3GPP RAN WG2 Meeting #115e R2-2108896

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: Phase 2

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)

Updated Scope: Continue the discussion on p3 from R2-2108883 and to see if additional details based on company comments can be agreed:

* 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:

* Updated deadline (for companies' feedback): **Monday 2021-08-23 1600 UTC**
* Updated deadline (for rapporteur's summary in R2-2108896): **Monday 2021-08-23 2000 UTC**

The following guidance has been further provided by session chair:

*Proposals marked "for agreement" in R2-2108896 not challenged until Tuesday* ***2021-08-24 0800 UTC*** *will be declared as agreed via email by the session chair (for the rest the discussion might continue online during the CB session).*

A summary of phase 1 discussion may be found in [R2-2108883](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_115-e/Inbox/R2-2108883.zip), and a summary of company contribution to RAN2#115e is provided in [R2-2109031](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_115-e/Inbox/R2-2109031.zip). Companies are encouraged to review these document for relevant background.

# Continuation of P1A/P1B

## UL HARQ retransmission state: definition and indication

In Phase 1, the following was agreed regarding introduction/configuration of an UL HARQ retransmission state:

* For at least dynamic grants, the network may optionally configure an UL HARQ retransmission state per HARQ process. Two UL HARQ retransmission states are defined in NTN: HARQ state A and HARQ state B (FFS whether "HARQ state A" and "HARQ state B" should be renamed)
* HARQ state A/B are defined as follows:
* HARQ state A: length of drx-HARQ-RTT-TimerUL is extended by UE-gNB RTT (i.e. UE PDCCH monitoring is optimized to support UL retransmission grant based on UL decoding result).
* HARQ state B: drx-HARQ-RTT-TimerUL is not started.
* Configuration of UL HARQ retransmission state is semi-static, signalled via RRC, and the decision and criteria to configure UL HARQ retransmission state is under network control.
* If HARQ process has not been configured with an UL HARQ retransmission state, new LCH mapping rule has no effect (i.e. UE applies legacy behaviour).
* UE determines drx-HARQ-RTT-TimerUL behaviour per HARQ process based on configured UL HARQ retransmission state.
* For HARQ process(es) not configured with an UL HARQ retransmission state, drx-HARQ-RTT-TimerUL and drx-RetransmissionTimerUL behave as per legacy.

Although there was significant support for configuration of multiple UL HARQ retransmission states in Phase 1, there remains some divergence in the details of how each state should be defined. Due to this divergence, the following has been captured in chair notes:

* *Continue the discussion to see if additional details based on company comments can be agreed*

The following questions have been derived based on company comment to Phase 1:Q1 in an attempt to find further commonality in the definition of HARQ state A and HARQ state B.

**Question 1: What are the primary reasons for configuring an UL HARQ retransmission state? Companies may select one or more of the following:**

