**3GPP TSG-RAN WG2 Meeting #114-eR2-210xxxx**

**Electronic, 19th - 27th May, 2021**

Agenda Item: 8.1.3

Source: Huawei, HiSilicon

**Title: Offline discussion: [AT114-e][039][MBS] MCCH and MCCH change notification (Huawei)**

Document for: Discussion and decision

# Introduction

This documents aims at gathering and summarizing companies views for the following offline discussion:

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| * [AT114-e][039][MBS] MCCH and MCCH change notification (Huawei)         Scope: Determine whether to have multiple MCCH, whether MCCH change notification is needed, and details on the mechanism.        Intended outcome: Report        Deadline: EOM (CB if needed) |

The following agreements relevant for this discussion were made by RAN2 so far:

RAN2#113-e

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| * **Both idle/inactive UEs and connected mode UEs can receive MBS services transmitted by NR MBS delivery mode 2 (Broadcast service as already agreed, TBD other). The ability for connected mode UEs to receive this may depend on the network provisioning of the service (e.g. which freq), UE connected mode configuration and UE capabilities.** * **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.** * **Assume it is possible to reuse LTE SC-PTM mechanism for the CONNECTED UEs to receive the PTM configuration for NR MBS delivery mode 2, i.e. broadcast based manner.** * **Assume that MCCH change notification mechanism is used to notify the changes of MCCH configuration due to session start for delivery mode 2 of NR MBS (other cases FFS, if any).** |

RAN2#113bis-e

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| * **The MCCH transmission window is defined by MCCH repetition period, MCCH window duration and radio frame/slot offset.** * **New RNTI is defined for scheduling MCCH.** * **The concept of MCCH transmission window, similar to the one used for LTE SC-PTM, is used for NR MCCH scheduling. The exact parameters to define the window are FFS (discussed in the following proposals).** * **Common search space is needed for MCCH scheduling. RAN2 should request RAN1 to discuss the details of CSS for MCCH.** * **R2 assumes PDCCH occasions for MCCH search space are associated with SSBs in a pre-defined manner so that the UE can receive MCCH scheduling on PDCCH occasions according to its detected SSB.** * **R2 assumes, In case searchSpace#0 is configured for MCCH (if allowed, pending RAN1 decision), the mapping between PDCCH occasions and SSBs is the same as for SIB1.** * **R2 assumes that If common search space other than searchSpace#0 is configured for MCCH (if allowed, pending RAN1 decision), the PDCCH monitoring occasions for MCCH message which are not overlapping with UL symbols are sequentially numbered from one in the MCCH transmission window and mapped to SSBs using the similar rule as defined for OSI in TS 38.331.** * **Request RAN1 to discuss the details of the configuration of the bandwidth for MCCH reception.** * **The modification period is defined for NR MCCH and NR MCCH contents are only allowed to be modified at each modification period boundary.** * **The updated MCCH message should be sent in the same MCCH modification period where the change notification is sent.** * **UE in RRC IDLE/INACTIVE should be able to monitor/read both MCCH channel and SI/Paging without BWP switch. It is up to RAN1 to decide how this is ensured.** * **It is up to RAN1 to to decide about the RNTI and DCI format used for MCCH change notifications.** * **FFS whether to support multiple MCCH, e.g. to support different service types.** * **RAN2 will discuss and down-select from the following two options for the UE to get aware of session stop/modification:**   **Reading MCCH once per each MCCH modification period when receiving an ongoing broadcast session**  **DCI used for MCCH notification indicates the change of an ongoing broadcast session** |

The aim of this discussion is to clarify further aspects of MCCH configuration and MCCH change notification, especially the ones having an impact on RAN1 work. The inputs as provided by companies in their Tdocs [1] – [20] are considered in the following.

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# Discussion

## 3.1 MCCH configuration baseline

Even though it seems a common understanding, it should be noted that RAN2 did not make an explicit agreement that a new MBS specific SIB should be defined to carry MCCH configuration for delivery mode 2. This is proposed, e.g. in [5], [7], [13], [19].

**Question 1: Do companies agree that a new MBS specific SIB should be defined to carry MCCH configuration.**

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| **Company** | **Agree/disagree** | **Comments** |
| MediaTek | Agree |  |
| TCL | Agree |  |
| ZTE | Agree |  |
| Kyocera | Agree |  |
| ITRI | Agree |  |
| Xiaomi | Agree |  |
| CATT | Agree |  |
| SJTU | Agree |  |
| Samsung | Agree |  |
| Ericsson | Agree |  |

Similarly, it seems a common understanding that MCCH should contain at least configuration of MTCH channels corresponding to different services. For example, it is mentioned in [5], [7] that MCCH contents should include broadcast session MTCH configuration such as G-RNTI, MBS session ID and scheduling information for MTCH (e.g. search space, DRX).

