**3GPP TSG-RAN WG2 Meeting #112e R2-200XXXX**

**Electronic, 02nd – 13th November 2020**

**Agenda item: 8.1.3**

**Source: CATT**

**Title: Summary of Email Discussion [Post111-e][906][MBS] Idle mode support**

**WID/SID: NR\_MBS-Core**

**Document for: Discussion and Decision**

# 1 Introduction

This document is the report of the following email discussion.

* [Post111-e][906][MBS] Idle mode support (CATT)

 Scope: MBS support in Idle Inactive modes. Focus on Control Plane aspects. Collect and describe understanding of the consequences of the main solutions on the table: A) reuse Conn Mode solution vs B) reuse EUTRA solution. At limited level of detail, Identify further main sub-options if any (e.g. low high ambition level).

 Intended outcome: Report

 Deadline: Long

The topic has been discussed in RAN2 #111-e meeting, and the descriptions and potential issues for discussions are based on companies’ contribution [1]-[25].

The remainder of this document is organized as the following. In Section 2, discussions are carried out to achieve a converged description and impact analysis for solution A and B, respectively. Some initial discussions on further details to solution A and B are also included. Section 3 is the conclusions and proposals.

# 2 Discussion

## 2.1 Description and impact analysis of solution A

A high level description of solution A is it reuses connected mode solution for idle/inactive mode. But according to the previous discussions there may be different understanding regarding to what extend the reuse should be. More specifically two sub-options for Solution A are described as below.

Solution A1 is described in [1],[3],[8], and [9], where solution A1 is compared with solution B. Solution A2 is described in [3].

In the following discussions we aim at a converged understanding of solution A (i.e., A1 vs A2) and its impact. To achieve these we first collect companies’ comments on the description and potential impact analysis of solution A1 and A2.

**Description of Solution A1**

**Solution A1: MBS reception is supported for UEs in Idle/ inactive mode, but the PTM configuration acquired in connected mode is reused.**

With solution A1, to enable the MBS reception in idle/inactive mode, the UEs have to move to connected mode to get PTM configuration beforehand. After the successful reception of the PTM configuration, the UE can go back to idle/inactive mode for the reception of MBS user data.

Companies are requested to provide their comments if any on the above description.

**Question 1: Do companies agree with the description of solution A1?**

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| --- | --- | --- |
| Company | Yes/No | Comments if answer is No |
| CATT | Yes |  |
| Huawei, HiSilicon | Yes | As a very general description, this is valid, but some details need to be clarified, e.g. how is the configuration updated when the UE moves between cells, when configuration needs to be updated in the cell etc. |
| OPPO | Yes  | Agree with the description of solution A1, but do not agree with solution A1.For broadcast kind of MBS service, it means the RRC\_IDLE/RRC\_INACTIVE/RRC\_CONNECTED mode UE can receive the MBS service. It is no need to enter RRC\_CONEECTED only for configuration reception. Furthermore, if we did as Solution A1, the UE will enter RRC\_CONNECTD immediately after cell reselection.We can not see the necessary to support solution A1.The SC-PTM mechanism can be reused as LTE did. |
| Ericsson | Partially | * RAN#89 decided that ([RP-202086](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN//TSGR_89e/Docs/RP-202086.zip)): *NR-based broadcast is within the scope of RAN WI for NR MBS in Rel-17, as per the WID approved in [RP-201038](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN//TSGR_88e/Docs/RP-201038.zip)*. One of the assumptions/restrictions in the WID says: *No support of Free to air/receive only mode is provided in this WI*. And there is a NOTE in the WID for Idle/Inactive mode saying: .

*Note: the possibility of receiving Point to Multipoint transmissions by UEs in RRC\_IDLE/ RRC\_INACTIVE states, without the need for those UEs to get the configuration of the PTM bearer carrying the Broadcast/Multicast service while in RRC CONNECTED state beforehand, is subject to verification of service subscription and authorization assumptions during the WI.* Further discussion is needed to understand what is in scope for REL-17, and whether the UE is required to go to connected mode for service subscription verification and authorization to receive the PTM configuration. Or can the UE remain in Idle (and Inactive) without going to Connected mode, and receive MBS?. In case the UE remains in Idle/Inactive to receive MBS, the NW does not know where the UEs interested to receive the MBS session are and where to broadcast MBS (or when the UE has joined a group, but this information is not exposed to CN/RAN). In case MBS can be received in Idle/Inactive and Connected mode it should be discussed whether certain services are only received in Connected, and others in Idle/Inactive due to QoS, reliability, service continuity, etc. * It is not clear from the description of solution A1 if exactly the same PTM configuration as is used to receive MBS in connected mode is re-used to configure MBS in Idle/Inactive mode, i.e. would there be differences in the configuration (e.g. no UL feedback in Idle/Inactive, or different QoS)?
* The UE would also have to go to connected mode when the PTM configuration changes (otherwise the reception may be interrupted), and when the UE reselects to another cell (assuming the service continuity is supported).
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**Impact analysis of Solution A1**

Impact A1.1: Increased latency due to getting configuration in connected mode beforehand

It is mentioned in [1] that UE may not update the configuration in time when the network updates the configuration, which may affect the MBS data reception.

It is also mentioned in [7] that it increases latency significantly, especially when a new MBS service starts and the configuration of an ongoing MBS service is modified.

Impact A1.2: Increased Complexity as addition solutions are necessary

It is mentioned in [7] that solutions to enhance the paging efficiency and paging reliability may be necessary.

Impact A1.3: Increased UE power consumption and higher NG-RAN overhead

It is mentioned in [7] that it increases the network workload (e.g. RACH and Paging) significantly, especially when a new MBS service starts and the configuration of an ongoing MBS service is modified.

Besides, it is also mentionedin [8] that solution A1results in increased UE power consumption and higher NG-RAN overhead.

Impact A1.4: It is not future proof for some services to be supported in the future, like Free-to-air.

