3GPP TSG-RAN WG2 #116bis-e *R2-22xxxxx*

e-Meeting, 17th-25th January, 2022

**Agenda item:** **8.5.3**

**Source: vivo(Rapporteur)**

**Title:** **Report of [AT116bis-e][504][IIOT] UCE open issues**

**Document for: Discussion and Decision**

# 1 Introduction

This offline discussion aims to address the remaining CP open issues and reach some agreements for topics in 8.5.3 as follows:

* **[AT116bis-e][504][IIoT] UCE open issues (vivo)**

Deadline for providing comments:

* + - Companies inputs – **January 20, 23:59 UTC**
    - Rapporteur summary – **January 21**
    - Final comments on Rapporteur summary – **January 24, 23:59 UTC**

# 2 High Priority Issues

## 2.1 Selection of HARQ processes with equal priority between retransmission and initial transmission

In RAN2#116-e, it is agreed,

**Agreements:**

1. If HARQ process ID selection is among the retransmissions whose HARQ processes are with equal priority, it is up to UE implementation to select the prioritized HARQ process ID.

2. If HARQ process ID selection is among the initial transmissions whose HARQ processes are with equal priority, it is up to UE implementation to select the prioritized HARQ process ID.

It is still unclear how to select the HARQ process for a CG when two HARQ processes(i.e. one for retransmission and the other for initial transmission) available for the CG have equal priority.

According to the papers submitted, there are three options to handle the issue:

* **Option 1**: Depending on the UE implementation to select the prioritized HARQ process ID.
* **Option 2**: The UE prioritizes retransmission, i.e. UE prioritizes a HARQ process for retransmission if the collision is between the retransmission and the initial transmission.
* **Option3**: Up to UE implementation to perform prioritization according to gNB configuration as follows:
  + Prioritization among retransmissions only if Rel-16 baseline behaviour is configured
  + Prioritization among initial transmissions and retransmissions if new Rel-17 behaviour of prioritizing high priority data is configured

The reasons for **Option1** are following：

* Homogeneous behaviour for all equal priority cases in R17: it was agreed that for HARQ process ID selection among the initial transmissions or among the retransmissions with equal priority, it depends on the UE implementation to select the prioritized HARQ process ID
* Similar rule as Rel-16 IIoT: i.e. when overlapping CGs have equal priority, it depends on the UE implementation to select one CG to perform transmission.

The reasons for **Option2** are following：

* Ensure the latency requirement: generally speaking, the retransmission is more urgent than the initial transmission given their priorities are same. Thus, retransmission should be prioritized to avoid potential data loss. And the same logic/mechanism has been applied in Rel-16 NR-U.
* Prioritize initial transmission leads to more HARQ process IDs waiting for re-transmission, while prioritize retransmission data allows the retransmission to be received in the gNB first and allows to reduce memory usage at the gNB.
* Prioritize retransmission is more resource efficiency: retransmission can only be performed with the same HARQ process on the same carrier as its initial transmission, while initial transmission can be performed on any carrier. If initial transmission is prioritized over retransmission for current CGO on carrier1, the retransmission can not be mapped to a next CGO if the next CGO is on a carrier other than carrier1, and the next CGO is wasted. The issue will not occur if retransmission is prioritized.

The reason for **Option3** is following：

* It was agreed in RAN2#115e: *When lch-basedPrioritization and cg-RetransmissionTimer are both configured, the gNB can configure the UE per MAC entity whether it follows Rel-16 baseline or whether it prioritizes high priority data when selecting HARQ PID for a CG (i.e. option 2 is configurable).* The straightforward extension to RAN2 #116e agreements is to also leave the HARQ ID with equal priority selection to UE implementation depending on the gNB configuration.

Based on the above summary, rapporteur would like to ask companies to provide inputs for the following question:

***Question 1: If HARQ process ID selection is between the retransmission and the initial transmission, which is your preferred option regarding HPI selection among HARQ processes with equal priority?***

* ***Option 1. Depending on the UE implementation to select the prioritized HARQ process ID.***
* ***Option 2. The UE prioritizes the HARQ process for retransmission over initial transmission***
* ***Option 3. Up to UE implementation to perform prioritization according to gNB configuration.***
* ***Option 4: Other (please explain)***

