**3GPP TSG RAN WG1 #106-e R1-2108211**

**e-Meeting, August 16th – 27th, 2021**

**Agenda item:** 8.16

**Source:** Moderator (Qualcomm Incorporated)

**Title:** Feature lead summary on New bands and bandwidth allocation for LTE based 5G terrestrial broadcast

**Document for:** Discussion / Decision

# Introduction

In RAN#92-e, a new work item on *New bands and bandwidth allocation for LTE based 5G terrestrial broadcast* was approved (RP-211144) with the following objective:

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| * For MBMS-dedicated cells:   + Specify a PMCH allocation of 6/7/8 MHz and corresponding MBSFN reference signals [RAN1].     - Specify corresponding signaling [RAN2, RAN3] |

In RAN1#106-e the following contributions were submitted to this agenda item:

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| [R1-2106560](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2106560.zip) | On PMCH allocation of 6/7/8 MHz and corresponding reference signals | Huawei, HiSilicon |
| [R1-2106752](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2106752.zip) | Discussion on PMCH allocation and corresponding MBSFN reference signals | ZTE |
| [R1-2106753](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2106753.zip) | Considerations on bandwidth changing in MBSFN subframe for 15KHz subcarrier spacing | ZTE |
| [R1-2106762](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2106762.zip) | Work Plan for New Bands and Bandwidth Allocation for LTE based 5G Terrestrial Broadcast | Qualcomm Incorporated, EBU |
| [R1-2106763](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2106763.zip) | PMCH allocation of 6/7/8MHz | Qualcomm Incorporated, RWS, EBU |
| [R1-2107685](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107685.zip) | Numerologies supported for MBMS-dedicated cell | Huawei, HiSilicon |

In the following, we present a summary of the key issues presented to this meeting.

# Issue #1: Framework for 6/7/8MHz

The first issue regarding the general framework for 6/7/8MHz is how to operate the CAS and PMCH bandwidth.:

* x6560 (Huawei, HiSilicon) indicate that PMCH bandwidth is indicated by another parameter in e.g. SIB-MBMS, instead of the MIB bandwidth.
* x6752 (ZTE) states that the MIB bandwidth can be set to 6, 15 or 25 PRBs.
* x6763 (Qualcomm, RWS, EBU) states that the CAS bandwidth is set to 5MHz, and then the PMCH bandwidth can be set to a larger number. The detailed number of RBs is also provided

In view of the above, the feature lead thinks the following can be agreeable:

**Proposal 1.1: For supporting 6/7/8MHz PMCH:**

* **The bandwidth of CAS (system bandwidth indicated in MIB) is set to 25PRBs (5MHz).** 
  + **FFS: whether it can be set to 6 and/or 15 PRBs.**
* **The bandwidth for PMCH ( is indicated by another parameter in system information.**
  + **FFS: Details**

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| **Company** | **Comment** |
| Huawei, HiSilicon | Ok. Regarding whether it can be set to 6/15, we think it is not necessary. |
| ZTE | Currently, the bandwidth outside the CAS bandwidth is not used and it may potentially be utilized in the future if operator has such needs. From this perspective, it may be better if we can have some flexibility for network configuration in this aspect.  Regarding the second bullet, if the center frequency of CAS bandwidth and PMCH bandwidth is the same, then one parameter is sufficient. However, if the center frequency is not aligned, then more than one parameter may be needed.  For progress, we can accept the proposal with some modification.  **Proposal 1.1: For supporting 6/7/8MHz PMCH:**   * **The bandwidth of CAS (system bandwidth indicated in MIB) is set to 25PRBs (5MHz).**    + **FFS: whether it can be set to 6 and/or 15 PRBs.** * **The bandwidth for PMCH ( is indicated by another parameter in system information if the center frequency of bandwidth for CAS and bandwidth for PMCH is aligned.**   + **FFS: Details** |

Another issue under discussion is how to organize the bandwidth of PMCH and CAS:

* X6763 (Qualcomm, SWR, EBU) proposes that the bandwidth of system bandwidth and PMCH are aligned.
* X6752 (ZTE) proposes that the signaling can be different depending on whether the center of PMCH and system bandwidth are aligned or not.

In view of the above, it seems the case of aligning the center frequency should be supported, other cases can be further discussed.

