**3GPP T****SG-RAN WG2 Meeting #123-bis R2-23xx**

Xiamen, China, Oct. 9-13, 2023

**Agenda Item:** 7.11.3

**Work Item:** NR\_MBS\_enh-Core

**Source:** Qualcomm Incorporated (rapporteur)

**Title:** [Pre123bis][601][eMBS] Summary of 7.11.3 Shared processing

**Document for:**Discussion/Decision

# Background

Rel-18 WI on enhancements of NR MBS includes shared processing for MBS broadcast and unicast reception, see [1].

* *Specify Uu signalling enhancements to allow a UE to use shared processing for MBS broadcast and unicast reception, i.e., ‎including UE capability and related assistance information reporting regarding simultaneous unicast reception in RRC\_CONNECTED and MBS broadcast reception from the same or different operators [RAN2]*

The scenario under consideration is a UE receiving NR unicast from a unicast gNB, while receiving (or being interested to receive) NR MBS broadcast from a non-serving gNB (which may be collocated or non-collocated, and may belong to same or different operator.

Related to this objective, RAN2#119e agreed the following:

* RAN2 focuses on solutions taking multi-Rx UEs (i.e. no specific enhancements for 1Rx UEs).

RAN2#119bis-e agreed the following:

* For shared processing we adopt the following as a baseline:

1) new IE is added in system information to control whether MBSInterestIndication for shared processing can be sent or not;

2) MBSInterestIndication message content and related procedure is updated for shared processing.

* New IE to control whether MBSInterestIndication for shared processing can be sent or not is added to SIB1.
* In MBSInterestIndication, for a broadcast service that the UE is receiving or is interested to receive, at least the following information can be signalled: broadcast frequency, subcarrier spacing, and bandwidth. FFS details/exact parameters and other information. FFS in which scenarios the UE reports this information (e.g. intra-PLMN case, inter-PLMN case)
* FFS whether UE capability is needed to enable shared processing.

There was no discussion on this agenda item in RAN2#120. Then RAN2#121 agreed the following:

* Indicate the capability of receiving MBS broadcast from a non-serving cell. FFS whether the granularity is at FeatureSetDownlink or FeatureSetDownlinkPerCC level.
* FFS Whether to include additional information in MII can be controlled by the network. Should consider whether this would be two-step procedure or one-step procedure (e.g. having more info in SIB1)

Then there was no discussion on this agenda item in RAN2#121bis. Further, RAN2#122 agreed the following:

* The granularity for capability of receiving MBS broadcast from a non-serving cell is at FeatureSetDownlinkPerCC level. This capability does not imply simultaneous reception on multiple CCs.
* No additional signalling is introduced to control information to be reported by the UE (on top of what we have already agreed).
* When sending MII, UE reports the whole information (i.e. at least frequency, bandwidth, SCS) when indicated by SIB1 of its unicast serving cell. FFS whether there are cases where this information is not available at the UE and what happens then.
* FFS if any special handling is needed when the non-serving cell updates the configuration (which is relevant for MII)
* No additional information is added to MII on top of what has been already agreed.

RAN2#123 agreed the following:

* As per the previous agreement, if the UE is able to get the additional information (i.e. its current configuration does not prevent it from doing so), the UE shall do this (if capable and configured by the network)
* In case additional information (SCS, bandwidth) is not available at the time of sending the MII to the unicast serving cell (e.g. the UE is not able to read SIB1 from the non-serving cell), the UE reports whatever is available information at that time (i.e. at least the frequency, and optionally SCS and/or BW as available).
* UE reports updated MII after acquiring additional information from the non-serving cell (if previously it reported only frequency) or if the information in the non-serving cell changes.
* The SCS in the MII is set to the SCS of the CORESET#0 for the MBS broadcast cell.
* Combination of FreqBandIndicatorNR and ARFCN-ValueNR is used to signal the frequency information in the MII for shared processing.
* At least CFR bandwidth is reported by the UE in MII. FFS whether “location” needs to be also reported and how exactly this is captured in RRC (i.e. which IE is used).

This report summarizes the contributions submitted under 7.11.3 Shared Processing and provides some proposals on the remaining aspects.

