**3GPP TSG-RAN WG2 Meeting #115-e R2-210xxxx**

Online, Aug 16 – Aug 27, 2021

Agenda Item: 8.1.3.2

Source: Samsung

**Title: Report of [AT115-e][048][MBS] Notifications**

Document for: Discussion and decision

# Introduction

In this offline discussion, we invite companies to share their views on L3 Centric notifications, as described below.

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| * [AT115-e][048][MBS] Notifications (Samsung)   Scope: Treat R2-2108847. Reach agreements as far as possible, can also define FFSes when helpful.  Intended outcome: Agreements, report  Deadline: Wednesday W2 (CB if needed) |

Please share your inputs by Aug 24 UTC 1200 or earlier, to provide sufficient time to prepare final proposals.

Please also kindly provide your contact information in the table below.

|  |  |  |
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# Discussions

## Broadcast Notifications

### DCI/RNTI for MCCH Change Notification

RAN1 made below agreement in RAN1#105-e meeting [23]. Agreement pertains to RNTI/DCI alternatives whereas specific contents of MCCH change notification are up to RAN2 to decide.

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| --- |
| **Agreement:**  For RRC\_IDLE/RRC\_INACTIVE UEs, for broadcast reception, study the following alternatives for MCCH change notification indication due to session start:   * Alt 1: Define a dedicated RNTI to scramble the CRC of a DCI indicating a MCCH change notification; * Alt 2: Use of a field in a DCI format scheduling a MCCH without a dedicated RNTI for MCCH change notification;   Other solutions are not precluded and it is also not precluded whether to support both Alt1 and Alt2.  **Conclusion:**  It is up to RAN2 to decide the specific contents of the MCCH change notification, e.g, whether notification only informs about session start, whether or not notification also informs about session modification/stop or whether or not the notification informs about any other information. |

Contributions [1][4][9][19][20][21] have addressed this issue. Contribution [1] proposes a dedicated RNTI to scramble the CRC of a DCI indicating a MCCH change notification. Contribution [4] specifies that RNTI for MCCH change notification is pending on RAN1 progress. Contribution [9] considers to allow both MCCH-RNTI and G-RNTI used for decoding the MBS configuration change notification in DM2 with either one of them can be used in different scenarios. Contribution [19] observes that MCCH-RNTI based change notification is more beneficial compared with dedicated RNTI for change notification, considering potential miss of notification and proposes to indicate preference to RAN1 by sending an LS. However, contribution [20] proposes no need for optimization regarding missing MCCH change notification irrespective of either of RAN1 alternatives. Contribution [21] thinks only one RNTI used for MCCH scheduling and change notification is sufficient.

Diverse views are expressed by different contributions. Rapporteur understands the decision lies with RAN1 and it has already identified two alternatives and also not precluded support of both. It is proposed:

**Proposal 1: RAN2 waits for RAN1’s final decision on which RNTI/DCI (i.e. Alt1 and/or Alt 2 as identified by RAN1) for MCCH change notification to be adopted.**

**Please provide your views on Proposal 1**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree [Y/N]** | **Comments** |
| Ericsson | Y | We see no need to rush RAN1 in this and we are fine to wait for them. |
| MediaTek | Yes | We can wait for RAN1 conclusion |
| Kyocera | Y |  |
| Samsung | Y | We should wait for RAN1 decision |
| Huawei, HiSilicon |  | As indicated on our paper, reusing MCCH-RNTI allows avoiding issues with UE missing the MCCH notification. We think we should make RAN1 aware of this and the final decision can still be on their side. |
| LGE | Y |  |
| Futurewei | Y | RAN2 should let RAN1 know all possible options to facilitate RAN1 to make their final decision. |
| Qualcomm | Y |  |
| CATT | Y | Wait for RAN1 decision. |
| NEC | Y |  |
| TD Tech, Chengdu TD Tech | Yes | We think whether or not the other information can be sent using the MCCH change notification needs to be decided in the current RAN2 meeting.  If more information needs to be sent using the MCCH change notification, the new LS to RAN1 is needed because the sent LS to RAN1 for the MCCH change notification indicates that only two bits need to be sent using the MCCH change notification. If more bits are needed, maybe MCCH has no enough bits reserved for the MCCH change notification.  In the past RAN2 meetings, when the configuration information of an MBS session is updated, the MCCH change notification is sent.  In order to save the power in UE, we suggest more detailed configuration update information is needed. For example, assign a new field of N bits long. The new field is sent using the MCCH change notification. If some MBS session of the n-th MBS type (group) has its configuration updated, the MCCH change notification is sent with the n-th bit of the new field set as 1.  Such detailed configuration update information can save the power in UE. For example, if UE is only interested in one MBS session or several MBS sessions of same MBS type (group). |
| Spreadtrum | Y | We can wait for RAN1 decision. |
| Apple | Y |  |

### Contents for MCCH Change Notification

RAN2 agreed following related to contents for MCCH change notification in previous meeting [24] and an LS was sent to RAN1 [25]

|  |
| --- |
| **Agreement:**   * Indication of an MCCH change due to modification of an ongoing session’s configuration (including session stop) is provided with an explicit notification from the network (provided that RAN1 confirms a separate bit for this purpose can be accommodated in the MCCH change notification DCI, in addition to a bit for session start notification). FFS on whether this notification can be reused for modification of other information carried by MCCH, if any. |

Contributions [1][4][6][9][12][17][21] have addressed this aspect. Contribution [1] proposes to define 8 bits in DCI for MCCH change notification with one bit corresponding to one MBS session Id or MBS session group. Contribution [17] suggests a new field of N bits long with each bit corresponding to one MBS type should be introduced to indicate the configuration information of which MBS type(s) is(are) modified to further reduce power consumption in UE. Contribution [4] considers whether modification bit can be reused for other information (i.e. neighbour cell information) carried by MCCH, depends on SA2 clarification regarding requirement for supporting broadcast via unicast PDU session in non-MBS cell. Contribution [6] proposes a common notification for modification of ongoing session’s configuration and/or modification of other information in MCCH. Contribution [9] has similar view. Contribution [21] also supports notification for neighbour cell list change, if it is supported.

