(es). If UE receives a grant assigned to a HARQ process that the LCH is mapped to, the mapping restriction is satisfied. The advantage of this method is that it is simple. The downside is that it may be restrictive. For example, a suitable UL grant may arrive and be assigned to a HARQ process which the LCH is not mapped to. Even though the the grant may support the LCH’s QoS requirements, the UE will be prevented from multiplexing data from that LCH due to the LCP restriction.

In Option 2, an LCH is mapped to an UL HARQ retransmission state. Upon arrival of an UL grant, UE will check the UL HARQ retransmission state (if configured) of the HARQ process the grant is assigned to. If the UL HARQ retransmission state matches the allowable UL HARQ retransmission state provided by the mapping, the mapping restriction is satisfied. The advantage of this method is that it is flexible. The disadvantage is that it requires two configurations: LCH to a UL HARQ retransmission state, and a HARQ process to a UL HARQ retransmission state (it is noted however that this additional configuration may be necessary anyways e.g. for configuration fo *drx-HARQ-RTT-TimerUL*).

**Question 5:** **Which of the following methods do you support for new mapping rule?:**

1. **An LCH can be optionally mapped directly to one or more HARQ process(es).**
2. **An LCH can be optionally mapped to an UL HARQ retransmissions state.**
3. **Other, please describe.**

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| **Company** | **Supported option(s)** | **Additional comments** |
| Xiaomi | Option 2 | We do not see the benefit of per HARQ process granularity, which further limit the number of available HARQ processes. Thus, we prefer retransmission state granularity. |
| CATT | Option 2 | Option 2 is more flexible. For the option 1, if the UL HARQ retransmission state is changed for the HARQ process by network, LCP mapping restriction regarding “HARQ process” of LCH configuration should also be updated. So, we prefer the UL HARQ retransmission state. |
| Lenovo | Option 2 | Option 2 is preferred for flexibility. |
| OPPO | Option 2 | As Rapporteur states, Option 2 is more flexible. Based on that, we can futher consider to discuss the following two types of LCP restrictions:  - allowing data from all LCHs to be mapped to the grant according to an adjusted priority  - only allowing data from partial LCHs to be mapped to the grant. |
| vivo | 1 or 2 | Option 1 is slightly preferable, as we don’t need to further discuss a similar issue as in Question 6. |
| Huawei, HiSilicon | Option 2 | Option 2 only needs to add an 1-bit indication for each LCH, therefore has less overhead than Option 1. |
| Samsung | Option1 | I think this question is quite related to the Question 1. |
| Panasonic | Option 2 | Option 2 is simpler than option 1. |
| LG | Option 1 | Option 1 is simpler than Option 2 |
| Ericsson | Option 2 | Probably there will only be two HARQ processes that are reused before a full HARQ RTT has elapsed. Thus either we do “2” or we can do  “Option 3 other: An LCH can optionally be mapped to one or more forbidden HARQ process(es)”  because “1” will require a longer list of HP IDs per LCH than “3” for most LCHs.  Anyway, “2” seems like less signalling and gives all the needed flexibility. |
| Apple | Option 2 | Prefer this for the flexibility it provides. |
| ZTE |  | Each LCH can be optionally configured to be mapped to one of the two HARQ groups, if configured. |
| Qualcomm | Option 2 | We agree option 2 is simple. However, agree additional configuration between HARQ process ID to HARQ process group is needed. |
| Spreadtrum | Option 2 | Option 2 is simple. The mapping between HARQ process and HARQ retransmission state is an independent issue. |
| Nokia | Option2 | We think both Option1 and Option2 can work for LCP. However, Option2 is necessary for DRX setting. |
| Intel | Neutral |  |
| ETRI | Option 1 | Option 2 give more flexibility. However, we think it may have impact on DCI by defining new field of HARQ retransmission state or new definition of HARQ process ID. We wonder how gNB know the HARQ process id used by the UE. So, we prefer Option 1 for this release, but enhancement can be discussed in the next release. |
| MediaTek | Option 2 | Both options could work, but option 2 seems more aligned with the original intention for this enhancement and could reduce signalling. |
| Sequans | Option 2 | Option 1 gives flexibility to map all the different LCHs to different HARQ processes, which is useless and overkill.  Same comment about "state" as before. |

In the agreement from RAN2#115e, it is also stated that if no RRC configuration is provided (i.e. LCH is not configured with new mapping rule), the the mapping has no effect and legacy behaviour applies:

*For dynamic grants, each LCH can optionally be semi statically configured (by RRC) to be mapped to one or more HARQ processes (FFS if it's possible to map to more than one HARQ process/ process type. FFS on mapping method). If there is no RRC configuration for this, this mapping has no effect (legacy behaviour applies).*

However, Option 2 requires two RRC configurations: one RRC configuration mapping LCH to UL HARQ retransmission state, and the other mapping HARQ process to UL HARQ retransmission state. As can be seen in Figure 1, UE behaviour needs to be defined for the case when the new LCP restriction is configured for the LCH, but an UL HARQ retransmission state has not be configured for the HARQ process the UL grant is assigned to. To align with above agreement, it is suggested that UE may also apply legacy behaviour in this case (i.e. mapping has no effect).

