3GPP RAN WG2 Meeting #114e R2-2106523

eMeeting May 19th – May 27th, 2021

Agenda Item: 8.10.2.2

Source: InterDigital (summary rapporteur)

Title: [DRAFT] Report of [AT114-e][103][NTN] Other MAC aspects

Document for: Discussion, Decision

# Introduction

This document continues the pre-meeting summary discussion of 8.10.2.2 – Other MAC aspects. The following scope and intended list of outcomes has been provided:

* [AT114-e][103][NTN] Other MAC aspects (Interdigital)

Initial scope: Continue the discussion on proposals from [R2-2106488](file:///C:\Data\3GPP\RAN2\Inbox\R2-2106488.zip) as well as those on drx-RetransmissionTimerDL, sr-ProhibitTimer and CGT/CGRT

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

* + - List of proposals for agreement (if any)
    - List of proposals that require online discussions
    - List of proposals that should not be pursued (if any)

The following deadlines have been provided:

* Initial deadline (for companies' feedback): **Friday 2021-05-21 1000 UTC**
* Initial deadline (for rapporteur's summary in R2-2106523): **Friday 2021-05-21 1800 UTC**

Please also note the following further guidance provided by chair:

* Proposals marked "for agreement" in R2-2106523 not challenged until **Monday 2021-05-24 10:00** UTC will be declared as agreed via email by the session chair.

# UL HARQ Retransmission

From RAN2 perspective it has been agreed that the NW can continuously schedule the UE using one or a combination of scheduling strategies to avoid HARQ stalling in NTN UE:

* HARQ with retransmissions based on the previous PUSCH decoding result
* HARQ with (blind) retransmissions not based on the previous PUSCH decoding result
* HARQ with no retransmission

## drx-HARQ-RTT-TimerUL

In RAN2#112e it was agreed that for dynamic grant, HARQ uplink retransmission may be “disabled” by gNB sending grant with NDI not toggled/toggled without waiting for decoding result of previous PUSCH transmission. However, handling of RTT timers (specifically *drx-HARQ-RTT-TimerUL*) is listed as FFS. In RAN2#113bis-e, it was agreed:

*RAN2 confirms 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 or drx-HARQ-RTT-TimerDL is running or not. No specification change is needed.*

*RAN2 confirms that in NTN using the value= “zero” for drx-HARQ-RTT-TimerUL and drx-RetransmissionTimerUL is possible. No specification change is needed.*

*In NTN, The drx-HARQ-RTT-TimerUL is configured per UE DRX group and the behaviour can be configured per HARQ process. FFS the different behaviours and how to indicate the behaviour to the UE and the number of behaviours (e.g., two or more behaviours).*

### Possible configured values

In RAN2#114e, the following was agreed regarding possible values for the *drx-HARQ-RTT-TimerUL*:

*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.*

In online session it was discussed whether the timer offset should be aligned with agreement for *drx-HARQ-RTT-TimerDL* (i.e. RAN2 working assumption that the offset to UL RTT timer be offset via UE-gNB RTT). As discussion was ultimately inconclusive, companies which would like an alternative solution are encouraged to further explain their position.

**Question 1)** **Do you support the following proposed working assumption?:**

***RAN2 working assumption: Offset for drx-HARQ-RTT-TimerUL is equal to UE-gNB RTT (if RAN1 decides something that requires to change this we can revisit it as in DL).***

**If “No” please explain why not, and provide an alternative wording/solution which would be acceptable.**

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| **Company** | **Yes/No** | **Additional comments** |
| Xiaomi | Yes | Response to the concern of Ericsson that why not use Koffset + Kmac(the RTT between RP and gNB) for the offset of DRX RTT timer. Although Koffset is usually configured larger than UE specific TA to leave margin to cope with the change of UE specific TA during a period, the margin will only increase the gap beween receiving the DCI and the transmission of PUSCH, it has no impact on when the DCI is received. The receiving time of DCI is still decided by UE-gNB RTT. |
| APT | Yes |  |
| ZTE | Yes | In our understanding, RAN1 has agreed on UE-specific koffset handling, which is used to compensate the RTD in NTN, so it is not common that Koffset is larger than UE-gNB RTT, therefore this shall be fine. |
| OPPO | Yes | We should align with DL. |
| Samsung | Yes | We should support some form of TA reporting from the UE to the gNB (e.g., rule-based {preferred}, periodic, or DCI request-based) so that the UE and the gNB have same/similar understanding of the current TA of the UE.  Rule-based TA Reporting: UE reports the TA in a MAC CE when the difference between the last reported TA and the current TA exceeds a threshold.  Our understanding is that TA reporting has support from numerous companies. |
| MediaTek | Yes | The duration of the timer can be increased (offset) by the UE-gNB RTT, that can be calculated by the UE. |
| Qualcomm | Yes |  |
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### Selection between values

Considering the multiple options supported for *drx-HARQ-RTT-TimerUL*, configuring different behaviours of *drx-HARQ-RTT-TimerUL* per HARQ process could ensure the UE is monitoring PDCCH at the optimal time for each of the various NW scheduling strategies (i.e. to take increased RTT into account, or to facilitate immediate reception). Considering what strategy the NW uses to avoid HARQ stalling in NTN is up to NW implementation, what behaviour the UE applies to timers for each HARQ process shall also be up to network implementation.

