**3GPP TSG-RAN WG2 Meeting #113 electronic *R2-200wxyz***

**Online, Jan 25 - Feb 5, 2021**

Agenda Item: 8.1.x.x

Source: MediaTek Inc.

**Title: [Post112-e][069][MBS] Delivery mode 2 (MediaTek)**

Document for: Discussion and decision

# Introduction

This document is to kick off the following email discussion:

* [Post112-e][069][MBS] Delivery mode 2 (MediaTek)

      Scope: Progress on solutions CP focus: MCCH or not for PTM configuration. PTM configuration change notification.

      Intended outcome: Report with agreeable proposals / identified open issues

      Deadline: Long

During last RAN2 meeting (RAN#112e), there were discussions on delivery modes for NR MBS. The delivery mode 2 is for “low” QoS requirement, where the UE can also receive data in INACTIVE/IDLE. The delivery mode 2 was assumed by RAN2 for broadcast sessions at last RAN2 meeting and it is FFS for its applicability for multicast sessions.

Agreements

=>For Rel-17, R2 specifies two modes:

1: One delivery mode for high QoS (reliability, latency) requirement, to be available in CONNECTED (possibly the UE can switch to other states when there is no data reception TBD)

2: One delivery mode for “low” QoS requirement, where the UE can also receive data in INACTIVE/IDLE (details TBD).

R2 assumes (for R17) that delivery mode 1 is used only for multicast sessions.

R2 assumes that delivery mode 2 is used for broadcast sessions.

The applicability of delivery mode 2 to multicast sessions is FFS.

As one of the post-meeting discussions for RAN#111e, [906], MBS Idle mode support was initially discussed, and the following conclusion was made during the online discussion based on the email summary (R2-2008796).

Agreements

=>UE receives the MBS configuration (for broadcast/delivery mode 2) by BCCH and/or MCCH (TBD), and this can be received in Idle / Inactive mode. Connected mode FFS (dep on UE cap and where service is provided etc). A notification mechanism is used to announce the change of MBS Control information.

According to abovementioned background, this email discussion aims to discuss the detailed CP aspects of delivery mode 2.

# Clarification of Delivery mode 2

## 2.1 Applicability of Delivery mode 2 on RRC states

According to the agreements made during last RAN2 e-meeting (i.e. RAN2#112e), there is no clear statement with regard to the RRC states for the applicability of Delivery mode 2. Rapporteur thinks it is helpful to clarify it before any discussion on other issues. Rapporteur assumes that NR MBS delivery mode 2 supports both idle/inactive UEs and connected mode UEs based on the agreements so far.

### **Question 1**

Do you agree that both idle/inactive UEs and connected mode UEs can receive MBS services transmitted by NR MBS delivery mode 2?

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| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes | We assume NR MBS delivery mode 2 can provide the same/similar support as LTE SC-PTM does. Meanwhile since NR MBS delivery mode 2 supports the UE reception for low QoS MBS service, connected mode UEs should not be excluded for such reception. |
| Huawei, HiSilicon | Yes | As mentioned by Mediatek, two delivery modes are targeted at different use cases and UEs in RRC Connected should be able to receive all kinds of services. Therefore, UEs in RRC Connected should be able to receive MBS service provided with delivery mode 2 in the same way as in LTE SC-PTM. FFS whether this is subject to UE capability, which should be discussed at a later stage. |
| QC | Yes for Broadcast only. | We think Multicast is mainly useful for high reliability QoS and there is no need to support low reliability QoS services using Multicast. Broadcast can be used to support low reliability services and in all RRC states. In IDLE/INACTIVE state, it is not possible to support high reliability and Multicast can be limited to RRC\_CONNECTED state for high reliability services. Note that LTE SC-PTM supports only Broadcast services. |
| OPPO | Yes | RAN2 agreements in RAN2#112e:  2: One delivery mode for “low” QoS requirement, where the UE can also receive data in INACTIVE/IDLE (details TBD).  RAN1 agreements in RAN1#103e:  **Agreements:** From physical layer perspective, for broadcast reception, the same group-common PDCCH and the corresponding scheduled group-common PDSCH can be received by both RRC\_IDLE/RRC\_INACTIVE UEs and RRC\_CONNECTED UEs.  Based on the agreements from RAN1 and RAN2, it is reasonable delivery mode 2 is supported for RRC\_IDLE/INACTIVE/CONNECTED mode UE. |
| CATT | Yes | For a specific MBS services with low QoS requirement, it should be delivered by delivery mode 2 in idle/inactive mode and connected mode.  1. A UE receiving MBS in idle/inactive mode with delivery mode 2 may need to enter connected mode for unicast reception.To secure the service continuity, the MBS services should be able to continued when UE transitions to connected mode.  2. A specific MBS services should has same QoS requirement in idle/inactive mode or connected mode, therefore a MBS service which is delivered with delivery mode 2 in idle/inactive should also be delivered with delivery mode 2 after UE transitions to connected mode. |
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## 2.2 Delivery mode 2 characteristics

As concluded during last RAN2 e-meeting, delivery mode 2 supports the transmission of MBS services with lower QoS requirement. In this case, delivery mode 2 means PTM reception only, i.e. there is no PTP-PTM switch nor PTP assistance to improve PTM quality. Delivery mode 2 may support a huge number of users (i.e. UE in idle/inactive state). To enable delivery mode 2 reception, the UE does not need to take session join and/or authentication at NAS layer. In summary, the UE receiving MBS services transmitted by delivery mode 2 is not required to interact with the network before its MBS service reception (i.e. pure broadcast delivery).

### **Question 2**

Do you agree that the UE receiving MBS services transmitted by delivery mode 2 is not required to interact with the network before its MBS service reception?