1. **Configure proper *drx-HARQ-RTT-TimerUL* behaviour.**
2. **Support new LCH mapping rule.**
3. **Restrict network scheduling behaviour (i.e. prevent network from scheduling according to one or more scheduling strategies).**
4. **Other, please describe.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Supported Option(s)** | **Additional comments** |
| Qualcomm | Option1, Option2 and Option 3 | In our understanding, all options are somewhat applicable.  Network is not supposed to blindly schedule UL grant with HARQ state A and behave as like HARQ state B (as explained in details in responses below). |
| Huawei, HiSilicon | Mainly Option 2 | The movitation for introducing HARQ retransmission state is to facilitate LCP procedure. For instance, if the gNB is performing scheduling with UL retransmission disabled, the UE is not supposed to put the data with reliability requirement on the UL grant.  Of cource, DRX timer behaviours and network scheduling behaviour should be in line with the HARQ retransmission state configuration, but not the primary reason. |
| vivo | 1 and 2 with comment | On top of 1 and 2, we think the root motivation is to enable different services to be transmitted respectively via proper HARQ retransmission scheme(s) (adaptive to their requirements) and proper DRX timer handling accordingly. |
| MediaTek | 1 and 2 | Because of the high RTT in NTN, in order to sustain high throughput with the same number of HARQ processes, it is necessary for the network to send new transmission grants (with NDI toggled) without processing the previous UL grant for the same HARQ process. However, some data might require high reliability and might not require high throughput. Therefore, some HARQ processes might continue using the “legacy” HARQ mechanism, and some LCH data may be transmitted on these HARQ processes. Therefore, reason 2 seems to us as the primary reason.  If the network is not expected to send UL retransmission grants for some HARQ processes, then the functionality in DRX where the UE waits for a possible retransmission UL grant from the network may not be required for those HARQ processes. This can save some UE power. This results in reason 1.  Regarding 3, there is no need to restrict the network behaviour. If the UE is in active time (for any reason), the network can send a retransmission grant or a new transmission grant for any HARQ process and the UE can process it. |
| InterDigital | 1 and 2 | For 1: Based on Phase1 agreement UE determines *drx-HARQ-RTT-TimerUL* behaviour based on configured UL HARQ retransmission state, so configuration of HARQ state is necessary for proper timer configuration.  For 2: New LCH mapping rule maps LCH to one or more HARQ processes indirectly via UL HARQ retransmission state, so configuration of HARQ state is necessary to support new mapping rule.  For 3: There is no strong motivation to introduce scheduling restrictions on top of new LCH mapping rule, especially considering it is generally understood UE should always act as indicated in grant/assignment regardless of HARQ state configuration anyways. |
| Lenovo | 1 and 2 | *drx-HARQ-RTT-TimerUL* behaviour is associated to UL HARQ retransmission state. Some service requirement including reliability is also associated to UL HARQ retransmission state, which is implemented by LCH mapping rules. |
| Xiaomi | 1, 2 and facilitate gNB blind scheduling | The ultimate reason is not to configure the behaviour of DRX RTT timer, but to facilitate gNB blind scheduling. That is why disabling DRX RTT timer is not sufficient, the DRX retransmission timer should still be restarted to enable sufficient time for blind retransmission scheduling, not just rely on inactivity timer. Otherwise, network may have to configure larger inactivity timer value which may not be suitable for the traffic. |
| Apple | Option 2 | Reason 2 is the main purpose according to us. The HARQ behaviour and timers should then follow. |
| CATT | Option 2 | The data form LCHs with different QoS requirements should be correctly mapping to UL resources. |
| LG | Option 1 and 2 | The motivation of introducing for UL HARQ retransmission state is that the SDUs associated with same services are contained in a MAC PDU. Considering this, the LCP procedure should be associated with the UL HARQ retransmission state. In addition, according to the UL HARQ retransmission state, the proper DRX configuration for drx-HARQ-RTT-TimerUL should be configured as well. |
| OPPO | 1, 2 and 3 | We share the save view as Qualcomm. The motivation for defining different HARQ states is mainly to provide different QoS, and we think once network configures the HARQ state, it should ensure to schedule UE according to the configured HARQ state. |
| Nokia | Option 1 and 2 | We think the intention to define UL retransmission states is to facilitate new LCP restriction to guarantee each LCH’s QoS and to support different DRX RTT timer configuration for different retransmission states to save UE’s power. |
| ZTE | 2 | The intention to have two states is to allow a finer granularity of LCH-HARQ process mapping so that each LCH can be mapped to the intended UL grant. |
| ETRI | Option 1 and 2 | We think that it is necessary to configure the UL HARQ retransmission state to support options 1 and 2. |
| Intel | 1 with comment | As we commented during 1st phase of email discussion, if drx-HARQ-RTT-TimerUL behaviour is the only reason for configuring an UL HARQ retransmission, we do not think that a new UL HARQ retransmission state is needed. Instead, drx-HARQ-RTT-TimerUL behaviour can be configured directly. |
| Ericsson | 1 and 2 | NTN will work fine without any change to UL HARQ.  Option 3 is not acceptable in any way, shape, or form. If the UE receives a grant that is “unexpected” (due to any reason such as UE missing a grant, gNB missing a PUSCH transmission, drx state mismatch etc.), the ONLY reasonable thing to do is for the UE to follow the grant – any other resolution will make the situation worse. Also, there is nothing in the MAC spec nor PHY spec that allows the UE to ignore a grant. |

In Phase 1, it was proposed that HARQ state A and B be defined as “high reliability” and “low latency”. However, based on question response a majority of companies did not agree with this classification. Companies are therefore asked to identify the primary differentator of State A/B to help with definition/naming.

