3GPP TSG-RAN WG4 Meeting #97-e R4-201xxxx

E-meeting, 2 – 13 November, 2020

**Agenda item:** 7.10.1

**Source:** Moderator (China Telecom)

**Title:** Email discussion summary for [97e][325] NR\_DL256QAM\_FR2\_Demod

**Document for:** Information

# Introduction

This email thread discusses the demodulation and CSI reporting requirements for FR2 DL 256QAM in agenda 7.10.1.

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

* 1st round: Invite companies to provide comments (if any) on the recommended WF directly under each issue in section 1.2, 2.2 and 3.2, and on the CRs in section 1.3 and 2.3.
* 2nd round: TBA

# Topic #1: PDSCH normal demodulation requirements

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2014546 | Intel Corporation | Proposal 1: Define FR2 256QAM demodulation requirements for TDL-D 30 ns 35 Hz channel model. |
| R4-2014547 | Intel Corporation | Summary of simulation results |
| R4-2014674 | China Telecom | Updated work plan |
| R4-2014675 | China Telecom | Proposal 1: Use TDLA30-300 fading channel for PDSCH demodulation requirements. |
| R4-2015019 | ZTE | Proposal 1: Use TDLD30-75 fading channel. |
| R4-2015021 | ZTE | CR to demodulation performance requirements |
| R4-2015596 | Huawei, HiSilicon | CR on applicability and FRC for PDSCH normal demodulation for DL 256QAM for FR2 |
| R4-2015597 | Huawei, HiSilicon | Observation 1: Both Propagation condition of TDLD30-35 and TDLA30-300 is feasible.  Proposal 1: Define requirements for NR DL 256QAM for FR2 with the propagation condition of TDLA30-300. |
| R4-2016095 | Ericsson | Simulation results. |
| R4-2015314 | NTT DOCOMO, INC. | Observation 1  Table 1. Summary of ideal simulation results   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Rank | Channel Model | Antenna configuration | CBW (MHz) | SNR point (dB) @70%TP  Using MCS index: | | 20 | | 1 | TDLD  30-75 | 2x2 | 50 | 16.5 dB | | 1 | TDLA  30-300 | 2x2 | 50 | 17.4 dB |   Observation 2: Considering around 3dB impairment margin, TDL-D 30-75 and TDL-A 30-300 are testable under 50MHz CBW with full PRB allocation.  Proposal 1: Define FR2 DL 256QAM demodulation requirements with TDLA30-300 |

## Open issues summary

### PDSCH normal test parameters

**Issue 1-1: Propagation condition**

* *Agreement in RAN4 #96e (R4-2012666, WF)*
  + *Propagation condition*
    - *Use fading channel*
    - *In the next meeting, companies are encouraged to provide ideal and impairment results for both option 1A and option 1B, and down select one of the two options based on simulation results.*
      * *Option 1A: TDLA30-300*
      * *Option 1B: TDLD30-75*
* *Note: extra effort on TDLD channel model simplification is needed.*
* Proposals:
  + Option 1A: TDLA30-300 (CTC, Huawei, DCM)
    - CTC: 1) We do not see the testability issue when using TDLA30-300 channel. 2) NLOS is more practical for demodulation tests and no LOS model is used in Rel-15 FR2 demodulation tests. 3) LOS channel models including TDL-D and TDL-E have not been specified in TS 38.101-4 yet.
    - HW: 1) Both Propagation condition of TDLD30-35 and TDLA30-300 is feasible. 2) Extra effort on TDL-D channel model simplification is needed.
    - DCM: 1) Considering around 3dB impairment margin, TDL-D 30-75 and TDL-A 30-300 are testable under 50MHz CBW with full PRB allocation. 2) NLOS channel model (TDL-A) is more typical for UE demodulation tests than LOS channel model (TDL-D).
  + Option 1B: TDLD30-75 (ZTE, Intel)
    - ZTE: 1) LOS scenario could closer to the actual application scenario. 2) Performance of TDLD is better than TDLA.
    - Intel: Testing point for TDL-A channel model will be very close to SNR limit 22 dB.
* Summary of ideal simulation results (dB):

