**3GPP TSG RAN WG1 #106-e R1-2108324**

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

**Agenda item:** 8.16

**Source:** Moderator (Qualcomm Incorporated)

**Title:** Feature lead summary #2 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]
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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 |

NOTE: In order to keep the document brief, the inputs from the first round have been removed. They can be checked in R1-2108211.

# Issue #1: Signalling details for larger bandwidth

The following agreements were reached in the 1st GTW call of RAN#106-e:

Agreement:

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 ($N\_{RB}^{PMCH})$ is indicated by another parameter in system information if the center frequency of bandwidth for CAS and bandwidth for PMCH is aligned.
	+ FFS: Details

For the PMCH bandwidth, the following values (corresponding to 8,7,6MHz) are proposed by Qualcomm in x6763

**Proposal 1.1: The following PMCH bandwidth values are supported:**

* **8MHz:** $N\_{RB}^{PMCH}=40$
* **7MHz:** $N\_{RB}^{PMCH}=35$
* **6MHz:** $N\_{RB}^{PMCH}=30$

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| **Company** | **Comment** |
| ZTE | We are ok with the above proposal. But just one question for clarification, is RAN1 the appropriate working group to determine the number of RBs for each PMCH bandwidth? It seems RAN4 will be more appropriate to take this job from our perspective.  |
| Qualcomm | OK with the proposal. |
| Huawei, HiSilicon | Ok with the proposal. If send LS to RAN4 regarding this issue, not sure how RAN4 will handle it because it seems RAN4 has the item only for Rel-18.  |

One of the remaining issues is the granularity of PMCH bandwidth. Based on brief discussion during GTW1, the following alternatives are presented:

* Alternative 1: The configuration is per cell
	+ All MBSFN areas in the cell have the same bandwidth.
	+ The bandwidth is configured by network implementation (not standardized)
* Alternative 2: The configuration is per MBSFN area
	+ Different MBSFN areas may have different bandwidth.
	+ The PMCH bandwidth is configured by the MCE via M2AP.

Alternative 1 has the benefit of simplicity, but does not allow for a cell to simultaneously serve legacy UEs (e.g. Rel-16 UEs) with legacy bandwidth and new UEs with new bandwidth. We think RAN1 should dowselect among the following two options after some technical discussion:

**Proposal 1.2: The signalling of PMCH bandwidth is:**

* **Alt 1: Per cell**
* **Alt 2: Per MBSFN area**

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| **Company** | **Comment** |
| Qualcomm | Our preference would be to have it per MBSFN area, but we are open to other views. |
| Huawei, HiSilicon | Not sure really whether RAN1 is the right WG to make this decision. For my better understanding of simultaneously serving legacy UEs with legacy bandwidth and new UEs with new bandwidth, basically legacy UE can be configured with a specific area using legacy bandwidth and new UE can be configured within another area where the new bandwidth can be configured specifically for this area, so that the cell can sever legacy and new UEs in different areas. Is it what you are saying?@Alberto If it is the correct understanding, it seems indeed one benefit of Alt2.  |
| Qualcomm | Thanks Jinhuan, yes, that is what I meant (2 MBSFN areas, one for legacy one for new) |

One remaining FFS is whether only 25 PRB (5MHz) CAS is supported, or lower values (15/6PRBs) are also supported:

**Proposal 1.3: For CAS bandwidth values, RAN1 to downselect between the following:**

* **Alt.1: Only 25PRB (5MHz) is supported.**
* **Alt.2: 25PRBs (5MHz), 15 PRBs (3MHz) and 6 PRBs (1.4MHz) are supported.**

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| **Company** | **Comment** |
| EBU | Although support for 5 MHz is enough , a bandwidth of 3 MHz may provide some benefits in terms of robustness and may still allow for sufficient capacity to handle signalling. We find 1.4 MHz insufficient to deliver the necessary signaling. Our preference is “**25PRBs (5MHz) and 15 PRBs (3MHz) are supported.”** |
| ZTE | From our perspective, 25PRBs (5MHz), 15 PRBs (3MHz) and 6 PRBs (1.4MHz) are all workable. If companies have strong concern on 6PRB that it may not be sufficient to handle signalling, we are also ok to support 25PRBs and 15PRBs. |
| Qualcomm | Although we have a slight preference towards Alt.1, in view of the comments from EBU and ZTE we would also be OK with supporting 25 and 15 PRBs. |
| Huawei, HiSilicon | We would prefer Alt1 for simplicity.  |

# Issue #2: Non-aligned center frequencies

The following agreement was made in the 1st GTW session:

Agreement:

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)

One input (x6752, ZTE) proposed that non-aligned PMCH bandwidth and system bandwidth should be supported. This issue was briefly discussed during the 1st GTW session, with the following arguments:

* Pros: It was argued that aligning the center frequencies creates some spectrum fragmenetation, which will be reduced if the CAS bandwidth can be put in one edge of the spectrum.
* Cons:The DC subcarriers will be no longer aligned. The use case of reusing part of the spectrum doesn’t seem to be worth optimizing.