**Question 2: The primary differentiator of UL HARQ retransmission state A and B is:**

1. **Possible delay associated with UL retransmission grant reception.**
2. **Reliability.**
3. **Other, please describe.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Supported Option(s)** | **Additional comments** |
| Qualcomm | Option 1 and 2 | In NTN, delay associated with RTT is reasonable. HARQ state A in addition deserves to be able to offer reliability with a retransmission when previous PUSCH decoding fails. |
| Huawei, HiSilicon | Option 1 and 2 | Both reliability and latency should be taken into consideration when determining a HARQ retransmission state. However, these do not need to be reflected in the spec. In NTN, there’s no real low latency, only relatively low latency. |
| vivo | 3 | We think both 1 and 2 are reasons/motivations for such differentiation. On the other hand, we don’t think the differentiation should be made by performance, at least in the Spec. Instead, we prefer differentiating HARQ states by the HARQ retransmission scheme(s) actually supported by each state (as it does not look normal to specify what performance is expected by which scheme(s) in the AS spec). |
| MediaTek | 1 and 2 | In our view, the main difference is the reliability. It is true that reliability can be improved by blind retransmissions or by other means (repetitions, MCS, etc.), but excluding these additional mechanisms, from normal HARQ operation point of view, the main difference is the reliability. This is because of the delay associated with UL retransmission grant, so in a way 2 is a result of 1. |
| InterDigital | 1 and 2 | We assume HARQ state A will generally use the “retransmission grant based on UL decoding result” scheduling as DRX timer configuration is optimized for this. In this case it seems likely that if decoding fails a retx grant will be provided ensuring reliability, but at the expense of requiring at least a delay of UE-gNB RTT.  For HARQ state B it is assumed that any retransmission will most likely be blind retransmission. Ensuring reliability via this method may lead to unnecessary retransmission since based on target BLER it is likely most packets will be successfully received. So in HARQ state B retransmissions can be performed with less delay but since it wastes channel resources will most likely not be done for every packet. On average this will cause HARQ state B not be as reliable as HARQ state A. |
| Lenovo | 1 and 2 | Fulfilling different reliability requirement in large delay scenario is the main reason of defining UL HARQ retransmission states. |
| Xiaomi | 1 | During the SI phase, the motivation of introducing HARQ disabling is delay. It is not justified that reliability will be degraded by blind scheduling. |
| Apple | 1 and 2 | Achieving low latency with reasonable reliability in large propagation delay environments as defined in SI. |
| CATT | Option 1 | The both state A and state B can be used in the scenario with requirement of reliability when the state B is configured with blind retransmission, but the state A cannot be used in the scenarios with requirement of delay. |
| LG | Option 1 and 2 | Even if a UL HARQ retransmission state does not support “retransmission grant based on UL decoding result”, the reliability can be enhanced by supporting the blind retransmission for a UL HARQ retransmission state. |
| OPPO | 1 and 2 | State A is supposed to provide more reliability yet with a bit longer service delay. |
| Nokia | Option 1 and 2 | For NTN, it is clear that State A will have high latency since the retx is based on UL decoding result. For State B, the reliability is up to NW implementation (e.g. via link adaptation or blind retransmission) while the latency is assumed to be low. We think the first differentiator should be latency. We are open to discuss if reliability should be used to differentiate State A and B. |
| ZTE | 1 and 2 | NW configure the state with joint consideration of the QoS requirement of on-going services. If only delay is required, then we don’t need retransmission at all. If only reliability is required, then HARQ retransmission is not needed either since RLC ARQ can be used to ensure the reliability. Therefore, we think the HARQ state will be determined by taking both reliability and delay into account. |
| ETRI | 1 | Option 2 is the result of option 1. |
| Intel | 1 |  |
| Ericsson | 3 | The intended effects of the UL HARQ retransmission state A and B are only:  1) affect the starting drx-HARQ-RTT-TimerUL for certain HARQ processes and  2) affect the LCP mapping of LCH data to certain HARQ processes.  How the gNB choses to schedule the UEs is NOT affected by this.  How the UE shall act when receiving a grant (besides 1 and 2) is NOT affect ted by this. |

From response to Phase 1 Q3 there appears to be general understanding that UE shall always act as indicated in a grant/assignment regardless of whether an UL HARQ retransmission state is configured or not. However, an UL HARQ retransmission state may be better suited to support a subset of UL HARQ retransmission types, for example, by optimizing when UE is monitoring PDCCH.

Note: Q3/Q4 does NOT intend to restrict network scheduling strategy. It is only meant to clarify whether based on existing definitions of HARQ state A/B (i.e. differentiated HARQ RTT Timer behaviour) UE behaviour is better suited to receive an UL retransmission grant according one possible strategy vs another.

**Question 3: HARQ state A (i.e. extending the *drx-HARQ-RTT-TimerUL* by UE-gNB RTT) best supports which UL HARQ retransmission type(s)?**

1. **UL retransmission based on UL decoding result.**
2. **Blind UL retransmission.**
3. **No UL retransmission.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Supported Option(s)** | **Additional comments** |
| Qualcomm | Option 1 | We think option 1 is the main retransmission type, but we are open to discuss on how to support option 2 in certain cases as described in Q6. |
| Huawei, HiSilicon | Option 1 | That should be clear based on the phase 1 agreements. |
| Vivo | 1 | We think by having non-zero RTT timer values, intuitively the related HARQ process is intended for the decoding-based retransmission scheduling, as the configured HARQ RTT timer is expected to earn power saving gain from the UE-gNB RTT time. This intention may even more apply in NTN, with RTT time/timer extended but other DRX timers not. However, this does not intend to place a restriction that the NW must schedule in this way. |
| MediaTek | 1 | In our understanding, this is normal HARQ operation, except for the extension to DRX RTT timer. |
| InterDigital | 1 | As stated in HARQ state A definition: “*(i.e. UE PDCCH monitoring is optimized to support UL retransmission grant based on UL decoding result).*” |
| Lenovo | 1 | UL HARQ retransmission states are better to be aligned with *drx-HARQ-RTT-TimerUL* behaviour for less complexity. |
| Xiaomi | 1 |  |
| Apple | 1 | Same views as others. |
| CATT | Option 1 | As in legacy, we think the HARQ transmission with HARQ state A can also be configured with blind retransmission by network. |
| LG | 1 |  |
| OPPO | Option 1 |  |
| Nokia | 1 |  |
| ZTE | - | We think the use of HARQ state mainly depends on the scenarios (LEO, GEO) and QoS requirement of service (i.e. requirement on delay and reliability).  For example, in case there are two types of services required by UE simultaneously, and some of them has requirement on latency but the others do not, if the UL retransmission based on UL decoding cannot satisfy the requirement for the delay sensitive services (e.g. large RTT in GEO), then the following retransmission schemes could be associated to the two HARQ states to ensure the blind UL retransmission grant will only be used for the LCH with such requirement.  Configuration A:   * State A: Other * State B: Blind UL retransmission   If blind UL retransmission is not needed according to the QoS requirement, we think the retransmission schemes associated to the two HARQ states can be as follow:  Configuration B:   * State A: UL retransmission based on UL decoding result * State B: No UL retransmission   Although we prefer to decouple the configuration for HARQ RTT timer and HARQ scheme, to make progress on this topic, we are ready to accept the meeting agreement that two HARQ states are defined based on the configuration of HARQ RTT timer. However, we think such definition shall not restrict the behaviour on NW side. For state A, it is still up to NW to determine whether retransmission shall be performed or not, especially in case all the HARQ process associated to state A is stalled (i.e. UE cannot assume UL decoding based HARQ retransmission will always happen for state A. It is still possible there is no UL HARQ retransmission for such HARQ process). |
| ETRI | Option 1 |  |
| Intel | 1 |  |
| Ericsson | 1 and 2 | 3 is also supported but may be less power efficient as DRX timer is always started.  There is nothing that limits the gNB to send any type of grant to the UE at any time if the UE is in Active Time when the receiving the grant and respecting the L1 restriction on time between grants and PUSCH transmissions for a specific HARQ process. |

