**3GPP TSG-RAN WG4 Meeting #94-e R4-20xxxxx**

**Electronic Meeting, Feb.24th – Mar.6th 2020**

**Agenda item:** 7.14.3

**Source:** Moderator (Qualcomm Incorporated)

**Title:** Email discussion summary for RAN4#94e\_#88\_LTE\_terr\_bcast\_Demod

**Document for:** Information

# Introduction

Agenda item 7.14.3 is demod performance requirement for 5G terrestrial broadcast WI. Since this is the first RAN4 meeting for demod performance requirement discussion, only general discussion is listed in topic to be discussed. Under general discussion, proposals in submitted contributions are categorized into several open issues:

1. Demod requirement scope: proposals and discussions for which requirements to be introduced are collected under this open issue category.
2. Propagation condition: many proposals are listed in the contributions on propagation conditions for different scenario. Therefore, propagation condition is separated from other simulation assumptions as an individual open issue category.
3. Simulation assumptions: proposals and discussion for all the configuration and parameters for future simulations except propagation condition are collect in this open issue category.

Since this is the first RAN4 meeting for 5G terrestrial broadcast demod requirement, hopefully the agreement on requirement scope and principles for simulation assumption discussion can be reached.

# Topic #1: General Discussion

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2001453 | Huawei | **Observation 1: New performance requirements is needed to verify the performance of the UE for different RS types in rooftop reception scenario and corresponding test applicability needs to be specified.**  **Observation 2: New performance requirements are needed to verify the performance of the UE in 250km/h scenario.**  **Observation 3: It is no needed to define new performance requirements for PDCCH format 4.**  **Observation 4: New performance requirements are needed to verify the performance gain of PBCH.**  **Proposal 1: Define new performance requirements for:**   * **0.37 kHz SCS new numerology for rooftop reception**   + **MBSFN RS type 1 and type 2 (corresponding test applicability needs to be specified)** * **2.5 kHz SCS new numerology for mobility up to 250km/h** * **PBCH reception in CAS**   **Proposal 2: Define simulation assumptions as Table 2.2.2-1 for 0.37 kHz SCS new numerology for rooftop reception.**  **Proposal 3: Define simulation assumptions as Table 2.2.2-1 for 2.5 kHz SCS new numerology for up to 250km/h.**  **Proposal 4: Use simulation assumptions as Table 2.2.3-1 for PBCH reception in CAS.** |
| R4-2000773 | Qualcomm | **Proposal 1: Use Table 2‑1 as simulation assumptions for PMCH demod test.**  **Proposal 2: Majority of the received signal power by UE needs to be concentrated on echoes/channel taps within CP window.**  **Proposal 3: EI windows length to be considered for long numerology test is 800us, by taking RS pattern and implementation margin into consideration.**  **Proposal 4: Use the following assumption to design propagation condition: echoes/channel taps outside EI window are week and should have negligible impact on system performance.**  **Observation 1: EI window location during initial acquisition is [x-EI\_length/2, x+EI\_length/2], where x is the strongest tap identified during initial acquisition, and EI\_length = 800us. After initial acquisition, EI winodws moves with CP window as they have the same center.**  **Proposal 5: Take observation 1 into consideration when designing propagation condition.**  **Observation 2: 64QAM is feasible with EVA and EVA\_MBMS channels when consider 78Hz and 162Hz Doppler spread.**  **Proposal 7: Take application scenarios provided by operator into consideration to set test configurations.**  **Proposal 8: consider the following options for CAS detection test**   1. **Rooftop scenario: no mobility, AWGN is considered in this option, 1 Tx and 1Rx for antenna configuration.** 2. **Mobility: car travel with speed 120km/h or 250km/h, EVA is considered in this option. 1Tx and 2Rx for antenna configuration.**   **Proposal 9: reuse LTE requirement on PBCH and PDCCH detection rate for CAS requirement.** |

## Open issues summary

### Demod requirement scope

There are some proposals for what demod tests to be introduced, summarize below:

**Issue 1-1: PMCH**

* Proposals
  + Option 1 (Huawei): Define following test
  + 0.37 kHz SCS new numerology for rooftop reception
    - MBSFN RS type 1 and type 2 (corresponding test applicability needs to be specified)
  + 2.5 kHz SCS new numerology for mobility up to 250km/h
  + Option 2 (QC): Take application scenarios provided by operator into consideration to set test configurations
* Recommended WF
  + Define following test
  + 0.37 kHz SCS new numerology for rooftop reception
    - MBSFN RS type 1 and type 2 (corresponding test applicability needs to be specified)
  + 2.5 kHz SCS new numerology for mobility, with speed options:
    - 120km/h
    - 250km/h

**Issue 1-2: CAS**

* Recommended WF(from Huawei contribution)
  + PBCH reception in CAS
  + No need to define new performance requirements for PDCCH format 4

### Propagation condition

There are more proposals for propagation conditions, hence this subtopic is separated from other simulation assumptions as an individual subtopic.

