3GPP RAN WG2 Meeting #116bis-e R2-2201748

eMeeting January 17th – 25th, 2022

Agenda Item: 8.10.2.2

Source: InterDigital (summary rapporteur)

Title: Summary of [AT116bis-e][107][NTN] Other MAC aspects: Phase 2

Document for: Discussion, Decision

# Introduction

This document is a discussion paper to obtain company input to the Phase 2 of the following offline discussion:

* [AT116bis-e][107][NTN] Other MAC aspects (InterDigital)

Initial scope: Discuss remaining MAC open issues, focussing on DRX timers, CG/SPS and remaining HARQ state aspects

Updated scope: Discuss remaining issues from R2-2201739

Updated 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 deadline for company feedback has been provided:

* Initial deadline (for companies' feedback): **Monday 2022-01-24 1800 UTC**
* Initial deadline (for rapporteur's summary in R2-2201748): Monday 2022-01-24 2000 UTC

Please also note the following chair guidance:

* Proposals marked "for agreement" in R2-2201748 not challenged until **Tuesday 2022-01-25 0800 UTC** will be declared as agreed via email by the session chair (for the rest the discussion might continue in the GTW session).

# Summary

## ConfiguredGrantTimer extention

*Question 1a: Would extension of CGT by UE-gNB RTT (Option 1) possibly lead to mismatch between UE and gNB regarding timer duration? If “Yes”, please describe possible impacts to system performance (if any).*

Out of 12 responding companies, the following table presents a summary of responses to the above question:

|  |  |  |
| --- | --- | --- |
| ***Would extension of CGT by UE-gNB RTT (Option 1) possibly lead to mismatch between UE and gNB regarding timer duration?*** | | |
| Yes | No | Maybe |
| 7 | 4 | 1 |

The following key comments are noted (detailed summary in Section 3):

* Does not lead to mismatch:
  + [3] already applies to various timers (HARQ RTT) and no issue has been identified
    - [3] Difference is HARQ RTT used for PDCCH monitoring, whereas CGT used to resolve overlap between CG and DG. Latter case leads to decrease in resource efficiency
* Can lead to mismatch:
  + [3] network may schedule the CG resource for DG while UE may use this CG for new transmission
  + [3] network may wait for new UL transmission on the CG resource while UE will not send new UL transmission on the CG resource.
* [4] NW cannot configure value less than CGT, so blind retransmission is not allowed

Input to this question is jointly considered with Question 1b.

*Question 1b: To address issues described in Q1a (if any):*

* *Option 1: Rely on existing specification (e.g. TA update mechanism is sufficient);*
* *Option 2: Additional specification impact is necessary (please describe).*

Out of 11 responding companies, the following table presents a summary of responses to the above question (Please note that one company (Nokia) has not provided an explicit response, however based on comment has been added to the “Option 2” tally):

|  |  |
| --- | --- |
| ***Preferred method to address issues described in Q1a?*** | |
| Option 1 | Option 2 |
| 8 | 3 |

The following key comments are noted (detailed summary in Section 3):

* Option 1:
  + [2] Existing mechanism is sufficient
* Option 2:
  + [2] Easy for NW implementation
  + [2] Avoids resource management issues
  + [2] Does not lead to additional overhead when configuring CG as existing CGT field is optional

Based on company input to Questions 1a and 1b, the following observation can be made:

*Observation 1:**While (7/12) agree that extension of CGT by UE-gNB RTT could lead to mismatch between UE and gNB, a large majority (8/11) think this may be handled by existing mechanisms with no further specification impact.*

*Question 2: Could values in Option 2 be selected to balance additional overhead and approximately compensate UE-gNB RTT?*

* *If “Yes”, please describe how such a tradeoff can be accomplished.*
* *If “No”, please describe possible impacts to system performance (if any).*

Out of 11 responding companies, the following table presents a summary of responses to the above question:

|  |  |
| --- | --- |
| ***Could values in Option 2 be selected to balance additional overhead and approximately compensate UE-gNB RTT?*** | |
| Yes | No |
| 4 | 7 |

The following key comments are noted (detailed summary in Section 3):

* [2] Values selected to cover different CG periodicities

Based on company input, the following observation can be made:

*Observation 2:**A majority (7/11) do no not think that values in Option 2 can be selected to balance overhead and approximately compensate UE-gNB RTT.*

*Question 3: As a compromise, could both Option 1 and 2 be specified and left to NW configuration?*

Out of 11 responding companies, the following table presents a summary of responses to the above question (a detailed summary of company comment can be found in Section 3):

|  |  |
| --- | --- |
| ***Could both Option 1 and 2 be specified and left to NW configuration?*** | |
| Yes | No |
| 1 | 10 |

Based on company input, the following observation can be made:

*Observation 3:**There is near consensus (10/11) that only one option is to be specified.*

**Rapporteur summary of Questions 1-3:**

Based on company input to Questions 1 through 3, the following observations can be made:

*Observation 1:**While (7/12) agree that extension of CGT by UE-gNB RTT could lead to mismatch between UE and gNB, a large majority (8/11) think this may be handled by existing mechanisms with no further specification impact.*

*Observation 2:**A majority (7/11) do no not think that values in Option 2 can be selected to balance overhead and approximately compensate UE-gNB RTT.*

*Observation 3:**There is near consensus (10/11) that only one option is to be specified.*

Rapporteur notes that Option 1 impacts blind retransmission and can complicate gNB resource management. However, proponents note a similar mechanism has already been specified (e.g. HARQ RTT timers), and a large majority think problems with Option 1 can be already addressed by existing mechanisms. Furthermore, definition of new IE values could lead to a prolonged discussion with very little time remaining considering few companies think proper UE-gNB RTT approximation is even possible with low overhead. Rapporteur suggests that RAN2 agree to Option 1 for the sake of progress.