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| Company | Yes/No | Comments |
| MediaTek | Yes | Since NR MBS delivery mode 2 supports the Idle/Inactive mode UE reception, it is not realistic to require the UEs to interact with the network before service reception. |
| Huawei, HiSilicon | Yes | From 3GPP perspective, there is no such requirement. There may be some subscription mechanism at application layer, but this is out of scope of 3GPP. |
| QC | Yes for Broadcast | Broadcast services can be received by all UEs in Broadcast service area and can be received in all RRC states. For receiving Broadcast services , UEs are not required to join Broadcast session and NW does not keep UE context for delivering Broadcast services. |
| QC | Yes | LTE SC-PTM can be baseline.  We also cannot see the necessary to make RRC state transition for the reception of MBS configuration for delivery mode 2. |
| CATT | Yes, but | The answer is Yes from RAN perspective.  From RAN perspective, UE does not need to interact with the network before MBS service reception, as we have agreed that “UE receives the MBS configuration (for broadcast/delivery mode 2) by BCCH and/or MCCH”.  However, from SA2 perspective, Even there is no join procedure for broadcast but join procedure is needed for multicast. For now it is better not to limit the applicability of delivery mode 2 to broadcast only, as RAN2 has agreed that“The applicability of delivery mode 2 to multicast sessions is FFS.”  In addition to above, we do not see the need for RAN2 to conclude whether there is interaction with the network on CN level before MBS service reception. |
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## 2.3 Delivery mode 2 for multicast/broadcast session

According to the online discussion of RAN2#112e, RAN2 assumes that delivery mode 2 is used for broadcast sessions. The applicability of delivery mode 2 to multicast sessions is not decided yet.

It should be helpful to decouple the concept of multicast/broadcast session from delivery mode. As such, the multicast sessions may be transmitted by delivery mode 1 or delivery mode 2, depending on the application-layer requirement for MBS service. Consequently, the multicast session that does not require high quality reception (lower QoS requirement) could be provided in the broadcast manner (i.e. delivery mode 2). This should be confirmed by RAN2.

### **Question 3**

Do you agree that delivery mode 2 can also support the transmission of multicast sessions?

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| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes | However, as discussed at Question 2, NR MBS delivery mode 2 does not require UE interaction with the network (e.g. Idle/Inactive mode). Then the session join procedure for low QoS multicast session may be not supported in this case, which may need be coordinated with SA2. |
| Huawei, HiSilicon | No | SA2 defines two different types of MBS session: multicast session and broadcast session. For multicast session. As the rapporteur described in section 2.2, for multicast sessions the UEs need to interact with Core Network to join the session. Hence delivery mode 2 is not appropriate for providing multicast sessions. If an MBS service does not require high QoS, then it can use broadcast session and delivery mode 2. (This does not prevent the service provider to introduce some service subscription/join mechanism at application layer as we mentioned above). |
| QC | No | Same view as Huawei. For services requiring low reliability, broadcast mode can be used and which mode to be used for a given service is decided by 5GC NFs based on interaction with Content Provider and QoS requirements. |
| OPPO | No | We share the same view as Huawei. |
| CATT | Yes | Multicast session can be used to delivery services with high QoS requirement and services with low QoS requirement. Therefore multicast session for delivering services with low QoS requirement should be delivered by delivery mode 2, considering the limited capacity of NG-RAN to accommodate the large amount of connected UEs.  We think the key characteristic of a multicast session is the need of joining group but not the high QoS requirement. |
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# Transmission of PTM configuration

## 3.1 PTM configuration transmitted by MCCH

The MBS PTM configuration can be configured via two-step based approach or one step based approach (as depicted by Figure 1) for delivery mode 2.

In LTE SC-PTM, the configuration is provided by two steps, i.e., SIB20 and SC-MCCH. SIB20 provides the SC-MCCH scheduling information; and SC-MCCH provides the SC-MTCH scheduling information. The SC-MCCH is scheduled by SC-RNTI at PDCCH and the SC-MTCH scheduled by G-RNTI at PDCCH. The two-step configuration offers the benefit that the PTM configuration scheduling is independent from SIB scheduling.

However, as discussed within email discussion [Post-111e][906], PTM configuration can also be provided by one step approach, i.e. at SIB. Some companies think that with this approach, the UEs can easily know what MBS services are provided by simply reading the MBS control information SIB without the need to monitoring MCCH.

RAN2 needs to decide the way for the transmission of PTM configuration for delivery mode 2 according to the discussion above.



*Figure 1: MBS configuration alternatives*

### **Question 4**

Do you agree that the two-step based approach (i.e. BCCH and MCCH) as adopted by LTE SC-PTM is reused for the transmission of PTM configuration for NR MBS delivery mode 2?

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| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes | Two-step configuration approach as adopted by LTE SC-PTM has the benefit of latency control and there is no impact to legacy UEs. |
| Huawei, HiSilicon | Yes | As indicated by Mediatek, this approach has an advantage of more flexibility for scheduling updates (e.g. there is no limitation to update the scheduling only according to BCCH modification period) and allows to avoid impact on legacy UEs. |
| QC | Yes for Broadcast | MCCH allows to differentiate unicast SIBs from Broadcast. MCCH modification period can be much shorter than BCCH modification period. LTE SIB15 equivalent can be used to specify list of MBS services in a given freq/cell to assist service continuity during idle cell reselection procedure. |
| OPPO | Yes | LTE SC-PTM is baseline. |
| CATT | Yes | Agree with MTK and Huawei on the the benefit of latency control and avoiding impact to legacy UEs. |
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## 3.2 Reception of PTM Configuration for connected UEs

This section assumes NR MBS delivery mode 2 supports both idle/inactive UEs and connected mode UEs, which depends on the confirmation of Question 1.

As discussed in the previous section, the PTM configuration for the MBS sessions supported by delivery mode 2 can be acquired on BCCH and/or MCCH. There may be no ambiguity for idle/inactive UEs. However it would be needed to clarify if the same principle also applies to connected mode UEs.

There are two alternatives according to the contributions submitted to RAN2#112e. At first alternative, the UEs in connected mode acquires the PTM MBS configuration from broadcast (BCCH and/or MCCH). At second alternative, the UEs in connected mode receives the MBS configuration via dedicated signaling. Note that LTE SC-PTM adopts the first alternative.