**Question 4: HARQ state B (i.e. not starting the *drx-HARQ-RTT-TimerUL*) best supports which UL HARQ retransmission type(s)?**

1. **UL retransmission based on UL decoding result.**
2. **Blind UL retransmission.**
3. **No UL retransmission.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Supported Option(s)** | **Additional comments** |
| Qualcomm | Option 3 | We think option 3 is the primary characteristic of HARQ state B. However, in this case also, we are open to discuss how to support option 2, whether to support blind retransmission in both HARQ state A and B or only one of them. |
| Huawei, HiSilicon | Option 3 | Blind retransmission is another issue, it can have its own solutions: e.g. larger *drx-InactivityTimer*. |
| Vivo | 3 and 2 | Since power saving gain based on HARQ RTT timer may not be expected in this case, Option 2 and 3 apply. Specifically, for blind UL retransmission in option 2, if companies intend to depend on inactivity timer to cover its retx scheduling (though there was an agreement on no modification to *drx-InactitiyTimer* in previous meetings), it eventually ends up with having no extra impacts on DRX timer handling, thus being able to be simply included in State B as well. |
| MediaTek | 3 | State B can be most accurately described as no (expected) UL retransmission. |
| InterDigital | 3 | Not starting the *drx-HARQ-RTT-TimerUL* means the *drx-RetransmissionTimerUL* timer is not started, and retransmission grant reception has to rely on UE being in DRX Active time by other means (e.g. the drx-InactivityTimer). This is clearly not optimal for grant reception so behaviour best supports no UL retransmission (but does not mean it can’t happen e.g. via blind retransmission). |
| Lenovo | 3 and possibly 2 | UL HARQ retransmission states are better to be aligned with *drx-HARQ-RTT-TimerUL* behaviour for less complexity. We are open to discuss whether to include blind retx as well. |
| Xiaomi | 2 & 3 | In this state, network can decide whether to blindly schedule UE or do not schedule retransmission. We should not restrict network behaviour. Either inactivity timer or DRX retransmission timer can be served for blind retransmission. We prefer the latter, since it can provide more opportunity for network to use time diversity for retransmission scheduling. |
| Apple | 3 |  |
| CATT | 3 | Blind retransmission can be supported in HARQ state B for enhancing reliability without introducing delay, but not to restrict it in HARQ state B. |
| LG | 2 and 3 | In order to enhance the reliability, the blind retransmission for UL HARQ retransmission state B should be supported. For this, the drx-InactivityTimer can be used. |
| OPPO | Option 3, and option 2 with some enhancement | If we keep the existing start condition for *drx-RetransmissionTimerUL*, then not starting the *drx-HARQ-RTT-TimerUL* means that not starting the *drx-RetransmissionTimerUL*, therefore this suits best with the no UL retransmission strategy.  If we are to support blind retransmission, we should consider modify the start condition for *drx-RetransmissionTimerUL,* e.g. to start the drx-RetransmissionTimerUL at the end of PUSCH transmission, otherwise, blind retransmission has to rely on other running timers. |
| Nokia | 3 and 2 | For blind retransmission, it should be included in State B since UE need to monitor PDCCH for retx after initial transmission grant, and we prefer not to start the drx-HARQ-RTT-TimerUL. Agree with Xiaomi that using DRX retx timer will provide more opportunity for network to support time diversity for retransmission scheduling. |
| ZTE | - | Please refer to our comments in Q3. |
| ETRI | Option 3 | For blind retransmission, it can be in State A or B depending on with or without feedback. |
| Intel | 2 or 3 depending on clarification on 2 | Our understanding is that blind UL retransmission should be gNB operation i.e. gNB provide UL grant without waiting UL decoding,  If it is really UE blind UL retransmission (UE send retransmission without UL grant), it should not be considered as option.  Provided that the blind transmission is gNB providing UL grant without waiting UL decoding, the difference between 2 and 3 is whether the UE store packet until the UE receives the next initial transmission. Given that there is not much difference between option 2 and 3, it would be good to have flexibility for gNB to allocate retransmission even in HARQ state B if more reliability is required with low latency. |
| Ericsson | 1 and 2 and 3 | 1 is also supported if the HARQ process have not been reused and the gNB may have to wait until the UE is in Active Time.  There is nothing that limits the gNB to send any type of grant to the UE at any time if the UE is in Active Time when the receiving the grant and respecting the L1 restriction on time between grants and PUSCH transmissions for a specific HARQ process. |

Based on the above questions, companies are asked to provide initial naming suggestions to facilitate stage 3 discussions.