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Intel | CTC | ZTE | DCM | HW | E/// | SPAN | Average |
| TDLA30-300 | 18.9 | 17.8 | 18.4 | 17.4 | 17.94 | 17.3 | 1.6 | 18.0 |
| TDLD30-75 | 17.8 |  | 17.1 | 16.5 | 16.70 |  | 1.3 | 17.0 |
| AWGN |  |  |  |  |  | 15.3 | 0.0 | 15.3 |

* + Observations from the simulation results for TDLA30-300:
    - The ideal simulation results from 6 companies are well aligned, and the average of ideal simulation results is 18.0 dB.
    - When considering a 3dB margin including impairment margin and extra margin, the expected requirement value for TDLA30-300 is 21.0dB, which is testable under 50MHz CBW.
* Recommended WF
  + Based on the above observation, can we select option 1A, i.e., TDLA30-300?

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| **Company** | Comments collection for 1st round |
| XXX |  |
| China Telecom | We agree with the recommended WF. Based on all companies’ simulation results, both TDLA and TDLD conditions are testable. Considering extra effort on TDLD model simplification is needed, we still prefer option1A (TDLA30-300). |
| Rohde & Schwarz | Based on the RAN4 estimations in the past the proposed SNR values here should be testable. However during this meeting RAN5 is further analysing the demod testability for FR2. Based on R5-206168 and R5-205702, the crest factor is increased by up to 10 dB through the various fading profiles. The impact is currently being studied by RAN5 and this may lead to a further reduction of the testable SNR range depending on the fading profile and if/how much the signal could be clipped by the TE without affecting the test result.  Since this only affects TCs with fading SDR tests are not affected by the further testable SNR range reduction discussed in RAN5. |
| Qualcomm | We share the same concerns as ZTE and Intel. Prefer to stay with TDL-D30-75 for safely reserving the margin to ensure testability. Therefore, option 1B is supported. |
| ZTE | Considering the propagations in FR2 are most of LOS and TDLD could ensure testability, so we prefer option 1B. |
| Intel | Prefer Option 1B. For TDL-D, the SNR operating point is more testable. There are no requirements with LOS channel model, and it will be very beneficial from test coverage point of view to define requirements for such scenario. Also, based on section 5.2.1.10 in TR 38.883, we can observe that several companies show that TDL-D channel model is more suitable for achieving of performance benefits of 256QAM over 64QAM. |
| docomo | From the simulation results, both TDLA and TDLD are testable.  Option 1A is 1st priority. Option 1B is 2nd priority. |
| Huawei | As per concern from Rohde & Schwarz, we are not sure if TDLA30-300 or TDLD30-75 is feasible to test. We think it is better to make decision after RAN5’s study result. Or we can define the requirements with the note that 256QAM is not required to test if the defined SNR is larger than maximum testable SNR. Considering the extra workload is needed for TDL-D and TDL-A is more typically used, we prefer to TDLA30-300 for requirements definition. |
| Ericsson | According to the discussion papers from RAN5 as pointed out by R&S the demodulation requirements under fading conditions do not seem feasible to us. Introducing performance requirements which are not testable may cause confusion in the specification. It is not preferred to introduce test cases which are not testable. We should wait until RAN5 has concluded on the feasibility of FR2 testing under fading conditions before we create requirements. |

## Companies views’ collection for 1st round

### Open issues

Provided under each issue.

### CRs/TPs

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| **CR/TP number** | **Comments** |
| R4-2015021: draft CR for requirement and FRC, ZTE | Moderators’ note: According to the work plan agreed at RAN4 #96e, FRC will be included in HW’s CR. |
| China Telecom: On the coversheet, ‘Current Version’ is missing. The requirement part looks good for us. For the FRC table part, based on our calculation, HW’s version is correct. |
| ZTE: we will revise the FRC table as HW`s calculation result. |
| Intel: Section with requirements looks fine for us. |
|  |
| R4-2015596: CR on applicability and FRC, HW | Moderators’ note: As commented by RAN4 secretary, the CR number 0095 is missing on the coversheet. In addition, given that draft CR for the requirements is submitted in this meeting, we may consider both CRs are for endorsement. |
| China Telecom: Looks good for us |
| Qualcomm: we are fine with the endorsement. |
| Intel: looks fine for us. |

