3GPP TSG-RAN WG2 #115-e R2-21xxxxx

Online, 16-27 August 2021

Agenda Item: xx

Source: Xiaomi Communications

**Title: Summary of [Post114-e][073][MBS] Service continuity for Delivery Mode 2 (Xiaomi)**

Document for: Discussion, decision

# 1 Introduction

This document is a report on the following email discussion, initiated after RAN2#114-e:

* [Post114-e][073][MBS] Service continuity for Delivery Mode 2 (Xiaomi)

Scope: Service continuity for Delivery Mode 2, including cell selection/reselection prioritization, The need for enablers for connected mode including MBS interest indication

Intended outcome: Report

Deadline: Long

Email discussion deadline: August 5th, 0900 UTC

Note: silent period is July 5-30 (may be updated during TSG RAN)

The email discussion deadline for company feedbacks is one day earlier than the tdoc submission deadline (i.e. August 6th) of RAN2#115-e, so as to allow the email discussion rapporteur to have extra time to provide the summary of the email discussion.

In general, the function of service continuity of MBS reception is to keep the UE in the cell/frequency where the MBS service(s) of UE interest is provided when the UE moves from one cell to another, as not all frequencies or cells will provide the MBS service(s) of UE interest. In LTE, the IDLE/CONNECTED service continuity of MBMS service is based on the MBS service continuity information provided by the eNB and the UE. The UE (which could be capable of receiving MBMS service via serving cell or non-serving cell) is allowed to prioritize a MBMS frequency in IDLE when the UE can only receive the MBMS service while camping on the frequency on which the MBMS service is provided, and is allowed to indicate the MII (i.e. *MBMSInterestIndication*) message in CONNECTED when the UE is able to receive the MBMS service(s) simultaneously on the corresponding MBMS frequencies. According to the NR MBS discussion, the RAN2 agreements related to the service continuity of the Delivery Mode 2 are listed as follows:

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| RAN2#113e meeting agreements:   * 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). * MBS Interest Indication is NOT supported for UEs in idle/inactive mode for NR MBS delivery mode 2. * Assume that some information for purpose of service continuity can be provided for NR MBS delivery mode 2. (FFS what - need to be revisited, e.g. based on progress in other groups, e.g. USD, SAI/TMGI etc) * FFS whether support UE awareness of MBS services on frequency basis for service continuity for NR MBS delivery mode 2 (i.e. Reuse LTE SC-PTM mechanism). * FFS Support frequency prioritization during cell reselection for service continuity for NR MBS delivery mode 2 (i.e. Reuse LTE SC-PTM mechanism). |

# 2 Contact Points

Respondents to the email discussion are kindly asked to fill in the following table.

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| Company | Name | Email Address |
| Xiaomi (rapporteur) | Yumin Wu | wuyumin@xiaomi.com |
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# 3 Discussion

## 3.1 IDLE/INACTIVE service continuity

### 3.1.1 Cell reselection priority

According to the IDLE UE mobility for LTE SC-PTM [20], the UE can autonomously set the MBS frequency as the highest priority, when following 2 conditions are all fulfilled:

* Condition 1: The reselected cell is broadcasting MBS SIB (i.e. LTE SIB20) carrying MCCH configuration.
* Condition 2: when either of the following conditions is fulfilled:
  + Condition 2.1: If MBS service continuity information is provided in SIB (i.e. LTE SIB15), the SAI associated with the MBS frequency indicated in MBS SIB matches the SAI associated with the same MBS frequency indicated in USD.
  + Condition 2.2: If MBS service continuity information is not provided in SIB (i.e. LTE SIB15), the MBS frequency is provided in USD.

The MBS service continuity information in LTE SIB15 provides the mapping between the SAI and the MBS frequency. In general, the IDLE/INACTIVE service continuity for MBS reception should allow the UE to autonomously prioritize the MBS frequency.

#### Question 1: Is the UE allowed to prioritize the MBS frequency of interest **ONLY** when the reselected cell provides MBS SIB carrying the MCCH configuration, as LTE SC-PTM?

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Figure 2: IDLE/INACTIVE UE MBS reception capability

According to the LTE SC-PTM, the IDLE UE can optionally receive MBS on non-serving cell. Alike the LTE SC-PTM, the IDLE/INACTIVE UE of NR could have the following two different reception capabilities for MBS:

* Type-1 capability (i.e. serving cell reception of MBS) of IDLE UE: The UE can only receive the MBS service while camping on the MBS frequency of interest
* Type-2 capability (i.e. non-serving cell reception of MBS) of IDLE UE: The UE can camp on another frequency while receiving MBS services on the MBS frequency simultaneously.

For Type-1 UE, the UE is required to prioritize the MBS frequency as the UE can only receive the MBS service by camping on the MBS frequency of interest. For Type-2 UE, the UE does not need to prioritize the MBS frequency when the UE camping on another frequency can receive the MBS via the non-serving MBS frequency of interest.

