3GPP TSG-RAN WG2 Meeting #116bis-e ***R2-220xxxx***

Electronic Meeting, Jan 17 – 25, 2022

**Agenda item: 8.1.3.3**

**Source: MediaTek**

**Title: [AT116bis-e] [026][MBS] UE capabilities (MediaTek)**

**Document for:**  **Discussion**

# 1. Introduction

This paper is to trigger the following email discussion of UE capabilities in MBS:

* [AT116bis-e][026][MBS] UE capabilities (MediaTek)

Scope: Initial discussion on MBS UE capabilities, Identify easy agreements (can be agreed offline), discussion points and points that may need LS to other working group(s). Coordination may be needed between this discussion and the main UE caps discussion.

Intended outcome: Report

Deadline: Friday W1 for parts that need concrete action at current meeting by online CB, otherwise EOM.

## 1.1 Contacts

Contact person for each participating company:

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| --- | --- | --- |
| Company | Name | Email Address |
| CATT | Rui Zhou | zhourui@catt.cn |
| OPPO | Shukun Wang | wangshukun@oppo.com |
| vivo | Yitao Mo (Stephen) | yitao.mo@vivo.com |
| TD Tech, Chengdu TD Tech | Limei Wei | limei.wei@td-tech.com |
| Spreadtrum | Lifeng Han | lifeng.han@unisoc.com |
| Apple | Fangli XU | fangli\_xu@apple.com |
| Nokia | Jarkko Koskela | Jarkko.t.koskela@nokia.com |
| Samsung | Sangkyu Baek | sangkyu.baek@samsung.com |
| LGE | Seong Kim | sj117.kim@lge.com |
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# 2. Discussion

## 2.1 Capabilities for multicast and broadcast reception

Since RAN1 has agreed to have separate capabilities for multicast and broadcast. From RAN2 perspective, it is reasonable to support separate reception for MBS multicast and broadcast service. From the rapporteur’s understanding, UE capabilities for broadcast and multicast should be separate and let RAN2 confirm this understanding.

#### Question 1: Do companies agree to support separate capabilities for MBS Broadcast and MBS Multicast?

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| **Company** | **Answer (Yes/No)** | **Comments** |
| Huawei, HiSilicon | Yes | It is what RAN1 has agreed (we don’t need this discussion), and functionally of the two delivery modes can be decoupled. |
| Ericsson | Yes | Introduce optional UE capability for broadcast (without capability signalling) and multicast (with capability signaling) as suggested by RAN1 |
| CATT | Yes | It aligns with the UE feature list provided by RAN1. |
| OPPO | Yes |  |
| Qualcomm | Yes |  |
| vivo | Yes | We are fine to follow the RAN1 agreement. |
| TD Tech, Chengdu TD Tech | Yes |  |
| Spreadtrum | Yes |  |
| Apple | Yes |  |
| Nokia | Yes | These features are self contained and some UEs/Networks/Operators have interest only to one type of service |
| Samsung | Yes |  |
| LGE | Yes | For broadcast, no capability signalling is necessary. |
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## 2.2 Maximum G-RNTIs / G-CS-RNTI for multicast/broadcast

During the discussion of Rel-17 MBS, RAN2 agreed to support one-to-one mapping between G-RNTI/G-CS-RNTI and MBS session. Then, at RAN2#114-e meeting, RAN2 agreed that in order to receive multiple MBS services, UE need to support multiple G-RNTIs and/or G-CS-RNTIs and it is FFS whether this depends on UE capability (R2-2106687 LS to RAN1).

In RAN2#116e, one-to-many mapping between G-RNTI and MBS sessions is agreed. The network can map multiple sessions to the same G-RNTI and UE can join multiple session at the same time. There should be some constraints for network to map all UE interested sessions to one G-RNTI.

Meanwhile, monitoring multiple G-RNTI/G-CS-RNTIs actually puts a lot of burden for UEs receiving MBS services. From the rapporteur’s understanding, in order to simplify the UE implementation, it is preferred to limit the maximum number of G-RNTIs/G-CS-RNTIs (or their combination) for UE to monitor, and this should be jointly discussed with RAN1.

Before we get the input from RAN1, RAN2 can initially discuss the issue.

#### Question 2: Should the UE provide the maximum number of G-RNTIs / G-CS-RNTIs he can simultenously monitor to the network as UE capability?

