**3GPP TSG RAN WG1 #103-e R1-200XXXX**

**e-Meeting, October 26th – November 13th, 2020**

**Agenda item: 8.12.3**

**Source:** Moderator (BBC)

**Title:** Feature lead summary on RAN basic functions for broadcast/multicast for UEs in RRC\_IDLE/ RRC\_INACTIVE states

**Document for:** Discussion and Decision

# Introduction

During TSG RAN #86, 3GPP approved a Release-17 Work Item (WI) to introduce support for Multicast and Broadcast Services in NR (NR MBS) [1]. The NR MBS WI includes the following objective:

|  |
| --- |
| * Specify RAN basic functions for broadcast/multicast for UEs in RRC\_IDLE/ RRC\_INACTIVE states [RAN2, RAN1]:   + Specify required changes to enable the reception of Point to Multipoint transmissions by UEs in RRC\_IDLE/ RRC\_INACTIVE states, with the aim of keeping maximum commonality between RRC\_CONNECTED state and RRC\_IDLE/RRC\_INACTIVE state for the configuration of PTM reception. [RAN2, RAN1].   Note: the possibility of receiving Point to Multipoint transmissions by UEs in RRC\_IDLE/ RRC\_INACTIVE states, without the need for those UEs to get the configuration of the PTM bearer carrying the Broadcast/Multicast service while in RRC CONNECTED state beforehand, is subject to verification of service subscription and authorization assumptions during the WI. |

In this document the Feature Lead (FL) provides a summary of the technical documents (tdocs) submitted to RAN1#103-e to the Agenda Item (AI) 8.12.3 on Basic functions for broadcast/multicast for RRC\_IDLE/ RRC\_INACTIVE UEs. The AI 8.12.3 was not treated at RAN1#102-e meeting. Hence, this is the first meeting that discusses this AI.

Based on tdocs inputs, key issues are identified, analysed and a set of initial proposal by the FL are presented in Section 2. Section 3, includes a summary of the key issues and a first order prioritisation proposal by the FL on the issues to be addressed at RAN1#103-e. This prioritisation proposal can be discussed by email and at the online GTW sessions planned for the NR Multicast and Broadcast Services WI during RAN1#103-e.

# Issues

The order of issues presented in this section do not imply a specific prioritisation nor do imply that some issues are more important than others.

## Issue 1: Group scheduling for UEs in RRC\_IDLE/ RRC\_INACTIVE states

This issue has been discussed/mentioned in 7 tdocs (8 companies). At RAN1#102-e it was agreed that for RRC\_CONNECTED UEs, at least support group-common PDCCH with CRC scrambled by a common RNTI to schedule a group-common PDSCH, where the scrambling of the group-common PDSCH is based on the same common RNTI. This issue addresses group scheduling for UEs in RRC\_IDLE/ RRC\_INACTIVE states.

In particular:

* In [3, Chengdu TD Tech Ltd] for periodic scheduling, it proposed to support that the PDCCH with CRC scrambled with SPS G-RNTI is used to activate/de-activate the SPS PDSCH resource. For dynamic scheduling, it is proposed to support that the PDCCH with CRC scrambled with G-RNTI is transmitted with the allocated PDCCH resource and the PDSCH with G-RNTI used in the bit scrambling is transmitted with the allocated PDSCH resource.
* [6, CMCC] proposes the support of group-common PDCCH based group scheduling for RRC\_IDLE/ RRC\_INACTIVE UEs for MBS service reception.
* In [7, LGE] group scheduling of MBS data is discussed. Here it is discussed that a UE should be provided one or more search space sets in which the UE monitors PDCCH candidates to detect DCI with Group RNTI.
* In [8, Samsung] it is proposed that high layer signalling delivers CORESET for multicast and group-specific RNTI.
* In [12, Lenovo, MotoM] it is proposed to support a group-common DCI to schedule a group-common PDSCH for MBS for Idle/Inactive UEs.
* [13, Intel] proposes that RRC\_IDLE/INACTIVE UEs can be configured with a common MBS frequency resource and MBS CORESET within the common frequency resource by SIB where it can monitor the group common PDCCH within a CSS.
* In [16, Ericsson] it is observed that for Idle/Inactive UEs to receive the RRC Connected multicast transmission they need to reuse the RRC connected configuration, e.g. using the same G-RNTI. UEs in Idle/Inactive mode could use this to monitor the G-RNTI-based PDCCH and get the scheduling of the G-RNTI-based PDSCH, using the same processing as Connected UEs.

In the contributions above, the 7 inputs (8 companies) propose and/or discuss the support of group-common PDCCH based group scheduling for UEs in RRC\_IDLE/RRC\_INACTIVE sates.

Based on the above the FL makes the following proposal:

### **Initial FL proposal for Issue 1**

**Proposal 1:** For RRC\_IDLE/RRC\_INACTIVE UEs, support group-common PDCCH with CRC scrambled by a common RNTI to schedule a group-common PDSCH, where the scrambling of the group-common PDSCH is based on the same common RNTI.

