**3GPP T****SG-RAN WG2 Meeting #116-e R2-210xxxx**

**E-meeting, 1 – 12 November 2021**

**Agenda item:**8.1.x

**Source:** Huawei, HiSilicon

**Title:** [Report of] e-mail discussion: [Post115-e][091][MBS] Remaining control plane issues (Huawei)

**WI code:** NR\_MBS-Core

**Document for:** Discussion and Decision

# 1 Introduction

This document aims at gathering and summarizing companies’ views for the following e-mail discussion:

* **[Post115-e][091][MBS] Remaining control plane issues (Huawei)**

 Scope: Determine and address MBS Remaining CP issues

 Intended outcome: Report with open issues, and proposed resolutions as far as reasonable.

 Deadline: Long

# 2 Discussion

## 2.1 Neighbouring cell information in MCCH

This topic has been already discussed as part of e-mail discussion summarized in [1] and there was a vast majority of companies agreeing that it is useful if the gNB provided a list of neighbouring cells where the MBS broadcast service is provided. Based on this information, the UE can request unicast reception of the service before changing to a cell not providing the MBS service. During the discussion during RAN2#115-e meeting some companies raised that this mechanism may be complex to manage and that it should not be mandatory for the network. On the other hand, it was noted this information can be particularly useful, e.g. for Public Safety applications.

**Question 1: Do companies agree that it should be possible for the network to optionally broadcast in MCCH a list of neighbour cells providing the same broadcast MBS service(s) as provided in the current cell?**

**NOTE1: It is assumed that network coordination to achieve this is up to OAM/implementation.**

**NOTE2: It is assumed that how this information is utilized by the UE is up to UE implementation.**

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| **Company** | **Yes/No** | **Comments / justification** |
| OPPO | Yes  | It is reasonable to make it optional for both UE and network. |
| MediaTek | **Yes** |  |
| Ericsson | **No** | Service continuity for broadcast is not seamless and we do not expect that with this enhancement it will be seamless neither. That is also why it is optional for MBS in LTE for both UE and NW, i.e. it is not essential to have. The UE is typically not roaming at the "border", i.e. we think this does not need to be optimized. In case a lot of UEs roam in such area, we assume the broadcast will be provided via MRB, i.e. non-supporting node will become supporting node. When the UE is supposed to request a unicast bearer before changing to a cell not providing the session, then there can be issues:* When the UE requests a unicast bearer while in coverage of the target cell, then there is a risk that the source cell ends up with unicast bearers for UEs that had the intention to move out of the source cell, but eventually did not do so.
* When the UE requests a unicast bearer of the target cell when the cell re-selection criteria of the target cell are fulfilled then the continuity is likely not seamless, and we wonder what use this feature has.

The required UE behavior when to request a unicast bearer should be discussed further and specified. The list of cells for intra- and inter-frequencies will increased the MCCH size, and increase the power consumption for UE and NW. It is complex and costly for the NW to configure and maintain cell lists. In our view cell list should be avoided, and only applied when there are problems to solve in a specific area (e.g. specific cell). But cell lists should be avoided to be needed for general deployment of the feature as a whole. We are not sure if this enhancement is needed. A simpler way to configure and maintain this functionality is to introduce an "MCCH area" (instead of cell lists) similar as with s*ystemInformationAreaID*. |
| Samsung | **Yes** | Neighbour cell information was added to SC-PTM to enhance the service continuity aspects, alleviating drawbacks with the LTE eMBMS having no prior information for service availability accessible to the UEs. Regarding Ericsson comment for “MCCH area”, it seems to be difficult to have a such static and common deployments when different cells may have different service requirements and network operational factors may also differ across cells. Neighbour cell information can provide more flexibility. NR MBS broadcast resembles SC-PTM significantly, it seems legacy approach of neighbour cell information can be adopted easily. |
| CATT | **Yes with comments** | We are fine to follow if this is the majority view, even though it is not clear whether it is in the R17 scope to support unicast reception of the broadcast service on a cell not providing the MBS service(i.e. out of the Broadcast MBS service area).At least it seems not supported according to SA2 TS 23.247,

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| NOTE: When the UE moves out the Broadcast MBS service area, how the UE get the same content via application level is out scope of 3GPP. |

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**Question 2: If Q1 is agreed, do companies agree that MCCH changes due to neighbouring cell information modification reuse the MCCH modification notification bit, if agreed by RAN1?**

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| **Company** | **Yes/No** | **Comments / justification** |
| OPPO | Yes  |  |
| MediaTek | **Yes** |  |
| Ericsson | **Yes** |  |
| Samsung | **Yes** | RAN1 is considering at least 2 bits for MCCH change notification and further discussion in RAN1 is on whether it is based on either Alt1 or Alt2 approach. It is up to RAN2 to define the purpose of change notification bits and it seems straightforward to reuse MCCH modification notification bit (2nd bit) to also indicate neighbour cell information modification |
| CATT | **Yes** |  |

## 2.2 MCCH related issues

RRC running CR [4], contains the following editor’s notes:

* FFS whether to keep MCCH-RNTI name or use another one.
* FFS whether the values of MCCH window parameters captured currently need to be modified.

Based on this, the following questions are asked.

**Question 3: Do you agree to use the name “MCCH-RNTI” for the RNTI scheduling MCCH? If not, please justify and propose an alternative naming.**

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| **Company** | **Yes/No** | **Comments / justification / alternative name** |
| OPPO | Yes  |  |
| MediaTek | **Yes** |  |
| Ericsson | **Wait?** | In our understanding RAN1 is still studying whether to use a dedicated RNTI for the MCCH notification, i.e. perhaps we should wait for RAN1 progress?: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.Agreement:Study and reach an agreement by RAN1#106b-e on whether Alt1 and Alt2 for MCCH change notification indication can accommodate at least 2 bits for the notification of MCCH configuration changes due to a session start and the notification of MCCH configuration changes of an ongoing session (including session stop). |
| Samsung | **Yes** | It is rightly mentioned by Ericsson that RAN1 is yet to decide on Alt1 or Alt2. However, in any case there is a need for RNTI for DCI scheduling MCCH (whether DCI does not include change notification field as in Alt1 or DCI includes for change notification field also as in Alt2) and it should be defined. MCCH-RNTI seems appropriate name of RNTI for DCI scheduling MCCH.  |
| CATT | **Yes with comments** | It is fine to use the name “MCCH-RNTI” .but for simplification, would it be better to use a shorter name such as “M-RNTI”? |