Whereas contribution [12] assumes modified configuration should be applied from next modification period and start/stop should be applicable in same modification period. Hence, it proposes MCCH change notification with one bit for start/stop and another bit for session modification. It seems same view is not expressed by any other contribution.

It is proposed:

**Proposal 2: MCCH change notification can be reused for modification of other information carried by MCCH.**

**Further, for the other information carried by MCCH, MCCH change notification includes**

1. **Change of neighbour cell information (reuse of 2nd DCI bit of MCCH change notification) [Assuming support of neighbour cell information in MCCH]**
2. **Modification of configuration of MBS Session Id or Session group (extension of DCI bits of MCCH change notification)**
3. **Both**

**Please provide your views on Proposal 2 and the other information**

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **Agree [Y/N]** | **Other Information [a/b/c]** | **Comments** |
| Ericsson | N | - | It seems the FFS hinges on the presence of fields in DCI. Until RAN1 has decided those fields exist, we think this discussion can wait. |
| MediaTek | No |  | Can anyone clarify the scenario where there is frequent change of neighbour cell information for MBS? In general we would like to understand the motivation for MCCH change. |
| Kyocera | Y | c | We think the “other information” is still FFS, while we assume it’s simpler that MCCH Change Notification is sent for any changes of MCCH, from the UE point of view. |
| Samsung | Y | a | We can notice that as in SC-PTM, we may have large number of services (max 1024 in SCPTM), so on average neighbour cell information for such a large system may change, even though a particular service's neighbour cell information may not be that dynamic. Further, if reusing 2nd DCI bit of change notification, there is no additional cost to indicate neighbour cell information change, when it happens. Not reading MCCH, when neighbour cell information changes for a UE may be drastic. So we see some merit with this option a.  We think Option b seems an overkill and has further dependencies on RAN1 |
| Huawei, HiSilicon | Y, if RAN1 agrees a second bit in DCI for session modification indication | a) | We think the only additional information needed in MCCH is neighbouring cell information. This information is relevant for the UEs which are currently receiving an MBS session, so it can reuse the DCI bit for session modification, if confirmed by RAN1 (no additional bit is required). |
| LGE |  | c | Though ‘the other info’ is FFS, the single indication can be used to notify any change of MCCH contents for on-going MBS session, since the expected UE behaviour is always the same.  However, a separate indication should be used to notify the session start because the required UE behaviour is different upon receiving each indication as follows:   * Upon receiving indication of session start, UE immediately acquires the MCCH. * Upon receiving indication of session modification, UE acquires the MCCH at the next modification period. |
| Futurewei | Y | c | If an additional change bit is added to DCI, we assume it is used for any configuration change on an activated MBS session carried by MCCH. The possible configuration changes could include MRB configuration change, broadcast scheduling configuration change and neighbouring cell information change. |
| Qualcomm | Y (assuming DCI bits specified by RAN1) | C | Same view as LG and Futurewei. |
| CATT | Y | a | Same view as Huawei |
| NEC | Y | a | We agree with SS&HW’s comment to b that this need more dependencies on RAN1. |
| TD Tech, Chengdu TD Tech | Yes | We don’t agree with option (a) due to the fact that the neighbour cell information is needed only when UE executes cell selection.  If option (a) reuses the associated bit for the configuration update, more power is needed in UE to acquire the updated neighbour cell information even if UE is at the centre of the cell.  For option (b), we think the more detailed description is needed. | We suggest option (b) is updated as below to make the related method more clear.  **Modification of configuration of each MBS type/group (extension of DCI bits of MCCH change notification, with one-to-one mapping between extended bit and MBS type/group)** |
| Spreadtrum | Y | c | Same view as LGE. |
| Apple | - |  | The discussion should be postponed until RAN1 agrees the notification design. |

### UE Missing MCCH Change Notification

RAN2 has following agreement from previous meeting [24]

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| --- |
| **Agreement:**   * FFS whether the possibility of UE missing an MCCH change notification needs to be addressed or can be left to UE implementation. |

Contributions [4][6][11][12][18][20][21] propose that it is up to UE implementation to resolve MCCH notification missing issue. Contribution [9] further specifies some UE actions when decoding errors are detected or no change of MCCH over pre-determined period of time. Further on this issue, contribution [19] also assumes that problem of missed notification is more relevant with dedicated RNTI based notification approach, as UE may not be able to distinguish the situation when the change notification was not received as the network did not send it or because a UE simply failed to detect. However, for this assumption it may need be further checked that even when there is no change, network may send change notification (with DCI bit(s) set to 0).

Majority of contributions have supported UE implementation based addressing for issue of missing MCCH change notification. It is proposed:

**Proposal 3: Do not specify any mechanism to address the possibility of UE missing an MCCH change notification and it is left to UE implementation.**

**Please provide your views on Proposal 3**

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| --- | --- | --- |
| **Company** | **Agree [Y/N]** | **Comments** |
| Ericsson | Y |  |
| MediaTek | Yes |  |
| Kyocera | Y |  |
| Samsung | Y |  |
| Huawei, HiSilicon | Y, but see comments | We are OK to leave it up to UE implementation, but it would be good to have an MCCH design which does not lead to this issue. Therefore, we think it is preferable to use MCCH-RNTI for MCCH notification (see reply to Q1 and our paper in [19]) |
| LGE | Y |  |
| Futurewei |  | If most companies prefer to let UE implementation to handle the change notification miss detection issue, we are ok. Suggest in stage 3 text, note the notification-indication-missing issue to let UE vendors being aware. |
| Qualcomm | Yes |  |
| CATT | Y |  |
| NEC | Yes | No need to address this issue at all, UE can totally handle it. |
| TD Tech, Chengdu TD Tech | Yes | That the missing MCCH change notification is left to the UE implementation is feasible. |
| Spreadtrum | Y |  |
| Apple | Yes |  |

## Multicast Session Group Notification

In previous meeting, RAN2 agreed the following for multicast session group notification approach [24].

