**3GPP TSG RAN WG1 #102-e R1-200xxxx**

**e-Meeting, August 17th – 28th, 2020**

**Agenda item:** 6.2.4

**Source:** Moderator (Qualcomm Incorporated)

**Title:** Feature lead summary on LTE-based 5G terrestrial broadcast

**Document for:** Discussion and Decision

# Summary of contributions

The following contributions have been submitted to R1#102-e:

|  |  |  |
| --- | --- | --- |
| [R1-2005424](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_102-e/Docs/R1-2005424.zip) | TS 36.300 correction for the new numerologies of LTE-based 5G terrestrial broadcast | ZTE |
| [R1-2006190](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_102-e/Docs/R1-2006190.zip) | Correction for PBCH repetition | Qualcomm Incorporated |
| [R1-2006416](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_102-e/Docs/R1-2006416.zip) | Corrections to LTE-based 5G Terrestrial Broadcast | Huawei, HiSilicon |

# Issue #1: Corrections for TS 36.300

In x5424 two TPs are included to add the new CPs and reference signals to TS 36.300:

***TP1.1****: {TS 36.300 Section 5.1.1}*

|  |
| --- |
| 5.1.1 Basic transmission scheme based on OFDM The downlink transmission scheme is based on conventional OFDM using a cyclic prefix. The OFDM sub-carrier spacing is *Δf* = 15 kHz. 12 consecutive sub-carriers during one slot correspond to one downlink *resource block*. In the frequency domain, the number of resource blocks, NRB, can range from NRB-min = 6 to NRB-max = 110 per CC or per Cell in case of CA or DC.  In addition, there are also four reduced sub-carrier spacings, *Δflow* = 7.5 kHz, *Δflow1* = 2.5 kHz, *Δflow2* = 1.25 kHz and *Δflow3* ≈ 0.37 kHz for both MBMS-dedicated cell and MBMS/Unicast-mixed cell.  In the case of 15 kHz sub-carrier spacing there are two cyclic-prefix lengths, corresponding to seven and six OFDM symbols per slot respectively.  - Normal cyclic prefix: TCP = 160×Ts (OFDM symbol #0) , TCP = 144×Ts (OFDM symbol #1 to #6)  - Extended cyclic prefix: TCP-e = 512×Ts (OFDM symbol #0 to OFDM symbol #5)  where Ts = 1/ (2048 × Δf)  In case of 7.5 kHz sub-carrier spacing, there is only a single cyclic prefix length TCP-low = 1024×Ts, corresponding to 3 OFDM symbols per slot.  In case of 2.5 kHz sub-carrier spacing, there is only a single cyclic prefix length TCP-low1 = 3072×Ts, corresponding to 1 OFDM symbol per slot.  In case of 1.25 kHz sub-carrier spacing, there is only a single cyclic prefix length TCP-low2 = 6144×Ts, corresponding to 1 OFDM symbol per subframe.  In case of 0.37 kHz sub-carrier spacing, there is only a single cyclic prefix length TCP-low3 = 9216×Ts, corresponding to 1 OFDM symbol per 3ms slot.  In case of FDD, operation with half duplex from UE point of view is supported.  <---------------------------Other parts are omitted -------------------------------> |

***TP1.2****: {TS 36.300 Section 5.1.4}*

|  |
| --- |
| 5.1.4 Downlink Reference signal and synchronization signals The downlink cell-specific reference signals consist of known reference symbols inserted in the first and third last OFDM symbol of each slot for antenna port 0 and 1. There is one cell-specific reference signal transmitted per downlink antenna port. The number of downlink antenna ports for the transmission of cell-specific reference signals equals 1, 2, or 4.  Physical layer provides 504 unique cell identities using Synchronization signals and resynchronization signals.  The downlink MBSFN reference signals consist of known reference symbols inserted every other sub-carrier in the 3rd, 7th and 11th OFDM symbol of sub-frame in case of 15kHz sub-carrier spacing and extended cyclic prefix; every four subcarriers in the 2nd, 4th and 6th symbol of sub-frame in case of 7.5kHz sub-carrier spacing; every four subcarriers in the single symbol of slot in case of 2.5kHz sub-carrier spacing; every six subcarriers in the single symbol of subframe in case of 1.25kHz sub-carrier spacing; and every twelve subcarriers for MBSFN reference signal pattern type 1 or every six subcarriers for MBSFN reference signal pattern type 2 in the single symbol of 3ms slot in case of 0.37kHz sub-carrier spacing.  In addition to cell-specific reference signals and MBSFN reference signals, the physical layer supports UE-specific reference signals, positioning reference signals, CSI reference signals, and discovery signals.  A UE may assume presence of the discovery signals consisting of cell-specific reference signals, primary and secondary synchronization signals, configurable resynchronization signals, and configurable CSI reference signals.  <---------------------------Other parts are omitted -------------------------------> |