## 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.*

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

*Recommendations on WF/LS assignment*

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

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

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| **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*

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| **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: SDR requirements

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2014548 | Intel Corporation | Proposal 1: Do not define SDR requirements for FR2 256QAM. |
| R4-2014676 | China Telecom | Observation1: If 256QAM is not covered in the FR2 SDR requirements, for the band supporting 256QAM (maximum modulation format 8), additional efforts on deriving MCS1 based on 64QAM MCS table are needed.  Observation 2: The chance for using 256QAM in FR2 SDR test does exist, it is not reasonable to prevent introducing FR2 SDR tests due to the testability issue.  Proposal 1: Add 256QAM (modulation format of 8) to FR2 SDR requirements:   * Add MCS indexes 26, 21, 20 and 11 in MCS table 2 for both 1 and 2 MIMO layers. * Run simulations to derive the required SNR at 85% throughput for MCS 20 to MCS 26 in MCS table 2, with both 1 layer and 2 layers. |
| R4-2015315 | NTT DOCOMO, INC. | Proposal 1: Add 256QAM (modulation format of 8) to FR2 SDR requirements |
| R4-2015598 | Huawei, HiSilicon | CR on SDR requirements for DL 256QAM for FR2 |
| R4-2015599 | Huawei, HiSilicon | Observation 1: Considering extra 0.8dB margin,   * For maximum supporting MIMO layer 1, MCS 26 can be test only for the bandwidth less than 200MHz, MCS 20 can be test for the bandwidth less than 500MHz. * For maximum supporting MIMO layer 2, MCS 26 can be test only for the bandwidth of 50MHz, MCS 20 can be test for the bandwidth less than 200MHz.   Proposal 1: Do not define SDR requirements for FR2 256QAM for Rel-16. |
| R4-2015600 | Huawei, HiSilicon | Summary of simulation results for SDR requirements |
| R4-2016093 | Ericsson | Proposal 1: Do not define SDR requirements for FR2 256QAM |

## Open issues summary

### SDR test parameters

**Issue 2-1: Whether to define SDR requirements for FR2 256QAM**

* *Agreement in RAN4 #96e (R4-2012666, WF)*
  + *Whether to define SDR requirements for FR2 256QAM*
    - *Option 1: Add 256QAM (modulation format of 8) to FR2 SDR requirements*
    - *Option 2: Not to define FR2 SDR requirements for 256QAM*
* Proposal
  + Option 1: Add 256QAM (modulation format of 8) to FR2 SDR requirements (CTC, DCM)
    - CTC: 1) The chance for using 256QAM in FR2 SDR test does exist, it is not reasonable to prevent introducing FR2 SDR tests due to the testability issue.
    - DCM: 1) RAN4 has agreed not to put any limit on the upper SNR into the specification. In this sense, the introduction of SDR requirements and the testability issue should basically be discussed separately. 2) The possibility of using 256QAM in SDR test currently exists.
  + Option 2: Not to define FR2 SDR requirements for 256QAM (Intel, Huawei, Ericsson)
    - Intel: 1) Rather high MCSs (i.e. MCS 24-27) can be tested mainly for 50 and 100 MHz aggregated channel bandwidth. 2) If UE supports Rank 2 transmission and aggregated CBW 500 MHz for bands n257, 258, 261, then such UE will be tested with 64QAM modulation.
    - Huawei: The MCS for SDR testing is mainly limited by TE maximum achievable SNR, and 256QAM will not be tested in most of cases.
    - Ericsson: It is still to a certain extent questionable whether larger bandwidths with higher MCSs will see any benefit to UE performance testing.
* Analysis on testable SNR for SDR requirements:
  + CTC: According to the “Spreadsheet 2 - Demod SNR range calculator.xls” file attached to the TR 38.810, for indirect far field (IFF) method, at least the SNR of 19.9 dB is feasible for 100MHz channel bandwidth.
  + Huawei: The maximum testable SNR can be derived as per the following equations referenced from TS 38.810.