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| **Agreements:**   * Use PCCH for Multicast activation notification (also for MBS supporting nodes). * Confirm that we convey the MBS session ID in the notification. * Use of paging in all (legacy) PO with PRNTI is the baseline assumption (can still discuss other variants) |

### PO for multicast session group notification

Contributions [3][7][16] propose to do paging for multicast activation notification in all legacy POs. [7] reasons that there is large N2 signalling overhead for providing subscribed UE information to RAN. Whereas contributions [6][14][19][21] propose to restrict the paging to the relevant legacy Pos for Ues with deactivated multicast session(s) in order to save paging resources. Contribution [14] further proposes that list of UE Paging Identity of the Ues in the multicast group and corresponding Paging DRX should also be provided by AMF to the gNB for Pos calculation. Contribution [19] further mentions that the signalling overhead is less as same paging related information can be applicable for multiple Ues and an LS can be sent to RAN3 and SA2 to request specifying the required network signaling. On other hand, contribution [18] argues that group ID is used as the UE identity with paging, i.e. the group ID determines the PO that is used for paging. Contribution [17] has similar view but suggests to use TMGI to determine the PO for the multicast session activation notification.

Majorly there seem two approaches (i.e. paging in all legacy Pos and paging in relevant legacy Pos) as proposed by contributions, RAN2 should discuss and decide on Pos for paging for multicast activation notification.

It is proposed:

**Proposal 4: RAN2 to agree one of the following options:**

* **Option 1: Paging for multicast activation notification is used in all legacy Pos.**
* **Option 2: Paging for multicast activation notification is used in the relevant legacy Pos for the Ues with deactivated multicast session(s).**

**Please provide your views on Proposal 4**

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| --- | --- | --- | --- |
| **Company** | **Agree [Y/N]** | **Pos alternatives [Option 1 / Option 2]** | **Comments** |
| Ericsson | N | - | Contributions highlight the impact on the network. Understanding network complexity is the expertise of RAN3 and therefore we think they should make this decision. |
| MediaTek |  | Option 2 | By the way, our understanding on the PO selection for Multicast activation notification is actually network implementation |
| Kyocera | Y | Option 1, from the UE’s perspective | We assume Options 1 and 2 are the same from the UE’s perspective, i.e., the UE only monitors paging at its unicast PO. So, we agree with Ericsson that Option 2 is discussed in RAN3, while these Options should be transparent from RAN2 point of view. |
| Samsung | Y | Option 2 | We have same opinion and other WGs RAN3 and SA2 should be consulted |
| Huawei, HiSilicon |  | Option 2 | Option 2 can save a lot of overhead over the air interface. It is true that it has an impact on signalling over network interfaces, but the overhead is not significant (as for network interfaces) since T-DRX and UE Paging IDs (5G-S-TMSI mod 1024) can be common for multiple Ues and thus an exhaustive list of 5G-S-TMSIs for Ues in this group is not needed. Nevertheless, since the signalling would have to be designed by RAN3, we are OK if they check the feasibility. |
| LGE |  | Option 2 | It is more important to reduce the broadcast signalling rather than N2 signalling. |
| Futurewei |  | Option 2 | We also think it is more important to reduce the air interface signalling overhead. The network should be designed to minimize the signalling overhead in air interface and only page the Pos associated the idle/inactive Ues in the MBS group. |
| Qualcomm |  | Option 2 | Option 2 helps to reduce OTA signalling overhead. We agree that RAN3/SA2 can decide how UE IDs can be sent from AMF to gNB to assist gNB to determine which Pos to be used.  If UE IDs are not provided from AMF to gNB, RAN can send paging in all Pos. |
| CATT |  |  | For option 2, Whether it is feasible should be decided by RAN3. It seems a large overhead over NG interface, i.e., CN needs to send DRX cycle and UE ID of all multicast Ues in the tracking area to each gNB in the tracking area. |
| NEC |  | Option 2 | UE MBS subgrouping helps reducing the PO signalling overhead. |
| TD Tech, Chengdu TD Tech | No | The group notification is used to activate an MBS session because the LS from the related SA group indicates there’s the need to save the network element resource.  Due to the same logic, the Uu resource consumption needs to be taken into account for the group notification. From the Uu resource point of view, there exists option 3：   * **Option 3: Paging for the multicast activation notification is used in a single legacy PO indicated by TMGI or group ID of the associated multicast session for the Ues receiving the associated multicast session**   Option 1 needs no extra power consumption in UE but will consume most Uu paging resource.  Option 2 needs no extra power consumption in UE but will still consume more Uu paging resource.  Opton 3 needs UE to monitor the extra PO for the group notification of the associated multicast session but will consume the least Uu paging resource. | We suggest to consider option 3. We don’t think option 3 will need too much power in UE.  Usually UE is only receiving a multicast session. Under such case how much extra power consumption is needed by UE?  We think the power consumption and the Uu paging resource consumption of each option will be evaluated and compared before the selection is made. |
| Spreadtrum |  | Option1 | Option2 requires huge extra network signalling, so we think it should be decided by RAN3. |
| Apple |  | Option 1 and 2 | From UE perspective, both Options are work. And the difference between two options is the coordination complexity between gNBs and gNB and CN, and it should be discussed in RAN3 or SA2. |

**Proposal 5: If RAN2 agrees for paging only in the relevant legacy POs for the UEs with deactivated multicast sessions, RAN2 should send an LS to RAN3 and SA2 to request specifying required network signalling.**