**Question 2: Do companies agree that MCCH contents should include broadcast session MTCH configuration such as G-RNTI, MBS session ID and scheduling information for MTCH (e.g. search space, DRX).**

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| **Company** | **Agree/disagree** | **Comments** |
| MediaTek | Agree |  |
| TCL | Agree |  |
| ZTE | Agree | RAN1 part (e.g., Layer1 config, time/frequency allocation) will need RAN1's input. |
| Kyocera | Agree |  |
| ITRI | Agree |  |
| Xiaomi | Agree |  |
| CATT | Agree, but | Agree that MCCH contents should include MTCH configuration of broadcast session, but the details should be discussed further. For example, the parameters like G-RNTI, MBS session ID should be per session, not per MTCH.is it accurate to call it  MTCH configuration? |
| SJTU | Agree |  |
| Samsung | Agree |  |
| Ericsson | Agree | We agree with ZTE that RAN1 decides on the L1 parameters. The structuring of the MCCH info may depend on which mapping options of G-RNTI and TMGI will be supported? |

Furthermore, RAN2 agreed that PTM configuration carried by MCCH can be read by UEs in both RRC IDLE/INACTIVE and RRC CONNECTED states. However, for example in [14], it is mentioned that in some scenarios the UE might be configured with a dedicated BWP not overlapping with MCCH while the UE is in RRC CONNECTED state. It is then proposed that it should be possible to deliver MCCH to the UE in a dedicated configuration. On the other hand, in [1] it is indicated that such configuration is unlikely as in case MCCH cannot be read by the UE in its active BWP, then most likely the UE is not able to receive the MTCH in the active BWP as well. In this case, MTCHs should also be delivered on the dedicated BWP using separate PDCCH/PDSCH.

**Question 3: Do companies think that providing MCCH in a dedicated signaling to the UE in RRC CONNECTED state should be supported?**

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| **Company** | **Agree/disagree** | **Comments** |
| MediaTek | Disagree | We did not see the need. The RAN1 discussion did not hint a dedicated BWP not overlapping with MCCH. |
| TCL | - | We think such scenarios can be avoided by UE and network (NW) coordination (e.g., UE sends interest indication to NW and retunes to receive MCCH on initial BWP). Dedicated signaling will increase UE complexity. |
| ZTE | Agree | Not in all cases, but for some like HO, this is beneficial just like the legacy mechanism that target SIB info could be delivered to UE through HO ACK and then HO command to UE.  This can be easily done since network is already aware of UE's interests. Few spec impacts are anticipated. |
| Kyocera | Agree | We think it’s up to NW in which BWP it transmits MCCH (and MTCH, as well as unicast). So, the specification should allow such a flexibility. |
| ITRI | Agree | We think at least for the HO case as ZTE mentioned, providing MCCH in a dedicated signaling to the UE should be possible. |
| Xiaomi |  | Maybe this can be discussed after the RAN1 decision on the dedicated MBS BWP. |
| CATT | Disagree | In case the CFR used for MCCH is not overlapped with active BWP, it is also very likely that CFR used for MTCH are also not overlapped with active BWP. So it does not make sense to send PTM configuration of delivery mode 2 via dedicated RRC signalling to UE in connected, as even thorough UE can acquire the PTM configuration via dedicated RRC signalling, UE still cannot received MTCH data on CFR. |
| SJTU | Disagree | We are not sure about the scenario that UE might be configured with a dedicated BWP not overlapping with MCCH. Even so, we agree with [1] that，in case MCCH cannot be read by the UE in its active BWP, then most likely the UE is not able to receive the MTCH in the active BWP as well. In this case, the UE should be reconfigured with DRB for the MBS data. |
| Samsung | Disagree | We think broadcast (DM2) is provided as best effort based delivery and it should be supported provided dedicated BWP can have overlapping with MCCH in RRC\_CONNECTED state. Network can know DM2 UE's presence through interest indication in RRC\_CONNECTED state. As per last meeting agreement “Assume that MBS Interest Indication is supported for UEs in connected mode for Broadcast service (assume that as usual there is no mandatory network requirement, network action is up to network)”. Therefore, it seems providing MCCH configuration should also be not a defined behavior for network (including during HO signaling). In conclusion, no special approach is needed i.e. dedicated configuration delivery is not supported. |
| Ericsson | Disagree | We agree with other companies that if UE cannot receive MCCH it most likely can also not receive the MTCH, and this problem could potentially be resolved via Interested signalling, if needed. We consider DM2 a best effort type of service, and do not see the need to provide it via dedicated is signalling in case of HO. |

