**3GPP TSG-RAN WG4 Meeting #94-e R4-2002379**

**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 [x]Hz |
| 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 CAS 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***

|  |  |
| --- | --- |
| $$l$$ | Slot and symbol number pair $\left(n\_{s}^{'},l^{'}\right)$ |
| 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 |
| Huawei, HiSilicon | We are OK for 0.37 kHz SCS new numerology for rooftop reception. For 2.5 kHz SCS new numerology for mobility, we suggest only test 250km/h since UE support 250km/h can also support 120km/h. |
| EBU, BBC, IRT | We also support 250 kmph. |

**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. |
| Huawei, HiSilicon | For PDCCH AL 16, we think there is no change in algorithm. We are OK to perform simulation first to evaluate the performance gain. |
|  |  |

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

|  |  |
| --- | --- |
| **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. |
| Huawei, HiSilicon | Option 1 is also acceptable for us. i.e. the following propagation condition:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Delay (us) | 0 | 130 | 220 | 240 | 400 | 520 | 650 |
| Relative power (dB) | -11 | -10 | -4.5 | -3.5 | -13 | -20 | -25 |

 |
| EBU, BBC, IRT | Thank you for the constructive approach. Our understanding is that the specific values of the table above (i.e. delays and relative powers) are subject to confirmation.  |

**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.
 |
| Huawei, HiSilicon | Considering pre-echoes, we prefer QC’s method to make the 4th echo the strongest echo and move it to 0, then the first 3 echoes become pre-echoes. |
| EBU, BBC, IRT | Thank you, this seems like a pragmatic way forward. |

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

|  |  |
| --- | --- |
| **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). |
| Huawei, HiSilicon | Option 2 is also acceptable for us but prefer 250 km/h for mobility case. |
| EBU, BBC, IRT | For mobility case we support 250 kmph test. |

**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.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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.  |
| Huawei, HiSilicon | We would like to get more clarification to choose 64QAM 2/3, also we have different TBS calculation from Qualcomm 486\*(5/6)\*50\*6\*(2/3)=81000, we are not sure if we missed anything.For antenna configuration, 1x1 is fine for us.For test metric, by referring to TR 36.776, the evaluation test metric used by RAN1 is 95% SINR point, the existing MBMS is using 1% BLER, the reliability performance for MBMS system needs to be ensured by many aspects not purely from demodulation performance point of view, we prefer to reuse the existing Rel-14 1% BLER test metric. |
| EBU, BBC, IRT | Thank you for the comments. Regarding the test metric, for convenience we accept 1% BLER for the tests. |

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

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| --- | --- |
| **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.  |
| Huawei, HiSilicon | For modulation order, to meet approximately 1 bps/Hz, maybe TBS of 9912 bits which correspond to MCS 12 is more suitable.For cell type, Dedicated cell is fine for us. |

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

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| --- | --- |
| **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. |
| Huawei, HiSilicon | We are OK with the following 2 cases.For coding rate, notice that the CAS subframe is repeated transmitted four times during 16 radio frames, the channel bits should be multiplied by 4(6\*92\*2\*4=4416). Therefore, the code rate should be 40/4416. |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **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

Executive summary of the discussion:

PMCH and PBCH in CAS demod test scope are mostly agreed. PDCCH requires more discussion, we would like to know if proposed WF based on 1st round discussion is agreeable.

We have good progress rooftop and mobile propagation condition discussion, however, based on 1st round discussion input, more work/simulations might be needed to finalize the propagation conditions. We propose the plan and suggestion, see if they are agreeable and can be written done in WF. Propagation conditions for CAS seems agreeable, please comment if I missed anything.

We have reached a good consensus for simulation assumptions for PMCH demod. Beside propagation conditions, MCS is the major open issues, and more simulation results are needed to decide reasonable MCS for demod test. Hence we recommend to simulate based on the agreed assumptions and starting point of propagation condition (based on the outcome of 2nd round discussion) and in next meeting we can further discuss MCS based on the simulation results. PBCH in CAS seems mostly agreeable, listed as tentative agreement below.

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Issue 1-1: PMCH test scope** | *Tentative agreements:** + 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, e.g., UE can report supported MBSFN type 1 or 2, and UE is not mandated to support both)
	+ 2.5 kHz SCS new numerology for mobility with 250km/h

*Recommendations for 2nd round:** If all companies agree with the tentative agreements above, we can put them on WF
* Could Huawei clarify “(corresponding test applicability needs to be specified)” before we put the tentative agreements into WF?
* In first round, 250km/h is agreed by all the companies. Can we proceed to discuss the corresponding Doppler? With 700MHz, the Doppler spread corresponds to 250km/h speed is 162Hz. Companies can comment on this Doppler spread number.
 |
| **Issue 1-2: CAS test scope** | *Tentative agreements** Define PBCH in CAS detection test

Pending issue:* Whether to define PDCCH in CAS detection test

Recommended WF: companies are encouraged to bring simulation results for PDCCH in CAS in next meeting for further discussion.*Recommendations for 2nd round:** If all companies agree with the tentative agreements and recommended WF above, we can put them on WF
 |
| **Issue 2-1: PMCH rooftop scenario propagation condition** | *Tentative agreement** Design propagation channel based on the following assumptions:
	+ 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.

Use the following propagation condition (in table below) as starting point, necessary adjustment can be made by appending echo/tap and adjustment of echo/tap location and power based on the agreed assumptions and modulation order/code rate *Pending issue:*Plan for next meeting:Since limited simulation results are provided in this meeting, it is recommended to use the agreed starting point for propagation condition together with the simulation assumptions in the following subtopics to provide simulation results in next meeting. Companies are encouraged to provide recommendation of propagation conditions adjustment based on simulation results in next meeting.*Recommendations for 2nd round:** If all companies agree with the tentative agreements and recommended WF above, we can put them on WF
* There are some typos and missed columns in the propagation condition we (QC) included in our contribution, companies please check if the correct version is acceptable (should be better aligned to the proposed assumptions)
* If the “plan for next meeting” listed in pending issue is agreeable, we can catch it in WF
 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Delay (us) | 0 | 130 | 220 | 240 | 400 | 520 | 650 | 800 |
| Relative power (dB) | -11 | -10 | -4.5 | -3.5 | 0 | -13 | -20 | -25 |

|  |  |
| --- | --- |
| **Issue 2-2: PMCH mobility scenario propagation condition** | *Tentative agreement** Pre-echo can be captured by the following adjustment to Huawei’s proposal: in first cluster, making the 4th echo the strongest echo and move it to 0, then the first 3 echoes become pre-echoes

*Recommendations for 2nd round:** Use Huawei’s proposal with the agreed modification as starting point (as the table shown below), continue the discussion

  |

|  |
| --- |
| Extended Delay Spread |
| Relative Delay [ns] | Relative Mean Power [dB] |
| -310 | -3.6 |
| -280 | -1.5 |
| -160 | -1.4 |
| 0 | 0 |
| 60 | -0.6 |
| 780 | -7.0 |
| 49650 | -10 |
| 49680 | -11.5 |
| 49800 | -11.4 |
| 49960 | -13.6 |
| 50020 | -10.6 |
| 50740 | -17.0 |
| 109650 | -20 |
| 109680 | -21.5 |
| 109800 | -21.4 |
| 109960 | -23.6 |
| 110020 | -20.6 |
| 110740 | -27.0 |

|  |  |
| --- | --- |
| **Issue 2-3: Propagation condition for CAS** | *Tentative agreement** Rooftop scenario: no mobility, AWGN is considered in this scenario
* Mobility scenario: EVA with 250km/h speed is considered in this scenario

*Recommendations for 2nd round:** If all companies agree with the tentative agreements, we can put them on WF
 |
| **Issue 3-1: Simulation assumptions for PMCH rooftop scenario**  | *Tentative agreement** Rooftop scenario agreed assumption is captured in the following table

*Pending issue: MCS**Recommendations for 2nd round:** If all companies agree with the tentative agreements, we can put them on WF
* Discuss MCS options to list on WF
 |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **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 | TBD | TBD | 1x1 | 1% PMCH BLER | 1 | 13 |
| 2 | Dedicated | 10 | TBD | TBD | 1x1 | 1% PMCH BLER | 2 | 13 |

|  |  |
| --- | --- |
| **Issue 3-2: Simulation assumptions for PMCH mobility scenario**  | *Tentative agreement** Mobility scenario agreed assumption is captured in the following table

*Pending issue: MCS**Recommendations for 2nd round:** If all companies agree with the tentative agreements, we can put them on WF
* Discuss MCS options to list on WF
 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **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 | 1% PMCH BLER | 39 |

|  |  |
| --- | --- |
| **Issue 3-3: Simulation assumptions for CAS mobility scenario**  | *Tentative agreement** CAS PBCH scenario agreed assumption is captured in the following tables

*Recommendations for 2nd round:** If all companies agree with the tentative agreements, we can put them on WF
 |

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| **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 | [AWGN] | 1x1 low | 1% Pm-bch |
| 2 | Table 6.6.4.1-1 in TS 36.211 | 1.4MHz | 10MHz | Table 2.2.3-2 | [EVA162Hz] | 1x2 low | 1% Pm-bch |

|  |  |
| --- | --- |
| $$l$$ | Slot and symbol number pair $\left(n\_{s}^{'},l^{'}\right)$ |
| 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 | 40/4416 |
| Payload (without CRC) | 24 |

*Recommendations on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 | R4-2002423 WF for 5G broadcast demod requirement | Qualcomm |

### 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)

First round summary is added to each issue for you convenience. The plan is to catch the tentative agreement in first round and any agreement in second round on pending issue and recommendation of discussion. Please comment on tentative agreement if any revision is wording/option is needed, and provide opinions for pending issue and recommendation.

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

*Tentative agreements:*

* + 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, e.g., UE can report supported MBSFN type 1 or 2, and UE is not mandated to support both)
	+ 2.5 kHz SCS new numerology for mobility with 250km/h

*Recommendations for 2nd round:*

In first round, 250km/h is agreed by all the companies. Can we proceed to discuss the corresponding Doppler? With 700MHz, the Doppler spread corresponds to 250km/h speed is 162Hz. Companies can comment on this Doppler spread number. Please bring up any other topics

|  |  |
| --- | --- |
| **Company** | **Comments** |
| EBU, BBC, IRT | * We do not agree with the following tentative agreement sub-bullet about 0.37 kHz SCS new numerology for rooftop reception test:

“*MBSFN RS type 1 and type 2 (corresponding test applicability needs to be specified, e.g., UE can report supported MBSFN type 1 or 2, and UE is not mandated to support both)*”. In a dedicated downlink only carrier, the UEs can be ROM (receive only mode) devices. Hence, no capability can be fed back to the transmitter. The UEs need to support both MBSFN RS types 1 and 2.* we agree with test scope for 2.5 kHz SCS.
* We agree with the Doppler spread of 162 Hz to model mobile reception at 250 kmph at 700 MHZ carrier frequency.

  |
| QC | * We suggest that in the WF, replace the current description by the following:

*Corresponding test applicability for UE with both Tx and Rx functionalities needs to be specified, e.g., UE can report supported MBSFN type 1 or 2, and UE is not mandated to support both*And add a note, “*For receiver only type UEs, the applicability rule related to RS types is FFS*” |
| Huawei, HiSilicon | * For Doppler, we agree 162Hz corresponding carrier 700MHz and velocity 250km/h.
* After double check with RAN1 core specification, we agree with EBU’s view about 0.37kHz SCS test. UE cannot report the capability for supported MBSFN RS types, it is configured by network. For 0.37kHz, both MBSFN RS type 1 and type 2 can be supported.
* @QC, if we reach common understanding about supporting of MBSFN RS type 1 and type 2, it is not necessary to add the note “*For receiver only type UEs, the applicability rule related to RS types is FFS*”
 |

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

*Tentative agreements*

* Define PBCH in CAS detection test

*Pending issue:*

* Whether to define PDCCH in CAS detection test

Recommended WF: companies are encouraged to bring simulation results for PDCCH in CAS in next meeting for further discussion.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| EBU, BBC, IRT | We agree with the tentative agreement and proposed WF. |

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

*Tentative agreement*

* Design propagation channel based on the following assumptions:
	+ 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.

Use the following propagation condition (in table below) as starting point, necessary adjustment can be made by appending echo/tap and adjustment of echo/tap location and power based on the agreed assumptions and modulation order/code rate

*Pending issue:*

Plan for next meeting:

Since limited simulation results are provided in this meeting, it is recommended to use the agreed starting point for propagation condition together with the simulation assumptions in the following subtopics to provide simulation results in next meeting. Companies are encouraged to provide recommendation of propagation conditions adjustment based on simulation results in next meeting.

*Recommendations for 2nd round:*

* There are some typos and missed columns in the propagation condition we (QC) included in our contribution, companies please check if the correct version is acceptable (should be better aligned to the proposed assumptions)

|  |  |
| --- | --- |
| **Company** | **Comments** |
| EBU, BBC, IRT | The latest corrected version of the PDP is acceptable to us as starting point for evaluations. We agree with the tentative agreement, plan for the next meeting and proposed WF. |
| Huawei, HiSilicon | It is acceptable for us. |

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

*Tentative agreement*

* Pre-echo can be captured by the following adjustment to Huawei’s proposal: in first cluster, making the 4th echo the strongest echo and move it to 0, then the first 3 echoes become pre-echoes

*Recommendations for 2nd round:*

* Use Huawei’s proposal with the agreed modification as starting point (as the table shown below), continue the discussion

|  |  |
| --- | --- |
| **Company** | **Comments** |
| EBU, BBC, IRT | We agree with this recommendation. |

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

*Tentative agreement*

* Rooftop scenario: no mobility, AWGN is considered in this scenario
* Mobility scenario: EVA with 250km/h speed is considered in this scenario

|  |  |
| --- | --- |
| **Company** | **Comments** |
| EBU, BBC, IRT | We agree with tentative agreement. |

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

*Tentative agreement*

* Rooftop scenario agreed assumption is captured in the following table

*Pending issue: MCS*

|  |  |
| --- | --- |
| **Company** | **Comments** |
| EBU, BBC, IRT | We agree with tentative agreement. |
| QC | We suggest the following options for MCS, but other options are not precluded if UE can’t achieve 1% BLER PMCH with necessary implementation margin with current options:For RS type Td=4 and Td=2:MCS 21, TBS 66592MCS 22, TBS 68808MCS 24, TBS 81176 |
| Huawei, HiSilicon | We prefer to also add MCS 18 for both Dt=4 and Dt=2 for next meeting evaluation besides those proposed by QC.MCS 18 for Dt=4, TBS 57336MCS 18 for Dt=2, TBS 51024@QC, for MCS 24, TBS should be 84760. |

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

*Tentative agreement*

* Mobility scenario agreed assumption is captured in the following table

*Pending issue: MCS*

|  |  |
| --- | --- |
| **Company** | **Comments** |
| EBU, BBC, IRT | We agree with tentative agreement. |
| QC | We suggest to use MCS 12 as a starting point, as suggested by Huawei, but other options are not precluded if UE can’t achieve 1% BLER PMCH with necessary implementation margin with MCS 12. |
| Huawei, HiSilicon | We are OK with MCS 12. |

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

*Tentative agreement*

* CAS PBCH scenario agreed assumption is captured in the following tables

|  |  |
| --- | --- |
| **Company** | **Comments** |
| EBU, BBC, IRT | We agree with tentative agreement. |

## Summary on 2nd round (if applicable)

Only issues which companies provided comments other than recommended WF is agreeable are listed below

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Issue 1-1: PMCH test scope** | *Pending issue: applicability rule for MBSFN RS type 1 and 2 for different UEs**Recommendations for WF:** Applicability rules are FFS
 |
| **Issue 3-1: Simulation assumptions for PMCH rooftop scenario**  | *Pending issue: MCS**Recommendation for WF(only MCS is on WF for simplicity):*For RS type Td=4:MCS 18, TBS [55056]MCS 21, TBS [63776]MCS 22, TBS [68808]MCS 24, TBS [81176]For RS type Td=2:MCS 18, TBS [48936]MCS 21, TBS [63776]MCS 22, TBS [68808]MCS 24, TBS [81176]Other options are not precluded if UE can’t achieve 1% BLER PMCH with necessary implementation margin with current options.Note that companies have different interpretation of the following sentence from 36.213, “*For PMCH with  the UE shall scale the derived transport block size by , then round half-way towards positive infinity to the closest valid transport block size in the union of Table 7.1.7.2.1-1 and Table 7.1.7.2.4-1 by including, in the rounding procedure, only the TBS entries in Table 7.1.7.2.1-1 with* $I\_{TBS}\leq 33B$ *and the entries in 7.1.7.2.4-1 for which the TBS\_L1 is present in Table 7.1.7.2.1-1 with* $I\_{TBS}\leq 33B$ *if the UE is configured by higher layers to decode the PMCH based on QPSK, 16QAM, 64QAM, and 256QAM, only the TBS entries in Table 7.1.7.2.1-1 with* $I\_{TBS}\leq 26A$ *and the entries in 7.1.7.2.4-1 for which the TBS\_L1 is present in Table 7.1.7.2.1-1 with* $I\_{TBS}\leq 26A$ *otherwise. The UE shall set the redundancy version to 0 for the PMCH*.”Therefore, TBS values are left in square bracket, companies are encouraged to provide input on the reflector after RAN4#94e meeting to have simulation assumption aligned. |
| **Issue 3-2: Simulation assumptions for PMCH mobility scenario**  | *Pending issue: MCS**Recommendation for WF:*Use MCS 12 as a starting point, but other options are not precluded if UE can’t achieve 1% BLER PMCH with necessary implementation margin with MCS 12. |

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| R4-2002423 WF | Based on 2nd round of comments collection, moderator recommend the WF as agreeable |