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| **Company** | **Preferred option(s)** | **Comments** |
| CATT | 1 or 3 | The running CR already captures:  “If the MAC entity is not configured with *intraCG-Prioritization*, for HARQ Process ID selection, the UE shall prioritize retransmissions before initial transmissions.”  Therefore we understand the discussion is only about the case when the MAC entity is configured with *intraCG-Prioritization* and so option 3 is the same thing as option 1. |
| Huawei, HiSilicon | Option 2 | The motivation and benefits for option 2 are clearly clarified as above.  For option 1, homogeneous behaviour or just trying to follow Rel-16 IoT rule are not convinced without clear gains. It does not make sense to follow Rel-16 IOT rule, instead, Rel-16 NR-U rule should be followed since in Rel-17 we are talking about to support URLLC over unlicensed spectrum.  For option 3, we think this mechamis is quite complicated as the UE needs to support different behaviour under different configuration, introducing more complexicity on UE implementation and having additional specification impact compared to option 2. At the current stage, we should not adopt this kind of solution. |
| Ericsson | Option 2 | The rapporteur has well-summarized the technical arguments to support the option 2. On the other hand, there does not seem to have any technical reasons to support the option 1. |
| Nokia | Option 2 | The goal of introducing data *intraCG-Prioritization* is to allow more rapid transmission of more urgent data, in order to fit more stringent latency requirement that is foreseeable in URLLC use cases. When the LCH priority of the two HARQ processes are equal, it is very clear that retransmission is more urgent than initial transmission because the TB is generated earlier (i.e. the data of which has arrived earlier and it is closer to the delivery deadline in accordance to the delay budget). Therefore, prioritizing retransmission makes more sense to fit the goal of *intraCG-Prioritization* to fulfil latency requirement when this feature is configured. |
| Fujitsu | Option 2 | We share the view with the rapporteur. |
| Qualocmm | Option 1/Option 3 | Agree with CATT. We are proponents of Option 3 and our proposal was intended to clarify that the Option 1 rule only works when *intraCG-Prioritization* is configured so Option 1/3 are the same thing.  We support option 1/3 because it achieves consistency with earlier agreements regarding prioritization between equal priority TBs to be left ti implementation whether they are transmissions or retransmisions. It makes sense that this extends to when considering a combination of the two. Option 2 seems like a carve-out to fall back to Rel-16 rules in special cases which makes UE behavior cumbersome. |
| Lenovo, Motorola Mobility | Option 1/3 | We don’t have a strong opinion. Those options will be more inline with earlier agreements, i.e. to leave it to UE implementation in case of equal priority. However we support the majority view. |
| Xiaomi | No strong view on Option 1 or Option 2 | We think that either Option 1 and Option has its reason for the HARQ process selection. However we do not think that Option 3 is needed, as it introduces more complexities at the UE. |
| LGE | Option1 or 2 | Option 1 is of no harm and would allow the specification implementation easier. However, option2 is also acceptable because it is to keep the legacy principle in Rel-16. |
| OPPO | Option 1/3 | To us, it is reasonable to reuse similar rule as Rel-16 IIoT to select a prioritized HPI when multiple HARQ processes have equal priority. Moreover, this way can keep a unified UE behaviour for all sub-cases and avoid the UE’s complexity. |
| vivo | Option2 | The retransmission is more urgent than the initial transmission given their priorities are same. |
| Samsung | Option 2 | We think the new behaviour should be generalized from the legacy Rel-16. |
| Intel | Option 2 | We agree with the benefits of option 2, as summarized by rapporteur. |
| MediaTek | Option 1/3 | Same view as Qualcomm and CATT.  As for the technical reason: In IIoT, always prioritizing retransmissions may not be the desired behaviour because of low latency requirements and the fact that retransmissions may be out of date. Instead, new transmissions that carry fresh data may be prioritized. |
| InterDigital | Option 2 | This is the legacy R16 behaviour |
| Futurewei | Option 2 | Agree with all the reasons for Option 2 as summaried by the rapporteur. |
| Apple | Option 1/3 | Option 1 is preferred to have a similar behavior for all equal priority cases. We share the view from CATT and Qualcomm.  Option 2 is acceptable but less preferred. |
| III | Option 2 | We think the legacy behavior can support this issue and do not see any issue. |

**Summary of answers to Q1**:

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| Tdoc Num | Involved Proposals | Source |
| [1] R2-2200183 | Proposal 1: For HARQ process ID selection for a CG between the retransmission and the initial transmission with the same data priority, the UE should fall back to Rel-16 behaviour and prioritize retransmission. | Nokia |
| [2] R2-2200321 | Proposal 1: If HARQ process ID selection is among initial transmission(s) and retransmission(s) with equal priority, it is up to UE implementation to select the prioritized HARQ process ID. | CATT |
| [3] R2-2200478 | Proposal 1: For HPID selection among initial transmission and retransmission with equal and highest priority, the UE prioritizes a HARQ process for retransmission. | Huawei, HiSilicon |
| [4] R2-2200927 | [Proposal 1 It is up to the UE implementation to choose the prioritized HPI when HARQ processes with equal priority are associated with the initial transmission and the retransmission.](#_Toc92803188) | OPPO |
| [5] R2-2200953 | [Proposal 1 When intraCG-Prioritization is configured, if the priorites of HARQ processes of retransmission and initial transmission are equal, HARQ Process ID of the retransmission is selected.](#_Toc92719644) | Ericsson |
| [6] R2-2201018 | Proposal 1: If HARQ process ID selection is among initial transmissions and retransmissions whose HARQ processes are with equal priority, it is up to UE implementation to perform prioritization according to gNB configuration as follows:   * Prioritization among retransmissions only if Rel-16 baseline behaviour is configured. * Prioritization among initial transmissions and retransmissions if new Rel-17 behaviour of prioritizing high priority data is configured. | Qualcomm |
| [7] R2-2201226 | Proposal 1: For HPI selection for one CG occasion, if priority level of one candidate HPI for re-transmission is equal one candidate HPI for initial-transmission, the HPI for retransmission shall be selected for the upcoming CG occasion. | ZTE |
| [8]R2-2201264 | Proposal1: UE prioritizes the HARQ process for retransmission when performing HARQ process ID selection among the HARQ processes with equal priority for initial transmission and retransmission. | vivo |
| [9]R2-2201285 | Proposal#1: When the HARQ process selection happen in different HARQ process collision with equal priority, the legacy behavior can support this issue and do not see any issue. | III |
| [10]R2-2201368 | Proposal 1. For HPI selection between initial transmission and retransmission with the highest priority in Intra-CG Prioritization, UE shall prioritize retransmission. | Samsung |
| [11]R2-2201460 | Proposal 3: If HARQ process ID selection is between the retransmission and the initial transmission among HARQ processes with equal priority, it is left to the UE implementation to select the prioritized HARQ process ID. | MediaTek |

## 2.2 Deprioritized MAC PDU handling when AutoTx is not configured and CGRT is configured

In the RAN2#113e, we have reached the following agreement:

1. Option 1: AutoTx and CGRT are responsible for deprioritized MAC PDU and LBT-failed MAC PDU, respectively. If CGRT is not configured, LBT-failed MAC PDU is not retransmitted. If AutoTx is not configured, deprioritized MAC PDU is not retransmitted.

However, there are different understandings on whether the highlighted part in the above agreement also covers the case *cg-RetransmissionTimer* is configured and *AutonomousTx* is not configured. For the case, the following two options are on the table for further discussion according to the papers submitted.

If *cg-RetransmissionTimer* is configured and *AutonomousTx* is not configured:

* **Option 1**: a deprioritized MAC PDU is not transmitted in a subsequent CG occasion using the Rel-16 URLLC autonomous transmission mechanism. However, autonomous retransmission based on Rel-16 NR-U behavior can still take place. RAN2 confirms no specification change is required.
* **Option 2**: keep the earlier agreement and a deprioritized MAC PDU is not autonomous (re)transmitted. RAN2 needs to consider how to reflect the changes to the specification.