**Question 2)** **Do you agree that which *drx-HARQ-RTT-TimerUL* value is applied for each HARQ process is up to network implementation (e.g. to support NW scheduling strategy to avoid HARQ stalling)?**

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| **Company** | **Agree/Disagree** | **Additional comments** |
| Xiaomi | Disagree | If this proposal means explicit configuration of timer behavior, then the answer is no. There is no need to explicitly configure the behavior of DRX HARQ RTT timer, whose behavior 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 behavior. |
| APT | Agree | It’s no doubt that the scheduling strategy should be up to NW implementation. Moreover, NW should let UE know the scheduling strategy for a HARQ process to achieve the best balance between scheduling efficiency and power consumption. |
| ZTE | Yes |  |
| OPPO | Agree with comments | From gNB’s perspective, there are three different scheduling strategies, and they are up to NW implementation.  So, from UE’s perspective, different DRX behaviour could be applied for each HARQ process to support these scheduling strategies, which is of course up to NW to control. It’s not clear what it means here by NW implementation, or the intention is to say “up to NW’s configuration”?. Meanwhile, how many types of DRX behaviours supported by UE should be FFS. |
| Samsung | Agree with comments | As far as the timer value is concerned, we agree. However, we should have a separate and explicit indication of whether the current UL assignment (which can occur whether the UE is operating in the DRX mode or not) corresponds to HARQ feedback enabled or disabled so that the UE can carry out suitable LCP. |
| MediaTek | Agree | Network decides which HARQ process(es) will be enabled/disabled for UL HARQ retransmissions and therefore the impact on the drx-HARQ-RTT-TimerUL. |
| Qualcomm | Agree with revision | UE needs to be configured with this behavior (whether be it directly configured or derived implicitly from HARQ retransmission configuration).  But this can be agreed with following revision, i.e., clarifying what is network strategy.  “which drx-HARQ-RTT-TimerUL value is applied for each HARQ process is configured/indicated by network based on NW scheduling strategy to avoid HARQ stalling (i.e., HARQ retransmission is enabled/disabled).” |
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For DL case, behaviour of *drx-HARQ-RTT-TimerDL* is defined based on whether HARQ feedback is enabled or disabled. Referring to agreements from RAN2#113e:

*For HARQ processes with DL HARQ feedback disabled, drx-HARQ-RTT-TimerDL is not started.*

*For HARQ processes with DL HARQ feedback enabled, drx-HARQ-RTT-TimerDL length is increased by offset (i.e. existing values within value range increased by offset). RAN2 working assumption: offset is equal to UE-gNB RTT (if RAN1 decides something that requires to change this we can revisit it)*

Adopting the same principal for *drx-HARQ-RTT-TimerUL* would mean that a HARQ retransmission scheme would be associated with a *drx-HARQ-RTT-TimerUL* behaviour. For example, if network indicates that retransmission is enabled for a HARQ process, UE could automatically know to apply offset to timer without explicit configuration. It is noted that actual mapping between timer option/retransmission scheme requires further discussion.

**Question 3) Do you agree the value of drx-HARQ-RTT-TimerUL is connected to an UL HARQ retransmission scheme (e.g. as in DL for HARQ feedback enabled/disabled)?**

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| **Company** | **Agree/Disagree** | **Additional comments** |
| Xiaomi | Agree | It is straightforward that the behavior of RTT timer is linked with the UL HARQ retransmission scheme, once the scheme is configured for a HARQ, the RTT timer behavior can be determined without ambiguity. |
| APT | Agree | It is known that the drx-HARQ-RTT-TimerUL is used to trigger the drx-retransmisisonTimer. In this sense, the UE behaviors on the drx-HARQ-RTT-TimerUL can be connected to the UL HARQ retransmission scheme. |
| ZTE | Disagree | We think the drx-HARQ-RTT-TimerUL is only used to control UE’s behavior on monitoring PDCCH for power saving purpose, which is unnecessarily related to UL transmission scheme. NW shall be able to schedule UE with either new transmission and retransmission so long as UE is in ACTIVE time, which is confirmed in last meeting.  Therefore, even in case the drx-HARQ-RTT-TimerUL is set to 0, the blind retransmission should still be allowed.  In addition, it is clear specified in MAC that “If *REPETITION\_NUMBER* > 1, after the first transmission within a bundle, at most *REPETITION\_NUMBER* – 1 HARQ retransmissions follow within the bundle”, the repetition transmission scheduled by a single DCI is also described as HARQ retransmission in MAC specs, thus we think the HARQ retransmission should be allowed in any case from RAN2 perspective. |
| OPPO | Agree | We should align with DL. It is straightforward that each UL HARQ retransmission scheme has its own DRX behaviour. |
| Samsung | Agree with comments | Based on the explicit indication about the HARQ feedback enabled/disabled in the DCI {preferred by us due to best performance} or semi-static HARQ process configuration {less preferred due to lower performance arising from lack of fast adaptation}, the timer would behave accordingly. |
| MediaTek | Agree | DL and UL configuration and mechanisms should be similar, therefore the behaviour for drx-HARQ-RTT-TimerUL should be based on whether UL HARQ retransmission is enabled for the particular HARQ process or not (instead of separate explicit indication for the timer behaviour per HARQ process). |
| Qualcomm | Agree with comments | Adoting same principle as in DL is simple.  (1) drx-HARQ-RTT-TimerUL = 0 for the case HARQ retransmission based on decoding result is disabled.  (2) drx-HARQ-RTT-TimerUL is extended by offset for the case HARQ retransmission based on decoding result is enabled.  For the case when blind retransmission scheduling is disabled in option (1), we can discuss how DRX retransmission timer is used |
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## Indication of HARQ retransmission scheme

Depending on which scheduling strategy is employed to avoid HARQ stalling state, UE may expect a retransmission grant after UE-gNB RTT, before UE-gNB RTT, or not at all. This may impact DRX timers or LCP, which is discussed further in Section 3. The possible options have been captured in Pre-meeting summary discussion:

**Indication by RRC:**

Companies which support semi-static indication via RRC note that if UE receives a grant with NDI toggled, it cannot tell whether the gNB wants to perform scheduling with UL retransmission disabled or the gNB just wants a new transmission. UE will need to know the different scheduling strategies of each HARQ process, for example, for LCP restriction to map LCH to HARQ process or to properly configure HARQ RTT timer. It is also mentioned that semi-static indication per HARQ process is already agreed for enabling/disabling DL HARQ feedback.

**Implicit indication**

In pre-meeting summary a compromise was suggested where HARQ retransmission scheme may be determined implicitely by UL HARQ RTT Timer behaviour. Since the configured value of this timer is meant to optimize UE PDCCH monitoring for a particular strategy, this would provide a likely indication of which retransmission scheme is employed per HARQ process. The additional benefit is that an implicit indication does not restrict network to a specific scheduling strategy as retransmission grant can be sent any time the UE is in DRX Active time.