When it comes to MCCH window parameters values, currently the CR in [4] captures the following:

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| MCCH-Config-r17 ::= SEQUENCE {mcch-RepetitionPeriodAndOffset-r17 MCCH-RepetitionPeriodAndOffset-r17, mcch—WindowStartSlot-r17 INTEGER (0..79), mcch—WindowDuration-r17 ENUMERATED {sl2, sl4, sl8, sl10, sl20, sl40,sl80, sl160} OPTIONAL, -- NEED S mcch-ModificationPeriod-r17 ENUMERATED {rf2, rf4, rf8, rf16, rf32, rf64, rf128, rf256, rf512, rf1024, r2048, rf4096, rf8192, rf16384, rf32768, rf65536}}MCCH-RepetitionPeriodAndOffset-r17 ::= CHOICE { rf1-r17 INTEGER(0), rf2-r17 INTEGER(0..1), rf4-r17 INTEGER(0..3), rf8-r17 INTEGER(0..7), rf16-r17 INTEGER(0..15), rf32-r17 INTEGER(0..31), rf64-r17 INTEGER(0..63), rf128-r17 INTEGER(0..127), rf256-r17 INTEGER(0..255)} |

**Question 4: Do you think the currently captured values of mcch-RepetitionPeriodAndOffset, mcch-WindowStartSlot, mcch-WindowDuration, mcch-ModificationPeriod are appropriate and sufficient? If not, please indicate which values should be removed/added.**

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| **Company** | **Yes/No** | **Comments / justification** |
| OPPO | Yes with other comments | (1)*mcch—WindowStartSlot* and *mcch—WindowDuration* are useful only when MCCH repetition period is longer enough than *mcch—WindowDuration*, right? So *mcch—WindowStartSlot* and *mcch—WindowDuration* are not essential parameters and the both two parameters can be optional.(2)Network should ensure that the MCCH repetition period is longer than *mcch—WindowDuration.*  |
| MediaTek | **Yes** |  |
| Ericsson | **Yes with comments** | We are not sure (but do not have strong view):* is a repetition period of 1 frame needed (it gives an odd 9 element in the list)?
* Should the window duration be in submsec/msec like the DRX inactivityTimer?

PS: there is a different format/type for the highlighted dash?mcch—WindowStartSlot-r17mcch—WindowDuration-r17  |
| Samsung | **Yes** | *mcch-WindowstartSlot* and *mcch-WindowDuration* are needed given MCCH can be likely segmented and needs to be accommodated in multiple slots.@Oppo, we understand MCCH repetition period will always be configured longer than *mcch-WindowDuration*. So there should be no such concern. |
| CATT | **Yes with comments** | The values for these IEs are related to the latency requirement of the supported MBS services, it is hard to say whether the currently captured values for these IE are appropriate and sufficient as there is no clear latency requirement.so we can keep the current currently captured values until there is requirement coming in. |

## 2.3 Cell reselection and frequency prioritization in RRC IDLE/INACTIVE

Even though the general rules of frequency prioritization are captured in the 38.304 running CR in [5], there are also some open points which need to be clarified, as captured by the following FFS points:

1. FFS whether UE needs to read the SIBx of the candidate cell before cell reselection. As an alternative, UE may determine whether the reselection candidate cell is broadcasting SIBx based on whether the scheduling info of SIBx is present in SIB1 of the reselection candidate cell or not.
2. FFS whether UE should stop to prioritize the frequency if SIBx is not scheduled on the serving cell(i.e. reselected cell) anymore.
3. FFS whether frequency in USD should also be checked when One or more IDs (e.g. SAI) of that frequency are indicated in SIBy of the serving cell.
4. FFS whether the UE can prioritize the frequency indicated in USD when SIBy is broadcast but does not provide the mapping for the concerned service.

With respect to the first bullet, the rapporteur understands that the UE is not required to read the contents of SIBx broadcasted in another cell, but needs to ensure that SIBx is available in the cell which is a candidate for reselection, i.e. it is scheduled by SIB1 in this cell. Furthermore, even though the condition as captured currently in the running 38.304 CR [5] speaks of SIBx being broadcast, SIBx can actually be available on demand and may therefore not be broadcast, but still present in SI-SchedulingInfo in SIB1 in the reselection candidate cell. Similar consideration holds for SIBy (i.e. “service continuity” MBS SIB). Companies are then requested to answer the following questions.

**Question 5: Do you agree that SIBx and SIBy can be available on demand?**

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| **Company** | **Yes/No** | **Comments / justification** |
| OPPO | No  | Considering the service interruption during cell reselection, SIBX cannot be on demand. |
| MediaTek | **Yes** | We do not think the UE needs to read the SIBx of the candidate cell before cell reselection, as this will make the cell reselection procedure complicated |
| Ericsson | **Yes, with comments** | We do not have a strong view, but perhaps SIBx can be off until the first BC session starts in the cell (again), i.e. there is no interruption to service continuity in such case. It is not obvious when to switch SIBx off again, but perhaps this can be done during certain "no broadcast" hours. We do not see strong reasons to exclude this option, even though the whole BC solution is far from "on demand".  |
| Samsung | **Yes** | UE need not read SIBx of the candidate cell before cell reselection. SIBx and SIBy can be available on demand. |
| CATT | **No** | 1. UE should not be required to read SIBx of the reselection candidate cell, the scheduling info in SIB1 of the candidate cell is sufficient. but it is not the reason to support on demand SIBx is supported or not.2.The reason why on demand MBS SIB(i.e. SIBx,SIBy) should not be supported is similar as logic to not support on demand MCCH, i.e. this mechanisms will cause more issues than benefits, e.g. due to impact to the service continuity of idle/inactive mode UEs, extra service interruption due to request the on demand SIBx etc.//RAN2#115e agreement* [049] On-demand MCCH mechanism is not introduced in Rel-17.
 |

