3GPP TSG RAN WG2 Meeting #117-e R2-22xxxxx

e-Meeting, 21st February – 3rd March, 2022

**Agenda item: 8.1.3.1**

**Source: Samsung**

**Title: Report of [Pre117-e][002][MBS] UP open Issues Input**

**Document for: Discussion**

# 1 Introduction

This document is a report of the following open issue discussion:

* [Pre117-e][002][MBS] UP open Issues Input (Samsung)

This discussion covered UP open issues captured by the open issue document [1], for which company tdocs are not invited, as follows:

- RRC CR-related issue

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| FFS whether RRC can enable/disable C-RNTI based PTM retransmission |  | Company input into Pre117-e-offline (i.e. no company tdocs). |
| FFS whether the UE for multicast can be configured with multiple MTCHs with the same LCID (to be scheduled using different G-RNTIs like broadcast) |  | Company input into Pre117-e-offline (i.e. no company tdocs). |

- MAC CR-related issues

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| FFS how to start the RTT timer when no feedback is transmitted in NACK only case. | 5.7b | Company input into Pre117-e-offline (i.e. no company tdocs). The question would be rephrased. |
| FFS to support DRX Command MAC CE for MBS DRX. | 5.7b | Company input into Pre117-e-offline (i.e. no company tdocs). The question would be rephrased. |
| FFS to support short DRX for MBS. | 5.7b | Company input into Pre117-e-offline (i.e. no company tdocs). |
| FFS to HARQ disable or HARQ is not configured case for MBS. | 5.7b | Company input into Pre117-e-offline (i.e. no company tdocs). The question would be rephrased. |
| Editor’s note: FFS how to associate the G-CS-RNTI and MBS SPS. | 5.8.1a | Company input into Pre117-e-offline (i.e. no company tdocs). The question will be rephrased. It seems not releveant in MAC. May discuss in RRC. |
| Whether there are MBS specific impacts on MAC reset procedure |  | Company input into Pre117-e-offline (i.e. no company tdocs). The question would be rephrased. |

- PDCP CR-related issue

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| FFS whether it is up to UE implementation to prevent COUNT wrap-around for broadcast, given that HFN is selected by the UE itself. |  | Company input into Pre117-e-offline (i.e. no company tdocs) |

- Other open issue

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| FFS whether dedicated broadcast HARQ processes are used for MCCH and MTCH? |  | Company input into Pre117-e-offline (i.e. no company tdocs) |

# 2 Contact Information

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| **Company** | **Name** | **Email** |
| Qualcomm | Prasad Kadiri | pkadiri@qti.qualcomm.com |
| Samsung | Sangkyu Baek | sangkyu.baek@samsung.com |
| MediaTek | Xiaonan Zhang | Xiaonan.Zhang@meidatek.com |
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# 3 Discussion

## 3.1 DRX Command MAC CE and Short DRX

During RAN2 offline discussion [AT116bis-e][028][MBS] MAC Open Issues [2], necessity and signalling including format were discussed but the companies’ view were not converged.

There were two split views:

1. Support DRX Command MAC CE for Multicast MBS:
   * It can achieve more power saving.
   * Considering service specific traffic pattern, MBS DRX is needed.
2. Not support DRX Command MAC CE for Multicast MBS:
   * Benefits may be marginal considering there are multiple DRX configurations for MBS.
   * It’s less efficient, since some UEs may miss the MAC CE and not sleep.
   * It just increases the complexity of MBS DRX.

For WI completion, RAN2 has to decide whether to have the MAC CE.

**Q1) Do companies support DRX Command MAC CE for Multicast MBS?**

1. **Yes, DRX Command MAC CE for Multicast MBS is needed.**
2. **No, DRX Command MAC CE for Multicast MBS is not needed**

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| **Company** | **Yes/No** | **Comment** |
| Qualcomm | Yes | This is very much needed to improve UE power saving. MAC-CE is more dynamic than RRC signalling based configuration change. |
| Samsung | No | The gain is not quantified and we think it’s very marginal saving gain in total modem power consumption. |
| MediaTek | Yes |  |
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Depending on conclusion of Q1 (in case that the MAC CE is introduced), further discussion on the format and signalling would be useful. One thing is clear that, DRX Command for a G-RNTI (irrespective of detailed format and delivered RNTI), *drx-onDurationTimerPTM* and *drx-InactivityTimerPTM* timer for that G-RNTI shall be stopped. Based on the assumption, we may discuss a next-level for progress.