**Question 5: How should HARQ state A/B be named? Companies are invited to provide suggestions below:**

|  |  |
| --- | --- |
| **Company** | **Suggested naming for HARQ state A/B** |
| Qualcomm | No strong view. As it is also fine to us. |
| Huawei, HiSilicon | No strong view as long as the behaviours are clear. Maybe HARQ state retx and HARQ state non-retx. |
| vivo | We think the decoding-based HARQ retransmission may be named “adaptive UL HARQ”. Along with our comments to Q3 and Q4, we suggest HARQ state A named “Adaptive HARQ enabled”, and HARQ state B named “Adaptive HARQ disabled”. If finally “No UL retransmission” is made into one separate category, whereas the other two HARQ schemes are in the other category, we are fine to follow Huawei’s suggestion above.  As another finding, if state A/B are finally defined directly by the corresponding DRX timer handling as in the agreed P1B, it seems somewhat contradictory to the majority’s view that reached the agreed P7, for which the majority’s view was not to apply an *Explicit* indication that directly configures intended DRX timer behaviour as in P1B (see Q8 of Phase1 disc).  Proposal 1B: HARQ state A/B are defined as follows:  - HARQ state A: length of drx-HARQ-RTT-TimerUL is extended by UE-gNB RTT (i.e. UE PDCCH monitoring is optimized to support UL retransmission grant based on UL decoding result).  - HARQ state B: drx-HARQ-RTT-TimerUL is not started.   * P1B is agreed   Proposal 7: UE determines drx-HARQ-RTT-TimerUL behaviour per HARQ process based on configured UL HARQ retransmission state. (14/20)   * Agreed |
| MediaTek | No strong view. We are fine with State A/B with some description in the specs for the expected behaviour. |
| InterDigital | No strong view. Perhaps suggestion by MTK may be a good way to avoid prolonged discussion. |
| Lenovo | No strong view. Clear definitions of states are more necessary than names. |
| Xiaomi | We prefer to name state A and B in a user friendly way, i.e. can know the fundamental purpose of this state. As such, we prefer:  HARQ state A: HARQ retransmission based on decoding result  HARQ state B: HARQ retransmission not based on decoding result |
| Apple | No strong view and what MTK suggested is fine for us. |
| CATT | No strong view. The name can be considered after the state is confirmed. |
| LG | The definition for UL HARQ retransmission state should be firstly decided. After that, we can decide the name. |
| OPPO | We share the save view as Xiaomi. No strong view on the naming, but the interpretations can be captured in the spec. |
| Nokia | No strong view now. The name can be discussed after reaching conclusion on Q3 and Q4. |
| ZTE | We think state A/B is sufficient, what matters is the expected behavior will be specified in specs. |
| Intel | Basically, we prefer not to introduce new state. Nevertheless, if we need, there is no need to name it specifically, HARQ state A/B should be enough not to waste RAN2 discussion time. |
| Ericsson | The effects of configuring this A and B are only 1) change the starting of drx-HARQ-RTT-TimerUL and 2) change mapping between LCH and HARQ process marked A and B.  For the naming we propose to use “UL HARQ DRX mode A and B”, or “UL HARQ LCP mode A and B”, maybe even “UL HARQ DRX-LCP mode A and B”.  We do not accept a name insinuating an effect on what type of reliability or retransmission scheme that will be used. |

# Continuation of P3

In Phase 1 of discussion, based on large majority support for Q3/Q4, the following was proposed:

Proposal 3: UE shall always act as indicated in a grant/assignment regardless of whether an UL HARQ retransmission state is configured or not (as in legacy). (18/20)

In subsequent discussion one company had concerns with grant assignment while the *drx-HARQ-RTT-TimerUL* is running, stating that network should not try to assign a grant for the same HARQ process for which the *drx-HARQ-RTT-TimerUL* citing the following text from MAC specification:

“drx-HARQ-RTT-TimerUL (per UL HARQ process): the minimum duration before a UL HARQ retransmission grant is expected by the MAC entity”

Companies which did not agree with this interpretation note that text states “expected” which does not necessary imply a restriction. Apart from RAN1 timing restrictions there is no explicit text which prevents network scheduling a HARQ retransmission for a HARQ process while drx-HARQ-RTT-TimerUL is running.