**Question 6: Do you agree to clarify that the UE in RRC IDLE/INACTIVE may consider the frequency for prioritization in case SIBx is included in SI-SchedulingInfo in SIB1 of the reselection candidate cell (i.e. the status of the associated SI message can be either broadcasting or notBroadcasting and the UE is not required to read SIBx before making prioritization)?**

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| **Company** | **Yes/No** | **Comments / justification** |
| OPPO | Yes  | If majority view to support on demand SIB X/Y, we think Q6 is yes.  |
| MediaTek | **Yes** |  |
| Ericsson | **Yes** |  |
| Samsung | **Yes** |  |
| CATT | **Yes** | UE should not be required to read SIBx of the reselection candidate cell, the scheduling info in SIB1of the candidate cell is sufficient.  |

When it comes to the second bullet, i.e. “whether UE should stop to prioritize the frequency if SIBx is not scheduled on the serving cell (i.e. reselected cell) anymore”, rapporteur’s understanding is that this refers to a situation where not all cells on a certain frequency provide SIBx. In that case, it may happen that even though the UE verified the frequency prioritization conditions positively, it ended up on a cell not providing SIBx after cell reselection on a prioritized frequency. It is rapporteur’s understanding that even though such situation may happen, it would rather be a corner case, mainly due to bad UE implementation. Furthermore, if the UE was forced to deprioritize the frequency, this could lead to ping-pong situation. Companies are then requested to answer the following question.

**Question 7: Do you agree that it is not required to address the case where the UE reselects a cell not providing/scheduling SIBx, after having performed frequency prioritization/deprioritization?**

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| **Company** | **Yes/No** | **Comments / justification** |
| OPPO | Yes  |  |
| MediaTek | **Yes** | We have the same understanding as rapporteur and think that it would be a corner case if the UE verified the frequency prioritization conditions positively, but it ended up on a cell not providing SIBx after cell reselection on a prioritized frequency.  |
| Ericsson | **No, with comments** | The UE has to check if SIBx is scheduled in SIB1 of the **strongest/highest ranked cell** on the target frequency, i.e. the UE reselect to a cell broadcasting SIBx. It is a NW configuration error when SIB1 indicates SIBx, but SIBx it not broadcasted. In case some cells on the target frequency do not support MBS the UE may end up on a cell not broadcasting SIBx due to mobility. But in case some cells on the frequency do not support MBS, we assume that cells on other frequencies in the same geographical area as the non-supporting cell do not broadcast SIBy either, i.e. they would not "redirect" the UE to that frequency. We thought that bullet 2 describes the use case where the MC session has stopped, because it says "*not scheduled … anymore*". When there are no more active sessions in the cell, we assume that the MCCH and SIBx are removed. Perhaps this should be discussed more, i.e. is there a use case where the last session is stopped and a new session is started frequently, i.e. this would then cause frequency SIB changes?In case the UE is no longer interested in a MC session, or the MC session has stopped, the UEs should "disperse" from the MBS frequency in our view. Otherwise there is a risk that MC UEs start to congregate on the MBS frequency, which is unwanted for load balancing reasons. This was captured in LTE with the offset:NOTE: UE should search for a higher ranked cell on another frequency for cell reselection as soon as possible after the UE stops using QoffsetSCPTM. |
| Samsung | **Yes** | We agree with rapporteur’s understanding that it is a corner case that UE ends up on a cell not providing SIBx after cell reselection on a prioritized frequency |
| CATT | **No,with comments** | The answer to Q7 itself is Yes. But it is not the case that the FFS tries to address.As the rapporteur of the 38.304 running CR, please allow me to clarify this FFS further.The FFS is added due to the companies’ different views on which word to use (i.e. “reselected cell” or “reselection candidate cell”) when performing the frequency prioritization. The “reselection candidate cell” is used in the current 304 CR, but the “reselected cell” is used in LTE.The reason why “reselected cell” is used in 36.304 is for the case below,1. UE receiving broadcast service did the frequency prioritization and reselected to a cell which scheduling/broadcasting SIBx. 2. After reselection, UE continues the broadcast reception based on SIBx and MCCH on the new serving cell.3. The serving cell stop the scheduling/broadcasting of the SIBx for some reason (e.g. for congestion control in LTE).The conclusion in LTE is: UE should stop to prioritize the related frequency after step 3 above. So the wording “reselected cell” is used finally to address this issue. |

With respect to the third bullet above, i.e. “whether frequency in USD should also be checked when One or more IDs (e.g. SAI) of that frequency are indicated in SIBy of the serving cell”, there were different views in the e-mail discussion on the running 38.304 CR. Some companies indicated this is how frequency prioritization conditions were worded in LTE while other companies indicated that this condition is unnecessary as SIBy based prioritization could be independent of the information carried by USD.

**Question 8: Do you agree that the UE should be allowed to prioritize a frequency in case this frequency is signaled in SIBy for the UEs service/session of interest (e.g. identified by an additional ID such as SAI) regardless of whether this frequency is included in the USD for this service?**

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| **Company** | **Yes/No** | **Comments / justification** |
| OPPO | Not sure | It is related the concept of USD, we can wait for response from SA2. |
| MediaTek | **Yes** |  |
| Ericsson | **Maybe** | In case frequency info is provided in both USD and SIBy, then there is a potential risk for conflicts. Perhaps we can say that the frequency info in SIB is prioritized (configured by RAN), when it conflicts with the frequency info in USD (service announcement). But we are not sure if both methods of redirecting would be deployed together.  |
| Samsung | **-** | We think it is related to USD which is to be defined by other WGs. In implementations, Service announcement or USD information is typically refreshed frequently through certain pre-configured MTCH channel, even accessible to the UEs in IDLE/INACTIVE state and therefore, there should not be issue related to mismatch between USD and SIB transmission in general. |
| CATT | **Yes** | If the frequency and SAI mapping info for the interested broadcast service is present in SIBy, there is no need to check the frequencies for this service in USD further.  |

The fourth bullet above, i.e.: “whether the UE can prioritize the frequency indicated in USD when SIBy is broadcast but does not provide the mapping for the concerned service” was captured based on the observation that in LTE, in case SIBy was provided in the cell, the UE could not prioritize the frequency included in USD, even in case the related service was not included in SIBy. However, for some services which are deployed on the same frequency throughout the operator’s network, it may make more sense to provide a semi-static frequency configuration in USD directly, while still providing frequencies via SIBy for other services. Therefore, companies are requested to answer the following question:

