**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?**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| 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). | |
| Lenovo, Motorola Mobility | | Yes | | To make it more precise:  Solution A1: MBS reception is supported for UEs in Idle/ inactive mode, but the PTM configuration is provided by RRC dedicated signalling e.g. *RRCRelease*.  We are wondering solution A1 is a good solution. It might be good to add description on the potential benefits of solution A1. | |
| MediaTek | | Yes | | But this solution seems introduce more signalling overhead… | |
| QC | | Partly agree with description. But  **For Multicast:** No support for idle/inactive multicast reception.  **For Broadcast:** use MCCH without entering into connected state. | | In RAN#89e, it was confirmed that NR Broadcast is in scope. So RAN2 need to discuss solutions for both Multicast and Broadcast. In our view dynamic PTP/PTM switching is applicable only for Multicast services in RRC\_CONNECTED state and is not applicable for Broadcast services. NR Broadcast reception using ROM is not supported.  **Multicast:** To get Multicast service, every UE must join Multicast session first and this requires UE to establish RRC Connection. UE can get multicast configuration in 2 different ways. 1) in connected mode using dedicated RRC signalling or 2) part of multicast configuration in MCCH and UE specific dedicated configuration (example: L1 HARQ configuration) in connected mode.  For Multicast service both RAN and CN need to have UE context. In idle state, NW does not have any UE context and Inactive state will have NW context and it is not clear how NW will provide multicast service for Idle state UEs. When UE does idle cell reselection, to get Multicast configuration UE need to get into RRC\_CONNECTED state, which is not efficient from both signalling and UE power efficiency perspective.  Any service which does not require high reliability, can be served by broadcast and there is no need to support multicast in RRC Idle/inactive states and it adds lot of additional complexity. Note that in idle/inactive state, there is no support for reliable transmission, no feedback support, no support for loss-less HO. In R17, we think it is reasonable to limit Multicast functionality to high reliability services in RRC\_CONNECTED state only.  **Proposal: In R17, limit multicast functionality only to high reliability services in RRC\_CONNECETD state. i.e no support for multicast reception in RRC\_IDLE/INACTIVE states.**  **Broadcast**: can be received by UEs in idle/inactive/connected state. unlike multicast, broadcast receiving UEs are not required to join broadcast session and broadcast configuration can be received by using MCCH based mechanism. No need to get Broadcast service configuration in Connected state. | |
| Sony | | Yes | |  | |
| BT | | Partially agree | | RAN#89e has agreed that NR broadcast is in the scope. Therefore, RAN2 needs to work on it.  Before we agree on how the UE gets the configuration, it seems logical that first we define which services are supported in idle or inactive mode and which services are supported in connected mode.  Solution A1 is not clear as it seems to imply that a UE capable of NR Broadcast shall move to connected mode. In addition, it is not clear what happens after a cell reselection.  Therefore, at this stage we don’t agree with the fact that the PTM configuration acquired in connected mode is reused. | |
| Kyocera | | Yes | |  | |
| Spreadtrum | | Yes | | We are also wondering how the UE to get the MBS services information of neighbour cells in mobility case. | |
| ITRI | | Yes | | We agree with the description of solution A1. | |
| Samsung | | Yes | | We agree to the description | |
| LG | | Yes | | We agree with the description of solution A1, but do not agree with the solution A1. | |
| Nokia | | Maybe but description on very high-level | | This is bit misleading to categorize this as not received MBS in IDLE if UE does based on configuration it has. This solution is merely considering that UE would apply configuration received prior entering IDLE state in IDLE but UE still receives the MBS in IDLE.  Anyway as a positive point for this solution is that one would not need to monitor MCCH (and probably not even define such) thus most likely improving UE battery life and simplifying RAN2 work, avoid overhead of MCCH etc..  Of course updating configuration is going to be bit more complex as UE needs to be moved to connected state and we would need to define notification method (paging likely) to indicated updated parameters needs to be acquired. Naturally this kind of method is needed for all B-category solutions as well. . | |
| Futurewei | | Yes | | We agree on the description of solution A1. But solution A1 is only suitable for stationary or low mobility UEs. | |
| Convida | | Yes | | We agree with the description of solution A1, but do not feel this should be the solution adopted for the UE to acquire the PTM configuration while in Idle/ inactive mode. As others have mentioned, it would lead to more signalling overhead to deal with cell reselections or any time an MBS configuration changes. | |
| ZTE | | Basically yes. | | We assume the question proposed here (and the same kind of question below, on the description itself, not the solution) is to have the consensus of categorization of the potential solutions before we go deeper into the discussion of the solutions itself.  We have a concern here in the description (similar to what Lenovo suggested):  - What does "PTM configuration acquired in connected mode" mean? Is it through dedicated signaling or broadcast signaling? Note that for UE in RRC\_CONNECTED is able to and should receive broadcast signaling (e.g, SIB, SC-MCCH in LTE eMBMS) in some circumstances.  We guess it is for dedicated signaling only, which is why UE has to be in RRC\_CONNECTED or go back to RRC\_CONNECTED when the PTM config is updated as described in Impact A1.1.  If so, we would like to rephrase the description as below, to be more specific:  "Solution A1: MBS reception is supported for UEs in Idle/ inactive mode, but the PTM configuration acquired in connected mode through dedicated signaling is reused. And then, we say Yes to the description.  Regarding QC's comment on "Any service which does not require high reliability, can be served by broadcast", we think it is SA1/SA2 or even Application layer's job to make such conclusion rather than RAN2's. Before we have such conclusion or assumption, it is still possible that we will have multicast service with low reliability requirements. We agree that for multicast service it makes less sense to support RRC\_IDLE, but for RRC\_INACTIVE it can be FFS. | |
| Intel | | Yes | | We agree with the description. | |
| NEC | | Yes | | We can support A1 as the baseline. | |