**Please provide your views on Proposal 5**

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| --- | --- | --- |
| **Company** | **Agree [Y/N]** | **Comments** |
| Ericsson | Y | As this option has network impact it is important to let at least RAN3 know. But as argued in the previous question we think RAN3 should ultimately decide which option to choose. |
| MediaTek | - | It is not clear why SA2 should be involved in this discussion |
| Kyocera | Y | We agree with Ericsson, but we prefer it’s no impact on UEs regardless of which Option RAN3 decides to use, as we commented in P5 above. |
| Samsung | Y | We understand UE service subscription information will be relevant for paging only in the relevant legacy POs for the UEs. Note that AMF has the UE list for specific TMGI and *“The AMF sends a paging request message to the NG-RAN node(s) belonging to this Paging Area with the TMGI as the identifier to be paged if the related NG-RAN node(s) support the MBS session”[23.247v100].* In our understanding. SA2 also needs to be informed as SA2 has assumed group paging with TMGI and some clarity on UEs list for the TMGI is needed. Though we agree RAN3 will be the main WG to work out paging for MBS. |
| Huawei, HiSilicon | Y | We think we at least need to indicate in the LS that this brings significant benefit when it comes to signalling overhead over the air interface. |
| LGE | Y |  |
| Futurewei | Y |  |
| Qualcomm | Y | Same view as Samsung |
| CATT | Y | We can indicate the benefit to RAN3 if there is consensus on benefit in RAN2. But leave it for RAN3 to make the decision. |
| NEC | Y |  |
| TD Tech, Chengdu TD Tech | Yes but see the comments from our side | Because no decision on the group notification PO/POs is made, we think proposal 5 needs some modification as below to make the LS to RAN3 and SA2 with the enough information.  **Proposal 5: If RAN2 agrees for paging using the POs/PO as listed below for the UEs with deactivated multicast session, RAN2 should send an LS to RAN3 and SA2 to request specifying required network signalling.**  **Option 1: only using the relevant POs for the UEs with deactivated multicast session.**  **Option 2: only using the related PO indicated by TMGI or group ID of the multicast session** |
| Spreadtrum | Y |  |
| Apple | Y |  |

### Paging message structure

Several contributions addressed the paging message structure for group activation notification as follows:

* Extend the paging message to include a new paging record list for MBS [2][3][16]
* RAN2 to discuss shared or separate paging message for MBS [5]
* Per UE paging record for UE to check its interested multicast session Id [7]
* Add new paging identity to the paging message to indicate multicast paging (e.g. MBS session ID) [15]
* The group ID (5G S-TMSI or an MBS session ID) is used as the UE identity for Paging [18]

Majority of contributions have considered same paging message for unicast and MBS. As remarked in some contributions, extending paging message to include a new paging record list can be a clean solution and does not impact legacy UE. Note that MBS running RRC CR [27] is also considering extension of unicast paging message.

It is proposed:

**Proposal 6: Confirm extending the unicast paging message to include a new paging record list for group activation notification of multicast sessions.**

**Please provide your views on Proposal 6**

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| --- | --- | --- |
| **Company** | **Agree [Y/N]** | **Comments** |
| Ericsson | Y | We think the 5G S-TMSI or an MBS session ID is used for UE identity, in which case the paging record list must be extended. |
| MediaTek | - | We are open for both new message and new paging message. Meanwhile we need probably more discussion to know the content within the said “new paging record list” |
| Kyocera | Y | RAN2 already endorsed the running RRC CR (R2-2108205), which should be the baseline. |
| Samsung | Y | We understand MBS session ID e.g. TMGI is used as UE identity in the MBS paging record list. |
| Huawei, HiSilicon | Y | The current running CR already implements a new paging record list for this purpose (pagingGroupList parameter) |
| LGE | Y |  |
| Futurewei | Y | We are fine with the new paging record list implemented in the running CR. |
| Qualcomm | Y | Already captured in RRC running CR. |
| CATT | Y | Follow the endorsed RRC running CR. |
| NEC | Y | Already captured in RRC running CR. |
| TD Tech, Chengdu TD Tech | Y |  |
| Spreadtrum | Y |  |
| Apple | Y |  |

### Release of MBS Session

Contributions [3] [6] have addressed this issue. [3] proposes to discuss about avoiding unnecessary activation notification monitoring after multicast session is released by CN and if needed, sending a LS to SA2. Contribution [6] also proposes RAN2 to define a clear behaviour for UE with regard to multicast session release for RRC\_IDLE and RRC\_INACTIVE states. Some of the options mentioned include considering whether UE is expected to indefinitely monitor for activation notification or whether UE is provided with release notification or whether UE is provided with some specified or configured inactivity timer to terminate session or initiate a session release.

It seems relevant for RAN2 to clarify this issue for supporting RRC\_IDLE and RRC\_INACTIVE UEs. Hence it is proposed:

**Proposal 7: RAN2 to clarify the behaviour for RRC\_IDLE and RRC\_INACTIVE Ues for monitoring of activation notification after multicast session is released by CN. Some of the options for consideration are**

* **Option 1: UE is expected to indefinitely monitor for activation notification**
* **Option 2: UE is provided with release notification. If so, RAN2 should consult SA2**
* **Option 3: UE is provided with some specified or configured inactivity timer to terminate session or initiate a session release**

**Please provide your views on Proposal 7**

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **Agree [Y/N]** | **Alternatives [Option1 / Option 2 / Option 3]** | **Comments** |
| Ericsson | Y | Option 1 | Option 1 makes it sound like the Ues would monitor until the end of time. This is not the case. If the session ends, the network can page the relevant Ues and release the sessions with dedicated signalling. Option 2 and 3 sound like unnecessary optimizations which only two companies addressed. |
| MediaTek | Y | Option 1 | Option 1 is the normal PO monitoring behaviour |
| Kyocera | N | (Option 1) | We think that if the UE in IDLE/ INACTIVE is interested in an MBS session then it checks the paging record list for group activation notification as in P6 above. Otherwise, the UE does not do it. So, we just assume it depends on UE’s interest, rather than CN’s release of the MBS service, and it does not any extra burden since the UE would monitor its legacy Pos. |
| Samsung | Y | (FFS) | We understand this should be marked as FFS as RAN2 can clearly check how to handle the scenario. Notably, Scenario can be quite common. Option 1 can be one possible approach but it needs to be accompanied with network action to page UE (dedicatedly) and inform dedicatedly about session release. There may be power consumption burden on UE due to unnecessary monitoring paging e.g. PEI based paging power saving feature may not be applicable to such Ues and also Ues monitor and process all paging indefinitely. |
| Huawei, HiSilicon | Y | Option 1 | We have the same understanding as Ericsson, i.e. if the session is released, then Ues that are in IDLE are paged and informed about this. This is already captured in TS 23.247, Figure 7.2.2.3-1. Option 2 and 3 are then unnecessary as they duplicate option 1. |
| LGE | Y | Option 1 | Option 1 doesn’t require any further UE efforts since the legacy PO/RNTI is used for group notification. |
| Futurewei | Y | Option 1 | The Ues only need to monitor their own PO as usual. No additional efforts are required. It is the advantage of using legacy PO for MBS group paging. |
| Qualcomm | Y | Option 1 | We agree with Ericsson.  When Multicast session is deactivated and UE enters IDLE/INACTIVE state, UE monitors Unicast PO for Multicast session activation. If Multicast session is released or UE leaves Multicast session via NAS signalling then UE is not required to monitor for group paging ID for activation. Otherwise, UE continues to monitor group paging ID for multicast session activation. |
| CATT | Y | FFS | It is unreasonable for Multicast Ues to monitor the group notification when the session is released. UE needs to be informed anyway.  Some companies suggested that if the session is released, then Ues that are in IDLE are paged and informed about this. Does that mean that all the multicast Ues in the tracking area need to be paged one by one via individual paging when the session is released? |
| NEC | Y | Option 1 | The Ues only need to monitor their own PO as usual. |
| TD Tech, Chengdu TD Tech | Y | Option 1 or option 2 | It depends on how to send the group notification.  If the group notification is sent over the relevant Pos for the relevant Ues, option 1 is preferred, where continuing the PO monitoring for the released multicast session needs no extra power in UE.  If the group notification is sent over the single PO indicated by TMGI or group ID of the multicast session, option 2 is better. Correspondingly the release notification is sent over the PTM mode of the multicast session to all related Ues. |
| Spreadtrum | Y | Option 1 | Share views with Ericsson |
| Apple | Y | Option 1 | We share the same understanding as Ericsson. If the MBS session is released, NW should request UE to back to CONNECTED via legacy paging and notify UE via the dedicated signaling. |