It is mentioned in [1] and [8] that and this approach has the limitation that UE needs to enter RRC\_ CONNECTED state, which is not future-proof to some services/UEs such as Free-to-air service UEs.

Companies are requested to provide their comments on the impact analysis of solution A1.

**Question 2: Do companies have any comments about the impact analysis of solution A1?**

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| Company | Comments |
| CATT | Agree with the impact analysis A1.1-A1.4. |
| Huawei, HiSilicon | In addition to the issues mentioned above, there is an additional signalling overhead while the UE is moving around the network. The UE would have to setup the connection with the network every time it reselects a new cell to get an updated MTCH configuration. |
| OPPO | Agree  |
| Ericsson | * Even when it is agreed that MBS reception is also supported in Idle/Inactive mode (without going to connected mode), perhaps some MBS services may not be supported in Idle/Inactive mode due to lack of QoS, reliability, service continuity, etc. When MBS is received in Connected mode, the UE is in Idle/Inactive mode most of the time, i.e. the NW has to support Paging (or MCCH) to notify the UE to transition to Connected mode when the MBS session starts, i.e. solution A is not introducing a new case in that respect. In case a (multicast) service is only supported in Connected mode, then also a latency is experienced when the UE needs to transition to Connected mode. The impact described in question 2 is also experienced when MBS is received in Connected mode.
* Notifications of MBS session start/stop is required, whether MBS is received in Idle/Inactive mode or in Connected mode. It requires further discussion/analysis whether MBS notifications in Idle, Inactive and Connected mode, are carried via Paging/SI or MCCH.
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**Description of Solution A2**

**Solution A2: MBS reception is not supported for UEs in idle/inactive mode, i.e., UEs need to transit to and stay in connected mode for MBS reception.**

**Question 3: Do companies agree with the description of solution A2?**

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| Company | Yes/No | Comments if answer is No |
| CATT | Yes |  |
| Huawei, HiSilicon |  | In our opinion, this is not a valid solution to the problem of MBS reception in IDLE/INACTIVE mode reception. It requires the UE to be in RRC Connected mode to receive the MBS service while the objective (per WID) is *“to enable the reception of Point to Multipoint transmissions by UEs in RRC\_IDLE/ RRC\_INACTIVE states”*. |
| OPPO | Yes  | Agree with the description of solution A2, but do not agree with solution A2. |
| Ericsson | Partially | * The MBS solution is much simpler and there is maximum re-use of connected mode functionality when MBS is received in Connected mode. MBS reception in Idle/Inactive introduces much complexity to be discussed and resolved (reduced QoS, no reliability, no UL feedback, RoHC U-mode only, PTM only, no dynamic MBS transmission area, no seamless service continuity, initial BWP may not be sufficient to support MBS, need to configure MBS on all beams, over-allocation of NW resources when the NW does not know where/when UEs interested in MBS session are listening, handling of RRC state where to receive the MBS session, etc).
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**Impact analysis of Solution A2**

The impact of solution A2 is similar as solution A1, i.e., it leads to increase of UE power consumption and network signalling overhead. And the impact may be more severe comparing to solution A1 as UE should always stay in connected mode during the MBS reception.

**Question 4: Do companies have any comments about the impact analysis of solution A2?**

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| Company | Comments |
| CATT | Agree with the impact analysis. |
| Huawei, HiSilicon | This solution does not meet the objective of the WI. |
| OPPO | Agree  |
| Ericsson | * There is maximum re-use of connected mode functionality, and connected mode provides the best QoS, service continuity, reliability, resource usage. No discussion where to receive which service is required.
* Even when MBS is supported in Idle/Inactive, not all MBS services will be supported in Idle/Inactive, i.e. in our understanding solution A2 will be supported.
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Based on the previous discussions, companies are request to provide their view regarding which sub-option, i.e., A1 or A2 is chosen as the understanding of solution A in further discussions.

**Question 5: What is companies’ view on solution A1 vs. A2, as the understanding of solution A for further discussions?**

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| --- | --- | --- |
| Company | A1 or A2 | Comments |
| CATT | A1, as the understanding of solution A | Both solution A1 and A2 will result in high UE power consumption and network signaling overhead. But the impact of solution A2 may be more severe, compared with solution A1.Besides, solution A2 has high requirement on the capacity of NG-RAN node. Considering the limited capacity of NG-RAN, it is unrealistic to require all the MBS services to be received only in RRC\_CONNECTED state, e.g., there are mission critical MBS services which need to support a large number of devices. Furthermore, solution A2 is not suitable for broadcast service. It is unreasonable to require UEs to stay in connected state for receiving the broadcast. |
| Huawei, HiSilicon | A1 | As mentioned above, since solution A2 does not meet the objective of the WI, it should not be considered. |
| OPPO | A1 |  |
| Ericsson | A2 | * In our understanding A2 is already in, i.e. some MBS session will only be supported in Connected mode. It is not clear to us why the UE would go back to Idle/Inactive to receive MBS, i.e. connected mode offers cDRX for power saving.
* When there is a need to receive MBS in Idle/Inactive, then this should be motivated. In our understanding the discussion should be why Connected mode reception is not sufficient, instead of just enabling Idle/Inactive mode MBS reception. In case Connected mode cannot support the required number of users, or when RACH becomes overloaded when MBS session starts, then that could be possible reasons why Idle/Inactive mode reception is required. But it is not clear whether the requirements cannot be met in Connected mode, and Idle /Inactive will add much complexity and they provide different QoS/reliability. Furthermore in case the NW has to continuously broadcast multiple MBS sessions in the complete services because the NW does not know where the interested UEs are, then that will result in a very inefficient use of the NW resources.
* About A1 vs A2: transitioning back to Idle/Inactive to receive MBS in Idle/Inactive only increases the signalling load further. From a signalling and latency perspective it is preferable that either the UE stays in Idle/Inactive and receives MBS there without going to Connected, or the UE transitions to Connected mode and receives MBS there.
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## 2.2 Description and impact analysis of solution B