**Indication via DCI**

It is suggested that a DCI-based dynamic enabling/disabling of HARQ feedback could be used in addition to semi-static RRC signaling-based. This would utilize radio resources more efficiently and to adapt to the prevailing radio environment and QoS requirements. It is proposed to send an LS to RAN1 regarding re-purposing DCI PDCCH bits for this purpose.

**No indication**:

It was noted that when the UE receives a new transmission grant/assignment (that is, NDI is toggled), then previous TB cannot be retransmitted by HARQ. Previous TB may have been successfully received or not, and time elapsed since last time a grant/assignment for the same HARQ process was received with toggled NDI may be shorter or longer than the HARQ RTT. Semi-static indication may limit network scheduling flexibility, and in NTN, as in legacy, the UE shall always do what received grants and assignments indicate.

**Question 4)** **Which of the following method(s) for indication of HARQ retransmission scheme do you support:**

**1) Semi-static RRC configuration;**

**2) Determined implicitly, e.g. via current HARQ RTT Timer behaviour;**

**3) Dynamic DCI indication;**

**4) No indication is needed.**

**5) Other**

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| **Company** | **Indication method(s)** | **Additional comments** |
| Xiaomi | option 1 | semi-static RRC configuration is engough, no need for dynamic change of retransmission scheme since the scheme is related to traffic QoS, which does not change.  option 2 is very strange, since retransmission scheme doesn’t only impact the behavior of DRX RTT timer, but also impact LCP. Using RTT behavior to represent retransmission scheme is very misleading for spec reader. |
| APT | 1 and 3 | Option 1 can be the baseline to conquer the issues on DRX timers and concerns on LCP/QoS.  Option 3 provides a more dynamic option for the NW to change the HARQ retransmission scheme. However, option 3 cannot be applied for CG and has RAN1 impact, we are also fine to deprioritized it.  Option 2 is not clear how to implement it by implicit way. Since the value of the drx-HARQ-RTT-TimerUL can only be configured per DRX group/MAC entity now, i.e., it cannot be configured per HARQ process. If we want to introduce different behaviors for different HARQ processes, somewhat a new indication/configuration to indicate the behavior per HARQ process is needed.  Option 4 is not supported because the impacts on the DRX timers and LCP/QoS cannot be addressed without understanding the HARQ retransmission schemes by UE. |
| ZTE | 3 or 4 | As commented in previous question, we don’t think any restriction on the HARQ retransmission is needed.  We should focus on the DRX and the handling of HARQ RTT timer.  In addition, it is not clear how many HARQ retransmission schemes are we talking about here. From our point of view, the following four different HARQ retransmission behaviour can be identified:   * No HARQ retransmission at all (i.e. either repetition transmission or blind retransmission is allowed) * Only repetition based HARQ retransimssion (NDI will always be toggled. HARQ retransmission can only be scheduled by repetition transmission with a single DCI) * Blind retransmission is allowed (HARQ retransmission can be scheduled by different DCI with the same NDI. And the blind retransmisison can be scheduled before the initial UL transmission is received by NW) * Normal HARQ retransmission (no retransmission is expected to be scheduled before the expiration of HARQ RTT timer)   Among the HARQ retransmission schemes above, at least the repetition based HARQ retransmission can be indicated by DCI. |
| OPPO | Option 1 | Option 1 aligns with DL.  Besides, if the mapping between UL HARQ retransmission scheme and HARQ RTT Timer behaviour is one to one, there are no difference between Option 1 and 2. |
| Samsung | Option 3 {preferred} | Since the resource assignment is occurring using a DCI and since there are long delays in an NTN (if RRC siganling were used to change enabling/disabling command), this option would give the best performance due to fast adaptation. However, for additional flexibility to the gNB, we are fine supporting Option 1 in addition to Option 3. |
| MediaTek | 1 | This was already discussed in the SI: the UE should be informed using semi-static mechanism with RRC configuration. |
| Qualcomm | 1 or 2 | Either (1) or (2) is sufficient. As HARQ RTT timer behavior needs to be configured by RRC anyway even with (2).  But we do not agree to change any DCI field as in (3). |
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Regardless of whether indication is configured via RRC or implictly determined, the majority of companies seem to support that an indication of HARQ retransmission scheme (if agreed) should be per HARQ process.

**Question 5)** **Do you agree that indication of HARQ retransmission scheme (if agreed) is per HARQ process?**

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| **Company** | **Agree/Disagree** | **Additional comments** |
| Xiaomi | Yes |  |
| APT | Agree |  |
| ZTE | Depends | It depends on the discussion to the previous issues. For example, we think the repetition based HARQ retransmission (scheduled by a single DCI) should be allowed in all cases.  In addition, it is not clear why we need to indicate the HARQ retransmission scheme. From our point of view, we only need to focus the handling of HARQ RTT timer. |
| OPPO | Agree |  |
| Samsung | Agree |  |
| MediaTek | Agree |  |
| Qualcomm | Agree | It is cleaner to indicate per HARQ process. |
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# LCP

The following was agreed in RAN2#113bise:

*LCP restrictions should be further considered for an UL HARQ process in NTN. FFS if no further LCP restrictions are needed, or if (R16) existing LCP restrictions can be re-used or if new LCP restriction shall be defined for this purpose.*

This section summarizes proposals addressing LCP, including the whether additional LCP restrictions are necessary and if introduced how the existing procedure can be modified.

## Introduction of new LCP restriction

In legacy specification, RRC controls LCP procedure by configuring mapping restrictions for each logical channel (LCH). The following LCP restrictions are defined, with parameters *configuredGrantType1Allowed* and *allowedCG-List* specific to configured grant, and *allowedPHY-PrioirtyIndex* specific to dynamic grant:

- ***allowedSCS-List*** which sets the allowed Subcarrier Spacing(s) for transmission;

- ***maxPUSCH-Duration*** which sets the maximum PUSCH duration allowed for transmission;

**- *configuredGrantType1Allowed*** which sets whether a configured grant Type 1 can be used for transmission;

- ***allowedServingCells*** which sets the allowed cell(s) for transmission;

**- *allowedCG-List*** which sets the allowed configured grant(s) for transmission;

- ***allowedPHY-PrioirtyIndex*** which sets the allowed PHY priority index(es) of a dynamic grant for transmission.