**Issue 2-1: PMCH rooftop scenario propagation condition**

* Proposals
  + Option 1 (QC): use the following assumption to design the propagation condition
    - Majority of the received signal power by UE needs to be concentrated on echoes/channel taps within CP window.
    - EI windows length to be considered for long numerology test is 800us, by taking RS pattern and implementation margin into consideration.
    - Echoes/channel taps outside EI window are week and should have negligible impact on system performance.
  + Option 2 (Huawei): use the following channel for rooftop scenario

|  |  |
| --- | --- |
| Extended Delay Spread | |
| Maximum Doppler frequency [5Hz] | |
| Relative Delay [ns] | Relative Mean Power [dB] |
| 0 | 0 |
| 30 | -1.5 |
| 150 | -1.4 |
| 310 | -3.6 |
| 370 | -0.6 |
| 1090 | -7.0 |
| 124900 | -10 |
| 124930 | -11.5 |
| 125050 | -11.4 |
| 125210 | -13.6 |
| 125270 | -10.6 |
| 125990 | -17.0 |
| 274900 | -20 |
| 274930 | -21.5 |
| 275050 | -21.4 |
| 275210 | -23.6 |
| 275270 | -20.6 |
| 275990 | -27.0 |

* Recommended WF
  + Need discussion and operator input

**Issue 2-2: PMCH mobility scenario propagation condition**

* Proposals
  + Option 1 (Huawei): reuse Rel-14 FeMBMS channel in TS 36.101 Table B.2.6.2-1

|  |  |
| --- | --- |
| Extended Delay Spread | |
| Maximum Doppler frequency [5Hz] | |
| Relative Delay [ns] | Relative Mean Power [dB] |
| 0 | 0 |
| 30 | -1.5 |
| 150 | -1.4 |
| 310 | -3.6 |
| 370 | -0.6 |
| 1090 | -7.0 |
| 49960 | -10 |
| 49990 | -11.5 |
| 50110 | -11.4 |
| 50270 | -13.6 |
| 50330 | -10.6 |
| 51050 | -17.0 |
| 109960 | -20 |
| 109990 | -21.5 |
| 110110 | -21.4 |
| 110270 | -23.6 |
| 110330 | -20.6 |
| 111050 | -27.0 |

* + Option 2 (QC): add two taps with delay 10us and 50us and relative power -20dB and -25dB to EVA channel
* Recommended WF
  + Need discussion and operator input

**Issue 2-3: Propagation condition for CAS**

* Proposals
  + Option 1 (Huawei): ETU70
  + Option 2 (QC):

(1) Rooftop scenario: no mobility, AWGN is considered in this scenario.

(2) Mobility: car travel with speed 120km/h or 250km/h, EVA is considered in this scenario.

* Recommended WF
  + Need discussion and operator input

### Simulation assumptions

**Issue 3-1: Simulation assumptions for PMCH rooftop scenario**

* Proposals
  + Option 1 (Huawei):

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Test number** | **Cell** | **Bandwidth(MHz)** | **Modulation order** | **Propagation**  **condition** | **Antenna configuration** | **Test metric** | **MBSFN RS type** | **Number of MBSFN subframes per 40ms** |
| 1 | Dedicated | 10 | 16QAM 1/2 | Table 2.2.1-1 | 1x2 low | 1% BLER | 1 | 13 |
| 2 | Dedicated | 10 | 16QAM 1/2 | Table 2.2.1-1 | 1x2 low | 1% BLER | 2 | 13 |

* + Option 2 (QC):
    - Basic configuration in below table

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Unit |  |
| Downlink power allocation |  | dB | 0 |
|  | dB | 0 (Note 1) |
| σ | dB | 0 |
| at antenna port | | dBm/15kHz | -98 |
| PDSCH transmission mode in PCell and SCell | |  | 1 |
| Bandwidth | | MHz | 10(Note 2) |
| Note 1: .  Note 2: For both Pcell and Scell | | | |

* + - 1x1 antenna configuration
    - MCS TBD
* Recommended WF
  + Need discussion and operator input

**Issue 3-2: Simulation assumptions for PMCH mobility scenario**

* Proposals
  + Option 1 (Huawei):

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Test number** | **Cell** | **Bandwidth(MHz)** | **Modulation order** | **Propagation**  **condition** | **Antenna configuration** | **Test metric** | **Number of MBSFN subframes per radio frames** |
| 1 | Mixed | 10 | 16QAM 1/2 | Table B.2.6.2-1 | 1x2 low | 1% BLER | 8(except 0 and 5) |