## Issue 2: Configuration mechanisms for group scheduling of IDLE/INACTIVE UEs

This issue has been discussed/mentioned in 8 tdocs (11 companies).

Two main approaches have been discussed in the contributions for the configuration of the multicast/broadcast services and the point-to-multipoint transmission configuration. The first approach relies in broadcasting the configuration information in SIBs/MCCH-type channels as standardised for LTE SC-PTM. The second approach transmits the configuration on-demand via dedicated RRC signalling, which requires the UEs to change from RRC\_IDLE/RRC\_INACTIVE state to RRC\_CONNECTED state to receive the dedicated signalling and then change back to RRC\_IDLE/RRC\_INACTIVE state if required. Some technical inputs also discuss system information, transport channels and control channels (i.e., SIBs, MCCH and MTCH) for the configuration and delivery of MBS services. There are also inputs highlighting that no decisions have been made at RAN2 on i) the type of transmission approach for the configuration of MBS and ii) the type of SI, control channels and transport channels for MBS.

In particular:

* In [2, Huawei, HiSilicon] it is proposed that the broadcast (SIB and/or MCCH) based mechanism could be applied as the baseline to enable the MBS configuration for UEs in RRC\_IDLE/ RRC\_INACTIVE states.
* [3, Chengdu TD Tech Ltd] proposes to reuse the LTE SC-PTM mechanisms as per the following proposals (II-UES stand for idle/inactive state UEs):
  + *SC-MTCH is used to carry each RB of the PTM bearer of an MBS for II-UEs.*
  + *SC-MCCH is used to carry the PTM bearer configuration information for the PTM bearer of an MBS for II-UEs.*
  + *A new SIB is used to carry the configuration information of SC-MCCH. The same transmission manner with the medication period and repetition period as in LTE SC-PTM is reused*
  + *PDCCH with CRC scrambled by SC-RNTI I is used to carry the dynamic scheduling information of SC-MCCH.*
  + *The SC-MCCH notification is used to indicate a new MBS session in the NR cell. The SC-MCCH notification is sent by PDCCH with CRC scrambled by SC-N-RNTI.*
* In [5, CATT, CBN] it is proposed that the solution of the PTM configuration acquiring for MBS services (at least for broadcast service) can be discussed based on LTE SC-PTM mechanisms.
* In [6, CMCC] states that the design for RRC\_ IDLE/RRC\_INACTIVE is highly related to RAN2 design, e.g., the PTM configuration is provided using MCCH-like channel or getting the PTM configuration in RRC\_CONNECTED state beforehand. Considering the objectives for RRC\_IDLE/RRC\_INACTIVE states are led by RAN2, [6] thinks this part can be with lower priority for RAN1 and the discussion in RAN1 can be triggered by RAN2 progress and input. Based on this it is proposed that the discussion on basic functions for MBS in RRC\_IDLE/RRC\_INACTIVE states can be lower priority for RAN1 and triggered by RAN2 progress.
* In [7, LGE] first presents the argument that in UMTS/LTE MBMS, the network broadcasts MBMS SIB which carries MBMS specific configuration mainly because idle/inactive UEs as well as connected UEs should be able to receive MBMS transmissions. [7] states that it seems likely to introduce a MBMS SIB for NR MBMS, even though whether to introduce a MBMS SIB seems up to RAN2. [7] has the next two proposals:
  + *Assuming that RAN2 introduces a new MBMS SIB, if UE is interested to receive a MBS TB, UE monitors PDCCH for Type0A-PDCCH CSS set to detect a DCI with SI-RNTI and receive MBMS SIB on PDSCH for a serving frequency.*
  + *Assuming that RAN2 introduces a MCCH, if UE is interested to receive a MBS TB, UE monitors PDCCH for a PDCCH CSS set to detect a DCI with SC-RNTI and receive MCCH information on PDSCH. FFS on which type of PDCCH CSS set is used for MCCH, if supported*
* In [11, Nokia, NSB] it is discussed that it is expected that the RAN1 discussion on the support of support of 5G NR broadcast/multicast services for RRC\_IDLE/INACTIVE UEs mainly depends on the outcome solution of ongoing parallel RAN2/SA2 discussions. [11] presents that RAN2 is discussing solutions for the support of UEs in idle/inactive states, Solutions A and Solution B. While Solutions A reuse the approach that will be defined for the connected state, Solution B is an approach similar to the broadcast type solution supported in LTE SC-PTM. [11] also states that it is also not clear whether RAN2 will define a MCCH-type of channel. Based on this [11] has the following two observations:
  + *There is no conclusion yet on which solution, i.e. Solution-A1, Solution-A2, or Solution-B, is going to be chosen in RAN2 RRC\_IDLE/INACTIVE mode design.*
  + *It is not clear if LTE kind of MCCH will be specified for 5G NR and whether the SC-MCCH is sufficient for NR broadcast only.*
* [13, Intel] makes the proposal that NR MBS uses LTE SC-PTM as the baseline for support of multicast for RRC\_IDLE/INACTIVE UEs wherein MBS control information is provided in MCCH and traffic on MTCH.
* [15, Qualcomm] makes the following proposal:
  + *Define MCCH/MTCH for supporting the broadcast reception.*
    - *SIB is used to provide the configuration of an MCCH. MCCH is carried over PDSCH, which is dynamically scheduled by PDCCH.*
    - *MCCH is used to provide the configuration of one or more MTCHs for broadcast services. MTCH is carried over PDSCH, which is dynamically scheduled by PDCCH.*