### Impact on legacy UEs or UE w/o MBS configuration

Contributions [2][3][5][8] have addressed the impact of paging for group notification on legacy UE or UE w/o MBS configuration

* The paging WUS can be used to notify the paging is MBS only paging or not and further notify which MBS session triggers the MBS paging [2]
* Send an LS to RAN1 to check the possibility of achieving this via reserved state ‘00’ of short message indicator, or any other potential means [3]
* The network uses unicast Paging to notify Ues RRC\_CONNECTED state through Short messages with associated Paging message [5]
* Add a Multicast activation notification indication in Short Message to indicate whether MBS session ID is contained in the corresponding paging message [8]

Short message based prior indication for multicast activation notification can be beneficial. However, this may need more discussion and analysis in RAN2. It is proposed:

**Proposal 8: RAN2 to agree that short message based indication for multicast activation notification in corresponding paging message is used.**

**Please provide your views on Proposal 8**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree [Y/N]** | **Comments** |
| Ericsson | 1 bit: FFS  2 bits: No | It is beneficial to limit the impact on legacy Ues. The way the proposal is described in [8] we cannot understand how the 2-bit signal would work as a legacy UE would not comprehend the value “11” and would thus not decode the PDSCH. The paper states: “If the value of the indication is 11, all types of Ues will read the following corresponding paging message to acquire the MBS session id and/or UE-record-list.”  As the number of bits in the Short message is very limited RAN2 should be very careful in using them. We think the 2-bit option should not be explored, but further discussion on *potentially* using 1 bit would be welcome. |
| MediaTek | Yes | Our understanding is that one code point should be used |
| Kyocera | FFS | We’re wondering how the legacy UE avoids decoding the paging message, by the new 1 bit (e.g., “Bit 3”) in Short Message. We understand it may be useful for Rel-17 UE which is not interested in MBS, but we’re wondering if it’s the typical case that the paging message carries both the legacy paging record (for unicast) and the group notification (for multicast). In this case, the UE not interested in MBS anyway needs to decode the paging message (for unicast), so the power consumption is not so different. |
| Samsung | Y | One code point from short message can be used for Rel-17 UE w/o MBS configuration, to indicate paging only for MBS case |
| Huawei, HiSilicon | FFS | We think reusing WUS can be a viable solution to notify that paging contains MBS paging and should be investigated. This can be discussed together with ePowSav WI where UE paging grouping is being discussed and where MBS paging can be considered as a specific group.  When it comes to using SM indicator, it should be noted that there is only a single reserved value so we should use it up really carefully. |
| LGE | Y | In power saving WI, RAN2 agree to introduce paging subgroup. If the subgroup is used, UE monitors paging occasion only if its subgroup ID is indicated in PEI. We think the same approach can be used for group notification. If the indication for group notification is indicated in PEI, then UE which has joined a deactivated multicast session will monitor the following PO, though its subgroup ID is not indicated |
| Futurewei | Y | We would prefer to use the solution under the framework of WUS suggested by [2]. The approach suggested by [3] would also work in principle though. |
| Qualcomm | No for short message approach | We think R16 PDCCH based WUS can be enhanced to indicate whether paging message contains only UE specific Paging ID or Group Paging ID or both. Short message based indication of whether paging message contains only group paging ID or Unicast Paging ID does not help to reduce UE power consumption since UE has to wake up during Unicast PO to read Paging PDCCH to decode SM and then determine whether to read Paging Message or not. For R16 legacy Ues, this does not help. Even for R17 Ues, enhanced PDCCH based WUS is more appropriate for power saving than SM based approach. |
| CATT | Y | It is a possible way to reuse the reserved state ‘00’ of filed “Short Messages Indicator”, as proposed in our paper [4].  And we agree with Kyocera that any enhancement to the “Short Messages” cannot stop legacy UE to decode paging message carried on PDSCH. For legacy UE, it determines to decode paging message based on the value “Short Messages Indicator” not “short message” in paging DCI, according to RAN1 spec.  //TS 38.212  DCI format 1\_0 with CRC scrambled by P-RNTI:  - Short Messages Indicator – 2 bits according to Table 7.3.1.2.1-1.  - Short Messages – 8 bits, according to Clause 6.5 of [9, TS38.331]. If only the scheduling information for Paging is carried, this bit field is reserved. |
| NEC | Y | One code point from short message can be used for Rel-17 MBS configuration to indicate paging only for MBS case |
| TD Tech, Chengdu TD Tech | FFS |  |
| Spreadtrum | Y | The short message can indicate only MBS indication in paging message, the UE not interested in MBS will not decode the paging message.  We think this issue should be discussed in MBS WI and should not rely on the Pow Saving feature. |
| Apple | Y | 1 code point can be used to avoid the impact to the legacy UE or the UE without MBS configuration. |

### Impact on PRACH capacity

RAN2#113bis-e meeting made the below agreement

|  |
| --- |
| **Agreement:**   * It is FFS whether RAN2 needs to handle PRACH capacity issues due to group notifications |

Contributions [3][8][19][20] consider PRACH capacity issue due to group notifications as insignificant or unnecessary to handle. One reasoning is the distribution of the UEs across different Pos for multicast group activation notifications. Whereas, [6][10][15][16][17][22] see PRACH capacity issue as real due to large number of Ues for multicast and have indicated different approaches like UAC, back off timer, providing more temporary resources, distributing access in time, spreading PRACH transmission in frequency/time domain etc.