**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?**

|  |  |  |  |
| --- | --- | --- | --- |
| 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. | |
| Lenovo, Motorola Mobility | | Basically, we agree with the impact analysis of solution A1. Another potential impact is that it increases signalling overhead and latency when UE reselects to another cell, in which case the UE may need to acquire the PTM configuration in the new cell by transiting into RRC\_CONNECTED. | |
| MediaTek | | Agree with the impact analysis A1.1-A1.4. | |
| QC | | Agree with Ericsson comments.  Like we mentioned in Q1 response, UE need to join multicast session by establishing RRC\_CONNECTION. For Multicast services, which can only be received in RRC\_CONNECTED state, there is no issue to get Multicast configuration in RRC\_CONNECTED state. We think no need to support multicast reception in RRC\_IDLE/INACTIVE states.  For Broadcast service reception in idle/inactive state, MCCH provided Broadcast service info and PTM configuration is better choice. Since UE is not required to join broadcast session (unlike multicast session joining procedure). | |
| Sony | | Agree | |
| BT | | In the same line that we commented above, it is difficult to make an analysis if it is still not clear which services will be supported in idle and inactive mode. | |
| Kyocera | | We agree with the rapporteur’s summary. | |
| Spreadtrum | | Agree | |
| ITRI | | Yes, we agree with the impact analysis A1.1-A1.4. | |
| Samsung | | We think the design needs to cater to R17 requirements and does not need to be optimized for future use cases | |
| LG | | Agree with the impact analysis. | |
| Nokia | | Our general comment is that the analysis needs to differentiate between broadcast and multicast.  A 1.1: For multicast, this may not be always true but reconfiguration of large number of UEs may be challenging. For broadcast, this would be challenging if the configuration needs to be delivered when the service starts but it should not be a problem to provide configuration prior the service starts for delay tolerant services.  A 1.2: Seems not to consider the issues related to BWP operation, possible need of BWP switching and impacts of that. Especially for MCCH solutions (B category?) it is not that easy to ensure all UEs could receive it. Thus for BWP handling any solutions not requiring additional configuration channel provision is likely simpler.  A 1.3: SC-MCCH in LTE is sent with repetitions that may have very high frequency, which also means an overhead. | |
| Futurewei | | Agree with the impact analysis. In addition, for UEs have normal or high mobility, service interruption is introduced and increased signalling overhead at reselections. | |
| Convida | | We agree with the impact analysis, as well as the additional issues brought up related to increased signalling. | |
| ZTE | | Agree with all the impacts. The latency issue seems even worse than what LTE eMBMS is able to provide (minimum modification period of SC-MCCH is 20ms). | |
| Intel | | We agree with the impact analysis. | |
| NEC | | Agree with the analysis | |

**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). | |
| Lenovo, Motorola Mobility | | Yes | |  | |
| MediaTek | | Yes, but | | Agree with Huawei, this is not a workable solution to support MBS reception for UEs in idle/inactive mode. | |
| QC | | Yes for Multicast Connected mode services.  No for Broadcast. | | Agree with Ericsson comments and limitations of supporting multicast in idle/inactive states.  For Multicast services, which can only be received in RRC\_CONNECTED state (i.e high reliability multicast services), this is fine.  For NR broadcast service reception, we think it is not efficient to get into Connected state to receive broadcast service configuration and MCCH is better choice. | |
| Sony | | Yes | |  | |
| BT | | Partially | | Agree for multicast services.  Don’t agree for broadcast services. A service that is broadcasted in a cell and received in idle or inactive mode, it is a waste of resources and power to force the UE to move to connected mode and come back to idle each time the UE reselects a cell. | |
| Kyocera | | Yes | |  | |
| Spreadtrum | | Yes, but | | This is solution for the service reception in connected mode not for service reception in idle or inactive mode. Some multicast service with high reliability may needs to be received only in connected mode. While the broadcast service can be received in idle or inactive mode. | |
| ITRI | | Yes | | We agree with the description of solution A2. | |
| Samsung | | Yes | |  | |
| LG | | Yes | | We agree with the description of solution A2, but do not agree with the solution A2. | |
| Nokia | | Yes | | Supporting multicast in IDLE/INACTIVE seems quite difficult so likely we need this solution regardless of discussion to support broadcast services.. | |
| Futurewei | | Yes, but | | We agree on the description of solution A2. But solution A2 is only suitable for the MBS applications have very high reliability requirement. Normally it is not the case for the MBS applications targeting to all the UEs where majority is idle/inactive. | |
| Convida | | Yes | | We agree with the description of solution A2, but do not think it addresses the objective to enable the reception of Point to Multipoint transmissions by UEs in RRC\_IDLE/ RRC\_INACTIVE states. | |
| ZTE | | Basically yes. | | Same concern as in Q1.  Like our comments on Q1, even for UE in RRC\_CONNECTED state, dedicated signaling and broadcast signaling are both possible (or both as QC suggested). We assume in current description of A2, the signaling issue is not touched (open for FFS). Or if the intention of rapporteur is to have dedicated signaling only in solution A, we assume the option of broadcast signaling is included in Solution B. | |
| Intel | | Yes | | We agree with the description. | |
| NEC | | Yes | | Agree with the description of solution A2, but do not agree with solution A2. | |
|  | |  | |  | |

**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?**

|  |  |  |  |
| --- | --- | --- | --- |
| 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. | |
| Lenovo, Motorola Mobility | | A2 is also not future proof for some services to be supported in the future, like Free-to-air.  How to support broadcast in A2? If broadcast can not be supported, solution A2 is not in line with current WID scope. | |
| MediaTek | | Agree with Huawei. | |
| QC | | Agree with Ericsson comments.  Like we commented for Q2, for Multicast services, which can only be received in RRC\_CONNECTED state, there is no issue to get Multicast configuration in RRC\_CONNECTED state. | |
| Sony | | Agree. Power saving in RRC\_Connected mode for multicast may be discussed further. | |
| Kyocera | | We agree with the rapporteur’s view. | |
| Spreadtrum | | Agree with Lenovo. | |
| ITRI | | We agree with the impact analysis. | |
| LG | | Agree with the impact analysis. | |
| Nokia | | This seems to be simplest solution to support MBS reception in IDLE/INACTIVE. UE just needs to move to CONNECTED in order to receive MBS. If there is no data transmission in connected apart from MBS services what would cause extra UE battery consumption as there are ways to minimize power consumption in connected (DRX) but it seems that plenary has agreed that broadcast needs to be supported probably this solution is not that optimal for that purpose but for multicast purpose this still is likely the easiest solution.. | |
| Futurewei | | Agree on the impact analysis. | |
| Convida | | Agree with the impact analysis | |
| ZTE | | Agree with the impact analysis. | |
| Intel | | We agree with the impact analysis. Solution A2 has significant impact regarding UE power consumption and network efficiency. Solution A2 is not practical to support scenarios with large number of UEs receiving MBS service. Given that RAN plenary and SA plenary have agreed to support broadcast mode, we think receiving MBS services in RRC\_IDLE/INACTIVE should be supported. | |
| NEC | | Agree with the impact analysis. | |