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| --- |
| SNRmax = Ps,max / Pnoise,Σ  Pnoise,Σ = NnoiseRF \* BW  Ptotal,max = Ps,max  SNRmax = Ptotal,max / (NnoiseRF \* BW) |

|  |  |  |  |
| --- | --- | --- | --- |
| Channel Bandwidth/MHz | Maximum SNR/dB | | |
| DNF | DFF | IFF |
| 50 | 32.75 | 29.55 | 29.85 |
| 100 | 29.87 | 26.67 | 26.97 |
| 200 | 26.86 | 23.66 | 23.96 |
| 400 | 23.85 | 20.65 | 20.95 |
| 500 | 22.88 | 19.68 | 19.98 |
| 600 | 22.09 | 18.89 | 19.19 |
| 700 | 21.42 | 18.22 | 18.52 |
| 800 | 20.84 | 17.64 | 17.94 |
| 900 | 19.83 | 16.63 | 16.93 |
| 1000 | 19.37 | 16.17 | 16.47 |

* + Intel: Testable SNR for Normal and SDR requirements is different because generation of noise is not needed for SDR and more power can be used for generation of useful signal.

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| **Band** |  | **Aggregated channel bandwidth, [MHz]** | | | | | | | | |
|  | **50** | **100** | **200** | **400** | **500** | **600** | **700** | **800** | **1000** |
| **n257, 258, 261** | **TE SNR, [dB]** | 32.1 | 29.3 | 26.3 | 23.2 | 22.3 | 21.5 | 20.8 | 20.2 | 18.8 |
| **Feasible MCS (Rank 1)** | MCS27 | MCS27 | MCS26 | MCS23 | MCS22 | MCS22 | MCS21 | MCS21 | N/A |
| **Feasible MCS (Rank 2)** | MCS27 | MCS26 | MCS23 | MCS21 | N/A | N/A | N/A | N/A | N/A |
| **n260** | **TE SNR, [dB]** | 29.5 | 26.7 | 23.7 | 20.6 | 19.7 | 18.9 | 18.2 | 17.6 | 16.2 |
| **Feasible MCS (Rank 1)** | MCS27 | MCS26 | MCS22 | MCS21 | MCS20 | N/A | N/A | N/A | N/A |
| **Feasible MCS (Rank 2)** | MCS26 | MCS23 | MCS21 | N/A | N/A | N/A | N/A | N/A | N/A |

* Analysis on testable bandwidth with MCS table 2 for SDR requirements:
  + Huawei: Assume DFF method is used, considering extra 0.8dB margin,
    - For maximum supporting MIMO layer 1, MCS 26 can be test only for the bandwidth less than 200MHz, MCS 20 can be test for the bandwidth less than 500MHz.
    - For maximum supporting MIMO layer 2, MCS 26 can be test only for the bandwidth of 50MHz, MCS 20 can be test for the bandwidth less than 200MHz.
  + Intel: we can observe that 256QAM MCS and Rank 2 can be tested for channel bandwidth up to 400 MHz for bands n257, n258, n261 and up to 200 MHz for band n260. Also, we can observe that rather high MCSs (i.e. MCS 24-27) can be tested mainly for 50 and 100 MHz aggregated channel bandwidth, which is not the case for SDR requirements.

Estimations on tested Data Rate for different MCS Tables

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Band** |  |  | **Aggregated channel bandwidth, [MHz]** | | | | | | |
|  |  | **150** | **200** | **400** | **500** | **600** | **700** | **800** |
| **n257, 258, 261** | **Rank 1** | **Data Rate MSC Table 1** | 5777 | 7701 | 15409 | 19260 | 23114 | 26965 | 29507 |
| **Data Rate MSC Table 2** | 7870 | 10494 | 18038 | 21317 | 24096 | 28112 | 32129 |
| **Data Rate gain, %** | **36%** | **36%** | **17%** | **11%** | **4%** | **4%** | **9%** |
| **Rank 2** | **Data Rate MSC Table 1** | 11555 | 15409 | 29509 | 35243 | 42292 | 45905 | 52462 |
| **Data Rate MSC Table 2** | 14266 | 18038 | 32131 | 35243 | 42292 | 45905 | 52462 |
| **Data Rate gain, %** | **23%** | **17%** | **9%** | **0%** | **0%** | **0%** | **0%** |
| **n260** | **Rank 1** | **Data Rate MSC Table 1** | 5777 | 7701 | 15409 | 18441 | 21144 | 22956 | 26236 |
| **Data Rate MSC Table 2** | 7500 | 9511 | 16064 | 19260 | 21144 | 22956 | 26236 |
| **Data Rate gain, %** | **30%** | **24%** | **4%** | **0%** | **0%** | **0%** | **0%** |
| **Rank 2** | **Data Rate MSC Table 1** | 11555 | 15409 | 26231 | 30323 | 36388 | 40173 | 41980 |
| **Data Rate MSC Table 2** | 12790 | 16064 | 26231 | 30323 | 36388 | 40173 | 41980 |
| **Data Rate gain, %** | **11%** | **4%** | **0%** | **0%** | **0%** | **0%** | **0%** |