* + Option 2 (QC):
    - 1x2 antenna configuration
    - MCS TBD
* Recommended WF
  + Need operator input
  + Use simulation assumptions proposed in option 1, with following TBD
    - Propagation condition (see issue 2-2)
    - MCS

**Issue 3-3: Simulation assumptions for PMCH mobility scenario**

* Proposals
  + Option 1 (HW):

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Test number** | **PBCH repetition pattern** | **PBCH Bandwidth** | **Transmission bandwidth** | **Reference channel** | **Propagation**  **condition** | **Antenna configuration** | **Test metric** |
| 1 | Table 6.6.4.1-1 in TS 36.211 | 1.4MHz | 10MHz | Table 2.2.3-2 | ETU70 | 1x2 low | 1% Pm-bch |

***Table 6.6.4.1-1 in TS 36.211: 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) |

**Table 2.2.3-2 Reference channel**

|  |  |
| --- | --- |
| **Parameter** | **Value** |
| Number of transmitter antennas | 1 |
| Channel bandwidth | 1.4MHz |
| Modulation | QPSK |
| Target coding rate | 40/1824 |
| Payload (without CRC) | 24 |

* + Option 2 (QC)
    - Consider 1x1 antenna configuration for rooftop scenario, and 1x2 antenna configuration for mobility scenario
    - Requirement: 1% BLER
* Recommended WF
  + Use simulation assumptions proposed in option 1 with necessary corrections based on discussion, except propagation condition (see issue 2-3)

## Companies views’ collection for 1st round

### Open issues

**Issue 1-1: PMCH test scope**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| EBU/BBC/IRT | We agree with the proposed WF. |
| QC | 2.5kHz SCS speed we prefer 120km/h, but if operator prefer 250km/h it is also acceptable to us |

**Issue 1-2: CAS test scope**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| EBU/BBC/IRT | Would it be possible to elaborate on why it is not necessary to define new performance requirements for the CAS given that format 4 involves aggregation level 16 and should therefore be more robust. In any case, we would like the simulations to be done to reflect the effect of the improved AL. |

**Issue 2-1: PMCH rooftop scenario propagation condition**

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| **Company** | **Comments** |
| EBU/BBC/IRT | Option 1 (QC) is preferred, and we agree with the assumptions it sets out. The 7-tap PDP example in R4-2000773 at the bottom of page 2 would be a good place to begin the discussion on power delay profiles for fixed rooftop.  We do not believe that the PDP in Option 2 would be sufficient. As presented in our discussion paper (R4-1914749) we believe it is essential to guard against pre-echoes or echoes with delays longer than the CP but within the equalization interval. The PDP in option 2 does not include taps that test for such echoes. |

**Issue 2-2: PMCH mobility scenario propagation condition**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| EBU/BBC/IRT | The delay profile in Option 1 (Huawei) appears to be in line with the 100us CP of this numerology, and it would seem pragmatic to re-use it. However, we also ask whether it would be prudent to include pre-echoes and echoes beyond the CP but within the equalization interval as per channel profile for rooftop in **Issue 2-1** as we expect for this sort of echoes to also occur in the mobile channel. |
| QC | Comments for option 1 and EBU’s comment:   1. We need to take operating scenario into consideration. If it is urban scenario, UE is likely to receive from 1 cell only since for other cells when signal reaches to UE, it is too weak due to blocking and reflections by dense buildings. On the other hand, in rural scenario, far cells can reach UE, but the number of taps/echoes from nearest cell and other cells should be small. 2. We agree with EBU’s comments on pre-echoes. However, pre-echoes are unlikely from cells except the nearest one. We can revise the first cluster of echoes in HW’s proposal, e.g., making the 4th echo the strongest echo and move it to 0, then the first 3 echoes become pre-echoes. 3. In mobile scenario, we prefer to keep all the taps inside CP (or slightly outside like option 1 last few echoes), because high Doppler spread is considered in this scenario, possible ICI is there already, adding ISI might prevent UE from achieving higher throughput. Also, very long delay tap is unlikely in mobility scenario, even in rural area, LOS from very far cell to vehicle is unlikely to exist due to car or building blocking. Echoes/taps outside CP is more likely in rooftop scenario, but not mobility scenario. |

**Issue 2-3: Propagation condition for CAS**

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| --- | --- |
| **Company** | **Comments** |
| EBU/BBC/IRT | Option 2 is preferred as it includes propagation conditions for both fixed rooftop reception and mobile reception (up to 250 kmph). |