### CG-specific LCP restriction in NTN

In the pre-meeting summary it was suggest that for configured grant, the current LCP restrictions are sufficient to support enabled/disabled UL retransmission. If allowedCG-List is configured to a logical channel, MAC SDUs from the logical channel can only be mapped to the indicated configured grant configuration, so the network can control the allowed CG type and CG to be used for transmission of certain LCHs. Since the configuration of CG and HARQ process ID is also controlled by NW, current LCP is sufficient to guarantee the mapping between LCHs and HARQ process ID for CG case.

It was further noted that discussion on disabling UL retransmission and various scheduling strategies to avoid HARQ stalling has focused primarily on dynamic grant i.e. referring to agreement from RAN2#112e:

*From RAN2 perspective, for dynamic grant, one possibility for "enabling"/"disabling" HARQ uplink retransmission at UE transmitter is without introducing an additional mechanism (i.e. gNB can send grant with NDI not toggled/toggled without waiting for decoding result of previous PUSCH transmission). FFS on the handling of RTT timers. Other solutions for enabling/disabling HARQ UL reTX are not precluded*

Past discussion has also focused on whether *allowedPHY-PriorityIndex* is sufficient (i.e. a dynamic-grant specific parameter). To reduce scope of discussion, it is suggested to attempt conclusion that at least no additional LCP restrictions *specific to configured grant* are needed.

Note: if a new LCP restriction is agreed for dynamic grant, the following proposal does not preclude future discussion on whether it may also apply to configured grant.

**Question 6)** **Do you agree no new CG-specific LCP restriction is introduced for NTN?**

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| **Company** | **Agree/Disagree** | **Additional comments** |
| Xiaomi | yes | allowedPHY-PriorityIndex has the limitation that it only applies to dynamic grant, not to configured grant. Some company clarify that for configured grant allowedCG-List can be used. However, allowedCG-List has the limitation that the CG will be linked with HARQ retransmission disabled. LCH that requires HARQ retransmission enabled cannot use the CG. However, there is no reason why CG cannot accomodate both HARQ retransmission enabled and retransmission disabled. |
| APT | Agree, but | allowedCG-List can only direct the LCH to a CG configuration but not direct the LCH to the specific HARQ process(s) (with the same HARQ retransmission scheme). Although the *nrofHARQ-Processes* and *harq-ProcID-Offset* can be used to restrict the usable HARQ processes for the CG configuration, it will somehow introduce the restriction on the usage of the HARQ process(s) for the CG. For example, the NW should ensure these consecutive HARQ processes have the same HARQ retransmission scheme. However, it seems not favorable to make the restriction to NW on the usage of the HARQ process(s) for the CG.  It is noted that the HARQ process ID for the UL transmission of CG is derived from the equation. If the indication of HARQ retransmission scheme for a HARQ process (in Q4) can be supported, the indication can also be used on the equation for determining the HARQ process ID for CG transmission. |
| ZTE | Agree | For CG, we already support using RRC to configure the mapping between CG and LCHs, no additional restriction is needed. |
| OPPO | Agree | If a new LCP restriction is agreed for dynamic grant, it may also apply to configured grant. |
| Samsung | Agree |  |
| MediaTek | Disagree | We think that it is too early to rule out this possibility. We can come back to this issue (whether any new LCP restrictions are needed for CGs) after progressing the dynamic grant case further. In other words, we are fine to postpone this discussion until we progress the LCP restrictions for the dynamic grant case, and we know more about the nature of (potential) restrictions, but we don’t think we need to make an agreement to rule out the CG case now. |
| Qualcomm | Agree | Existing LCP would work for CG. |
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### LCP restrictions for dynamic grant

As previously mentioned NW can continuously schedule the UE using one or a combination of scheduling strategies to avoid HARQ stalling in NTN UE. As described in the pre-meeting summary, due to the different scheduling strategies for UL HARQ retransmission, HARQ processes with different delay/reliability attributes may coexist. To ensure, for example, a UE does not multiplex data from a LCH requiring high reliability to a HARQ process without retransmission, LCP may require modification.

Past discussion has focused on whether re-purposing existing LCP restrictions (*allowedPHY-PriorityIndex*) can serve this purpose. The parameter *allowedPHY-PriorityIndex* was introduced in R16 IIoT to ensure high priority (i.e. mainly time-sensitive) data is mapped to an appropriate UL grant. gNB may configure LCHs with less important data to use PHY priority index p0 and p1, while important LCHs are configured to only use priority index p1. gNB can distinguish between SR for low priority data and SRs for high priority data via separate PUCCH SR resources, and gNB may dynamically decide which PHY index (p0 or p1) to use for each grant.

According to current specification, the usage of *allowedPHY-PriorityIndex* is given as follows:

* ***allowedPHY-PriorityIndex* is configured and the dynamic grant has a PHY-priority index**: UL MAC SDUs from this LCH can only be mapped to the dynamic grants indicating PHY-priority index equal to the values configured by this field.
* ***allowedPHY-PriorityIndex* is configured and the dynamic grant does not have a PHY-priority index:** UL MAC SDUs from this logical channel can only be mapped to this dynamic grant if the value of the field is p0. Since the presence of PHY-priority index is configured by IE priorityIndicatorDCI-0-1 in RRC signaling, the present or not can not be changed dynamically.
* ***allowedPHY-PriorityIndex* is not configured**: UL MAC SDUs from this logical channel can be mapped to any dynamic grants.

The following is a summary of views provided in contributions regarding introduction of a new LCP restriction for UL HARQ process in NTN.

**Support for new restriction:**

Supporting companies argue that uplink traffic is generally differentiated by mapping QoS flows to logical channels (LCHs). The UE should be able to route certain traffic (e.g. requiring high reliability) using the HARQ processes for which HARQ UL retransmission is enabled, and other traffic (e.g. requiring high throughput) using the HARQ processes for which HARQ UL retransmission is disabled.

