**3GPP TSG RAN WG1 #109-e R1-220XXXX**

**e-Meeting, May 9th – 20th, 2022**

**Agenda item: 8.12.2**

**Source:** Moderator (BBC)

**Title:** Feature lead summary #1 on discussion of RAN2 LS on HARQ process for MCCH and Broadcast MTCH(s)

**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 agreements in previous RAN1 meetings for this WI is provided in [2].

In R1-2203044, RAN2 requests input from RAN1 on HARQ process for MCCH and Broadcast MTCH(s). The email discussion in [109-e-Prep-AI5] (Incoming LS handling for RAN1#109-e) concludes that a response from RAN1 is needed and that this discussion is to be handled as part of the Rel-17 MBS maintenance in this RAN1#109-e meeting.

As announced by the Chair, the details of the email discussion are as follows:

[109-e-R17-MBS-01] Email discussion on LS in R1-2203044 until May 12 – David (BBC)

This document provides, in section 2, a summary of the tdocs submitted to this meeting addressing the RAN2 LS, an assessment based on the inputs and a list of proposals for discussion to form a response to RAN2. Sections 3 and 4 provide a summary of the agreements reached at this meeting and relevant references, respectively.

# Discussion on RAN2 LS on HARQ process for MCCH and Broadcast MTCH(s)

## Background

The RAN2 LS in R1-2203044 (cf. annex A) on HARQ process for MCCH and Broadcast MTCH(s) informs RAN1 about the following agreement with an assumption:

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| **There are no dedicated HARQ process IDs for MCCH and Broadcast MTCH (assumption: single HARQ process for MCCH and single HARQ process for MTCH, not clear whether they can share the same, details would be RAN1 scope)** |

Based on this agreement RAN2 kindly asks RAN1 to confirm the RAN2 assumption on single HARQ process for MCCH and single HARQ process for Broadcast MTCH(s).

The following agreements for RRC\_IDLE/RRC\_INACTIVE UEs at RAN1#107bis-e are relevant for this discussion:

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| **Agreement**For RRC\_IDLE/INACTIVE UEs, a UE is not required to support reception of FDMed MCCH PDSCH and MTCH PDSCH in PCell.**Agreement**For RRC\_IDLE/INACTIVE UEs, a UE is not required to support reception of FDMed multiple MTCH PDSCHs in PCell.**Conclusion**Additional HARQ process(es) is(are) not introduced for Rel-17 MBS broadcast reception on serving cell.* + Note: The UE is not expected to support hardware for more HARQ processes for receiving broadcast in Rel-17 in addition to the maximum number of HARQ processes supported for receiving unicast in Rel-16, i.e. the HARQ process resources are shared between broadcast, unicast and multicast