## 3.2 MCCH change notification

So far RAN2 agreed that MCCH change notification is only sent by the network to indicate that a new session starts. For an indication of session configuration modification for an ongoing session two options for down-selection were agreed, i.e.:

* 1. UE reads MCCH contents once per MCCH modification period (as in LTE SC-PTM).
  2. Session configuration modification is indicated with an explicit notification from the network (as for session start).

The proponents of the first approach (e.g. [1], [4], [12], [17]) indicate that change notifications for session modification will introduce additional signalling overhead, will impact power consumption of the UEs which are waiting for session start (and not receiving any service) and that UE may miss the notification of session modification resulting in a temporary service interruption. In [12] it is indicated the problem with missing the notification is especially relevant in case separate RNTIs are used for MCCH reception and for MCCH change notification reception.

The proponents of the second approach (e.g. [6], [7], [10], [11], [15], [18], [19], [20]) indicate that reading MCCH each modification period will impact the power consumption of the UEs which are already receiving an ongoing broadcast session. In [15] and [16] it is also suggested that RAN1 should be consulted about whether a notification DCI can accommodate session modification indication in a separate bit (different from the one used for session start indication).

The rapporteur would like to request companies to indicate their view on the session modification notification by answering the following question.

**Question 4: Which option do you prefer for the UE to get aware of ongoing session configuration modification:**

1. **UE reads MCCH contents once per MCCH modification period**
2. **Session configuration modification is indicated with an explicit notification from the network (provided that RAN1 confirms a separate bit for this purpose can be accommodated in the MCCH change notification DCI, in addition to a bit for session start notification)**

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| **Company** | **Preferred option** | **Comments** |
| MediaTek | Op-2 |  |
| TCL | Option 2 | We agree on consulting RAN1 regarding the session modification indication within the notification DCI |
| ZTE | no strong view. | It depends on how ambitious we are in this release, considering RAN1 impacts, robustness, and complexity. |
| Kyocera | Option 2 |  |
| ITRI | Option 1 |  |
| Xiaomi | Option 2 |  |
| CATT | Option 1 | It is straight forward for NR to take the mechanism for normal UEs in SC-PTM as baseline (i.e. option 1) as we believe pros/cons of each option have been fully discussed in LTE. |
| SJTU | Option 1 | There may be the problem of UE missing the session modification notification for option2. As a result, additional enhancements may be needed to compensate for that. And this may be too complicated. |
| Samsung | Option-1 | We think SC-PTM approach is sufficient. Typically, with large modification period for MCCH in DM2 and same reception occasion for change notification and MCCH, there seems no much benefit with additional indication of session configuration modification. We prefer to keep the separation of regular MCCH monitoring for UEs actively receiving service and change notification monitoring for UEs interested but not actively receiving service. |
| Ericsson | Option 2 | In case RAN1 confirms that a separate bit is available for "modification" without impacting the robustness, we do not quite follow the potential problems that other companies refer to.  We assume that "modification" can include both a change in the configuration and session stop? We assume that when "modification" is indicated, the UE needs to re-acquire the MCCH anyways to check what exactly has changed? |

Assuming the above proposal is agreeable, there is a further question on whether the problem of UE missing the notification which can happen for this approach should be somehow addressed.

**Question 5: If option 2 is preferred, do companies think the issue of UE missing the session modification notification should be addressed?**

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| **Company** | **Agree/disagree** | **Comments** |
| MediaTek | Disagree |  |
| TCL | Agree |  |
| ZTE | Agree | But could be UE's implementation by monitoring the repeating transmission of such notification. |
| Kyocera | Disagree | We assume the UE, which misses the notification in poor radio condition, will likely miss MCCH. So, we assume the risk of service interruption due to missing of notification or MCCH is not the issue specific to Option 2. |
| Xiaomi | Disagree | Not sure whether this is a critical issue as the UE would anyway be required to read the notification in every MCCH modification period. Maybe this can be discussed in RAN1. |
| CATT | Disagree |  |
| SJTU | Disagree |  |
| Samsung | Disagree |  |
| Ericsson | Probably not | In our understanding we need to wait for the RAN1 decisions, i.e. the expected missed detection probability. We assume that the missed detection can be rather low, and that no special action in RAN2 is needed. Furthermore we understand that missed detection is that same for "start" and "modification" notification. The impact of missing a "start" seems also more serious then missing a "modification", i.e. a change/stop may also be noticed because the reception actually stops. |

In [15], it is proposed to clarify that the MCCH change notification is sent in the first MCCH monitoring occasion of each MCCH repetition period, as in LTE. It seems beneficial to make this clarification (regardless of whether the notification is for session start only or for session modification as well).

**Question 6: Do companies agree that the MCCH change notification is sent in the first MCCH monitoring occasion of each MCCH repetition period.**

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| **Company** | **Agree/disagree** | **Comments** |
| MediaTek | Agree |  |
| TCL | Agree |  |
| ZTE | Agree but | But shall not limit the implementation to have better robustness. |
| Kyocera | Agree |  |
| ITRI | Agree |  |
| Xiaomi | Agree |  |
| CATT | Agree | No reason to deviate from LTE mechanism |
| SJTU | Agree |  |
| Samsung | Agree |  |
| Ericsson | Agree and | We think it would be beneficial to have a configurable time offset between PDCCH notification and PDSCH scheduling, similar as enabled with WUS/PEI configuration ([R2-2105653](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2//TSGR2_114-e/Docs/R2-2105653.zip)). |

## 3.3 Multiple MCCH

There are different views on whether multiple MCCH configurations are needed and in general, three different approaches are proposed in companies’ contributions:

1. Multiple MCCH channels are supported ([6], [10], [14], [18], [20])
2. Only a single MCCH is supported ([4], [7], [11], [12]. [13], [15], [16], [17], [19])
3. Single MCCH channel with multiple modification/repetition periods is supported ([2], [9])

The proponents of the first approach think multiple MCCH is useful to accommodate different latency requirements of different broadcast services.

The proponents of the second approach indicate that delivery mode 2 is targeted at the use cases and services which do not require high reliability and low latency. For such services, delivery mode 1 should be utilized and hence a single MCCH is sufficient for broadcast services.

The proponents of option 3 indicate that support of multiple MCCH channels brings significant complexity to the system which may outweigh its benefits. On the other hand, they think it is worth addressing the MCCH overhead issue and/or different latency requirements of different services. According to the proponents of this option, this can be achieved with a single MCCH channel configured with multiple repetition/modification periods where each MCCH occasion carries configuration of different broadcast sessions (i.e. a single MCCH occasion may contain a subset of MTCH configurations that are provided by the network).

The issues that have to be solved for both option 1 and 3 are:

1. How the UE is made aware of the mapping between the service it is interested in and the MCCH channel or MCCH occasion where it can obtain corresponding MTCH configuration.
2. How notifications for multiple MCCH channels are handled, e.g. whether a separate RNTI is used for each MCCH channel or whether such information is included in Short Message.

Companies are therefore asked to answer the following question:

**Question 7: Which of the below option do you prefer:**

1. **Multiple MCCH channels are supported**
2. **Only a single MCCH is supported**
3. **Single MCCH channel with multiple modification/repetition periods is supported**

**In case option 1 or option 3 is your preferred option, please clarify how the issues outlined above should be solved.**

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| **Company** | **Preferred option** | **Comments** |
| MediaTek | Op-1 |  |
| TCL | Option 1 or 3 | For these two options, we think; under the assumption that only one bit is needed (i.e., form the 8 bit additional bitmap of the MCCH DCI, if agreed in RAN1) for indicating the notification change as in LTE SC-PTM. The other additional bits can be used to handle the issue of UE awareness of MCCH/MCCH occasions and service mapping and the issue of nonfictions of multiple MCCHs. In addition, short messages and/or other MAC CEs are also possible options for handling these issues. |
| ZTE | Option 3. | **A. Option 3 is consistent with option 2.**  **B. It is essential to have power efficiency in mind, especially in the 1st release that owns the best chance to be commercialized.**  **C. For the issues that have to be solved, e.g., mapping between MCCH transmission or config and UEs interested MBS, the very basic solution can be (other solutions not excluded):**  **- phase 1.** UE monitors the MCCH transmission based on the minimum required period (e.g., in SIBx, as in legacy) before it has acquired its interested MBS config.  (Cases include: UEs are still monitoring the session start in the cell, or for UEs is about to receive the MBS when the service is already being broadcast in the cell. Both wont last long since UE is well aware of the rough session start timing from USD).  **- phase 2.** UE monitors the MCCH modification after UE has acquired the MBS specific modification period (e.g., in MTCH content.) |
| Kyocera | Option 1 | We assume the MBS-specific SIB may indicate the mapping between MBS services and multiple MCCHs, and each MCCH may have different MCCH occasions/modification boundaries. We also assume, as a baseline, the same change notification (and the same RNTI as well) for single MCCH, i.e., Option 2, can be used, especially in case the change notification is sent in the first MCCH monitoring occasion of each MCCH repetition period as in Q6 above. We’re fine to discuss further optimization e.g., with separate RNTIs or Short Message. |
| ITRI | Option 2 | We don’t think that multiple MCCH channels are needed.  The MCCH is designed for DM2 services, and the services delivered by DM2 are considered as a kind of low QoS requirement services. Therefore, we may not need to further differentiate the different QoS requirements among the services delivered by DM2. |
| Xiaomi | Option 2 | Multiple MCCH channels (Option 1) or multiple MCCH configurations (Option 3) would bring more complexities in both the UE and the network, and causes more signaling overheads  Option 1 or Option 3 could cause more UE power consumption given the case that one UE which is interested in more than one MBS services would be required to monitor more than one MCCH change notifications.  The reduced latency for Option 1 or Option 3 is questionable. From our understanding, the gNB by implementation should indicate the start of a MBS session **Earlier** before scheduling the corresponding the MBS service, to avoid the reception loss of the MCCH change notification and the MBS service and to allow the UE to have some time to prepare for the MBS service reception. |
| CATT | Option 1 or Option 2 | No strong view on which one to choose between option 1 and option 2, OK to follow the majority view. |
| Nercdtv | Option 1 | Multiple sets of MCCH configuration can provide flexibility for scheduling considering services with different QoS. MBS specific SIB can be used to indicate the mapping between multiple MBS services and multiple MCCHs. And we assume separate RNTIs may be used for different MCCHs. |
| SJTU | Option 1 | We think multiple MCCHs should be introduced in NR, which is useful to accommodate different latency requirements of different MBS services.  MBS specific SIB may indicate the mapping between multiple MBS services and multiple MCCHs.  Separate RNTIs or Short Message could be further studied. |
| Samsung | Option-2 | Single MCCH is sufficient for broadcast services (DM2) and there is no need for unnecessary complexity |
| Ericsson | Option 2 | We are not convinced that we have strong QoS requirements for DM2 that need to be optimized. In case such latency requirements exist, we are not sure if they apply to the session start, but perhaps apply to the data transfer latency after the session has started. There will always be the SIB acquisition latency to acquire the MCCH configuration anyways, i.e. the MCCH does not resolve that latency. |

# Conclusions

TBD

# References

1. R2-2104757 Further Discussion on delivery mode 2 CATT, CBN
2. R2-2104825 Idle and Inactive mode UEs support of NR MBS ZTE, Sanechips
3. R2-2104937 Discussion on MBS interesting indication and service continuity for delivery mode 2 OPPO
4. R2-2104984 On NR MBS operation in Idle/Inactive mode Samsung
5. R2-2105007 MCCH Configuration and messaging in MBS delivery mode 2 Futurewei
6. R2-2105013 NR MBS control signalling aspects for UEs in different RRC states Qualcomm Inc
7. R2-2105288 Open Issues for Delivery mode 2 vivo
8. R2-2105387 Discussion on delivery mode 2 for NR MBS CHENGDU TD TECH LTD.
9. R2-2105439 Discussion on Multicast Control Channel Scheduling Configurations for Delivery Mode 2 TCL Communication Ltd.
10. R2-2105511 Control plane aspects for delivery mode 2 in NR MBS Kyocera
11. R2-2105552 Discussion issues on delivery mode2 Spreadtrum Communications
12. R2-2105578 MBS support for delivery mode 2 Huawei, CBN, HiSilicon
13. R2-2105653 Open issues broadcast Ericsson
14. R2-2105668 MCCH design details Nokia, Nokia Shanghai Bell
15. R2-2105729 Remaining issues of MCCH and MCCH change notification Xiaomi Communications
16. R2-2105835 Discussion on Idle and Inactive mode UEs Lenovo, Motorola Mobility
17. R2-2105914 MBS support for RRC\_IDLE/INACTIVE Intel Corporation
18. R2-2106242 Discussion on delivery mode 2 remaining issues cmcc
19. R2-2106350 MBS in IDLE/INACTIVE LG Electronics Inc.
20. R2-2106361 NR MBS Configuration Information Convida Wireless