The first issue could be how to identify the MBS DRX Command MAC CE. We may have the following options:

1) A new LCID value is used for MBS DRX Command MAC CE. This MAC CE should be separated from unicast MAC CE.

2) MBS DRX Command MAC CE can be separated by G-RNTI. If the MAC CE is received by G-RNTI, it will be MBS MAC CE. The same LCID value(s) (60: DRX command and/or 59: Long DRX Command) can be reused.

3) MBS DRX Command MAC CE can be separate by R bit in MAC subheader as in the following format.



**Q2) If RAN2 agreed to introduce DRX Command MAC CE, which option do companies support for separation of MBS DRX Command MAC CE?**

1. **New LCID value**
2. **Used RNTI (G-RNTI 🡪 MBS DRX, C-RNTI 🡪 Unicast DRX)**
3. **R-bit in MAC subheader**

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| **Company** | **Option** | **Comment** |
| Qualcomm | Option 2 |  |
| Samsung | 1 | Option 2 may not work well. Since C-RNTI is used for both unicast and PTP retransmission of PTM initial transmission. If PTP retransmission resource includes the DRX Command MAC CE, it should be interpreted as MBS DRX MAC CE but UE may misinterpret in case that initial G-RNTI DCI is missed.  We do not support Option 3, since we have to be very careful to use R bit. |
| MediaTek | Option 1 | Option1 can work and reserve LCID/extend LCID space for MBS Command MAC CE.  For Op2, the same issue may occur when the PTP is used for PTM retransmission |
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In the offline discussion [2], companies view on short DRX was almost evenly split (9 support vs 11: not).

1. Support Short DRX
   * It can used for voice with talk burst/silence period and public safety
   * It could be NW flexibility to optionally configure.
2. Not support Short DRX
   * There is a potential cycle mismatch problem (Some UEs may not receive the MAC CE, thus it may not work well)
   * MBS will not have URLLC or delay-sensitive data. Emergency feedback can be delivered via unicast/PTP.
   * It just increases the complexity of MBS DRX.

Both camps have reasons and the discussion has been done many times. Thus, the rapporteur would like to check companies view once again to find a way forward.

**Q3) Do companies support Short DRX for MBS?**

1. **Yes**
2. **No**

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| **Company** | **Yes/No** | **Comment** |
| Qualcomm | Yes | We strongly prefer to support short DRX for MCPTT kind of applications. As short DRX is already supported for unicast and we don’t think it adds any complexity. Note that MBS is designed to serve diverse applications and based on application characteristic network can configure short DRX. It is NOT correct to say “MBS will not have URLLC or delay-sensitive data.” |
| Samsung | No | The side-effect on cycle mismatch may not be controlled. It may not work properly. |
| MediaTek | Yes | It should be optional and up to NW to configure the DRX pattern depending on multiple UEs |
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## 3.2 DRX Timer Handling

In the offline discussion [2], the start condition of *drx-HARQ-RTT-TimerDL-PTM* and *drx-RetransmissionTimerDL-PTM*, for NACK-only feedback was not concluded due to the lack of time. But there were proposals with clear majority support as follows:

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| **Proposal 10: (14/19) If there is no real HARQ feedback transmission due to ACK in NACK only case, the UE will not start DRX RTT timer.**  **Proposal 11: (15/19) After DRX RTT timer expires, UE will not start DRX retransmission timer if the corresponding MAC PDU is decoded successfully.** |

In the rapporteur’s understanding, P10 and P11 are aligned to the current MAC running CR [3], i.e. no further change is required.