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| **Company** | **Answer (Yes/No)** | **Comments** |
| Huawei, HiSilicon | Yes | This can be a capability, and based on this number(s) the network can decide whether it needs to map different MBS services to one Multicast MRB, if the number of supported G-RNTIs is fewer than the interested MBS multicast services.  We may need to further discuss whether this number is across multicast and broadcast if the UE supports both features, or they are separate numbers for multicast and broadcast. |
| Ericsson | Yes | It can simply be a max total number as it will not anyway be possible in all cases to know if e.g., a BC RB is received. In our mind receiving/ descrambling RNTIs themselves is not “a lot of burden” but scheduled by (receiving) multiple RNTIs should be discussed. Also, during which timeframe. Suggest input from RAN1 on the L1 constraints. In out view a UE that supports concurrent MBS sessions scheduled via G-RNTI/G-SC-RNTI shall be able to monitor multiple G-RNTIs/G-CS-RNTI per slot. |
| CATT | No | The UE capability on the maximum number of G-RNTIs / G-CS-RNTIs is necessary. But we think gNB does not need to know this, so “capability without signalling” is enough. |
| OPPO | Yes |  |
| Qualcomm | Yes | Actual number can be FFS |
| vivo | Yes | We assume a binary UE capability can be used. If it is reported, then the NW assumes the UE supports *N* parallel reception, where *N* is the max number mentioned above. |
| TD Tech, Chengdu TD Tech | May be |  |
| Spreadtrum | Yes | This capability is necessary. The gNB can determine the mapping between MBS session and G-RNTI/G-CS-RNTI according to the UE capabilities.  Whether this number is across multicast and broadcast or not needs further discussion, E.g.,for UE in RRC idle/inactive state, the gNB cannot be aware of its capability. |
| Apple | Yes |  |
| Nokia | Yes | Actual number can be FFS |
| Samsung | Yes |  |
| LGE | Yes |  |
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#### Question 3: Companies are invited to provide the views on the actual maximum number of G-RNTIs/G-CS-RNTIs (or their combination) for UE to simultenously monitor?

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| **Company** | **Comments** |
| Huawei, HiSilicon | Can be INTEGER (1..4) as a baseline, and open for discussion. |
| Ericsson | This can be decided as a second step to Q2 (and RAN1 input) |
| CATT | It should be decided by RAN1 |
| OPPO | It is up to RAN1. |
| Qualcomm | Wait for RAN1 discussion on this |
| vivo | Further RAN1 input is needed. |
| TD Tech, Chengdu TD Tech | Further discussion is needed |
| Spreadtrum | Further RAN1 input is needed. |
| Apple | Wait for RAN1 |
| Nokia | RAN1 needs to be consulted. |
| Samsung | Up to RAN1 (probably 4 or 8?) |
| LGE | Wait for RAN1 discussion or we may need to ask RAN1 about minimum capabilities for G-RNTI monitoring and PDSCH decoding. |
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## 2.3 Multicast split-bearer capability

For reliability of multicast service, it was agreed in RAN2#113e that split-MRB architecture is introduced for multicast reliability with one common PDCP entity and two separate RLC entities. One MRB can be configured with PTM only or PTP only or split-MRB architecture. In MBS stage-2 running CR R2-2111605, the detailed configurations for multicast MRB are supported:

* Multicast MRB with DL only RLC-UM or bidirectional RLC-UM configuration for PTP transmission;
* Multicast MRB with RLC-AM entity configuration for PTP transmission;
* Multicast MRB with DL only RLC-UM entity for PTM transmission;
* Multicast MRB with two RLC-UM entities, one DL only for PTP transmission and the other DL only RLC-UM entity for PTM transmission as described in section 16.x.5.5;
* Multicast MRB with three RLC-UM entities, one DL RLC-UM entity and one UL RLC-UM entity for PTP transmission and the other DL only RLC-UM entity for PTM transmission as described in section 16.x.5.5;
* Multicast MRB with two RLC entities, one RLC-AM entity for PTP transmission and the other DL only RLC-UM entity for PTM transmission as described in section 16.x.5.5.

The last 3 MRB configurations have a split bearer with two RLC entities, which should be indicated by a separate UE capability. However there is also a proposal in R2-2200819 saying that these MRB configuration can be mandatory for UE multicast reception.