**Proposal 1: *configuredGrantTimer* length is extended by UE-gNB RTT in NTN.**

## HARQ/LCP configuration for CG/SPS

*Question 4: Do you agree that in the general case (i.e. all HARQ processes used by a CG configuration are configured with the same HARQ state) allowedHARQ-DRX-Mode and allowedCG-List accomplish the same thing?*

Out of 12 responding companies, the following table presents a summary of responses to the above question:

|  |  |  |
| --- | --- | --- |
| ***Do you agree that in the general case allowedHARQ-DRX-Mode and allowedCG-List accomplish the same thing?*** | | |
| Agree/Agree with comment | Disagree | No explicit response |
| 4 | 2 | 6 |

The following key comments are noted (detailed summary in Section 3):

* [6] It is fully up to NW implementation
* [2] No benefit to apply *allowedHARQ-DRX-LCP* to the CG instead of *allowedCG-List*.

Input to this question is jointly considered with Q5.

*Question 5: If allowedHARQ-DRX-Mode applies to CG and all HARQ processes used by a CG configuration are not configured with the same HARQ state, what is the preferred method of handling a conflict between allowedHARQ-DRX-Mode and allowedCG-List, if configured?*

* *Option 1: NW cannot simultaneously configure allowedHARQ-DRX-Mode and allowedCG-List;*
* *Option 2: allowedHARQ-DRX-Mode overrules allowedCG-List;*
* *Option 2a: allowedCG-List overrides allowedHARQ-DRX-Mode;*
* *Option 3: Other, please describe.*

Out of 12 responding companies, the following table presents a summary of responses to the above question:

|  |  |  |  |
| --- | --- | --- | --- |
| ***If allowedHARQ-DRX-Mode applies to CG and all HARQ processes used by a CG configuration are not configured with the same HARQ state, what is the preferred method of handling a conflict between allowedHARQ-DRX-Mode and allowedCG-List, if configured?*** | | | |
| Option 1 | Option 2 | Option 2a | Option 3 |
| - | - | 2 | 7 |

Several companies have also described the following alterative options to those listed above:

* [1] none
* [1] the assumption is not valid
* [1] company did not provide an explicit response

The following key comments are noted (detailed summary in Section 3):

* [9] Configuration up to NW implementation e.g. to avoid conflict between configurations
* [6] NW should configure only one retransmission scheme for a CG, which means all HARQ processes used by a CG should be configured with the same HARQ state

**Rapporteur summary of Questions 4 and 5:**

Based on comment, a large majority of companies (9/12) mention that proper configuration of LCP restrictions for an LCH is up to NW configuration, and that there is no need to discuss invalid NW configuration. Furthermore, a minority of companies (4/12) agree that *allowedCG-list* and *allowedHARQ-DRX-LCP* accomplish the same thing. Rapporteur therefore suggests that the new LCP restriction can also apply to CG, and configuration is fully left up to NW.

**Proposal 2: *allowedHARQ-DRX-LCP* also applies to CG, and it is up to NW implementation to properly configure *allowedHARQ-DRX-LCP* and/or *allowedCG-List* for a LCH (e.g. to avoid conflicting configuration).**

## PUSCH transmission scheduled by RAR

*Question 6: For the cases that HARQ process 0 carries PUSCH transmission scheduled by RAR or PUSCH payload of MsgA, what is your preferred option?:*

1. *allowedHARQ-DRX-LCP shall not apply to LCP for Msg3/MsgA PUSCH FFS whether this can be left to NW implementation, or explicitly specified.*
2. *Configuration of HARQ mode and allowedHARQ-DRX-LCP is up to NW implementation, and UE always follows it.*

Out of 12 responding companies, the following table presents a summary of responses to the above question:

|  |  |
| --- | --- |
| ***For the cases that HARQ process 0 carries PUSCH transmission scheduled by RAR or PUSCH payload of MsgA, what is your preferred option?*** | |
| Option 1 | Option 2 |
| 3 | 9 |

The following key comments are noted (detailed summary in Section 3):

* [5] Can be avoided by proper NW configuration

Based on large majority, the following is proposed:

**Proposal 3: When HARQ process 0 carries PUSCH transmission scheduled by RAR or PUSCH payload of MsgA, configuration of HARQ mode and *allowedHARQ-DRX-LCP* is up to NW implementation, and UE always follows it (no specification impact). (9/12)**

*Question 7: If “Option 1” in Q6, what is the preferred method of ensuring allowedHARQ-DRX-LCP shall not apply to LCP for Msg3/MsgA PUSCH?*

1. *Left to NW implementation;*
2. *Explicitly specified.*

Out of 3 responding companies, the following table presents a summary of responses to the above question:

|  |  |
| --- | --- |
| ***If “Option 1” in Q6, what is the preferred method of ensuring allowedHARQ-DRX-LCP shall not apply to LCP for Msg3/MsgA PUSCH?*** | |
| Option 1 | Option 2 |
| - | 3 |

Based on outcome of Q6, no proposal is made.

# Remaining issues from first round

## ConfiguredGrantTimer extention

For a configured grant (CG) configuration, the network may optionally configure a *configuredGrantTimer*. While the *configuredGrantTimer* is running, the corresponding HARQ process will not be used for a new CG transmission. This facilitiates network scheduling of retransmissions for that HARQ process ID. To ensure the length of *configuredGrantTimer* can cover the larger round trip delay in NTN for smaller values of periodicity, in RAN2#116e it was agreed that the *configuredGrantTimer* may be extended, however the method of extension remains FFS:

* *configuredGrantTimer can be extended in NTN. FFS details of when extension is applicable and method of extention.*
* *FFS:RAN2 to down-select between the following options to extend configuredGrantTimer: 1) Introducing value(s) of configuredGrantTimer larger than 64; 2) Value of the configuredGrantTimer is extended by UE-gNB-RTT;”*

Below is a summary of technical arguments provided via contributions submitted to RAN2#116bis-e:

**configuredGrantTimer extended by UE-gNB RTT [1, 2, 3, 6, 8, 11, 17]:**

Proponents of extending the *configuredGrantTimer* by UE-gNB RTT note that introducing additional values of CGT would lead to unnecessary signaling overhead [1, 2] and it would be difficult to configure values which properly match the RTT [2, 11]. This may lead to a waste of CG resources for some UEs near cell center [6], and it would be simple and efficient to extend by UE-gNB RTT similar to the HARQ RTT Timer [3, 8, 11].