Unless a mapping between LCHs and UL HARQ processes is introduced, at the time of initial transmission of PUSCH, UE will have no idea whether network intends to disable HARQ retransmission or not. UE therefore risks multiplexing data from a logical channel that is unsuitable for the UL retransmission scheme (i.e. HARQ enabled/disabled). In case of HARQ transmission loss, RLC retransmission mechanism to recover the data could be too costly in terms of latency impact, UE power consumption and network resources (if RLC retransmission is even configured).

Regarding re-use of *allowedPHY-PriorityIndex*, several companies mention that re-purposing this field from IIoT may not be a good way forward. They note that this may: limit possible adoption of IIoT for NTN in a future release, may impact future standardization work in IoT over NTN, affect intra-UE prioritization (which would have to be evaluated by RAN1), and cannot cover the configured grant case.

**Not introduced**

Companies not in favour of introducing further LCP restrictions note that are already several mechanisms to ensure transmission reliability (e.g. BSR MAC CE have retxBSR-Timer, RRC messages can have RLC retransmissions).

Considering gNB is aware of the decoded data and failed decoding, it can adapt the scheduling and/or link adaptation and/or the gNB estimation algorithm for UE buffer status. For example, the gNB can estimate the UE buffer content from BSRs, SRs, and previously decoded TBs so can schedule accordingly. Furthermore, link adaptation in NTNs will most likely aim at a lower block error rate (i.e. possibly 1% BLER) because the pathloss differences are smaller over a cell and the long RTT has severe drawbacks as retransmissions are delayed for long.

Splitting HARQ processes into groups based on if retransmissions are enabled or disabled will require new management algorithms, and if there are available resources in the gNB at the end of a data burst, the gNB may not be able to schedule a retransmission because the HARQ process was configured with ”disable uplink HARQ retransmissions” leading to added delay at the burst end.

Legacy parameters (e.g. *allowedPHY-PriorityIndex*) allow reserving a certain type of grant for some LCHs and to control the QoS of each LCH. If *allowedPHY-PriorityIndex* is configured for a logical channel and the dynamic grant has a priority index, e.g., high or low, the MAC SDUs from the logical channel is only mapped to the dynamic grant indicating the priority index equal to the values.

### Details of enhancements to LCP

The following options were captured in the pre-meeting summary regarding LCP in NTN:

1. Two mapping relationships shall be indicated to UE. The first performs mapping between LCH and HARQ process type (configured for every LCH via RRC) to indicate whether LCH could be transmitted via HARQ process with or without feedback. The second performs mapping between HARQ process ID and HARQ process type, with mapping indicated via RRC message.
2. An “allowed HARQ process list” provides suitable mapping between an LCH and one or more HARQ processes.
3. Network should indicate whether to allow UL retransmission per logical channel
4. enabled HARQ UL retransmission is further differentiated into retransmission based on PUSCH decoding, or blind retransmission. If two kinds of services are multiplexed into one MAC PDU, one service (e.g,LCH1) requires the blind retransmission while the other service(e.g ,LCH2) requires decoding-result based HARQ retransmission, the gNB should adopt the blind retransmission to meet the QoS of LCH1. LCH2 is not necessary to use this retransmission scheme, which cause the waste of system resources for blind retransmission. It is proposed LCH with different QoS requirement can be mapped to HARQ processes with corresponding retransmission scheme. To let UE know different retrnamission schemes and LCHs preferred retrnamission scheme, NW indicates each LCH's association with one or multiple HARQ processes to UE.
5. A possible mapping strategy is provided to acommodate different service types via possible UL retransmission strategies. It is noted given there are 3 possible retransmission schemes which may each support a different type of services, the 1 bit available by re-purposing the *allowedPHY-PriorityIndex* is possible but may not provide an optimal/expected mapping. Possible alternatives include extending *allowedPHY-PriorityIndex* to 2 bits, or grouping HARQ processes with different priority together to decide which LCHs can be mapped to UL grant linked to HARQ process, however NW can still configure UE with one or more transmission schemes for each HARQ process based on it's implementation. To reduce complexity in NW implementation for some NTN scenarios, this may be optionally configurable.

It is noted that conclusion on a particular method this meeting is unlikely. Companies are therefore invited to select one or more options they would like to further study in an attempt to down-select between possible options.

**Question 7)** **Which of the following options for LCP in NTN do you support for further study:**

1. ***allowedPHY-PriorityIndex* is re-used;**
2. ***allowedPHY-PriorityIndex* is re-used and extended;**
3. **A new LCP restriction is introduced to map LCH to one or more HARQ process(es). HARQ processes can be classified as having retransmission “enabled” or “disabled”;**
4. **A new LCP restriction is introduced to map LCH to one or more HARQ process(es). HARQ processes can be classified as having retransmission “enabled based on PUSCH decoding result”, “enabled based on blind retransmission” or “disabled”.**
5. **A new LCP restriction is introduced to map LCH to one or more HARQ process(es). NW can still configure UE with one or more transmission schemes for each HARQ process based on it's implementation.**