#### Question 4: Do companies agree to use one UE capability to indicate the support of the split-bearer configurations for MRB and how, or it is a mandatory MRB for UE multicast reception?

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| **Company** | **Answer (Yes/No)** | **Comments** |
| Huawei, HiSilicon | Mandatory | Split MRB is a basic feature of multicast which makes multicast more reliable than broadcast, so it should be a basic multicast capability. Furthermore, for unicast, split DRB (with one UL path) is a mandatory feature without capability signalling, so it has no additional efforts for the UE to support split MRBs which is downlink only. |
| Ericsson | Mandatory | Agree w Huawei |
| CATT | No | it should be mandatory for UE multicast reception |
| OPPO | No | It should be M. |
| Qualcomm | Mandatory |  |
| vivo | No | We share the same view with Huawei. |
| TD Tech, Chengdu TD Tech | Mandatory |  |
| Spreadtrum | Mandatory | Agree with Huawei. |
| Apple |  | The capability indication is needed regardless that is mandatory or optional. |
| Nokia | Mandatory | Agree with Huawei |
| Samsung | Mandatory | We are fine not to have separate indication. |
| LGE | No | It should be mandatory. |
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## 2.4 UE capability for maximum MRB number

In the TS 38.306, it is captured that the maximum number of DRBs that a NR UE shall support is 16, For one MAC entity, the maximum number of DRBs is 8. Since MRB is introduced, the maximum number of MRBs supported by the UE need to be discussed.

Considering the legacy UE capability for DRBs, MBS UE may reuse a total number of configured MRB+DRB=16 with some additional note in the TS 38.306. As part of total 16 MRBs + DRBs, the default number of supporting MRB can be 4, according to R2-2200531.

As indicated by R2-2200819, for some use cases and UEs, it would be beneficial to have a possibility to support additional MRBs, which may be useful for UEs which would be receiving multiple MBS sessions simultaneously. Additional MRBs support is based on UE capability.

#### Question 4: Do companies agree to reuse a total number of configured MRB+DRB=16 as the maximum number of radio bearers?

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| **Company** | **Answer (Yes/No)** | **Comments** |
| Huawei, HiSilicon |  | We assume this question is only for Multicast MRBs.  Multicast MRB+DRB=16 should be the maximum number that the UE is mandatory to support, and the UE is optional to support >16 Multicast MRB+DRBs. |
| Ericsson | Yes | The current defined max RB should be sufficient (without new signalling) and that only capability signalling for additional supported RB is needed. Note that there may be some consideration needed for the support of Split MRB, and this would be analogue to the RB limitation given by legacy PDCP duplication. |
| CATT | Yes | We prefer not to define a separate UE capability for the supported MRB number, but the requirement can be reflected by some additional note in the TS 38.306, that for a UE the total number of configured DRBs and MRBs is up to 16 per UE |
| OPPO | Yes |  |
| Qualcomm | Yes | DRBs + MRBs = 16 , with no UE capability. We assume 4 MRBs is by default and any additional MRBs is based on capability within 16. Note that split MRB is considered as count 2, similar to unicast Split MRB.  DRBs + MRBs > 16 has to be based on UE capability. |
| vivo | Yes | We agree to resue the existing constraints for UE capabilities to avoid additional spec impacts and further complicated implementation. |
| TD Tech, Chengdu TD Tech |  | MRB+DRB=16 shall be supported. If not enough, MRB+DRB=32 can be considered. |
| Spreadtrum | Yes | We can reuse 16 and no UE capability is needed. |
| Apple | Yes |  |
| Nokia | Yes | Agree with Ericsson |
| Samsung | Yes |  |
| LGE | Yes | To keep UE complexity reasonable, we support to keep 16 as the number of supported DRBs+MRBs, i.e., UE shall support 16 DRBs+MRBs without capability signalling.  Regarding Huawei’s comment on the scope of this capability, we also think this is for multicast MRBs. |
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#### Question 5: Do companies agree to set the default number of supporting MRBs to 4?