**configuredGrantTimer extended by additional values [4, 13, 14, 15, 16, 18]:**

Proponents of extending the CGT by additional values note that this method is simple [4, 13], and that extension by UE-gNB RTT may be complicated as this value changes over time [14, 15]. Furthermore, current specification allows network to configure values of CGT lower than RTT to enable e.g. blind retransmission, which would not be possible by UE-gNB extension methods [15, 16]. Furthermore, the need for many additional values may also be limited as there is little benefit in covering more than one RTT in GEO due to unreasonably long delays [18].

Out of 17 companies participating in Phase 1 discussion, the following table presents a summary of responses (companies are encouraged to refer to the original discussion document in R2-2101739 for detailed summary):

|  |  |  |
| --- | --- | --- |
| ***Preferred method to extend configuredGrantTimer in NTN?*** | | |
| Extend by UE-gNB RTT | Values larger than 64 | Both |
| 8 | 9 | 1 |

Based on company input, the following is noted:

* **Option 1:**
  + Advantages are that it can accurately offset the timer with a value already used/maintained to offset other timers (e.g. the HARQ RTT Timers) without additional signalling overhead.
  + Concerns are that use of the UE-gNB RTT could lead to a mismatch between UE and gNB regarding the value, possibly leading to missed CG transmission.
* **Option 2:**
  + Advantages are that it is simple with minimal specification impact, and gNB would be in full control of the timer avoiding UE-gNB mismatch.
  + Concerns are that it would require additional signalling overhead, and would be difficult to accurately compensate the UE-gNB RTT.

The following questions are intended to address the above issues:

**Question 1a: Would extension of CGT by UE-gNB RTT (Option 1) possibly lead to mismatch between UE and gNB regarding timer duration? If “Yes”, please describe possible impacts to system performance (if any).**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Additional comments** |
| OPPO | No | Extension by UE-gNB RTT applies to various timers in NTN. The mismatch issue between UE and gNB has not been identified for the other timers such as drx-HARQ-RTT-TimerUL/DL. For configuredGrantTimer the situation is the same, and there is no reason to consider it problematic. |
| Xiaomi | Yes | Case 1:If network considers a CG resource recurring before the CG timer expiry but UE doesn’t, network may schedule the CG resource for DG while UE may use this CG for new transmission;  Case 2: If network considers a CG recurring after the CG timer expiry but UE doesn’t, network may wait for new UL transmission on the CG resource while UE will not send new UL transmission on the CG resource.  However, for case 1, if network think there may be state mismatch, network can simply not schedule the CG resource for other purpose; Compared with option 2, this resource waste is less severe. Because option 2 uses semi-static configuration of the CG timer, which will cause much severe mismatch of RTT with CG timer, leading to more CG resources unable to use for new transmission. For case 2, if network doesn’t receive new transmission on CG resource, network considers it as UL skipping.  Thus, we do not see any issues. |
| LG | Yes | Same view as Xiaomi. |
| vivo | No | We share the same view with OPPO. |
| CATT | No | We share the same view with OPPO. We wonder the impacts of CG timer on intial CG transmission. |
| Huawei, HiSilicon | Maybe, but | The mismatch issue can be alleviated by implementation. |
| ZTE | Yes | The difference between configureGrantTimer and DRX HARQ RTT timer is that for rest of HARQ RTT timer it is used to control UE’s PDCCH monitoring behavior while CGT timer is mainly used to resolve the overlapping between configured grant and dynamic grant, e.g., whether the configured grant is protected to allow retransmission. For DRX handling, even there is a mismatch UE can still monitor PDCCH if there are other configuration keep them in ACTIVE time, but for the mismatch in CGT, it will leads to decrease resource efficiency as indicated in Xiaomi’s comments. Also another drawback on option 1 is that NW cannot configure a configuredGrantTimer with a value less than UE-gNB RTT as in legacy, therefore blind retransmission is not allowed.  But if majority view consider no blind retransmission is acceptable, we are willing to compromise for the sake of progress. |
| Nokia | Yes | Due to the RTT value changes over time, the mismatch between UE and gNB on the time duration may lead to UE missing CG transmission(s), which may cause additional/unwanted dynamic scheduled retransmissions. |
| Samsung | Yes | We share the view of Xiaomi and ZTE. It’s hard to align the timer length between UE and the network due to RTT changing and TA report delay or missing. We think CG timer should be configured semi-static, not changes dynamically as RTT changes. DG can be used for resource allocation to accommodate RTT change. |
| MediaTek | No | TA reporting mechanism introduced for NTN as well as legacy UL time alignment maintenance mechanism using Timing Advance Command MAC CE should avoid any mismatch.  This is how we think Option 1 could work:  The network can configure a small value for CGT, say X, and indicate that the UE-gNB RTT extension will be applied. When the network receives the UL transmission for a CG, it will have time X to respond with a retransmission grant. Note that in Option 1, the CGT value will be extended by UE-gNB RTT. |
| Ericsson | Yes | If UE did not update the UE-gNB RTT of CGT, but gNB did, then gNB will not try to decode a CG transmission and it is therefore lost, this may not happen very often.  However, when the CGT becomes a varying function the gNB do not know how many *periodicity* that the CGT covers, which is a change from legacy. This makes gNB resource management much more difficult as the UEs UE-gNB RTT will not vary in the same pattern for different UEs and thus the processing load to decode the CGs will vary.  Using a new optional field configuredGrantTimer-r17 of 8-bits has no extra signalling overhead compared to the existing configuredGrantTimer because configuredGrantTimer is an optional field. |
| InterDigital | Yes | Same view as ZTE. |

