**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 |
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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 |
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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 |
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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 |
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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 |
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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 |
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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 |
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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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**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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**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 |
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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?**

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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?**

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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?**

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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?**

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| Company | Yes/No | Comments |
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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?**

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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?**

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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?**

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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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| **Company Name** | **Participant name/contact** |
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