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| When multicast DRX is configured for a G-RNTI or G-CS-RNTI, the MAC entity shall for this G-RNTI or G-CS-RNTI:  1> if a MAC PDU is received in a configured downlink multicast assignment:  2> start the *drx-HARQ-RTT-TimerDL-PTM* for the corresponding HARQ process in the first symbol after the end of the corresponding transmission carrying the DL HARQ feedback;  2> stop the *drx-RetransmissionTimerDL-PTM* for the corresponding HARQ process.  1> if a *drx-HARQ-RTT-TimerDL-PTM* expires:  2> if the data of the corresponding HARQ process was not successfully decoded:  3> start the *drx-RetransmissionTimerDL-PTM* for the corresponding HARQ process in the first symbol after the expiry of *drx-HARQ-RTT-TimerDL-PTM*.  1> if [(SFN × 10) + subframe number] modulo (*drx-LongCycle-PTM*) = *drx-StartOffset-PTM*:  2> start *drx-onDurationTimerPTM* after *drx-SlotOffsetPTM* from the beginning of the subframe.  NOTE 1: In case of unaligned SFN across carriers in a cell group, the SFN of the SpCell is used to calculate the DRX duration.  1> if the MAC entity is in Active Time for this G-RNTI or G-CS-RNTI:  2> monitor the PDCCH for this G-RNTI or G-CS-RNTI as specified in TS 38.213 [6];  2> if the PDCCH indicates a DL multicast transmission:  3> start the *drx-HARQ-RTT-TimerDL-PTM* for the corresponding HARQ process in the first symbol after the end of the corresponding transmission carrying the DL HARQ feedback;  3> stop the *drx-RetransmissionTimerDL-PTM* for the corresponding HARQ process.  2> if the PDCCH indicates a new multicast transmission for this G-RNTI or G-CS-RNTI:  3> start or restart *drx-InactivityTimerPTM* in the first symbol after the end of the PDCCH reception.  NOTE 2: A PDCCH indicating activation of multicast SPS is considered to indicate a new transmission. |

ACK 🡪 feedback is not generated nor transmitted 🡪 *drx-HARQ-RTT-TimerDL-PTM* is not started. & *drx-RetransmissionTimerDL-PTM* is stopped.

NACK 🡪 feedback is generated and transmitted on a PUCCH resource 🡪 *drx-HARQ-RTT-TimerDL-PTM* is started in the first symbol after the end of the corresponding transmission carrying the DL HARQ feedback & *drx-RetransmissionTimerDL-PTM* is stopped. 🡪 Since it was NACK (not successfully decoded), the *drx-RetransmissionTimerDL-PTM* is started in the first symbol after the expiry of *drx-HARQ-RTT-TimerDL-PTM*.

Although there were other options, the rapporteur think we can go with option supported by clear majority and without further text change.

**Q4) Do companies accept the following proposals made in [AT116bis-e][028][MBS]?**

* **If there is no real HARQ feedback transmission due to ACK in NACK only case, the UE will not start DRX RTT timer.**
* **After DRX RTT timer expires, UE will not start DRX retransmission timer if the corresponding MAC PDU is decoded successfully.**

**1) Yes (current MAC running CR)**

**2) No (please provide the alternative TP)**

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| **Company** | **Yes/No** | **Comment** |
| Qualcomm | Yes |  |
| Samsung | Yes |  |
| MediaTek | Yes |  |
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HARQ feedback enable/disable is supported by DCI or RRC according to RAN1 agreement, and was implemented in the RRC running CR [4].

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| ***harq-FeedbackEnablerMulticast***  Indicates whether the UE shall provide HARQ-ACK feedback for MBS multicast. Value *dci-enabler* means that whether the UE shall feedback HARQ-ACK for MBS multicast is indicated by DCI. Value *enabled* means the UE shall always feedback the HARQ-ACK for MBS multicast. When the field is absent, the UE shall not feedback the HARQ-ACK for multicast. |

In the offline discussion [2], multiple companies agreed that even if HARQ feedback is disabled for a UE, gNB can retransmit the data for other UEs or perform blind retransmission, especially for cell-edge or poor coverage UE. An issue here is if Multicast DRX’s Active Time should be extended by DRX retransmission timer in case that HARQ-ACK feedback is disabled or not configured. A simple way could be similar to the case of non-numerical k1 value, i.e. start the *drx-RetransmissionTimerDLPTM* in the first symbol after the PDSCH transmission