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?**

|  |  |  |
| --- | --- | --- |
| 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. |
| Lenovo, Motorola Mobility |  | We prefer a unify solution for both broadcast and groupcast. Both solution A1 and A2 are not appropriate. |
| MediaTek | A1 |  |
| QC | A2 for Multicast.  Broadcast uses MCCH without entering into connected state. | Agree with Ericsson comments for Multicast mode.  **Multicast Connected mode reception (high reliability services): A2**  UE can get multicast configuration in 2 different ways. 1) in connected mode using dedicated RRC signalling or 2) part of multicast configuration in MCCH and UE specific dedicated configuration (example: L1 HARQ configuration) in connected mode.  **Multicast Idle/Inactive mode reception (reliability is not guaranteed)**:  No need to support.  **NR Broadcast reception (No ROM): No for A1 and No for A2**  MCCH provided multicast service configuration. |
| Sony |  | We think A2 is a good initial starting point for multicast and UEs in connected mode but it will keep the UE in Connected mode always. If, however, broadcast based solution can be re-used for multicast in some cases then this should be discussed further. |
| BT |  | We consider only broadcast is considered for broadcast service while for multicast the UE shall move to connected mode.  At this stage, we don’t agree with solution A1 where is it stated “the PTM configuration acquired in connected mode is reused.”. From RAN#89e, it is clear that MBS in idle/inactive mode shall be supported so A2 statement “MBS reception is not supported for UEs in idle/inactive mode” cannot be considered. |
| Kyocera | A1 | We think the PTM reception in Idle/Inactive should be supported. We think it’s up to NW implementation whether to release RRC connection, even if A1 is supported. |
| Spreadtrum | A1 | We think A2 is for the connected-only services. |
| ITRI | A1 | We think solution A1 could be understood as solution A for further discussions. |
| Samsung | A2 | We think A2 is sufficient for this release. We think A1 is simply an enhancement/ optimization compared to A2, for some use cases. We are fine to study complexity/ benefit if time allows (but as a 2nd priority) |
| LG | A1 |  |
| Nokia | A2 | A1 is more category B solution as UE can receive MBS in IDLE/INACTIVE or is the intention of category A and B to say that do we have MCCH? It is not clear.  A2 is clearly different as UE moves to CONNECTED to actually receive the data but this seems to be almost essential to support multicast services.  Then if one cannot provide all services by A2 needs to be discussed as adding another layer of services by introducing broadcast is not going to simplify RAN2 work (and other WGs as well). |
| Futurewei | A1 | A1 can still be considered as a solution for UEs in idle/inactive mode although it is useful only in limited scenarios. We don’t consider A2 is a solution for UE in idle/inactive mode. It can be considered part of solution for applications require RRC CONNECTED. For those applications, the idle/inactive UEs should be waked up first if such a MBS application is targeted to the UEs (including some idle ones) in the coverage area. |
| Convida | A1 | We don’t think A2 meets the work item objectives. We would agree to have solution A1, as the “understanding of solution A for further discussions”. |
| ZTE | A2 | The latency issue introduced by paging in Solution A1 might be unacceptable. While for A2, it fits into certain cases like MBS with higher reliability.  Solution A2 might be one of the solutions or solution sets which 3GPP is going to offer. We don't need to choose either A or B in current stage. They might be complementary to each other, depending on the QoS requirements of the MBS.  Therefore, we doubt if any "down-scoping" being the aim of this email discussion is really feasible in current stage. One of the possibilities is both are needed at the end of the day. |
| Intel | A1 | A2 has more UE and network impact compared with A1. |
| NEC | A1 | UE in idle/inactive mode should be supported. |

## 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,

|  |
| --- |
| 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?**

|  |  |  |
| --- | --- | --- |
| 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? |
| Lenovo, Motorola Mobility | Yes | Regarding the terminology, SC-MCCH and SC-MTCH should be changed to MCCH and MTCH respectively.  MBMS related information should be MBS related information. Furthermore, it should be clarified what kind of information the message carries. In SC-PTM the SCPTMConfiguration message carries information about:  The configuration of each SC-MTCH in the current cell (MBMS session info, g-RNTI, SC-MTCH scheduling info).  List of neighbour cells providing MBMS services via SC-MRB. |
| MediaTek | Yes |  |
| QC | Yes only for NR Broadcast and No for Multicast Connected services. | LTE SC-PTM supports only Broadcast service and LTE system does not support Multicast services. We think MCCH based solution is more appropriate for NR Broadcast services. MCCH details can be discussed further. |
| Sony | Yes | LTE SC-PTM should be the baseline. |
| BT | Partially | At this stage, we align with Ericsson. Before we adopt a solution, we consider it is worth to study which services will be supported in idle and inactive mode and after that, we will be in position to discuss which is the best solution. |
| Kyocera | Yes |  |
| Spreadtrum | Yes | LTE SC-PTM should be the baseline. |
| ITRI | Yes |  |
| Samsung | Yes |  |
| LG | Yes |  |
| Nokia | No (description seems to assume this is already baseline which is not yet agreed) | On technical content we agree on high level description. Note that A1 solution is basically same but only MCCH channel is not there and thus saving broadcast capacity.  And generally, in this email discussion it is not clear whether we are talking only about broadcast services, multicast services or both? Thus it is quite difficult to response comprehensively. |
| Futurewei | Yes, not complete, with comments | Solution B can be considered as a baseline solution for broadcast type of MBS services. Since this type of applications mostly will serve both idle/inactive and connected UEs, we should look into the commonality part with connected mode solution and maintain as much as possible the common solution. |
| Convida | Yes | We agree with the description of solution B |
| ZTE | Having concerns. | If Solution A is about UE receiving the PTM config in RRC\_CONNECTED, we shall have in Solution B at least the complement of Solution A. Moreover, "SC-PTM as baseline" can be ambiguous as it covers too many details.  We suggest phrasing like below (considering Solution A is more about dedicated signaling as we understand it)  - "UE relies on MCCH-like broadcast control channel to get the PTM configuration."  without going into too many details.  It will then be FFS on how to support UE in different RRC states, and how to notify UEs about the PTM configuration update. |
| Intel | Yes | We’re OK with the description in general. For the example channel names, maybe we can remove prefix “SC-” since it is possible to support transparent SFN across several cells. |
| NEC | Yes |  |