**Question 6:** **Do you agree that if HARQ process has not been configured with an UL HARQ retransmission state, new mapping rule has no effect (i.e. UE applies legacy behaviour)?**

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| **Company** | **Agree/Disagree** | **Additional comments** |
| Xiaomi | Yes |  |
| CATT | Yes |  |
| Lenovo | Yes |  |
| OPPO | Yes |  |
| vivo | Yes | If the HARQ process is not configured with no such UL HARQ retransmission state, it typically means that the related UL grants are not with such a new grant attribute, so that the multiplexing of the LCHs onto the related UL grants are not subject to this new restriction. This is just like the LCH-to-CG mapping introduced in IIOT, where, if a CG is not linked to any LCH, any LCH can be mapped into the grant (as long as other LCP restrictions match). |
| Huawei, HiSilicon | Agree |  |
| Samsung | Disagree | We understand the intention, but Q6 is written based on the assumption Q1 is agreed. If Q1 is not agreed, the wording “UL HARQ retransmission state” needs to be updated. In our understanding, if LCH is mapped to a HARQ process type, this LCH should not be transmitted while if LCH is not mapped to any HARQ process type, this LCH can be transmitted. With the our understanding above, we think we cannot say no impact at all, i.e. needs some level of modification accordingly. |
| Panasonic | Agree |  |
| LG | Agree |  |
| Ericsson | Agree |  |
| Apple | Agree |  |
| ZTE | Agree |  |
| Qualcomm | Agree | We understand it is like setup/release configuration. In case of setup, 1 bit indication tells which HARQ process group. |
| Spreadtrum | Agree |  |
| Nokia | Agree |  |
| Intel | Agree |  |
| ETRI | Agree |  |
| MediaTek | Agree, and | If the semi-static configuration via RRC is not provided for a HARQ process/LCH (i.e. no mapping), then legacy behaviour applies. |
| Sequans | Agree | Same comment about "state" as before. |

# DRX-HARQ-RTT-TimerUL

## Drx-HARQ-RTT-TimerUL

In RAN2#113e it was agreed that in NTN, the *drx-HARQ-RTT-TimerUL* is configured per UE DRX group and the behaviour can be configured per HARQ process. In RAN2#114e, the following agreement was made capturing possible supported behaviours:

*The following options are supported for drx-HARQ-RTT-TimerUL in NTN per HARQ process: 1) Timer length is extended by offset; 2) Timer set to zero and/or 3) Timer disabled (i.e. not started). FFS if this is based on explicit configuration or not. We can also come back to see whether both 2 and 3 are needed.*

Nearly all companies contributing to this topic [1, 10, 11, 14, 15, 17, 20]propose to support only two behaviours. This section presents a summary of company views regarding support of setting the *drx-HARQ-RTT-TimerUL* to zero vs. not starting the timer.

**Timer not started** [1, 4, 11, 14, 15, 20]

Proponenents of not starting the *drx-HARQ-RTT-TimerUL* mention that the UE has no need to monitor the PDCCH for retransmissions since it will never come, causing unnecessary power consumption [11, 20]. Though noted in [1] that to support the *drx-RetransmissionTimerUL* a moderate spec change is needed to receive blind retransmissions, this may not be necessary as the UE can rely on other timers such as the *drx-InactivityTimer* or *drx-onDurationTimer* [15]. Additional arguments are that not starting the timer is aligned with behaviour for *drx-HARQ-RTT-TimerDL* [4, 11], and that considering *drx-HARQ-RTT-TimerUL* value in current specs is configured per *DRX-Config*, to avoid too many spec impact it is proposed to reuse the same principle here that only one value for *drx-HARQ-RTT-TimerUL* is configured [14].

**Timer set to zero** [3, 10, 17]

In addition to less specification impact [3] the key motivation for setting the *drx-HARQ-RTT-TimerUL* is to facilitate reception of blind retransmission grant. According to [10], reliance on the DRX inactivity timer to receive blind retransmission grants may not be suitable, noting that retransmission scheduling will not restart the DRX inactivity timer and will thus will limit the number of scheduled retransmissions, especially when time diversity is applied in retransmission scheduling or when radio is overloaded. Furthermore, if the inactivity timer length is no less than DRX retransmission timer (it is possibly the case) there is no gain in not setting the timer to 0. [17] mentions that reliability may not be ensured because the reliability relies on one-shot transmission (i.e. due to reduced ability to schedule a retransmission). The requirement of the NTN service may therefore not be satisfied according to the LS in R2-2104622, which provides the requirement of packet error rate in NTN is 10-6.