There is no clear majority as (4/10) contributions see PRACH capacity issue due to group notifications as insignificant while (6/10) contributions support addressing PRACH capacity issue. RAN2 should discuss this issue.

It is proposed:

**Proposal 9: RAN2 to agree on one of the following for addressing of PRACH capacity issue due to group notification.**

1. **No need to address PRACH capacity issue**
2. **Need to address PRACH capacity issue**

**Please provide your views on Proposal 9**

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **Agree [Y/N]** | **Alternatives [a / b]** | **Comments** |
| Ericsson | Y | A | We think this is not important at the moment. RAN2 can consider it as second priority. |
| MediaTek | Y | a | Agree with Ericsson |
| Kyocera | Y | b | We think RAN2 should consider huge number of Ues may be served by MBS, in certain use cases (e.g., public safety). |
| Samsung | Y | b | PRACH capacity may be addressed for specific cases e.g. dense deployments etc. |
| Huawei, HiSilicon |  | A | Since different Ues will have different UE paging identities, their determined Pos will also be different. Therefore Ues interested in an MBS service will be monitoring different Pos and usually the number of Ues mapped to a single PO is limited. This will already ensure that Ues’ network access attempts will be distributed in time which automatically mitigates RACH congestion issue. Furthermore, RAN can choose by itself to further spread group paging in time by not including MBS session ID in all Pos simultaneously. This can be achieved by implementation and therefore we see no need to handle PRACH capacity issues due to group notification. |
| LGE |  | A |  |
| Futurewei |  | A | The existing RACH has large capacity. The impact of multicast group paging to RACH load is not very clear. The existing RACH load control mechanism should be good. MBS using the legacy PO also mitigates the access load surge due to the MBS group paging. At least no need to address the access loading issue for MBS in Rel-17. |
| Qualcomm |  | A | Since Unicast PO is used for group paging purpose, Msg1 RACH capacity may not be major concern or If any RACH capacity concern then it can be second priority.  If any RACH Msg1 capacity concern exists, we are fine to introduce Group Paging response delay either at AS or NAS level. |
| CATT | Y | A | it is not to be a typical scenario (at least for this release) where a large number of Ues are in the RRC connected state and receiving the multicast service. If such use case was with high priority, restricting multicast service delivery only to RRC connected Ues is not a good option in the first place. |
| NEC |  | c | We think PRACH capacity should be addressed and to be resolved. |
| TD Tech, Chengdu TD Tech | Yes | B | The PRACH capacity question (like question 7) depends on how to send the group notification.  If the group notification is sent over the relevant Pos for the relevant Ues, the PRACH question is not very serious because the relevant Ues have the different Pos.  If the group notification is sent over the single PO indicated by TMGI or group ID of the multicast session, the PRACH capacity question is very serious. When the group is large, many Ues in the group may not enter RRC\_CONNECTED in time to receive the multicast session due to the PRACH capacity question. |
| Spreadtrum |  | A | The group notifications to different Ues will be distributed according to the different Pos. The time gap between group notification and real data transmission is sufficient, which can also release the PRACH capacity congestion.  This issue can be achieved by gNB implementation and no need to handle this issue. |
| Apple | Y | B | PRACH capacity issue depends on the number of the INACTIVE/IDLE UE who are in INACTIVE/IDLE state due to the MBS session deactivation.  When the MBS session is deactivated, if the NW keeps the UE in CONNECTED mode, it’s not good for UE power and for CONNECTED capacity. So we think the normal NW implementation will release the UE to INACTIVE/IDLE state, and the consequence is that the number of INACTIVE/IDLE UE due to the MBS deactivation is not small, and the PRACH capability problem arises. |

### Access Control

Contributions [6][10][13][22][28] consider MBS specific UAC approach. Further, [10] specifies two options for configurations viz. Option 1: The mapping table between the MBS session and AC/AI for the access control is defined in NAS/CT spec or configured by NW and Option 2: The MBS session specific ACB parameters is broadcasted in SIB1. Whereas [2] proposed that no UAC is applied for RRC connection setup/resume for MBS reception if triggered by MBS paging. Contribution [20] sees no need to introduce new Access Categories and new establishment cause for multicast. Contribution [10] proposes MBS specific establishment cause and resume cause; whereas contributions [11][13][14] propose establishment cause and resume cause as “MT-Access”. Contribution [17] discusses the collision scenario where N multicast activation notifications and M=0/1 unicast paging collide for a UE and the related solution is suggested.

Many companies think considering network congestion, MBS specific UAC approach can be beneficial. RAN2 should discuss this aspect.

It is proposed:

**Proposal 10: RAN2 to agree to introduce MBS specific UAC.**

**Please provide your views on Proposal 10**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree [Y/N]** | **Comments** |
| Ericsson |  | RAN2 should at least investigate the area if there are any issues. We are concerned if MC-PTT UEs would be paged and use mt-access as establishment cause for example. Not applying UAC in combination with a crude paging mechanism does not seem viable. |
| MediaTek |  | We did not see the need to introduce MBS specific UAC. The motivation should be clarified |
| Kyocera |  | We wonder if RAN2 should first identify the issues, before UAC enhancements. |
| Samsung | Y | MBS specific UAC will be useful to address network congestion and service prioritization from network perspective |
| Huawei, HiSilicon | N | Since group paging is just another kind of paging mechanism, we think that UE behaviour upon receiving Paging can be directly reused, i.e. the UE can use mt-access as the establishment cause and there is no need for special MBS specific UAC. |
| LGE | Y | If the connection establishment/resume triggered by group notification is subject to UAC, it would be beneficial to control the PRACH congestion. |
| Futurewei | N | It appears we may not be able to have MBS as one separate access class/category since MBS can be used for different vertical applications which can belong to different access class. The control or baring on certain access class may be applicable to certain MBS applications but not on others. A particular MBS application could be classified under current UAC mechanism for access control. No need to introduce MBS specific UAC mechanism. |
| Qualcomm | Yes (i.e. enhance existing UAC) | In our view, existing UAC mechanism need to be enhanced by introducing new Acs and requires CT1/SA1 involvement. Motivation is to mitigate RAN congestion due to multiple UE initiated Multicast session joining procedure when RAN is overloaded.  By introducing multicast traffic specific new access categories as part of UAC, it gives flexibility for gNB to configure different access barring parameters for multicast & unicast traffic and Ues access can be controlled based on priority of different multicast services. |
| CATT |  | To enable gNB to control the access attempt for the multicast reception purpose, it seems reasonable to define new access category specific for the multicast. Since it is the scope of CAT/SA2, at least we need to request them to discuss it. |
| NEC | N | RAN2 should discuss what is the scenario and benefit of MBS specific UAC. We did not see the need to introduce MBS specific UAC. The motivation should be clarified. |
| TD Tech, Chengdu TD Tech | FFS is needed before the answer is made | We hope the following collision question will be discussed together with the current UAC question to derive the unitary solution for both questions.  Collision question:  For the collision scenario where N multicast activation notifications and M=0/1 unicast paging collide for a UE, how to do by the UE needs studying. |
| Spreadtrum | Yes | For the multicast in PTM mode, the UL link feedback is needed which will also cost the radio resource in gNB, then the access control for UE with multicast session is needed. The PTM/PTP leg of multicast will consume the DL resource mainly, which is different from unicast service. Therefore, network may apply different access control policy for unicast and multicast service. So we think MBS specific UAC is needed. |
| Apple | Yes | UAC should be applicable for the MBS activation triggered RRC Connection Request/Resume procedure, which can mitigate the PRACH capacity issue. |

**Proposal 11: RAN2 to define the establishment cause and resume cause for MBS upon multicast activation notification.**

**Please provide your views on Proposal 11.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree [Y/N]** | **Comments** |
| Ericsson |  | We think this can be FFS. |
| MediaTek |  | We did not see the need to define the establishment cause and resume cause for MBS upon multicast activation notification. The motivation should be clarified |
| Kyocera | Y | We assume the resources consumed by the UE only for multicast reception is quite different from one by the UE for unicast communication. So, we think it’s unexpected for the UE on multicast reception to be rejected by the network in some cases, i.e., at least it may be beneficial for the network to know whether this UE intends multicast reception or unicast communication before its decision (i.e., accept or reject). |
| Samsung | Y | We think congestion and service prioritization can be potential cases. |
| Huawei, HiSilicon | N | Same reply as above. |
| LGE | N | For transmission of multicast session, the PTM transmission would be mainly used and not increase the RAN overload., so ‘mt-Access’ that is used for unicast paging seems suitable also for group paging. |
| Futurewei | N | The existing cause matching with the MBS application could be used. |
| Qualcomm | Y | When a multicast UE is accessing gNB for multicast service purpose, it is beneficial for gNB to identify the purpose of UE’s access attempt to determine whether to accept or reject RRC setup/resume request. This can be accomplished by specifying a new establishment cause and a resume cause for multicast service in both RRC setup request message and RRC resume request message. |
| CATT | Y | For load balance, gNB may accept or reject RRC connection request based on the establishment cause from UE. Since multicast services may have different priorities compared to unicast services, it is beneficial to specify a new establishment cause for the purpose of multicast reception. |
| NEC | N | We don’t see how congestion is mitigated by introducing MBS specific establishment cause and resume cause |
| TD Tech, Chengdu TD Tech | FFS is needed before the answer is made | The current question is related to question 10. These two questions and the collision question need to be studied together. |
| Spreadtrum | N |  |
| Apple | Y | The MBS specific cause can help NW to perform the access control between MBS and unicast in the access congestion case, e.g. to prioritize the unicast access over the MBS triggered access. |

### Paging Repetitions

Contributions [6][10] have addressed potential loss of activation notification for UE. Contribution [6] proposes that paging based group notification approach includes paging repetitions to support UEs which may miss session notification. Some examples given include temporary service or coverage loss, notification decoding issue, MUSIM switching gap. Contribution [10] considers the scenario wherein the multicast session activation notification is sent when UE is outside the multicast service area, UE will miss the multicast session activation notification and cannot receive the multicast service after coming into the multicast service area

Only two contributions have addressed this issue. RAN2 should further discuss on the potentiality of issue and need for addressing the same.

It is proposed:

**Proposal 12: RAN2 to agree there is a need for reliability and robustness of notification approach (e.g. paging repetitions) for addressing scenario of potential notification loss for UEs.**

**Please provide your views on Proposal 12. Companies can also indicate in the comments how the scenario should be addressed, if any.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree [Y/N]** | **Comments** |
| Ericsson | N | A UE can go out of coverage at any time. Wouldn't this imply that the network would need to constantly page the UEs informing them that a session as started? With the selected paging solution which uses all capacity we don't see how this can work.  If the UE is configured with a dedicated PUCCH feedback, the absence of feedback can be used as an indication that the UE did not join the session. |
| MediaTek | No | Paging Repetitions can be subject to network implementation |
| Kyocera | N |  |
| Samsung | Y (FFS) | We think there is a possibility for some UE missing paging for activation notification due to many reasons. So question is whether such Idle/Inactive UEs will never be able to join back the activated multicast session. It seems there is a real problem and this issue should be FFS so that RAN2 can explore problem sufficiently |
| Huawei, HiSilicon | N | The same issue exists for unicast Paging and the same network procedures/implementations can be used to handle this (the network knows which UEs subscribed to a session and did not reply to a group paging). |
| LGE | N |  |
| Futurewei | N | In case some UEs missed page, the network could re-page them again following the legacy paging approach. The network implementation determines the MBS re-paging area. |
| Qualcomm | N | RAN can perform paging repetition. |
| CATT | N | It is sufficient to follow the unicast paging procedure |
| NEC | N | We have our comment in P3 that the missing of notification can be resolved by UE implementation. |
| TD Tech, Chengdu TD Tech | Y | For the multicast session with high QOS requirement, the missing group notification needs to be solved. |
| Spreadtrum | N | It is up to implementation. |
| Apple | N | It is up to NW implementation. |

### Prioritize cell with MBS/multicast support

Unicast paging is used for a node that does not support MBS. Contribution [3] sees some benefit to prioritize the cells with multicast support (or MBS support) during reselection, to support mobility of UE monitoring multicast activation notification. It may involve some broadcast signalling and some modification to reselection procedure.