### **Question 5**

Select the alternative for connected UEs to receive the PTM Configuration for MBS services for NR MBS delivery mode 2?

Alt-1: Reuse LTE SC-PTM mechanism (i.e. receive the PTM configuration via broadcast)

Alt-2: Receive the PTM Configuration for MBS services via dedicated signaling

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| --- | --- | --- |
| Company | Selected Alt(s) | Comments |
| MediaTek | Alt-1 | We prefer a unified solution for both Idle/Inactive UEs and confectioned mode UEs for the transmission of PTM Configuration. |
| Huawei, HiSilicon | Alt-1 | We should not multiply different configuration options unnecessarily, i.e. for delivery mode 1 the configuration is provided via dedicated signalling and for delivery mode 2 it is always provided via broadcast signalling. The UEs is RRC Connected are currently capable of receiving SIB information and MBS enabled UEs will also need to be capable of receiving PTM transmission, so it is unclear why they should require to receive a dedicated MBS configuration for delivery mode 2. In case the PTM configuration is not broadcast within the UE’s active BWP, a container with the broadcast PTM configuration can be sent to the UE via dedicated signaling, like what has been done for SIBs. |
| QC | Alt-1 for Broadcast only | Note that this is not applicable for Multicast services.  Multicast services supported in RRC\_CONNCTED state only can receive the MRB configuration using dedicated RRC signaling. |
| OPPO | Alt-1 | We prefer to use a unified solution for RRC\_IDLE/INACTIVE/CONNECTED mode UE. |
| CATT | Both Alt-1 and Alt-2 | Agree with Huawei, the SIB approach could be reused.  UE in connected mode could  1.Acquire PTM configuration via broadcast signaling.  2. Or a container with the broadcast PTM configuration in dedicated signaling is also possible since the BCCH/MCCH may not transmitted on the dedicated BWP of UE. |
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## 3.3 Area specific MBS SIB and PTM configuration

As discussed in many contributions submitted to RAN2#112e, the MBS SIB and MCCH configuration may be area specific. If the MBS SIB and PTM configuration are area specific, the UE may not need to read the MBS SIB after cell reselection and then may help to ensure better service continuity. On the other hand, according to the view within the contributions, some company thinks that PTM configuration (e.g. in MCCH) should be cell specific as different cell may deliver different MBS services.

### **Question 6**

Do you agree that MBS SIB can be area specific for NR?

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| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes | MBS SIB as a regular SIB can be area specific. We think MBS SIB can cell specific. Then the area specific MBS SIB can be set as optional. |
| Huawei, HiSilicon | Yes | This is as for any other SIB, so no extra work for this Is required for MBS. |
| QC | Yes | Same view as MediaTek. |
| OPPO | Yes | We share the same view as MediaTek. |
| CATT | Yes | Agree with MTK and Huawei. |
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### **Question 7**

Do you agree that the PTM configuration (e.g. in MCCH) can be area specific for NR MBS delivery mode 2?

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| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes | PTM configuration (e.g. in MCCH) can both area specific and cell specific. It may be a network implementation issue. |
| Huawei, HiSilicon | No | MCCH contains scheduling configuration which is performed by each cell independently depending on the load situation, available resources etc. and may change rather dynamically. We think it will be very hard, if not impossible, for the network to configure areas with the same MCCH configuration. |
| QC | Yes | Same view as MediaTek. It upto configuration whether to use cell specific or area based. |
| OPPO | Yes | We share the same view as MediaTek.  We also see the benefit of reduction for interruption of the MBS service during cell reselection if the MCCH is area specific. |
| CATT | Maybe | This may be feasible within a DU.  But area-specific MBS configuration among different NG-RAN nodes need further discussed. The MBS control information contained in the MCCH is hard to align between NG-RAN nodes. Such as the following,  1. Ongoing MBS services on each cell may be different.  2. G-RNTI of a specific MBS service are allocated by each cells independently. |
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## 3.4 On-demand MCCH transmission/PTM configuration

As discussed in many contributions submitted to RAN2#112e, MCCH for NR MBS can be provided in on-demand mode following the similar principle of On-demand SI transmission as supported by NR Rel-15/Rel-16. For delay tolerant services, On-demand MCCH transmission may be able to optimize the resource consumption for MCCH signalling. On the other hand, it may be not friendly to delay sensitive services. In addition, On-demand MCCH transmission require the UE-Network interaction before the MBS service reception. In order to allow some flexibility, NR MCCH can be transmitted either by using Broadcast mode or on-demand following network configuration.

### **Question 8**

Select the alternative to support MCCH transmission/PTM configuration:

Alt-1: Reuse LTE SC-PTM mechanism (i.e. Broadcast mode based MCCH transmission)

Alt-2: NR MCCH/PTM configuration can be transmitted either by using Broadcast mode or on-demand following network configuration

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| --- | --- | --- |
| Company | Preferred Alt(s) | Comments |
| MediaTek | Alt-1 | We think that On-demand MCCH transmission is not friendly to UEs in Idle/Inactive mode. It may be over-specified. |
| Huawei, HiSilicon | Alt-1 | We find such mechanism unnecessary. For broadcast sessions, we can rely on proper service delivery planning by higher layers / OAM. |
| QC | Alt-2 | It is upto NW to configure either on-demand or broadcast MCCH depending on service requirements. If area based MCCH is configured, when idle UEs are moving from one cell to another cell, there is no need to request on-demand MCCH as long as UE is within that configured area. Alt2 allows flexibility for NW resource optimization in addition to meeting delay requirements of different services. |
| OPPO | Alt-1 | We worried about the impact on the MBS service interruption during cell reselection if on-demand mechanism is introduced for MCCH and also for MBS BCCH. |
| CATT | Alt-1 | We do not see the benefit of on demand MCCH.  MCCH is used to inform the start/stop of MBS services, Reachability to all the interested UE is important. So it should be in broadcast mode. |
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## 3.5 Multiple MCCHs within one cell

This discussion of this section assumes MCCH is adopted for PTM configuration transmission.