# Tdocs list

Following are the submitted considered for this summary report:

1. [R2-2309559](http://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_123bis/Docs/R2-2309559.zip) Remaining Issues on Shared Processing CATT, CBN discussion Rel-18 NR\_MBS\_enh-Core
2. [R2-2309566](http://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_123bis/Docs/R2-2309566.zip) Bandwidth Location Issue for Shared Processing Report vivo discussion Rel-18 NR\_MBS\_enh-Core
3. [R2-2310060](http://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_123bis/Docs/R2-2310060.zip) Discussion on shared process between broadcast and unicast NEC Corporation. discussion Rel-18 NR\_MBS\_enh-Core
4. [R2-2310088](http://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_123bis/Docs/R2-2310088.zip) Shared processing for broadcast and unicast reception Samsung R&D Institute India discussion Rel-18
5. [R2-2310267](http://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_123bis/Docs/R2-2310267.zip) Discussion on shared processing CMCC discussion Rel-18 NR\_MBS\_enh-Core
6. [R2-2310586](http://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_123bis/Docs/R2-2310586.zip) Discussion on the CFR location for shared MBS capability Xiaomi discussion Rel-18 NR\_MBS\_enh-Core
7. [R2-2310714](http://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_123bis/Docs/R2-2310714.zip) Discussion on shared processing for MBS broadcast and unicast reception Huawei, HiSilicon discussion Rel-18 NR\_MBS\_enh-Core
8. [R2-2311006](http://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_123bis/Docs/R2-2311006.zip) Additional scenarios for shared processing Nokia, Nokia Shanghai Bell discussion Rel-18 NR\_MBS\_enh-Core [R2-2308744](http://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_123bis/Docs/R2-2308744.zip)
9. [R2-2311049](http://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_123bis/Docs/R2-2311049.zip) Remaining aspects of shared processing for MBS broadcast and unicast reception Qualcomm Incorporated discussion Rel-18 NR\_MBS\_enh-Core

In the following section, a summary of the observations and proposals is provided. For quick reference, the Annex includes full list the observations and proposals from these tdocs.

# Discussion

## FFS whether “location” needs to be also reported and how exactly this is captured in RRC (i.e. which IE is used)

Relevant text from running CR is reproduced here for quick reference:

A screenshot of a computer

Description automatically generated

Regarding this FFS, following is summarized from the submitted Tdocs.

[1] proposes to clarify that the *frequency* reported for shared processing is the absolute start position (i.e. ARFCN-ValueNR) of the CFR of the non-serving cell, and not report the “location” for the CFR.

[2] observes that the location of broadcast CFR may not be of further help but for simplicity proposes to report *locationAndBandwidth* parameter of the CFR instead of RAN2 trying to define a new parameter.

[3] questions whether the *frequency* that was previously agreed is central location of non-serving CFR, or the central location of non-serving cell band. If the former, only #of PRB is sufficient, if latter then more information is needed e.g., locationAndBandwidth, pointA.

[4] and [7] propose to report CFR BW (i.e. #of PRBs) without CFR location info. [7] explains that if locationAndBandwidth is used in MII, then offsetToCarrier and PointA is also needed which adds additional overhead.

[5] suggests that location of CFR is useful and *locationAndBandwidthBroadcast* can be used to indicate it.

[6] explains that if *locationAndBandwidth* of CFR is reported, then lowest subcarrier AFRCN of PRB#0 needed to be included, but *freqInfoMBS*, *bandwidthMBS* and *subcarrierSpacing* are sufficient for locating the operating frequency range for receiving MBS. Therefore, [6] proposes to clarify when the *bandwidthMBS* (i.e. number of PRBs) and *subcarrierSpacing* are reported, the *freqInfoMBS* (i.e. ARFCN and band) represents the central frequency for MBS reception. No extra signalling for frequency location is needed.

[9] argues that CFR BW may not be available to the UE until later and when CFR BW is available and reported, it is not sufficient without the location info since just knowing the CFR BW, that does not clearly tell which part of the carrier BW is being used by the CFR. So, [9] proposes UE to report CHOICE of the actual value of *locationAndBandwidthBroadcast-r17* (either obtained from *locationAndBandwidth* or from broadcast gNB’s SIB1 depending on what is signalled) encoded as INTEGER (0..37949), or *carrierBandwidth* signalled by broadcast gNB as defined in *SCS-SpecificCarrier* corresponding to the indicated SCS (encoded as INTEGER (1..*maxNrofPhysicalResourceBlocks*)), based on the availability at the UE. [9] also provides ASN.1 TP to capture this as follows:

NonServingInfo-r18 ::= SEQUENCE {

freqInfoMBS-r18 FreqInfoMBS-r18,

bandwidthMBS-r18 CHOICE {

carrierBandwidth INTEGER (1..maxNrofPhysicalResourceBlocks),

locationAndBandwidthBroadcast INTEGER (0..37949)

} OPTIONAL,

subcarrierSpacing-r18 SubcarrierSpacing OPTIONAL

}

**Summary:**

Several papers touch upon the aspect of FFS whether ‘location’ needs to be reported. One paper [9] provides ASN.1 TP regarding the FFS on “how exactly this is captured in RRC (i.e. which IE is used)”.