To summarize: nearly all companies contributing to this topic propose that only two *drx-HARQ-RTT-TimerUL* behaviours are supported. All support offset to timer length as one option, and twice as many companies support option 3 (timer disabled). In pre-meeting email discussion it was therefore proposed that behaviour be downscoped to the following two behaviours: 1) Timer length is extended by offset; 2) Timer disabled (i.e. not started).

**Question 7:** **Do you agree the following behaviours are supported for *drx-HARQ-RTT-TimerUL* in NTN per HARQ process: 1) Timer length is extended by offset; 2) Timer disabled (i.e. not started)?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/Disagree** | **Additional comments** |
| Xiaomi | NO | We prefer timer set to zero instead of disabling the timer. The drawback of timer disabled is that it relies totally on inactivity timer for scheduling retransmission. As discussed in RAN1, for DL, network cannot continuously schedule DL, a minimum gap Xms is required between two consecutive DL scheduling. Similar agreement may be adopted for UL. In that case, inactivity timer may not be able to accommodate enough blind schedulings.Furthermore, if DRX retransmission timer length is smaller than inactivity timer(which is often the case), the two timer overlaps, there is no additional power consumption. |
| CATT | Agree |  |
| Lenovo | Agree |  |
| OPPO | Agree with comments | Not starting the timer is aligned with behaviour for drx-HARQ-RTT-TimerDL. And in order to support blind retransmissions, the start of *drx-RetransmissionTimerUL* is necessary since UE can not have enough chance for blind retransmission if only relying on Active Time due to other timers. |
| vivo | Agree |  |
| Huawei, HiSilion | Agree |  |
| Samsung | Agree |  |
| Panasonic | Agree |  |
| LG | Disagree | As commented in Qx, considering that the requirement of the reliability in NTN, the blind retransmission should be supported. If we go Option 2 (not started), the blind retransmission may not be supported.  Of course, the drx-InactivityTimer can be used for blind retransmission. However, as commented by Xiaomi, drx-InactivityTimer would not be sufficient to receive the blind retransmission. |
| Ericsson | Agree | There is no issue to support blind retransmissions for the case that a HARQ process is intended to be reused before a full HARQ RTT has elapsed because when the UE receives the grant with NDI toggled, it will restart the drx-InactivityTimer (which usually is configured with a longer time than the drx-RetransmissionTimerUL), thus there is time to send many many blind retransmissions before the drx-InactivityTimer expires even retransmissions separated in time for time diversity.  A value of zero for HAR-RTT-TimerUL would restart drx-RetransmissionTimerUL for each retransmission grant received, thus maybe maybe a small advantage if we want to spread the blind retransmissions in a long time period and there happens to be no new data that makes the HARQ process to be reused. This seems unlikely to happen often, and thus it is sufficient to rely on drx-InactivityTimer for blind retransmissions. |
| Apple | Agree |  |
| ZTE | Agree |  |
| Qualcomm | Agree |  |
| Spreadtrum | Agree |  |
| Nokia | Agree |  |
| Intel | agree for (1) and TBD for 2) | We don’t see any advantage to just disable the drx-HARQ-RTT-TimerUL timer compared to setting to zero. However, if drx-RetransmissionTimerUL can start without drx-HARQ-RTT-TimerUL timer, we could accept distabling the drx-HARQ-RTT-TimerUL timer.  Regarding (1), it is natural to increase drx-HARQ-RTT-TimerUL because propagation delay is long. |
| MediaTek | Agree |  |
| Sequans | Agree |  |

## Configuration of drx-HARQ-RTT-TimerUL behaviour

In RAN2#114e there was an FFS whether configuration of the *drx-HARQ-RTT-TimerUL* behaviour is performed explicitly or not:

*The following options are supported for drx-HARQ-RTT-TimerUL in NTN per HARQ process: 1) Timer length is extended by offset; 2) Timer set to zero and/or 3) Timer disabled (i.e. not started). FFS if this is based on explicit configuration or not. We can also come back to see whether both 2 and 3 are needed.*

The following presents a summary of proposals addressing this FFS.

**Explicit configuration** [15, 17]

[15] and [17] proposes explicit signalling is added to configure per HARQ process behaviour. [15] additionally proposes that when this new signal is not present, legacy behaviour for drx-HARQ-RTT-TimerUL apply, whereas [17] proposes that network should explicitly configure the drx-HARQ-RTT-TimerUL in a semi-static manner, i.e., RRC signalling.