**Question 9: Do you agree that the UE should be allowed to prioritize the frequency indicated in USD when SIBy is provided in the cell but does not provide the frequency mapping for the concerned service?**

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| **Company** | **Yes/No** | **Comments / justification** |
| OPPO | Not sure | It is related the concept of USD, we can wait for response from SA2. |
| MediaTek | **Yes** |  |
| Ericsson | **Maybe** | This depends on whether the two methods of frequency redirection can be used simultaneously (i.e. frequency info in USD and SIBy) |
| Samsung | **-** | We think it is related to USD which is to be defined by other WGs |
| CATT | **Maybe** | We agree with the general idea, but We are wondering which frequency to be prioritized by UE if a TMGI maps to multiple frequencies in USD? |

Finally, there is also an issue captured in TS 38.304 running CR [5] related to multicast MBS, i.e. whether the UE is RRC IDLE/INACTIVE mode which joined a multicast session, should be allowed to prioritize a frequency for multicast activation monitoring:

* FFS if there is a need to prioritize a frequency with multicast support for idle/inactive UEs that monitor multicast activation notification.

The rapporteur’s understanding is that the goal of such prioritization would be to minimize the paging overhead by restricting paging to only a certain frequency. On the other hand, some issues would have to be resolved, e.g. how can the UE determine which frequency to prioritize, can it be ensured that all UEs which joined the session camp on the same frequency in a certain area etc.

Question 10: Should it be possible for the UE in RRC IDLE/INACTIVE which joined a multicast session to prioritize a certain frequency for group paging monitoring? If yes, please clarify how this can be achieved.

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| **Company** | **Yes/No** | **Comments / justification** |
| OPPO | No  | No matter the camped cell is MBS cell or non-MBS cell, the paging will be available for UE due to MBS activation. Even if the serving cell is non-MBS cell, the unicast can be used to receive MBS service. |
| MediaTek | **No** | We did not see the need and we think it is a bit unusual to mandate the idle UE behaviour as such, since multicast activation notification is based on unicast paging.  |
| Ericsson | **Yes, with comments** | We sent an LS to RAN3/SA2 to ask if group paging can only happen in the POs where MC users are monitoring. It would be beneficial when paging can also be reduced in the frequency domain as well.In case the session is deactivated, and the UE is released to idle/inactive, the UE should perhaps consider this frequency the highest priority frequency, as long as the UE is interested in it, the UE has not left the group, and the session has not stopped. This would enable the NW to group page only on the "MC" frequency. When the UE roams out of "MC" frequency coverage, the UE re-selects to another frequency, and would not be able to receive MC session when it is activated again. Only when the UE roams into "MC" frequency coverage again, and reselects to the "MC" frequency the UE can receive the MC session again when it is activated. The NW may have to perform some "periodic" group paging, to catch UEs that return out of coverage. |
| Samsung | **No** | When the serving cell is non-MBS cell, unicast means are available for paging. Prioritization for multicast is needed only when activated session is being received by UE and it can be taken care by connected mode mobility by network (e.g. non-MBS to MBS mobility). We think it is undesired complexity to prioritize a frequency for activation notification monitoring. |
| CATT | **Yes** | Obviously it is resource efficient to receive the MBS data via multicast session/PTM on MBS cell if possible, when the deactivated session is reactivated again.So UE should prioritize to camp on a frequency where multicast cell exists in case there are MBS cell and non-MBS cell nearby. |

## 2.4 MBS Interest Indication

With respect to MBS Interest indication, the following FFS is captured in RRC running CR [4]:

* It is FFS whether the any modification is needed for MII triggers as captured above.

The triggering conditions that are mentioned are as follows:

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| An MBS capable UE in RRC\_CONNECTED may initiate the procedure in several cases including upon successful connection establishment, upon entering or leaving the broadcast service area, upon MBS broadcast session start or stop, upon change of interest, upon change of priority between MBS broadcast reception and unicast reception, upon change to a PCell broadcasting *SIBx1*. |

**Question 11: Do you think the currently captured triggers for sending MII are correct and sufficient? If not, please indicate which condition should be removed/modified or added.**

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| **Company** | **Yes/No** | **Comments / justification** |
| OPPO | Yes  |  |
| MediaTek | **Yes** |  |
| Ericsson | **Yes, with comments** | This introduction paragraph specifies the trigger conditions as a "may", i.e. a hint to the UE implementation. The normative text for the sending the MMI message and setting the content is more critical. We are not sure if the UE should send MMI message when the session stops, assuming that the UE send the MMI message when it has started. In our understanding "entering or leaving the broadcast service area" is not clearly defined, and it overlaps with "PCell broadcasting *SIBx1*"?It would be beneficial to understand the use cases we are trying to solve, some of which might be the same as for LTE (e.g. HO/SCell config, unicast and BC scheduling) and some might be different (e.g. BWP config). In our view there should be more control over the MMI signalling, i.e. currently the UE may send a lot of MMI signalling. There is no possibility for the NW to disable MMI signalling, there is no prohibit timer for UE frequently changing its interest/priority, and it is not possible to control the signalling for specific use cases. It seems that the MMI signalling only covers the case where the frequency info is provided in SIBx1. We wonder if the case where the frequency info is provided in USD only should also be included.  |
| Samsung | **No** | Apart from “upon entering or leaving the broadcast service area” as were in legacy, there is also new BWP aspect in NR MBS. BWP switch may restrict/allow MBS broadcast reception for the UE and UE should additionally consider this event for sending MII to the network. |
| CATT | **No** | An MBS capable UE may send MII during connection establishment(i.e. before security activation), according to the following agreement,//RAN2#115e agreement,* Send an LS to SA3 to check whether the MBS interest information can be reported by the UE before security activation.
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What is also still unclear are the procedures for frequencies and services of interest determination. In LTE, the frequencies of interest are determined in the following way, as per TS 36.331 [6]:

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| 5.8.5.3 Determine MBMS frequencies of interestThe UE shall:1> consider a frequency to be part of the MBMS frequencies of interest if the following conditions are met:2> at least one MBMS session the UE is receiving or interested to receive via an MRB or SC-MRB is ongoing or about to start; andNOTE 1: The UE may determine whether the session is ongoing from the start and stop time indicated in the User Service Description (USD), see TS 36.300 [9] or TS 26.346 [57].2> for at least one of these MBMS sessionseither *SystemInformationBlockType15* acquired from the PCell includes for the concerned frequency one or more MBMS SAIs as indicated in the USD for this session or this session is in receive only mode; andNOTE 2: The UE considers a frequency to be part of the MBMS frequencies of interest even though E-UTRAN may (temporarily) not employ an MRB or SC-MRB for the concerned session. I.e. the UE does not verify if the session is indicated on (SC-)MCCHNOTE 3: The UE considers the frequencies of interest independently of any synchronization state, e.g. TS 36.300 [9], Annex J.1.2> the UE is capable of simultaneously receiving MRBs and/or is capable of simultaneously receiving SC-MRBs on the set of MBMS frequencies of interest, regardless of whether a serving cell is configured on each of these frequencies or not; and2> the *supportedBandCombination* the UE included in *UE-EUTRA-Capability* contains at least one band combination including the set of MBMS frequencies of interest;NOTE 4: Indicating a frequency implies that the UE supports *SystemInformationBlockType13* or *SystemInformationBlockType20* acquisition for the concerned frequency i.e. the indication should be independent of whether a serving cell is configured on that frequency.NOTE 5: When evaluating which frequencies it can receive simultaneously, the UE does not take into account the serving frequencies that are currently configured i.e. it only considers MBMS frequencies it is interested to receive.NOTE 6: The set of MBMS frequencies of interest includes at most one frequency for a given physical frequency. The UE only considers a physical frequency to be part of the MBMS frequencies of interest if it supports at least one of the bands indicated for this physical frequency in *SystemInformationBlockType1* (for serving frequency) or *SystemInformationBlockType15* (for neighbouring frequencies). In this case, E-UTRAN may assume the UE supports MBMS reception on any of the bands supported by the UE (i.e. according to *supportedBandCombination*). |

The procedure depends to a large extent on the reply to an LS RAN2 send in [7] related to USD/SAI definition for NR. However, the parts highlighted in yellow are not depending on this and they were tentatively discussed in [1], but not concluded eventually. This discussion is somewhat related to UE capabilities as well and the following relevant capabilities are captured in TS 36.306 [8] for MBMS:

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| 4.3.17.1 *mbms-SCell-r11*This parameter defines whether the UE in RRC\_CONNECTED supports MBMS reception via MBSFN on a frequency indicated in an *MBMSInterestIndication* message, when an SCell is configured on that frequency (regardless of whether the SCell is activated or deactivated), as specified in TS 36.331 [5].4.3.17.2 *mbms-NonServingCell-r11*This parameter defines whether the UE in RRC\_CONNECTED supports MBMS reception via MBSFN on a frequency indicated in an *MBMSInterestIndication* message, where (according to *supportedBandCombination* and to network synchronization properties) a serving cell may be additionally configured, as specified in TS 36.331 [5]. If this is supported, the UE shall also support MBMS reception via MBSFN on a frequency when an SCell is configured on that frequency (regardless of whether the SCell is activated or deactivated), as specified in TS 36.331 [5]. |

The UE capabilities can be discussed at a later stage, so it is proposed to focus on the supported functionalities for the moment, i.e. leave aside the aspect of whether they require a separate capability or not for the moment. Considering this, the companies are requested to answer the following questions.

**Question 12: Do you agree that the UE may receive MBS broadcast service from an SCell?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments / justification** |
| OPPO | Yes  | It is up to UE capability and can receive broadcast service from both MCG SCell and SCG SCell, and also possible on a non-serving cell. |
| MediaTek | **No** | Our assumption is that in Rel-17 MBS, UE receives MBS broadcast service only from a PCell. Otherwise, RAN1 work is needed.  |
| Ericsson | **Yes, but** | The MMI discussion is shifting from what the UE is not capable to do, into what the UE is capable to do. But the expected NW actions are not clear to us in the latter case. If the UE is capable to receive BC session(s) on SCells and SCells are configured on the frequencies of interest, then there is no NW action, and the UE should not send the MII, right? The procedure text does not seem to be clear on this in LTE. 36.300 also say:- the UE may indicate its MBMS interest even if the current configured serving cell(s) do not prevent it from receiving the MBMS services it is interested in.We do not understand what problem the MMI signalling solves in this case, and we prefer to limit excessive signalling, if possible. In LTE simultaneous reception of multiple services is left to UE implementation: In this release of the specification, an MBMS capable UE is only required to support reception of a single MBMS service at a time, and reception of more than one MBMS service (also possibly on more than one MBSFN area) in parallel is left for UE implementation.But then for MII signalling there is an attempt to make simultaneous reception on multiple frequencies work?If the UE is capable to receive a BC session simultaneously on another frequency than the PCell frequency, we wonder why the NW should be informed about this, i.e. why does this then require SCell configuration or HO (change of PCell) be needed? This can then be left to UE implementation? Perhaps RAN1 should be involved in this discussion and verify the need for MII signalling.We think that reception of multiple BC sessions on multiple frequencies easily becomes complex to handle. The UE may be able to receive multiple BC sessions on one frequency, and only one BC session on another frequency, while the UE cannot indicate which sessions are more important than others.  |
| Samsung | **No** | For Rel-17 we should restrict this to PCell given limited WI time and RAN1 work involved. |
| CATT | **Yes** | As it is already supported in LTE, it seems that there are no reasons to not support MBS on scell in NR. However, it should be confirmed with RAN1. |

**Question 13: Do you agree that the UE may receive MBS broadcast service from a non-serving cell in either RRC CONNECTED or RRC INACTIVE/IDLE state?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments / justification** |
| OPPO | Yes  | It is up to UE capability. |
| MediaTek | **No** |  |
| Ericsson |  | Is there an expected NW action? |
| Samsung | **No** | For Rel-17 we should restrict this to PCell given limited WI time and RAN1 work involved. |
| CATT | **Yes** | It is also related to the conditions to do the frequency prioritization in 38.304 running CR.//38.304 running CRIf the MBS capable UE is receiving or interested to receive an MBS broadcast service(s), the UE may consider cell reselection candidate frequencies at which it can not receive the MBS broadcast service to be of the lowest priority during the MBS broadcast session as specified in TS 38.300 [2], as long as the condition 1) above is fulfilled for the cell on the MBS frequency which the UE monitors and as long as the condition 2) above is fulfilled for the serving cell. |

**Question 14: For MII, do you agree that the UE should only report the set of MBS frequencies of interest the UE is capable to simultaneously receive?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments / justification** |
| OPPO | Yes  |  |
| MediaTek | **Yes** |  |
| Ericsson | **Yes, with comment** | Simultaneous to receive when SCells are configured? |
| Samsung | **Yes** |  |
| CATT | **Yes, with comment** | We understand the question is whether the reported frequencies are also used for handover decision. It seems unnecessary. As TMGI is also included in MBS interest indication, serving gNB can make HO decision (i.e.to determine the target cell) based on TMGI. The assumption is that gNB is aware of which neighbouring cell providing what broadcast session identified by TMGI. However, it should be confirmed with RAN3 on this point. |

**Question 15: For MII, do you agree that the UE should only report the set of MBS broadcast frequencies of interest in case the UE supports at least one band combination containing this set of frequencies?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments / justification** |
| OPPO | Yes  |  |
| MediaTek | **Yes** |  |
| Ericsson | **Yes, with comment** | Is that not implicitly included?  |
| Samsung | **Yes** |  |
| CATT | **Yes** | It is relevant to Q14 |

**Question 16: For MII, do you agree that, when evaluating which frequencies it can receive simultaneously, the UE does not take into account the serving frequencies that are currently configured i.e. it only considers MBMS frequencies it is interested to receive?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments / justification** |
| OPPO | Yes  | It does not matter to report the current serving frequency or not. We think the serving frequency is default frequency UE can receive simultaneously. |
| MediaTek | **Yes** |  |
| Ericsson | **Yes** |  |
| Samsung | **Yes** |  |
| CATT | **Yes** |  |

Other aspects of frequencies and services of interest determination are proposed to be postponed until receiving a reply from other WGs related to USD/SAI definition. Similarly, whether MII is reported via UEAssistanceInformation or a new RRC message is dependent on the reply to the LS RAN2 sent to SA3, hence is not discussed at the moment.

## 2.5 MBS specific UAC and establishment cause

Whether to support MBS specific UAC and establishment cause was discussed tentatively in [2], but no conclusion could be reached. Proponents indicated that MBS specific UAC and EC allows the network to control the access attempts more flexibly and to apply specific treatment for MBS related access attempts during congestion. The sceptical companies indicated that MBS can be used to provide different kinds of services which can apply the current ACs/AIs and that mt-Access establishment cause can be reused as the UE replies to paging from the network. Companies are then requested to answer the following questions.

**Question 17: Do you think that UE access attempts due to multicast MBS (i.e. triggered by group paging) should apply MBS specific Access Categories during UAC and why? If yes, please also indicate some examples of additional ACs, e.g. should there be a common AC for MBS or depending on MBS service etc.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments / justification** |
| OPPO | Yes  | Multicast is different from unicast, the multicast can serve more users and can define another UAC cat. |
| MediaTek | **No** | We assume the current Access Categories can be reused  |
| Samsung | **Yes** | MBS specific UAC will be useful to address network congestion and service prioritization from network perspective |
| Ericsson | **No, for now** | In case the MC group is large, there is a risk that group paging causes congestion when the session is activated again, because the UE is not required to perform UAC check when reply to paging using *mt-Access* (i.e. the NW is supposed to suppress/control paging to avoid overload due to paging). But then again, the NW can decide to keep (most of) the UEs in connected mode when the MC session is deactivated and there are many MC UEs in connected mode that could cause congestion when released. In case a new MBS specific UAC control is introduced it is not obvious how to configure and control the access in such a way that all UEs of a very large group have returned to connected mode when the session is activated and ensure that no data is missed by any UE. In case of very large groups in connected mode, it might make more sense to handle them partly in idle/inactive temporarily, as was discussed before, but this topic was down-prioritized.  |
| CATT | **Yes** | To enable gNB to control the access attempt for the multicast reception purpose, it seems necessary to define new access category specific for the multicast. Since it is the scope of CAT/SA2, we need to request them to discuss it. |

**Question 18: Do you think that UE access attempts due to multicast MBS (i.e. triggered by group paging) should apply MBS specific establishment/resume cause and why? If yes, please also indicate some examples of additional establishment/resume causes, e.g. should there be a common establishment/resume cause for MBS or depending on MBS service etc.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments / justification** |
| OPPO | Yes  | The MBS specific cause can aid the network to decide to reject the access or not due to congestion. |
| MediaTek | **No** | We assume the establishment/resume cause can be reused  |
| Samsung | **Yes** | It is beneficial for network to selectively reject UEs for congestion issue. Among, MBS, there can be low priority MBS, high priority MBS or critical MBS which may need different treatment. We think at least one MBS specific cause value is necessary. Details can be discussed later. |
| Ericsson | **No** | There is *highPriorityAccess* and *mcs-PriorityAccess* that can be used during establishment to not reject high priority access, but reject other accesses. We are not sure if anything new is needed, or if an MBS establishment is needed, which can carry many different services. |
| CATT | **Yes** | For load balance, gNB may accept or reject RRC connection request based on the establishment cause in MSG3 from UE. Since multicast services could have different priorities compared to unicast services, it is beneficial to specify a new establishment cause for the purpose of multicast reception.  |

## 2.5 Data loss minimization during HO to non-MBS supporting nodes

With respect to this topic, the following has been previously agreed by RAN2:

* **[037] RAN2 assumes that from RAN2 perspective, mobility from the source gNB supporting MBS to target gNB not supporting MBS can be achieved by switching the traffic from delivery via MRB to delivery via DRB either before or during the handover. Whether and how this can be done without data losses has to be further investigated and requires progress and input from other WGs, i.e. RAN3 and SA2.**