From the inputs above, although it is recognised that there are ongoing RAN2 discussions that can affect the RAN1 designs, there are 5 inputs (7 companies) that propose at least using as baseline some of the broadcast-based mechanisms specified in LTE SC-PTM (e.g. SIB and/or MCCH) for the configuration of the MBS services for UEs in RRC\_IDLE/ RRC\_INACTIVE states.

Based on the above the FL makes the following initial proposal:

### **Initial FL proposal for Issue 2**

**Proposal 2**: Subject to RAN2 decision, assume as the baseline to enable the MBS configuration for UEs in RRC\_IDLE/ RRC\_INACTIVE states the broadcast-based mechanism, i.e. SIB and/or MCCH, as specified in LTE SC-PTM.

## Issue 3: Broadcast and Multicast support by UEs in RRC\_IDLE/RRC\_INACTIVE state

This issue has been discussed/mentioned in 5 tdocs (7 companies). The inputs argue whether both multicast and broadcast type of services should supported/considered for UEs in RRC\_IDLE/RRC\_INACTIVE states.

In particular:

* [5, CATT, CBN] proposes that it is necessary for RRC\_IDLE/RRC\_INACTIVE UEs to receive MBS services in NR at least for broadcast service.
* In [11, Nokia, NSB] first discusses that supporting broadcast only in RRC\_IDLE/INACTIVE mode or support multicast only in RRC\_CONNECTED mode may simplify the specification work on RAN2 design a lot by considering the limited working timeframe in Rel-17 MBS. Based on this in [11] it is observed that it is still not clear whether there is the need to support both broadcast and multicast services in RRC\_IDLE/INACTIVE mode.
* In [14, Convida] two proposal are done. The first proposal supports using broadcast to deliver PTM transmission in RRC\_INACTIVE state and in RRC\_IDLE, while the second proposes that further study is needed to evaluate the benefits of using multicast to deliver PTM transmission in RRC\_INACTIVE state and in RRC\_IDLE state.
* [15, Qualcomm] makes two proposals. For the first proposal, multicast reception with high reliable QoS requirement is not supported for UEs in RRC\_IDLE/RRC\_INACTIVE states. For the second proposal, broadcast reception with no specific QoS requirement can be supported for UEs in RRC\_IDLE/INACTIVE/CONNECTED states.
* [16, Ericsson] proposes to study the reception of the same multicast service by UEs in all RRC states for the case when UEs have first been configured in RRC Connected.

In the inputs above for UEs in RRC\_IDLE/ RRC\_INACTIVE states: there are 3 inputs (4 companies) that support broadcast reception, there is 1 input (1 company) that proposes that multicast reception is not supported, and there are 3 inputs (3 companies) that either ask whether multicast reception is needed or propose that further studies are done for the reception of multicast.

Based on the above the FL makes the following initial proposals.

### **Initial FL proposals for Issue 3**

**Proposal 3**: broadcast service reception can be supported for UEs in RRC\_IDLE/INACTIVE/CONNECTED states.

**Proposal 4:** study multicast service reception for UEs in RRC\_IDLE/INACTIVE/CONNECTED states.

## Issue 4: MBS frequency resources of UEs in RRC\_IDLE/ RRC\_INACTIVE states

This issue has been discussed in 14 tdocs (17 companies). This issue addresses the MBS frequency resource for UEs in RRC\_IDLE/ RRC\_INACTIVE states.

In particular:

* [2, Huawei, HiSilicon] proposes that for broadcast (SIB and/or MCCH) based mechanism, the frequency resource of MBS for UE in RRC\_IDLE/ RRC\_INACTIVE states can be the initial BWP or configured via SIB or MCCH.
* In [3, Chengdu TD Tech Ltd] it is first proposed that the frequency range [F1, F2] with the initial DL BWP contained can be set to provide the MBS for II-UEs (II-UEs stand for UEs in RRC\_IDLE/ RRC\_INACTIVE states). The frequency range [F1, F2] can be divided into several II-UE BWPs to lower the power consumption of II-UEs with each II-UE BWP containing the initial DL BWP. [13] also proposes that one or several secondary II-UE BWPs can be configured outside the frequency range [F1, F2] to meet the bandwidth requirement for MBS for II-UE. Each secondary II-UE BWP can not only provide the MBS for II-UEs, but they can also act as the initial DL BWP.
* [4, VIVO] proposes for MBS transmission bandwidth part, the following cases are supported for Rel-17 MBS. Case 1: The MBS transmission is included within the initial BWP. Case 2: The initial BWP is included within the MBS transmission bandwidth.
* [5, CATT, CBN] states that for RRC\_IDLE/RRC\_INACTIVE UEs, the CORESET#0 or the initial BWP can be configured into the mixed BWP. [5] also suggests that each UE should only support one common frequency resource to simplify the operation.
* [6, CMCC] discusses that if Rel-17 MBS service provided for RRC\_IDLE/RRC\_INACTIVE UE(s) is still in initial BWP, the bandwidth may be not enough, especially considering SSB, CORESET 0 and PDSCH associated with SI-RNTI have occupied many resources of initial BWP. Therefore, [6] proposes to further study whether to support a larger BWP used for MBS service reception for RRC\_IDLE/RRC\_INACTIVE UEs.
* In [7, LGE] it is proposed to support MBS transmission/reception based on a new MBS specific BWP as well as the initial/active BWP.
* [8, Samsung] discusses that to allow enough resources for multicast, larger bandwidth is allocated for multicast BWP. Not to have BWP switching between multicast BWP and initial BWP, it is better to have CORESET#0 included in multicast BWP. [8] makes the proposal that a separate BWP is configured for multicast.
* [10, ZTE] proposes that NR MBS supports configuring a MBS-specific DL BWP for MBS transmission for RRC\_IDLE/INACTIVE UEs via SIBx or multicast control information (e.g., carried on MCCH).
* [11, Nokia, NSB] first proposes to discuss if there is enough capacity for SC-MCCH in the initial BWP for RRC\_IDLE/INACTIVE UEs. [11] also observes that for avoiding BWP switching, the SC-MTCH (i.e. group common PDSCH) and SC-MCCH shall be provided in the same BWP. The final proposal in [11] is to discuss how to support BWP operation for RRC\_IDLE/INACTIVE UEs.
* [12, Lenovo, MotoM] first proposes that the group-common DCI is transmitted in CORESET 0 and the group-common PDSCH for MBS is transmitted within initial DL BWP. [12] further provides details on RB numbering and the payload size of frequency domain resource assignment (FDRA) indicator in the DCI.
* [13, Intel] proposes that RRC\_IDLE/INACTIVE UEs can be configured with a common MBS frequency resource and MBS CORESET within the common frequency resource by SIB where it can monitor the group common PDCCH within a CSS.
* [14, Convida] states that in unicast scenario, the initial BWP is used in RRC idle/inactive to support paging delivery, system information delivery, etc. However, if we further consider supporting MBS, the initial BWP may be not enough anymore. Therefore [14] proposes that enhancements on BWP operation are needed to support MBS for UEs in RRC\_IDLE/RRC\_INACTIVE states.
* [15, Qualcomm] proposes that the broadcast BWP can be same as initial BWP by default. FFS more than one Broadcast BWP and/or different Broadcast BWP for MCCH/MTCH(s).
* In [16, Ericsson] it first observed that in RRC Idle/Inactive the UE is required to monitor signalling, such as SIB1 and paging, in the initial BWP. [16] also observes that to avoid BWP switching in RRC Idle/Inactive, when receiving MBS, an RRC Idle/Inactive UE may be configured with a single BWP. Finally, [16] also observes that when an RRC Idle/Inactive UE is configured with a second BWP (may be same as for unicast), different from the initial BWP, and the initial BWP is a subset of that second BWP, the UE may both receive MBS data and monitor the initial BWP signaling without BWP switching.

In the inputs above regarding the common frequency resource to receive MBS data for UEs in RRC\_IDLE/ RRC\_INACTIVE states: 7 inputs (10 companies) support that it can be the initial BWP, 8 inputs (9 companies) support to define a specific MBS BWP, 4 inputs (4 companies) discuss that a specific BWP containing the initial BWP can avoid BWP switching, while 3 inputs (4 companies) propose/suggest to study enhancements to the initial BWP.

Based on the above the FL makes the following initial proposals.

### **Initial FL proposals for Issue 4**

**Proposal 5:** for RRC\_IDLE/RRC\_INACTIVE UEs, the initial BWP can be the default common frequency resource to receive MBS data.

* FFS: one/more MBS specific BWPs where to avoid BWP switching the MBS specific BWP(s) can contain the initial BWP.

## Issue 5: Retransmissions and HARQ feedback for UEs in RRC\_IDLE/ RRC\_INACTIVE states

This issue has been discussed in 7 tdocs (9 companies). This issue addresses the potential support (or not) of reliability and/or spectral efficiency enhancements for UEs in RRC\_IDLE/ RRC\_INACTIVE states by HARQ-feedback retransmissions and/or repetitions with and without UL transmissions.

In particular:

* [2, Huawei, HiSilicon] discusses that for IDLE/INACTIVE state, ACK/NACK based mechanism is hard to be used, but common NACK based mechanism could be one potential solution.
* [4, VIVO] discusses that supporting the uplink feedback of the IDLE/INACTIVE UE for the MBS reception would require lots of standard efforts. Thus, [4] considers that only requiring the CONNECTED UE to provide the feedbacks would be sufficient to ensure the reliability of the MBS transmission in Rel-17. [4] proposes that uplink feedback for MBS reception is not supported for the IDLE/INACTIVE UE.
* [6, CMCC] discusses that if HARQ-ACK feedback is not supported in RRC\_IDLE/RRC\_INACTIVE states, gNB can use conservative MCS and PDSCH repetition to guarantee the reliability requirement of MBS service. [6] also discusses that the efficiency of NACK-only based HARQ-ACK feedback is low, the specification effort is complicated and the final resource utilization may be the same with the method using conservative MCS. Therefore [6] proposes HARQ-ACK feedback in RRC\_IDLE/RRC\_INACTIVE states is not supported.
* [9, OPPO] proposes that for RRC idle and inactive state UEs to provide HARQ feedback in order to meet reliability requirement of MBS application/service. Furthermore, the proposal states that only NACK feedback is needed since the number of RRC idle and inactive state UEs may not be accurately known by the network.
* In [11, Nokia, NSB] it is observed that based on the WID description for Rel-17 MBS [1], it is understood that the reliability improvement is only targeting on the RRC\_CONNECTED UEs, and the reliability improvements for RRC\_IDLE/INACTIVE UEs are beyond the scope of the Rel-17 MBS WI.
* In [13, Intel] it is first proposed that RRC\_INACTIVE/IDLE UEs can support HARQ feedback with NACK-only transmission on a common PUCCH resource configured by 4-bit RMSI indication and selected using the PRI in DCI and the starting CCE index of the PDCCH reception. [13] also discusses that in some cases, the UEs can alternately also retain HARQ configuration from previous connected mode provided they are still camped on the same cell. [13] also proposes that for RRC\_IDLE/INACTIVE UEs, HARQ can be configured on/off by RMSI.
* [16, Ericsson] discusses that when there are HARQ retransmissions sent using G-RNTI, triggered by HARQ feedback from UEs in RRC Connected, also UEs in Idle/Inactive could receive these and benefit from the increased robustness, in the same way as UEs in Connected mode. Therefore, it is observed that UEs in RRC Idle/Inactive can benefit from HARQ retransmissions and PDSCH repetitions, despite not being able to provide feedback.

In the inputs above for UEs in RRC\_IDLE/ RRC\_INACTIVE states: 3 inputs (4 companies) do not support either reliability improvements, HARQ-feedback, or UL feedback; 3 inputs (4 companies) consider/propose HARQ-feedback with NACK-only transmissions; 2 inputs (2 companies) consider that HARQ retransmissions initiated in RRC\_CONNECTED can be received by UEs in RRC\_IDLE/ RRC\_INACTIVE states; and 2 inputs (2 companies) consider PDSCH repetitions.

Based on the above the FL makes the following initial proposals.

### **Initial FL proposals for Issue 5**

**Proposal 6**: for RRC\_IDLE/RRC\_INACTIVE UEs, consider support of NACK-only based HARQ-feedback for multicast and broadcast.

**Proposal 7**: for RRC\_IDLE/RRC\_INACTIVE UEs, consider reception of HARQ retransmissions initiated by UEs in RRC\_CONNECTED state for multicast and broadcast.

**Proposal 8**: for RRC\_IDLE/RRC\_INACTIVE UEs, consider support of PDSCH repetitions for multicast and broadcast.

## Issue 6: Beam sweeping for UEs in RRC\_IDLE/ RRC\_INACTIVE states

This issue has been discussed in 8 tdocs (10 companies). This issue address beam sweeping mechanisms for MBS for UEs in RRC\_IDLE/ RRC\_INACTIVE states.

In particular:

* [2, Huawei, HiSilicon] discusses that beam sweeping mechanism is widely used for common channel transmissions in NR, such as SSB, SI and paging, in order to guarantee the coverage requirement. For example, one paging occasion contains multiple sub-occasions each linked with corresponding SSB index, so a UE only needs to monitor a subset of the sub-occasions for paging. [2] proposes that beam sweeping mechanism and the corresponding monitoring behaviour for multicast scheduling should be considered.
* [3, Chengdu TD Tech Ltd] proposes that the beams for transmitting the SS/PBCH Block are used to transmit the PTM bearer.
* In [4, VIVO] proposes that the MBS PDCCH monitoring occasion is associated with SSB and that the UE is only required to monitor the MBS PDCCH monitoring occasion associated with at least one SSB.
* [5, CATT, CBN] first proposes that multi-beam operation is supported for Rel-17 MBS transmission. [5] also proposes that for saving the frequency resource, the indications of PTP/PTM mode can be based on per-SSB.
* [6, CMCC] proposes that the association between SSB indexes and monitoring occasions for group-common PDCCH scheduling MBS PDSCH can be defined to support beam sweeping in RRC\_IDLE/RRC\_INACTIVE states.
* [10, ZTE] observes that for Rel-15 paging mechanism different UEs are separated into different POs, while for Rel-15 SIBx mechanism different SI messages are separated into different SI-windows. [10] compares paging and SIBx mechanisms and based on their analysis, the SIBx mechanism is more appropriate to Rel-17 broadcast. Hence, [10] proposes to consider beam sweeping mechanism for NR Rel-15 SIBx transmission as the starting point for Rel-17 broadcast.
* [14, Convida] proposes that beam sweeping mechanism can be considered for supporting MBS for UEs in RRC\_IDLE/RRC\_INACTIVE states. The details can be for further study.
* [15, Qualcomm] proposes that the UE may assume that PDCCH/PDSCH for MCCH is QCL’d with SSB or TRS if configured in SIB for broadcast reception.

In the inputs above for UEs in RRC\_IDLE/ RRC\_INACTIVE states: 8 inputs (10 companies) propose/consider the support of beam sweeping for MBS, 6 inputs (8 companies) discuss UE monitoring occasions are associated with a subset of the total SSB indexes, 1 input/company proposes that the UE monitoring and association is based on beam sweeping SIBx procedures, 1 input/company proposes that QCL assumptions based on SSB or TRS are configurable, and 1 input (2 companies) proposes that the PTP/PTM indications can be done per SSB.

Based on the above the FL makes the following initial proposals.

### **Initial FL proposal for Issue 6**

**Proposal 9**: for RRC\_IDLE/RRC\_INACTIVE UEs, beam sweeping is supported for Rel-17 MBS transmissions.

* FFS: UE monitoring occasions are associated with a subset of the total SSB indexes.
* FFS: UE monitoring and association is based on beam sweeping SIBx/paging procedures.
* FFS: QCL assumption based on SSB or TRS based on SIB configuration.
* FFS: PTP/PTM indications can be done per SSB.

## Issue 7: PDCCH Search Space for UEs in RRC\_IDLE/ RRC\_INACTIVE states

This issue has been discussed in 5 tdocs (6 companies). This issue addresses initial aspects of the PDCCH common search spaces for UEs in RRC\_IDLE/ RRC\_INACTIVE states.

In particular:

* [2, Huawei, HiSilicon] discusses that control resource set (CORESET) and related common search space (CSS) set for multicast scheduling should be configured jointly or separately for MCCH and MTCH. If not, the default could be CORESET0 and Type0 CSS set.
* [4, vivo] proposes that the MBS-specific CORESET/searchingSpace can be configured.
* [6, CMCC] proposes that CSS is supported for group-common PDCCH monitoring in RRC\_IDLE/ RRC\_INACTIVE states. [6] also proposes that further study whether to define a new CSS type or reuse current CSS type.
* [7, LGE] proposes that assuming that RAN2 introduces a new MBMS SIB, if UE is interested to receive a MBS TB, UE monitors PDCCH for Type0A-PDCCH CSS set to detect a DCI with SI-RNTI and receive MBMS SIB on PDSCH for a serving frequency. [7] also proposes that assuming that RAN2 introduces a MCCH, if UE is interested to receive a MBS TB, UE monitors PDCCH for a PDCCH CSS set to detect a DCI with SC-RNTI and receive MCCH information on PDSCH where FFS on which type of PDCCH CSS set is used for MCCH, if supported. [7] also proposes to discuss whether to define a new type CSS set or a new MBS specific SS set (e.g. MSS) for group scheduling of MBS data.
* [15, Qualcomm] proposes that a new type of CSS is defined as the SS of PDCCH for MCCH, configured by SIB.

In the inputs above for UEs in RRC\_IDLE/ RRC\_INACTIVE states: 5 inputs (6 companies) support the definition/study of new CSS types, and 3 inputs (4 companies) discuss/propose to reuse existing CSS types.

Based on the above the FL makes the following initial proposals.

### **Initial FL proposal for Issue 7**

**Proposal 10**: for RRC\_IDLE/RRC\_INACTIVE UEs, CSS is supported for group-common PDCCH.

* FFS: reuse current CSS types and/or define a new CSS type.