**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?**

|  |  |
| --- | --- |
| 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. |
| Lenovo, Motorola Mobility | Solution B can avoid Paging & RACH load of UE & NW compared to solution A.  Solution B can also be used for broadcast and Free-to-Air.  We do not think SIB overhead is a problem since only limited information as MCCH configuration is included in SIB.  We can take legacy SC-TPM specification as baseline, which will save RAN2 specification effort. |
| QC | Agree that MCCH adds additional complexity but it is flexible for Broadcast Idle/Inactive reception. Note that same solution can not be used for all broadcast and multicast scenarios. |
| Sony | LTE SC-PTM should be the baseline and further enhancements may be discussed further. |
| Kyocera | We think the broadcast signallings, i.e., SIB and SC-MCCH, consume a certain amount of radio resources even if there is no UE to receive the MBS service, since these need to be broadcasted periodically. |
| Spreadtrum | We do not think there will be higher cost of complexity and impact for solution B as it was already supported in LTE.  The LTE SC-PTM can be the baseline. To avoid the signalling overhead, some enhancements including On-demand SI can be introduced. |
| ITRI | We think LTE SC-PTM can be the baseline at least for broadcast Idle/Inactive reception. |
| Samsung | We already have a lot to cover in R-17 and we think Solution B increases the specification work and complexity. |
| LG | We think the SC-PTM in LTE can be the baseline with some improvement based on NR features. We already have an on-demand based mechanism to provide the SIB in NR. The SIB overhead doesn’t matter. |
| Nokia | This is naturally much more complex than A1/A2 as it requires completely new transport channel for configuration and thus we should discuss what are benefits of MCCH channel especially as in NR we will support already multicast services which could be used to mimic broadcast services. It is not so clear what is best way to realize MCCH in NR when we take BWP operation, multiple services types into account. |
| Futurewei | SIB dedicated to broadcast type of MBS is a simple and efficient way to address the mobility issue with idle/inactive UEs. The cost of SIB overhead is worth to pay. Since anyway SIB is used in LTE-like approach, we should consider the possibility that SIB carries the configuration of the shared control channel for MBS in RRC-CONNECTED. Then we could have a common solution -- the only difference is for connected, the configuration is done by RRC signalling, for idle UEs, the SIB serves the function of configuring idle/inactive UEs. |
| Convida | Although solution B introduces a separate MBS control channel, we do not feel that this will result in a higher cost of complexity, especially if we consider that such an approach is already supported in LTE. We therefore think that we should use the SC-PTM solution as the baseline and we can discuss if any additional enhancements are necessary for NR. |
| ZTE | MCCH-like mechanism introduces overhead definitely.  However, we see the benefits of MCCH-like mechanism when the UE number of the Multicast group or Broadcast service is high. This is at least a more scalable solution compared to Solution A. And for LTE eMBMS like Broadcast services, UE will have to rely on such broadcast control channel to receive the PTM config. |
| Intel | We think SC-PTM in LTE can be used as baseline for Solution B. |
| NEC | We think the SC-PTM in LTE can be the baseline with some improvement based on NR features. |

## 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.

|  |
| --- |
| RAN2#92 agreement  SC-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?**

|  |  |  |
| --- | --- | --- |
| 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. |
| Lenovo, Motorola Mobility |  | Support of MBS on cell basis depends on SA2 study outcome (“Local MBS service”). Nonetheless, the priority of cell reselection is per frequency basis (following the LTE Release 8 principle). We prefer to have per frequency basis cell reselection as baseline. The cell basis cell reselection needs further discussion. |
| MediaTek | Yes | If we want to deploy NR MBS service on a cell basis, then the mechanism in SC-PTM can’t be reused directly, but similar principle can be reused, e.g., prioritizing or providing MBS service information for neighbour cells. |
| QC |  | **For NR Broadcast** : service will be provided in a given service area. Similar to LTE eMBMS/SC-PTM, within a given service area it is reasonable to assume that broadcast service is provided on per frequency basis. LTE like SIB15 and per frequency service information will work for NR Broadcast as well.  Broadcast specific frequency prioritization rule during cell reselection in LTE SC-PTM is also applicable to NR. We need to further discuss possibility of per cell level as well. |
| Sony | Yes | We think that TMGI information of sessions supported in the neighbouring cells may be broadcasted and service continuity should be maintained by the deployment. UE should not unnecessarily switch between frequencies.  The prioritization of MBS frequency during cell reselection depends on MBS deployment. If mixed deployment is common for MBS then such prioritization wont work. |
| BT | Yes | MBS deployed on cell basis is relevant in border areas between different RAN vendors. It is possible that RAN\_vendor\_A has its MBS idle/inactive mode solution ready but not RAN\_vendor\_B. In all these borders, the mobile operator will prefer a reselection based on the cell rather than the frequency as both vendors may use the same frequency.  Apart, the UEs capable of MBS will be a subset and in congested areas, the fact that the operator may move UEs based on the cell will alleviate the problem. |
| Kyocera | Yes | We agree with the rapporteur’s view in general.  Regarding 2.3.1.1, we think the neighbour cell information should be provided and used for service continuity of Idle/Inactive UEs due to UE mobility.  Regarding 2.3.1.2, according to TS36.304, the UE considers the frequency as the highest priority if “*the UE is capable of SC-PTM reception and the reselected cell is broadcasting SIB20*”, for example. So, we wonder if SC-PTM eventually supported the per-cell basis MBMS. |
| Spreadtrum |  | We think we should wait for the input from SA2. |
| ITRI | Yes | We think NR MBS can be deployed on a cell basis.  Regarding 2.3.1.1 and 2.3.1.2, whether to directly reuse the mechanism as LTE SC-PTM may need to be further discussed but the same principle should be kept. |
| Samsung | Yes | It is true that not all cells on a freq may be part of service area. Think LTE solution is not based on this principle. A UE camping on cell A will use neighbouring info from that cell which may differ from the neigbouring info of another cell. It could however be that only some of A’s neighbours are in the service.  In our understanding, a UE camping on cell A will use neighbouring info from that cell which may differ from the neighbouring info of another cell. Therefore, the neighbour information on a cell can be transmitted specific to services that it supports. Therefore, from a cell reselection prioritization PoV, we think LTE solution can still be considered baseline. |
| LG | Yes | Support both in NR. |
| Nokia |  | Multicast services can be provided per cell basis without really additional complexity on top of agreed mobility between cells supporting MBS..  For possible broadcast approach we should not violate any basic reselection rules that UE is not supposed to camp on the best cell on a carrier but naturally carrier prioritization for receiving broadcast should not have technical issues (as already used in LTE). |
| Futurewei | Yes | We agree the first step is to support MBS at a per cell basis with proper support for service continuity with mobility. LTE SIB15-like mechanism and priority rules could be used as a baseline. |
| Convida | Yes | We feel that there may be use cases where not all cells on a frequency are transmitting MBS services. As Ericsson mentioned, this may be because the cell may not support the feature or because this cell is not currently included in the MBS service area.  As a result, we agree that UE should be provided neighbour cell information, to assist in mobility decisions.  As for the frequency prioritization rule, we tend to believe that this should be used as a baseline. |
| ZTE | Yes | Per cell deployment can be the finest granularity we can support.  As for the per frequency deployment, it has something to do with SA2 on the setting of USD, on the deployment requirements of the Broadcast services, and on how 3GPP exposes/opens its Broadcast capability to the service provider. This can not be determined by RAN2 itself, and confirmation from SA2 is needed. It is not clear that in 5G MBS such service model will be kept or not.  Before that it is hard to discuss if service continuity mechanism in eMBMS can be adopted or not. |
| Intel |  | We agree that it is network decision on whether the MBS services are available in cell level or frequency level. As for specification impact, we prefer to follow LTE approach that during cell reselection UE prioritize frequency providing the service(s) that UE is interested in. |
| NEC | Yes | Cell basis multicast service can be provided as the baseline. |