Rapporteur would like to note the following:

1. The issue is UE behaviour while drx-HARQ-RTT-TimerUL is running, so there should be no concerns for when UE is configured with HARQ state B (i.e. timer is not started).
2. It has already been confirmed by RAN2 in RAN2#113bise 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.
3. Under NTN, considering that in HARQ state A the drx-HARQ-RTT-TimerUL is extended by UE-gNB RTT, if network is prevented from assigning a grant to a HARQ process while timer is running the HARQ process can be locked up for a significant duration and could result in HARQ stalling state.
4. If an UL HARQ retransmission state is not configured the duration of drx-HARQ-RTT-TimerUL can only be up to a maximum 56 symbols. If no UL HARQ retransmission state is configured this issue may be considered unlikely (at least compared to HARQ processes configured with HARQ state A).

Given the above points, Rapporteur would like to focus discussion on the primary issue: expected UE behaviour for HARQ processes configured with HARQ state A.

**Question 6: Do you agree for HARQ process(es) configured with HARQ state A, UE in DRX active time may receive a grant/assignment while *drx-HARQ-RTT-TimerUL* is running and UE will act as indicated in grant/assignment?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/Disagree** | **Additional comments** |
| Qualcomm | Agree with revision | We also think this is mainly to address the HARQ stalling issue.  HARQ state A deserves the possibility to offer reliability with a retransmission if needed (in case network fails to decode PUSCH). This cannot be turned off by network whenever it wants by blindly sending a UL grant for new transmission while drx-HARQ-RTT-TimerUL is running. Therefore, conditions when this can happen should be clarified. We think a reasonable scenario is to allow scheduling new UL grant when all the HARQ processes configured with HARQ state A are stalled (i.e., all *drx-HARQ-RTT-TimerUL* timers are running for all HARQ processes configured with HARQ state A).  Without any additional condition, we fail to see the reason to even have two HARQ states because both A and B states would be same otherwise.  Note that in current MAC spec, there is a reason why “restart” and “stop” of *drx-HARQ-RTT-TimerUL* is not specified while “restart” and “stop” events of other timers such as *drx-InactivityTimer* is specified. That is because according to current spec, no UL grant is expected for the same HARQ process when the timer is already running as clearly captured in the definition of the timer that rapporteur have shown above (thereby ruling out any restart/stop situations, only possibility being the expiration of the timer and that is already specified.)  2> if the PDCCH indicates a UL transmission:  3> start the *drx-HARQ-RTT-TimerUL* for the corresponding HARQ process in the first symbol after the end of the first transmission (within a bundle) of the corresponding PUSCH transmission;  3> stop the *drx-RetransmissionTimerUL* for the corresponding HARQ process.  2> if the PDCCH indicates a new transmission (DL or UL) on a Serving Cell in this DRX group:  3> start or restart *drx-InactivityTimer* for this DRX group in the first symbol after the end of the PDCCH reception.  Therefore, we also need to add the “restart” condition of *drx-* *HARQ-RTT-TimerUL* for the case when a new UL grant is received for the same HARQ process as result of potential agreement here in NTN.  Therefore, we think the following proposals are clear and sufficient and hope they are acceptable:  **Proposal 3A: For a HARQ process configured with HARQ state A, if all HARQ process(es) configured with HARQ state A are stalled, UE in DRX active time may receive a grant/assignment while *drx-HARQ-RTT-TimerUL* is running and UE will act as indicated in grant/assignment.**  **Proposal 3B: If UE receives** **a UL grant while *drx-HARQ-RTT-TimerUL* is running, restart the *drx-HARQ-RTT-TimerUL* for the corresponding HARQ process.** |
| Huawei, HiSilicon | Disagree | In our understanding, if a HARQ process is configured with an UL HARQ retransmission state, the UE shall not receive grant with an unexpected NDI value (e.g. for a high reliability HARQ process, NDI indicating new transmission before UE-gNB RTT).  For the original P3 in phase 1 discussion, it only says UE shall not go against NW scheduling, which is acceptable to us (though we would prefer not having any proposal at all, because there’s no need to emphasize what would only happen in error config):  Proposal 3: UE shall always act as indicated in a grant/assignment regardless of whether an UL HARQ retransmission state is configured or not (as in legacy). (18/20)  But the suggested wording in this I (“may receive a grant/assignment while drx-HARQ-RTT-TimerUL is running”) makes the inappropriate configuration even more emphasized.  The etwork implementation will anyway guarantee the NDI value shall not go against HARQ retransmission state, and no changes are needed to the spec.  HARQ stalling is another issue, blind retransmission can be used to solve the problem.  We suggest not have any proposal or simply clarify that:  **RAN2 confirms that NW implementation will guarantee the NDI value will not go against HARQ retransmission state.** |
| Vivo | Agree with comment | Possible, as when drx-HAQR-RTT-TimerUL is running, it is possible that other DRX timers (e.g. Inactivity timer and/or Onduration timer) are running in parallel, keeping the UE still in DRX Active time for PDCCH monitoring. But we wonder whether this is a case normally happening in NTN, as drx-HARQ-RTT-TimerUL length is extended and would be very long, but Onduration timer and Inactivity timer were not expected to be extended as per previous agreements. |
| MediaTek | Agree, but | This should not result in any spec changes. The DRX/UL grant processing mechanisms are unchanged from legacy (i.e. Rel-16). The only difference between legacy and NTN for State A is the extension of the DRX RTT timer with UE-gNB RTT.  If a HARQ process is configured with State A (UL retransmission/new transmission grant only after decoding the previous PUSCH), then it is normal for that HARQ process to stall during the RTT, so we don’t understand why this is an unexpected problem. The network has the freedom not to configure and HARQ process with State A and configure all with State B if it wants to.  If the intention is to solve a potential issue on if and how to support blind retransmission in State A, we prefer to discuss that question separately. |