Solution B has been discussed in contributions from most of companies. In online session of RAN2#111e meeting, a number of companies also expressed their views about reusing SC-PTM solution as baseline. And chairman also shared his observation in chairman notes which can be found in [26] as below,

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| Chair observations: Many proposals to reuse (to significant extent or even 100%) LTE SC-PTM for Idle/Inactive for NR. Some companies suggest to do control etc in connected also for Idle/Inactive delivery. |

In SC-PTM, the configuration of PTM bearer is transmitted over a MBS specific control channel (SC-MCCH).The overall channel structure for SC-PTM is characterized by:

 - There is one SC-MCCH and one or more SC-MTCH(s) mapped on DL-SCH within a cell;

 - SC-MCCH and SC-MTCH transmissions are each indicated by a logical channel specific RNTI on PDCCH (there is a one-to-one mapping between TMGI and G-RNTI used for the reception of the DL-SCH to which a SC-MTCH is mapped);

The general procedure for acquisition of the PTM configuration is shown as Figure 1 below,

 Step 1: UEs interested in MBS service receive the single SC-MCCH configuration by reading SIB20;

 Step 2: UEs interested in MBS service receive the SC-MTCH configuration in *SCPTMConfiguration* message which is transmitted in the SC-MCCH;

 Step 3: UEs receive the interested MBS service using the SC-MTCH configuration acquired in step 2.

 

Figure 1 LTE SC-PTM configuration and service acquire procedure

Therefore, we conclude the description of solution B as below:

**Description of Solution B**

**Solution B: Use the SC-PTM solution as the baseline, including the following characteristics,**

 - **A limited amount of MBS control information is provided on e.g. BCCH, to indicate how to acquire the MBS control channel, e.g. SC-MCCH;**

 - **Most MBS Control information is provided on the MBS control channel, e.g. SC-MCCH;**

 - **The MBS control channel carries a message to indicate the MBMS related information;**

 - **MBS radio bearers are transmitted on respective MBS traffic channel, e.g. SC-MTCH(s);**

 - **A notification mechanism is used to announce the change of MBS Control information.**

**Question 6: Do companies agree with the description of solution B?**

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| Company | Yes/No | Comments if answer is No |
| CATT | Yes |  |
| Huawei, HiSilicon | Yes | We do not see issues in applying the LTE SC-PTM framework as a baseline while the benefit is that we do not have to repeat many discussions which already took place in the past for LTE.  |
| OPPO | Yes  |  |
| Ericsson | Partially | * It should be discussed further whether MBS notifications and MBS control information is transmitted via Paging and System Information and MCCH notification channel and SC-MCCH control channel. Paging/SI is supported by UE and NW and can potentially be re-used, instead of introducing new logical channels. Further discussion is needed whether the configured Paging DRX cycle, and the configured SI modification period can be re-used for MBS.
* In our understanding SC-PTM compared to MBMS introduces the possibility to only support SC-PTM in some cells, but not all cells, of a frequency. Such support introduces extra complexity, and we would like to understand why this is motivated? In case SC-PTM is not supported in some cells, then this may conflict with the objective of service continuity. We also would like to understand how “dynamic MBS transmissions” fit into the SC-PTM concept? Perhaps MBS is not transmitted in a cell when it is not needed, but when needed an MBS session transmission is started? We think these aspects need to be discussed first before agreeing on an “SC-PTM” solution. PS: we do not propose SFN transmissions, i.e. that is a separate aspect.
* To what extend is the USD a substitute or compliment to the information carried on SC-MCCH? Perhaps for some services SC-MCCH info is not needed because the information is pre-configured and provided via the USD?’
* It is not explicitly described for solution B above whether the “notification mechanism” is another SC-MCCH with a special RNTI?
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**Impact analysis of Solution B**

It is mentioned in [3] that introduction of a separate control channel for MBS (SC-PTM like) offers much more flexibility, but it comes at a higher cost of complexity and impact, for both UE and NW.

Besides, companies also have some discussion on whether SIB overhead is a problem during RAN2#111e, which can be found in chairman notes [26].

**Question 7: Do companies have any comments about the impact analysis of solution B?**

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| Company | Comments |
| CATT | We do not think there will be higher cost of complexity and impact for solution B, compared with solution A. SC-PTM solution can be simply reused as much as possible if we choose solution B. Therefore the design complexity of solution B will be low. On the contrary, solution A requires further discussions and some mechanisms are needed to handle issues mentioned in section 2.4. |
| Huawei, HiSilicon | An alternative to introducing SC-MCCH is to provide MBS control information directly in SIB. However this could have an impact on other UEs, not interested in MBS services, whenever the control information provided in the SIB changes. With this approach, in case MBS control information changes would be notified via SI change notification, such UEs would have to read SIB1 to determine whether the SI change has impact on them. Another drawback of this approach is that the changes could be introduced only in subsequent SI modification period, which limits network flexibility and may increase the delay for UEs to start receiving the service. To avoid such impacts, we prefer to reuse LTE mechanism to provide MBS control information via SC-MCCH. |
| OPPO | We think the SC-PTM in LTE can be the baseline with some improvement based on NR features as proposed in [5]. |
| Ericsson | * The use of Paging and System Information is another alternative to SC-MCCH notification channel and SC-MCCH control channel. The introduction of new logical channels in NR should be motivated.
* Furthermore, in case MBS reception is supported in different RRC states, it should be discussed what which control/data channels are (re-)used in the different states.
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## 2.3 Further details of Solution A and B

The following further detail issues mentioned in companies’ contributions are applicable to solution A and solution B.

**Issue 2.3.1: Whether NR MBS can be deployed on a cell basis?**

The key issue to enable the service continuity of MBS reception for UE during cell reselection is how to determine whether a candidate cell supports the receiving MBS service, then UE in idle/inactive mode could chose cell supporting its onging service to achieve the service continuity. There are some frequency based mechanisms defined in SC-PTM.