* + - Significant tested data rate increasing can be observed only for scenarios with small aggregated channel bandwidth (**up to 500 MHz for n257, 258, 261** and **up to 200 MHz for n260**).
    - If UE supports Rank 2 transmission and aggregated CBW 500 MHz for bands n257, 258, 261, then such UE will be tested with 64QAM modulation. For band n260, similar situation will be observed in case UE supports Rank2 and aggregated CBW 400 MHz
* Recommended WF
  + Encourage further discussion.

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| **Company** | Comments collection for 1st round |
| XXX |  |
| China Telecom | Based on companies’ analysis, the probability of choosing 256QAM in SDR test does exist. As RAN4 has agreed not to put any limit on the upper SNR into the specification, it is not reasonable to prevent introducing FR2 SDR tests due to the testability issue. So, we still prefer adding 256QAM (modulation format of 8) to FR2 SDR requirements.  In addition, the issue has been discussed for several meetings, and interested companies have already brought simulation results, so the additional simulation efforts are very limited. Hope we can reach consensus in this meeting, so as to complete the WI by the next March. |
| Qualcomm | Since it’s not clear if SDR tests can be defined for all the cases, we prefer not to introduce it.  Option2 is supported. |
| Intel | Based on our understanding, RAN4 should define requirements which can be tested. FR2 has testability limitation, which we usually try to take into account as a part of discussion of FR2 requirements definition. Also, SDR testing procedure is defined under assumption that testable SNR is limited for FR2.  In our paper, we’ve showed, that the only scenarios, where 256QAM will be tested, are scenarios with rather low aggregated channel bandwidths and 64QAM or low modulation will be used for typical UEs, which support higher aggregated CBW. Based on our understanding, 256QAM feature was introduced to increase throughput for scenarios where we have limitation on available spectrum and throughput can not be increased by increasing of aggregated CBW. Therefore, testing od UEs, which support only around 200 MHz aggregated CBW in FR2, looks rather unpractical. |
| Huawei | In Rel-15, the MCS for SDR testing is mainly limited by UE capabilities. Only for some situations that large bandwidth combination with strong UE capability, the MCS for SDR testing is limited by TE maximum achievable SNR. For 256QAM, the MCS for SDR testing is mainly limited by TE maximum achievable SNR, and 256QAM will not be tested in most of cases. Therefore, it is suitable to not define SDR requirements for FR2 256QAM. |
| Ericsson | We support option 2. It is unclear if SDR requirements can be tested for all bandwidths and MCSes. |

**Issue 2-2: MCS and rank for SDR test**

* *Agreement in RAN4 #96e (R4-2012666, WF)*
  + *If it is agreed to define SDR requirements, consider the following test parameters:*
    - *MCS and rank*
  + *Option 1: Add MCS indexes 26, 21, 20 and 11 in MCS table 2 for both 1 and 2 MIMO layers. Run simulations for MCS 20 to MCS 26 in MCS table 2 to derive the required SNR achieving 85% of peak throughput under AWGN conditions.*
  + *Other options are not precluded.*
* Proposal
  + Option 1 (CTC)
    - Add MCS indexes 26, 21, 20 and 11 in MCS table 2 for both 1 and 2 MIMO layers.
    - Run simulations to derive the required SNR at 85% throughput for MCS 20 to MCS 26 in MCS table 2, with both 1 layer and 2 layers.
* Recommended WF
  + TBA

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| **Company** | Comments collection for 1st round |
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## Companies views’ collection for 1st round

### Open issues

Provided under each issue.