**Issue 3-1: Simulation assumptions for PMCH rooftop scenario**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| EBU/BBC/IRT | The proposal appears to be in order. We highlight the following points:   * Fixed rooftop is normally intended to provide high capacity. We therefore suggest a MODCOD such as 64QAM 2/3 would be more representative of the modes deployed in such situations. * The Antenna configuration should be edited to be 1x1 instead of 1x2 in the table e.g. as highlighted in red below. * Regarding the “Test metric”: we think such a high BLER target is too high for broadcasting applications such as TV. For testing purposes broadcasters normally target quasi-error-free reception (e.g. 1 visible error per hour that translates to BER in the order of 10-11). Since achieving such a low BER is too onerous to obtain by simulations, BERs in the order of 10-7 are used as a compromise. Therefore, we would like to suggest a lower BLER target than 1%. A BLER target of 0.01% may be appropriate.  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **Test number** | **Cell** | **Bandwidth(MHz)** | **Modulation order** | **Propagation**  **condition** | **Antenna configuration** | **Test metric** | **MBSFN RS type** | **Number of MBSFN subframes per 40ms** | | 1 | Dedicated | 10 | 64QAM 2/3 | TBD | 1x1 | TBD | 1 | 13 | | 2 | Dedicated | 10 | 64QAM 2/3 | TBD | 1x1 | TBD | 2 | 13 | |
| QC | * Modulation order and code rate   We are open to discuss modulation order and code rate, and using 64QAM 2/3 code rate as starting point is fine for us. 64QAM 2/3 is close to TB size of 59256.   * Antenna configuration of 1x1 is good for us * Test metric   But we have serious concern for EBU’s comment on test metric. To get statistical significant results, we at least need to collect 100 block errors. With 0.01% BLER, 100 block errors require 10^6 received TBs in average, and with 3ms per TB, this leads to 50 minutes testing time in average per test. 50 minutes testing time is very long for RAN4/5 defined test, it can create huge burden on testing and debugging, might not be practical for 5G broadcast demod requirement. We suggest to have 0.5% BLER, smaller than legacy test but the testing time is reasonable. Another consideration is that 64QAM is high modulation order and 2/3 is high code rate, and the delay spread we considered in issue 1.2.2 is very large compared to LTE channels. Even with legacy LTE channels, 64QAM 2/3 requires high SNR to achieve BLER < 1%. With much larger delay spread, UE probably can’t achieve low BLER with 64QAM 2/3 no matter what PDP we agree. |

**Issue 3-2: Simulation assumptions for PMCH mobility scenario**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| EBU/BBC/IRT | Agree with proposed WF but we think the table needs to be amended as below:   * we think it should be “Dedicated” cell * “Test metric” should be discussed as per our comment in **Issue 3-1**. * The Modulation order that provides a system spectral efficiency (e.g. transport block size of 9912 bits) approximately 1 bps/Hz may be appropriate.  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | **Test number** | **Cell** | **Bandwidth(MHz)** | **Modulation order** | **Propagation**  **condition** | **Antenna configuration** | **Test metric** | **Number of MBSFN subframes per 40 ms** | | 1 | Dedicated | 10 | TBD | TBD | 1x2 low | TBD | 39 | |
| QC | MCS 13 is close to 1 bps/Hz. We can use MCS 13 as a starting point. |

**Issue 3-3: Simulation assumptions for CAS mobility scenario**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| EBU/BBC/IRT | Agree with proposed WF.   * we would like two tests, one test for fixed rooftop (1x1 antenna configuration) and one test for mobility (1x2 antenna configuration); |
| QC | Suggest to use the following table as WF, to incorporate EBU comments.  Can Huawei explain how target code rate is calculated? The number of coded bit in one CAS is 6RB\*92RE(/RB)\*2bits = 1104 bits, if all the repetition are considered as coded bits. With PBCH decoding based on one CAS subframe, the code rate should be 40/1104. By replacing code rate to 40/1104, then the rest of configurations look good to us. |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Test number** | **PBCH repetition pattern** | **PBCH Bandwidth** | **Transmission bandwidth** | **Reference channel** | **Propagation**  **condition** | **Antenna configuration** | **Test metric** |
| 1 | Table 6.6.4.1-1 in TS 36.211 | 1.4MHz | 10MHz | Table 2.2.3-2 | TBD | 1x1 low | 1% Pm-bch |
| 2 | Table 6.6.4.1-1 in TS 36.211 | 1.4MHz | 10MHz | Table 2.2.3-2 | TBD | 1x2 low | 1% Pm-bch |

### CRs/TPs comments collection

*Major close-to-finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

*Recommendations on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 |  |  |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provides recommendation on CRs/TPs Status update*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |