**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).**
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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.

# Company contact details

|  |  |
| --- | --- |
| Company | Name and e-mail |
|  |  |
| TCL | ahmed.mikaeil@tcl.com |
| ZTE | qi.tao3@zte.com.cn |
| Kyocera | masato.fujishiro.fj@kyocera.jp |
| ITRI | moumou3@itri.org.tw |
| Xiaomi | Yumin Wu@xiaomi.com |
| CATT | Rui Zhou(zhourui@catt.cn) |
| SJTU | jiaotianyu@sjtu.edu.cn |
| Samsung | shrivastava@samsung.com |
| Ericsson | martin.van.der.zee@ericsson.com |
| vivo | Yitao Mo (yitao.mo@vivo.com) |
| Qualcomm | pkadiri@qti.qualcomm.com |
| Futurewei | Jialinzou88@yahoo.com |
| Spreadtrum | Lifeng.han@unisoc.com |
| LGE | sangwon7.kim@lge.com |
| Intel | Yujian Zhang (yujian.zhang@intel.com) |
| NEC | Chen\_zhe@nec.cn  |
| CMCC | liuxiaoman@chinamobile.com |
| Lenovo, Motorola Mobility | Congchi Zhang, zhangcc16@lenovo.com |
| Nokia | Jarkko.t.koskela@nokia.com |
| Huawei | dawid.koziol@huawei.com |
| OPPO | Wangshukun@oppo.com |
| Apple | fangli\_xu@apple.com |
| TD Tech, Chengdu TD Tech | limei.wei@td-tech.com |
| Convida | Rocco DiGirolamo (digirolamo.rocco@convidawireless.com) |

# 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.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/disagree** | **Comments** |
| MediaTek  | Agree |  |
| TCL |  Agree |  |
| ZTE | Agree |  |
| Kyocera | Agree |  |
| ITRI | Agree |  |
| Xiaomi | Agree |  |
| CATT | Agree |  |
| SJTU | Agree |  |
| Samsung | Agree |  |
| Ericsson | Agree |  |
| vivo | Agree | This design helps to avoid potential impacts on the legacy UE. |
| QC | Agree |  |
| Futurewei | Agree |  |
| Spreadtrum | Agree |  |
| LGE | Agree |  |
| Intel | Agree |  |
| NEC | Agree  |  |
| CMCC | Agree |  |
| Lenovo, Motorola Mobility | Agree |  |
| Nokia | Agree |  |
| Huawei, HiSilicon | Agree |  |
| OPPO | Agree  |  |
| Apple | Agree |  |
| TD Tech, Chengdu TD Tech | Agree |  |
| Convida | 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).**

|  |  |  |
| --- | --- | --- |
| **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? |
| Vivo | Agree |  |
| QC | Agree | Same view as ZTE |
| Futurewei | Agree, and | Many such configurations carried by MCCH are similar as LTE. Some of broadcast MRB configuration should also be carried by MCCH. |
| Spreadtrum | Agree  |  |
| LGE | Agree |  |
| Intel | Agree |  |
| NEC | Agree |  |
| CMCC | Agree |  |
| Lenovo, Motorola Mobility | Agree |  |
| Nokia | Agree on high level  | MCCH should include any parameters required for MTCH reception but it should be noted that more than one MTCH could be mapped to DL-SCH (which is received by G-RNTI). Some of those are RAN1 defined and we do not need to spend time on those. So basically what RAN2 can decide is that there needs to be identity for session (MBS session ID) in the MCCH with corresponding L1 parameters. We agree with CATT point that it would be more appropriate to call this MTCH configuration. Instead e.g. we could name set of parameters to “list of MBS broadcast session configuration” |
| Huawei, HiSilicon | Agree | To avoid confusion as outlined by CATT and others, we can rephrase this to, e.g.: “MCCH contents should include broadcast session information ~~MTCH configuration~~ such as G-RNTI, MBS session ID and scheduling information for MTCH (e.g. search space, DRX).” |
| OPPO | Agree  |  |
| Apple | Agree |  |
| TD Tech, Chengdu TD Tech | Agree | We think the following description may be better.MCCH should contain the configuration of each MBS session with delivery mode 2. The detail content of the configuration of an MBS session with delivery mode 2 needs further discussion. |
| Convida | Agree |  |

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.  |
| vivo | Disagree | Since MCCH based notification for multicast has been excluded, we cannot find a valid use case for this, also considering the DM2 is used for low QoS requirements.  |
| Qualcomm |  | Agree with ZTE for HO case. Lets wait for RAN1 discussion about whether MCCH/MTCH uses same CFR or not ? Even if MCCH CFR region does not overrap with active BWP, it may be possible to do TDM/FDM or UE can switch between Active BWP and MCCH CFR. RAN2 can make decision based on RAN1 outcome. |
| Futurewei | Disagree | The scenario raised by [14] seems unlikely happen based on the RAN1 CFR design principle. In general, treat connected UE differently for broadcast will increase the complexity. We also agreed that no additional effort should be made on connect UEs to improve the service for them only in delivery mode 2. |
| Spreadtrum |  |  We are not sure the scenarios mentioned in [14] really exists according to the related RAN1 agreements. For the HO case, it should be discussed in the mobility item later. |
| LGE | Disagree | If MCCH is not transmitted within the active BWP, the MTCH also would not be transmitted within the active BWP. In this case, the broadcast session should be transmitted via DTCH, and the MCCH is not needed.The delivery mode2 can be used only for MBS services requiring low QoS so any optimization to reduce the interruption is not needed even for handover scenario. |
| Intel | Disagree | We tend to agree the analysis in [1] that MCCH and MTCH are in the same BWP. |
| NEC |  | Agree with Xiaomi that this can be discussed after the RAN1 decision on the dedicated MBS BWP. |
| CMCC | Agree |  |
| Lenovo, Motorola Mobility | Disagree | Tend to agree with CATT that if MCCH is sent over a BWP not overlapping with the BWP for RRC CONNECTED state, it’s likely that the MTCH is sent over the same BWP as MCCH not overlapping with the BWP for RRC CONNECTED state. Also, MCCH is (mainly) for broadcast services, if we support on demand MCCH, that would mean MCCH is handled with higher priority than other SIBs, which we don’t think it’s necessary.  |
| Nokia  | Agree  | We are bit worried on some of the inputs on this question. In practice we would have two options:A) No dedicated RRC to send MCCH content: Then we would need to get the interest indication about MBS broadcast sessions from the UE and then NW needs to reconfigure the UE to BWP where it can receive MCCH before MCCH is updated. We are bit worried on this approach as it would require NW to retune BWP of the UE whenever MCCH is modified as we cannot assume that every UE is on the BWP where MCCH is provided.B) MCCH content is sent over dedicated RRC: This way, the UE could be given the MBS broadcast session configuration and receive the session (DL-SCH and MTCHs) immediately after BWP switching.. |
| Huawei, HiSilicon | Agree | We think it is OK to reuse the dedicated SIB configuration for this purpose, which would have almost no specifications impact.  |
| OPPO | Agree  | For service continuity and service interruption purpose, the dedicated signling is used to configure MCCH during HO. |
| Apple |  | The discussion is related to RAN1 MBS CFR design. So it’s better to be poseponed after RAN1 CFR design is decided. Our view is that the frequency resource for the MCCH and MTCH transmission should be same or overlapped. So if the CONNECTED UE cannot receive the MCCH via current BWP, UE cannot receive MTCH either. And in this case, the MCCH configuration via dedicated RRC configuration is useless. |
| TD Tech, Chengdu TD Tech | See our comments to the right | The scenario needs further discusisonl. Maybe MCCH can be configured on the unicast BWP because the content of MCCH can be changed with time. |
| Convida | Wait for RAN1 decision | In our view we should wait for RAN1 decision regarding MBS BWP, as RAN1 is still discussing whether the common frequency resource (CFR) is smaller, same size, or larger than the initial BWP |

## 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? |
| Vivo | Option 2 | For UE power saving, the SC-PTM scheme for NB-IoT can be reused as the baseline.  |
| Qualcomm | Option 2 | Same view as Ericsson |
| Futurewei | Option 2 | We think option 2 is a better solution and support to consult with RAN1. As long as Ran1 don’t see a problem with DCI indication, option 2 would be more efficient: upon DCI indicated no change or session stopped, the UE need not to further decode the MCCH message. |
| Spreadtrum | Option 2 | As in LTE SC-PTM, only when receiving the DCI indication, UE will read the modified MCCH information at the beginning of the next modification period. Hence, for the sake of power saving, we support to have an explicit notification of the configuration modification.  |
| LGE | Option 2 | UE should be required to read the MCCH only when the MCCH is updated. No reason to do the blind monitoring. |
| Intel | Option 1 | We prefer to use LTE SC-PTM approach (Option 1). The potential power saving gain of Option 2 is rather limited for Ues already receiving MTCH. |
| NEC | Option 2 | We also identify that option 1 brings more power consumption.  |
| CMCC | Option 2 |  |
| Lenovo, Motorola Mobility | 2 | Using separate DCI bits for session start and session modification would be the best solution to avoid Ues waiting for session start but has to read MCCH for configuration modification (as many companies are oncerned).  |
| Nokia | Option 1 | Probably question should be rephrased a bit on this part “**ongoing session configuration modification** ” to say “ session configuration modification for ongoing MBS broadcast session”. The current wording can be misunderstood.If UE is already receiving MTCH is there really anything to gain in power consumption to check every now and then MCCH as it is almost guaranteed that at some instances MTCH/MCCH occasions are overlapping within each modification period. Option 2 is pure optimization that does not bring any gains. |
| Huawei. HiSilicon | Option 1 | This option is more error-proof and avoids impact for the Ues not yet receiving the MBS service they are interested in. |
| OPPO | Option 2 | We prefer to use a unified solution. |
| Apple | Option 2 | We prefer the power efficient option. |
| TD Tech, Chengdu TD Tech | See our comments to the right | We have the following understanding on LTE SC-PTM:1. In LTE SC-PTM, if UE is receiving an MBS session, it needs to receive MCCH per modification period because the configuration of the MBS session it’s receiving may be changed from the start of each modification period.
2. In LTE SC-PTM, after a UE receives MCCH, if it doesn’t find the interested MBS session, it will only monitor MCCH change notification for a new MBS session. UE doesn’t need to receive MCCH per modification period.
3. In LTE SC-PTM, if a UE wants to receive an MBS session, it needs to receive MCCH from the nearest repetition period to obtain the newest MBS session configuration.

Based on the above description, an MBS capatible UE needs to receive MCCH after power on, it saves the content on MCCH.If it doesn’t find an interested MBS session, it will only monitor the MCCH change notification afterwards. If UE finds an interested MBS session, it will start to receive the MBS session with the just acquired configuration on MCCH.If after some time UE decides to receive an ongoing MBS session, it will receive MCCH in the nearest repetition period to obtain the newest MBS session configuration and then receive the MBS session.Therefore, we think the queston needs to be changed as below.**Question 4: Which option do you prefer for the UE to get aware of ongoing session configuration modification:**1. **UE reads MCCH in the nearest repetition period if UE is not receiving this MBS. UE reads MCCH contents once per MCCH modification period if UE is receiving this MBS.**
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)**

Based on the updated question, option 1 reuses the method in LTE SC-PTM. We think both option 1 and option 2 can work. |
| Convida  | Option 2 |  |

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.  |
| vivo | Disagree | In our understanding, UE implementation can handle this, and no specific normative work is needed. |
| Qualcomm | No need | Same view as Ericsson |
| Futurewei | Disagree | Don’t see why option 2 is less reliable than option 1. I presume PDCCH is more reliable than traffic channel to which MCCH maps. Similar view as Ericsson, even the change/session-stop indication is missed, the consequence is less power saving. The UE behavior is just like that the session change/stop indication does not exist. |
| Spreadtrum | Disagree | Share view of Ericsson |
| LGE | Disagree | UE doesn’t read SI once per SI modification period. Even PWS relies on the SI change indication. I don’t think a more robust mechanism is required to notify the MCCH change. |
| Intel | Disagree | We don’t prefer option 2, but in case option 2 is supported, we prefer that related discussion and specification impacts for option 2 should be minimized given that option 2 is an optimization compared to option 1 (which is the approached used in LTE). |
| NEC | Disagree | We have similar observation with Kyocera that UE which misses the notification in poor radio condition, will likely miss MCCH.  |
| CMCC | Disagree | Similar view with Ericsson. |
| Lenovo, Motorola Mobility | Disagree | It seems a common issue, i.e. missing the signaling if channel condition is poor. It will be a problem if UE does not read MCCH unless UE receives a start/modification indication, which we doubt is the case.  |
| Huawei, HiSilicon | Disagree | It can be left up to UE implementation, but it would be better to avoid the issue by following option 1. |
| OPPO | Disagree | Up to UE implementation. |
| Apple | Disagree |  |
| TD Tech, Chengdu TD Tech | Agree | Such question is up to UE’s implementation. UE can receive the related notification several times. |
| Convida | Disagree |  |

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)).  |
| vivo | Agree |  |
| Qualcomm | Agree |  |
| Futurewei | Agree |  |
| Spreadtrum | Agree |  |
| LGE | Agree |  |
| Intel | Agree |  |
| NEC | Agree  |  |
| CMCC | Agree |  |
| Lenovo, Motorola Mobility | Agree | If it means following LTE principle.  |
| Nokia | Agree but | We are fine with the proposal (assuming this is within modification period and no repetions need to extend over modification period) as such but why would we need to define anything in the specification on this one? Or is there going to be some UE behaviour defined e.g. UE needs to try to acquire MCCH change notification multiple times per modification period? |
| Huawei, HiSilicon | Agree | This seems sufficient and we do not see big benefits of having a flexibility here. This is for the UE to know where to look for the notification and repeating it several times is for robustness and for the flexibility to for the UE to choose which repetition to receive this in. |
| OPPO | Agree  | Same as LTE did. |
| Apple | Agree |  |
| TD Tech, Chengdu TD Tech | Agree |  |
| Convida  | Agree |  |

## 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.**

|  |  |  |
| --- | --- | --- |
| **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 overheadsOption 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.  |
| vivo | Option 2 | For UE simplicity, we prefer Option 2.  |
| Qualcomm | Option 1 | For different services having different latency requirements, we prefer to use different MCCH instead of same MCCH. |
| Futurewei | Option 1 | For different services with different requirement, it is cleaner to set up different MCCH. With option 2, any one service is activated all the UEs of different services will be waked up to decode the MCCH. In addition, more aggressive MCCH configuration is needed to meet the low latency requirement. Overall it is not efficient and more UE power consumption. Option 3, addressed some of the issues with option 1, but it increases the complexity and could be limited by number of alternative configurations which can be adopted by a MCCH. |
| Spreadtrum | Option 2 | We have already defined two delivery modes, and divided the MBS services into two modes based on the service requirements. The services with low Qos will be delivered in DM2.Option 1 and 3 will introduce further complication. There is no need to introduce multiple MCCHs for DM2. |
| LGE | Option 2 | We already have two different delivery modes depending on the QoS level, and agreed the delivery mode2 is only applicable to MBS sessions having low QoS requirement. Single MCCH is sufficient to support the latency-tolerant sessions. |
| Intel | Option 2 | There are issues with option 1, e.g. more power consumption for UEs monitoring multiple MCCHs. In addition, there are increased complexity and more discussion is needed on option 1, e.g. how UE can know which subset of MCCHs to monitor, MCCH notification, and DRX for multiple MCCH monitoring.The issues with Option 3 is that the mapping between MBS session and related modification/repetition should be signaled in SIB. Addition of MBS session requires the update of SIB. There are two issues: 1) Latency for MBS session start since paging is needed to update SIB and the minimum BCCH modification period is 640 ms. 2) Impacts to power saving of UEs not receiving MBS service. System information change notification is transmitted via paging. As long as there is any MBS configuration change, paging is used to indicate the change. Consequently, all UEs need to at least acquire SIB1 if there is any MBS configuration change.  |
| NEC | Option 1 | Given more service supported for NR MBS, we see the benefit of introducing multiple MCCH, as some of the service is delay sensitive. In order to fulfill the requirement of delay sensitive service, we need to introduce multiple MCCH. These MCCH have different MCCH modification periods/repetition periods. The configuration of multiple MCCH can be discussed later, e.g. how to support multiple MCCH in SIB, whether we use multiple RNTIs. |
| CMCC | Option1 | For UE’s awareness of the relationship between MBS services and MCCHs issue, it could be indicated in the MBS specific SIB, and we don’t think it will bring more extra workload in MBS specific SIB design. Multiple MCCH could adapt different MBS services’ latency requirements, and for some UEs only interested in some specific MBS services, for example services with low latency requirements, it’s power effective.And for the notification issue, we prefer to reuse the same RNTI for each MCCH scheduling, and DCI could be used to indicate the changes like short message in paging. |
| Lenovo, Motorola Mobility | 2 | The delivery mode 2 is mainly for MBS service with low QoS requirements, we don’t need to over optimize things.  |
| Nokia | Option 1 | We are bit puzzled with comments saying that option 1 has more power consumption. If that is the case then we should go for option 2. We thought with option 2 NW has to choose shortest required periodicity for MCCH i.e. then basically UE wanting to receive service with only needing low repetition rate for MCCH still needs to receive MCCH in frequent manner. If this is OK for UE vendors we are fine with option 2. Regarding Intel comment – It seems that based on this email discussion everyone agrees that BCCH carries information for MCCH(s). So there does not seem nothing special in case we would have multiple MCCHs. UE would only monitor those MCCHs for which services it is interested in.  |
| Huawei, HiSilicon | Option 2 | Considering there are two delivery modes specified already, having such enhancements for low QoS services is an overkill to us. |
| OPPO | Option 1 | No stronge opinion. |
| Apple | Option 2 | Single MCCH channel is sufficient for the MBS service with low QoS requirement. |
| TD Tech, Chengdu TD Tech | Optoin 1, option 2 and option 3 with different optons for different scenarios. | (1) Option 2 is a special case of option 3 when option 3 only uses one modification/repetition period.(2) How option 3 works and what differences are between option 3 and option 2:Step 1: after power on, an MBS capable UE receives the MBS specific SIB to obtain multiple modification/repetition periods for MCCH. Step 1 is also appled for option 2. But for opton 2, the MBS specific SIB carries only one modification/repetition period for MCCH.Step 2: UE determines the MCCH transmission period which is equal to the minimum repetition period among all repettion periods for MCCH.Option 2 has no need for Step 2. Step 3: UE receives MCCH from the nearest MCCH transmission period and keeps receiving MCCH in each MCCH transmission period until UE acquires the configurations of all MBS sessions.Step 3 is also applied for option 2. But for option 2, UE receives MCCH in each repetition period instead of each transmission period for option 3.Step 4a or Step 4b: UE executes one of the two steps.These two steps are also applied for option 2.Step 4a: For an interested MBS session, UE finds its modification/repetition period from its configuration. UE receives the interested MBS session according to its modification/repetition period.Step 4b: If UE doesn’t find an interested MBS session, UE will montor the MCCH change notification for a new MBS session. UE will use the minimum modification period to monitor the MCCH change notification.For option 2, UE will use the unique modification period to monitor the MCCH change notification instead of the minimum modification period for opton 3. But the modification period for option 2 is equal to the minimum modificaitn period for option 3 if the modification period is set according to the most delay sensitive MBS session.Step 5: Some time after step 4b, if UE decides to receive an MBS session, UE finds the modification/repetition period of the MBS session from its configuration and then UE receives the MBS session according to its modification/repetition period. Step 5 is also applied for option 2.(3) Scenarios for different options(3-1) Opton 2 can be applied just for simplicity. With option 2, the unique modification/repetition period can be set according to the most delay sensitive and most reliability sensitive MBS services. For example, modification/repetition period is 20ms/10ms.If the configuration information of a MBS session needs X bits, 5 voice sessions and 5 data sessions will consum (5X+5X) \*4 bits in each 40ms long period.（3-2）Option 3 can be applied to meet the different QOS requirements of the different MBS types with the minimum network radio resource consumptiom.For option 3, the modification/repetition period for the voice session is set as 20ms/10ms while the modification/repetition period for the data session is set as 40ms/20msFor 5 voice sessions and 5 data sessions, option 3 wil consume 5X\*4+5X\*2 bits in each 40ms long period.Obvously option 3 can meet the different QOS requirements of the different MBS types with much less radio resource.（3-3）Option 1 can be applied for the scenario that more than one unicast BWPs are set and each unicast BWP is not overlapped with the CFRs for delivery mode 2. From the scenario of Opton 1, opton 1 is not against option 3. Under such scenario, in order to make UE know the MBS sessions with delivery mode 2 without BWP switching, one MCCH can be configured on each unicast BWP. These MCCHs can have the same RNTI and identified with the different BWP IDs.Furthermore, if several UEs on the same unicast BWP want to receive an MBS session with delivery mode 2 and the CFR providing the MBS session has no overlapping part with the unicast BWP, gNB can provide the MBS session in PTM mode on the unicast BWP. Certainly, gNB can reconfigure the unicast BWP for the UEs to make the reconfigured unicast BWP contain the CFR. But if the reconfigured unicast BWP is two large, MCCH and the MBS session with delivery mode 2 are provided in PTM mode on the unicast BWP is also a alternative for UE power saving. |
| Convida | Option 1 | In our view multiple MCCH are not only useful to accommodate different latency requirements but also to accommodate different traffic profiles of the services.For Issue 1, our view us that the UE could be made aware of the mapping between the service it is interested in and the MCCH channel, in the MBS specific SIB. For Issue 2, we think that both options discussed are feasible (separate RNTI or short message). We prefer that the notification mechanism provide an indication of which of the MCCH logical channels is changing – for example through an 8-bit bitmap (as was used in LTE MBSFN to signal the MBSFN area configuration that is changing). |

# Conclusions

TBD

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