Issue 2.3.1.1: Whether to reuse the mechanism in SC-PTM that providing MBS service information for neighbour frequencies(like in SIB15)?

In SC-PTM, the UE is made aware of which frequency is providing which MBMS services via MBSFN or SC-PTM through the combination of the following MBMS assistance information, according to clause 15.4 in TS36.300,

- user service description (USD): in the USD , the application/service layer provides for each service the TMGI, the session start and end time, the frequencies and the MBMS service area identities belonging to the MBMS service area;

- system information: MBMS and non-MBMS cells indicate in *SystemInformationBlockType15* the MBMS SAIs of the current frequency and of each neighbour frequency.

It is worth to clarify that a list of neighbour cells where ongoing MBMS sessions provided via SC-MRB in the current cells are also provided on SC-MTCH, but this information is not used for idle mode mobility, according to the agreement in RAN2#92 meeting.

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| RAN2#92 agreementSC-PTM service continuity information is provided in SC-MCCH. The information should not be used to idle mode mobility. |

It is mentioned in [6] that legacy LTE SC-PTM MCCH transmission of neighbour cell frequency list mechanism can be the baseline of NR MBS for service continuity.

Besides, it is also mentioned in [9] that the network can provide the MBS service information (e.g. TMGI) of the current cell and the neighbour frequencies via SIB as the service continuity assistance information.

Issue 2.3.1.2: Whether to reuse the mechanism in SC-PTM that prioritizing the frequency providing its interested MBS service during cell reselection?

There is frequency prioritization rule specified for MBMS in LTE. UE can prioritize the frequency providing its interested MBS service during cell reselection, to ensure service continuity.

According to 36.304, if the UE is capable either of MBMS Service Continuity or of SC-PTM reception and is receiving or interested to receive an MBMS service and can only receive this MBMS service while camping on a frequency on which it is provided, the UE may consider that frequency to be the highest priority during the MBMS session as long as the conditions of UE capability and the broadcast SIB are fulfilled.

It is mentioned in [4],[6],[9] that the idle and inactive UE prioritizes the frequency providing its interested MBS service during cell reselection procedure.

On the other hand, it is suggested in [8] to reconsider whether to reuse the above frequency based SC-PTM mechanisms for NR MBS. As in LTE, the related mechanisms are based on assumption that MBS service is deployed on a per frequency basis. When it comes to NR MBS, the MBS services will not necessarily be deployed on a per frequency basis, but it may be on a cell basis. Then how UE will be made aware of which cell is providing which MBS services may need be considered.

**Question 8: Do companies think NR MBS can be deployed on a cell basis,** **and if yes what is companies’ comments on issue 2.3.1.1 and issue 2.3.1.2?**

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| Company | Yes/No | Comments |
| CATT | Yes | NR MBS could be deployed on a cell basis. If so, related frequency based mechanism in SC-PTM mentioned in Issue 2.3.1.1/ Issue 2.3.1.2 could not be reused.Even in LTE SC-PTM, the MBMS could also be deployed on a cell basis. But it chose to follow the frequency based mechanism of MBSFN. The reason is more or less for avoiding the extra specification changes.When it comes to NR MBS, it will not necessarily be deployed on a per frequency level, cell level based MBS transmission could be considered in NR for a flexible deployment. So it does not make sense to indicate the MBS services in system information on a granularity of frequency. |
| Huawei, HiSilicon | Yes | We should not exclude such option as it would limit the network deployment flexibility. On the other hand, we should not violate the rule that a UE shall camp on the strongest cell on the certain frequency. We can however keep the LTE mechanism where the UE prioritizes a frequency where it is able to receive MBS service as per information provided via SIB (similar to SIB15 in LTE). |
| OPPO | Not sure | We are not sure whether the MBS deployment is on a cell basis or frequency basis we think we can postpone this issue and wait for inputs from SA2. |
| Ericsson |  | * There are different issues discussed here:
	1. Should service continuity be supported in Idle/Inactive?
	2. Configuration restrictions (MBS on all or some cells on the same frequency)?
	3. What type of neighbour cell is needed for idle/Inactive mode service continuity?
	4. How to provide this neighbour cell information (SIB, MCCH)?
* Our feedback:
	1. The service in Idle/Inactive will have different QoS/reliability compared to connected mode. If service continuity is supported, we assume that the service continuity in Idle/Inactive will be more relaxed.
	2. We think a distinction between currently not broadcasted (dynamic MBS transmissions) and not supported should be made. We assume that the latter is discussed here. In case the MBS session is not supported on some cells, then this may conflict with the service continuity requirement, i.e. the UE may roam out of “MBS session service area”. To enable true service continuity the MBS session should be supported on the “coverage layer”, otherwise the UE would need to change frequencies during Idle mode mobility. On a frequency the UE should always select the strongest/highest ranked cell, also when the UE wants to receive MBS. Otherwise the UE may create interference, which should be avoided. The UE could temporarily, when interested to receive MBS, re-select to a frequency where MBS is supported, but when no longer interested to receive MBS, there should be a proper dispersion to avoid conflicts with load balancing, and UEs congregating on MBS frequencies.
	3. For the NW it is complex and costly to provide MBS information on **granularity of MBS session** information (e.g. start/stop times per MBS session) **on a per cell basis** in the neighbour cell information. What are the use cases where this information cannot be provided more semi-statically in a pre-configured USD from the upper layers, and when does this information need to be dynamically provided in SIBs? What is the impact on Paging with SI modification when new groups/MBS sessions are dynamically created and deleted all the time, and SIBs need to be updated in all neighbouring cells continuously? Typically system information, except for ETWS/CMAS, is not changed frequently.
	4. We think that both SIB and MCCH are feasible to provide neighbour cell information. The concern is more when this neighbour cell information needs to provided with high granularity (per MBS session and per cell) and the signalling impact when this information frequently changes.
* As we indicated earlier Paging and System Information is another alternative to SC-MCCH notification channel and SC-MCCH control channel. We think that Paging/SI and MCCH like solution should be further analysed and evaluated, before any conclusion.
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**Issue 2.3.2: whether BWP framework is applied in NR MBS?**

UE in RRC\_IDLE/RRC\_INACTIVE state operates on initial Downlink BWP which is common for all UEs in the cell coverage. System information acquisition and paging reception in RRC\_IDLE/RRC\_INACTIVE states could all be performed by UE on initial downlink BWP. Bandwidth of the initial downlink BWP may be not so large as there is limited data to be transmitted on initial downlink BWP.