**Agreement**HARQ process ID is not indicated in DCI format 4\_0 for both MCCH and MTCH. |

## Tdoc analysis

* In [R1-2203195, ZTE]
	+ Proposal 5: Reply RAN2 LS R1-2203044/R2-2204017 with the following response [R1-2203245].
		- RAN1 confirms the RAN2 assumption on single HARQ process for MCCH and single HARQ process for Broadcast MTCH(s).
		- Further, a same HARQ process can be shared for reception of MCCH and Broadcast MTCH(s) from RAN1 perspective. It is similar as reception of SIB1 and OSI, in which a dedicated HARQ process is shared among them by assuming that there is no requirement for receiving them simultaneously.
		- [draft reply can be found in R1-2203245.]
* In [R1-2203299, Spreadtrum]
	+ *Discuss*: In light of the highlighted part of the conclusion, it clearly can been seen that there are no dedicated HARQ process for MCCH and MTCH. From the perspective of physical layer, both MCCH and MTCH are also PDSCHs. Thus, it is natural that one single HARQ process for MCCH is needed, and one single HARQ process for MTCH is needed. In latest TS38.212 h10[3], it can be seen that there is no HARQ process field in DCI format 4\_0, which is for the scheduling of MCCH and MTCH. Thus, in our understanding, the HARQ process for MCCH and/or MTCH is up to UE’s implementation, and there is no spec impact, i.e., the HARQ process of MCCH can be the same as or different from HARQ process of MTCH.
	+ Observation 1: Single HARQ process for MCCH and single HARQ process for MTCH can be same or different, and it is up to UE’s implementation.
	+ Proposal 1: From the perspective of RAN1, RAN2 assumption can be confirmed.
* In [R1-2203527, vivo]
	+ *Discuss*: Regarding to HARQ process for MCCH and Broadcast MTCH(s), it has agreed that HARQ process ID is not indicated in DCI format 4\_0 for both MCCH and MTCH. There is also a conclusion that additional HARQ process(es) is(are) not introduced for Rel-17 MBS broadcast reception on serving cell. Additionally, RAN 1 has also agreed that a UE is not required to support reception of FDMed MCCH PDSCH and MTCH PDSCH in PCell as well as a UE is not required to support reception of FDMed multiple MTCH PDSCHs in PCell for RRC\_IDLE/INACTIVE UEs. Thus, single HARQ process is enough for MCCH or broadcast MTCH(s) and it is up to UE implementation to perform HARQ combination for the MCCH or broadcast MTCH. Furthermore, it is up to UE implementation on whether MCCH and broadcast MTCH(s) share the same HARQ process or not.
	+ Proposal 2: Single HARQ process is used for MCCH.
	+ Proposal 3:Single HARQ process is used for broadcast MTCH.
	+ [draft reply can be found in R1-2203492]
* In [R1-2203766, Xiaomi]
	+ *Discuss*: determination of HARQ process resource(s) for broadcast is/are up to UE implementation. From RAN1 perspective, single HARQ process for MCCH and single HARQ process for broadcast MTCH(s) can share the same.
* In [R1-2203976, OPPO]
	+ *Discuss*: There is no dedicated HARQ process ID that is allocated/indicated for MBS broadcast. Which HPID is used for MCCH/MTCH is up to UE implementation, because the HPID resources are shared between broadcast, unicast and multicast. Furthermore, from RAN1’s perspective, MCCH and MTCH are both mapped in PDSCH, which is not differentiated by physical layer. There is no necessary to use different HPID for MCCH and MTCH(s), respectively. According to the agreement copied above, the reason why DCI 4\_0 does not include or indicate HPID for MCCH/MTCH is that it is difficult to align and simultaneously use a HPID which is forced all UEs to use this HPID, no matter it is occupied by unicast or not.
	+ Proposal 1: There is no dedicated HARQ process ID for MCCH and Broadcast MTCH(s).
	+ Proposal 2: A single HARQ process can be used for MCCH and Broadcast MTCH(s), for which MCCH and MTCH(s) are sharing this single HARQ process.
	+ [draft reply can be found in R1-2203977]
* In [R1-2204270, CMCC]
	+ *Discuss*: According to RAN1’s conclusion, that additional HARQ process(es) is(are) not introduced for Rel-17 MBS broadcast reception on serving cell without the impact on UE’s hardware which is aligned with RAN2’s agreement that no dedicated HARQ process IDs for MCCH and Broadcast MTCH. In addition, RAN1 also agreed that no HARQ process ID is to be indicated in the DCI format for both MCCH and MTCH.
	But whether different HARQ processes can be allocated to MCCH and MTCH doesn’t have a clear agreement. There are several ways to realize it, for example, it is up to UE’s implementation to buffer different data in different HARQ processes according to the RNTI. For RRC\_IDLE/INACTIVE UEs, this method is feasible since they don’t have unicast or multicast service. However, for RRC\_CONNECTED UEs, if each broadcast service (G-RNTI) occupy one HARQ process, it will impact on the unicast and multicast scheduling since gNB doesn’t know which HARQ process(es) is(are) used by broadcast.
	From this point of view, it is beneficial to restrict that only single HARQ process for MCCH and single HARQ process for MTCH. Regarding whether MCCH and MTCH can share the same HARQ process, it can be up to UE’s implementation depending on the number of unused HARQ processes.
	+ Proposal 1. Reply the LS to RAN2 with the RAN1’s confirmation that on single HARQ process for MCCH and single HARQ process for Broadcast MTCH(s). From RAN1’s perspective, it’s up to UE’s implementation whether to share the same HARQ process for MCCH and Broadcast MTCH(s) or not.
* In [R1-2204927, Huawei]
	+ *Discuss*: Hence, UE shall upon detection of a PDCCH with a configured DCI format 1\_0, 1\_1, 4\_0, 4\_1, 4\_2 or 1\_2 decode the corresponding PDSCHs as indicated by that DCI by using the HARQ process UE supports per cell.
	In addition, support of higher layer configured slot-level repetition up to 8 for MTCH is one of components of FG33-1 for broadcast [2]. However, from the description from TS 38.214 [3].
	As agreed HARQ-ACK feedback for HARQ process scheduling MBS broadcast is not supported (equivalent to HARQ feedback is disabled) and with the above description from TS38.214 in bold, it is understood that the interleaved repetitions for MTCHx and for MTCHy with the same HARQ process ID as illustrated in Fig. 1 is NOT supported.
	Therefore, from RAN1 perspective, a single HARQ process can be used for broadcast MTCH(s). In addition, MCCH and MTCH(s) can share the same HARQ process ID.
	+ Proposal: Confirm RAN2’s assumption that a single HARQ process can be used for broadcast MTCH(s). In addition, MCCH and MTCH(s) can share the same HARQ process ID.
* In [R1-2203875, Samsung]
	+ *Discuss*: There is no dedicated HARQ process associated with MCCH/MTCH(s) as it is also evident from the fact that DCI format 4\_0 does not include a HPN field. It is also up to the gNB whether to use single HARQ process or separate HARQ processes for MCCH and MTCH (e.g. depending on the scheduling and on whether there are ‘blind’ retransmissions) but from a UE perspective it is OK to assume single HARQ process for MCCH and single HARQ process for MTCH(s).
	+ Proposal 7: Confirm the RAN2 understanding in [2].