**Observation 1:** Further clarification needed on what *frequency* that was previously agreed and captured in running CR as *carrierFreqMBS* actually means, whether that relates to broadcast gNB’s whole band where MBS service is provided, or only the CFR for broadcast; and further whether that is centre or the absolute start position [1], [3], [6].

**Note:** since the frequency information provided in the MII by the UE also depends on how this is signalled in the USD as defined by SA4, we should take into account e.g. whether USD can include CFR information or is it centre frequency of the carrier. Rapporteur assumption is USD includes centre frequency of the carrier.

**Observation 2**: Multiple views on whether CFR location is needed to be explicitly reported in the MII:

* No need to signal CFR location explicitly, signal only the CFR BW as #PRBs (as captured in current CR): [1], [4], [6], [7]
* Value of *locationAndBandwidthBroadcast* (either obtained from *locationAndBandwidth* or from broadcast gNB’s SIB1 depending on what is signalled) encoded as INTEGER (0..37949): [2], [5], [9]
* Value of *carrierBandWidth* if CFR info not available (with clarification that it is as defined in *SCS-SpecificCarrier* corresponding to the indicated SCS): [9]
* Depends on what *carrierFreqMBS* in FreqInfoMBS-r18 means; *locationAndBandwidth* as well as *pointA* may be needed: [3]

Based on the papers, it seems different companies have different view mostly based on how they interpret what *carrierFreqMBS* in the current running CR refers to.

It seems most of the companies share the view that knowledge of the location of the CFR is needed; but the argument seems to be whether it needs to be explicitly signalled on top of what is already captured.

If *carrierFreqMBS* refers to center of CFR, then CFR of location info would not be needed. If *carrierFreqMBS* refers to center of the carrier, there would be need of additional offset of starting RB to center of CFR to know the CFR location. If *carrierFreqMBS* refers to point A, then there would be need of addition offset of starting RB wrt point A to know the CFR location.

Following are potential discussion points during the meeting:

**[Discussion point 1] Clarify further what *carrierFreqMBS* in the running CR refers to: whether that relates to broadcast gNB’s whole band where MBS service is provided, or only the CFR for broadcast; and further whether that is centre or the absolute start position, taking into account what information can be available in USD.**

**[Discussion point 2] Considering the outcome of discussion point 1, what additional information is required for MII for shared processing compared to parameters already captured in the running CR.**

## Proposals for potential easy agreements

[1] proposes that UE initiates the MII reporting for the non-serving cell upon stopping the reception of all the broadcast services from a non-serving cell, and provides a TP for RRC running CR section 5.9.4.2.

**Rapporteur’s view: this is a good suggestion and seems potentially easy to agree.**

[4] brings up the case that the unicast gNB may not be providing SIB21 or USD but those may instead be received from non-serving cell, therefore the procedural text needs to be corrected to include such case. The paper also provides a TP in annex.

**Rapporteur’s view: this is a valid concern and suggested TP makes sense. This seems like a potentially easy to agree.**

## Other/Misc Proposals

[3] proposes to introduce network response, after MII reporting by the UE, to control whether the UE is allowed to receive broadcast service from the non-serving cell. The paper further proposes to consider how to solve resource collision between unicast and broadcast due the potentially conflicting (re)configuration from the unicast serving gNB.

**Rapporteur’s view:** The intention of the WI objective is not to control the UE’s reception from other non-serving cell, but rather enable the UE to report the capability sharing information to the unicast gNB so that unicast gNB can take that into account.

[7] observes according to current specification FSPC supporting broadcast reception in non-serving cell from a different PLMN cannot be reported for a band combination in UE capability, and proposes to have additional network control whether a frequency band specifically for MBS reception from non-serving cell of inter-PLMN is allowed to be reported in band combinations.