## Issue 8: CORESET for UEs in RRC\_IDLE/ RRC\_INACTIVE states

This issue has been discussed in 7 tdocs (9 companies). This issue addresses whether new and/or existing control resource set (CORESET) are used for UEs in RRC\_IDLE/ RRC\_INACTIVE states.

In particular:

* [2, Huawei, HiSilicon] discusses that control resource set (CORESET) and related common search space (CSS) set for multicast scheduling should be configured jointly or separately for MCCH and MTCH. If not, the default could be CORESET0 and Type0 CSS set.
* [3, Chengdu TD Tech Ltd] proposes that at least one CORESET and SS group needs to be configured for each II-UE (II-UES stand for idle/inactive state UEs) BWP or each secondary II-UE BWP.
* [4, vivo] proposes that the MBS-specific CORESET/searchingSpace can be configured.
* [8, Samsung] proposes that high layer signalling also delivers CORESET for multicast and group-specific RNTI.
* [12, Lenovo, MotoM] proposes that the group-common DCI is transmitted in CORESET 0 and the group-common PDSCH for MBS is transmitted within initial DL BWP.
* [13, Intel] proposes that RRC\_IDLE/INACTIVE UEs can be configured with a common MBS frequency resource and MBS CORESET within the common frequency resource by SIB where it can monitor the group common PDCCH within a CSS.
* [15, Qualcomm] discusses that CORESET for MCCH can be same as CORESET0 by default. It is possible to configure the CORESET for MCCH by SIB. CORESET for brodcast MTCH can be CORESET0 or configured by MCCH within the Broadcast BWP. [15] proposes that CORESET of PDCCH for MCCH can be same as CORESET0 by default.

In the inputs above for UEs in RRC\_IDLE/ RRC\_INACTIVE states:7 inputs (9) companies discuss/support defining a MBS CORESET, where 3 inputs (4 companies) state that the MBS coreset could be the CORESET0.

Based on the above the FL makes the following initial proposals.

### **Initial FL proposal for Issue 8**

**Proposal 11**: for RRC\_IDLE/RRC\_INACTIVE UEs, an MBS-specific CORESET is defined where the CORESET of PDCCH can be CORESET0 by default.

## Other Issues

In this subsection, we list other identified issues from the technical contributions submitted to AI 8.12.3. Most of the issues in this subsection either provide a more detailed technical discussion than the issues identified above or have been discussed by less than 3 companies. The FL suggestions is that these issues are discussed either once the previous key issues have been discussed, which provide a more general discussion on this topic, or are discussed at the next RAN1 meetings. The order of the next other issues does not imply any prioritisation between them.

### **Other Issue 1: MBS PTM Radio Bearer (MRB) and Monitoring Occasions (MO)**

This issue has been proposed in [5].

### **Other Issue 2: Discontinuous Reception (DRX) and Wakeup Signals (WUS)**

This issue has been proposed in [5].

### **Other Issue 3: MBS service configuration on a inter-frequency non-service cell**

This issue has been proposed in [7].

### **Other Issue 4: PDSCH configuration of transmission parameters (e.g. MCS and number of MIMO layers)**

This issue has been proposed in [8, 15].

### **Other Issue 5: Frequency resource allocation and DCI payload size determination**

This issue has been proposed in [12].

### **Other Issue 6: UE measurements based on configured triggers**

This issue has been proposed in [16].

### **Other Issue 7: Semi Persistent Scheduling of MBS data**

This issue has been proposed in [3].

# Summary

In this section, first we summarise the key issues identified for potential discussion at RAN1#103-e based on the technical documents submitted to the agenda item 8.12.3. Secondly, we propose a first order prioritisation of the issues for discussion at this meeting for AI 8.12.3. The prioritisation by the moderator is motivated by either the number of companies that have discuss the particular issue and/or whether the issue deals with high level aspects. The proposed de-prioritised issues by the moderator could be discussed at this meeting if the previous issues are addressed or they can be discussed at next meetings based on the technical document inputs from companies.

## Summary of identified Issues for RAN1#103-e

### **Issue 1**: Group scheduling for UEs in RRC\_IDLE/ RRC\_INACTIVE states

* Proposal 1: For RRC\_IDLE/RRC\_INACTIVE UEs, support group-common PDCCH with CRC scrambled by a common RNTI to schedule a group-common PDSCH, where the scrambling of the group-common PDSCH is based on the same common RNTI.

### **Issue 2**: Configuration mechanisms for group scheduling of IDLE/INACTIVE UEs

* Proposal 2: Subject to RAN2 decision, assume as the baseline to enable the MBS configuration for UEs in RRC\_IDLE/ RRC\_INACTIVE states the broadcast-based mechanism, i.e. SIB and/or MCCH, as specified in LTE SC-PTM.

### **Issue 3**: Broadcast and Multicast support by UEs in RRC\_IDLE/RRC\_INACTIVE state

* Proposal 3: broadcast service reception can be supported for UEs in RRC\_IDLE/INACTIVE/CONNECTED states.
* Proposal 4: study multicast service reception for UEs in RRC\_IDLE/INACTIVE/CONNECTED states.

### **Issue 4**: MBS frequency resources of UEs in RRC\_IDLE/ RRC\_INACTIVE states

* Proposal 5: for RRC\_IDLE/RRC\_INACTIVE UEs, the initial BWP can be the default common frequency resource to receive MBS data.
  + FFS: one/more MBS specific BWPs where to avoid BWP switching the MBS specific BWP(s) can contain the initial BWP.

### **Issue 5**: Retransmissions and HARQ feedback for UEs in RRC\_IDLE/ RRC\_INACTIVE states

* Proposal 6: for RRC\_IDLE/RRC\_INACTIVE UEs, consider support of NACK-only based HARQ-feedback for multicast and broadcast.
* Proposal 7: for RRC\_IDLE/RRC\_INACTIVE UEs, consider reception of HARQ retransmissions initiated by UEs in RRC\_CONNECTED state for multicast and broadcast.
* Proposal 8: for RRC\_IDLE/RRC\_INACTIVE UEs, consider support of PDSCH repetitions for multicast and broadcast.

### **Issue 6**: Beam sweeping for UEs in RRC\_IDLE/ RRC\_INACTIVE states

* Proposal 9: for RRC\_IDLE/RRC\_INACTIVE UEs, beam sweeping is supported for Rel-17 MBS transmissions.
  + FFS: UE monitoring occasions are associated with a subset of the total SSB indexes.
  + FFS: UE monitoring and association is based on beam sweeping SIBx/paging procedures.
  + FFS: QCL assumption based on SSB or TRS based on SIB configuration.
  + FFS: PTP/PTM indications can be done per SSB.

### **Issue 7**: PDCCH Search Space for UEs in RRC\_IDLE/ RRC\_INACTIVE states

* Proposal 10: for RRC\_IDLE/RRC\_INACTIVE UEs, CSS is supported for group-common PDCCH.
  + FFS: reuse current CSS types and/or define a new CSS type.

### **Issue 8**: CORESET for UEs in RRC\_IDLE/ RRC\_INACTIVE states

* Proposal 11: for RRC\_IDLE/RRC\_INACTIVE UEs, an MBS-specific CORESET is defined where the CORESET of PDCCH can be CORESET0 by default.

## FL proposal for prioritisation of Issues for discussion at RAN1#103-e

The FL proposes the following prioritisation of topics for discussion at RAN1#103-e:

* Issue 1, Issue 2, Issue 3, Issue 4, Issue 5 and Issue 6.

This prioritisation proposal is for consideration and can be discussed by email and at the planned online GTW NR MB sessions at RAN1#103-e.

# References

1. RP-201038 *Revised Work Item on NR Multicast and Broadcast Services*, Huawei, HiSilicon
2. R1-2007564 *Discussion on multicast support for IDLE/INACTIVE UEs*, Huawei, HiSilicon
3. R1-2007639 *Basic functions for MBS for RRC\_IDLE/RRC\_INACTIVE UEs*, CHENGDU TD TECH LTD.
4. R1-2007693 *Discussion on basic functions for broadcast/multicast for RRC\_IDLE/RRC\_INACTIVE Ues*, vivo
5. R1-2007837 *Discussion on basic functions for broadcast/multicast for RRC\_IDLE/RRC\_INACTIVE UEs*, CATT, CBN
6. R1-2008036 *Discussion on NR MBS in RRC\_IDLE/RRC\_INACTIVE states*, CMCC
7. R1-2008066 *Basic function for broadcast/multicast*, LG Electronics
8. R1-2008194 *On basic functions for broadcast/multicast for RRC\_IDLE/RRC\_INACTIVE UEs*, Samsung
9. R1-2008244 *Discussion on enhancements for IDLE and INACTIVE state UEs*, OPPO
10. R1-2008828 *Basic Functions for Broadcast or Multicast for RRC\_IDLE or RRC\_INACTIVE UEs*, ZTE
11. R1-2008884 *Basic Functions for Broadcast / Multicast for RRC\_IDLE / RRC\_INACTIVE UEs,* Nokia, Nokia Shanghai Bell
12. R1-2008928 *Basic functions for broadcast/multicast in idle/inactive states*, Lenovo, Motorola Mobility
13. R1-2009002 *NR-MBS for RRC\_IDLE/INACTIVE UEs*, Intel Corporation
14. R1-2009167 *On NR multicast and broadcast for RRC\_IDLE/RRC\_INACTIVE UEs*, Convida Wireless
15. R1-2009276 *Discussion on broadcast/multicast for RRC\_IDLE/RRC\_INACTIVE UEs*, Qualcomm Incorporated
16. R1-2009307 *Support for NR multicast reception in RRC Inactive/Idle*, Ericsson