**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?**

|  |  |  |
| --- | --- | --- |
| 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). |
| Lenovo, Motorola Mobility | Yes | Currently at a given point of time only one BWP is active for a UE. Whether a dedicated MBS BWP is used or whether the MBS BWP is same with or covers the initial BWP should be addressed by RAN1.  And the BWP adaptation and configuration during initial access can be further discussed. |
| MediaTek | Yes | MBS specific BWP should be jointly discussed with RAN1. |
| QC | Wait for RAN1 discussion | RAN1 is already discussing about BWP and RAN2 should wait for RAN1 progress. |
| Sony | Yes | As a starting point, RAN2 should assume that the MBS service transmission BWP should be different from the initial or the dedicated BWP. |
| BT | Yes | Yes but in RAN1. RAN2 should wait until RAN1 finish. |
| Kyocera | Yes | We think at least the BWP(s) for the MBS Control Channel (e.g., SC-MCCH) and the MBS Traffic Channel(s) (e.g., SC-MTCH) should be configurable. Of course, it’s up to NW implementation whether to configure all MBS operations are done within the initial DL BWP. |
| Spreadtrum | Yes | MBS specific BWP is needed as there may be no enough capacity in initial BWP to accommodate all the MBS services. Whether the MBS BWP is same with or covers the initial BWP should be discussed in RAN1 first. |
| ITRI | Yes | Yes, but we should wait for the RAN1 decision first. |
| Samsung | Yes | We think it is useful to apply BWP framework for MBS transmission. However,we think it is too early to decide and we need to discuss this further. |
| LG | Yes | We think some working assumption is needed about BWP. For example, if a MBS service is transmitted outside initial BWP, UE in IDLE/INACTIVE cannot receive the service. Even though we support the MBS reception in IDLE/INACTIVE, we also believe that some MBS service is available only in CONNECTED mode and such services can be transmitted outside the initial BWP. |
| Nokia | Yes | Naturally one would need some BWP for MBS service transmission but likely this is handled in RAN1 and we do not need to spend time on this. Handling of multicast and broadcast BWP is likely going to be quite different as other service is running in connected and other in IDLE/INACTIVE. Additionally it is not clear regarding MCCH can it be provided in initial BWP etc..thus we need more discussion whether MCCH approach is really the best way forward. |
| Futurewei | Yes | We agree on that there are BWP issues raised by rapporteur, the initial BWP may not be enough to support MBS and MBS specific BWP maybe needed. The issues should be discussed in RAN1 first. |
| Convida | Yes | We think that this should be discussed. We agree that the capacity of the initial BWP may not be sufficient to satisfy both unicast operations and MBS IDLE/INACTIVE operations. However, we may need to wait for input from RAN1 |
| ZTE | Yes | From the forward compatibility perspective, BWP is the better solution to be aligned with NR. However, as many companies suggested, this shall be jointly discussed with RAN1 where the limitation truly lies in. |
| Intel | Wait for RAN1 | RAN2 should wait for RAN1 progress. |
| NEC | Yes | We think it is useful to apply BWP framework for MBS transmission. The network can provide configuration of BWP associated with PTM service. |