#### Question 2: Is the IDLE/INACIVE UE allowed to prioritize the MBS frequency of interest when the UE is only capable of receiving the MBS service by camping on the MBS frequency, as LTE SC-PTM?

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According to LTE SC-PTM [20], the UE is allowed to set “cell reselection candidate frequencies at which it cannot receive the MBMS service to be of the lowest priority during the MBMS session”. As such the MBS frequency of interest would have the highest frequency compared with other frequencies.

#### Question 3: Is the IDLE/INACIVE UE allowed to set cell reselection candidate frequencies at which it cannot receive the MBS service to be of the lowest priority during the MBS session, as LTE SC-PTM?

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### 3.1.2 Assistance information for service continuity



Figure 1: Determination of MBS frequency of interest

Although this discussion is under the section for the IDLE/INACTIVE service continuity, the assistance information provided by the gNB or upper layer can be used for both IDLE/INACTIVE service continuity and CONNECTED service continuity.

For the IDLE/INACTIVE service continuity, after selecting its interested MBS service (e.g. LTE TMGI) by using the USD (User Service Description) file which provides the SAI and the frequency of the MBS service, the UE knows the SAI and the frequency of its interested MBS service. For Condition 2.1, to support the prioritization of MBS frequency, the gNB provides the mapping between frequency and MBS service via SIB15. The UE determines its MBS frequency of interest when the SAI and the frequency of the USD match the SAI and the frequency of SIB15. For Condition 2.2, as the gNB does not provide the SIB15, the UE determines its MBS frequency of interest only based on the MBS frequency information provided in the USD. According to the LTE MBMS service continuity discussion, the SAI and the frequency information in USD was determined and asked by RAN2. As an example, the mapping between frequency (including intra-frequency and inter-frequency) and MBS service in LTE SIB15 is quoted as follows:

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| 36.331:  mbms-SAI-IntraFreq-r11 MBMS-SAI-List-r11 OPTIONAL, -- Need OR  mbms-SAI-InterFreqList-r11 MBMS-SAI-InterFreqList-r11 OPTIONAL, -- Need OR |

#### Question 4: Is the mapping between frequency and MBS service provided in upper layer signalling (e.g. USD), as LTE SC-PTM?

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#### Question 5: Is the mapping between frequency and MBS service provided in SIB, as LTE SC-PTM?

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To enable the service continuity for IDLE/INACTIVE/CONNECED UE, the network needs to provide the MBS service continuity information (i.e. mapping between SAI and frequency) via SIB. In LTE SC-PTM, SIB15 is designed independently from other MBMS related SIBs to only carry the mapping between SAI and frequency, which can be used to control the MII reporting for the CONNECTED UE. Note that even cells not supporting/deploying LTE eMBMS transmission can also broadcast SIB15 and then allow the UE to report MII for service continuity purpose. If the NR MBS service continuity information is not carried in an independent SIB, RAN2 may need to find another way to broadcast the information for the cell not supporting MBS transmission.

#### Question 6: Is the mapping between frequency and MBS service allowed to be sent in cells not supporting MBS transmission, as LTE SC-PTM?

(This question is provided by assuming that the mapping between frequency and MBS service is provided via SIB.)

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#### Question 7: Is the mapping between frequency and MBS service provided in a new SIB different from the MBS SIB providing the MCCH configuration, as LTE SC-PTM?

(This question is provided by assuming that the mapping between frequency and MBS service is provided via SIB.)

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[1] proposes to use a group ID (alike LTE SAI) of MBS services in SIB and USD for the UE to determine its interested MBS frequency. From rapporteur’s understanding, if we provide the TMGI information in SIB, the SIB not supporting segmentation may not be able to contain a large number of TMGIs, as the size of one TMGI could be more than 48bits as quoted below.

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| 36.331:  TMGI-r9 ::= SEQUENCE {  plmn-Id-r9 CHOICE {  plmn-Index-r9 INTEGER (1..maxPLMN-r11),  explicitValue-r9 PLMN-Identity  },  serviceId-r9 OCTET STRING (SIZE (3))  } |

#### Question 8: Is a group ID (alike LTE SAI) of MBS services needed in SIB and USD, as LTE SC-PTM?

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As mentioned in [1], the SC-MCCH message in LTE “indicates a list of neighbour cells where ongoing MBMS sessions provided via SC-MRB in the current cells are also provided” [21]. When the UE reselects to a neighbour cell not providing the UE’s interested MBS service, the IDLE UE may decide to trigger RRC connection establishment in advance, so as to reduce the service interruption.

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| 36.331:  SCPTM-NeighbourCellList-r13 ::= SEQUENCE (SIZE (1..maxNeighCell-SCPTM-r13)) OF PCI-ARFCN-r13  PCI-ARFCN-r13 ::= SEQUENCE {  physCellId-r13 PhysCellId,  carrierFreq-r13 ARFCN-ValueEUTRA-r9 OPTIONAL  } |

#### Question 9: Can the gNB indicate a list of neighbour cells where ongoing MBS service provided in the current cells are also provided, as LTE SC-PTM?

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## 3.2 CONNECTED service continuity

### 3.2.1 Content of MII

According to the LTE SC-PTM [21], the CONNECTED UE could indicate the following information via the *MBMSInterestIndication*:

* mbms-FreqList-r11 (a list of frequencies): MBS frequency(ies) of interest
* mbms-Priority-r11 (1bit per UE): Reception priority between MBS reception and unicast reception
* mbms-Services-r13 (a list of TMGI(s)): MBS service(es) of interest

For mbms-FreqList-r11, the frequency is determined when the SAI of the frequency in the SIB matches the SAI in the USD. For mbms-Priority-r11, the priority between MBS reception and unicast reception is indicated when the UE is not able to receive MBS bearer and unicast bearer simultaneously due to the limited UE processing capability. For mbms-Services-r13, the MBMS service ID (i.e. TMGI) is indicated as a supplement information to mbms-FreqList-r11. The TMGI is determined when the SAI of the TMGI in USD matches the SAI in SIB.

#### Question 10: Which of the following MBS interest information is indicated by the CONNECTED UE?

* Option 1: MBS frequency, as LTE SC-PTM
* Option 2: priority between MBS bearer and unicast bearer, as LTE SC-PTM
* Option 3: MBS service ID (i.e. TMGI), as LTE SC-PTM
* Option 4: Other information

(Multiple selection is allowed. Companies selecting Option 4 are encouraged to provide the information details in the “Comments” column.)

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| **Company** | **MBS frequency**  **(Yes/No)** | **Priority between MBS and unicast**  **(Yes/No)** | **TMGI**  **(Yes/No)** | **Other Information**  **(Yes/No)** | **Comments** |
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According to LTE SC-PTM, when the UE indicates a list of frequencies, the gNB may not be able to configure all frequencies for the UE, due to the different radio conditions (e.g. congestion) on different frequencies. Then the frequencies indicated via MII is sorted by decreasing order of interest.

#### Question 11: Is the MBS frequencies indicated sorted by decreasing order of interest, as LTE SC-PTM?

(This question is provided by assuming that the frequencies are indicated in MII.)

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According to the LTE SC-PTM, when indicating the support of *scptm-NonServingCell-r13*, the CONNECTED UE can include the non-serving frequency(ies) in the MII message, when the serving frequency(ies) and the non-serving frequency(ies) belong to the same *supportedBandCombination*. The support of *scptm-NonServingCell-r13* reuses the CA capability (i.e. *supportedBandCombination* and network synchronization properties of CA) as the baseline for the MBS reception of non-serving cell. When indicating the support of *scptm-AsyncDC-r13*, the UE reuses the async-DC capability (i.e. *supportedBandCombination* and network synchronization properties of aync-DC in which the MCG and the SCG are not synchronized) as the baseline for the MBS reception of non-serving cell. Thus if the UE is capable of receiving MBS via non-serving cell, the gNB does not need to configure the UE with the serving cell for MBS reception when the gNB receives the MII indicating the MBS reception interest of a non-serving frequency. When the UE reports a list of frequencies in MII, the set of MBS frequencies of interest needs to fulfil the following conditions:

* Condition 1: The UE is capable of simultaneously receiving MBS on the set of MBS frequencies of interest.
* Condition 2: At least one band combination includes the set of MBMS frequencies of interest.

#### Question 12: When a list of frequencies are indicated in MII, should the UE be capable of simultaneously receiving MBS on the set of MBS frequencies of interest (regardless of whether a serving cell is configured on each of these frequencies or not), as LTE SC-PTM?

(Note that the capability bit for the non-serving cell reception of MBS can be discussed separated from this question.)

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#### Question 13: When a list of frequencies are indicated in MII, should the set of MBS frequencies of interest be part of a band combination of the UE, as LTE SC-PTM?

(The band combination in the above question refers to the UE capability signaling of *supportedBandCombination*.)

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### 3.2.2 MII reporting

Regarding the RRC message used to indicate the UE interest of MBS, we could have the following options:

* Option 1: *UEAssistanceInformation*
* Option 2: New RRC message (e.g. a new *MBSInterestIndication* message)
* Option 3: *RRCSetupComplete* [5]
* Option 4: *SecurityModeComplete* [5]

From the rapporteur’s understanding, it is technically feasible to re-use the *UEAssistanceInformation* message to carry the MBS interest information, and re-using the *UEAssistanceInformation* message would also save some standard efforts as many other information from the UE are also reported via the same message. Besides Option 1, [2] claims that Option 3 can be used to avoid the service interruption due to the BWP switching after the gNB receives *RRCSetupComplete*, as the gNB which does not know the UE’s MBS interest may change the UE’s active BWP (which provides the MBS service of UE interest) to another one (which does not provide the MBS service of UE interest).

#### Question 14: Which message is used to indicate MII?

* Option 1: *UEAssistanceInformation*
* Option 2: New RRC message (e.g. *MBSInterestIndication*)
* Option 3: *RRCSetupComplete* [5]
* Option 4: *SecurityModeComplete* [5]

(Multiple selection is allowed for the above options.)

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In LTE SC-PTM, the MII can be reported (unprotected) prior to security activation. [1] indicates that the MBS services that UEs are receiving or interested in are confidential, and then the MII should be reported after security activation.

#### Question 15: Can the MII be reported prior to security activation?

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## 3.3 Other issues

For the cell ranking criterion during the cell reselection procedure, [4] proposes to introduce an extra offset to the cell where the MBS service is provided. Then the UE applies the offset only to the cells which provide UE interested MBS services, rather than to all cells on the frequency with highest priority.

#### Question 16: Is the extra offset to cell (which provides the MBS service) needed for the cell ranking criterion?

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# 6 Conclusions

**Rapporteur’s Observation: An LS to RAN1 is expected to discuss the UE capability details on the simultaneous broadcast/multicast/unicast reception on single/multiple cells/frequencies and on the non-serving cell after RAN2 determines the MBS reception requirements for IDLE/INACTIVE/CONNECTED.**

**Rapporteur’s Observation 2: An LS to SA2, SA4 and RAN3 is expected after RAN2 determines the required content in USD and SIB.**

**Rapporteur’s Observation 3: An LS to SA3 may also be needed to confirm the understanding on the security protection on MII reporting if RAN2 agrees to send MII unprotected before security activation.**

Based on the discussion in the above section, we propose the following outcomes:

**Potential easy agreements:**

**Other proposals:**

# 7 References

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2. [R2-2105653](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_114-e\Docs\R2-2105653.zip) Open issues broadcast Ericsson discussion Rel-17 NR\_MBS-Core R2-2103517
3. [R2-2104757](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_114-e\Docs\R2-2104757.zip) Further Discussion on delivery mode 2 CATT, CBN discussion Rel-17 NR\_MBS-Core
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5. [R2-2104937](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_114-e\Docs\R2-2104937.zip) Discussion on MBS interesting indication and service continuity for delivery mode 2 OPPO discussion Rel-17 NR\_MBS-Core R2-2102894
6. [R2-2104984](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_114-e\Docs\R2-2104984.zip) On NR MBS operation in Idle/Inactive mode Samsung discussion
7. [R2-2105007](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_114-e\Docs\R2-2105007.zip) MCCH Configuration and messaging in MBS delivery mode 2 Futurewei discussion Rel-17 NR\_MBS-Core R2-2103152
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9. [R2-2105288](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_114-e\Docs\R2-2105288.zip) Open Issues for Delivery mode 2 vivo discussion Rel-17 NR\_MBS-Core
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11. [R2-2105439](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_114-e\Docs\R2-2105439.zip) Discussion on Multicast Control Channel Scheduling Configurations for Delivery Mode 2 TCL Communication Ltd. discussion Rel-17
12. [R2-2105511](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_114-e\Docs\R2-2105511.zip) Control plane aspects for delivery mode 2 in NR MBS Kyocera discussion Rel-17 R2-2103372
13. [R2-2105552](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_114-e\Docs\R2-2105552.zip) Discussion issues on delivery mode2 Spreadtrum Communications discussion Rel-17 NR\_MBS-Core
14. [R2-2105728](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_114-e\Docs\R2-2105728.zip) Service continuity for delivery mode 2 Xiaomi Communications discussion Rel-17 NR\_MBS-Core R2-2104230
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16. [R2-2105914](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_114-e\Docs\R2-2105914.zip) MBS support for RRC\_IDLE/INACTIVE Intel Corporation discussion Rel-17 NR\_MBS-Core
17. [R2-2106242](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_114-e\Docs\R2-2106242.zip) Discussion on delivery mode 2 remaining issues cmcc discussion Rel-17 NR\_MBS-Core
18. [R2-2106350](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_114-e\Docs\R2-2106350.zip) MBS in IDLE/INACTIVE LG Electronics Inc. discussion Rel-17 NR\_MBS-Core
19. [R2-2104936](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_114-e\Docs\R2-2104936.zip) Discussion on beam sweeping transmission for delivery mode 2 OPPO discussion Rel-17 NR\_MBS-Core R2-2102893
20. 3GPP TS 36.304, “Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) procedures in idle mode”.
21. 3GPP TS 36.331, “Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC)”.