# Issue #2: Indexing of PBCH scrambling

In x6190, it is proposed to change the indexing from *k* to *k’* in the PBCH scrambling as follows:

|  |  |
| --- | --- |
| ***Reason for change:*** | The current PBCH scrambling is given by  However, *k* (aboslute subcarrier index) is not known before decoding PBCH. |
|  |  |
| ***Summary of change:*** | PBCH repetition is scrambled based on *k’* (as defined in 6.6.4)*,* not *k* |
|  |  |
| ***Consequences if not approved:*** | PBCH repetitions cannot be used until after decoding PBCH. |

**<TP2, 36.211>**

**<Omitted in summary>**

6.6.4.1 PBCH repetition in the cell acquisition subframe

**<Omitted in summary>**

Resource elements already reserved or used for transmission of cell-specific reference signals in absence of repetition shall not be used for additional mapping of cell-specific reference signals.

The quantity is given by

where the relationship between and is defined in clause 6.6.4, and the pseudo-random sequence is given by clause 7.2 and initialized for each OFDM symbol with

**Table 6.6.4.1-1: Slot and symbol number pair for repetition of PBCH.**

|  |  |  |
| --- | --- | --- |
|  | **Slot and symbol number pair** | |
| **Normal cyclic prefix** | **Extended cyclic prefix** |
| 0 | (0, 4) | - |
| 1 | (1, 4) | (0, 3) |
| 2 | (1, 5) | (1, 4) |
| 3 | (0, 3), (1, 6) | (1, 5) |

**</TP2 >**

# Issue #3: Corrections for 0.37 SCS (subframe/slot)

In x6416 the following TP is proposed to discuss the relationship between slots/subframes for 0.37 kHz SCS:

**<TP3, 36.211>**

**6 Downlink**

**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. Each MBSFN subframe is divided into a non-MBSFN region and an MBSFN region. For MBSFN slot with , the duration of the slot spans three consecutive MBSFN subframes.

- For subframes using , 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 , , , or slot using , 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. For the MBSFN region is defined as one slot of 3 ms.

For an MBMS-dedicated cell, subframes where PSS/SSS/PBCH or PDSCH carrying system information are transmitted with  are non-MBSFN subframes.

For frame structure type 3, MBSFN configuration shall not be applied to downlink subframes in which at least one OFDM symbol is not occupied or discovery signal is transmitted.

Unless otherwise specified, transmission in each downlink subframe shall use the same cyclic prefix length as used for downlink subframe #0.

**< Unchanged parts are omitted >**

**6.10.2 MBSFN reference signals**

MBSFN reference signals shall be transmitted in the MBSFN region of MBSFN subframes/slots only when the PMCH is transmitted. MBSFN reference signals are transmitted on antenna port 4.

For an MBMS-dedicated carrier configured with a single MBSFN area, and for a PMCH transmitted with 0.37 kHz subcarrier spacing in slot , which is indicated to contain MCCH by higher layer parameter *MCCH-Config:*

- for MBSFN reference signal pattern type 1, the UE may assume that MBSFN reference signals associated with the same are present in the three preceding slots to slot .

- for MBSFN reference signal pattern type 2, the UE may assume that MBSFN reference signals associated with the same are present in the preceding slot to slot .

MBSFN reference signals are defined for extended cyclic prefix only.

**</TP3>**

# Proposed scope of discussion

Given the input to this meeting, and the budget of 2 email discussions announced by Mr. Chairman, feature lead makes the following proposal:

**Proposal: The scope of email discussions for RAN1#102-e is as follows:**

* **Email discussion 1: Discuss potential corrections to TS 36.300, taking as starting point the TPs in R1-2005424 (Issue#1 in this document)**
* **Email discussion 2: Discuss potential corrections to TS 36.211, based on the following two issues:**
  + **PBCH scrambling indexing, as described in R1-2006190 (Issue#2 in this document)**
  + **Slot/subframe terminology, as described in R1-2006416 (Issue#3 in this document)**