**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?**

|  |  |  |
| --- | --- | --- |
| 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”. |
| Lenovo, Motorola Mobility | No | The counting for IDLE Ues has been discussed in LTE Rel-10 sufficiently and it is not supported due to the complexity. We prefer to not to have counting for IDLE/INACTIVE Ues as what we did in LTE. |
| MediaTek | No | Counting/UE interest indication for UE in idle mode is too complicated, when comparing with LTE SC-PTM. |
| QC | Yes for Broadcast if UE is receiving in connected state.  No for Multicast. | **NR Broadcast** : needed counting and interest indication mechanism for connected state service continuity and also Ues preference of broadcast vs unicast.  **NR Multicast** : No need of counting and UE Interest Indication since every Multicast UE has to join multicast session and NW has UE context.  Note that dynamic PTP/PTM switching is applicable only for Multicast services in RRC\_CONNECTED state only and is not applicable for Broadcast case. |
| Sony | Yes | We think that counting or some other information is needed for the network be able to decide between PTP and PTM. Network may count the RA preambles for on-demand SI requests for MBS SIBs. |
| Kyocera | Yes | We think MII and Counting in LTE are basically for Ues in RRC Connected, while we’re fine to discuss whether these are extended to Ues in Idle/Inactive. |
| Spreadtrum | No | The counting/UE interest indication in idle/inactive mode will bring more complexity. This issue had been discussed in LTE and the interest indication was not introduced at last. We should take the LTE SC-PTM as baseline in NR.  Besides, RAN3 has achieved the agreement that Counting procedures for multicast are not introduced in Rel-17 for Ues in RRC\_CONNECTED State. |
| ITRI | Yes | We think counting mechanism or UE interest indication mechanism is useful for the PTM/PTP switch. |
| Samsung | Yes | Interest indication (or some indication) is required to ensure network can provide service prioritized by UE. It is required for UE to indicate its priority between unicast and multicast services. However, we think the actual approach requires further study. |
| LG | No | It is too premature to discuss this issue. Basically, we prefer to follow the LTE principle. |
| Nokia | yes for broadcast | For multicast services counting is not needed like explained by QC.  If we would have broadcast services supporting counting is useful. Moreover, if all UEs are required to transition to RRC\_CONNECTED to send the counting response then solution A1 can be considered for broadcast as well. |
| Futurewei | No | Not for the idle UEs. It can be very complicated to poll the idle UEs for counting/interest reporting due to the mobility. The motivation of doing so is moot. It may not be worth the effort. In most common broadcast -type scenarios, when idle UEs are also targeted, it means much larger number of UEs in service. There is much less concern on resource efficient issue. |
| Convida | Yes | For broadcast mode, the interest indication procedure and the counting procedure, could both be used to allow the network to dynamically change the MBS service area. Without these procedures, it would be hard for the network to know about the UEs interested in an MBS service, and it can not determine whether to offer a service in a cell. |
| ZTE | No (assuming the question is only for UE in RRC\_IDLE or INACTIVE state) | In LTE, both counting and MBS interest indication (MII) are for UE in RRC\_CONNECTED:  - Counting is initiated from MCE to count the interested UE for specific MBS, to help MCE determine if suspension/resume is needed for specific MBMS.  - MII is initiated from UE but signaled eNB to help eNB better schedule for the UE.  However, in NR:  - there will be no MCE,  - if there is MII, counting seems redundant.  - for Multicast service, gNB knows which UE is associated with which MBS.  Therefore, we suggest:  - Counting is not needed either for Multicast or Broadcast.  - MII is needed only for Broadcast for UE in RRC\_CONNECTED.  For UE in RRC\_IDLE or RRC\_INACTIVE, we suggest not supporting MII. It is not supported in LTE, and we see no specific reason to support it in NR considering the complexity and overhead. |
| Intel | No | Counting/interest indication is not needed for UEs in RRC\_IDLE/INACTIVE. These aspects were discussed in LTE before and were not agreed due to complexity, signalling overhead / congestion etc. |
| NEC | Yes | The counting can apply both IDLE and CONNECTED UE. |

## 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*. |
| Lenovo, Motorola Mobility |  | Too early to discuss, it seems like stage 3 issue. |
| MediaTek | Yes | Prefer alternative 1, because, it might require different configurations for connected mode and idle/inactive mode. |
| QC | Multicast : No  Broadcast: MCCH provided common configuration for all RRC states. | See our Q1 response.  **Multicast:** To get Multicast service, every UE must join Multicast session first and this requires UE to establish RRC Connection. UE can get multicast configuration in 2 different ways. 1) in connected mode using dedicated RRC signalling or 2) part of multicast configuration in MCCH and UE specific dedicated configuration (example: L1 HARQ configuration) in connected mode.  For Multicast service both RAN and CN need to have UE context. In idle state, NW does not have any UE context and Inactive state will have NW context and it is not clear how NW will provide multicast service for Idle state UEs. When UE does idle cell reselection, to get Multicast configuration UE need to get into RRC\_CONNECTED state, which is not efficient from both signalling and UE power efficiency perspective.  Any service which does not require high reliability, can be served by broadcast and there is no need to support multicast in RRC Idle/inactive states and it adds lot of additional complexity. Note that in idle/inactive state, there is no support for reliable transmission, no feedback support, no support for loss-less HO. In R17, we think it is reasonable to limit Multicast functionality to high reliability services in RRC\_CONNECTED state only.  **Proposal: In R17, limit multicast functionality only to high reliability services in RRC\_CONNECETD state. i.e no support for multicast reception in RRC\_IDLE/INACTIVE states.**  **Broadcast**: can be received by Ues in idle/inactive/connected state. Unlike multicast, broadcast receiving Ues are not required to join broadcast session and broadcast configuration can be received by using MCCH based mechanism. No need to get Broadcast service configuration in Connected state. |
| Sony |  | We think it is too early to conclude |
| BT |  | It is early to initiate this discussion. We prefer to advance more with the solutions and then see how if the configuration can be reused. |
| Kyocera | Yes | We slightly prefer Option 2) above, reusing the configuration for RRC\_CONNECTED state, since we don’t see the reason to separate the PTM configurations for Connected, Inactive and Idle respectively. |
| Spreadtrum |  | We should first discuss whether the PTM configuration in connected mode can be reused for UE in idle/inactive mode. E.g. the PTM configuration in connected mode used for the service with high reliability cannot be reused for the UE in idle/inactive mode directly. |
| ITRI |  | It may be too early to discuss this. |
| Samsung |  | We think reusing the configuration for RRC CONN state can be considered as baseline can further discuss any additions needed. |
| LG |  | It is too early to discuss this. |

|  |  |  |
| --- | --- | --- |
| Nokia |  | For broadcast, alternative 2.  For multicast, and if the reception of multicast in RRC\_IDLE/INACTIVE should be supported, then UEs in RRC\_CONNECTED state will be configured for feedback which means that there are going to be different configurations in RRC states. |
| Futurewei |  | We also agree with many companies that this is a secondary issue which can be discussed later after RAN2 decides that A1 is adopted. |
| Convida | Yes | This should be addressed if Solution A1 is the chosen way forward. We do think that the PTM configuration in RRC\_CONNECTED state will be different from the PTM configuration in RRC\_IDLE/RRC\_INACTIVE state |
| ZTE |  | Seems to be a network behaviour considering the below case: UE already receiving in PTM config is released to RRC\_INACTIVE --- both alternatives are possible for the UE. |
| Intel |  | RAN1 and RAN2 are at the initial stage in discussing features available in different RRC states, so we think it is too early to conclude whether to reuse configuration in RRC\_CONNECTED. |
| NEC |  | It is too early to discuss this issue. |