***Rapporteur Summary:***

*Out of 12 responding companies, the following table presents a summary of responses to the above question:*

|  |  |  |
| --- | --- | --- |
| ***Would extension of CGT by UE-gNB RTT (Option 1) possibly lead to mismatch between UE and gNB regarding timer duration?*** | | |
| *Yes* | *No* | *Maybe* |
| *7* | *4* | *1* |

*The following key comments are noted:*

* *Does not lead to mismatch:*
  + *[3] already applies to various timers (HARQ RTT) and no issue has been identified*
    - *[3] Difference is HARQ RTT used for PDCCH monitoring, whereas CGT used to resolve overlap between CG and DG. Latter case leads to decrease in resource efficiency*
  + *Mismatch alleviated by:* 
    - *NW implementation*
    - *TA reporting mechanism+legacy UL time alignment maintenance could avoid mismatch*
* *Can lead to mismatch:*
  + *[3] network may schedule the CG resource for DG while UE may use this CG for new transmission*
    - *NW could simply not schedule CG resource if it thinks there is a mismatch*
  + *[3] network may wait for new UL transmission on the CG resource while UE will not send new UL transmission on the CG resource.* 
    - *NW may simply consider as UL skipping*
  + *May cause unwanted/additional dynamic scheduled retransmissions*
  + *Could lead to lost CG transmissions*
  + *gNB resource management much more difficult as UEs UE-gNB RTT will not vary in the same patter for different UEs. Leads to varying processing load to decode CGs*
* *[4] NW cannot configure value less than CGT, so blind retransmission is not allowed*
* *Option 2 will lead to more severe resource waste (due to semi-static config)*
* *DG can be used for resource allocation to accommodate RTT change*
* *Using new optional field of 8 bits has no additional signalling overhead copared to existing CGT as it is an optional field.*

*Input to this question is jointly considered with Question 1b.*

**Question 1b: To address issues described in Q1a (if any):**

* **Option 1: Rely on existing specification (e.g. TA update mechanism is sufficient);**
* **Option 2: Additional specification impact is necessary (please describe).**

|  |  |  |
| --- | --- | --- |
| **Company** | **Preferred Option** | **Additional comments** |
| OPPO | Option 1 | TA update mechanism is sufficient, and we don’t need the further optimization. |
| Xiaomi | Option 1 | By TA update, the mismatch can be reduced a lot, and leads to less resource waste compared with option 2. Because option 2 uses semi-static configuration of the CG timer, which will cause much severe mismatch of RTT with CG timer, leading to more CG resources unable to use for new transmission. |
| LG | Option 1 |  |
| vivo | Option 1 |  |
| CATT | Option 1 |  |
| Huawei, HiSilicon | Option 1 |  |
| Nokia | - | We prefer “Option2 Introducing value(s) of configuredGrantTimer larger than 64” (as discussed in Phase1) to avoid the mismatch between UE and gNB on the time duration, which is easy for NW implementation. |
| Samsung | Option 1 |  |
| MediaTek | Option 1 | Existing mechanisms are sufficient. |
| Ericsson | Option 2 | To avoid the gNB resource management issues by having CGT varying due to the UE-gNB RTT, we shall have a new optional field configuredGrantTimer-r17 of 8-bits for adding fixed values above 64. Note that this will not give any overhead when configuring CG as the existing field configuredGrantTimer is optional. |
| InterDigital | Option 2 | Agree with Nokia and Ericsson |
|  |  |  |

***Rapporteur Summary:***

*Out of 11 responding companies, the following table presents a summary of responses to the above question (Please note that one company (Nokia) has not provided an explicit response, however based on comment has been added to the “Option 2” tally):*

|  |  |
| --- | --- |
| ***Preferred method to address issues described in Q1a?*** | |
| *Option 1* | *Option 2* |
| *8* | *3* |

*The following key comments are noted:*

* *Option 1:*
  + *[2] Existing mechanism is sufficient*
  + *Leads to less resource waste compared with Option 2 due to semi-static configuration/more severe mismatch of RTT and CG timer*
* *Option 2:*
  + *[2] Easy for NW implementation*
  + *[2] Avoids resource management issues*
  + *[2] Does not lead to additional overhead when configuring CG as existing CGT field is optional*

*Based on company input to Questions 1a and 1b, the following observation can be made:*

*Observation 1:**While (7/12) agree that extension of CGT by UE-gNB RTT could lead to mismatch between UE and gNB, a large majority (8/11) think this may be handled by existing mechanisms with no further specification impact.*

**Question 2: Could values in Option 2 be selected to balance additional overhead and approximately compensate UE-gNB RTT?**

* **If “Yes”, please describe how such a tradeoff can be accomplished.**
* **If “No”, please describe possible impacts to system performance (if any).**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Additional comments** |
| OPPO | No | RTT is quite different for LEO/GEO scenarios with different altitude and is constantly changing. In order to match diffrent RTT, many different values need to be introduced, which leads to extra signalling overhead. Note that the unit of configuredGrantTimer is periodicity of CG. The length of configuredGrantTimer depends not only on the value of configuredGrantTimer but also on the length of periodicity. Hence, it would limit the configuration on periodicity, if we choose to balance additional overhead and approximately compensate UE-gNB RTT. |
| Xiaomi | No | We do not see how this works |
| LG | No |  |
| vivo | No |  |
| CATT | No |  |
| Huawei, HiSilicon | No |  |
| Nokia | Yes | Select the values together with different CG periodicities to cover the UE-gNB RTT but may not support continuous values to save the additional overhead. |
| Samsung | Yes | We think CG timer should be configured semi-static, not changes dynamically as RTT changes. DG can be used for resource allocation to accommodate RTT change. To avoid a super large integer multiple when periodicity is very small, e.g. sym2, a combination of an integer multiple value and an offset can be configured to accommodate large RTT. |
| MediaTek | No | Realistically, it is not possible for the network to configure optimal CGT values for all UEs in a large cell. Network would have no option other than using the worst case value (with the largest RTT). |
| Ericsson | Yes | For CG operation with retransmissions, it is sufficient to configure CGT and *periodicity* to be longer than the UE-gNB RTT. If no retransmissions are wanted, network can configure CGT and *periodicity* to not cover a full HARQ RTT. |
| InterDigital | Yes | Agree with Nokia. A subset of values may be selected to cover a general approximation of various RTTs, and up to NW implementation to select the proper value. |
|  |  |  |