## FL Assessment

Given the RAN1 conclusion that confirms that no additional HARQ processes are introduced in Rel-17 NR MBS, it is understood that broadcast reception reuses existing hardware for HARQ processes, and these are shared between unicast, multicast and broadcast. This aspect has been highlighted by [Spreadtrum, vivo, OPPO, CMCC, Samsung].

Given the RAN1 agreement on not including HARQ Process ID in the DCI format 4\_0 for MCCH/MTCH and the RAN2 agreement on no dedicated HARQ process IDs for MCCH/MTCH, it is understood that it is up to the receiver implementation to select unused HARQ processes for broadcast reception with the additional constrain that these need to be shared with multicast and unicast. This aspect has been highlighted by [Spreadtrum, vivo, OPPO, CMCC, Samsung].

On RAN2’s assumption on single HARQ process for MCCH and single HARQ process for MTCH:

* In NR MBS Rel-17 there is only a single MCCH scheduled with MCCH-RNTI, hence, it understood that a single HARQ process is sufficient.
* For MTCH, multiple contributions discuss why a single HARQ process is enough. [vivo] highlights that there is no UE requirement to support reception of multiple MTCH PDSCHs FDMed in PCell for RRC\_IDLE/ INACTIVE UEs. [Huawei] further clarify that interleaved slot-level repetition of different MTCHs is not supported, hence one HARQ process is enough. [CMCC] also discusses that although a different HARQ process could be used per G-RNTI, this could have an impact when sharing these with unicast/multicast, hence, it is preferred a single HARQ process for MTCH.
* All inputs [ZTE, Spreadtrum, vivo, Xiaomi, OPPO, CMCC, Huawei, Samsung] support confirming RAN2’s assumption on single HARQ process for MCCH and single HARQ process for MTCH.
* Given the discussion above and the consensus, Proposal 2.1 below confirms RAN2’s assumption.

On whether the HARQ process for MCCH and MTCH can be the same/different:

* In NR MBS Rel-17, as highlighted by [vivo], a UE is not required to support reception of FDMed MCCH PDSCH and MTCH PDSCH in PCell for RRC\_IDLE/INACTIVE UEs. Given this, it is understood that the same HARQ process could be shared between MCCH PDSCH and MTCH PDSCH. [ZTE] further discusses that it is similar to the reception of SIB1 and OSI that share a HARQ process given there is no requirement for simultaneous reception.
* Most inputs [ZTE, Spreadtrum, vivo, Xiaomi, OPPO, CMCC, Huawei] agree that MCCH PDSCH and MTCH PDSCH can share the same HARQ process.
* [Spreadtrum, vivo, CMCC] also support that MCCH PDSCH and MTCH PDSCH can use different HARQ process since this is up to UE’s implementation.
* However, no company argues that a UE should *not* be able to use different HARQ process for MCCH PDSCH and for MTCH PDSCH.
* Given the discussion above, Proposal 2.1 below proposes to clarify that from RAN1 perspective, it is up to the UE’s implementation whether the HARQ process for MCCH and the HARQ process for MTCH is the same or different.