It is proposed in [8] to define the MBS specific BWP for MBS service transmission. And it is mentioned in [10] that MBS BWP can be same as or cover initial BWP. Furthermore, it is proposed in [21] that different BWPs in a cell can provide different MBS services.

On the other hand, it is proposed in [19] that whether BWP framework is applied in NR MBS shall be jointly discussed with RAN1.

**Question 9: Do companies think BWP for MBS should be discussed, and if yes what is companies’ what are companies’ comments?**

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| Company | Yes/No | Comments |
| CATT | Yes | BWP framework should be applied to MBS transmission to achieve a flexible use of frequency resources, and minimize potential impact to other non-MBS services in a cell.And it seems MBS specific BWP is needed as there may be no enough capacity in initial BWP to accommodate the transmission of the variety of MBS services supported by the cell. |
| Huawei, HiSilicon | Yes | Yes, we have to specify the BWP that should be used by the UEs for MBS reception. BWP configuration for MBS has to be discussed also for RRC Connected mode and this discussion should take place in RAN1 in the first place.  |
| OPPO | Yes  | For broadcast kind of MBS, the RRC\_IDLE/RRC\_INACTIVE mode UE will receive the MBS service, so the cell level MBS dedicated BWP should be configured. If no, the MBS delivery will only rely on the bandwidth of CSS#0. If so, it will impact the capacity of the cell and the data rate of the MBS. We should also note that the broadcast kind of MBS will be transmitted via beam sweeping. It will use more radio resource so the radio resource will be not enough if only rely on bandwidth of CSS#0.  |
| Ericsson | Yes | This should be discussed in RAN1. But we think that the initial BWP can be used to configure MBS reception in Idle/Inactive (if agreed). In case a wider initial BWP needs to be configured to accommodate MBS, then this has minimal impact on the UE power consumption as Idle/Inactive mode power consumption is only 10-20% of the overall UE power consumption, and the main Idle mode power consumption source is waking up from sleep, and not to a wider BWP/CORESET to monitor (i.e. single digit power consumption of the Idle mode power consumption).  |
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**Issue 2.3.3: Whether to introduce counting/UE interest indication mechanism for UE in idle/inactive mode?**

According to 36.300, there are separated counting procedure and MBMS interest indication in LTE. The MBMS Service Counting procedure is used to trigger the eNB to count the number of connected mode UEs that either are receiving the MBMS service(s) or are interested in the reception of the MBMS service(s), which is used for MBSFN. MBMS interest indication procedure is used for service continuity with mobility in connected mode, which is applicable to MBSFN and SC-PTM

In NR MBS, the counting and interest reporting mechanisms may be combined into one in Uu interface, and could be utilized for the NG-RAN to decide the PTP/PTM switch. It is proposed in [6], [8], [22] that UE in idle/inactive mode could be able to report interests. It is also mentioned in [8] that the interest in MBS by UE in idle/inactive mode needs to be sent to MBS capable NG-RAN node upon cell reselection, to enable target cell to trigger the establishment of multicast transport if not already existing.

Furthermore, it is proposed in [6] that UE in idle/inactive mode could report the counting without entering RRC\_CONNECTED state.

**Question 10: Do companies think counting/UE interest indication mechanism should be introduced for UE in idle/inactive mode?**

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| --- | --- | --- |
| Company | Yes/No | Comments |
| CATT | Yes | UE interest in MBS could be used for PTM/PTP switch, and may also be used to trigger the MBS session resource UP establishment in target cell during cell reselection. To determine the PTP/PTM mode switch within a cell, NG-RAN needs to know the number of UEs interested in MBS services. It will be not accurate if interest of UEs in idle/inactive mode is not taken into account.Interest reported by UE in idle mode could also be used by the target cell to request MBS session resource UP establishment upon cell reselection, to ensure the basic service continuity for UE in idle/inactive mode. This is based on RAN3 agreement that RAN may request MBS session resource UP establishment, e.g. in handover (FFS).Maybe this can be extended to cell reselection. |
| Huawei, HiSilicon | No | It is preferable to reuse LTE SC-PTM mechanism as a baseline, i.e. support MII report (at least for broadcast scenario where no registration info is known to the network) when the UE is in RRC\_CONNECTED state or is going to RRC\_CONNECTED (not for UE in RRC IDLE/INACTIVE) and there is no need of counting in this release. |
| OPPO | Yes  | It is too early to discuss this issue. RAN2 can wait for more inputs from SA2.For now, the MBS identities, MBS deployment, MBS service establishment procedure are not clear. |
| Ericsson | Depends | * Depends on the service and RRC state. RAN3 agreed that counting in connected mode (for multicast) is not supported, because the NW knows which UEs are interested in MBS from the MBS context in the UE context. But when broadcast service means that the UE does not need to join a group, or the group information is not exposed to the RAN, then there could be a security issue with counting, because the NW cannot check if the UE is authorized to received broadcast service (i.e. turn broadcast transmissions on/off).
* The need for “interested” signalling in Idle/Inactive depends on whether it is agreed that MBS reception in Idle/Inactive mode is supported (irrespective if it concerns a multicast or broadcast service). In case MBS reception in Idle/Inactive mode is supported it is beneficial to support dynamic MBS transmissions, i.e. only broadcast the MBS session when a UE in Idle/Inactive mode is interested to receive it. Ideally the first UE in the cell that is interested in the MBS session actives the MBS transmission, and the last UE leaving switches it off. SI on demand can be consider for the former case, and some “interested” signalling can be considered for the latter case. But in both cases possible security issues may need to be considered, to prevent a fraudulent/non-authorized UE to “switch on and off the light”.
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## 2.4 Further details of solution A

In this subsection, solution A is further discussed.