RAN3 made the following agreements during RAN3#112-e meeting [3]:

|  |
| --- |
| * For mobility from supporting to non-supporting nodes:
	+ WA: Standards shall provide means whereby the SMF knows when receiving a Path Switch Request when a target NG-RAN node does not support MBS and means for SMF to then switch from shared delivery to individual delivery.
	+ WA: MBS support Indicator is included in Path Switch Request Transfer sent by an MBS supporting node to indicate support.
	+ MBS traffic delivery resources will be set up at target side using the information provided in the associated PDU session resource context in HO Request (for both Xn and NG mobility)
	+ Standards support data forwarding to minimize data loss during handover from MBS-supporting nodes to non-MBS supporting nodes.
	+ If data forwarding is used from MBS-supporting nodes to non-MBS supporting nodes, the source NG-RAN node should include in forwarded packets the unicast (flow) QFI mapped from the received MBS (flow) QFI.
 |

The second WA above was subsequently turned into an agreement during RAN3#113-e meeting and is already considered in the handover procedures described by SA2 in TS 23.247 [9]. From SA2 perspective, the Xn/N2 handover procedures are described in sections 7.2.3.2 and 7.2.3.3 of TS 23.247 [9] and they cover both MBS supporting nodes and non-MBS supporting nodes. For the latter, the traffic is switched from multicast session to the PDU session during the handover and the mapping between multicast QFI and the corresponding unicast QFI is provided by SMF to UPF. SA2 also captures the main principles of the handover from MBS supporting node to a node not supporting MBS in section 6.3.1 of TS 23.247 [9]:

|  |
| --- |
| To support Handover from NG-RAN node that supports MBS to a target NG-RAN node that does not support MBS:- mapping information about unicast QoS flows for multicast data transmission and the information of associated multicast QoS flows are provided to the NG-RAN node. This is already performed during the PDU session modification procedure for the PDU session associated with the MBS session when the UE Joins into the MBS Session;- during the handover procedure, the delivery method is switched from 5GC Shared MBS traffic delivery method to 5GC Individual MBS traffic delivery method, i.e. the N3 tunnel of the PDU Session for 5GC Individual MBS traffic delivery needs to be activated towards the target NG-RAN node. The SMF realizes that the target NG-RAN node does not support MBS.- the SMF and the MB-SMF shall activate the GTP tunnel between the UPF and the MB-UPF for 5GC Individual MBS traffic delivery method, if needed. |

Based on the above, it can be seen that in order to minimize the data loss, the source gNB can forward multicast data with a unicast QFI included, to the target gNB. Subsequently, target gNB can send this data to the UE using unicast, i.e. a DRB. However, in order to avoid packet loss and duplicate forwarding to application layer, the UE needs to be able to associate the data received in the source cell with data received via DRB in the target cell. However, it should be noted that in case the UE is configured with an MRB while the handover to a node not supporting MBS is performed, the target gNB will have to perform full configuration which inevitably leads to data loss or duplicate packet delivery to application layer. One way to avoid this happening would be to reconfigure MRB to DRB in the source node before the handover and deliver multicast data via DRB as a transient state. Companies are then requested to answer the following question.

Question 18: Do you agree that in order to minimize data loss during a handover from MBS supporting node to a node not supporting MBS, the source gNB may provide multicast data via DRB shortly before the handover? If not, please indicate how full configuration can be avoided and data loss minimization ensured otherwise.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments / justification** |
| OPPO | Yes  | No strong view. |
| MediaTek | **Yes** |  |
| Samsung | **Yes** |  |
| Ericsson | **-** | This is something for RAN3 to discuss further. We should consult RAN3 in an LS before deciding in RAN2.  |
| CATT | **No** | DRB is associated to unicast PDU session ,and for handover from MBS cell to non-MBS cell case, the unicast PDU session used for multicast is only activated in target cell, as captured in SA2 spec as below,

|  |
| --- |
| - during the handover procedure, the delivery method is switched from 5GC Shared MBS traffic delivery method to 5GC Individual MBS traffic delivery method, i.e. the N3 tunnel of the PDU Session for 5GC Individual MBS traffic delivery needs to be activated towards the target NG-RAN node. The SMF realizes that the target NG-RAN node does not support MBS. |

 |

## 2.6 Other FFS points from the RRC running CR

This section addresses some other FFS points from the RRC running CR related to Control Plane:

1. The definitions/acronyms of radio bearers related to MBS need to be agreed and aligned between TS 38.331 and TS 38.300.
2. Whether mtch-SchedulingInfo is provided in MBS-SessionInfo IE or another place (e.g. depending whether the DRX configuration can be common for multiple MBS sessions).
3. Whether if this field is absent (mtch-schedulingInfo), the MTCH may be scheduled in any slot.
4. Whether and extensible IE should be used instead of TMGI within PagingGroupList.

With respect to the first bullet RAN2 actually made a decision during RAN2#115-e meeting to define MRB as MBS Radio Bearer covering RBs for both multicast and broadcast. However, during the e-mail discussion on the RRC running CR it turned out that it is anyway required to distinguish radio bearers used for multicast and those used for broadcast as a vast majority of procedures applies to one type of MRB only, but not to the other. This resulted in referring to multicast MRBs and broadcast MRBs in the current RRC running CR. However, there is no definition of multicast MRB and broadcast MRB currently in the CR. The rapporteur thinks there are two possibilities to resolve this:

* Option 1: Revert the previous decision and introduce MRB as Multicast Radio Bearer and BRB as Broadcast Radio Bearer.
* Option 2: Introduce definitions of broadcast MRB and multicast MRB in the specifications.

First option seems to be cleaner, but would require RAN2 to revert its previous decision (this is not necessarily very problematic), while the second option is aligned with the current RAN2 decision and RRC running CR, but is a bit less clear. In any case, the companies are requested to provide their preference for this issue.