**Proposal 1.2: It is supported that the center frequency of system bandwidth and center frequency of PMCH bandwidth are aligned**

* **FFS: Other cases (non-aligned center frequencies)**

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| **Company** | **Comment** |
| Huawei, HiSilicon | The work in RAN1 should not expand this item too much nor optimize something unnecessary, so ok with this proposal for minimizing the efforts. |
| ZTE | From our perspective, more discussion is needed.  If the center frequency of system bandwidth and center frequency of PMCH bandwidth is aligned, then there are always two fragmented unused frequency resource on the two sides of CAS subframes. It is not convenient if operators want to reuse such frequency resource in the future.  One way to address this issue is to allow unaligned center frequency as shown in the following figure. In this case, the unused frequency resource can be reserved on one side and can be combined with other PMCH bandwidth. More continuous frequency resource can be reserved in this case. |

Issues for further consideration:

Once the proposals above are stable, the following topics can be discussed:

* What is the set of potential values for (X6763 proposes {30,35,40} PRBs)
* FFS for details of signaling , including:
  + Granularity of the signaling (e.g. per cell, per MBSFN area).
  + SIB which includes the signaling
* FFS for non-aligned center frequencies: need and potential signaling.

# Issue #2: Impact on reference signals and TBS determination

All the relevant inputs (x6560, x6752, x6763) consider that the equation for mapping MBSFN RS to REs should be modified to take into account the PMCH bandwidth instead of system bandwidth. Thus, we make the following proposal:

**Proposal 2.1: For PMCH allocation of 6/7/8 MHz on MBMS-dedicated cells, mapping the MBSFN reference signal to REs is based on the PMCH bandwidth of 6/7/8 MHz instead of** **.**

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| **Company** | **Comment** |
| Huawei, HiSilicon | Ok. |
| ZTE | OK. |

Although a single input (x6763) discussed TBS determination, the feature lead thinks this proposal is straightforward and should be agreeable:

**Proposal 2.2: For PMCH allocation of 6/7/8 MHz on MBMS-dedicated cells, the TBS determination is based on the PMCH bandwidth of 6/7/8 MHz instead of** **.**

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| **Company** | **Comment** |
| Huawei, HiSilicon | Ok. |
| ZTE | Ok. |

# Issue #3: Handling 15kHz SCS

The case of 15kHz SCS is discussed in two inputs:

* x7685 (Huawei, HiSilicon) state that 15kHz SCS is not currently supported for MBMS-dedicated cells.
* X6753 (ZTE) state that, for 6/7/8MHz, 15kHz SCS is supported without control region.

The first issue to be clarified is whether 15kHz SCS is supported in MBMS-dedicated cells. In the following, feature lead will provide his point of view ():

FL view on current support of 15kHz:

x7685 correctly points out that the IE added in Rel-16 (*subcarrierSpacingMBMS-r16* within *MBSFN-AreaInfo-r16*) does not allow for configuring 15kHz SCS. The way to configure 15kHz SCS, however, is via *MBSFN-AreaInfo-r9*. This is what 36.331 states about the field *subcarrierSpacingMBMS*

***subcarrierSpacingMBMS***

The value indicates subcarrier spacing for MBSFN subframes, kHz7dot5 refers to 7.5 kHz subcarrier spacing, kHz2dot5 refers to 2.5 kHz subcarrier spacing and so on as defined in TS 36.211 [21], clause 6.12. These subframes do not have non-MBSFN region. If *subcarrierSpacingMBMS-r14* is present, then *non-MBSFNregionLength* shall be ignored. EUTRAN configures parameter *subcarrierSpacingMBMS* only when the MBSFN subframes have subcarrier spacing other than 15 kHz. If *subcarrierSpacingMBMS* indicates 0.37 kHz subcarrier spacing, the slot as defined in TS 36.211 [21], clause 4.1 is valid only when all the corresponding subframes are configured as MBSFN subframes in this slot.

Additionally, there is an explicit agreement from Rel-14 (RAN1#86) on supporting 15kHz SCS for MBMS-dedicated cells:

Agreements in respect of at least objectives a, b and c:

* If a carrier is operated with 100% MBSFN subframe allocation, the new CP length and legacy extended CP for 15kHz subcarrier spacing are supported
  + It is understood that 100% MBSFN subframe allocation does not preclude some resources being set aside for e.g. cell search
    - In these subframes, FDM between PMCH and other channels (potentially with a different numerology) is not precluded.
  + With the 100% MBSFN subframe confuguration, this carrier does not support unicast transmissions in the downlink
  + This carrier can be configured without a unicast control region in a subset of the MBSFN subframes (including all of them)
    - The UE is not expected to receive PMCH with legacy extended CP for 15kHz subcarrier spacing in the MBSFN subframes without unicast control region
    - The UE is not expected to receive PMCH with the new CP in MBSFN subframes with unicast control region