**Rapporteur’s view:** RAN2#122 previously agreed that no additional network control is needed other than finalizing the exact signalling for the MII parameters from earlier agreements.

[8] observes shared processing scenario should not be limited to unicast + broadcast but should include multicast (from serving cell) + broadcast from non-serving cell, as there seems to be no additional spec impact, and asks RAN2 to confirm. Further, [8] also proposes RAN2 to discuss the impact of Rel-18 support of multicast reception in RRC\_INACTIVE on the shared processing due e.g. to UE mobility in RRC\_INACTIVE.

**Rapporteur’s view:** multicast from serving cell + broadcast from non-serving cell does not seem to be within the scope of the current WI objective.

[8] observes supporting shared processing by a 1Rx/1Tx UE can reuse Rel-17 MUSIM gap and proposes RAN2 to discuss and agree scenario of 1Rx/1Tx which can be supported with additional minimal enhancements to MII signalling.

**Rapporteur’s view**: RAN2 during one the initial meetings of Rel-18 ruled out any enhancements for single 1Rx UEs. “RAN2 focuses on solutions taking multi-Rx UEs (i.e. no specific enhancements for 1Rx UEs).

**Summary**: Rapporteur suggestion is to deprioritize the proposals in this section as either they were excluded by previous agreements or WI scope. These can be discussed based on the contributions based on available discussion time.

# Summary and Proposals

As discussed above, following is proposed as the summary:

[For potentially easy agreements]

**Proposal 1: UE initiates the MII reporting for the non-serving cell upon stopping the reception of all the broadcast services that UE were receiving on a non-serving cell (TP in R2-2309559 can be taken as baseline).**

**Proposal 2: For Rel-18 MII reporting, frequency of interest determination is amended to add a condition that at least one of the MBS sessions is from non-serving cell for the concerned frequency included in SIB21 and/or USD from the non-serving cell (TP in R2-2310088 can be taken as baseline).**

[For discussion]

**Proposal 3: [Discussion point 1] Clarify further what *carrierFreqMBS* in the running CR refers to: whether that relates to broadcast gNB’s whole band where MBS service is provided, or only the CFR for broadcast; and further whether that is centre or the absolute start position, taking into account what information can be available in USD.**

**Proposal 4: [Discussion point 2] Considering the outcome of discussion point 1, what additional information is required for MII for shared processing compared to parameters already captured in the running CR.**

**[Lower priority proposals, can consider if time allows]**

From [3]

Proposal 3: Introduce a network response to control the UE of whether it is allowed to receive broadcast service from other non-serving cell after MII reporting.

Proposal 4: RAN2 is suggested to consider how to solve resource collision between unicast and broadcast happens again upon the reception of new (updated) configuration for unicast.

From [7]

Proposal 2: The gNB indicates whether a frequency band specifically for MBS reception from non-serving cell of inter-PLMN is allowed to be reported in band combinations.

From [8]

Proposal 1: RAN2 to confirm whether shared processing in RRC\_CONNECTED can also involve multicast service reception in RRC\_CONNECTED in the serving cell while receiving broadcast service from non-serving cell.

Proposal 2: RAN2 is kindly requested to discuss the impact of Rel-18 support for multicast reception in RRC\_INACTIVE on MBS Shared Processing, due to UE mobility in RRC\_INACTIVE.

Proposal 3: RAN2 is kindly requested to agree to support single Rx/single Tx UE configuration also for shared processing in RRC\_CONNECTED in Rel-18 and reuse the Rel-17 MUSIM gap solution with some additional minimal enhancements to MII signalling.

# References

[1] [RP-221458](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_96/Docs/RP-221458.zip), Revised WID: Enhancements of NR Multicast and Broadcast Services, CATT, CBN, June 2022

