**3GPP TSG RAN WG1 #106-e R1-210xxxx**

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

**Agenda item:** 8.16

**Source:** Moderator (Qualcomm Incorporated)

**Title:** Feature lead summary #3 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:

|  |
| --- |
| * 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:

|  |  |  |
| --- | --- | --- |
| [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 and second rounds have been removed. They can be checked in R1-2108211 and R1-2108324, respectively.

# Issue #1: Granularity of larger bandwidth

The following agreement was reached in the 2nd GTW call of RAN#106-e:

Agreement:

The signalling of PMCH bandwidth is to be selected to be one of the following:

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

In the following table, we try to compare these two approaches, adding references to the necessary specification change, including references to previously presented CRs to 36.331 and 36.443 to implement Alt.2.

|  |  |
| --- | --- |
| Per cell | Per MBSFN area |
| All MBSFN areas have the same bandwidth. Hence, a cell that has larger bandwidth cannot serve legacy R14/R16 UEs. | Each MBSFN area may have a different bandwidth. A cell can be configured to have some MBSFN areas to serve legacy UEs (e.g. by setting it to the same BW as CAS), and some MBSFN areas for new UEs (e.g. by setting it to 8MHz) |
| Requires a new RRC parameter to indicate the bandwidth (per cell, in SIB). No RAN3 impact. | Requires a new RRC parameter per MBSFN area. This parameter is set by the MCE, so the RRC signaling needs to be propagated to M2AP.This approach was followed in the initial submission to RAN#90e (when the current WI was proposed as a TEI for Rel-16). The corresponding 36.331 CR is in [RP-202413](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_90e/Docs/RP-202413.zip), and the 36.443 CR in [RP-202822](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_90e/Docs/RP-202822.zip).NOTE: Those CRs were proposed for Rel-16. In Rel-17, the structure for the RRC CR may need to be slightly different to keep backward compatibility with Rel-16. |

During GTW#2, there seemed to be a slight preference to go with Alt.2, but some companies requested more time to check the details. Feature lead makes the following proposal

**Proposal 1.1: The signalling of PMCH bandwidth is per MBSFN area.**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | Ok with the proposal. |
| Huawei, HiSilicon | Thanks Alberto for the efforts, appreciated. I did check our RAN3 delegate on the potential RAN3 spec impact and such CR seems reasonable. As long as it is the exhaustive RAN2/RAN3 spec impact, it is acceptable to us. We are ok to this proposal.  |
| BBC | We agree with proposal 1.1: The signalling of PMCH bandwidth is per MBSFN area. |
| EBU | We agree with proposal 1.1. |
| Qualcomm | OK with the proposal. |

# Issue #2: 15kHz SCS

The other remaining issue in this meeting is the handling of 15kHz SCS. In GTW#2, the following was agreed:

Agreement:

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. The UE is not required to process the control region.
* Alt 2: The MBSFN subframes with 15kHz SCS do not have control region.
* Alt 3: The MBSFN subframes with 15 kHz SCS have a control region but its content is not defined

Alt.1/3 were presented as simple changes that would enable 15kHz SCS. Alt.2 would offer more spectral efficiency, but there were concerns about its specification impact.

In the following, the feature lead provides TPs with the estimated specification impact of Alt.2, so that companies can assess whether the changes are acceptable or not. Note that there is some degree of redundancy in the text, since 36.211 Clause 6.5 and 36.213 Clause 11.1 convey the same information as 36.211 Clause 6.7.

**<TP1: 36.211 – Determines that 15kHz starts from the first symbol>**

6.5 Physical multicast channel

The physical multicast channel shall be processed and mapped to resource elements as described in clause 6.3 with the following exceptions:

- No transmit diversity scheme is specified.

- Layer mapping and precoding shall be done assuming a single antenna port and the transmission shall use antenna port 4.

- The PMCH can only be transmitted in the MBSFN region. For PMCH with Δ*f* = 15 kHz, if higher layer parameter *PMCH-Bandwidth* is not configured, the index  in the first slot in the MBSFN subframe fulfils  where  is equal to the value given by the higher layer parameter *non-MBSFNregionLength* [9].

**</TP1: 36.211>**

**<TP2: 36.211 – Determines that there are 0 PDCCH symbols>**

6.7 Physical control format indicator channel

The physical control format indicator channel carries information about the number of OFDM symbols used for transmission of PDCCHs in a subframe. The set of OFDM symbols possible to use for PDCCH in a subframe is given by Table 6.7-1.