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| **Company** | **Supported option(s)** | **Additional comments** |
| APT | 4 | New LCP restriction can be used for mapping the LCH(s) to all kinds of different scheduling strategies, which reflect the different requirements on UL (re-)transmission. |
| ZTE | 1;  2 or 5 if new restriction is considered as necessary based on majority interest. | As discussed in our paper, we think the restriction of LCP in NTN is to prevent LCHs with higher requirement on latency and reliability can only be mapped to UL grant with blind retransmission, and LCHs with higher requirement on reliability (but not latency) will not be mapped to UL grant without any retransmission. And above restrictions can be guaranteed by proper configuration with current LCP restrictions, but the consequence is that in some case, for LCHs with normal requirement on both reliability and latency, they cannot use UL grant with HARQ blind retransmission, which can lead to waste of some UL resource. From our point of view, such situation might not always happen, and it is acceptable considering it is just first release.  But if majority company consider it is not acceptable,and optimization is needed. Then we think a simpler solution is to extend the bit-length of AllowedPHY-PriorityIndex, which allows NW to dynamically adjust the mapping between UL grant and LCHs with less RAN2 specs impact. Another acceptable alternative is to allow mapping between LCHs and HARQ process, for which, since the mapping between UL grant and HARQ is assigned dynamically, therefore the mapping between LCHs and UL grant can be guaranteed. Unlike alt3 and 4 where the transmission scheme is configured semi-statically, for alt5, the HARQ process is not linked to a specific transmission scheme, therefore it is still possible for NW to adjust the scheduling strategies based on joint consideration of the service requirement, HARQ occupation, resource utilization and etc. |
| OPPO | Option 3 | From gNB’s perspective, there are three scheduling strategies:  1) HARQ with retransmissions based on the previous PUSCH decoding result;  2) HARQ with (blind) retransmissions not based on the previous PUSCH decoding result;  3) HARQ with no retransmission.  From service delay’s perspective, retransmissions based on the previous PUSCH decoding result is quite different from blind retransmission in NTN as the former can ensure more reliability but slower, while blind retransmission has smaller difference with no retransmission. Hence, from UE’s perspective, classifying the HARQ processes into two types by LCP restriction could be enough for LCP restriction, i.e., “enabling” means retransmissions based on the previous PUSCH decoding result, and “disabling” means blind retransmission or no retransmission. And whether “disabling” means blind retransmission or no retransmission could be up to NW implementation. |
| Samsung | Option 3 |  |
| MediaTek | 3, 5 | Options 3 and 5 can be studied as possible options for mapping UL HARQ behaviour to LCP rules.  On Options 1 and 2: We object to the use of allowedPHY-PriorityIndex for this purpose as this feature is used for prioritization/cancellation of UL grants and UCI transmissions. This can lead to a lot of unnecessary side effects.  On Option 4: There is no benefit of informing the UE about the blind retransmissions for LCP purposes. |
| Qualcomm | (3) | We can live with (3).  (4) seems to add complexity with more options. For (5) it is not clear why a single HARQ process needs to be configured with one or more schemes. |
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It was also noted that HARQ is essential for MAC CEs. As described in the pre-meeting summary, there is no LCP limitation on the MAC CE transmission in IIoT priority index feature (i.e., the MAC CE can be transmitted in both the grant with P0 and the grant with P1). The MAC CE which requires high reliability (e.g. Configured Grant Confirmation for the CG deactivation/activation) maybe transmitted in grant without retransmission instead of other retransmission schemes with retransmissions for high reliability. As a counter, it is noted in that lack of reliability can be overcome by blind retransmission.

**Question 8) If a new LCP restriction is introduced for NTN, should it also apply to MAC CEs?**

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| **Company** | **Agree/Disagree** | **Additional comments** |
| Xiaomi | Disagree | RAN1 has not evaluate whether the reliability of blind retransmission will be lower than HARQ retransmission. But from PER point of view, both blind retransmission and HARQ retransmission should be able to acheive the same PER. We tend to think that the reliability of blind retransmission and HARQ retransmission is the same.  In addition, we think UE do not need to know whether a HARQ will be blindly scheduled or not if HARQ retransmission disabled. Network can decide by implementation whether to schedule blind retransmission. Because, to achive the target PER, it is very corner case that network will always apply the strategy of disable HARQ retransmission completely. The motivation and benefit for not scheduling retransmission at all is unclear to us, any enhancement for this is not justified.  In sum, the reliability will not be deteriorated due to blind retransmisison, there is no need to introduce LCP restriction for MAC CE. Furthermore, even MAC CE is lost, the consequence is not serious. |
| APT | Agree | Without a new LCP restriction for MAC CE(s), there is no way to overcome it by blind retransmission. The reason is that the MAC CE(s) cannot be directed to the specific HARQ process(es) (with blind retransmission scheme) based on the current mechanism. In other words, the MAC CE(s) will be multiplexed to any UL resource no matter the HARQ process and its HARQ retransmission scheme. |
| ZTE | Disagree | The priority handling and LCH for MAC CE is a common issue for NR. Since it has been discussed before in IIOT and some potential solution have already been evaluated, we think it should be further discussed in IIOT not in NTN, if needed. |
| OPPO | Agree |  |
| Samsung | Neutral | Since this is not specific to the NTN, perhaps we can invest our time on other higher priority topics. |
| MediaTek | Agree | Some MAC CEs might require high reliability and could benefit from being transmitted on HARQ processes with UL HARQ retransmissions enabled. Therefore new LCP restrictions should also apply to a subset of MAC CEs. One example is the CG Confirmation MAC CE. Loss of this MAC CE would cause loss of sync between the UE and the network with regards to the activation state of Type 2 CG. BSR, PHR, and BFR MAC CEs can also be considered for the new LCP restriction. Which MAC CEs should be included in the new LCP rule could be under network control, as in other LCHs (e.g. DRB/SRBs). |
| Qualcomm | Agree | We should definitiely discuss whether certain MAC CEs can be multiplexed with a LCH data that goes through HARQ process with retransmission disabled. |
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# Other Timers

In addition to aspects covered by the pre-meeting summary, the following timers are also to be considered. Companies are encouraged to refer to the contributions listed below for motivation why a specific solution is necessary.

### Drx-RetransmissionTimerDL

It has been agreed that if HARQ feedback is disabled for a HARQ process, the *drx-HARQ-RTT-TimerDL* will not be started. According to legacy specification, the *drx-RetransmissionTimer* will therefore not be started as well. The following contributions discuss possible modification to the *drx-RetransmissionTimer* e.g. whether a new start condition is necessary to support blind retransmission.