Question 19: Please indicate your preferred option for the multicast/broadcast radio bearers’ definition.

|  |  |  |
| --- | --- | --- |
| **Company** | **Preferred option** | **Comments / justification** |
| OPPO | Option 1? | In R17, the multicast MRB is only for RRC\_CONNECTED and multicast MRB is similar as DRB. Some text in 38.331 will mention multicast MRB as DRB did. But broadcast MRB is mainly for RRC\_IDLE/INACTIVE, some text in 38.331 cannot mention broadcast MRB as DRB did. So, it is better to introduce two definition for multicast MRB and broadcast MRB respectively.However, if we introduce multicast reception for RRC\_INACTIVE/IDLE UE in R18, it seems there is no much difference between multicast MRB and broadcast MRB.**So we can introduce one common definition for MRB, if the text should mention MRB for multicast only or broadcast only, we can say “multicast MRB” or “broadcast MRB”.** |
| MediaTek | **Option-2** |  |
| Samsung | **No change needed (Refer comments)** | **It is possible to distinguish with mentioning in text as broadcast MRB and multicast MRB when needed. There can be one common definition for MRB. We opine to do no change.**Further, we think in an attempt to make things easy now, we may face more issues later e.g. if multicast reception is supported for IDLE/INACTIVE in Rel18.  |
| Ericsson | **Option-2** |  |
| CATT | **Option-2** |  |

With respect to the second bullet above, the main question that needs to be addressed is whether the DRX configuration can be common for multiple MBS sessions which are mapped to different G-RNTIs (since the DRX configuration is per G-RNTI, it seems obvious it can be common for multiple sessions mapped to the same G-RNTI, if such mapping is allowed).

Question 20: Do you think it should be possible to apply the same DRX configuration for more than one G-RNTI?

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments / justification** |
| OPPO | Yes  | The ASN.1 should allow this case. |
| MediaTek | **No** | We think we should keep the current assumption that the DRX configuration is per G-RNTI. Whether multiple G-RNTIs are configured with the same DRX pattern is an implementation issue.  |
| Samsung | **Yes** | It is quite likely that multiple MBS broadcast services (G-RNTIs) may use same DRX configuration. Choice can be on network implementation to flexibility configure as and when needed, however, we agree with OPPO that ASN.1 should allow this case. Not considering this may lead to limited number of MBS broadcast services supported in MCCH or a large MCCH information message (may not be allowed by PDCP max SDU size limitation) or more segmentation causing multiple slots transmission (due to restricted BWP usage for MCCH) |
| Ericsson | **Yes, with comments** | We seem to discuss a signalling optimization. MDTK confirms that without this optimization the NW can also configure the same DRX configuration for different G-RNTIs. We are not sure why this signalling optimization should not be allowed. PS: the details are not clear though, i.e. this means that the common DRX configuration is lifted up to *MBSBroadcastConfiguration*? |
| CATT | **-** | Agree with MediaTek and Ericsson, i.e. The same DRX configuration can be used for more than one G-RNTI, but it can be covered by current IE structure, So we can leave it to NW implementation. |

With respect to the following FFS: “Whether if this field is absent (mtch-schedulingInfo), the MTCH may be scheduled in any slot”, it is understood that what is actually intended is that in case mtch-schedulingInfo is not configured (i.e. there is no DRX provided for the G-RNTI), the UE should monitor for PDCCH scrambled with G-RNTI in any slot according to the search space configured for MTCH.

Question 21: Do you agree that in case mtch-schedulingInfo is absent for a G-RNTI, the UE should monitor for PDCCH scrambled with G-RNTI in any slot according to the search space configured for MTCH.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments / justification** |
| OPPO | Yes  | We think the RAN1 spec should make it clear for this case. |
| MediaTek | **Yes** | We think in this case, there is no DRX pattern |
| Samsung | **No** | *mtch-schedulingInfo* being absent is not efficient from power consumption perspective and need not be allowed/implemented. Otherwise, we think benefit or rationale should be made clear for such a choice. |
| Ericsson | **Yes** |  |
| CATT | **Yes** |  |

The last bullet above, i.e. “whether an extensible IE should be used instead of TMGI within PagingGroupList”, refers to the following structure in the RRC running CR:

|  |
| --- |
| PagingGroupList-r17 ::= SEQUENCE (SIZE(1..maxNrofPageGroup-r17)) OF TMGI-r17 |

Instead of that, the structure similar to the one used for unicast paging record could be introduced:

|  |
| --- |
| PagingRecord ::= SEQUENCE { ue-Identity PagingUE-Identity, accessType ENUMERATED {non3GPP} OPTIONAL, -- Need N ...} |

This was considered by the RRC CR rapporteur initially, but the drawback of this approach is that it would introduce additional overhead of three bytes for each group paging record if this extension is used in future while currently it is unclear whether the extension will ever be needed. Even if extension for more IDs is needed in future, the most signalling effective way is to use the extension field in the end of the message. Considering this, the companies are requested to answer the following question:

Question 22: Do you think an extensible IE should be used instead of TMGI within PagingGroupList?

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments / justification** |
| OPPO | Yes  | It is better to define a new IE who including TMGI for future extension. |
| MediaTek | **-** | We prefer that the structure similar to the one used for unicast paging record be introduced |
| Samsung | **-** | In general, a structure similar to legacy unicast paging format seems suitable, but it is not clear if there is a need for any other ID than TMGI as far as MBS is concerned. |
| Ericsson | **No** | We agree with the rapporteur that a 3 byte overhead is introduced when the record would be extended in the future, and it is more efficient to add an extension field at the end of the message when needed (i.e. list of similar size as PagingGroupList-r17).  |
| CATT | **No** | We agree with rapporteur and Ericsson that it is better to add an extension field at the end of the message when needed in future. |

# 3 Summary

TBD

# References

1. [R2-2108799](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2//TSGR2_115-e/Docs/R2-2108799.zip), *Summary of [Post114-e][073][MBS] Service continuity for Delivery Mode 2 (Xiaomi)*, Xiaomi Communications
2. R2-2109078, *Report of [AT115-e][048][MBS] Notifications*, Samsung
3. RP-211361, *Status report for WI: Core part: NR multicast and broadcast services; rapporteur: Huawei*, RAN2
4. R2-2108970, *38.331 running CR for NR MBS*, Huawei, HiSilicon
5. R2-2108923, *38.304 running CR for NR MBS*, CATT
6. 3GPP TS 36.331, *Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification*
7. R2-2108914, *LS on the MBS broadcast service continuity and MBS session identification*, Source: RAN2
8. 3GPP TS 36.306, *Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio access capabilities*
9. 3GPP TS 23.247, *Architectural enhancements for 5G multicast-broadcast services, version 2.0.0*