**Q5) Do companies support to extend Multicast DRX’s Active Time for receiving retransmission in case that HARQ-ACK feedback is disabled or not configured?**

1. **Yes**
2. **No**

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| **Company** | **Yes/No** | **Comment** |
| Qualcomm | No | If HARQ feedback is disabled or not configured, then any blind re-transmission or for other UEs may or may not happen. It is unnecessary for UE to start RTT timer when there is no feedback configured. |
| Samsung | Yes | Disabling HARQ-ACK was introduced due to the assumption that a number of UEs are receiving multicast services and PUCCH resource for HARQ feedback is not sufficient. Thus, blocking reception of retransmission will degrade the reliability performance of multicast. |
| MediaTek | Yes | UE can still receive retransmission for other UE/blind retx data even if the HARQ feedback is not sent. |
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## 3.3 Indication to enable/disable C-RNTI based PTM retransmission

RAN2 needs to discuss whether RRC can enable/disable C-RNTI based PTM retransmission. This may be related to the following agreement on DRX:

* In PTP for PTM retransmission, the UE monitors UE specific PDCCH/C-RNTI only during unicast DRX’s active time. Unicast DRX’s RTT timer can be started when PTP retransmission is expected.

More specifically, how the UE expects PTP retransmission, i.e. RRC enable/disable C-RNTI based retransmission or UE always starts the unicast DRX’s RTT timer when HARQ ACK feedback is transmitted (as least for ACK/NACK FB and NACK-only FB).

**Q6) Do companies support the RRC indication to enable/disable C-RNTI based PTM retransmission?**

1. **Yes**
2. **No**

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| **Company** | **Yes/No** | **Comment** |
| Qualcomm | No but no strong view | We think it is dynamic for GNB to use C-RNTI based Re-Tx or not. From UE perspective, there should not be any issue. |
| Samsung | Yes | It’s useful for power saving to avoid unnecessary unicast Active Time. |
| MediaTek | No | We think it is up to gNB scheduling to aligned the Unicast DRX’s timer for PTP based PTM retransmission and there is no specification work. |
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## 3.4 Dedicated HARQ Process for Broadcast (MCCH/MTCH)

A common understanding on HARQ process is that Multicast (PTM/PTP) and Unicast shares the HARQ process and HARQ process ID space. The issue is whether Broadcast MCCH/MTCH requires a dedicated HARQ process(es) or can share the same HARQ process. In the rapporteur’s understanding, gNB does not 100% correctly know which UEs are receiving which Broadcast data, so dedicated HARQ process for Broadcast could avoid further confusion on HARQ process handling. But, someone could argue that gNB should control it.

**Q7) Do companies support dedicated HARQ processes for MCCH and Broadcast MTCH?**

1. **Yes**
2. **No**

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| **Company** | **Yes/No**  **for MCCH** | **Yes/No**  **for**  **MTCH** | **Comment** |
| Qualcomm | No | No | RAN1#107bis-e discussed same topic and concluded not to have any dedicated HARQ Process ID for MCCH and MTCH. |
| Samsung | Yes | Yes | We think it should be avoided at any rate to have any interruptions and conflicts for HARQ process(es) usage among MCCH, broadcast MTCHs and multicast MTCHs for the UE. MCCH has quite fixing timings and behaviour resembles to the SI reception. However, broadcast HARQ process defined for SI is not usable for MCCH given their independent timings. Therefore, MCCH should be provided a dedicated broadcast HARQ process.  While the HARQ processes for broadcast MTCHs and multicast MTCHs can possibly be scheduled with some flexibility by network but it comes at an increased complexity and coordination requirements between commonly accessed broadcast services and UE/UE-group specific multicast services on the network part, and may not be 100% accurate always.  We understand RAN1 conclusion is just not to increase HW capability for HARQ process management, but RAN2 can further consider on the HARQ process separation aspects. |
| MediaTek | No | No | Agree with Qualcomm |
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## 3.5 Initial HFN Selection for Broadcast

In RAN2#116bis-e, RAN2 agreed that the initial HFN value is selected by the UE [5]. A captured FFS point is whether it is up to UE implementation to prevent COUNT wrap-around for broadcast, given that HFN is selected by the UE itself. Note that NR PDCP Receive Operation does not support COUNT wrap-around, so RAN2 may need to decide how to prevent the COUNT wrap around, i.e. reaching the maximum COUNT value. The current status is fully up to UE implementation and no standardized solution is defined due to reasons including:

* PDCP Status Report is not needed for Broadcast. gNB does not check HFN value.
* Indication of HFN may be difficult for Broadcast.