| InterDigital | Agree | It is also our understanding that this is legacy behaviour and should not result in specification change. However, considering there seems to be divergent views on legacy behaviour this could perhaps be captured as a clarifying note in MAC spec.  We agree with the comment by QC that this problem is most critical when all HARQ processes in HARQ state A are stalled. However, we wonder about the proposed revision ““**if all HARQ process(es) configured with HARQ state A are stalled**”. Why we need to get to the worst-case scenario before network can do anything about it?  The suggestion by HW does not seem very useful as based on current definition HARQ states A/B only control DRX timer behaviour and places no restriction on scheduling. There is therefore no NDI value which will go against “go against HARQ retransmission state” |
| Lenovo | Agree with comments | The proposed behaviour is as in legacy and no spec change is needed. For the “all HARQ process(es) configured with HARQ state A are stalled” case there may be issues but we think it would be a rare case as NW can avoid this by proper configuration. |
| Xiaomi | Agree | It is legacy behavior |
| Apple | Agree | This is legacy behavior as Xiaomi suggested. |
| LG | Agree | Agree with MediaTek. |
| OPPO | Disagree | We agree with Huawei that network should guarantee that the scheduling shall not go against the configured HARQ retransmission state, otherwise, why does the network still configure the HARQ state? So we support Huawei’s suggestions.  **RAN2 confirms that NW implementation will guarantee the NDI value will not go against HARQ retransmission state.**  For UE with some HARQ process(es) configured with HARQ state A, during DRX active time, indeed the UE keep monitoring PDCCH as legacy behaviour. However, when drx-HARQ-RTT-TimerUL is running, NW should not schedule for the HARQ processes configured with state A, the scheduling can be for other HARQ processes with state B. note that HARQ state B is just the solution for HARQ stalling.  In addition, we agree with QC regarding the reasoning of not specifying “restart” and “stop” of *drx-HARQ-RTT-TimerUL* in MAC. |
| Nokia | Agree | It is legacy behaviour that MAC will just process whatever UL grant PHY receives when UE is in active time, even the HARQ RTT timer is running. We don’t see the motivation to change the spec. |
| ZTE | Agree | Agree with  analysis from InterDigital that the behavior is mainly to allow NW to adjust the scheduling strategies to avoid stalling situation when HARQ state A is configured. Thus we are fine with current statement in Q6, saying that this behaviour applies when HARQ state A is configured.  Note that our interpretation is still that this is/was the intended behaviour also in legacy. However we understand that there are different views (e.g. from Qualcomm) on what the legacy behaviour is and we are now ok not to say this is the legacy behaviour (which could be left unspecified / clarified with a note in MAC specs, but in case this should be discussed in the main session as part of the R15 maintainance, not in NTN). |
| ETRI | Agree, but | It is legacy behaviour. It does not result in any spec changes. |
| Intel | Agree with comment | One thing to clarify is that it is the case where the UE happen to be in Active while drx-HARQ-RTT-TimerUL is running. In this case, the UE will process the received UL grant according to the current MAC specification. |
| Ericsson | Agree | Of course, the only reasonable thing is that the UE does what a received grant indicates, any other thing (like ignoring the grant) will make a misalignment between the UE and the gNB worse.  There is NOTHING in the reception of a grant, see MAC spec section 5.4.1, that allows the UE to ignore a grant or that the UE shall check what the DRX state is for the concerned HARQ process. If the UE is in Active Time, it shall decode grants received on the PDCCH and act as indicated, regardless of possible DRX state of the concerned HARQ process.  Remember the system may even be used without DRX configured.  Possibly, there is a small mistake in the DRX section that it shall actually say restart. |
| Qualcomm | - | Just to address some comments:  First of all it is strange to see Ericsson’s argument:   1. In R2-2108452, they claim The descriptive text ”the minimum duration before a DL assignment for HARQ retransmission is expected by the MAC entity;” was unfortunate. 2. Now again they claim “Possibly, there is a small mistake in the DRX section that it shall actually say restart.”   This is really unfortunate when such claims are made for the specification which is already clear and stable.  Such discussion has already happened in other RAN2 session consuming RAN2’s significant online time. This is being repeated in NTN session where we have very limited time to resolve other important issues. Here is the reference, please see following tdocs and relevant agreements.  R2-1802720 Transport block repetition for reliability, Ericsson.  R2-1807297   Blind/HARQ-less repetition for scheduled DL-SCH and UL-SCH        Qualcomm Incorporated  **=> RAN2 confirms that according to current specification, UE’s are not expected to process consecutive UL-grants in time for the same HARQ process.**  **=>  RAN2 confirms that according to current specification, UE’s are not expected to process consecutive DL-grants in time for the same HARQ process.**  Anyway, we agree with ZTE that such legacy behavior should be discussed in main session if some companies think it is necessary (not in NTN session).  For now, our concern is not about UE or MAC spec. It is about what excuse network can get to override the HARQ state A behavior as accurately pointed out by OPPO. If UE receives a UL grant while drx-HARQ-RTT-TimerUL is running, how do you know network actually intentionally sent this to kill the HARQ state A (or the LCP restriction) or it was really due to some other reason (e.g., due to some mismatch).  The primary reason what we can discuss is the former, that is we should not emphasize this issue. This is what Huawei has proposed, in our understanding.  We understand we do not specify network restriction, that is why we specify what is **expected** by UE.  Therefore, we are fine with any of the followings in the order of preference.   1. we capture in chairman’s note what Huawei has proposed. 2. We capture nothing and rely on legacy behavior. 3. We add this in the following agreement we already made   **For HARQ process(es) not configured with an UL HARQ retransmission state or configured with HARQ state A, drx-HARQ-RTT-TimerUL and drx-RetransmissionTimerUL behave as per legacy.**   1. **For a HARQ process configured with HARQ state A, if all HARQ process(es) configured with HARQ state A are stalled, network can schedule a UL grant for UE in active time while drx-HARQ-RTT-TimerUL is running and UE will act as indicated by DCI in the UL grant.**   What is not acceptable is using NTN time resource to discuss and potentially change the current behaviour in NTN. |