The reasons for Option1 are following：

* More aligned with what we have discussed earlier in RAN2 that led to the above agreement we have made, i.e. the previous agreement did not cover the case where CGRT is configured.
* The current specification allows possible NR-U autonomous retransmission of deprioritized PDU upon expiry of CGRT, i.e. Option1 leads to minimum impact on the current MAC specification.
* If AutoTx is not configured, the IIoT behaviour regarding autonomous transmissions should be avoided, but the NR-U behaviour regarding autonomous retransmissions is still allowed.
* Autonomous retransmission of deprioritized PDUs should not be disabled, since the HARQ process ID of the deprioritized transmission is not known by gNB, so gNB can not recover the deprioritized MAC PDU by dynamic scheduling.

The reasons for **Option2** are following：

* Option 1 makes it impossible for the NW to disable the autonomous re-transmission of a deprioritized PDU.
* When *autonomousTx* is not configured, it means that the gNB is confident to recover the de-prioritized MAC PDU by itself even if the de-prioritized MAC PDU has never been completely transmitted.

Based on the above summary, rapporteur would like to ask companies to provide inputs for the following question:

***Question 2: When cg-RetransmissionTimer is configured but autonomousTx is not configured, which is your preferred option regarding the deprioritized MAC PDU handling?***

* ***Option 1: a deprioritized MAC PDU is not transmitted in a subsequent CG occasion using the Rel-16 URLLC autonomous transmission mechanism. However, autonomous retransmission based on Rel-16 NR-U behaviour can still take place. RAN2 confirms no specification change is required.***
* ***Option 2: keep the earlier agreement and a deprioritized MAC PDU is not autonomous (re)transmitted. RAN2 needs to consider how to reflect the changes to the specification.***
* ***Option 3: Other (please explain)***

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| **Company** | **Preferred option(s)** | **Comments** |
| CATT | 2 | 1) There is no single benefit performance-wise in reverting the agreement and going with option 1.  2) Option 2 reflects the principle that *cg-RetransmissionTimer* and *autonomousTx* keep controlling the autonomous (re)transmissions of NR-U and IIOT, respectively, as in R16. Clean and simple.  3) With Option 1, there is no way to prevent a UE from retransmitting a PDU from a deprioritized CG on another CG opportunity. In R16 IIOT, it was important to leave to NW the freedom to disable the autonomous transmission feature to prevent an autonomous transmission to block a new transmission in the next CGO. Otherwise, it removes the possibility for NW to configure a CG configuration to only address initial transmissions, which is the expected configuration for a periodic deterministic traffic.  4) Option 2 can be captured in a simple manner in AI 5.4.1:  1> if the MAC entity is not configured with *lch-basedPrioritization*, and the PUSCH duration of the configured uplink grant does not overlap with the PUSCH duration of an uplink grant received on the PDCCH or in a Random Access Response or the PUSCH duration of a MSGA payload for this Serving Cell:  2> […]  2> if, for the corresponding HARQ process, the *configuredGrantTimer* is not running and *cg-RetransmissionTimer* is not configured (i.e. new transmission):  3> […]  2> else if the *cg-RetransmissionTimer* for the corresponding HARQ process is configured and not running, then for the corresponding HARQ process:  3> if the *configuredGrantTimer* is not running, and the HARQ process is not pending (i.e. new transmission):  4> […]  3> else if the previous uplink grant delivered to the HARQ entity for the same HARQ process was a configured uplink grant which was not deprioritized (i.e. retransmission on configured grant):  4> deliver the configured uplink grant and the associated HARQ information to the HARQ entity. |
| Huawei, HiSilicon | Option 1 | If we adopt option 2, some specification impact cannot be avoided and actually it does not make sense as according to the current specification, autonomous retransmission is actually allowed but we modify the spec to disallow this retransmission just to strictly follow the previous agreement…  We think it is quite easy and straightforward to revise the previous agreement without any specification change while for option 2, we fail to understand the benefit and motivation. |
| Ericsson | Option 1 | We understand the previous agreement as that de-prioritized MAC PDU is not retransmitted using the AutoTx mechanism. Option 2 is not our understanding of the agreement.  We agree with the argument that “autonomous retransmission of deprioritized PDUs should not be disabled, since the HARQ process ID of the deprioritized transmission is not known by gNB, so gNB can not recover the deprioritized MAC PDU by dynamic scheduling.”. Also option 1 has no spec impact. |
| Nokia | Option 1 | Autonomous retransmission can still be performed for the deprioritized MAC PDU if CGRT is configured, in order to deal with potential LBT failure. We do not foresee specification impacts. |
| Fujitsu | Option 1 | Our understanding to reach the agreement was that no specification change was needed. |
| Qualcomm | Option 1 | Support for minimum spec impact.Agree with Ericsson that the gNB cannot actually recover the deprioritized PDU since the HARQ ID is unknown. We do not mind leaving the spec. as is which would mean in that case an NR-U autonomous retransmission would happen for this deprioritized PDU. |
| Lenovo/Motorola Mobility | Option 1 | Agree with Nokia |
| Xiaomi | Option 1 | Agree with Nokia. |
| LGE | Option1 | We don’t think the previous agreement intended to prevent any kind of retransmission but rather to avoid additional effort to enable autonomous transmission if AutoTx is not configured. |
| OPPO | Option 1 | As the legacy spec already supports the NR-U autonomous retransmission for such deprioritized MAC PDU, we suggest to choose option 1, which can avoid the impact on the MAC spec. |
| vivo | Option1 | Option1 matches with the intention of pervious agreement. |
| Samsung | Option 1 |  |
| Intel | Option 1 | We think Option 1 can be handled by current specification without any change. |
| MediaTek | Option 1 | Option 1 is simple and has the least specification impact. |
| InterDigital | Option 2 | Prefer not to revert agreements unless there is motivation. NW can configure AutoTx for handling of the deprioritized PDU. Option 1 is however fine if that’s the majority, assumign there is no further spec changes. |
| Futurewei | Option 1 | No spec impact foreseen. |
| Apple | Option 1 |  |
| III | Option 1 |  |

* **Summary of answers to Q2**:

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| Tdoc Num | Involved Proposals | Source |
| [1] R2-2200183 | Proposal 2: If cg-RetransmissionTimer is configured and AutonomousTx is not configured, the UE does not autonomously (re-)transmit the de-prioritized MAC PDU. | Nokia |
| [2] R2-2200321 | Proposal 2: RAN2 confirms that a deprioritized grant shall not be autonomously retransmitted when autonomousTx is not configured. RAN2 considers the above TP for implementing this. | CATT |
| [3] R2-2200478 | Proposal 2: RAN2 to confirm that if cg-RetransmissionTimer is configured and AutonomousTx is not configured, a deprioritized MAC PDU is not transmitted in a subsequent CG occasion using the Rel-16 URLLC autonomous transmission mechanism. However, autonomous retransmission based on Rel-16 NR-U behaviour can still take place. | Huawei, HiSilicon |
| [4] R2-2200927 | [Proposal 2 When cg-RetransmissionTimer is configured but autonomousTx is not configured, the deprioritized MAC PDU is not transmitted on the subsequent CG based on AutoTX mechanism but can be transmitted on the subsequent CG based on NRU autonomous retransmission mechanism.](#_Toc92803189) | OPPO |
| [6] R2-2201018 | Proposal 2: If cg-RetransmissionTimer is configured and AutonomousTx is not configured, a deprioritized MAC PDU can be retransmitted via autonomous retransmission based on Rel-16 NR-U behaviour. No spec. change is needed. | Qualcomm |
| [8]R2-2201264 | Proposal2: If cg-RetransmissionTimer is configured and AutonomousTx is not configured, a deprioritized MAC PDU is not transmitted in a subsequent CG occasion using the Rel-16 URLLC autonomous transmission mechanism. However, autonomous retransmission based on Rel-16 NR-U behavior can still take place. | vivo |
| [9]R2-2201285 | Proposal#2: If cg-RetransmissionTimer is configured and AutonomousTx is not configured, keep using the autonomous retransmission based on Rel-16 NR-U behavior can minimum specification impact. | III |
| [11]R2-2201460 | Proposal 1: If cg-RetransmissionTimer is configured and AutonomousTx is not configured, a deprioritized MAC PDU is not transmitted in a subsequent CG occasion using the Rel-16 URLLC autonomous transmission mechanism. However, autonomous retransmission based on Rel-16 NR-U behaviour can still take place. RAN2 confirms no specification change is required. | MediaTek |

## 2.3 CGRT handling for deprioritised UL grant when autoTx is not configured

In RAN2#113-e, it is agreed that CGRT is stopped when the associated uplink grant is deprioritized due to LCH-based prioritization.

3. the MAC entity stops cg-RetransmissionTimer when the CG resource associated with the timer is deprioritized due to LCH-based prioritization.

It was clear that the agreement is applied to the case where a*utonomousTx* is configured. But, there are different understandings on whether the above agreement can also be applied to the case where a*utonomousTx* is not configured. For the a*utonomousTx* not configured case, there are two options regarding the *cg-RetransmissionTimer* termination for the deprioritized CG on the table for further discussion according to the papers submitted.

* **Option 1**: *cg-RetransmissionTimer* should be stopped for the deprioritized CG.
* **Option 2**: *cg-RetransmissionTimer* should not be stopped for the deprioritized CG.

The reasons for Option1 are following：

* Not stopping CGRT brings no benefit but only needlessly delay the retransmission
* Align with the previous agreement

The reasons for Option2 are following：

* The Rel-16 NR-U autonomous retransmission behaviour should not be affected by deprioritization
* Compared with Option1, Option2 is simpler and has less specification impact
* Option2 allows the network flexibility on the retransmission schedule, e.g. the gNB may want to respond to the UE with a dynamic grant before the CGRT expiry if the HARQ process id can be determined by gNB
* With Option2, the network can configure *autonomousTx* if it wants to achieve the same UE behaviour as Option1

Based on the above summary, rapporteur would like to ask companies to provide inputs for the following question:

***Question 3: When cg-RetransmissionTimer is configured but autonomousTx is not configured, which is your preferred option regarding the cg-RetransmissionTimer termination for the deprioritized CG ?***

* ***Option 1: cg-RetransmissionTimer should be stopped for the deprioritized CG.***
* ***Option 2: cg-RetransmissionTimer should not be stopped for the deprioritized CG.***
* ***Option 3: Other (please explain)***

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| **Company** | **Preferred option(s)** | **Comments** |
| CATT | 1 | No specification change is needed for the handling of the CGRT. The clean solution is option 2 of Q2. |
| Huawei, HiSilicon | Option 2 | Stop the retransmission timer for deprioritized CG is some kind of optimization as retransmission is anyway allowed when the timer expires. |
| Ericsson | 2 | The benefit to stop the timer, as in option 1, is to allow the UE to autonomously retransmit data, however, to achieve the same UE behaviour, the network can configure *autonomousTx*. In other words, to stop *cg-RetransmissionTimer* in this case is in contradictory to the network intention of not configuring autonomousTx. |
| Nokia | Option 2 | The motivation of a CGRT is for the gNB to have sometimes to process the received MAC PDU and issue DFI or retransmission grant if possible. The gNB may not know if the MAC PDU has been deprioritized or not, so if the UE stops the CGRT imprudently, the gNB may not be aware of it and still issue retransmission grant blindly. This leads to complication in inter-operability between gNB and UE. |
| Fujitsu | Option 2 | Agree with Nokia. |
| Qualcomm | Option 1 | In this case the MAC PDU is headed for a retransmission anyway so we see no reason for running the timer except delaying transmission and potentially contending with other PDUs arriving to MAC later.  On the other hand, while CGRT is running, if the gNB has not decoded that PDU (e.g. the PDU was deprioritized before the transmission started) the gNB canot send a DFI or dynamically reschedule the PDU since the HARQ ID is unknown to gNB. The only case where the gNB may want to do that (as mentioned by Nokia) is if deprioritization happens between transmission and gNB DFI feedback which we do not think is a very common case comparing to prioritization before transmission in which for that case, stopping the timer makes much more sense. |
| Lenovo/Motorola Mobility | Option 1 | We see no reason to deviate from the previous agreement. |
| Xiaomi | Option 1 | If the answer to Question 2 is to allow retransmission, then we see no reason to run the CGRT. And this is also to align the UE behaviours with the case when autoTx is configured. |
| LGE | Option 2 | There seems to be no reason to stop the cg-RetransmissionTimer for the deprioritized CG. Although we allow the autonomous retransmission upon expiry of cg-RetransmissionTimer in this case, we have no intent to go far beyond that and allow even earlier/faster autonomous retransmission. |
| OPPO | Option 2 | Agree with Nokia. From another perspective, Option 1 blocks the network flexibility on the retransmission scheduling. |
| vivo | Option1 | Agree with Qualcomm and Xiaomi.  As the gNB has no idea of which HARQ process id is used for the deproirotized MAC PDU, it is no possible for gNB to schedule dynamic retransmission for the deproirotized MAC PDU during the CGRT is running. Hence, the gNB can do nothing before the CGRT expires. Therefore, it makes sense to stop the CGRT assocatied with the deprioritized MAC PDU which enables UE to perform autonomous retransmission earlier. |
| Samsung | Option 2 | RAN2 discussion has been pursuing decoupling of AutonomousTx and Autonomous Retransmission. We do not need to perform NR-U autonomous retransmission behaviour at deprioritization. |
| Intel | Option 2 | Agree that NR-U behavior (*cg-RetransmissionTimer*) should not be affected by CG de-prioritization. |
| MediaTek | Option 1 | There is no reason to delay the autonomous retransmission by keeping the CGRT running. We are not conviced that if the CGRT is kept running the network will be able to detect a deprioritized transmission and provide a retransmission grant. Even if that is the case, HARQ PID is indicated in UCI when CGRT is configured, so there should be no ambiguity or inter-operability issues between the UE and the network. |
| InterDigital | Option 1 | No strong motivation in changing the agreement or delaying the retransmission. |
| Futurewei | Option 2 | Agree with Nokia. |
| Apple | Option 2 | As mentioned by the rapporteur the agreement from R2#113e above was made for a scenario where CGRT and *autonomousTx* are configured together, which does not apply to this case. |
| III | Option 2 | Agree with Nokia. |