**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. |
| Lenovo, Motorola Mobility |  | Too early to discuss. Group paging could be a potential solution. |
| MediaTek | Yes | Group paging mechanism is needed. |
| QC | Yes | Details can be discussed further. |
| Sony |  | Too early to conclude. |
| BT | Yes | This needs to be addressed. |
| Kyocera | Yes | We think the group paging is efficient from the perspective of DL resource, but we wonder if there will be sufficient UL resource configured as this mechanism may cause PRACH collision etc. when the group paging triggers many access attempts from many UEs at the same time. |
| Spreadtrum |  | Too early to conclude |
| ITRI |  | It may be too early to discuss this. |
| Samsung |  | We think it is too early to discuss this. Isn’t a notification upon start/ modification/ release needed in any solution? We think some basic MBS configuration is broadcast in the cell. Using this in addition to a change notification mechanism should be sufficient. |

|  |  |  |
| --- | --- | --- |
| Samsung |  | We think it is too early to discuss this. Isn’t a notification upon start/ modification/ release needed in any solution? We think some basic MBS configuration is broadcast in the cell. Using this in addition to a change notification mechanism should be sufficient. |
| LG | Yes | If solution A1 is adopted, some enhancements would be required for group paging. |
| Nokia | Maybe | We need to consider whether existing paging is sufficient or more optimized solution needs to be introduced needs to be considered further. If one would need some feedback from UE (CSI/HARQ whatever) e.g. for link adapation then easiest is to handle this so that feedback is sent when UE is in connected state. |
| Futurewei |  | If we adopted A1, it should be addressed. Group paging would be good candidate of solution. |
| Convida | Yes | This should be addressed if Solution A1 is the chosen way forward. The exact mechanism may be left FFS. |
| ZTE | Yes but needs some clarification | start/modification/stop of a service can be of two level signaling/operation, e.g.:  - start is from the CN (which corresponds to CN paging)  - PTM config modification is from RAN (which corresponds to RAN paging or any other RAN notification mechanism)  In both cases, we have concerns on the latency issue. |
| Intel | Yes | For solution A1, paging is needed, otherwise solution A1 would be similar to solution B. Whether to have group paging can be discussed later. |
| NEC | Yes | Group paging can be enhanced to address this issue. |

**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. |
| Lenovo, Motorola Mobility |  | Too early to discuss. Anyway, the UE needs perform RACH procedure. |
| MediaTek | Yes | Agree with Huawei, both UE power consumption and signalling overhead will be introduced. |
| QC | Depends on whether Multicast service is supported in Idle/Inactive state. For Broadcast: No and MCCH can be used. | Multicast :  For Connected state, UE gets multicast configuration via dedicated signalling or through a combination of broadcast + dedicated signalling.  Broadcast : MCCH to be used for providing configuration and no need for idle/inactive UE to indicate what broadcast service UE is receiving when UE does idle cell reselection. |
| Sony |  | Too early to conclude |
| BT | Yes | There are several scenarios where this may happen, i.e., cell reselection. |
| Kyocera |  | We assume the UE always needs to transition to Connected if it needs the PTM configuration, unless it has a valid PTM configuration for Idle/Inactive. |
| Spreadtrum |  | Too early to conclude |
| ITRI |  | It may be too early to discuss this. |
| Samsung | Yes | A UE should be allowed to join an ongoing session e.g. upon cell reselection. |
| LG | Yes | If solution A1 is adopted, some enhancements would be required to re-acquire the configuration from a new serving cell upon cell reselection. |

|  |  |  |
| --- | --- | --- |
| Nokia | Yes | Similarly for any category B solutions this would need to be solved i.e. UE needs to get updated information after reselection. Whether UE moves to connected to get updated information or if this is provided while in IDLE could be further discussed. |
| Futurewei |  | Too early to discuss. If A1 is adopted, Yes, the UE have to be waked up to be reconfigured for the new cell. But how the network knows the UE reselected to a new cell? Does the UE need to send a location update every time conducting a reselection? It is not affordable for idle UEs. We think A1 only suitable for the application with stationary or low mobility UEs. There is still a big question whether we need to adopt A1. |
| Convida | Yes | This should be addressed if Solution A1 is the chosen way forward. If the UE does not already know the PTM configuration, then it would have to transition to Connected mode. During cell reselection, there may be cases that the UE knows the target cell and the source cell share the same PTM configuration. |
| ZTE |  | Too early to discuss. |
| Intel | Yes | Agree that this should be addressed for solution A1 if it is supported. |
| NEC | Yes | Yes but too early to discuss, and companies should submit contribution to provide solutions first. |

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. |
| QC | Yes | It seems we are mixing both multicast and broadcast modes and both needs to be addressed independently. |
| Sony | Yes | Agree with QC view above |
| BT | Yes | Multicast and broadcast need to be supported but it is not clear a clear border between them at the moment. |
| Nokia | Yes | Multicast and broadcast require different functionalities and thus solutions. The first point of differentiation is that UE is required to join multicast session. Thus the first question for multicast should be what are the benefits of supporting reception in RRC\_IDLE/INACTIVE noting that UL feedback and HARQ retransmissions could allow efficient link adaptation resulting in significantly improved spectral efficiency of PTM transmission. On the other, the seems to be a common understanding that broadcast should be receivable in RRC\_IDLE and the question is whether a UE shall be able to receive broadcast without transitioning to RRC\_CONNECTED. |
| ZTE |  | We suppose solution A1 and A2 are both for Multicast only |