**Implicit configuration** [10, 20]

[10] and [20] propose that the *drx-HARQ-RTT-TimerUL* behaviour can be implicitly deduced from the configuration of HARQ retransmission scheme, e.g. enabled/disabled, As the configuration of HARQ retransmission scheme is anyway needed for many cases, e.g. LCP, there is no need to have redundant configuration of DRX behaviour. [20] additionally adds that whether the network may additionally choose to override the baseline timer behaviour for an individual HARQ process and configure a custom behaviour may be further considered once the baseline set of agreements are confirmed.

**Question 8:** **Which of the following option(s) do you support for configuration of** ***drx-HARQ-RTT-TimerUL* behaviour?:**

1. **Explicit configuration (i.e. behaviour configured per HARQ process via dedicated RRC signalling);**
2. **Implicit configuration (i.e. behaviour determined implicitely per HARQ process via configured UL HARQ retransmission state, if available);**
3. **Both;**
4. **Other, please describe.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Supported option(s)** | **Additional comments** |
| Xiaomi | Option 1 | Since only two behaviour left, there is no need to have additional IE to explicitly configure the DRX RTT timer behaviour. |
| CATT | Option 2 | The HARQ process should be associated with one UL HARQ retransmission state, the drx-HARQ-RTT-TimerUL behaviour of the HARQ process can be indicated by UL HARQ retansmission state implicitly. |
| Lenovo | Option 2 | The configuration of HARQ retransmission scheme can indicate. |
| OPPO | Option 2 | In our understanding, two HARQ process states correspond to the two DRX behaviours separately, hence, there is no need to explicitly configure DRX behaviours. |
| vivo | 2 | With the HARQ process state definition in our comments for Q1, drx-HARQ-RTT-TimerUL can behave based on the configured state, i.e. started with extended offset in State 1 (enabled) and not started in State 2 (disabled). |
| Huawei, HiSilicon | Option 2 | No need for additional indications when implicit configuration is feasible. |
| Samsung | Option1 | Option1 sounds simple and straightforward. |
| Panasonic | Option 2 | We don’t see need to configure explicit configuration. |
| LG | Option 1 | In order to support configured grant and dynamic grant, we prefer Option 1. |
| Ericsson | Option 2 |  |
| Apple | Option 2 |  |
| ZTE | Option 1 | How NW configures the HARQ group shall be explicitly indicated, we don’t see the need to couple the discussion here. |
| Qualcomm | Option 2 | See response in Q5.  (1) Configuration between LCH to HARQ process group  (2) configuration between HARQ process ID to HARQ process group.  This is sufficient. |
| Spreadtrum | Option 2 |  |
| Nokia | Option2 | Since UL HARQ retransmission state can be used by both LCP and DRX timer setting, we prefer to option2 to save RRC signalling. |
| Intel | Option 1 | If option 1 is agreed, we can discussed during stage-3 the meaning when the field is absent. |
| ETRI | Option 1 | It is straightforward. |
| MediaTek | Option 2 | Option 2 can reduce signalling for configuration. |
| Sequans | Option 2 | Not crystal clear but it looks like Option 1 means that we can configure the timer behavior independently of the HARQ retransmission mode, which is useless. |

In pre-meeting email discussion, Proposal 8 attempted to clarify default *drx-HARQ-RTT-TimerUL* and *drx-RetransmissionTimerUL* behaviour when a UL HARQ retransmission state has not been configured for a HARQ process. Companies are invited to comment on the following proposal:

**Question 9:** **Do you agree for HARQ process(es) not configured with an UL HARQ retransmission state, *drx-HARQ-RTT-TimerUL* (unless explicitly configured with** **a different behaviour) and *drx-RetransmissionTimerUL* behave as per legacy?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/Disagree** | **Additional comments** |
| Xiaomi | Yes |  |
| CATT | Yes |  |
| Lenovo | Yes |  |
| OPPO | Yes |  |
| vivo | Yes | Similar comments as to Q4. |
| Huawei, HiSilicon | Agree |  |
| Samsung | Agree, but see comments. | We understand the intention, but Q9 is written based on the assumption Q1 is agreed. If Q1 is not agreed, the wording “UL HARQ retransmission state” needs to be updated. |
| Panasonic | Agree |  |
| LG | Agree |  |
| Ericsson | Agree |  |
| Apple | Yes |  |
| ZTE | Yes |  |
| Qualcomm | Agree | Yes, legacy behavior applies. |
| Spreadtrum | Agree |  |
| Nokia | Agree |  |
| Intel | Agree |  |
| ETRI | Agree |  |
| MediaTek | Agree |  |
| Sequans | Agree |  |

# Summary

<To be generated based on discussion outcome>

# Conclusion

<To be generated based on discussion outcome>

# References

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