3GPP TSG RAN WG1 #109-e R1-22xxxxx

e-Meeting, May 9th – 20th, 2022

**Agenda item: 5.1**

**Source: Moderator (Qualcomm)**

**Title: [109-e-AI5-LSs-02] Email discussion for incoming LS on UE capabilities for MBS (R1-2203218)**

**Document for: Discussion**

# Introduction

SA2 has sent an LS to RAN1 on UE capabilities of MBS in [1]. SA2 has requested RAN1 input on the following questions for SA2’s Rel-18 work on MBS enhancements study (FS\_5MBS\_Ph2).

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| ***Question 1****: Whether, similarly to eMBMS case for eMTC/NB-IoT, would it be useful for NG-RAN to receive from 5GC information on NR UE capabilities (e.g. RedCap) of the target recipients of MBS data in MBS broadcast mode.*  ***Question 2****: If the answer to Question 1 is yes, we would like to ask RAN1 which are the possible targeted NR UE capabilities that should be provided to NG-RAN by the 5GC. SA2 can further study mechanisms in the context of the MBS enhancements study (FS\_5MBS\_Ph2).* |

This contribution is a summary of the following email discussion:

[109-e-AI5-LSs-02] Email discussion for incoming LS on UE capabilities for MBS (R1-2203218) by May 13 – Le (Qualcomm)

optional

# Email discussion

## MBS broadcast for RedCap UEs

**ZTE [3]:**

**Issue#1: Whether Redcap UE is allowed to receive broadcast (and multicast)**

Overall, this issue can be left to the Redcap UE feature discussion. The basic principle should be that if there is any spec impacts or negative impacts for Redcap UEs to receive broadcast (and multicast), then it should NOT be supported, since the RedCap WI is completed currently and no more optimization with spec impacts is persued in the CR stage. More specifically, since Redcap UEs have limited bandwidth, if the Recap UEs and non-Redcap UEs share the same MBS CFR, then network can only configures a small CFR for all UEs, which will definitely impact the efficiency of non-Redcap UEs. Similar as bandwidth limitation, modulation and Rx branches are also reduced, which brings similar impacts on non-RedCap UE. Furthermore, since the CFR should contains CORESET#0, then for RedCap, we need to determine whether separate initial DL BWP for RedCap should be used for MBS, when this separate initial DL BWP contain CORESET#0 or not. Even MBS is only supported in initial DL BWP for non-RedCap, it is still needed to determine how/when to receive the MBS service if separate initial BWP is configured for RedCap UE in idle/inactive mode.

***Observation 1****: RAN1 sees lots of open issues on allowing Redcap UE to support MBS, e.g., reduced bandwidth, modulation order and Rx branches, separate initial DL BWP with/without CORESET#0 and impacts to non-Redcap UEs.*

***Proposal 1****: Before answering questions in* *R1-2203218, RAN1 decides whether to allow Redcap UE to support Rel-17 broadcast (and multicast) in Redcap UE feature discussion.*

***Proposal 2****: Reply to LS R1-2203218/ S2-2203020 that Redcap UE is NOT allowed to support MBS.*

vivo [4]:

Answer: During the RAN1 discussion of Rel-17 NR MBS WI, the issue raised by SA2 LS was not discussed. Per RAN1’s understanding, the Rel-18 WI on enhanced NR MBS (RP-213568) does not has related work scope and RAN1 TU.

CMCC [5]:

However, it should be noted that, whether RedCap UE can support broadcast service reception, i.e., FG 33-1 has not been discussed in RAN1. If RedCap UE cannot support MBS broadcast service, it would be not necessary for NG-RAN to receive from 5GC information on NR UE capabilities (e.g. RedCap) of the target recipients of MBS data in MBS broadcast mode.

Huawei [6]:

From RAN1 perspective, Rel-17 NR MBS UE features can be supported by eMBB UEs or RedCap UEs if there is use case for RedCap UEs to support MBS, e.g., receiving MBS broadcast for firmware update.

Qualcomm [7]:

In NR Rel-17 MBS, there has not been specific consideration on the support of MBS broadcast transmission for different types of UEs, such as RedCap UEs with reduced bandwidth capability.

### 1st round

**FL comments:**

Per FL’s understanding, SA2’s questions are for the MBS broadcast reception of RedCap UEs. Here we don’t need to discuss the MBS multicast reception for RedCap UEs in SA LS reply.

As [Huawei] mentioned, from RAN1 perspective, RedCap UEs are capable of receiving Rel-17 MBS broadcast services if supporting FG33-1 [2]. However, [ZTE, CMCC, vivo, QC] have showed concern that that in NR Rel-17 MBS discussion, there has not been specific consideration on the support of MBS broadcast transmission for different types of UEs, such as RedCap UEs with reduced bandwidth capability. The broadcast CFR with BW size larger than CORESET0 (i.e., Case C and Case E) cannot be supported by RedCap UEs. If RedCap UEs can support MBS broadcast reception in Rel-17 MBS, only CFR with BW size same as CORESET0 (i.e., Case A) can be configured and it limits the transmission of MBS broadcast services targeting to non-RedCap UEs. [vivo] mentioned that the Rel-18 WI on enhanced NR MBS (RP-213568) does not has related work scope and RAN1 TU.

Therefore, companies are encouraged to share comments on the following RAN1 issues:

**Proposal 1:**

**RAN1 to discuss the following:**

* **Confirm that RedCap UEs supporting FG33-1 are capable to receive MBS broadcast services in Rel-17**
* **Discuss whether further enhancement on broadcast CFR for MBS broadcast services targeting RedCap UEs and non-RedCap UEs can be considered in Rel-18 MBS WID**

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| **Company** | **Comments** |
| MediaTek | **For the 1st sub-bullet:** Not support.  From our understanding, the Rel-17 MBS broadcast is designed for eMBB-like UE instead of RedCap UE. For example, for MBS broadcast UE, the modulation order can be up to 64QAM/256QAM, supporting MBS broadcast service reception on SCell or non-serving cell, supporting FDMed b/w unicast PDSCH and group common PDSCH for broadcast PDSCH if agreed, and support the larger common frequency resources (i.g., case C and Case E) for broadcast reception and so on. Besides, considering the FG 33-1 is conditional mandatory FG for MBS broadcast, it means UE needs to support all the components in FG 33-1 if the UE can receive the broadcast services, especially for the RRC IDLE/INACTIVE UEs. Therefore, it is mandatory to support CFR of case C and case E for UE receiving the broadcast services, which against the RedCap UE’s restriction that the maximum bandwidth of an FR1 RedCap UE is 20MHz.  To sum up, the two FGs between RedCap and MBS are separately discussed and the MBS broadcast design in whole Rel-17 discussion does not consider for the RedCap UE (e.g., supporting CFR of case C/E, FDMed case, SCell and non-serving cell reception), we suggest making the following conclusion:  **Conclusion:** RedCap UE cannot receive the Rel-17 MBS broadcast services.  **For the 2nd sub-bullet:** From our understanding, the use case is not clear to use the RedCap UE to receive the MBS broadcast services, especially considering the UE bandwidth reduction to 5MHz in FR1 for Rel-18 RedCap UE. Besides, it needs to discuss the broadcast reception from different operator and UE needs to use shared processing for MBS broadcast and unicast reception as states in the objective of Rel-18 MBS WID, however, RedCap UE only has one CC restriction, it will have larger WID modification and need more discussion for the scope if RedCap UE can receive the Rel-18 MBS services, which is not preferred. Therefore, we suggest following the current RAN plenary’s decision (e.g., the objective of Rel-18 MBS/RedCap WID, TU allocation) and no need to do any change with the following conclusion:  **Conclusion:** RedCap UE cannot receive the Rel-18 MBS broadcast services. |
| ZTE | As we analysed in our contribution, at least two aspects need to be considered for MBS reception of Redcap UEs:   1. Negative impacts on non-Redcap UEs. Since broadcast is for all UEs under this cell, if we allow Redcap UEs to support MBS, it means the CFR has to be smaller than 20MHz. This will have negative impacts on the MBS deployments. 2. Relationship between CFR for MBS and separate initial BWP for Redcap UEs. The CFR has to contain CORESET#0 based on the MBS previous agreements. However, the separate initial BWP for Redcap UEs is not required to contain CORESET#0/CD-SSB. This issue needs to be addressed.   Considering Rel-17 discussion for MBS and Redcap has been finalized, we suggest to conclude that Redcap UE is not allowed to receive MBS.  If companies feel that Rel-18 may have some room for Redcap UE supporting MBS, then it can be discussed in RAN instead of RAN1.  Besides, we think it is more appropriate to discuss this issue in the Redcap UE feature session. Because companies have discussed similar issues for other functionalities for Redcap UE there. |
| vivo | **For the first sub-bullet: ok**  The two FGs between RedCap and MBS are separate. If RedCap UEs have the capability of supporting FG33-1, it is nature that these UEs are capable to receive MBS broadcast services in Rel-17. There is no limitation from specification perspective.  **For the second sub-bullet: not support**  RAN1 is not the right group to discuss the scope of the WID scope and it is clear that RAN1 is not involved based on the current Rel-18 MBS WID. |
| Lenovo | 1. For 1st bullet: Not support.   We don’t think it is a right timing to discuss the support of RedCap UE for MBS reception. As we defined in Rel-17 MBS, the design target is for eMBB UE. With consideration of RedCap UE for receiving MBS, the CFR has to be configured with a narrow bandwidth, which has negative on eMBB UE’s MBS experience. Especially, when Case C or even Case E is configured for idle/inactive UE, RedCap UE can’t be supported.   1. For 2nd bullet, it is OK to us if MBS services for RedCap UE and eMBB UEs are separately configured which is supposed no RAN1 impact. |
| Apple | For the first sublet, in principle if the RedCap UE has the capability of FG33-1, then RedCap UE could receive the broadcast service. But it will put restrictions on CFR configuration. According to current specification, RedCap UE receiving broadcast service is allowed.  For the second bullet, it seems not the enhancement of CFR configuration. If supporting Rel-18 RedCap UE, the CFR is further limited to 5MHz. |
| Spreadtrum | For the first bullet, in principle it is OK for Redcap UE to receive broadcast service when Redcap UE supporting FG33-1. Indeed, it would restrict CFR configuration and initial DL BWP configuration for Redcap UEs. But following current specification, such configuration, e.g., CORESET#0 as the CFR and no separated initial DL BWP is configured for Redcap UE, is allowed, and it is up to gNB’s implementation.  For the second bullet, it can be discussed in RAN, not RAN1. |
| Nokia, NSB | **1st bullet:** In principle, yes. A RedCap UE could indicate support for FG33-1. Whether this makes any practical sense is another question altogether as the network would very unlikely plan for RedCap MBS if that means different BW or different coverage. The debate on forbidding a RedCap UE to indicate FG33-1 should be deferred to RedCap UE features discussion as this question is not a key issue wrt. the LS answer.  **2nd bullet:** WID contents discussion is for RAN and not for RAN1 to do. |

## Question 1 in SA2 LS

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| ***Question 1****: Whether, similarly to eMBMS case for eMTC/NB-IoT, would it be useful for NG-RAN to receive from 5GC information on NR UE capabilities (e.g. RedCap) of the target recipients of MBS data in MBS broadcast mode.* |

ZTE [3]:

**Issue#2: If Recap UE is allowed to receive broadcast, would it be useful for NG-RAN to receive from 5GC information on NR UE capabilities on RedCap of the target recipients of MBS data in MBS broadcast mode?**

If Recap UE is allowed to receive broadcast, then it will be useful/necessary for NG-RAN to receive from 5GC information on NR UE capabilities on RedCap of the target recipients of MBS data in MBS broadcast mode. However, this is also a spec impact for allowing Redcap UEs to support broadcast.

CMCC [5]:

**Proposal 1. Reply the LS to SA2 on Question 1:** **It would be useful for NG-RAN to receive from 5GC information on NR UE capabilities (e.g. RedCap) of the target recipients of MBS data in MBS broadcast mode. However, RAN1 has not discussed whether** **RedCap UE can support broadcast service, e.g., receiving DCI format 4\_0.**

Huawei [6]:

Answer to Q1: If gNB is not aware of whether the MBS services transmission provided by gNB is targeting eMBB or RedCap UE only or both, gNB can configure resources with a smaller bandwidth for reception by all UE types. Nevertheless, it might be useful for NG-RAN to receive from 5GC information on NR UE capabilities, based on which gNB might be able to configure the resources for broadcast transmission more efficiently.

Qualcomm [7]:

Yes, we think it is useful at least for gNB to configure the bandwidth location/size of the common frequency resource for MCCH/MTCH.

### 1st round

**FL comments:**

[ZTE, CMCC, Huawei, QC] share the view that if RedCap UEs are capable of receiving MBS broadcast servicesand gNB is aware of whether the MBS broadcast service is targeting to RedCap UEs, it is useful for NG-RAN to receive from 5GC information on NR UE capabilities (e.g. RedCap) of the target recipients of MBS data in MBS broadcast mode.

**Proposal 2:**

**RAN1 to answer Q1 as follows:**

* **It is useful for NG-RAN to receive from 5GC information on NR UE capabilities (e.g. RedCap) of the target recipients of MBS data in MBS broadcast mode.**

Companies are encouraged to provide comments below:

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| **Company** | **Comments** |
| MediaTek | Not sppport.  As discussed in the Proposal 1, we suggest that RedCap UE cannot receive the MBS broadcast service, so, it naturally does not need to notify the RAN side about the RedCap UE capability for receiving the MBS broadcast services. Besides, the same MBS broadcast service targeted users are not only for RRC CONNECTED state, but also for RRC IDLE/INACTUVE state, however, if UE in RRC IDLE/INACTIVE state, the RAN also does not know which UE to receive the broadcast service, so, it is not useful for the RAN side to know the RedCap UE capability for MBS broadcast reception. |
| ZTE | From our perspective, it would be good to address the issues in proposal1 first and then come back to this question. |
| vivo | Not support.  Even if it might be a useful information, it has not been discussed during the discussion of Rel-17 MBS WI and it is quite clear that such information exchange is not in scope of Rel-18 MBS WID. |
| Lenovo | Agree with MediaTek |
| Apple | Agree with ZTE, this is depending on whether allow RedCap UE to receive the broadcast service. If yes, the information is useful. Otherwise, the information is not needed. |
| Spreadtrum | Agree with ZTE. |
| Nokia, NSB | We do not support this, and do not see the usefulness. When specifically thinking of RedCap, we agree with MediaTek, but the LS cited RedCap as an example UE type, not the UE type. |

## Question 2 in SA2 LS

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| ***Question 2****: If the answer to Question 1 is yes, we would like to ask RAN1 which are the possible targeted NR UE capabilities that should be provided to NG-RAN by the 5GC. SA2 can further study mechanisms in the context of the MBS enhancements study (FS\_5MBS\_Ph2).* |

CMCC [5]:

Proposal 2. Reply the LS to SA2 on Question 2: Whether a UE is a RedCap UE or not should be provided to NG-RAN by the 5GC.

Huawei [6]:

Answer to Q2: It is sufficient for 5GC to provide only an indication that a UE is known to be a RedCap UE.

Qualcomm [7]:

A basic capability of RedCap UEs has been defined as FG28-1, given in Appendix. If an indication of max BW of RedCap UE capability is received from the CN, which is expected to be specified by RAN2 as part of UE capabilities (need to be further confirmed by RAN2), gNB can know that a broadcast service is targeted to RedCap UEs and configure the common frequency resource for the broadcast service accordingly. For instance, the bandwidth of the broadcast service for RedCap UEs is limited to the maximum bandwidth of RedCap UEs (Max FR1 BW is 20MHz and max FR2 BW is 100MHz as in FG28-1). The information of coverage level capability is not specifically needed for RedCap UEs, since similar coverage is supported for NR RedCap UEs and non-RedCap UEs.

Note that, in our understanding, the “capability” referred to in the SA2 LS corresponds to an indication conveyed from the CN to the RAN indicating the target type of UE for a given service, and not an explicit indication from the UE to the CN. From RAN1 perspective, it is beneficial if the gNB has information for a given MBS broadcast service targeted to RedCap UEs, who has limited maximum TBS/bandwidth.

### 1st round

**FL comments:**

[CMCC, Huawei, QC] have similar view that whether a UE is a RedCap UE with the limited max BW capability as defined by FG28-1 [2] should be provided to NG-RAN by the 5GC. As [QC] mentioned, considering similar coverage is supported for NR RedCap UEs and non-RedCap UEs, the coverage level capability is not specifically needed for RedCap UEs (different from coverage level capability required for broadcast services targeting to LTE MTC/NB-IoT), which can be clarified in the reply.

**Proposal 3:**

**RAN1 to answer Q2 as follows:**

* **The only capability information to be provided to NG-RAN is the RedCap UE max BW capability as defined by FG28-1. The information of coverage level capability is not specifically needed for RedCap UEs.**

Companies are encouraged to provide comments below:

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| **Company** | **Comments** |
| MediaTek | As discussed in the proposal 2, the answer for Q1 is no. So, it does not need to reply this question. |
| ZTE | From our perspective, it would be good to address the issues in proposal1 first and then come back to this question. |
| vivo | As discussed in the proposal 2, the answer for Q1 is out of scope, it does not need to reply this question. |
| Nokia, NSB | Agree with MediaTek and ZTE. |

# Conclusion

# References

1. R1-2203128(S2-2203020), “UE capabilities for MBS”, SA2#150-e, April 6 – 12, 2022
2. R1-2202927, “LS on updated Rel-17 RAN1 UE features list for NR”, RAN1#108-e, Feb. 21 – Mar. 3, 2022.
3. R1-2203246 [Draft] Reply UE capabilities for MBS ZTE
4. R1-2203497 Draft Reply LS on MBS UE capabilities vivo
5. R1-2204273 Discussion on SA2 LS on UE capabilities for MBS CMCC
6. R1-2204928 Discussion on UE capabilities for receiving MBS broadcast Huawei, HiSilicon
7. R1-2204970 Discussion on SA2 LS on UE capabilities of NR MBS broadcast reception Qualcomm Incorporated

# Appendix: UE feature FG28-1 and FG33-1 [2]

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| **Features** | **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Need for the gNB to know if the feature is supported** | **Applicable to the capability signalling exchange between UEs (Sidelink WI only)”.** | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | **Need of FDD/TDD differentiation** | **Need of FR1/FR2 differentiation** | **Capability interpretation for mixture of FDD/TDD and/or FR1/FR2** | **Note** | **Mandatory/Optional** |
| 28. NR\_redcap | 28-1 | RedCap UE | 1. Maximum FR1 RedCap UE bandwidth is 20 MHz.  2. Maximum FR2 RedCap UE bandwidth is 100 MHz.  3. Early indication of RedCap UE in Msg.1 for 4-step RACH  4. Separate initial UL BWP for RedCap UEs  - It includes the configuration(s) needed for RedCap UE to perform random access  - Enabling/disabling of frequency hopping for common PUCCH resources  5. Separate initial DL BWP for RedCap Ues  - It includes CSS/CORESET for random access  - FFS: For separate initial DL BWP used for paging, CD-SSB is included  - For separate initial DL BWP only used for RACH, SSB may or may not be included  FFS whether to add any other basic features for RedCap UE |  | Yes |  | [Network assumes the UE is not a RedCap UE] | [Per UE] | [No] | [No] |  | [RedCap UEs do not support carrier aggregation or dual connectivity.]  It is up to RAN2 whether/how to capture the capabilities for early indication of RedCap UE in Msg 3 and Msg A | Optional with capability signaling  RedCap UE must indicate this FG is supported |
| 33. NR\_MBS | 33-1 | Broadcast | * + - 1. Support of group-common PDCCH/PDSCH with CRC scrambled by MCCH-RNTI.       2. Support of group-common PDCCH/PDSCH with CRC scrambled by G-RNTI.       3. Support of CFR configuration for broadcast.       4. Support of CORESET and common search space for broadcast.       5. Support of DCI format 1\_0 with CRC scrambled with G-RNTI/MCCH-RNTI for broadcast.       6. Support of inter-slot TDM between unicast PDSCH and group-common PDSCH in different slots.       7. Support MCCH change notification indication via DCI.       8. support of higher layer configured slot-level repetition up to 8 for MTCH   DCI indicated slot-level repetition up to 16 for MTCH is defined as another FG, FFS whether to merge with FG 33-3-1 |  | Up to RAN2 |  |  | Up to RAN2 | Up to RAN2 | Up to RAN2 |  |  | Up to RAN2 |