* **Summary of answers to Q3**:

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| Tdoc Num | Huawei, HiSilicion | Source |
| [1] R2-2200183 | Proposal 3: When autonomousTx is not configured, cg-RetransmissionTimer is not stopped upon de-prioritization of the MAC PDU. | Nokia |
| [4] R2-2200927 | [Proposal 3 The MAC entity does not stop cg-RetransmissionTimer for the deprioritized CG when cg-RetransmissionTimer is configured but autonomousTx is not configured.](#_Toc92803190) | OPPO |
| [5] R2-2200953 | Proposal 2 cg-RetransmissionTimer is not stopped for the de-prioritized CG when cg-RetransmissionTimer is configured but autonomousTx is not configured. | Ericsson |
| [6] R2-2201018 | Proposal 3: The earlier RAN2 agreement that the MAC entity stops cg-RetransmissionTimer when the CG resource associated with the timer is deprioritized due to LCH-based prioritization is confirmed. | Qualcomm |
| [8]R2-2201264 | Proposal3: If cg-RetransmissionTimer is configured and autonomousTx is not configured, the cg-RetransmissionTimer is stopped when the associated CG is deprioritized, i.e. the previous agreement is kept. | vivo |
| [9]R2-2201285 | Proposal#3: If cg-RetransmissionTimer is configured and AutonomousTx is not configured, a deprioritized MAC PDU is transmitted in a subsequent CG occasion using the Rel-16 NR-U autonomous retransmission mechanism, the cg-RetransmissionTimer should not be stopped for the deprioritized CG. | III |
| [10]R2-2201368 | Proposal 2. cg-RetransmissionTimer is stopped when CG configured with *AutonomousTx* is de-prioritized. cg-RetransmissionTimer is not stopped when CG not configured with *AutonomousTx* is de-prioritized. | Samsung |
| [11]R2-2201460 | Proposal 2: RAN2 confirms the previous agreement that the MAC entity stops cg-RetransmissionTimer when the CG resource associated with the timer is deprioritized due to LCH-based prioritization, regardless of whether AutonomousTx is configured or not. | MediaTek |

## 2.4 *configuredGrantTimer* handling when a CG for retransmission is deprioritized

[3] pointed that in the current MAC spec, if a CG is deprioritized, the associated *cg-retransmissionTimer* and *configuredGrantTimer* shall be stopped when *AutonomousTx* is configured for the CG configuration. For Rel-16 IIoT, a CG occasion can only be used for new transmission. It is fine to stop *configuredGrantTimer* if a CG is deprioritized. But when it comes to Rel-17 URLLC in UCE, CG occasions can also be used for retransmission. If the deprioritized uplink grant is a CG occasion for retransmission and if its associated *configuredGrantTimer* is running, it may cause unnecessary packet loss if we stop the *configuredGrantTimer*. To avoid packet loss explained above, two options are suggested according to the papers:

* **Option1**: if the *configuredGrantTimer* is running when a CG for retransmission is deprioritized, the associated *configuredGrantTimer* shall not be stopped.
* **Option2**: if the *configuredGrantTimer* is running when a CG for retransmission is deprioritized, both *configuredGrantTimer* and *cg-retransmissionTimer* are stopped, autonomous transmission is used to recover the deprioritized PDU and retransmit it.

Based on the above summary, rapporteur would like to ask companies to provide inputs for the following question:

***Question 4: When autonomousTx and cg-retransmissionTimer are configured, if an autonomous retransmission of a PDU is deprioritized with the HARQ not pending, which is your preferred option regarding recovery of the deprioritized PDU ?***

* ***Option 1: the configuredGrantTimer should not be stopped, to avoid potential packet loss***
* ***Option 2: both configuredGrantTimer and cg-retransmissionTimer are stopped, autonomous transmission is used to recover the deprioritized PDU, No change to CGT or CGRT operation is needed.***
* ***Option 3: Other (please explain)***