# Annex: List of observations and Proposals

|  |  |
| --- | --- |
| **Reference** | **Observations/Proposals** |
| [1] | Proposal 1: Clarify that the frequency (i.e., one of the agreed parameters) reported for shared processing is the absolute start position of the CFR of the non-serving cell.  Proposal 2: The “location” in the CFR configuration (i.e., locationAndBandwidthBroadcast-r17) of the non-serving cell is not reported by UE.  Proposal 3: UE initiates the MII reporting for the non-serving cell upon stopping the reception of all the broadcast services that UE were receiving on a non-serving cell. |
| [2] | Observation 1: The location of broadcast CFR bandwidth has no further help for RF adjustment or scheduling decision.  Proposal 1: RAN2 to agree that parameter *locationAndBandwidth* is reused to indicate the bandwidth of broadcast CFR. |
| [3] | Proposal 1: if the frequency information in MII means the central location of broadcast reception from non-serving cell (as like LTE way), only to provide bandwidth (e.g., the number of PRB) is enough.  Proposal 2: if the frequency information in MII means the central location of broadcast cell band, more information should be further considered, e.g., locationAndBandwidth, pointA.  Proposal 3: Introduce a network response to control the UE of whether it is allowed to receive broadcast service from other non-serving cell after MII reporting.  Proposal 4: RAN2 is suggested to consider how to solve resource collision between unicast and broadcast happens again upon the reception of new (updated) configuration for unicast. |
| [4] | Proposal 1: For Rel-18 MII reporting, MII procedure for frequency of interest determination is amended to consider a condition that at least one of the MBS sessions is from non-serving cell for the concerned frequency included in SIB21 and/or USD from the non-serving cell (Adopt TP#1 in annex).  Proposal 2: For Rel-18 MII reporting, UE reports CFR bandwidth (number of PRBs) without the location information. |
| [5] | Proposal 1: location of the CFR should be reported in MII for broadcast reception from non-serving cell.  Proposal 2: *locationAndBandwidthBroadcast* can be used to indicate the bandwidth and location A of CFR used for broadcast reception from non-serving cell. |
| [6] | Observation 1: If RAN2 includes the PRB location (i.e. *locationAndBandwidth*) of CFR for the shared capability reporting, the lowest subcarrier ARFCN of PRB#0 needs to be included.  Observation 2: *freqInfoMBS*, *bandwidthMBS* and *subcarrierSpacing* are sufficient for locating the operating frequency range for receiving MBS.  Proposal: When the *bandwidthMBS* (i.e. number of PRBs) and *subcarrierSpacing* are reported, the *freqInfoMBS* (i.e. ARFCN and band) represents the central frequency for MBS reception. No extra signalling for frequency location is needed. |
| [7] | Observation 1: The serving gNB determines which FSPC can be used for broadcast reception of non-serving cell according to the MII.  Proposal 1: CFR bandwidth is reported by PRB number in the MII, and there is no need to indicate other information about the “location” of CFR than the agreed frequency information (i.e. *FreqBandIndicatorNR* and *ARFCN-ValueNR*).  Observation 2: According to the current spec, the FSPC supporting broadcast reception in a non-serving cell from a different PLMN cannot be reported for a band combination in UE capability.  Proposal 2: The gNB indicates whether a frequency band specifically for MBS reception from non-serving cell of inter-PLMN is allowed to be reported in band combinations. |
| [8] | Observation 1: Shared processing where UE receives multicast service in serving cell and broadcast service from non-serving cell is a possible scenario. There are no additional specification impacts to support such a scenario.  Proposal 1: RAN2 to confirm whether shared processing in RRC\_CONNECTED can also involve multicast service reception in RRC\_CONNECTED in the serving cell while receiving broadcast service from non-serving cell.  Proposal 2: RAN2 is kindly requested to discuss the impact of Rel-18 support for multicast reception in RRC\_INACTIVE on MBS Shared Processing, due to UE mobility in RRC\_INACTIVE.  Observation 2: Support of shared processing by a single Rx/single Tx UE in two serving cells can reuse the Rel-17 MUSIM gap solution with minimal enhancements to MBS Interest Indication signalling to indicate to the broadcast cell any limitations in gap configuration, DRX on duration and MCCH transmission window duration and allow the cell providing the broadcast service to adapt to the limitation of a single Rx/single Tx UE.  Proposal 3: RAN2 is kindly requested to agree to support single Rx/single Tx UE configuration also for shared processing in RRC\_CONNECTED in Rel-18 and reuse the Rel-17 MUSIM gap solution with some additional minimal enhancements to MII signalling. |
| [9] | 1. For bandwidth information in the MII for shared processing, UE reports CHOICE of the actual value of *locationAndBandwidthBroadcast-r17* (either obtained from *locationAndBandwidth* or from broadcast gNB’s SIB1 depending on what is signalled) encoded as INTEGER (0..37949), or *carrierBandwidth* signalled by broadcast gNB as defined in *SCS-SpecificCarrier* corresponding to the indicated SCS (encoded as INTEGER (1..*maxNrofPhysicalResourceBlocks*)), based on the availability at the UE. |