Both solution A1 and A2 are listed, but intention is to down-select one already in section 2.1, so that in the conclusion of this email discussion we only include the further details of the selected sub-option if available.

**Solution A1**

Based on company contributions some further issues are discussed for solution A1.

**Issue A1.1: How to reuse the PTM configuration for connected mode?**

It is mentioned in [1] that obtaining MBS configuration in RRC\_CONNECTED state beforehand could be achieved by two alternatives:

1) Getting the separate configuration for RRC\_IDLE/ RRC\_INACTIVE state specially, or;

2) Reusing the configuration for RRC\_CONNECTED state.

It is mentioned in [3] and [9] that PTM configuration for idle/inactive mode could be delivered in *RRCRelease* message, which also implies that there will be separate PTM configuration for idle/inactive mode.

**Question 11: Do companies think issue A1.1 above should be addressed for solution A1,** **and if yes what is companies’ view on the two alternatives?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| CATT | Yes | Alternative 2 is better.For services that could be received in idle/inactive mode and connected mode, the PTM configuration should be same in any RRC state.  |
| Huawei, HiSilicon | Yes | It might be more straightforward to provide a separate configuration in RRCRelease. The configuration in RRC Connected might be different, e.g. it may have an additional PTP leg, HARQ configuration etc., so reusing it would be problematic in some cases. |
| OPPO | Yes  | For broadcast kind of MBS, RRC\_IDLE/RRC\_INACTIVE/RRC\_CONNECTED UE can receive this kind of MBS. So, there is no need to receive the MBS data after UE entering RRC\_IDLE/RRC\_INACTIVE. If the solution A1 is supported, we prefer reusing the configuration for RRC\_CONNECTED state. |
| Ericsson | Yes | It needs further discussion of the connected mode PTM configuration can be re-used as is or a modified configuration is needed (due to lack of feedback, QoS, reliability, etc in Idle/Inactive). We also would like to point out that variants on 2) are possible, e.g. configuration in *RRCRelease*.  |
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**Issue A1.2: How to inform the start/modification/stop of a service to UE in idle/inactive mode?**

As discussed in [7], upon the start/modification/stop of a service, the UEs that are interested in this service shall move to RRC\_CONNECTED state to acquire the corresponding MBS configuration. The paging is initiated by the CN to notify the UEs the start/modification/stop of a MBS service. With the assumption that the UEs have registered its MBS interests to the CN, the CN could page the UEs that are interested in this MBS service individually. However, as a MBS service is normally transmitted to multiple UEs, the individual paging is not efficient. To enhance the efficiency of paging and reduce the workload of the network, the group paging mechanism might be worth to be introduced. And to avoid bringing the UEs that are not interested in this service to RRC\_CONNECTED state, assistant information, i.e. the service ID or TMGI of this service, might be included to the paging message.

**Question 12: Do companies think issue A1.2 should be addressed for solution A1, and if yes what is companies’ view on solution to this issue?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| CATT | Yes | This issue needs to be addressed.Solution such as enhanced paging is needed to support the notification of the start/modification/stop of a service to UE in idle/inactive mode, in case solution A1 is standardized. |
| Huawei, HiSilicon | Yes | Paging the UEs individually would be inefficient, so a group paging mechanism would be required for this approach, together with additional information in the paging message (service ID or TMGI) to avoid bringing UEs to RRC Connected state unnecessarily. |
| OPPO | Yes  | If solution A1 is supported, we think the paging is the only way for the UE to update the configuration. But it will increase the delay, because only the RRC\_CONNECTED UE can get the MBS configuration. |
| Ericsson | Yes | * MBS notifications are required in all RRC states, independent where MBS content is received/supported.
* Whether to use MCCH or Paging to notify MBS changes needs further discussion. In case Paging is used, then impact on legacy UEs should be avoided, i.e. Paging DCI should indicate at least that this concerns an MBS change. The NW needs to page during at least 2 DRX cycles to reach all UEs reliably, and it is not clear if the DRX cycle configured for Paging satisfies the latency requirement for MBS.
 |
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**Issue A1.3: How the UE gets the configuration when joining an ongoing MBS session, or in case of cell reselection?**

As discussed in [7], A UE may need to continue receiving a MBS service, i.e. when after changing its serving cell(s). In this circumstance, the UE in RRC\_IDLE/ RRC\_INACTIVE state may need to first acquire the availability of the interested MBS service(s). If the service is available in this cell, the corresponding configuration could also be acquired and transmitted via dedicated RRC message (s). To accomplish the above procedure, the UE has to perform RACH to establish the RRC connection.

It is also mentioned in [7] thatin some scenarios, a UE may not enable the reception of the interested MBS service when the service begins for whatever reasons, e.g. the UE is not interested in this service at that moment. When the UE is willing/ enabled to receive this MBS service, it shall perform RACH to acquire the MBS configuration that is carried by dedicated RRC message(s).

**Question 13: Do companies think issue A1.3 should be addressed for solution A1, and if yes what is companies’ view on solution to this issue?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| CATT | Yes | Solution to trigger UE to enter connected mode is needed. There should be a mechanism to support UE entering connected mode for PTM configuration for these scenarios. And increase of network signalling overhead could be foreseen due to RACH procedure from multiple UEs.  |
| Huawei, HiSilicon | Yes | The UE will be required to establish a connection when willing to start receiving a service and every time it reselects a cell (since the configuration of SC-PTM can be different in different cells). This will impact UE power consumption and will increase signalling overhead.  |
| OPPO | Yes  | After cell reselection, the UE will enter RRC\_CONNECTED to update the MBS configuration if solution A1 is supported. It will increase the delay and data loss. |
| Ericsson | Yes | In our understanding this discussion depends on whether service continuity in Idle/Inactive is supported, and to what extend/level. One solution is that UE goes to Connected after cell re-selection, or goes to Connected when it becomes interested to receive MBS session.  |
|  |  |  |

Companies can provide their comments on any other issues for solution A1 if they are not covered by previous discussions.