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| **Company** | **Preferred option(s)** | **Comments** |
| CATT | Option 3 | As explained by Huawei in [3], option 2 cannot work when the deprioritized autonomous retransmission was triggered by a failed transmission, in which case, autoTx cannot take place because the PDU was fully sent once.  On the other hand, the solution of not stopping CGT will trigger an autonomous retransmission in between CGRT expiry and CGT expiry. However this may leave little room, if any, during the time interval in between the two timers expiries (because this is a 2nd retransmission and CGRT was restarted on the 1st retransmission attempt but not CGT).  Another option (Option 3) is to treat this case in a similar manner as an LBT failure, that is stopping both timers (no spec change) but switching the HARQ process to pending. This basically resets the procedure and there is again plenty of time to address the deprioritized retransmission by autonomous retransmission. |
| Huawei, HiSilicion | Option 1 | Proponent for Option 1. As we clarified in [3], in such case, autonomus transmission cannot be triggered due to the condition “*if none of PUSCH transmission(s) of the obtained MAC PDU has been completely performed*” for autonomous transmission is not satisfied. This is because the CGT keeping running and HARQ process being not pending which means the initial transmission and/or retransmission for this packet has been successfully transmitted. Therefore, the UE will never enter autonomous transmission branch according to the current specification. Instead, a new MAC PDU will be generated and flush the original packet stored in the HARQ buffer, which may lead to packet loss.  However we need to admit that for this case UE only losses some retransmission opportunites (i.e., some retransmission opportunities before the expriy of CGT) since anyway the CGT will expire. If the other companies do not think this is a significant issue, we are fine to not solve it. But anyway we cannot agree that autonomous transmission is used to recover the deprioritized PDU as we explained above. |
| Nokia | Option 1 but … | We think specification impacts for Option 1 may be smaller.  However, we think we can discuss this in more details in the maintenance phase after the WI completion. So we are okay to put this issue on hold. |
| Fujitsu | TBD | It seems that RAN2 needs to confirm if the case pointed out in [3] is NW scheduling error for IIoT over UCE scenario. |
| Qualcomm | Option 2 | We think if Autonomous Tx is configured, it should handle deprioritization as much as possible and CGRT should not intervene with reprioritizing and transmit PDUs. Thus, to maintain consistency we prefer going with option 2 and doning the required small speech changes to codify that. |
| Lenovo/Motorola Mobility | Option 3 | We agre with Huawei that autonomous transmission will not kick in if there was a complete PUSCH transmission. Therefore we also think that this issue should be handled in order to avoid some packet loss. We have some sympathie for the solution proposed by CATT, i.e. switching the HARQ status to pending. |
| Xiaomi | Option 1 | We think that the packet loss should anyway be avoided, and Option 1 seems working with small specification change. |
| LGE | Option 2 | The case, i.e., de-prioritization while the HARQ process is not pending, means that the transmission is de-prioritized by the network while the TB is in the air.  We don’t see any difference to handle this case differently for new transmission and retransmission. Regardless of whether it is autonomous retransmission or new transmission (in Rel-16), wee see no issue in stopping CGT because the network knows it.  Regarding CATT’s suggestion, switching the HARQ process status to pending means that the UE performs autonomous retransmission for the de-prioritized MAC PDU, which may complicate the retransmission principle in general. |
| OPPO | Option 1 | In our paper (R2-2103211, Proposal 2), we also mentioned this issue. In our understanding, if RAN2 agrees that packet loss is an issue, we suggest not to stop CGT. Otherwise, no spec change is needed and the UE is allowed to generate a new MAC PDU accordingly.  Option 2 is not correct, i.e. auto TX will not be triggered because such MAC PDU has been completely transmitted before. |
| vivo | Option1 | Option 1 can handle the packet loss issue with small specification effort. |
| Samsung | Option 2 | This case may happen if two conditions are satisfied:   * The first transmission has been performed but CGRT has been expired. * The second transmission by Autonomous Retransmission has been de-prioritized.   We think this case does not frequently happen. In this case it is ok to leave it as it is, and NW can handle the case, e.g. dynamic retranmsision is allocated. |
| Intel | Option 2 | We don’t think this is a critical issue to solve. As Huawei has explained, the only potential issue is that a retransmission opportunity with CG might not be utilized. Given that UE has already performed initial transmission and/or retransmission(s), gNB can also use dynamic grant for retransmission. Since this is an optimization, we prefer to either keep specification unchanged, or put the issue on hold and discuss it during maintenance phase after WI competition, as Nokia has suggested. |
| MediaTek | Option 2 | Agree with Qualcomm. We can check if a small clarification in the specification is needed. |
| InterDigital | Option 2 | This does not seem to be a common case. We are fine to leave the handling for NW implementation . |
| Futurewei | Option 1 |  |
| Apple | Option 1 but | Agree with Samsung that this case is not likely to happen frequently. Option 1 seems to work, but we are also fine to do nothing (i.e., option 2) or leave this case for later discussion during maintenance phase. |
| III | Option 1 |  |

* **Summary of answers to Q4**:

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| Tdoc Num | Involved Proposals | Source |
| [3] R2-2200478 | Proposal 3: If *AutonomousTx* is configured and when a CG for retransmission is deprioritized, the associated *configuredGrantTimer* for the corresponding HARQ process shall not be stopped if it is running. | Huawei, HiSilicon |
| [6]R2-2201018 | Proposal 4: RAN2 to confirm that when autonomous Tx and CGRT are configured together and an autonomous retransmission of a PDU is deprioritized with the HARQ not pending, the current spec. allows autonomous transmission to take place to recover the deprioritized PDU being retransmitted.  Proposal 5: RAN2 to confirm that when autonomous Tx and CGRT are configured together and an autonomous retransmission of a PDU is deprioritized with the HARQ not pending, autonomous transmission is used to recover the deprioritized PDU and retransmit it. No change to CGT or CGRT operation is needed. | Qualcomm |

## 2.5 Change of CG size in unlicensed spectrum

In IIOT, Autonomous Transmission is performed only if the size of the stored MAC PDU matches with CG. However, NR-U, change of the size is not assumed. A problematic case is pointed out[10]: if CGRT is not running, CGT is not running, HP is pending, and TBS changes, then NDI is not toggled for Autonomous Retransmission. However, the stored MAC PDU cannot be retransmitted due to the different size. In this case, the uplink transmission will be skipped due to the lack of the specified behaviour. It is proposed that autonomous retransmission is performed only if CG size does not change.

Rapporteur would like to ask companies to provide inputs for the following question:

***Question 5: whether it can be agreed that autonomous retransmission is performed only if CG size does not change in Rel-17.***

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| **Company** | **Yes/No** | **Comments** |
| CATT | FFS | We fail to see when this case may happen. The TBS is also checked for autonomous ReTx in AI 5.4.2.2:  If *cg-RetransmissionTimer* is configured, retransmissions with the same HARQ process may be performed on any configured grant configuration if the configured grant configurations have the same TBS. |
| Huawei, HiSilicon | Yes, but the this is already captured in the spec | In section 5.4.2.2 of the MAC spec, we have the following text “If *cg-RetransmissionTimer* is configured, retransmissions with the same HARQ process may be performed on any configured grant configuration if the configured grant configurations have the same TBS.” We think the intention has already been agreed in Rel-16 NR-U and has been captured in the spec. |
| Ericsson |  | Agree with CATT and Huawei |
| Nokia | Yes but | Agree with above companies |
| Fujitsu | Yes | Confirms the AI 5.4.2.2. |
| Qualcomm |  | Agree with CATT and Huawei |
| Lenovo/Motorola Mobility |  | Agree with Huaweil and CATT |
| Xiaomi | Yes | We are open to double-check the running MAC CR. |
| LGE | Yes | It would be general principle that retransmission is performed only if CG size does not change. So, it is unclear what the implication of this proposal would be. |
| OPPO |  | Agree with CATT and Huawei |
| vivo | Yes | Agree with CATT and Huawei |
| Samsung | Yes | The existing sentence does not capture the case of TBS within the same CG configuration but the case of multiple configuration sharing HPI. The intention of the existing sentence is to allow Autonomous Retransmission in the closest CG occasion of different CG configuration.  A rewording of the proposal is that if TBS changed, then new transmission is performed, i.e. NDI toggled. But the current spec does not allow to toggle NDI.  In the following example of a CG configuration with a single HPI.  At t1: LBT is failed -> HP status is pending  At t2: TBS changed by re-activation -> CGT & CGRT stopped  At t3: NDI is toggled by the condition in 5.4.1. But retransmission cannot be performed due to the different size of TB. UE behaviour is not specified.    In our view, the existing text do nothing in this procedure.  In our understanding, this problematic case was not discussed in Rel-16 NR-U whereas NR-U session focused on multiple CG configurations. Thus, to define harmonized UCE procedure, this should be captured.  It seems that companies seem to agree it is natural to support. A simple way is to add a condition to 5.4.1, e.g.if TBS is change, consider the NDI bit to have been toggled. |
| Intel | Yes | Agree with CATT and Huawei that TBS restriction has already been captured in MAC spec. |
| MediaTek | Yes, but | Agree with CATT and Huawei |
| InterDigital |  | Agree with CATT and Huawei |
| Futurewei |  | Agree with CATT and Huawei |
| III |  | Agree with CATT and Huawei. |

* **Summary of answers to Q5**:

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| [10]R2-2201368 | Proposal 3. Autonomous retransmission (CGRT) is performed only if CG size does not change (i.e. MAC PDU size) | Samsung |

# 3 Low Priority Issues

The following issues are proposed by only one company and are optimizations or not essential. Therefore, the rapporteur suggests only to give a summary in the following without proposals for discussions. They may be postponed until high priority issues are resolved.

## 3.1 Impact of one-shot HARQ feedback on *drx-HARQ-RTT-TimerDL*

RAN1 has agreed to introduce 3 one-shot HARQ feedback mechanisms, i.e. Type 3 CB (codebook), enhanced Type 3 CB and one-shot HARQ-ACK re-transmission. [2] pointed that the three mechanisms have the same characteristics from RAN2 perspective and propose a unified solution should be applied to handle the impact to *drx-HARQ-RTT-TimerDL* when any one-shot HARQ feedback mechanism is triggered. And a related TP is provided.

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| Tdoc Num | Involved Proposals | Source |
| [12] R2-2200321 | Proposal 3: A unified solution should be applied to drx-HARQ-RTT-TimerDL when any type of one-shot HARQ-ACK transmission/retransmission is triggered.  Proposal 4: UE should start drx-HARQ-RTT-TimerDL for the HARQ process(es) when HARQ-ACK feedback requested by DCI is received. RAN2 considers the above TP. | CATT |

## 3.2 Multi-TB scheduling in CG and without CGRT

In [5], it is proposed multi-TB scheduling for CG is not supported when *cg-retransmissionTimer* is not configured in unlicensed band, due to the potential impact on the current HARQ formula. In addition, [5] indicates that the benefits of *cg-nrofSlots/cg-nrofPUSCH-inSlot* can be achieved by configuring multiple CG configurations with high periodicities for the case when *cg-retransmissionTimer* is not configured, thus there is no need to do any modification of the HARQ formula.

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| Tdoc Num | Involved Proposals | Source |
| [5] R2-2200953 | [Proposal 3 In unlicensed band, multi-TB in CG is supported only when cg-retransmissionTimer is configured.](#_Toc92719646) | Ericsson |

## 3.3 R16 Intra-UE multiplexing for the transmission at the boundary of the UE FFP

Based on the RAN1 agreements, the UE can initiate the COT in a UE FFP by sending an initiated UL signal to NW, if the UL transmission is performed (i.e LBT is successful), the COT period in this UE FFP is available for the UE to perform UL transmission. However, the UL transmission to initiate COT in one UE FFP period can be deprioritized by another UL transmission with a higher priority. Thus, [7] proposes to prioritize the COT-initiated UL transmission if it collides with any other UL transmission not for initiating COT. [7] also proposes the LCH based priority rule shall be used for determining the prioritized COT-initiated UL transmission if both collided UL transmission is UL transmission for initiating COT.

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| Tdoc Num | Involved Proposals | Source |
| [7] R2-2201226 | Proposal 3: For the collision case involving UL transmission for initiating COT, if both collided UL transmission is UL transmission for initiating COT, the LCH based priority rule shall be used for determining the prioritized COT-initiated UL transmission.  Proposal 4: For the collision case involving COT-initiated UL transmission, if there is only one collided UL transmission is a COT-initiated UL transmission, then this COT-initiated UL transmission shall be prioritized. | ZTE |

## 3.4 UE processing time restriction on the retransmission grant selection

In [12], it is pointed out that with some CG configurations, the interval between the previous transmission which is deprioritized and the autonomous transmission for the previous transmission is too short for UE to prepare for the autonomous transmission. Hence, it is proposed that the interval between the subsequent uplink grant for retransmission and the deprioritized autonomous retransmission grant should be larger than the PUSCH preparation time.