However, a concern would be even if a (bad) UE implementation selects very large HFN value due to the lack of any guideline, nobody can say that it is not a 3GPP MBS compliant UE. Regarding solution, there may be a couple of options.

**Q8) Please provide your preference how to prevents COUNT wrap-around for broadcast MRB.**

**- Option 1) Fully up to UE implementation to prevent COUNT wrap-around, (successful delivery may not be guaranteed due to reaching the max COUNT value. No standardization.)**

**- Option 2) UE refreshes the HFN value to smaller value.**

**- Option 3) The initial HFN value is indicated by gNB via RRC (Revert the RAN2#116bis-e agreement)**

**- Option X) Other (please add)**

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| **Company** | **Preferred Option** | **Comment** |
| Qualcomm | Option 1 |  |
| Samsung | 1 | RAN2 already agreed that UE selects the initial value, although there is a risk to select larger initial HFN value. However, we are ok to keep it as it is (fully up to UE) |
| MediaTek | Option 1 | For broadcast, there will not be out-of-order delivery so there is no need to prevents COUNT wrap-around issue.  Option2 can be used by UE implementation to avoid COUNT to reach the max value. |
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## 3.6 MBS Impact to MAC Reset

TS 38.321 has two MAC reset procedures, i.e. 1) reset of the MAC entity and 2) Sidelink specific reset of the MAC entity, as follows:

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| 5.12 MAC Reset  If a reset of the MAC entity is requested by upper layers, the MAC entity shall:  1> initialize *Bj* for each logical channel to zero;  1> initialize *SBj* for each logical channel to zero if Sidelink resource allocation mode 1 is configured by RRC;  1> stop (if running) all timers;  1> consider all *timeAlignmentTimer*s as expired and perform the corresponding actions in clause 5.2;  1> set the NDIs for all uplink HARQ processes to the value 0;  1> sets the NDIs for all HARQ process IDs to the value 0 for monitoring PDCCH in Sidelink resource allocation mode 1;  1> stop, if any, ongoing Random Access procedure;  1> discard explicitly signalled contention-free Random Access Resources for 4-step RA type and 2-step RA type, if any;  1> flush Msg3 buffer;  1> flush MSGA buffer;  1> cancel, if any, triggered Scheduling Request procedure;  1> cancel, if any, triggered Buffer Status Reporting procedure;  1> cancel, if any, triggered Power Headroom Reporting procedure;  1> cancel, if any, triggered consistent LBT failure;  1> cancel, if any, triggered BFR;  1> cancel, if any, triggered Sidelink Buffer Status Reporting procedure;  1> cancel, if any, triggered Pre-emptive Buffer Status Reporting procedure;  1> cancel, if any, triggered Recommended bit rate query procedure;  1> cancel, if any, triggered Configured uplink grant confirmation;  1> cancel, if any, triggered configured sidelink grant confirmation;  1> cancel, if any, triggered Desired Guard Symbol query;  1> flush the soft buffers for all DL HARQ processes;  1> for each DL HARQ process, consider the next received transmission for a TB as the very first transmission;  1> release, if any, Temporary C-RNTI;  1> reset all *BFI\_COUNTER*s;  1> reset all *LBT\_COUNTERs*.  If a Sidelink specific reset of the MAC entity is requested for a PC5-RRC connection by upper layers, the MAC entity shall:  1> flush the soft buffers for all Sidelink processes for all TB(s) associated to the PC5-RRC connection;  1> consider all Sidelink processes for all TB(s) associated to the PC5-RRC connection as unoccupied;  1> cancel, if any, triggered Scheduling Request procedure only associated to the PC5-RRC connection;  1> cancel, if any, triggered Sidelink Buffer Status Reporting procedure only associated to the PC5-RRC connection;  1> cancel, if any, triggered Sidelink CSI Reporting procedure associated to the PC5-RRC connection;  1> stop (if running) all timers associated to the PC5-RRC connection;  1> reset the *numConsecutiveDTX* associated to the PC5-RRC connection;  1> initialize *SBj* for each logical channel associated to the PC5-RRC connection to zero. |

An issue to consider would be whether there are MBS specific impacts on MAC reset procedure. It may be useful when 1) only MBS-related MAC functions can be reset (unicast functions do not need to reset), e.g. MRB type change, or 2) only unicast MAC functions can be reset (Multicast MAC functions do not need to reset), e.g. reconfiguration with unicast security key change. A potential TP would be as follows:

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| If a MBS specific reset of the MAC entity is requested for MBS by upper layers, the MAC entity shall:  1> stop (if running) all timers associated to Multicast;  1> flush the soft buffers for all Multicast DL HARQ processes;   1. for each Multicast DL HARQ process, consider the next received transmission for a TB as the very first transmission;   1> initialize *Bj* for each logical channel associated to MRB to zero. |

**Q9) Do companies support to define MBS specific reset of the MAC entity?**

1. **Yes**
2. **No**

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| **Company** | **Yes/No** | **Comment** |
| Qualcomm | Yes |  |
| Samsung | Yes |  |
| MediaTek | Yes |  |
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## 3.7 Multiple Multicast MTCHs with the same LCID

An FFS point is whether the UE for multicast can be configured with multiple MTCHs with the same LCID (to be scheduled using different G-RNTIs like broadcast). In other words, RAN2 needs to decide if two different multicast RLC bearer (different RLC entities and corresponding logical channels) can share the same LCID value.

**Q10) Do companies support that the UE for multicast can be configured with multiple MTCHs with the same LCID?**

1. **Yes**
2. **No**

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| **Company** | **Yes/No** | **Comment** |
| Qualcomm | Yes |  |
| Samsung | No | Considering we have 32 LCID values for DTCHs and multicast MTCHs, we do not need this. Unique LCID value for each LCH is sufficient. |
| MediaTek | No | LCID space can be extended if is not enough for multicast. |
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## 3.8 CS-RNTI Monitoring in Unicast Active Time

The last FFS point covered by this discussion is FFS how to associate the G-CS-RNTI and MBS SPS. The main issues will be concluded in RAN1 based on RAN2 LS, but its RAN2 impact is probably DRX operation. In RAN2#116bis-e, RAN2 agreed “In PTP for PTM retransmission, the UE monitors UE specific PDCCH/C-RNTI only during unicast DRX’s active time. Unicast DRX’s RTT timer can be started when PTP retransmission is expected.” This agreement focused only on dynamic scheduling by C-RNTI but MBS SPS retransmission by CS-RNTI should be considered. Considering the case of dynamic grant was already agreed, the case of MBS SPS associated with CS-RNTI can be confirmed in the rapporteur’s understanding.

**Q11) Do companies confirm that the previous agreement is applicable for MBS SPS, as follows?**

**: In PTP for PTM retransmission, the UE monitors UE specific PDCCH/CS-RNTI only during unicast DRX’s active time. Unicast DRX’s RTT timer can be started when PTP retransmission is expected.**

1. **Yes**
2. **No**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comment** |
| Qualcomm | Yes |  |
| Samsung | Yes | It’s natural that CS-RNTI should be monitored. |
| MediaTek | Yes |  |
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# 4 Conclusion

To be updated.

# 5 References

[1] R2-2202025, Updated Open issue list for NR MBS, Huawei, Hisilicon

[2] R2-2201943, [AT116bis-e][028][MBS] MAC Open Issues (OPPO), OPPO

[3] R2-2201813, 38.321 running CR for NR MBS, OPPO

[4] R2-2201829, 38.331 running CR for NR MBS, Huawei, Hisilicon

[5] R2-2201874, Report of [AT116bis-e][027][MBS] PDCP and RLC initial variables (xiaomi), Xiaomi Communications

[6] R2-2201366, User Plane Aspects for MBS, Samsung