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| **Contribution** | **Relevant proposal(s)** | **Company** |
| [R2-2104851](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_114-e/Docs/R2-2104851.zip) | **P6:** The modified trigger condition of drx-RetransmissionTimerDL can be a MAC PDU is received in a configured downlink assignment or the PDCCH indicates a DL transmission when a DRX group is in Active Time.  **P7:** The start of the drx-RetransmissionTimerUL(DL) can be offset by UE-specific RTD (UE-gNB delay) in LEO/GEO adding the value of drx-HARQ-RTT-TimerUL(DL) only when HARQ feedback is disabled and the blind retransmission is configured. | CATT |
| [R2-2104967](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_114-e/Docs/R2-2104967.zip) | **P2:** If the functionality of DL blind retransmission is enabled, the UE should start the drx-RetransmissionTimerDL after the end of the PDSCH reception, else if the functionality of DL blind retransmission is disabled, the UE should not start the drx-RetransmissionTimerDL. | Asia Pacific Telecom, FGI |
| [R2-2105490](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_114-e/Docs/R2-2105490.zip) | **P1:** To minimize specification impact, UE would rely on drx-InactivityTimer to support blind retransmission when DL HARQ feedback is disabled and not start drx-RetrasnmissionTimerDL. | Pansonic |
| [R2-2106089](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_114-e/Docs/R2-2106089.zip) | **P4:** For HARQ processes with disabled HARQ feedback, there is no need to change the start of drx-RetransmissionTimerDL.  **P5:** There is no need to extend the drx-RetransmissionTimerDL. | Ericsson |

**Question 9) Which of the following statements do you support regarding the start of *drx-RetransmissionTimerDL* for HARQ processes with HARQ feedback disabled:**

1. **The start of the *drx-RetransmissionTimerDL* can be offset by UE-specific RTD (UE-gNB delay) in LEO/GEO adding the value of drx-HARQ-RTT-TimerUL(DL) only when HARQ feedback is disabled and the blind retransmission is configured.**
2. **If the functionality of DL blind retransmission is enabled, the UE should start the *drx-RetransmissionTimerDL* after the end of the PDSCH reception, else if the functionality of DL blind retransmission is disabled, the UE should not start the *drx-RetransmissionTimerDL*.**
3. **No need to change start of *drx-RetransmissionTimerDL* (i.e. UE would rely on *drx-InactivityTimer* to support blind retransmission when DL HARQ feedback is disabled and not start *drx-RetransmissionTimerDL*).**

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| **Company** | **Supported statement(s)** | **Additional comments** |
| Xiaomi | None | We agree that the DRX retranmission timer should be started, but the timing requires further discuss. We can decide the exact timing during next meeting.  drx-InactivityTimer has the issue that it will not be started due to transmission using configured grant. |
| APT | 2 | In the case that the DL blind retransmission is enabled/configured, the UE should wake-up to monitor the PDCCH in a time duration that the UE expects to receive a DL blind retransmission scheduling. Since we have agreed that the UE does not start*drx-HARQ-RTT-TimerDL* in HARQ feedback disabling case, i.e., the *drx-RetransmissionTimerDL* cannot be triggered by *drx-HARQ-RTT-TimerDL,* so a new start condition for the *drx-RetransmissionTimerDL* is necessary, or the UE may loss some chances to monitor the DL blind retransmission scheduling.  Comparing to *drx-InactivityTimer* and *drx-RetransmissionTimerDL*,the main difference is that the *drx-InactivityTimer* is applied per DRX group/MAC entity while the *drx-RetransmissionTimerDL* is applied per HARQ process. Since the transmission is associated with a HARQ process, the corresponding blind retransmission should also be expected to receive for that HARQ process. Therefore, *drx-RetransmissionTimerDL* is preferred to be applied for DL blind retransmission. |
| ZTE | 3 | If drx-HARQ-RTT-TimerDL is not started, then one simpler way to allow blind retransmission is to rely on the running of drx-InactivityTimer, which has less specs impact. |
| OPPO | none | If NW intends to do blind DL retransmission, it can simply disable HARQ feedback and any impact to the ***drx-RetransmissionTimerDL*** can be discussed in the context of HARQ feedback disabling. |
| Samsung | Discuss | Let’s discuss this further. We are fine evaluating all these options and any new option other contributors may have. |
| MediaTek | 3 | We think that the blind retransmission case can be handled by the Inactivity timer or by setting the drx-HARQ-RTT-TimerDL to 0. |
| Qualcomm | (2) | (2) is cleaner than (3) as UE knows beforehand whether to expect blind retransmission scheduling.  (1) is simply the case HARQ RTT timer = 0 + offset which can happen for the case HARQ feedback is enabled. |
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**Question 10) Do you agree a modified trigger condition of *drx-RetransmissionTimerDL* can be when a MAC PDU is received in a configured downlink assignment or the PDCCH indicates a DL transmission when a DRX group is in Active Time?**

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| **Company** | **Agree/Diasgree** | **Additional comments** |
| Xiaomi | Disagree | We agree that drx-RetransmissionTimerDL should be started for SPS, but the exact timing should be further discussed. We can decide the exact timing during next meeting. |
| APT | FFS | In RAN1#104, there is an agreement shows that the UE is not expected to receive another PDSCH scheduled for the given HARQ process that starts until X after the end of the reception of the last PDSCH for that HARQ process. The TB of the two PDSCHs can be the same, so this rule is applied to retransmission case. Since there is a scheduling restriction between the two PDSCHs, we can further discuss the exact timing to start the *drx-RetransmissionTimerDL*, e.g., whether an offset for scheduling restriction is needed. |
| ZTE | Disagree | We can rely on drx-InactivityTimer to schedule blind retransmission. |
| OPPO | Agree with comment | In our understanding, one more option could be considered:  In order to support blind retransmission, for a DL HARQ process with HARQ feedback disabled, UE could start drx-RetransmissionTimerDL for the corresponding HARQ process after receiving the PDSCH. |
| Samsung | Discuss | Let’s discuss all available options and pros and cons of each option before we choose a specific solution. |
| MediaTek | Disagree | As mentioned in Q9, Inactivity timer or setting the drx-HARQ-RTT-TimerDL to 0 can handle blind retransmissions. |
| Qualcomm | Disagree | In the configured downlink assignment, the HARQ Process ID is associated with the slot where the DL transmission starts. So simply we cannot apply same behavior to it.  The last part of the question is addressed by Q9 option (3). |
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**Question 11) Do you agree there is no need to extend the *drx-RetransmissionTimerDL*?**