**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. |
| Lenovo, Motorola Mobility |  | Too early to discuss. All above solutions are possible. |
| MediaTek | Yes | For starting a new service, paging is the only way (i.e., Solution 3). |
| QC | Yes | Solution 3 can be used and details FFS. |
| Sony | Yes | Solution 3 could be used |
| Kyocera | Yes | We think Solution 1 will be discussed in other WG(s). We need further clarification for Solution 2. For Solution 3, we have the same comment in Question 12 above |
| Spreadtrum | Yes |  |
| Samsung |  | We think some basic MBS configuration is broadcast in the cell. Using this in addition to a change notification mechanism should be sufficient. A group paging mechanism can also be considered. |
| LG | Yes | We think the issue A2.1 should be addressed for solution A2, but it is too early to select a single solution. |
| Nokia | Yes | UE needs to be informed about new services. It is not just RAN2 to decide which layer would trigger indication to the UE about change of services. If one considers multicast services UE is advertised the availability of multicast session at higher layers. If the higher layer is an application layer then it is up the application to decide when to join the session or even whether to join the session. |
| Futurewei | Yes | Solution 2-3 could be used. Solution 1 may be realized through solution 2 at the air interface. |
| Convida | Yes | This should be addressed if Solution A2 is the chosen way forward. We think that all three solutions are viable. |
| ZTE | Yes | Solution 3 will have the most significant spec impacts. |
| Intel | Yes | For solution A2, paging is needed, otherwise solution A2 would be similar to solution B. So we think paging (solution 3) is needed for solution A2. |
| NEC | Yes | Yes but too early to do down-selection. |

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. |
| MediaTek | Yes | Agree with Huawei. |
| BT | Yes | The following sentence is not clear “MBS reception is not supported for UEs in idle/inactive mode” and seems to be against RAN#89e decision. |
| Nokia | No | As one would follow completely CONNECTED mode solution for actual transmission this seems to be quite optimal solution for multicast services. |
| Futurewei |  | We don’t think A2 is a solution for MBS delivery to idle UEs. If an MBS application QoS requirement allows the idle reception, forcing A2 will cause the problem as pointed by Huawei. But we think A2 is needed as part of complete solution for the MBS applications require UEs in connected mode. |
| ZTE | Yes | A2 can be one of the solutions for some specific MBS with higher reliability requirement. It is optimal and natural for network NOT to release UE and keep UE in RRC\_CONNECTED. However, the signaling issue is still open as we have suggested in Q3. |

## 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. |
| Lenovo, Motorola Mobility |  | The MBS SIB could be area-specific if multiple cells have same MCCH configuration. However, if we have MCCH enhancement as B.2, then “per area MBS SIB” seems less useful.  MCCH should be cell specific since different cells have different ongoing MBS Sessions probably.  On-demand MBS SIB and MCCH increases delay of MBS service acquisition. On-demand MBS SIB and MCCH need more discussion.  We prefer to take LTE SC-PTM notification mechanism as baseline for 5G MBS. Any enhancements on this need further discussion. |
| MediaTek | Probably yes, but | As Huawei stated, baseline solution should be discussed first, for enhancement part, it should have lower priority. |
| QC | Yes | Details can be discussed further.  Note that MCCH is suitable for NR Broadcast. A single solution does not satisfy all requirements for both multicast and broadcast. |
| Sony | Yes | 1. Both MBS-SIB and MCCH could be having an area scope. 2. We should at least stick to the NR principle of delivering SI by on-demand. Further, MBS capable UE’s request for MBS-SIB and SC-MCCH may be combined for power saving purposes. 3. We wait for RAN1 |
| Kyocera | Yes | We think Issue B.1 and B.2 should be discussed. We also think the multiple MBS Control Channels (e.g., multiple SC-MCCHs) is beneficial for efficient handling of various use cases/services expected in NR MBS. |
| Spreadtrum | Yes | We think both B.1 and B.2 should be discussed.  B.1.1: we think the MBS SIB can be area specific. However, the MCCH signalling should be cell specific because the gNB can schedule the MBS services upon the requirement of UEs in each cell.  B.1.2: the on demand MBS SIB and MCCH signalling will reduce the signalling overhead and UE power consumption. The extra delay introduced by the on demand MBS SIB and MCCH signalling is not a serious problem because this will only influence the first UE which has interest for one MBS service.  B.2: We think we can reused the LTE SC-PTM change notification mechanism, and any enhancement needs further discussion. |
| ITRI | Yes | We think both B.1 and B.2 should be discussed. We also share the same view as Huawei that the baseline solution should be discussed first. |
| Samsung |  | We think this needs to be further discussed. |
| LG | Yes | We think on-demand MCCH can be easily achieved by reusing on-demand SI mechanism to minimize the signalling overhead.  Regarding the enhancements of MCCH change indication, we should discuss first whether to support multiple MCCH, and this is not an IDLE specific issue. |
| Nokia |  | B1 – We do not support multi-cell MBS transmission. So it seems unnecessary to consider any optimization for this.  B2 – Not critical to optimize. |
| Futurewei | Yes | We think both B-1 and B-2 should be further discussed. Some of LTE solutions are beneficial and can be considered for NR MBS. |
| Convida | Yes | We believe that both issues should be considered after selecting a baseline solution. An area specific MBS SIB could reduce service interruption after cell reselection.  We also agree that multiple MBS services may be transmitted, each with different MCCH modification cycles. Efficient mechanism to deal with these different cycles should be investigated. |
| ZTE | Yes | For B1.1, if it is found area-specific transmission is beneficial, solutions can be FFS. However for B1.2, latency can be a problem which makes it impracticable to adopt on demand design.  For B2, we can evaluate based on the benefits and complexity based on the solutions/inputs provided by companies. |
| Intel | Yes | We agree with Huawei that we should discuss baseline solution first, then discuss the enhancements.  B.1.1: for area specific SIB, it should be noted that SIB contains information regarding MCCH configuration. Therefore whether SIB can be area specific depends on details on MCCH design, e.g. there is only one MCCH as in LTE SC-PTM, and multiple MCCHs as in proposals from some contributions. Hence whether to have area specific SIB can be only decided once MCCH structure is agreed. As for area specific MCCH, our understanding is that in typical cases, MCCH can be cell specific regarding ongoing MBS sessions. Therefore area specific MCCH is not needed.  B.1.2: on-demand SIB and MCCH increases latency especially in consideration of service continuity. Therefore we prefer not to consider it.  B.2: currently we prefer to use LTE SC-PTM notification mechanism as baseline. |
| NEC | Yes | Multi-cell transmission can be supported. |

## 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

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[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

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

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

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[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

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

[26] R2-111e chairman notes

# 5 Participants

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