***Rapporteur Summary:***

*Out of 11 responding companies, the following table presents a summary of responses to the above question:*

|  |  |
| --- | --- |
| ***Could values in Option 2 be selected to balance additional overhead and approximately compensate UE-gNB RTT?*** | |
| *Yes* | *No* |
| *4* | *7* |

*The following key comments are noted:*

* *Yes:*
  + *[2] Values selected to cover different CG periodicities*
  + *CGT should be semi-static.*
  + *To avoid large integer multiple when periodicity small, a combination of integer multiple value+offset can be used.*
  + *Sufficient to configure CGT + periodicity to be longer than UE-gNB RTT.*
    - *If retransmission not wanted, can configure less than RTT*
* *No:*
  + *RTT different for LEO/GEO, and may constantly change.*
  + *To match RTT needs many values.*
  + *Length of CGT also depends on periodicity.*
  + *Not possible to reaslistically configure optimal CGT for all UEs within a large cell.*

*Based on company input, the following observation can be made:*

*Observation 2:**A majority (7/11) do no not think that values in Option 2 can be selected to balance overhead and approximately compensate UE-gNB RTT.*

In Phase 1, one company suggests that as a compromise, both options may be specified and left to NW implementation.

**Question 3: As a compromise, could both Option 1 and 2 be specified and left to NW configuration?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Additional comments** |
| OPPO | No | This leads to extra spec effort. We only needs to choose one. |
| Xiaomi | No |  |
| LG | No |  |
| vivo | No |  |
| CATT | No |  |
| Huawei, HiSilicon | No |  |
| Nokia | No | It is not clear how to address the mismatch issue for Option1 (extension of CGT by UE-gNB RTT). |
| Samsung | No |  |
| MediaTek | Yes | Even though we prefer Option 1 (extend CGT by UE-gNB RTT), for the sake of progress, we can compromise by supporting both options. In our view, supporting both options should not cause too much specification or implementation effort. This way, it can be left to the network implementation which option to apply. |
| Ericsson | No |  |
| InterDigital | No |  |
|  |  |  |

***Rapporteur Summary:***

*Out of 11 responding companies, the following table presents a summary of responses to the above question:*

|  |  |
| --- | --- |
| ***Could both Option 1 and 2 be specified and left to NW configuration?*** | |
| *Yes* | *No* |
| *1* | *10* |

*The following key comments are noted:*

* *Leads to extra spec impact.*
  + *Would not be too much additional effort, and left to NW implementation.*
* *Not clear how to address mismatch issue for Option 1.*

*Based on company input, the following observation can be made:*

*Observation 3:**There is near consensus (10/11) that only one option is to be specified.*

***Rapporteur summary of Questions 1-3:***

*Based on company input to Questions 1 through 3, the following observations can be made:*

*Observation 1:**While (7/12) agree that extension of CGT by UE-gNB RTT could lead to mismatch between UE and gNB, a large majority (8/11) think this may be handled by existing mechanisms with no further specification impact.*

*Observation 2:**A majority (7/11) do no not think that values in Option 2 can be selected to balance overhead and approximately compensate UE-gNB RTT.*

*Observation 3:**There is near consensus (10/11) that only one option is to be specified.*

*Rapporteur notes that Option 1 impacts blind retransmission and can complicate gNB resource management. However, proponents note a similar mechanism has already been specified (e.g. HARQ RTT timers), and a large majority think problems with Option 1 can be already addressed by existing mechanisms. Furthermore, definition of new IE values could lead to a prolonged discussion with very little time remaining considering few companies think proper UE-gNB RTT approximation is even possible with low overhead. Rapporteur suggests that RAN2 agree to Option 1 for the sake of progress.*

***Proposal 1: configuredGrantTimer length is extended by UE-gNB RTT in NTN.***

## HARQ/LCP configuration for CG/SPS

In RAN2 #115e and RAN2#116e a new LCP mapping restriction *allowedHARQ-DRX-LCP* was agreed for dynamic grant in NTN, however it is not clear whether this restriction also applies to configured grant case.

Below is a summary of technical arguments provided via contributions submitted to RAN2#116bis-e:

**New restrictions apply to CG [1, 2, 7, 18]**

Proponenets of applying *allowedHARQ-DRX-Mode* to CG note there is no potential use case to keep two different HARQ states between DG and CG, since the QoS requirement of a LCH is same [1, 7]. For simplicity, we can reuse *uplinkHARQ-DRX- Mode* and *allowedHARQ-DRX-Mode* to set mapping restrictions for configured grants, even though there is the existing *allowedCG-List* [18].

**New restrictions do not apply to CG [10, 13, 14, 15, 16]**

Proponents of not applying *allowedHARQ-DRX-Mode* to CG note that there are existing LCH restrictions in place which can accomplish the same thing [10, 13, 15, 16] and that the maximum number of configure grant configurations per BWP and MAC can provide granularity for different LCHs to be configured to different CG with different retransmission scheme [13]. Furthermore, there is common understanding that all HARQ processes associated to a CG configuration shall have the same UL HARQ state. It means one CG should have only one retransmission scheme and the *allowedCG-List* can be reused to perform LCP for different retransmission scheme in NTN [13, 14].