RAN1 should further discuss among the following two alternatives:

**Proposal 2.1: For non-aligned PMCH bandwidth and system bandwidth:**

* **Alt.1: Non-aligned PMCH bandwidth and system bandwidth is not supported.**
* **Alt.2: Only aligned PMCH bandwidth and system bandwidth is supported.**

**Proposal 2.1v2: For non-aligned PMCH bandwidth and system bandwidth:**

* **Alt.1: Non-aligned PMCH bandwidth and system bandwidth is supported.**
* **Alt.2: Non-aligned PMCH bandwidth and system bandwidth is not supported.**

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| **Company** | **Comment** |
| EBU | Benefits of non-aligned PMCH and system bandwidths are unclear as finding adjacent carriers may not generally be possible in real deployments. Any gain in decreasing spectrum fragmentation would only be possible once every 40 subframes. Our preference is that CAS and PMCH are aligned, as already supported in other broadcast standards. |
| ZTE | The two alternatives need to be updated since currently both of them are saying non-aligned PMCH bandwidth and system bandwidth is not supported.The main benefit of supporting non-aligned center frequency for PMCH allocation and system bandwidth is to have continuous reserved resource and decreasing spectrum fragmentation. Currently, LTE spec supports to configure up to 3 additional non-MBSFN subframes. If this is configured by the network, then more resources are reserved and the fragmentation issue is worse.From our perspective, the unaligned DC subcarriers may not be an issue since anyway UE needs to change the bandwidth between CAS and PMCH. Also, it may not be an issue if UE supports separate receiving module for synchronization/MIB and PMCH. |
| Qualcomm | The use case for Alt.2 is quite dubious from our point of view. Additionally, Alt.2 may create more work in RAN4 when defining the emission requirements, since 15kHz close to the edge may have more emissions than the PMCH (due to the SCS difference). |
| Huawei, HiSilicon | As discussed, the aligned center frequency seems the simplest so is preferred. However, as ZTE comments, the proposal needs to be updated to correctly reflection the real intention.  |
| Moderator (Qualcomm) | My apologies (I got confused with double negative). Updated in proposal 2.1v2 above. |

# Issue #3: Handling of 15kHz SCS

The following conclusion was reached in the 1st GTW session:

Conclusion:

It is RAN1’s understanding that 15kHz SCS is currently supported for MBMS dedicated cells.

* RAN1 to further discuss how to handle 15kHz SCS for 6/7/8 MHz PMCH bandwidth

The issue of how to handle 15kHz SCS was briefly discussed during the call. One issue, brought up by ZTE in x6752, is that 15kHz SCS has unicast control region. The bandwidth of the unicast control region cannot be changed (per WID objectives), so the following alternatives seem feasible:

**Proposal 3.1: For 6/7/8MHz PMCH bandwidth with 15kHz SCS:**

* **Alt 1: The control region in MBSFN subframes with 15kHz SCS has the same bandwidth as CAS.**
* **Alt 2: The MBSFN subframes with 15kHz SCS do not have control region.**
* **Alt 3: 15kHz SCS is not supported with 6/7/8MHz.**

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| **Company** | **Comment** |
| ZTE | Our first preference is Alt.2. Minor update in the spec can increase the resource utilization efficiency a lot.We are also OK with Alt.1 if majority companies can go with Alt.1.However, we are not ok with Alt.3, which reduces the supported numerologies for PMCH allocation with 6/7/8 MHz. |
| Qualcomm | We are fine to downselect between Alt.1 and Alt.2. |
| Huawei, HiSilicon | We are not strong to object 15Khz used for dedicated cell. However, our concern is the spec impact. As I commented earlier, 15kHz MBSFN subframe are used in many places in LTE, we don’t want to change LTE spec much especially for the thing that has exists in the spec in case affecting other deployed features because any potential change to existing things would generally needs to be checked whether it affects other features using the same thing. Comparing all these three alternatives, Alt3 is definitely the one has no spec impact so is preferred.  |

# Other issues

If there is any other issue that needs discussion, please provide your input below:

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| **Company** | **Comment** |
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# 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%22%20%5Ct%20%22_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** $N\_{RB}^{DL}=25$ **(5MHz system bandwidth):*** **8MHz:** $N\_{PRB}=40$
* **7MHz:** $N\_{PRB}=35$
* **6MHz:** $N\_{PRB}=30$

**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,** $N\_{RB}^{DL}$ **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.***  |