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| **Company** | **Agree/Disagree** | **Additional comments** |
| Xiaomi | Agree |  |
| APT | Disagree | Not sure the “extend” here means the extension of the timer length or introducing a new start condition on the drx-RetransmissionTimerDL.  If it means the latter case, without introducing a new start condition for the drx-RetransmissionTimerDL, the UE will loss some chances to monitor the blind retransmission scheduling. |
| ZTE | Agree | If drx-HARQ-RTT-TimerDL is correctly offseted with UE-gNB RTT, then it is no need to extend drx-RetransmissionTimerDL. If drx-HARQ-RTT-TimerDL is not started, then one simpler way to allow blind retransmission is to rely on the running of drx-InactivityTimer, which has less specs impact. |
| OPPO | Agree | If the new start condition of drx-RetransmissionTimerDL is agreed to support HARQ feedback disabling, no need to extend drx-RetransmissionTimerDL, so that there is no additional power consumption. |
| MediaTek | Agree |  |
| Qualcomm | Agree |  |
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### SR Prohibit Timer

In RAN2#113bise it was agreed to extend the timer length of sr-ProhibitTimer, with details FFS. This is addressed by the following contributions:

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| **Contribution** | **Relevant proposal(s)** | **Company** |
| [14] [R2-2105529](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_114-e/Docs/R2-2105529.zip) | **P1:** Extend SR-prohibitTimer by UE derived RTD. | Spreadtrum |
| [20] [R2-2106089](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_114-e/Docs/R2-2106089.zip) | **P20**: The values added to sr-ProhibitTimer in NTN shall include values lower than the round-trip time. | Ericsson |

**Question 12) Do you agree the SR-prohibitTimer should be extended by UE derived RTD?**

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| **Company** | **Agree/Disagree** | **Additional comments** |
| Xiaomi | Agree |  |
| APT | Agree |  |
| ZTE | Disagree | We don’t think it is necessary to make sr-ProhibitTimer dependent on varied UE-gNB RTT timer. And we agree with Ericsson that NW shall be able to configure sr-ProhibitTimer with value smaller than UE-gNB RTT to allow UE to send multiple SRs for high priority services. |
| OPPO | Agree with comment | To be more specific, it is the UE derived UE-gNB RTD. |
| Samsung | Agree | Yes- as OPPO has clarified, the extension should be “derived UE-gNB RTD.” |
| MediaTek | Agree | UE derived UE-gNB RTT (or RTD) can be used to extend the SR prohibit timer. |
| Qualcomm | Agree but | This must be extended by the same offset that will be used in other timer(s) such as HARQ RTT timer. |
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**Question 13) Do you agree values added to sr-ProhibitTimer in NTN shall include values lower than the round-trip time?**

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| **Company** | **Agree/Disagree** | **Additional comments** |
| Xiaomi | Disagree | The intention of this is to send multiple SR during a RTT to increase the reliability of SR, but network would think that UE requests for resources at different times and allocate resource for each SR, resulting in resource waste. If SR transmission is an issue, we think RAN1 can solve the issue. |
| APT |  | It seems no need to repeat transmitting the same scheduling request more than once. But we have no strong opinion to give NW flexibility for configuration. |
| ZTE | Agree | Similar to the extension of t-Reassembly timer, larger values can be introduced in NTN to enlarge the sr-ProhibiTimer value range, but how to configure the sr-ProhibitTimer is up to NW’s implementation as in legacy. |
| OPPO | Disagree | We think extending the timer using UE-gNB RTT is simple and sufficient. |
| Samsung | Discuss | It makes more sense to use UE-gNB RTT as the offset for this timer. Under what circumstances would a lower value be beneficial? Are these circumstances expected to occur frequently or infrequently? |
| MediaTek | Disagree | This is an optimization and it is not necessary for the working baseline. |
| Qualcomm | Disagree | We prefer not doing blind SR transmissions. |
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### CGT/CGRT

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| **Contribution** | **Relevant proposal(s)** | **Company** |
| [6] [R2-2105249](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_114-e/Docs/R2-2105249.zip) | **P:** UE specific pre-compensation offset for round trip delay (RTD) is applied to CGT and CGRT (if configured), i.e. the configured CGT/CGRT value is extended by UE-specific RTD. | MediaTek |

**Question 14) Do you agree UE specific pre-compensation offset for round trip delay (RTD) is applied to CGT and CGRT (if configured), i.e. the configured CGT/CGRT value is extended by UE-specific RTD?**

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| **Company** | **Agree/Disagree** | **Additional comments** |
| Xiaomi | Agree for CGT, not agree for CGRT | CGRT is introduced for AUL of NR-U. Since NR-U is not applied to NTN, there is no need to change the behavior of CGRT. |
| APT | Disagree | For CGT, the value is configured as multiples of periodicity of the CG, and the number of the multiples can be up to 64, which is enough to cover the RTD with smart NW implementation.  For CGRT, it was introduced for NR-U autonomous CG retransmission mechanism. In addition, per RRC spec, this timer cannot be configured for licensed spectrum. It seems we never discussed whether this can be supported for NTN.  ***cg-RetransmissionTimer***  Indicates the initial value of the configured retransmission timer (see TS 38.321 [3]) in multiples of *periodicity*. The value of *cg-RetransmissionTimer* is always less than or equal to the value of *configuredGrantTimer.* This field is always configured for operation with shared spectrum channel access together with *harq-ProcID-Offset*. This field is not configured for operation in licensed spectrum or simultaneously with *harq-ProcID-Offset2.* |
| ZTE | Agree |  |
| OPPO | FFS | Firstly, we need to clarify whether HARQ enabled/disabled is assumed here.  HARQ stalling for configured grant would still occur, if we simply extend CGT/CGRT value by UE-specific RTT offset. FFS is needed for CG. |
| Samsung | Discuss | We are open to further discussion on this topic. |
| MediaTek | Agree | Offsetting the CGT/CGRT with the UE-specific RTD can improve resource utilization for CGs and should be supported. |
| Qualcomm | Agree for CGT,  Disagree on need for CGRT | CGRT is for NR-U. If it becomes clear CGRT can be applicable to NTN, we can revisit it. |
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# Summary

<to be generated pending company feedback>

# Conclusion

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# References

1. R2-2106488 [Pre114-e][103][NTN] Summary 8.10.2.2 - Other MAC aspects (InterDigital)
2. RAN2-114e – R17 NTN-REDCAP\_2021\_05\_19\_1425 (Vice Chair session notes)