# Conclusion

<To be generated pending company input>

# References

1. [R2-2107076](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_115-e/Docs/R2-2107076.zip) Discussion on UL HARQ retransmission in NTN – OPPO
2. [R2-2107315](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_115-e/Docs/R2-2107315.zip) Discussion on HARQ Aspects and UL Scheduling Enhancement in NTN – CATT
3. [R2-2107361](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_115-e/Docs/R2-2107361.zip) Discussion on HARQ and LCP remaining issues – Spreadtrum Communications
4. [R2-2107449](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_115-e/Docs/R2-2107449.zip) Impact on DRX timers with UL/DL HARQ enhancement in NTN – vivo
5. [R2-2107450](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_115-e/Docs/R2-2107450.zip) Impact on LCP with disabled UL HARQ retransmission in NTN – vivo
6. [R2-2107563](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_115-e/Docs/R2-2107563.zip) LCP restriction for an UL HARQ process – Qualcomm Incorporated, Huawei, HiSilicon, Xiaomi, Samsung
7. [R2-2107632](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_115-e/Docs/R2-2107632.zip) HARQ Management and LCP Restrictions in NTN – Apple
8. [R2-2107790](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_115-e/Docs/R2-2107790.zip) Co-existence issue of BSR over CG and BSR over 2-step RACH – PANASONIC R&D Center Germany
9. [R2-2107909](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_115-e/Docs/R2-2107909.zip) BSR with configured 2-step RACH and CG – Lenovo, Motorola Mobility
10. [R2-2107986](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_115-e/Docs/R2-2107986.zip) Consideration on HARQ aspects – Beijing Xiaomi Mobile Software
11. [R2-2108115](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_115-e/Docs/R2-2108115.zip) Discussion on remaining MAC issues for NR NTN – Nokia, Nokia Shanghai Bell
12. [R2-2108318](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_115-e/Docs/R2-2108318.zip) On disabling uplink HARQ retransmission and associated LCP impacts – MediaTek Inc.
13. [R2-2108319](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_115-e/Docs/R2-2108319.zip) Round trip delay offset for configured grant timer – MediaTek Inc
14. [R2-2108351](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_115-e/Docs/R2-2108351.zip) Considerations on HARQ aspects – ZTE Corporation, Sanechips
15. [R2-2108452](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_115-e/Docs/R2-2108452.zip) On DRX, LCP, HARQ, SR/BSR, and configured scheduling – Ericsson
16. [R2-2108544](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_115-e/Docs/R2-2108544.zip) Discussion on LCP Restrictions and CG Impact in NTN – CMCC
17. [R2-2108608](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_115-e/Docs/R2-2108608.zip) Discussion on other MAC aspects – LG Electronics Inc.
18. [R2-2108610](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_115-e/Docs/R2-2108610.zip) Consideration on LCP in NTN – Huawei, HiSilicon
19. [R2-2108611](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_115-e/Docs/R2-2108611.zip) Discussion on TA report – Huawei, HiSilicon
20. [R2-2108661](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_115-e/Docs/R2-2108661.zip) UL HARQ retransmission – InterDigital
21. [R2-2108662](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_115-e/Docs/R2-2108662.zip) Impact of UE-gNB RTT determination on MAC – InterDigital
22. [R2-2108716](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_115-e/Docs/R2-2108716.zip) Discussion on UL retransmission and DRX RTT timer – ASUSTeK
23. [R2-2108768](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_115-e/Docs/R2-2108768.zip) HARQ Retransmission Enabling/Disabling for CG aspects – ITL