**Question 14: Is there any additional issues to be addressed for solution A1?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Huawei, HiSilicon | Yes | Since the UEs are required to access the network in many cases as discussed above, we can expect that there might be congestion issue for access especially when we trigger paging for service start/modification/stop and there are a lot of UEs interesting this service. |
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**Solution A2**

**Issue A2.1**: **How to inform the start of a new service to UE in idle/inactive mode?**

This issue for solution A2 is similar as issue A1.2 for solution A1.

With solution A2, the key issue is there should be a way to trigger the transition from idle to connected mode. This issue is raised and addressed in [3].

Several solutions have been discussed in [3] as below, in which the solution 3 on paging enhancement is also mentioned in issue A1.2 for solution A2.

Solution 1: MBS reception in Connected, transition from Idle triggered by higher layers

Solution 2: MBS reception in Connected, transition triggered from Idle triggered by RRC connection setup

Solution 3: MBS reception in Connected, transition from Idle via Paging

**Question 15: Do companies think the issue A2.1 should be addressed for solution A2,** **and if yes what is companies’ view on the** **solutions to the issue?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| CATT | Yes | Solution to trigger UE to enter connected mode is needed. It is worth to note that any solution to address this issue will increase UE power consumption and network signalling overhead. |
| Huawei, HiSilicon | Yes | We assume that similarly as in the case of solution A1, the notification of the new service requires that the network pages the UEs (Solution 3).  |
| OPPO | Yes  |  |
| Ericsson | Yes | * MBS change notification needs to be supported, whether MBS reception is done in Idle/Inactive or Connected mode! We were not sure which new question was asked here, and therefore not sure how to answer.
* The WID says to aim for maximum commonality between Connected mode and Idle/Inactive mode PMT configuration. This is achieved when UE transitions to Connected mode and receive MBS there. This also avoid differences in QoS, reliability, service continuity and in-efficient use of NW resources when the UE is in Idle/Inactive mode, and the NW does not know where the UEs are that are interested in the MBS session.
 |
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Companies can provide their comments on any other issues for solution A2 if not covered by previous discussions.

**Question 16: Is there any additional issues to be addressed for solution A2?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Huawei, HiSilicon | Yes | As mentioned previously, the main issue with solution A2 is that it does not meet the objective of allowing the UE to receive PTM transmission in RRC Idle/Inactive mode. |
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## 2.5 Further details of solution B

While solution B can reuse SC-PTM solution as much as possible, it seems meaningful to discuss enhancements on several aspects, taking into account difference between NR MBS and LTE MBS deployment, as well as the difference on the basic unicast functions which are the basis of MBS solution. Furthermore, enhancement to the issues that exist in SC-PTM solution could also be considered.

For example, there are a couple of issues/enhancement mentioned contributions from companies

**Issue B.1: Whether NR SIB mechanism could be considered in MBS SIB and MCCH signalling delivery?**

Issue B.1.1: Whether the MBS SIB and MCCH signalling could be area-specific?

In NR, the SIB can be cell specific or area specific. It is proposed in [5] that the MBS SIB is area specific SIB and the MCCH signalling can be configured as area specific and the area is FFS. If the MBS SIB and MCCH signalling are area specific, the UE may not need to read the MBS SIB after cell reselection, and it can reduce the MBS service interruption.

Issue B.1.2: Whether the MBS SIB and MCCH signalling could be sent in on demand manner?

In NR, the SIBs can be transmitted based on UE demand. Some companies have proposals on whether SIB and MCCH for MBS could be sent in on-demand manner. It is suggested in [24] that RAN2 should discuss the option if the control channel is provided on-demand basis, e.g, like On-demand SC-MCCH that was not in LTE. Besides, it is also mentioned in [25] that RAN2 considers providing the control information for NR multicast in on-demand manner.

Furthermore, it is suggested in [17] that a new On-demand MBS-SIB and its scheduling information should be included in SIB1 (like legacy NR SIBs), and Broadcast of SC-MCCH could be linked to the on-demand SI request for an MBS-SIB.

On the other hand, it is mentioned in [23] that on-demand SI broadcast is not suitable for provision the SC-PTM configuration in NR since SI acquisition introduces significant delay which may not be acceptable for low latency services and also the UE is not aware of availability of a new service (or session start) to trigger the request for SI

**Issue B.2: Whether to consider enhancement to the service change notification mechanism in SC-PTM?**

In SC-PTM, the change notification of the MBMS control information is sent in the first subframe in a Repetition Period where the SC-MCCH can be scheduled. The notification is sent using the DCI format 1C with SC-N-RNTI. When the UE receives the notification, it will acquire the updated SC-MCCH.

However, there is concern from companies on the flexibility and efficiency of such SC-PTM mechanism.

It is mentioned in [3] that using MCCH increases the UE requirements to regularly check for MCCH for changes, but UEs not interested in MBS are impacted by frequent SI change notifications.

It is also mentioned in [8] that UE may only be interested in some of the MBS services. But in current SC-PTM mechanism, UE in RRC\_IDLE/RRC\_INACTIVE state will need to waked up and receive the updated SC-MCCH control information blindly, then it is able to find out whether the interested MBS service has changed.it is also mentioned that a possible enhancement is that the MBS services could be grouped and the change is only notified to the involved UEs which have interest.

It is also mentioned in [12] that legacy MCCH notification is not flexible enough to support diverse NR MBS application transmission.A solution is also proposed in the same paper that the network groups some of MBS services together to form a MBS service group to share the same MCCH modification cycle, and Support group based MCCH modification cycle and repetition cycle in NR PTM. Furthermore MCCH logical channels are organized based on groups and Multiple MCCH logical channels are supported in NR MBS, with each providing the MCCH information to a group of MBS services.