Given the discussion above, it would be best if RAN1 could conclude first on the current status of 15kHz SCS in MBMS-dedicated cells:

**Proposal 3.1: (For conclusion after discussion) For MBMS-dedicated cells:**

* **Alt.1: It is RAN1’s understanding that 15kHz SCS is not currently supported.**
* **Alt.2: It is RAN1’s understanding that 15kHz SCS is currently supported.**
  + **RAN1 to further discuss how to handle 15kHz SCS for 6/7/8MHz PMCH bandwidth**

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| **Company** | **Comment** |
| Huawei, HiSilicon | At least something needs correction in our views to enable 15kHz for dedicated cells. For example, the *subcarrierSpacingMBMS* is mandatory in Rel-16. |
| ZTE | Our understanding is Alt.2 |

# Appendix – Summary of proposals

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| [R1-2106560](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2106560.zip" \t "_parent) | On PMCH allocation of 6/7/8 MHz and corresponding reference signals | Huawei, HiSilicon | ***Proposal 1: To support 6/7/8 MHz PMCH allocation on MBMS-dedicated cells, PMCH bandwidth is indicated by another parameter in, e.g., SIB-MBMS, instead of the transmission bandwidth indication from MIB-MBMS.***  ***Proposal 2: For PMCH allocation of 6/7/8 MHz on MBMS-dedicated cells, mapping the MBSFN reference signal to REs should be based on the PMCH bandwidth of 6/7/8 MHz instead of*** ***.*** |
| [R1-2106752](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2106752.zip) | Discussion on PMCH allocation and corresponding MBSFN reference signals | ZTE | ***Proposal 1****: dl-Bandwidth-MBMS in MasterInformationBlock-MBMS can be set to n6 (1.4 MHz), n15 (3 MHz) or n25 (5 MHz) when PMCH allocation of 6/7/8 MHz is specified.*  ***Proposal 2****: Regarding how to determine the frequency location of PMCH allocation bandwidth,*   * *If the center frequency of system bandwidth is aligned with PMCH allocation bandwidth, number of RBs for PMCH allocation bandwidth is indicated;* * *If the center frequency of system bandwidth is NOT aligned with PMCH allocation bandwidth, number of RBs together with a RB offset or resource allocation (e.g., SLIV) within 10MHz for PMCH allocation bandwidth are indicated.*   ***Observation 1****: Sequence generation of the MBSFN reference signals can be reused for PMCH allocation of 6/7/8 MHz.*  ***Proposal 3****: At least  in the equation of mapping of MBSFN reference signals should be changed to* |
| [R1-2106753](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2106753.zip) | Considerations on bandwidth changing in MBSFN subframe for 15KHz subcarrier spacing | ZTE | ***Proposal 1****: For MBMS-dedicated cells and SCS = 15KHz, zero size of non-MBSFN region is supported to avoid bandwidth changes within one subframe.* |
| [R1-2106763](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2106763.zip) | PMCH allocation of 6/7/8MHz | Qualcomm Incorporated, RWS, EBU | **Proposal 1: For supporting 6/7/8MHz PMCH bandwidth, the initial acquisition and system information acquisition is performed over a 5MHz bandwidth.**  **Proposal 2: Allow configuring PMCH bandwidth larger than the system bandwidth indicated by MIB. The following PMCH bandwidth values are supported for (5MHz system bandwidth):**   * **8MHz:** * **7MHz:** * **6MHz:**   **The PMCH bandwidth and 5MHz system bandwidth are centered around the same frequency.**  **Proposal 3: The UE uses the configured bandwidth (30/35/40 PRBs) to determine the TBS as per TS 36.213, Subclause 11.1**  **Proposal 4: In the equations for determining the MBSFN-RS mapping to resource elements, is replaced by the configured bandwidth for PMCH.** |
| [R1-2107685](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_106-e/Docs/R1-2107685.zip) | Numerologies supported for MBMS-dedicated cell | Huawei, HiSilicon | ***Observation 1: 15 kHz subcarrier spacing is not supported for PMCH for MBMS-dedicated cells.***  ***Observation 2: 7.5, 2.5, 1.25 and 0.37 kHz subcarrier spacing are supported for PMCH for MBMS-dedicated cells.*** |