Based outcome of Phase 1, the following relevant agreement and understanding where reached in RAN2#116bis-e:

Agreements online:

1. It is up to network implementation to ensure proper configuration of HARQ mode for HARQ processes used by a CG configuration (no Stage 3 specification impact). FFS if a note in Stage 2 is needed

RAN2 understanding:

1. RAN2 understanding is that: in general, all HARQ processes used by a CG configuration are configured with the same HARQ state (e.g. A or B). No specification impact

Considering the existing LCP restriction *allowedCG-List* maps a LCH to allowed configured grant(s), if all HARQ processes used by a CG configuration are configured with the same HARQ state, based on the above RAN2 understanding in the general case *allowedCG-List* and *allowedHARQ-DRX-Mode* may accomplish the same thing.

**Question 4:** **Do you agree that in the general case (i.e. all HARQ processes used by a CG configuration are configured with the same HARQ state) *allowedHARQ-DRX-Mode* and *allowedCG-List* accomplish the same thing?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/Disagree** | **Additional comments** |
| OPPO |  | In our understanding, we don’t need to discuss whether this two fields accomplish the same thing or not. It is fully up to network’s implementation to ensure they can work properly. |
| Xiaomi | Disagree | We do not think they are used for the same purpose. The *allowedCG-List can also take into account other parameters of CG resources, e.g. period.* But if network only considers HARQ state when configuring *allowedCG-List*, then it has the same function as *allowedHARQ-DRX-Mode.* |
| LG | Disagree | We do not see the benefit to apply the allowedHARQ-DRX-LCP to the CG instead of allowedCG-List. |
| vivo |  | Share the view of OPPO. |
| CATT |  | Agree with oppo. |
| Huawei, HiSilicon |  | Agree with OPPO. NW implementation can ensure this if proper configuration is made. |
| ZTE |  | Share the same view as LG. |
| Nokia | Agree with comment | From CG LCP restriction pov, we think allowedHARQ-DRX-LCP and allowedCG-List can serve the same purpose. But it is up to NW implementation how to configure the CG LCP restriction. |
| Samsung | Agree | We understand the rapportuor is referring to allowedHARQ-DRX-LCP. For the purpose of LCP mapping for HARQ state, they can result the same configuration. |
| MediaTek |  | Agree with OPPO. We can rely on the network to use proper configuration. |
| Ericsson | Agree |  |
| InterDigital | Agree |  |

***Rapporteur Summary:***

*Out of 12 responding companies, the following table presents a summary of responses to the above question:*

|  |  |  |
| --- | --- | --- |
| ***Do you agree that in the general case allowedHARQ-DRX-Mode and allowedCG-List accomplish the same thing?*** | | |
| *Agree/Agree with comment* | *Disagree* | *No explicit response* |
| *4* | *2* | *6* |

*The following key comments are noted:*

* *[6] It is fully up to NW implementation*
* *[2] No benefit to apply allowedHARQ-DRX-LCP to the CG instead of allowedCG-List.*
* *The allowedCG-List can also take into account other parameters of CG resources, e.g. period.*

*Input to this question is jointly considered with Q5.*

However, if it is agreed *allowedHARQ-DRX-Mode* applies to CG and all HARQ processes used by a CG configuration are ***not*** configured with the same HARQ state, a conflict may arise if *allowedCG-List* is also configured. It is noted that based on Phase 1 Q5) outcome companies largely disagreed that *allowedCG-List* overrules *allowedHARQ-DRX-Mode*, so this option is excluded from consideration.

**Question 5: If *allowedHARQ-DRX-Mode* applies to CG and all HARQ processes used by a CG configuration *are not* configured with the same HARQ state, what is the preferred method of handling a conflict between *allowedHARQ-DRX-Mode* and *allowedCG-List, if configured*?**

* **Option 1: NW cannot simultaneously configure *allowedHARQ-DRX-Mode* and *allowedCG-List*;**
* **Option 2: *allowedHARQ-DRX-Mode* overrules *allowedCG-List*;**
* **Option 2a: *allowedCG-List overrides allowedHARQ-DRX-Mode;***
* **Option 3: Other, please describe.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Preferred Option** | **Additional comments** |
| OPPO | Option 3 | We should trust the network to do the right thing, i.e., for a correct network configuration, all HARQ processes used by a CG configuration should be configured with the same HARQ state. |
| Xiaomi | Option 2a | If *allowedCG-List is configured, it takes all the parameters related to CG into account, including HARQ mode. In this sense, UE should only follow allowedCG-List, instead of allowedHARQ-DRX-Mode.* |
| LG | Option 2a |  |
| vivo | Option 3 | Agree with OPPO, the network can configure properly. |
| CATT | Option 3 | It is up to network implemention to guarantee a correct configuration. |
| Huawei, HiSilicon | None | This is why we suggested to add a note of the principle tha ***all HARQ processes used by a CG configuration are configured with the same HARQ state.***  In that case, NW implementation can easily ensure no confilict between these two parameters and no action is needed. |
| ZTE | This assumption is not valid | As the problem itself indicates, allowing applying *allowedHARQ-DRX-Mode* to CG will introduce more complex discussion, e.g, how to deal with conflict configuration, while there is no gain. |
| Nokia | Option 3 | For LCP restriction, it is up to NW implementation to configure *allowedHARQ-DRX-LCP* and/or *allowedCG-List* for a LCH. Furthermore, we understand NW should configure only one retransmission scheme for a CG, which means all HARQ processes used by a CG should be configured with the same HARQ state. We are not sure the necessity to configure different HARQ state for the same CG. |
| Samsung |  | RAN2 understanding is that: in general, all HARQ processes used by a CG configuration are configured with the same HARQ state (e.g. A or B).”. We think this case never happens. What is the exact scenario of this rare case? If it’s related to the invalid configuration aspect, we assume network will make sure it. |
| MediaTek | Option 3 | Agree with OPPO. We do not need to discuss invalid configurations by the network. |
| Ericsson | Option 3 | Agree with Nokia |
| InterDigital | Option 3 | Agree with others that invalid configuration can be handled by NW implementation |