## 1st round FL proposals

### Proposal 2.1

In the reply LS on HARQ process for MCCH and Broadcast MTCH(s) to RAN2, capture the following:

* RAN1 confirms RAN2’s assumption on a single HARQ process for MCCH and single HARQ process for MTCH.
* from RAN1 perspective, it is up to the UE’s implementation whether the HARQ process for MCCH and the HARQ process for MTCH is the same or different.

**Please provide your answers in the table below. Do you agree with Proposal 2.1?**

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| **company** | **comments** |
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# Summary of Agreements

This section includes the agreements for RAN1#109-e.

# References

1. RP-201038 Revised Work Item on NR Multicast and Broadcast Services, Huawei, HiSilicon
2. R1-2202946 Agreements for NR MBS up to RAN1#108, CMCC

**Relevant tdoc from AI 5**

1. R1-2203044 LS on HARQ process for MCCH and Broadcast MTCH(s) RAN2, Samsung
2. R1-2203245 [Draft] Reply LS on HARQ process for MCCH and Broadcast MTCH(s) ZTE
3. R1-2203299 Discussion on LS on HARQ process for MCCH and Broadcast MTCH(s) Spreadtrum Communications
4. R1-2203492 Draft reply LS on HARQ process for MCCH and Broadcast MTCH(s) vivo
5. R1-2203766 Draft reply to LS on HARQ process for MCCH and Broadcast MTCH(s) xiaomi
6. R1-2203976 Discussion on the LS from RAN2 on HARQ process for MCCH and Broadcast MTCH(s) OPPO
7. R1-2203977 Draft reply on LS from RAN2 on HARQ process for MCCH and Broadcast MTCH(s) OPPO
8. R1-2204270 Discussion on RAN2 LS on HARQ process for MCCH and Broadcast MTCH(s) CMCC
9. R1-2204927 Discussion on HARQ process for MCCH and broadcast MTCH(s) Huawei, HiSilicon

**Relevant tdocs from AI 8.12.2**

1. R1-2203195 Maintenance of other issues for broadcast and multicast ZTE
2. R1-2203527 Maintenance on NR Multicast and Broadcast Services vivo
3. R1-2203875 Maintenance on group scheduling for RRC\_CONNECTED UEs Samsung

# Annex A: [R1-2203044] RAN2 LS on HARQ process for MCCH and Broadcast MTCH(s)

R1-2203044 submitted to RAN1#109-e reproduced here for convenience:

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| **3GPP TSG RAN WG1#109-e R1-2203044****e-Meeting, May 9th – 20th, 2022****3GPP TSG RAN WG1#108-e R1-2202891****e-Meeting, 21th February – 3rd March, 2022****3GPP TSG RAN WG2#117-e R2-2204017****e-Meeting, 21th February – 3rd March, 2022****Title:** LS on HARQ process for MCCH and Broadcast MTCH(s)**Response to:** **Release:** Rel-17**Work Item:** NR\_MBS-Core**Source:** RAN2**To:** RAN1**Cc:** **Contact Person:** **Name:** Sangkyu Baek**E-mail Address:** sangkyu.baek@samsung.com**Send any reply LS to: 3GPP Liaisons Coordinator,** **mailto:3GPPLiaison@etsi.org****Attachments: None****1. Overall Description:**RAN2 has discussed about dedicated HARQ process IDs for MCCH and Broadcast MTCH(s), and made the following agreement with an assumption:**There are no dedicated HARQ process IDs for MCCH and Broadcast MTCH (assumption: single HARQ process for MCCH and single HARQ process for MTCH, not clear whether they can share the same, details would be RAN1 scope)****2. Actions:****To RAN1:****ACTION:** RAN2 kindly asks RAN1 to confirm the RAN2 assumption on single HARQ process for MCCH and single HARQ process for Broadcast MTCH(s).**3. Date of Next TSG RAN WG2 Meeting:**TSG-RAN2 Meeting #118-e May 16 - 27, 2022 e-MeetingTSG-RAN2 Meeting #119 August 22 - 26, 2022 Toulouse, France |