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| Tdoc Num | Involved Proposals | Source |
| [12] R2-2201374 | Proposal: The interval between the subsequent uplink grant for retransmission and the deprioritized autonomous retransmission grant should be larger than the PUSCH preparation time. | Xiaomi |

## 3.5 Prioritization between SR and UL-SCH

Currently, simultaneous PUCCH/PUSCH transmission is not allowed in NR according to TS38.321. However, RAN1 agreed to support the simultaneous PUCCH/PUSCH transmission for a few cases and other cases are still under discussion, as follows:

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| RAN1#102-e  Agreements:  Support simultaneous PUCCH/PUSCH transmissions on different cells at least for inter-band CA.  RAN#104-e  Agreements:  Per UE with the capability of inter-band CA, simultaneous PUCCH/PUSCH transmission of different PHY priorities over different cells can be RRC configured within the same PUCCH group  RAN2#107-e  Conclusion  There is no consensus in RAN1 to support simultaneous PUCCH/PUSCH transmission of same priority over different cells in Rel-17.  Conclusion  There is no consensus in RAN1 to support simultaneous PUCCH/PUSCH transmissions on different cells for intra-band CA in Rel-17. |

It will have impact to MAC which specifies prioritization/resource selection between SR (PUCCH) and UL-SCH (PUSCH). [10] proposes to revise prioritization between SR and UL-SCH (Rel-15 text and Rel-16 text) to support simultaneous PUCCH/PUSCH transmission. As the proposal is related to Rel-15 text and Rel-16 text, rapporteur thinks it can be handled in TEI.

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| Tdoc Num | Involved Proposals | Source |
| [10]R2-2201368 | Proposal 4. Prioritization between SR and UL-SCH (Rel-15 text and Rel-16 text) is revised to support simultaneous PUCCH/PUSCH transmission.  Proposal 5. The following TP is adopted. | Samsung |

Companies are invited to provide comments on the following Question:

***Question 6: Which of the above issue(s) do you think is critical for further discussion?***

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| **Company** | **Issue Id: 3.1~3.5** | **Comments** |
| CATT | 3.1 | We think the impact of one-shot HARQ feedback on *drx-HARQ-RTT-TimerDL* should be addressed at some point in R17 to take into account the latest RAN1 agreements. But maybe that is not the right agenda item… |
| Huawei, HiSilicon | 3.5 | For the other issues, we have the same view as the rapporteur. However for issue 3.5 which relates to intra-UE prioritization, we think some impact on RAN2 is forseen based on the latest RAN1 agreements, without the support from MAC specification, the UE is not allowed to perform simultaneous PUCCH/PUSCH transmission. However, there are still many open issues in RAN1 without conclusion, so from RAN2 perspective, we think we need to discuss if we have a separate agenda for this topic from next meeting to allow companies to submit contributions or we just wait for more RAN1 progress/potential LS from RAN1. |
| Nokia | None | We think most of these issues (if need to be addressed) can be handled in the maintenance phase after WI completion. Besides, many of these issues do not really fall into the WI objective of URLLC in UCE. |
| Fujitsu | 3.1, 3.3, 3.5 | 3.1: RAN2 can take a look at the MAC TP in [12], which seems simple.  3.3: The RAN1 decision seems to have RAN2 specification impact.  3.5: The RAN1 decision seems to have RAN2 specification impact. |
| Xiaomi | 3.4 | We are open to discuss all RAN1 related issues. Regarding the UE processing time, we think that this should be handled anyway, to avoid the packet loss and to avoid the collision between the RAN2 specification and the RAN1 specification. |
| LGE | 3.1 | We also provided our view on the same issue in TEI17. We’re not sure whether it can be discussed/decided in IIOT. |
| Samsung | None but need discussion anyway | Some issues are related to RAN1 agreements of Rel-17 IIOT WI. In order to make 3GPP RAN1 solutions working, RAN2 needs to update our spec, e.g. MAC. We agree with HW that we need to discuss if we have a separate agenda for this topic from next meeting to allow companies to submit contributions. |
| Apple | 3.1 | We also think that a common solution is needed for the One-shot HARQ-ACK in Rel-17, as indicated in our contribution in R2-2201131 and the TP in R2-2201132. |
| Apple | General topic | RAN1 has informed RAN2 of the Rel-17 RAN1 UE feature list and its respective RRC parameters in two LS’s and there are a number of features impacting MAC. RAN2 needs to review the RAN1 features while preparing the Rel-17 spec. Details are available in R2-2201131 and R2-2201132. We agree with Samsung and HW on the importance and ok to have a separate agenda item. |
| MediaTek | None | Agree with Nokia |

# 4 Conclusion

The summarized proposals are given below:

# 5 Contact information

|  |  |  |
| --- | --- | --- |
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# References

[1] R2-2200183 Remaining Issues on Configured Grant for URLLC in Unlicensed Nokia, Nokia Shanghai Bell

[2] R2-2200321 Leftovers of UCE CATT

[3] R2-2200478 Remaining issues about uplink enhancements for URLLC in UCE Huawei, HiSilicon

[4] R2-2200927 Remaining issues on URLLC over NRU OPPO

[5] R2-2200953 Remaining issues in UL CG enhancements Ericsson

[6] R2-2201018 CG Harmonization for Unlicensed Controlled Environment Qualcomm Incorporated

[7] R2-2201226 Further Consideration on the Intra-UE multiplexing in UCE ZTE

[8] R2-2201264 Remaining Issues for UCE vivo

[9] R2-2201285 Remaining issues for IIoT in UCE III

[10] R2-2201368 Remaining Issues on CG Enhancement and Intra-UE Prioritization Samsung

[11] R2-2201460 Remaining issues for UCE MediaTek Inc.

[12] R2-2201374 UE processing time restriction on the retransmission grant selection Xiaomi Communications