***Rapporteur Summary***

*Out of 12 responding companies, the following table presents a summary of responses to the above question:*

|  |  |  |  |
| --- | --- | --- | --- |
| ***If allowedHARQ-DRX-Mode applies to CG and all HARQ processes used by a CG configuration are not configured with the same HARQ state, what is the preferred method of handling a conflict between allowedHARQ-DRX-Mode and allowedCG-List, if configured?*** | | | |
| *Option 1* | *Option 2* | *Option 2a* | *Option 3* |
| *-* | *-* | *2* | *7* |

*Several companies have also described the following alterative options to those listed above:*

* *[1] none*
* *[1] the assumption is not valid*
* *[1] company did not provide an explicit response*

*The following key comments are noted:*

* *[9] Configuration up to NW implementation e.g. to avoid conflict between configurations*
* *[6] NW should configure only one retransmission scheme for a CG, which means all HARQ processes used by a CG should be configured with the same HARQ state*
  + *No need to discuss invalid configuration*
* *UE should follow allowedCG-list vs. allowedHARQ-DRX-Mode since it takes all parameters related to CG into account.*
* *applying allowedHARQ-DRX-Mode to CG will introduce more complex discussion with no gain.*

***Rapporteur summary of Questions 4 and 5:***

*Based on comment, a large majority of companies (9/12) mention that proper configuration of LCP restrictions for an LCH is up to NW configuration, and that there is no need to discuss invalid NW configuration. Furthermore, a minority of companies (4/12) agree that allowedCG-list and allowedHARQ-DRX-LCP accomplish the same thing. Rapporteur therefore suggests that the new LCP restriction can also apply to CG, and configuration is fully left up to NW.*

***Proposal 2: allowedHARQ-DRX-LCP also applies to CG, and it is up to NW implementation to properly configure allowedHARQ-DRX-LCP and/or allowedCG-List for a LCH (e.g. to avoid conflicting configuration).***

## PUSCH transmission scheduled by RAR

Since the HARQ process cannot be dynamically selected for a PUSCH transmission scheduled by RAR as for other dynamic PUSCH transmissions, NW has no tight control on the HARQ retransmission state applied for the data transmitted in the PUSCH and accordingly the corresponding UE DRX behaviour. This may lead to a situation that the allocated PUSCH resources cannot be efficiently used by the UE, i.e. the configured LCH restriction may prevent UE from using such allocated PUSCH resources or DRX behaviour is not suitable for the data transmitted on the PUSCH.

Below is a summary of technical arguments provided via contributions submitted to RAN2#116bis-e:

**Up to NW implementation [1, 10, 16]:**

Proponents of leaving this issue up to network implementation/not addressing this issue note that PDCCH monitoring behaviour during RA procedure is perfectly controlled by RAR window and the running of *ra-ContentionResolutionTimer*, and DRX timer running or not has no extra contribution to the PDCCH monitoring during RACH [1, 16]. Regarding LCP, we can simply leave proper configuration up to NW implementation without any specification impact [1, 10, 16].

**Ignore HARQ/LCP configuration [2, 3]**

Proponents of addressing this issue note that there may be multiple ways of solving the issue, for example *uplinkHARQ-DRX-LCP-Mode-r17* does not applies to HARQ process 0 carring PUSCH transmission scheduled by RAR or PUSCH payload of MsgA; or for UL grant in RAR or UL grant associated with MsgA PUSCH resource, LCP restriction of HARQ state does not apply [2]. From the perspective of [3], this should be discussed case by case where the triggering event should to be considered. A general principle is that we could make sure what needs to be transmitted to the gNB during RACH can be carried in the UL grant in RAR (In other words, the LCH that can use the UL grant in RAR is related with the triggering events. And for this LCH, the LCP restriction is not applied)

Out of 17 responding companies, the following table presents a summary of responses to the above question (companies are encouraged to refer to the original discussion document in R2-2101739 for detailed summary)::

|  |  |  |  |
| --- | --- | --- | --- |
| ***Preferred option for the cases that HARQ process 0 carries PUSCH transmission scheduled by RAR or PUSCH payload of MsgA?*** | | | |
| NW implementation | *uplinkHARQ-DRX-LCP-Mode-r17* does not applies | LCP restriction of HARQ state does not apply | Other |
| 11 | 1 | 6 | 1 |

After subsequent discussion via reflector the following two proposals were suggested:

**Proposal A:     *allowedHARQ-DRX-LCP* shall not apply to LCP for Msg3/MsgA PUSCH. FFS whether this can be left to NW implementation, or explicitly specified.**

**Proposal B: For the cases that HARQ process 0 carries PUSCH transmission scheduled by RAR or PUSCH payload of MsgA, configuration of HARQ mode is up to NW implementation, and UE always follows it.**

Rapporteur understands advantage of Proposal A is that will guarentee new LCP restriction does not interfere with legacy transmission of Msg3/MsgA PUSCH (with FFS addressing whether the network can handle this via configuration or there needs to be an exception captured in the MAC spec). The advantage of Proposal B is that there is less specification impact and additional NW flexibility by leaving it fully to NW configuration to avoid impact to legacy procedure.

**Question 6:** **For the cases that HARQ process 0 carries PUSCH transmission scheduled by RAR or PUSCH payload of MsgA, what is your preferred option?:**