**Question 17: Do companies think any enhancements (e.g. issue B.1 and B.2) should be considered for solution B, after reusing SC-PTM solution?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| CATT | Yes | Both issue B.1 and B.2 could be considered. For issue B.1.1, if same PTM configuration could be used among some adjacent cells, enhancement related to issue B.1.1 will make sense, and the solution could be simple by reusing NR SIB design. For issue B.1.2, concern about delay caused by on demand manner could be discussed further.For issue B.2, it should be considered carefully. On one hand, The enhancement may be beneficial for UE power consumption. On the other hand, we should also consider the potential increase of the signalling overhead and complexity of NG-RAN. |
| Huawei, HiSilicon | Maybe | It should be noted that all of those are enhancements, so should be considered only once the baseline solution is clear. On specific issues:B1.1: For MBS SIB, the legacy area-based solution can be reused. This is beneficial as it allows better service continuity while receiving SC-PTM in RRC Idle/Inactive state. But for MCCH, it is actually hard to achieve the gain by area configuration. That is because the content of MCCH is dynamically changed based on the ongoing services provided by the cells. Current area specific SI should be configured by OAM, which is not feasible for MCCH which changes dynamically. If each cell provides MBS services in MCCH based on UEs it serves, it is highly likely that each cell will provide different MBS services sets and configurations in MCCHs and thus make it impossible to have area specific content.B1.2: When it comes to sending SIB on demand, this is up to the network to decide for any SIB. When it comes to sending MCCH on demand, this could help in decreasing the overhead when there are no UEs interested in the service currently. However, as mentioned above, this is an optimization which can be considered as lower priority.B2: We think the LTE approach can be reused for change notifications, i.e. the network notifies the UEs in case the information in SC-MCCH changes either via dedicated RNTI (such as SC-N-RNTI) or be included directly in the DCI scrambled with SC-RNTI (this can be decided by RAN1).In addition, considering multicast services with diverse requirements, we may introduce multiple G-RNTIs and MCCH-RNTIs. However, since the assumption is that high priority services will have to be received by the UEs in RRC Connected mode, this should be lower priority. |
| OPPO | Yes  | 1. In order to reduce the service interruption, the MBS SIB and MCCH can be area specific as NR SIB now.
2. MBS delivery should be based on beam sweeping as NR SIB did now.
3. The low data loss should be considered for broadcast kind of MBS reception during cell reselection.

For the group-based MBS service, it is big change compared with LTE. We see the benefit of this change if the configuration change frequently; we can study the requirement firstly.  |
| Ericsson | Depends | * When MCCH notification is used, then during the time the UE is interested to receive an MBS session, the UE is required to monitor both MCCH notification channel and Paging PDCCH. When there is a strong MBS latency requirement the UE has to monitor SC-MCCH often. The use of SC-MCCH avoids impact on legacy UEs not supporting MBS completely, compared to grouping info in Paging DCI, i.e. legacy UEs will have to receive the Paging DCI indicating MBS change.
* B.1.1 and B.1.2 can be considered further if SC-MCCH is used.
* Concerning B.2: optimization of the MCCH notification channel are only motivated when frequent changes are anticipated, and when these frequent change can be classified in a pre-determined way (i.e. whether grouping information can be effective). But pre-requisites are not clear to us.
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## 2.6 Phase-2 discussion

Based on the output of phase-1, potentially down-select between solution A and solution B could be discussed.

# 3 Conclusion

# 4 References

[1]R2-2007416 Discussion on MBS supported UEs in RRC\_IDLE and RRC\_INACTIVE states; CMCC

[2]R2-2006795 NR Multicast services and configuration for UEs in different RRC states; Qualcomm

[3]R2-2007262 NR Multicast in Idle and Inactive mode; Ericsson

[4]R2-2007673 RRC IDLE/ INACTIVE aspects of NR MBS; Samsung

[5]R2-2006801 Discussion on MBS reception of idle or inactive mode UE; OPPO

[6]R2-2007014 Some consideration for IDLE mode and IN\_ACTIVE mode UE ; NEC

[7]R2-2007029 IDLE/INACTIVE UE support for NR MBS; Huawei, HiSilicon

[8]R2-2006597 Consideration on Idle and Inactive mode UEs; CATT

[9]R2-2007037 Discussion on Idle and Inactive mode UEs; vivo

[10]R2-2007055 MBS for Idle and Inactive mode UE; Spreadtrum

[11]R2-2007446 MBS for UE in RRC\_INACTIVE/RRC\_IDLE State; ZTE, Sanechips

[12]R2-2007896 Group Based MBS Notification for Idle/Inactive mode UEs; MediaTek

[13]R2-2008052 NR MBS solution for UE in RRC\_IDLE or RRC\_INACTIVE state; CHENGDU TD TECH

[14]R2-2006574 Overview on NR MBS Architecture; MediaTek

[15]R2-2006952 Consideration of L2 protocol impact by MBS; Intel

[16]R2-2007124 RAN2 Study on the NR MBMS; Apple

[17]R2-2007177 NR multicast architecture and SC-PTM; Sony

[18]R2-2007412 Initial considerations of NR Multicast; CMCC

[19]R2-2007442 Scope and Architecture analysis of NR MBS ZTE; Sanechips

[20]R2-2007550 Discuss NR MBS architecture and protocol stack; Futurewei

[21]R2-2007672 On Stage-2 aspects and overview of NR MBS; Samsung

[22]R2-2007033 Overview of NR MBS; vivo

[23]R2-2006983 Scope and solution approach for NR MBS; Nokia, Nokia Shanghai Bell

[24] R2-2007774 Initial consideration of NR MBS; Kyocera

[25] R2-2007993 Consideration on BWP and beam in NR multicast; LG

[26] R2-111e chairman notes

# 5 Participants

|  |  |
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