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| **Company** | **Answer (Yes/No)** | **Comments** |
| Huawei, HiSilicon | Yes for broadcast MRBs;  Not sure it is needed for Multicast DRBs | For broadcast, this default number needs to be defined, so that the network can configure broadcast MRBs accordingly.  But for multicast, do we need this default number at all? Or could we simply agree that in total it is 16 and all combinations should be supported (e.g. 10 MRBs and 6 DRBs etc.)?  Even it is supported for Multicast, this should be only for the case of max number of MRBs + DRBs = 16, as proposed in R2-2200531. We can further discuss the supported MRB number if MRBs + DRBs > 16 |
| Ericsson | No | For Multicast the current defined max RB should be sufficient (without new signalling) and that only capability signalling for additional supported RB is needed. Note that there may be some consideration needed for the support of Split MRB, and this would be analogue to the RB limitation given by legacy PDCP duplication. |
| CATT | No | See comments to Q4 above |
| OPPO | No |  |
| Qualcomm | Yes | Same comment as Q4 |
| vivo | No | Frankly, from the UE hardware implementation point of view, there is no essential difference between MRB and DRB. In this sense, MRB and DRB are supported to have equal status. Thus, as long as the total number of MRBs and DRBs does not exceed 16, the default limitation is not needed. |
| TD Tech, Chengdu TD Tech |  | We think the UE capability for support DRBs can be used for MRBs for broadcast sessions. |
| Spreadtrum | No | The maximum number of 16 will be used for DRB or/and MRB. No additional limitation for MRB is needed. |
| Apple | No | If the L2 memory requirement is no change, we donot need to specify the default max MRB number. |
| Nokia | Yes / No | Agree with Huawei. |
| Samsung | No | We do not need to limit the number of MRBs. If UE supports 16 DRBs+MRBs, such restriction is not necessary.  Also, considering a scenario discussed in SA2 that multiple MBS sessions are simultaneously served, e.g.  - In MCPTT (Mission Critical Push-To-Talk), the UEs can be involved in multiple group calls;  - In TV services, the UEs can be involved in multiple TV channels together with associated data channels;  4 DRBs are not sufficient. |
| LGE | Yes |  |
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#### Question 6: Do companies agree to introduce an optional UE capability of*maxMRB-Add* for additional MRBs support?

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| **Company** | **Answer (Yes/No)** | **Comments** |
| Huawei, HiSilicon | Yes | It is beneficial if the UE can support more than 16 RBs for user plane data, and this can be optional to UE. |
| Ericsson | Yes | See previous input |
| CATT | No | See comments to Q4 above |
| OPPO | Yes |  |
| Qualcomm | Yes | Same comment as Q4 |
| vivo | No strong view | We can follow the majority view. |
| TD Tech, Chengdu TD Tech |  | No strong tendency. |
| Spreadtrum | No strong view | Need further discussion. |
| Apple |  | No strong view. |
| Nokia | Yes | Although might never realise in practise. |
| Samsung | No |  |
| LGE | Yes |  |
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## 2.5 Mandatory UE features for Broadcast

As described in R2-2200819, the network is not able to know the capabilities of the UEs receiving MBS broadcast in RRC\_IDLE/INACTIVE in the cell. Therefore, it is necessary to specify a set of basic MBS broadcast capabilities that have to be supported by all the MBS broadcast enabled UEs. The basic feature set include not only those basic L2 features (mandatory without capabilities), but also some features which are currently mandatory with capability signalling, as shown below:

* PDCP short SN;
* RLC UM with short SN
* RLC UM with long SN
* DRX with long DRX cycle

#### Question 7: Do companies agree the above mandatory UE features with capability signaling in broadcast?

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| **Company** | **Answer (Yes/No)** | **Comments** |
| Huawei, HiSilicon | Yes | As MBS broadcast needs to support RRC\_IDLE/RRC\_INACTIVE UEs, the transmission cannot be based on UE capability reporting. It is necessary to make some well-supported features mandatory for MBS broadcast, so that the network can be free to configure these features.  The optional features can hardly if not at all be configured for MBS broadcast, as the network doesn’t know if the idle/inactive UEs support them. |
| Ericsson | Yes | Agree w Huawei |
| CATT | Yes | Agree with Huawei |
| OPPO | Yes |  |
| Qualcomm | Yes | Agree with Hauwei |
| vivo | Yes |  |
| TD Tech, Chengdu TD Tech | Yes |  |
| Spreadtrum | Yes | Agree with Huawei |
| Apple | Yes |  |
| Nokia | Yes | Agree with Huawei |
| Samsung | Yes |  |
| LGE | Yes |  |
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For broadcast, as described in R2-2200819, ROHC is currently an optional function of UE. It may increase the complexity of UE if it is considered as a mandatory for UE supporting broadcast. On the other hand, if it remains optional for MBS, then it is unclear how the network may determine whether it may use ROHC for a certain MBS session or not.

If ROHC is considered as a mandatory capability for UE to receive broadcasts service, the number of ROHC context sessions and the required ROHC profiles should be limited to reduce the impact on the UE.

#### Question 8: Companies are invited to provide the views on whether ROHC is treated as a basic MBS broadcast capability or not

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| **Company** | **Answer (Yes/No)** | **Comments** |
| Huawei, HiSilicon | Yes | RoHC with some non-demanding parameters (e.g. small number of ROHC contexts) should be treated as a basic MBS broadcast feature; otherwise, the network cannot use it at all, as it doesn’t know if an idle/inactive UE support it. |
| Ericsson | Yes | RAN2 can discuss a framework for minimum set. |
| CATT | Yes | For simplicity, it is better to treat ROHC as mandatory broadcast capability. |
| OPPO | Yes |  |
| Qualcomm | Yes |  |
| vivo | Yes |  |
| TD Tech, Chengdu TD Tech |  | No strong view |
| Spreadtrum | Yes |  |
| Apple | See comments | It depends on which ROHC profile is mandatory to be supported. |
| Nokia | Yes | A UE should be able to support ROHC (e.g. sufficient amount of ROHC contexts) for the number of MRBs it supports for MBS broadcast, otherwise the network may configure ROHC for MBS broadcast which the UE in IDLE won’t be able receive. |
| Samsung | No strong view |  |
| LGE | Yes |  |
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## 2.6 ROHC

In general, since ROHC can be operated at the PDCP entity in both DRB and MRB, the ROHC capabilities can be shared across all bearers configured for a UE. For “continueROHC-Context”, “supportedROHC-Profiles” and “uplinkOnlyROHC-Profiles”, no extra clarification is needed, as the capability bit per UE can be used for MRB and DRB. The maximum number of ROHC header compression context sessions can be across DRBs and MRB (i.e. per UE).

#### Question 9: Do companies agree that the maximum number of RoHC/EHC contexts are across all DRB/MRBs configured with RoHC/EHC for a UE ?

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| **Company** | **Answer (Yes/No)** | **Comments** |
| Huawei, HiSilicon | Yes, but.. | It should be clarified that it is across DRBs and Multicast MRBs.  For Broadcast MRBs, the number of supported RoHC/EHC contexts should be a separate capability. This is because the network doesn’t know how many RoHC/EHC contexts are used for broadcast MRBs, so if the number is also shared with broadcast MRBs, the network doesn’t know how many contexts are left for DRBs and multicast MRBs, if the UE is also receiving broadcast. |
| Ericsson | Yes | Same reasoning as for DRB+MRB. Agree w Huawei that the BC part needs some discussion. |
| CATT | Yes | There is no need to complicate the related requirements on RoHC/EHC contexts, and it is sufficient to just keep the corresponding requirements being across all bearers configured for a UE |
| OPPO | Yes |  |
| Qualcomm | Yes |  |
| vivo | Yes |  |
| TD Tech, Chengdu TD Tech | Yes |  |
| Spreadtrum | Yes |  |
| Apple | Yes |  |
| Nokia | Yes |  |
| Qualcomm | Yes |  |
| LGE | Yes |  |
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## 2.7 Multicast DRX

As described in R2-2200357, since RAN2 agreed that “For PTM transmission, a multicast DRX pattern is configured on a per G-RNTI(s) basis (i.e. independent of UE-specific DRX for unicast transmission).” Given that unicast DRX has optional UE capability, it is natural to introduce optional UE capability for multicast DRX.

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| Definitions for parameters | Per | M | FDD-TDD DIFF | FR1-FR2 DIFF |
| ***multicstDRX-r17***  Indicates whether the UE supports multicast DRX, as specified in TS 38.321 [8]. A UE supporting this feature shall also support Dynamic scheduling for multicast (RAN1 FG 33-2). | UE | No | No | No |

#### Question 10: Do companies agree to introduce optional UE capability for multicast DRX?

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| **Company** | **Answer (Yes/No)** | **Comments** |
| Huawei, HiSilicon | Yes/No | We have a preference to make it mandatory (at least for long DRX cycle), but no strong view. |
| Ericsson | Yes | Fine with mandatory also. |
| CATT | Yes, but | Multicast DRX should be mandatory for UE supporting multicast. |
| OPPO | Yes |  |
| Qualcomm | Yes | Fine with mandatory as well. |
| vivo | No | We prefer to make it mandatory, similarly to the unicast DRX with long DRX cycle. |
| TD Tech, Chengdu TD Tech | Mandatory |  |
| Spreadtrum | Yes | Fine with mandatory as well. |
| Apple | Yes |  |
| Nokia | Yes | Naturally fine with mandatory as well |
| Samsung | Yes |  |
| LGE | Yes |  |
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Meanwhile, there is a discussion within R2-2200819 on the mandatory setting for multicast-capable UEs with long DRX cycle. Then RAN2 is asked to confirm this view.

#### Question 11: Do companies agree that MBS DRX with long DRX cycle is mandatory for multicast capable UEs?

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| **Company** | **Answer (Yes/No)** | **Comments** |
| Huawei, HiSilicon | Yes | We have a preference to make it mandatory to UE considering its power saving benefits to UEs. |
| Ericsson | Yes |  |
| CATT | Yes |  |
| OPPO | Yes |  |
| Qualcomm | Yes | Short DRX can also be supported if UE support Long DRX. |
| vivo | Yes |  |
| TD Tech, Chengdu TD Tech | Yes |  |
| Spreadtrum | Yes |  |
| Apple | Yes |  |
| Nokia | Yes | And Short DRX too. |
| Samsung | Yes | Same as unicast |
| LGE | Yes |  |
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## 2.8 MBS reception on Scell and non-serving cell

For UE capability of receiving broadcast service in RRC connected state, last meeting RAN2 send a LS to RAN1 to check the feasibility of MBS broadcast reception on SCell:

* From RAN2 point of view, the UE may receive MBS broadcast service from SCell in intra-PLMN case and if supported this may be a separate UE capability. Send an LS to RAN1 to ask to check the feasibility of MBS broadcast reception on SCell.
* From RAN2 point of view, the connected UE may if supported receive MBS broadcast service from non-serving cell in intra-PLMN case, under the condition this does not have any impact to operation on serving cell(s). This may be a separate UE capability. Send an LS to RAN1 to ask to check the feasibility.

It is expected that the LS will be handled in RAN1#107bis-e meeting. Therefore, RAN2 can wait for RAN1’s feedback regarding the UE capabilities for MBS broadcast reception from SCell or non-serving cell.

Then rapporteur think s that no discussion is needed for this issue during this RAN2 meeting.

## 2.9 Other issues

#### Question 12: Companies are invited to comment if there are any other issues for MBS UE capabilities that needs to be discussed during this email discussion.

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| **Company** | **Answer (Yes/No)** | **Comments** |
| Ericsson | Yes | RAN2 should, as a Working assumption, assume that legacy DL combination types, i.e. Paging and System information etc, are not impacted when UE supports MBS (38.302). |
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# 4. Summary

# 5. Reference

[1] R2-2200237 Discussions on NR MBS UE Capabilities CATT discussion Rel-17

[2] R2-2200357 UE capabilities for Rel-17 MBS Intel Corporation discussion Rel-17

[3] R2-2200400 UE capabilities for MBS Samsung

[4] R2-2200531 MBS UE capability for supporting MRBs Qualcomm India Pvt Ltd

[5] R2-2200579 UE capabilities for NR MBS TD Tech, Chengdu TD Tech discussion Rel-17

[6] R2-2200819 Discussion on UE capabilities for MBS Huawei, HiSilicon discussion Rel-17

[7] R2-2200827 Discussion on UE capability for NR MBS MediaTek inc. discussion Rel-17

[8] R2-2200874 RAN2 UE Feature List for NR MBS CMCC discussion Rel-17

[9] R2-2200906 MBS BWP UE capability and MBS resources Sony discussion Rel-17

[10] R2-2200979 MBS Capabilities Ericsson

[11] R2-2201261 Discussion on UE capabilities for MBS vivo discussion Rel-17

[12] R2-2201380 Discussion on MBS support on MRDC Xiaomi Communications discussion Rel-17

[13] R2-2201384 UE capability for ROHC and EHC Xiaomi Communications discussion Rel-17