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

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

**Agenda item:** 7.13.3 / 7.13.4

**Source:** NTT DOCOMO, INC.

**Title:** Email discussion summary for RAN4#94e\_#87\_LTE\_high\_speed\_enh2\_Demod

**Document for:** Information

# Introduction

*Briefly introduce background, the scope of this email discussion and provide some guidelines for email discussion if necessary.*

*List of candidate target of email discussion for 1st round and 2nd round*

* 1st round: TBA
* 2nd round: TBA

The scope of this email discussion are Rel-16 LTE HST BS and UE demodulation requirements, and related agenda items are listed below:

7.13.3 UE Demodulation and CSI requirements (36.101)

7.13.3.1 Extension of demodulation requirements to CA

7.13.3.2 HST-SFN PDSCH demodulation requirements

7.13.3.3 Single tap HST PDSCH demodulation requirements

7.13.4 BS Demodulation requirements (36.104)

7.13.4.1 PUSCH demodulation requirements

7.13.4.2 PRACH requirements

List of candidate target of email discussion for 1st round and 2nd round

For UE demodulation:

* 1st round: Based on received comments, update related CRs
  + NOTE: If no further updates are needed, CR(s) may be agreed.
* 2nd round: Agree on CRs for TS 36.101

For BS demodulation:

* 1st round: Conclude the method of calculating SNR values for PUSCH and PRACH requirements
* 2nd round: Agree on CRs with final SNR values for TS 36.104 and TS 36.141

# Topic #1: UE Demodulation and CSI requirements (36.101) (7.13.3)

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-20xxxxx | Company A | Proposal 1:  Observation 1: |
| R4-2000872 | NTT DOCOMO, INC. | CRs to finalize PDSCH demodulation for HST-SFN with 500km/h velocity |
| R4-2001348 | Ericsson | CRs to finalize CA PDSCH demodulation for HST-SFN with 500km/h velocity |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 1-1: CRs for UE demodulation

*Sub-topic description:*

This sub-topic deals with finalization of UE demodulation performance requirements with 500km/h velocity.

*Open issues and candidate options before e-meeting:*

**Issue 1-1-1: Removal of square brackets**

* Proposals
  + Option 1: Remove all square brackets
  + Other options are not precluded
* Recommended WF
  + Remove all square brackets and agree on CRs.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |

### 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 |
|  |
| R4-2000872 |  |
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| R4-2001348 |  |
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## 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”* |
| R4-2000872 |  |
| R4-2001348 |  |

## 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”* |

# Topic #2: BS Demodulation requirements (36.104) (7.13.4)

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-20xxxxx | Company A | Proposal 1:  Observation 1: |
| R4-2000309 | Samsung | Simulation summary (To be uploaded) |
| R4-2000310 | Samsung | Observation 1: Due to the limited DMRS resource in small bandwidth, it is reasonable that there is performance loss with considering the inaccuracy frequency offset estimation.  Observation 2: The maximum Doppler value with 1944Hz is out of range of DMRS frequency offset tracking ability, even the DMRS in PUCCH. To some extent, with large Doppler value, there should be some performance loss.  Proposal 1: Encourage companies to provide the simulation results with ideal frequency offset for further alignment.  Proposal 2: Additional margin should be considered for deriving requirement, due to the diverse of two DMRS structure in PUSCH and PUCCH. |
| R4-2001452 | Huawei, HiSilicon | Ideal Simulation results for LTE PUSCH under HST single-tap |
| R4-2001720 | Nokia, Nokia Shanghai Bell | Observation 1: The choice of a Doppler compensation algorithm has an impact on PUSCH performance.  Observation 2: The SNR values for Scenario 1-LTE500b and Scenario 3-LTE500b are less than the corresponding SNR for Scenarios 1 and 3, respectively, which seems to be odd. A similar observation is made for Scenario 1-LTE500a and Scenario 3-LTE500a.  Proposal 1: SNR values for Scenario 1-LTE500b and Scenario 3-LTE500b that are smaller than the corresponding SNR for Scenario 1 and 3, respectively, should be excluded. |
| R4-2001718 | Nokia, Nokia Shanghai Bell | Observation 1: The SNR values for 1944 Hz for PRACH format 1, 2 and 3 are less than those for 1875 Hz, which seem to be odd.  Observation 2: As the frequency offset for 1944 Hz is slightly larger than 1875 Hz, the minimum SNR for achieving the target PRACH detection probability of 99% should be comparable to but not be less than the SNR values for 1875 Hz.  Observation 3: SNR values for the 1875 Hz frequency offset case can be used as a baseline for computing the final SNR based on simulation results of different companies.  Proposal 1: SNR values that are smaller or far greater than the corresponding SNR for 1875 Hz should be excluded from the averaging computation. |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 2-1: PUSCH

*Sub-topic description:*

This sub-topic deals with open issues related to PUSCH performance requirements for enhanced HST with 500km/h velocity.

*Open issues and candidate options before e-meeting:*

**Issue 2-1-1: Simulation alignment**

* Proposals
  + Option 1 (Samsung): Encourage companies to provide the simulation results with ideal frequency offset for further alignment.
  + Other options are not precluded
* Recommended WF
  + Further discussion is needed

**Issue 2-1-2: Additional margin**

* Proposals
  + Option 1 (Samsung): Additional margin should be considered for deriving requirement, due to the diverse of two DMRS structure in PUSCH and PUCCH.
  + Other options are not precluded.
* Recommended WF
  + Further discussion is needed

**Issue 2-1-3: Alignment of SNR values between existing and enhanced PUSCH HST tests**

* Proposals
  + Option 1 (Nokia): SNR values for Scenario 1-LTE500b and Scenario 3-LTE500b that are smaller than the corresponding SNR for Scenario 1 and 3, respectively, should be excluded.
  + Other options are not precluded.
* Recommended WF
  + Further discussion is needed

### Sub-topic 2-2: PRACH

*Sub-topic description*

This sub-topic deals with open issues related to PRACH performance requirements for enhanced HST with 500km/h velocity.

*Open issues and candidate options before e-meeting:*

**Issue 2-2-1: Alignment of SNR values between existing and enhanced PRACH tests**

* Proposals
  + Option 1 (Nokia): SNR values that are smaller or far greater than the corresponding SNR for 1875 Hz should be excluded from the averaging computation.
  + Option 2 (Samsung): Additional margin [0.5]dB
  + Other options are not precluded
* Recommended WF
  + Further discussion is needed

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 2-1:  Sub topic 2-2:  ….  Others: |
| Samsung | Sub topic 2-1:  Issue 2-1-1: Simulation alignment  Prefer option 1: Encourage companies to provide the simulation results with ideal frequency offset for further alignment  With small bandwidth, such as 1.4MHz and 3MHz, the SNR of 70%TP is lower than large bandwidth performance, around 1dB. Due to the limited DMRS resource in small bandwidth, it is reasonable that there is performance loss with considering the inaccuracy frequency offset estimation. While as indicated the simulation summary [2], the performance with different bandwidth in some companies results are very similar.  The SNR requirement with 70% TP is about -0.6 to -1.4dB in LTE. The alignment results should be around with -2.6 to -3.4dB with considering 2dB implementation margin. Considering the span of each company alignment result, the best performance should be around with -3.6 to -4.4dB.  Compare with LTE Rel-13 with 1340Hz Doppler value in HST open scenario, only the Doppler value is increasing with 1944Hz, To some extent, with large Doppler value, there should be some performance loss.  While as indicated in the simulation summary, the SNR with 70% under maximum Doppler value 1944Hz is better than the SNR with 70% under maximum Doppler value 1340Hz in some results  Issue 2-1-2: Additional margin  Prefer option 1: Additional margin should be considered for deriving requirement, due to the diverse of two DMRS structure in PUSCH and PUCCH. E.g. [0.5] dB margin can be considered, similarly other WI in LTE for requirement.  Since the PUSCH is considered as the measurement channel to specify the eNB performance for the high-speed train, it should be the baseline of requirement specified. With additional PUCCH configuration, the performance can be improved. Either using DMRS in PUCCH or DMRS in PUSCH for frequency offset estimation depends on BS implementation. From RAN4 perspective, the minimum requirement specified in RAN4 should consider the worst scenario. Considering the diverse of frequency tracking ability for two DMRS structure, we propose to add the additional margin for requirement. For example, LTE, we have already used additional 0.5dB margin for requirement, such as sTTI WI  Issue 2-1-3: Alignment of SNR values between existing and enhanced PUSCH HST tests  Prefer option 1: SNR values for Scenario 1-LTE500b and Scenario 3-LTE500b that are smaller than the corresponding SNR for Scenario 1 and 3, respectively, should be excluded.  Similar concern with Nokia, as mention in our contribution, the SNR with 70% under maximum Doppler value 1944Hz is better than the SNR with 70% under maximum Doppler value 1340Hz in some results. Compare with LTE, excepting for Doppler value, other simulation parameters are same.  Therefore, my understanding there are two proposals to handle the alignment issue, one option is to encourage interested companies to provide the ideal channel estimation results to further align. Another option is to remove some unreasonable results case by case.  Based on current summary result, most of results can be aligned. If no companies prefer to provide the ideal results with considering the effort and WI schedule, we agree with Nokia to remove some unreasonable results for requirement deriving.  Sub topic 2-2:  Issue 2-2-1: Alignment of SNR values between existing and enhanced PRACH tests  Prefer to use the different rule with PUSCH to handle the alignment of SNR for PRACH  Different with PUSCH, there is no strictly relationship for high frequency offset will results in the bad performance for PRACH. It depends on the PRACH detection window size, SCS of PRACH, restricted set.  Generally, the performance of 625Hz and 1875Hz should be the worst performance, where the value of 625Hz is the 0.5 times of SCS (1.25KHz), and 1875Hz is the 1.5 times of SCS (1.25Khz).  In RAN1 design, Normally, restricted set type A can allow the maximum Doppler value is 1.25KHz. For larger then 1250KHz, the correlation peak will be out of the (0, ±du) detection windows, which results in the detection ambiguity with cyclic shift.  As for restricted set type B, it can allow five detection windows with (0,±du, ±2 du)., and up to 2500KHz  In case with 625Hz and 1875Hz, he receiver is in difficult condition because several correlation peaks are observed, which results in the detection ambiguity with cyclic shift  While with 1944Hz, the strong correlation peak is far from the position of 1875Hz. So, it is expected that the performance of 1944Hz is slightly better than 1875Hz. The similar situation is existed for NR HST, the performance of 2334Hz is slightly better than 1875Hz. The reason is the strong correlation peak is close to 2500Hz.  In that sense, we prefer to handle the unaligned results case by case, different rule with PUSCH. One option is to add [0.5]dB margin. |
| Huawei | Sub-topic 2-1:  Issue 2-1-1: As per the latest result summary R4-2000309, only 3 cases still with diverse results, we do encourage company to double check and update their results if possible and try to align with each other. If still diverse results are left finally, RAN4 should discuss way forward how to handle the final requirements definition for those 3 cases, such as add additional margin, allow larger span or not take those results that cause larger span into account, etc.,  Issue 2-1-3: We have a little bit different view from Option 1. Take tunnel 5MHz scenario as an example, the simulation results provided by companies are shown below and we can observe the problem that average result for 1750Hz is worse than that for 1944Hz. However, when we only consider the results from companies who provide both 1750Hz and 1944Hz results, there is no such problem. The reason can be inferred that the companies who provide results are different and different companies use different frequency offset compensation algorithm so that there is some deviation about the average result. The same situation also exists between 1750Hz results and 1340Hz results which can be found in R4-082608.   |  |  |  | | --- | --- | --- | | Tunnel 5MHz | Value(dB) | | | 1750Hz | 1944Hz | | Samsung | 1.50 | 1.60 | | Ericsson | 0.80 | 0.80 | | Nokia | 1.66 | - | | Huawei | 0.43 | 0.43 | | Average(from R4-2000309) | 1.10 | 0.94 | | Average(companies that provide both 1750Hz and 1944Hz results) | 0.91 | 0.94 |   For 1944Hz cases, we do not think that the average results should be affected by 1750Hz result.  For 1750Hz cases, similarly, we do not think that the average results should be affected by 1340Hz results.  Therefore, we think that each scenario should be discussed separately and do not consider the impact of other scenarios considering the results from different companies and for different scenarios.  Similar view for PRACH requirements handling. |
| Nokia, Nokia Shanghai Bell | Sub-topic 2-1  Issue 2-1-1: Simulation alignment  Examining the summary of simulation results (R4-2000309) for PUSCH, two open issues:  1. The span of PUSCH for Open space scenario for 1750 Hz is greater than 2.5 dB but less than 3 dB.  2. The span of the other cases is less than 2 dB, but many of the average values are better than the corresponding HST Scenarios 1 (1350 Hz) and 3 (1150 Hz).    For bullet 1, a span greater than 2 dB can be expected since different Doppler compensation algorithms are used depending on implementation. If Doppler estimation is based on PUCCH DM-RS, then running simulations with ideal frequency offset estimations would not change the simulation results.  It is not clear if ideal frequency offset was used in the Rel-14 HST simulations.  For bullet 2, it is a concern if many of the average values are better than the corresponding HST Scenarios 1 (1350 Hz) and 3 (1150 Hz).  Issue 2-1-2: Additional margin  Option 1 is suited to address the open issue in bullet 2 above only.  One question is if the margin used to derive the impairment results for HST Scenario 1/3 and HST Scenario 1-LTE500/3-LTE500 is the same? The same margin should be used.  Issue 2-1-3: Alignment of SNR values between existing and enhanced PUSCH HST tests  Option 1 can be applied to address both bullets 1 and 2.  Sub-topic 2-2  Issue 2-2-1: Alignment of SNR values between existing and enhanced PRACH tests  Observations in R4-2001718 are based on simulation results. In addition to frequency offset 1944 Hz, simulations for 1875 Hz were run. Our simulation results do not show a significant difference between the two frequency offsets. An example is given below for 1875 Hz and 1944 Hz (without impairment) to confirm our observations. This is also not unexpected as the difference in the frequency is 69 Hz = 1944 Hz – 1875 Hz.      Examining the summary of simulation results (R4-2000309), two open issues:   1. The span of Format 0 (2/4/8 Rx) is greater than 3 dB 2. The span of the other formats is less than 2 dB, but the average is slightly better than 1875 Hz.   One question is if the margin used to derive the impairment results for 1944 Hz and 1875 Hz is the same? The same margin should be used.  The proposed option by Samsung to add a margin is an option to consider. However, it does not address the open issue in bullet 1. |
| Ericsson | Sub topic 2-1-1: No update our result from the last meeting. Let’s check the results.  Sub topic 2-1-2: It depends on the alignment status. If span is small, e.g., < 2dB, then we can set the requirements as usual. Same as other sub topics 2-1-3/2-1-4, we suggest to reviewing the updated simulation result summary, then discuss how to set requirements case by case in the 2nd round.  Sub topic 2-1-3: If we understand correctly the option 1 proposal by Nokia, does this mean the companies ideal simulation results for scenario 1-LTE500b and 3-LTE500b that are smaller than the corresponding SNR for scenario 1 and 3, respectively, in TS36.104, are excluded from the averaging computation? It could be one way if companies agree but we propose to review the updated simulation result summary first (same as 2-1-2) and then discuss how to derive the requirements in the 2nd round.  Sub topic 2-2-1: Same comment as 2-1-3. It could be one way if companies agree but we propose to review the updated simulation result summary first and then discuss how to derive the requirements in the 2nd round.  We would like to ask the moderator to highlight the test cases with large span (e.g., 2dB) after the 1st round. |
| NTT DOCOMO | Sub-topic 2-1-1: Taking into account of work plan, we need to conclude the requirements during this meeting, so we prefer to derive the requirements based on simulation results provided in this meeting.  Sub-topic 2-1-3: Based on the current simulation results in R4-2000309, the most of impairment results (Scenario 1-LTE500 and 3-LTE500) seem to be better performance than existing HST (Scenario 1 and 3) requirements. We need to discuss further one by one about how to derive the requirements.  Sub-topic 2-2-1: Based on latest simulation results provided from companies, for format 0, a span of simulation results is larger than 2dB, but the results seem to be aligned among Ericsson, Nokia and Samsung. We need further check on ideal simulation results for alignment.  For format 1/2/3, the most of results provided by companies are better than existing SNR values for 1875Hz frequency offset, so we couldn't solve this issue even if we take Option 1.  We added information into the following excel file for simulation summary in order to derive the requirements, and highlighted cases that are not align with existing requirements in red.  “R4-2000309 Simulation results summary of BS demodulation requirement for LTE Rel-16 HST\_Huawei\_DCM.xlsm”  For PUSCH, we observed that the most of impairment simulation results have better SNR values than existing HST requirements.  For PRACH format 0, we need further check on Huawei’s simulation results since other companies’ simulation results are already aligned.  For PRACH format 1/2/3, we observed that [0.5]dB additional margin can solve the issue of the alignment with existing PRACH requirement for 1875Hz frequency offset. |

### 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:* |

*Suggestion 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 provided recommendation on CRs/TPs Status update suggestion*

|  |  |
| --- | --- |
| **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”* |