Legacy MCCH uses a fixed modification period and repetition period and one MCCH may not cater for different characteristics of use cases for NR MBS. One possibility would be to consider whether the configuration channel should be separated for different use cases. For example, one MCCH provides the delay sensitive services frequently while another MCCH provides the delay tolerant services sparsely.

In LTE SC-PTM, there was the restriction that one cell has only one SC-MCCH. However, NR MBS can remove such a restriction, considering a larger number of use cases are assumed than LTE. If the multiple MCCHs are allowed in a cell, each MCCH can have different scheduling configuration, such as the repetition period, which can be optimized for certain services.

In this case, the PTM configuration can be transmitted by multiple MCCHs within one cell and the UE can only receive the MCCH configuration about the services that he is interested in.

### **Question 9**

Do you agree that the PTM configuration can be transmitted by multiple MCCHs within one cell for NR MBS delivery mode 2?

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| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes | PTM configuration transmitted by multiple MCCHs is a simple way to support multiple type of MBS services by one cell. |
| Huawei, HiSilicon | No | We already specify two delivery modes and delivery mode 1 is the one to be used for high-reliability / low latency services. It is unnecessary to optimize delivery mode 2 for such use cases. |
| QC | Yes | Allowing multiple MCCH allows NW to configure different MCCH modification periods for different service groups based on delay requirements as an optional configuration. It allows NW to configure broadcast MCCH and area based MCCH configuration depending on services supported by different MCCH. |
| OPPO | No | We cannot see the strong benefit and necessary to do this, maybe we can discuss it online. |
| CATT | - | This enhancement need further evaluated.  On one hand, we see some disadvantage on the single SC-MCCH approach of SC-PTM. UE only interested in one/several of the large amount MBS services supported by the cell. When any of the MBS services changes, UE in idle/inactive mode will need to receive the updated SC-MCCH control information blindly and to find out whether the interested MBS service has changed. This may result in the increase of UE power consumption.  On the other hand, Multiple MCCHs may also increase the overhead and complexity of NG-RAN.And UE may need to monitor multiple MCCHs, which will result in the increase of power consumption. |
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# Change notification for PTM configuration

## 4.1 Purpose of PTM change notification mechanism

It should be noted that the legacy change notification mechanism for MBMS (including eMTC/NB-IoT SC-PTM) was designed to notify the changes of (SC-)MCCH due to session start and the changes of (SC-)MCCH due to other purpose (e.g. modification of the transmission cycle, counting request for a service, etc.).

There is a view that from upper layer perspective, the broadcast session does not require session joining procedure for the UE before MBS service reception. If this is the case, NR delivery mode 2 may need not to support to notify the changes of PTM configuration (e.g. carried by MCCH) due to session start provided that only broadcast session is supported by NR delivery mode 2. This discussion may depend on the reply for Question 3 in section 2.3.

Meanwhile, rapporteur understanding is that NR delivery mode 2 need to support to notify the changes of PTM configuration due to other purposes (e.g. modification of the transmission cycle for a service).

RAN2 needs to confirm the above understandings.

### **Question 10**

Do you agree that the PTM change notification mechanism can be used to notify the changes of PTM configuration (e.g. carried by MCCH) due to session start for delivery mode 2 of NR MBS?

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| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes | It is not clear to us why LTE SC-PTM support notification of the session start but delivery mode 2 of NR MBS need not. Meanwhile we think that this can be coordinated with SA2. |
| Huawei, HiSilicon | Yes | gNBs should send session start notification when the broadcast session establishment request is received from the CN. |
| QC | Yes but | PTM configuration is carried by MCCH. we think the question is whether MCCH change notification mechanism can be used to alert Broadcast UEs to acquire MCCH based on MCCH modification period. With this understanding, MCCH change notification can be used to alert change of Broadcast service(s) (i.e addition/removal), broadcast session start/stop, PTM configuration change etc. |
| OPPO | Yes but | The MCCH change notification mechanism can be reused also in NR. But if it be can used to notify the session status, we should confirm it with SA2. |
| CATT | Yes | The session start can be informed to UE with change notification mechanism. SC-PTM mechanism should be the baseline. |
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### **Question 11**

Do you agree that the PTM change notification mechanism can be used to notify the changes of PTM configuration (e.g. carried by MCCH) due to other purpose (e.g. modification of the transmission cycle for a service) for delivery mode 2 of NR MBS?

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| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes | Same as legacy approach. |
| Huawei, HiSilicon | No | We prefer to use the same approach as in LTE SC-PTM, i.e. notifications are only sent for new session indication. For ongoing MBS sessions, the UE should read MCCH once per MCCH modification period to check whether any configuration updates were done. |
| QC | Yes | See Q10 response. |
| OPPO | Yes? | We are not sure if it is same as Huawei said? We are not sure if the transmission cycle for a service exists in SC-PTM? |
| CATT | ? | Same understanding on the SC-PTM mechanism as Huawei. Change notification mechanism in SC-PTM is only used to inform the session start.  Then the question is what is the problem if we stick to SC-PTM approach? Or what is the benefit if we extend the usage of the change notification mechanism? |
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## 4.2 Baseline of PTM change notification mechanism

The discussion of PTM change notification should be connected with the decision whether two-step approach (BCCH +MCCH) or one-step approach (BCCH only) is adopted for PTM configuration transmission, as discussed within section 3.1. However, this discussion in this section assumes that MCCH logical channel is adopted for the transmission PTM configuration as LTE SC-PTM.

It should be noted that the initial discussion for change notification for MBS was taken during email discussion [Post-111e][906] for Idle/Inactive mode UEs. According to that email discussion summary and the contributions submitted to RAN2#112e, rapporteur understanding is that the companies want to have a baseline for change notification before any specific enhancement discussion.

**Baseline: Use the legacy LTE SC-PTM change notification mechanism**

In LTE 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.

RAN2 needs to confirm this baseline for PTM change notification mechanism for NR MBS delivery mode 2.

### **Question 12**

Do you agree to use the legacy LTE SC-PTM change notification mechanism as the baseline for PTM change notification for delivery mode 2 of NR MBS?

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| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes | Same as legacy approach. |
| Huawei, HiSilicon | Yes | We think there is no reason to deviate from the legacy mechanism, either the one used for non-NB-IOT/MTC UEs (based on SC-N-RNTI) or the one used for NB-IOT/MTC UEs (based on SC-RNTI). |
| QC | Yes |  |
| OPPO | Yes |  |
| CATT | Yes |  |
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## 4.3 Group based PTM change notification

This section continue the discussion from previous section.

The legacy LTE SC-PTM change notification mechanism is a simple solution. However, as commented by some companies during the email discussion Post111-e(906), the SC-PTM change notification mechanism may lead the UE to monitor both MCCH and PCCH and to wake up and receive the updated MCCH control information for some MBS services which are not his interests and then may be not friendly to UE power consumption for the cases where PTM configuration changes too often.

According to the email discussion (Post111-e-906) summary [1] and the contributions submitted to RAN2#112e, rapporteur summarizes the following alternatives to handle the issue.

**Alternative 1: Multiple MCCHs to notify PTM configuration change**

The network groups some of MBS services together to form a MBS service group to share the same MCCH modification cycle and repetition cycle. For example, the frequently changed MBS services can be organized together into one service group and their PTM configuration and change notification shares one MCCH. As discussed in section 3.5, multiple MCCHs are used in this case.

If the MBS services could be grouped above, the PTM change notification can be only notified to the involved UEs which have interests. UE may refrain from frequent wake-up for MCCH check if he wants to only follow less frequently changed MBS services (e.g. IoT services).

**Alternative 2: Group based paging to notify PTM configuration change**

The spirit of this design is to merge the monitoring of PTM configuration change notification into the legacy paging monitoring to save UE power. The bits within the Short Message field of the legacy DCI format for paging or new DCI format can be used to indicate whether the NR MBS control information is changed. The field (e.g. short message) can further indicate which MBS service group’s MBMS control information are changed. The UE reads the paging and then reads the updated MCCH channel if needed.

This design also assume that the MBS services could be grouped. This design implies that the UE that is interested in the MBS services can be automatically grouped and then UE group based paging applies. It should be noted that UE group based paging is being discussed within Rel-17 power saving WI.

The benefit of this alternative is that the change notification is only notified to the involved UEs which have interests [28]. However the discussion of the DCI format may need coordination with RAN1. RAN2 also needs to discuss how to group the UEs to enable group based paging for different MBS service groups.

There may be pros and cons for the abovementioned alternatives. And there may be additional alternatives for the enhancement of baseline PTM change notification mechanism.

RAN2 can discuss which alternative should be adopted if an enhancement based on the baseline PTM change notification mechanism is considered.

### **Question 13**

Which alternative should be adopted if an enhancement based on the baseline PTM change notification mechanism is considered?

Alt-1: Multiple MCCHs to notify PTM configuration change

Alt-2: Group based paging to notify PTM configuration change

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| --- | --- | --- |
| Company | Preferred Alt(s) | Comments |
| MediaTek | Alt-1 | It should be noted that NR MBS delivery mode 2 may support both Idle/Inactive UEs and connected UEs. Requiring the connected UEs to monitor Paging channel is an additional burden for the UEs. In addition, grouping info in Paging DCI may lead to legacy UEs to receive the Paging DCI indicating MBS change if PO is not arranged correctly. |
| Huawei, HiSilicon | Neither | It is too soon to discuss such optimizations considering that we have not agreed on the baseline mechanism yet. |
| QC | Alt1 for Broadcast MCCH change notification but | Group paging is more appropriate for alerting Multicast UEs (assuming Multicast config is provided via RRC dedicated signaling) and MCCH change notification is appropriate for alerting Broadcast UEs to update MCCH changes. Even if there is single MCCH used, MCCH change notification can be used and no need to tie it to multiple MCCH case only. |
| OPPO | None | We share the same view with Huawei. |
| CATT | Alt-2 | We understand the method that notifying PTM configuration change in group can be used in SC-MCCH based change notification mechanism or paging mechanism.  The question is what is the principle/[granularity](javascript:;) to group the MBS services, |
|  |  |  |
|  |  |  |

# Counting and Interesting indication

In LTE eMBMS/SC-PTM, there are two different types of methods specified to collect UE’s receiving/interested services, i.e., MBMS Counting and MBMS Interest Indication (MII). RAN2 should discuss if the related mechanism can apply to delivery mode 2 of NR MBS.

## 5.1 Counting

In LTE eMBMS, counting is used to determine if there are sufficient UEs interested in receiving a service to enable the operator to decide if it is appropriate to deliver the service via MBSFN.

When the MCE entity requests the counting, MCE will send counting request to eNB. Upon reception of Counting Request from MCE, eNB will broadcast Counting Request to the UE, then the RRC\_CONNECTED UE will respond the counting response message to the network, in order to assist the network to decide the transmission method for the MBMS session. But for RRC\_IDLE UE, they are not mandated to enter RRC\_CONNECTED mode to respond the counting request.

For NR MBS delivery mode 2, even though there is no standardized support for MBSFN, the counting may still help to the network to decide the transmission method.

RAN2 needs to discuss the support of counting procedure for delivery mode 2 for both connected UEs and Idle/Inactive mode UEs.

Specific to Idle/Inactive mode UEs, some companies think that it would be possible to allow UE to respond the counting request without going to RRC connected mode if it is supported [4].

### **Question 14**

Should delivery mode 2 support counting procedure for connected mode UEs?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes | Same as legacy approach. |
| Huawei, HiSilicon | No | Counting is a complicated mechanism and we do not think it is necessary to support it. For multicast sessions, the network is aware of the number of the UEs using a service while for broadcast we can rely on proper network planning and higher layers. This is how it is handled in LTE SC-PTM where AS layer counting is not supported and instead we rely on application layer to collect the information about the number of receiving UEs and determine to use broadcast or unicast transmission. |
| QC | Maybe Yes | Can be useful to determine whether to broadcast a service or not. But for Multicast services, RAN3 agreed not to support counting procedure. |
| OPPO | No | It is already agreed in RAN3 that counting is not supported in NR MBS. |
| CATT | Depends | It depends on whether NG-RAN supports to dynamic control on the start/stop of broadcast services delivery based on number of interested UEs. |
|  |  |  |

### **Question 15**

Should delivery mode 2 support counting procedure for Idle/Inactive mode UEs?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | No | It may be too complicated to require Idle/Inactive mode UEs to provide counting response. |
| Huawei, HiSilicon | No | Please see answer to question 14. |
| QC | Yes | If counting is supported for Broadcast UEs, then it has to be supported for UEs in all RRC states to provide response. |
| OPPO | No | It is already agreed in RAN3 that counting is not supported in NR MBS. |
| CATT | Depends | Same as our answer to Q14. |
|  |  |  |

### **Question 16**

Should delivery mode 2 support counting procedure for Idle/Inactive mode UEs without mandating the UEs to enter RRC connected mode?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | No | This may be a RAN1 discussion. However requiring Idle/Inactive mode UEs to feedback may cause problem to the UEs if the uplink coverage is not good enough. |
| Huawei, HiSilicon | No | Please see answer to question 14. |
| QC | No |  |
| OPPO | No | It is already agreed in RAN3 that counting is not supported in NR MBS. |
| CATT | No |  |
|  |  |  |

## 5.2 Interesting indication

In LTE eMBMS/SC-PTM, the purpose of MBMS Interest Indication procedure is to inform E-UTRAN that the UE is receiving or is interested to receive MBMS via an MRB, and if so, to inform E-UTRAN about the priority of MBMS versus unicast reception.

As can be seen, the MBMS Interest Indication procedure is different from counting procedure. Furthermore, in LTE eMBMS/SC-PTM, UEs in RRC\_CONNECTED is allowed to send the MBMSInterestIndication message at any time. It contains the information related to MBMS frequencies of interest, MBMS services of interest, MBMS priority, etc. MBMS Interest Indication (MII) procedure is mainly used for the network to ensure that the UE can continue to receive its service of interest while in connected mode.

In LTE eMBMS/SC-PTM, MII cannot collect the information from UEs in IDLE mode, even though the majority of UEs may receive the broadcast services in IDLE mode.

According to the email discussion [Post111-e][906] and company contribution submitted to RAN2#112e, some companies think that unnecessary PTM transmissions can be avoided if the cell knows the interests of UEs in IDLE/INACTIVE. However, some companies have concerns about the complexity and signalling overhead of UE interest indication from UE in idle/inactive mode.

For NR MBS delivery mode 2, there may be both connected UEs and Idle/Inactive mode UEs. So then RAN2 can separate the discussion for connected UEs and Idle/Inactive mode UEs.

### **Question 17**

Should MBS Interest Indication is supported for UEs in connected mode for delivery mode 2?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes | We support this MBS Interest Indication to enable the service continuity for UE reception. |
| Huawei, HiSilicon | Yes | It is needed for service continuity, e.g. to allow the source gNB to select a target cell which supports the broadcast service for the UE during handover or to configure or schedule the UE in the way allowing it to receive PTM together with unicast while it is in RRC Connected. |
| QC | Yes for broadcast only | LTE MII is intended for service continuity for UEs receiving Broadcast services while in RRC\_CONNECTED state. The same is true for NR Broadcast as well. |
| OPPO | Yes | There is no AS context for the delivery mode 2, so interesting indication is good for connected UE when receiving delivery mode 2 MBS. |
| CATT | Yes | To secure handover with basic service continuity, NG-RAN should know which broadcast service(s) the UE in connected mode is receiving. |
|  |  |  |

### **Question 18**

Should MBS Interest Indication is supported for UEs in idle/inactive mode for delivery mode 2?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | No | It may be too complicated to require Idle/Inactive mode UEs to provide MBS Interest Indication for delivery mode 2. |
| Huawei, HiSilicon | No | There is no use of MBS Interest Indication for IDLE/INACTIVE mode UEs. |
| QC | No | See Q17 response. |
| OPPO | No |  |
| CATT | Depends | Same as our answer in Q14. |
|  |  |  |

## 5.3 Interaction between MBS interest indication and On-Demand SI

There is a discussion at the previous section (i.e. 3.4) on the support on-demand PTM configuration (as provided by e.g. MCCH). Then there is a proposal to correlate the procedure of MBS interest indication with on-demand request for MCCH configuration [19]. In practice, the UE can provide an MBMS interest indication as part of the process to acquire an MBS SIB or PTM configuration (e.g. carried by MCCH). Requesting MBS SIB/PTM configuration could be understood as some form of MBS interest from the UE. This can be seen as a signalling optimization to reduce latency.

### **Question 19**

Should MBS Interest Indication be merged with on demand MBS/PTM configuration request procedure for delivery mode 2?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | No | As replied at Question 8, we are not convinced for the benefit of on demand PTM configuration (e.g. in MCCH). |
| Huawei, HiSilicon | No | MBS Interest Indication should only be for UEs in RRC Connected while the configuration for delivery mode 2 is provided with broadcast signalling to ensure also RRC IDLE UEs can receive it. We do not see how this ca be correlated. |
| QC | No | Motivation of MII is different from on demand SIB/MCCH request. If a UE is requesting On-demand SIB/MCCH does not mean that UE is receiving a particular Broadcast service in RRC\_CONNECTED state. A UE requests on-demand SIB/MCCH to learn which broadcast services available in the cell or area then UE starts receiving Broadcast service based on user interest. If UE starts receiving some Broadcast services while in RRC\_CONNECTED state then for the purpose of service continuity UE can send MII to gNB. |
| OPPO | No | We think we should agree that the on-demand MCCH or MBS BCCH is supported firstly. |
| CATT | No | On demand MCCH is not preferred as we commented in Q8. |
|  |  |  |

# Service continuity for Delivery mode 2

## 6.1 Need of Service continuity for Delivery mode 2

The need of service continuity for Delivery mode 2 should be discussed. On one hand, the Delivery mode 2 is used for low QoS MBS service and then the service continuity for UE reception may be not very critical. On the other hand, the current service continuity mechanism for LTE SC-PTM/eMBMS is easy to be reused by Delivery mode 2. RAN2 can confirm the understanding before any other discussion for service continuity for Delivery mode 2 in the following sections.

### **Question 20**

Do you agree that service continuity is needed for NR MBS Delivery mode 2?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes | Same need as legacy approach for LTE SC-PTM/eMBMS. |
| Huawei, HiSilicon | Yes | Even though the service may have low QoS requirements, we should ensure that the UE is able to receive it whenever it is interested in this service. |
| QC | Yes |  |
| OPPO | Yes |  |
| CATT | Yes | From user experience point of view, at least basic service continuity in mobility should be supported naturally regardless of what delivery mode is used. |
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## 6.2 Mechanism to transmit the information for Service continuity for Delivery mode 2

For LTE SC-PTM, the service continuity was ensured via various ways as described below:

At first, to avoid the need for the UE to read MBMS related system information and potentially SC-MCCH on neighbor frequencies, the MBMS assistance information are provided by both USD (i.e. user service description) and system information (i.e. SIB15).

Secondly, the UEs in RRC\_IDLE applies frequency based prioritization during cell reselection.

Thirdly, for each MBMS service provided using SC-PTM, E-UTRAN indicates in the SC-MCCH the list of neighbor cells providing this MBMS service so that the UE can request unicast reception of the service before changing to a cell not providing the MBMS service using SC-PTM. The UEs in RRC\_CONNECTED informs the network about its MBMS interest, and then the network does its best to ensure that the UE is able to receive MBMS and unicast services subject to the UE’s capabilities during mobility.

Specific to NR delivery mode 2, this section can focus on the discussion of first way as mentioned above. The discussion of frequency based prioritization is taken at section 6.3 and 6.4. The discussion of the third way (i.e. interest indication and MCCH information) is taken at section 5 and section 7 respectively.

RAN2 needs to decide whether NR delivery mode 2 can assume that both USD and system information can be provided for purpose of service continuity as for LTE SC-PTM. It should be noted that USD will be discussed by SA/CT WGs and the design of the content of system information may be subject to the final description of USD.

### **Question 21**

Do you agree that both USD and system information can be provided for purpose of service continuity for NR MBS Delivery mode 2 (i.e. reuse legacy approach for LTE SC-PTM)?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes | The content of USD may rely on the input from SA/CT WGs. Then the SIB information cannot be decided now. However the general principle of legacy approach for LTE SC-PTM/eMBMS can be reused. |
| Huawei, HiSilicon | Yes | We agree the general principle can be reused. |
| QC | Yes | In LTE, USD main purpose is to configure list of broadcast services and frequencies of support etc. Based on USD list, UE can search for a frequency to acquire SIB15 and UE selects its interested broadcast service. The same approach can be used for NR Broadcast as well. |
| OPPO | Yes |  |
| CATT | Yes | Agree with MTK and Huawei that general principle in SC-PTM can be reused. |
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## 6.3 UE awareness of MBS services on cell/frequency basis for service continuity

In LTE, the MBMS service is deployed on frequency basis, and the mechanism specified to ensure UE service continuity is that, UE is made aware of which frequency is providing which MBMS services through the combination of USD and SIB15.

During the email discussion [Post-111e][906], there are diverse views on the reuse of the same mechanism as LTE SC-PTM. For example, some companies think that the MBS service information only for neighboring frequencies may not be enough and show preference to have a cell list per frequency per MBS service or a list about the services the cell/node could support (e.g. via BCCH). However this requires more configuration and maintenance of system information to provide neighbor cell info per cell. RAN2 need to discuss this issue from the perspective of delivery mode 2.

### **Question 22**

Select the alternative to support UE awareness of MBS services on cell/frequency basis for service continuity for NR MBS delivery mode 2?

Alt-1: Reuse LTE SC-PTM mechanism (i.e. per frequency)

Alt-2: Support cell based neighbor cell info for MBS service

|  |  |  |
| --- | --- | --- |
| Company | Selected Alt(s) | Comments |
| MediaTek | Alt-1 | We suggest to agree the baseline based on LTE SC-PTM, as per frequency approach is a simple solution in terms of SI configuration. And then consider Alt-2 based on further discussion if possible. |
| Huawei, HiSilicon | Alt-1 | We think the service should be provided on the same frequency in a certain area. Hence, the issue would only apply to area borders. We can think later whether it is worth introducing any optimizations for such cases, once we finalize the baseline mechanism. Please note that in our opinion it is still useful to provide the UE with the list of neighbour cells providing specific MBS services in the PTM configuration, as indicated in the answer to Q24. |
| QC | Alt1 as baseline | Same view as MediaTek. If needed, we can specify cell level info in a given frequency. |
| OPPO | Alt-1 | But it should be confirmed with SA2/1. |
| CATT | Alt1 as baseline | Firstly we can take LTE SC-PTM mechanism as baseline, then we can also work on cell based solution if there is strong need from operators on supporting cell basis deployment. |
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## 6.4 Frequency/cell prioritization for service continuity

In LTE, specific to the MBMS service, UE can determine whether to make the frequency which also provides current MBS service(s) a highest priority during the evaluation of cell reselection. However, if the specific MBS service is deployed on a cell basis, some interested MBS services may be only supported by a certain cell of a particular frequency. Then there may be no motivation to prioritize that frequency if the signal strength of that cell supporting the MBS services is not strong enough.

### **Question 23**

Select the alternative to support cell/frequency prioritization during cell reselection for service continuity for NR MBS delivery mode 2?

Alt-1: Reuse LTE SC-PTM mechanism (i.e. per frequency)

Alt-2: Support cell based prioritization for MBS service

|  |  |  |
| --- | --- | --- |
| Company | Selected Alt(s) | Comments |
| MediaTek | Alt-1 | Frequency based prioritization is the simplest solution for cell reselection and should be adopted as the baseline. The impact on the rule for cell reselection based on cell based prioritization needs more discussion. |
| Huawei, HiSilicon | Alt-1 | Cell based prioritization is unacceptable from IDLE mode procedures point of view. We cannot allow the UE to camp on non-best cell on a frequency as it would impact the efficiency of the whole system. |
| QC | Alt-1 | Same view as MediaTek. |
| OPPO | Alt-1 |  |
| CATT | Alt-1 as baseline | Agree with MTK. |
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# Content of PTM configuration

Furthermore, it should be clarified what kind of information the PTM configuration carries (e.g. by MCCH if supported). In LTE SC-PTM, the *SCPTMConfiguration* message carries information about:

* The configuration of each SC-MTCH in the current cell (including MBMS session info, G-RNTI, SC-MTCH scheduling info).
* List of neighbour cells providing MBMS services via SC-MRB.

Note that the first part of the information above for the configuration of the MBS service and the second part of the information is for the purpose of service continuity as discussed in section 6.2.

Correspondingly, for NR MBS delivery mode 2, PTM configuration can include the following information:

* The configuration of each MTCH in the current cell (including MBS session info, G-RNTI and MTCH scheduling info).
* List of neighbour cells providing MBS services via NR MBS delivery mode 2.

### **Question 24**

Do you agree that for NR MBS delivery mode 2, PTM configuration can include the following information?

* The configuration of each MTCH in the current cell (including MBS session info, G-RNTI and MTCH scheduling info).
* List of neighbour cells providing MBS services via NR MBS delivery mode 2.

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Alt-1 | We think the high level configuration principle of PTM configuration should be kept as same as LTE SC-PTM. The details of the information elements can be discussed further. |
| Huawei, HiSilicon | Yes | MTCH configuration is necessary for the UE to receive the service while the list of neighboring cells is useful to achieve service continuity. |
| QC | Yes | Same view as MediaTek. |
| OPPO | Yes | We think yes and it is based on LTE SC-PTM. |
| CATT | Partial agree | 1. MTCH configuration is necessary.  2. List of neighbour cells providing ongoing MBS services in SC-PTM is to secure service continuity for mobility from MBS cell to non MBS cell. Whether this RAN level mechanism still needed in NR should further discussed.  Maybe CN level mechanism is sufficient as SA2 has concluded “It shall be possible to establish an Associated PDU session for cases, if not exists, where mobility to non-5GMBS-supporting cells happens.” |
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# Conclusion

The following proposals are made based on the email discussion:

# References

1. *R2-2008796 Summary of Email Disc. Post111-e906 MBS Idle mode support, CATT*
2. *Chairman’s Notes, RAN2 #112-e, Nov 2020*
3. *R2-2009883 Security for PTP and PTM switching Sony*
4. *R2-2010234 Consideration of control plane aspects for NR MBS Kyocera*
5. *R2-2009196 MBS L2 Architecture, user plane and control plane Intel Corporation*
6. *R2-2010214 General considerations on NR MBS vivo discussion*
7. *R2-2008797 Further Discussion on MBS Idle Mode Support CATT, CBN*
8. *R2-2008869 Discussion on MBS reception of idle or inactive mode UE OPPO*
9. *R2-2008933 NR MBS for RRC\_IDLE/RRC\_INACTIVE UE CHENGDU TD TECH*
10. *R2-2008940 IDLE/INACTIVE UE support for NR MBS TCL Communication Ltd.*
11. *R2-2008991 MBS support for IDLE and INACTIVE states Intel Corporation*
12. *R2-2009038 NR Multicast-Broadcast services and configuration for UEs, Qualcomm*
13. *R2-2009157 MBS for Idle and Inactive mode UE Spreadtrum Communications*
14. *R2-2009283 Discussion on NR MBS structure allowing service for idle UEs Futurewei*
15. *R2-2009319 Consideration on MBS support in idle/inactive modes ETRI*
16. *R2-2009342 RRC states for MBS reception and Idle/Inactive UE, Huawei, HiSilicon*
17. *R2-2009441 MBS in IDLEI NACTIVE LG Electronics Inc.*
18. *R2-2009498 MBS reception in IDLE/INACTIVE state Apple*
19. *R2-2009555 IDLE and INACTIVE state UE operation Nokia, Nokia Shanghai Bell*
20. *R2-2009579 Introduce counting and UE interest indication for idle/inactive China Unicom*
21. *R2-2009611 IDLE /IN\_ACTIVE UE support of MBS NEC*
22. *R2-2009744 Support of Idle and Inactive mode UEs for NR MBS ZTE, Sanechips*
23. *R2-2009902 Open issues on MBS idle mode support MediaTek Inc.*
24. *R2-2009953 MBS reception in Idle and Inactive mode Ericsson*
25. *R2-2010078 RRC IDLE/ INACTIVE aspects of NR MBS Samsung*
26. *R2-2010145 On NR multicast and broadcast for IDLE/ INACTIVE UEs Convida*
27. *R2-2010219 Discussion on Idle and Inactive mode UEs vivo*
28. *R2-2010387 Discussion on Idle and Inactive UE MBS Reception CMCC*
29. *R2-2010644 Discussion on MBS support for UE in IDLE and INACTIVE states TD Tech*
30. *R2-2009315 Miscellaneous Aspects of MBS Nokia, Nokia Shanghai Bell*