It is proposed:

**Proposal 13: RAN2 to agree there is a need to prioritize a cell with MBS/multicast support for idle/inactive UEs that monitor multicast activation notification.**

**Please provide your views on Proposal 13. Companies can also indicate in the comments how this prioritization of cell with multicast support (or MBS support) during reselection should be addressed, if any.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree [Y/N]** | **Comments** |
| Ericsson | Y | Wouldn’t the agreements made yesterday point in this direction, even though they were made for broadcast? |
| MediaTek | Yes |  |
| Kyocera | Y | We agree with Ericsson, and we prefer the common behaviour between multicast and broadcast, for cell reselection. |
| Samsung | N | We suspect if there is a real need for prioritization of cell supporting multicast. Even on non-MBS cell, UE may be paged in legacy manner for activation notification. Further, there seems new complexity on broadcast signalling for multicast support by cell and cell reselection procedure modifications. |
| Huawei, HiSilicon |  | We think a cell level prioritization is not reasonable as the network does not know the cell where the UE camps. Hence, the unicast paging has to be anyway sent in all cells in the TA of the Ues that joined multicast service.  On the other hand, it might be useful to have frequency layer prioritization to [gather](javascript:;) Ues joining multicast services to a specific frequency for paging efficiency. This can be achieved by either a) extending the frequency layer prioritization agreed for broadcast to multicast or b) using dedicated frequency priority. |
| LGE |  | We think the service continuity mechanism we are discussing for broadcast can be simply reused for de-activated multicast session. |
| Futurewei | Maybe not, FFS | In DM2, for idle/inactive UE under broadcast service to perform reselection, MBS carrier with the same service should have high priority for UE reselection to ensure the service continuity. For multicast, the service is provided in connected mode. To support service continuity during the mobility, the network will prioritize the MBS supporting cell as the HO target cell. Only when multicast session is deactivated, the idle/inactive UE may have some benefit to camp on the MBS supporting cell/carrier. But in DM1, we need to add some mechanism indicate which cell/carrier is the multicast supporting cell/carrier. The increased complexity/cost may not worth the benefit. It is also a question whether we have fixed PTM multicast supporting cell. It maybe changed at the session activation by the network. We may need to identify in connected mode if there is use case for MBS cell prioritization in DM1. |
| Qualcomm |  | UE can prioritize frequency layer providing multicast service and within each frequency layer UE can select a cell based on radio channel conditions. |
| CATT | Y | From resource efficiency perspective, multicast UE should try to camp on a MBS cell if it exists during cell reselection. Then UE can receive the multicast session via shared delivery on MBS cell when the multicast session is activated.  Whether the mechanism for delivery mode 2 can be reused needs further discussion. |
| NEC | N | We agree with HW&QC that frequency level periodization makes more sense than cell level prioritization. |
| TD Tech, Chengdu TD Tech | Yes |  |
| Spreadtrum | N | We think the legacy paging is used to indicate the multicast activation and the UE maybe handover to the MBS cell subsequently based on the handover policy. We did not see significant benefits of prioritization of MBS cell during the cell reselection considering the introduction of indication of MBS cell/carrier. |
| Apple |  | We assume the proposal is to apply the same mechanism as broadcast. |

# Conclusion

**To be updated**: Based on the discussion in the previous sections we propose the following:

# Reference

1. R2-2107015, Discussion on MCCH change notification, OPPO
2. R2-2107016, Group notification and unicast paging for MBS activation, OPPO
3. R2-2107036, On Multicast Activation Notification, CATT, CBN
4. R2-2107037, Open Issues on MCCH Change Notification, CATT
5. R2-2107051, Notification for Multicast activation, MediaTek Inc.
6. R2-2107235, Considerations on Notifications for Multicast and Broadcast, Samsung
7. R2-2107340, Notifications for NR MBS, ZTE, Sanechips
8. R2-2107365, Discussion on multicast activation notification, Spreadtrum Communications
9. R2-2107530, Further discussion on the MBS group notification in DM2, Futurewei
10. R2-2107578, Access Control for the MBS Service Reception, Apple
11. R2-2107799, Discussion on MBS Notification and MCCH, vivo
12. R2-2107876, MCCH information acquisition, LG Electronics Inc.
13. R2-2107877, RRC connection establishmentresume initiated by group paging, LG Electronics Inc
14. R2-2107922, Notification for Multicast activation, Lenovo, Motorola Mobility
15. R2-2107982, MBS session activation and group paging, Nokia, Nokia Shanghai Bell
16. R2-2108001, Group notification for Delivery mode 1 in NR MBS, Kyocera
17. R2-2108035, Discussion on notificatons for NR MBS, CHENGDU TD TECH LTD.
18. R2-2108078, Aspects on notification, Ericsson
19. R2-2108202, Notifications for Multicast and Broadcast, Huawei, HiSilicon
20. R2-2108455, Multicast activation notification and MCCH change notification, Intel Corporation
21. R2-2108523, Discussion MBS notification schemes, CMCC
22. R2-2108800, PRACH congestion due to multicast paging, Xiaomi Communications
23. Draft Report of 3GPP TSG RAN WG1 meeting #105-e v0.2.0
24. Draft Report of 3GPP TSG RAN WG2 meeting #114-e v2
25. R2-2106544, LS on update for MCCH design
26. R2-2108847, Summary of L3 Centric Notifications (Samsung)
27. [R2-2108205](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_115-e\Docs\R2-2108205.zip), 38.331 running CR for NR MBS, Huawei, HiSilicon

[28] R2-2107546, NR MBS control signalling aspects for UEs in different RRC states, Qualcomm