1. ***allowedHARQ-DRX-LCP* shall not apply to LCP for Msg3/MsgA PUSCH FFS whether this can be left to NW implementation, or explicitly specified.**
2. **Configuration of HARQ mode and *allowedHARQ-DRX-LCP* is up to NW implementation, and UE always follows it.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Preferred Option** | **Additional comments** |
| OPPO | Option 2 | The LCP impact on PUSCH transmission scheduled by RAR or PUSCH payload of MsgA can be avoided by NW’s proper configuration with the least spec impact. |
| Xiaomi | Option 1 | First, we need to clarify whether the configuration of “No HARQ state” is per HARQ process or per UE? We think it should be per UE since it will apply no RTT offset for DRX which only relates to satellites height.  Second, if network configure HARQ process #0 with no HARQ state, dynamic scheduling may not be able to use this HARQ process since DRX RTT timer can not be extended by RTT.  Third, if network configure HARQ process #0 with harq state, it means the LCHs configured with other HARQ state can not use it even if the RACH is triggered by them due to data arrival. It will greatly increase the delay. |
| LG | Option 2 | The smart network would not configure the wrong HARQ state to the HARQ PID0. Thus, the UE should follow the configuration configured by the network. |
| vivo | Option 2 |  |
| CATT | Option 2 |  |
| Huawei, HiSilicon | Option 1 | We should make sure that what needs to be transmitted to the gNB during RACH can be carried in the UL grant in RAR. This means if we want the data from a LCH to be transmitted during RACH, the allowedHARQ-DRX-LCP should not apply to that LCH. |
| ZTE | Option 2 | According to existing specs, CCCH has default LCH parameters as below:   | Name | Value | Semantics description | Ver | | --- | --- | --- | --- | | SDAP configuration | Not used |  |  | | PDCP configuration | Not used |  |  | | RLC configuration | TM |  |  | | Logical channel configuration |  |  |  | | *>priority* | 1 | Highest priority |  | | *>prioritisedBitRate* | infinity |  |  | | *>bucketSizeDuration* | ms1000 |  |  | | *>logicalChannelGroup* | 0 |  |  |   *allowedHARQ-DRX-LCP* will not be configured for CCCH data and C-RNTI MAC CE as well as TA report MAC CE, thus they can be mapped to any HP state. And due to their priority they will always be put in received RAR UL grant before other LCH in HP#0, and if there are available grant to be used only LCH with the same state as HP#0 will be included. It shall not impact the transmission of CCCH or C-RNTI/TA report MAC CE in Msg3 or MsgA . NW implementation can handle it. |
| Nokia | Option 2 | NW can handle the issue (e.g. not configure the uplinkHARQ-DRX-LCP-Mode to process 0). |
| Samsung | Option 2 |  |
| MediaTek | Option 2 | We think that network can control this case. We expect Msg3/MsgA to be configured with HARQ State A and all LCH data allowed to be transmitted in it. But we can rely on the network to ensure this and avoid any invalid configurations (e.g. not allowing some LCH data to be transmitted on Msg3/MsgA). |
| Ericsson | Option 1 | It shall not apply to Msg3/MsgA at all. |
| InterDigital | Option 2 |  |

***Rapporteur Summary:***

*Out of 12 responding companies, the following table presents a summary of responses to the above question:*

|  |  |
| --- | --- |
| ***For the cases that HARQ process 0 carries PUSCH transmission scheduled by RAR or PUSCH payload of MsgA, what is your preferred option?*** | |
| *Option 1* | *Option 2* |
| *3* | *9* |

*The following key comments are noted (detailed summary in Section 3):*

* *Option 1:*
  + *If network configures HARQ process #0 with no HARQ state:* 
    - *dynamic scheduling may not be able to use this HARQ process*
  + *If network configure HARQ process #0 with harq state:* 
    - *LCHs configured with other HARQ state can not use it even if the RACH is triggered by them due to data arrival.*
  + *should make sure that what needs to be transmitted to the gNB during RACH can be carried in the UL grant in RAR.*
  + *Should not apply to Msg3/MsgA at all*
* *Option 2:*
  + *[5] Can be avoided by proper NW configuration*
  + *Least spec impact*
  + *allowedHARQ-DRX-LCP will not be configured for CCCH data and C-RNTI MAC CE as well as TA report MAC CE, thus they can be mapped to any HP state.* 
    - *due to their priority they will always be put in received RAR UL grant before other LCH in HP#0*

*Based on large majority, the following is proposed:*

***Proposal 3: When HARQ process 0 carries PUSCH transmission scheduled by RAR or PUSCH payload of MsgA, configuration of HARQ mode and allowedHARQ-DRX-LCP is up to NW implementation, and UE always follows it (no specification impact). (9/12)***

**Question 7:** **If “Option 1” in Q6, what is the preferred method of ensuring *allowedHARQ-DRX-LCP* shall not apply to LCP for Msg3/MsgA PUSCH?**

1. **Left to NW implementation;**
2. **Explicitly specified.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Preferred Option** | **Additional comments** |
| Xiaomi | Option 2 | NW implementation can not ensure it unless “no HARQ state” is configured for HARQ process #0. However, if “no HARQ state” is configured per UE, it will lead to other HARQ processes configured with “no HARQ state”. If “no HARQ state” is only configured for HARQ process #0, dynamic scheduling may not be able to use HARQ process #0 since DRX RTT timer can not be extended by RTT. |
| Huawei, HiSilicon | Option 2 | See the comment to Q6. |
| Ericsson | Option 2 |  |
|  |  |  |
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***Rapporteur Summary:***

*Out of 3 responding companies, the following table presents a summary of responses to the above question:*

|  |  |
| --- | --- |
| ***If “Option 1” in Q6, what is the preferred method of ensuring allowedHARQ-DRX-LCP shall not apply to LCP for Msg3/MsgA PUSCH?*** | |
| *Option 1* | *Option 2* |
| *-* | *3* |

*Based on outcome of Q6, no proposal is made.*

# Conclusion

In this contribution the following proposals are suggested based on contributions submitted to RAN2#116bis-e AI 8.10.2.2:

**Proposal 1: *configuredGrantTimer* length is extended by UE-gNB RTT in NTN.**

**Proposal 2: *allowedHARQ-DRX-LCP* also applies to CG, and it is up to NW implementation to properly configure *allowedHARQ-DRX-LCP* and/or *allowedCG-List* for a LCH (e.g. to avoid conflicting configuration).**

**Proposal 3: When HARQ process 0 carries PUSCH transmission scheduled by RAR or PUSCH payload of MsgA, configuration of HARQ mode and *allowedHARQ-DRX-LCP* is up to NW implementation, and UE always follows it (no specification impact). (9/12)**

# References

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