**Table 6.7-1: Number of OFDM symbols used for PDCCH**

|  |  |  |
| --- | --- | --- |
| **Subframe** | **Number of OFDM symbols for PDCCH when**  | **Number of OFDM symbols for PDCCH when**  |
| Subframe 1 and 6 for frame structure type 2 or a subframe for frame structure type 3 with the same duration as the DwPTS duration of a special subframe configuration | 1, 2 | 2 |
| MBSFN subframes with ,configured with 1 or 2 cell-specific antenna ports, and belonging to MBSFN areas for which *PMCH-Bandwidth* is not configured. | 1, 2 | 2 |
| MBSFN subframes with ,configured with 4 cell-specific antenna ports and belonging to MBSFN areas for which *PMCH-Bandwidth* is not configured. | 2 | 2 |
| MBSFN subframes with kHz or MBSFN slots with kHz, or MBSFN subframes with belonging to MBSFN areas for which *PMCH-Bandwidth* is configured. | 0 | 0 |
| Non-MBSFN subframes (except subframe 6 for frame structure type 2) configured with positioning reference signals | 1, 2, 3 | 2, 3 |
| All other cases | 1, 2, 3 | 2, 3, 4 |

The UE may assume the PCFICH is transmitted when the number of OFDM symbols for PDCCH is greater than zero unless stated otherwise in [4, clause 12].

**</TP2: 36.211>**

**<TP3: 36.211 – Stage 2 description>**

6.1 Overview

The smallest time-frequency unit for downlink transmission is denoted a resource element and is defined in clause 6.2.2.

A subset of the downlink subframes in a radio frame can be configured as MBSFN subframes by higher layers. For the MBSFN region is defined as one slot of 3 ms. Except for , each MBSFN subframe is divided into a non-MBSFN region and an MBSFN region.

- For subframes using  belonging to MBSFN areas for which *PMCH-Bandwidth* is not configured, the non-MBSFN region spans the first one or two OFDM symbols in an MBSFN subframe where the length of the non-MBSFN region is given according to Clause 6.7.

- For subframes using , , , slots using , or subframes using  belonging to MBSFN areas for which *PMCH-Bandwidth* is configured, the non-MBSFN region is of zero size.

- The MBSFN region in an MBSFN subframe is defined as the OFDM symbols not used for the non-MBSFN region.

**</TP3: 36.211 – Stage 2 description>**

**<TP4: 36.213 – Reception of PMCH>**

11.1 UE procedure for receiving the PMCH

In an MBSFN area for which *PMCH-Bandwidth* is not configured, a UE is not expected to receive PMCH with  (defined in [3]) other than  in an MBSFN subframe with non-zero-size non-MBSFN region.

In an MBSFN area for which *PMCH-Bandwidth* is not configured, A UE is not expected to receive PMCH with in an MBSFN subframe with zero-size non-MBSFN region.

In an MBSFN area for which *PMCH-Bandwidth* is configured, a UE is not expected to receive PMCH in an MBSFN subframe with non-zero-size non-MBSFN region.

**</TP4: 36.213 – Reception of PMCH>**

Companies are welcome to provide their views on the TP above, and whether these changes would be acceptable to proceed with Alt2:

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | Thanks moderator for the great efforts.We support Alt.2, as we can see above, the changes is only for MBMS dedicated cells, which should have no impact on other cases (such as 15khz with MBMS/Unicast-mixed cell). |
| Huawei, HiSilicon | Comparing these three Alts. Alt1: if UE is not required to process the control region, then why define its bandwidth? It turns out Alt3 eventually. Alt2, why is such SE improvement necessary? This work item is supposed to be deployed for HPHT, is 15kHz really workable in such case? Is 15KHz really needed for broadcast operators? Back to spec impact, I appreciate Alberto’s efforts for such examples to show the changes. However, I am not sure really whether they are exhaustive although Alberto is trustworthy. We should be cautious to changes of 15kHz, which are used by many places (or is default if no explicitly) especially they might be some ambiguity already for whether applicable to dedicated cell for PMCH specifically putting aside the MBSFN subframe with 15khz used for TM9/10. We are working on this item, so we all know now all the changes are for this item specifically. However, others may not know and they (perhaps including both operators and NW vendors who are responsible for such features which have been deployed) needs to check whether TM9/10 is affected (surely they don’t affect seemingly). They don’t deserve spending such efforts especially we are embracing 5G era and such efforts for check can be avoided by Alt3 (not supporting 15Khz for this item could be more perfect!). Hopefully it can be understood.  |
| BBC | Alt 2 is preferred |
| EBU | For consistency with other numerologies we support removing the control region of MBSFN subframes with 15 kHz for MBMS-dedicated cells (Alt 2) |
| ZTE2 | Just reply to Huawei’s comment above. Regarding the SE improvement, currently every 15 KHz subframe has to be configured with 1 or 2 symbols as control region. If this restriction can be removed for 15KHz for MBMS dedicated cell, the SE can be improved at least 7.14% (1symbol/14), 14.28% (2symbol/14) for NCP (and 8.3%, 16.7% for ECP). From our perspective, this is a huge SE improvement for MBMS dedicated cell.Regarding the spec impact, although we think this won’t impact any other aspects except for the ones already listed by Moderator, we would also be ok to follow Alberto’s suggestion to add “in an MBMS-dedicated cell” in the corresponding changes to make it clearer. |
| Qualcomm | We would also support Alt.2. |

# Other issues

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

|  |  |
| --- | --- |
| **Company** | **Comment** |
|  |  |
|  |  |

# 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 (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.***  |