### CRs/TPs

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| --- | --- |
| **CR/TP number** | **Comments** |
| R4-2015598, CR on SDR, HW | Note: The secretary commented that the CR number 0096 is missing on the coversheet. |
| Company A: |
| Company B: |
| Company C: |

## 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.*

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

*Recommendations on WF/LS assignment*

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|  | **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*

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| **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”* |
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## 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*

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| **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 #3: CQI reporting requirements

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2014677 | China Telecom | Observation 1: Under AGWN condition, when the SNR is equal to or larger than 19dB, the percentage of reporting CQI corresponding to 256QAM (CQI index > 11) is 49.00 % or higher.  Observation 2: Under fading condition, when the SNR is equal to or larger than 16dB, the percentage of reporting CQI corresponding to 256QAM (CQI index > 11) is 36.00 % or higher.  Proposal 1: Define FR2 CQI reporting test using CQI Table 2 for both AWGN and fading conditions.  Proposal 2: Configure 19/20 dB for AWGN condition and 17/18 dB for fading condition as the higher SNR point in FR2 CQI table 2 test, and discuss the lower SNR point later.  Proposal 3: Except for the CBW, the other test parameters for Rel-15 CQI Table 1 test can be reused. |
| R4-2014678 | China Telecom | Summary of CQI reporting simulation results for FR2 DL 256QAM (TDD) |
| R4-2015601 | Huawei, HiSilicon | Proposal 1: RAN4 should define the performance requirements for NR DL 256QAM for FR2 with the cases that satisfying the demand that required SNR is less than 22.6dB for 50MHz bandwidth.  Proposal 2: Do not define CQI reporting requirements under AWGN channel.  Proposal 3: Do not define CQI reporting requirements under fading channel. |
| R4-2016092 | Ericsson | Observation 1: SNR testing points for 256QAM in CQI table 2 could be too high to be feasible in FR2, in both AWGN and fading conditions.  Observation 2: For fading environment there is a measurement uncertainty of upwards of 42% of CQI reported outside of the range median CQI ±1. For CQI values corresponding to 256QAM modulation order.  Proposal 1: Do not define CQI reporting requirements for FR2 DL 256QAM |
| R4-2016094 | Ericsson | Simulation results |

## Open issues summary

### CQI test parameters

**Issue 3-1: Whether to define FR2 CQI reporting requirements for CQI table 2**

* *Agreement in RAN4 #96e (R4-2012666, WF)*
  + *Whether to define FR2 CQI reporting requirements for CQI table 2*
    - *In the next meeting, decide whether to introduce the requirements for AWGN and/or fading conditions based on the simulation results under 50MHz CBW:*
    - *For AWGN condition, companies are encouraged to simulate the required SNR for achieving median CQI of [11, 12 and 13] in CQI table 2.*
    - *For fading condition, companies are encouraged to simulate the required SNR where CQI indices corresponding to 256QAM (i.e., 12 and higher) in CQI table 2 can be reported with at least [10%] probability.*
    - *If it is agreed to define FR2 CQI reporting test for CQI table 2, use channel bandwidth of 50MHz.*
* Proposal
  + For AWGN condition:
    - Option 1: Yes (CTC)
    - CTC: When the SNR is equal to or larger than 19dB, the percentage of reporting CQI corresponding to 256QAM (CQI index > 11) is 49.00 % or higher.
    - Option 2: No (Huawei, Ericsson)
    - Huawei: Median CQI 11 is expected at SNR 22dB (add 3dB margin), of which the modulation order is 64QAM.
    - Ericsson: CQI 12 corresponding SNR is 17 dB in AWGN channel condition. Given additional impairment margin and IM, this could be too high to be feasible as SNR testing point in FR2.
  + For fading condition:
    - Option 1: Yes (CTC)
    - CTC: When the SNR is equal to or larger than 16dB, the percentage of reporting CQI corresponding to 256QAM (CQI index > 11) is 36.00 % or higher.
    - Option 2: No (Huawei, Ericsson)
    - Huawei: after add 3dB margin, only CQI 11 can be tested for fading channel and 256QAM has no chance to be tested.
    - Ericsson: 1) CQI 12 corresponding SNR is 17 dB in TDLA30-35 channel condition. Given additional impairment margin and IM, this could be too high to be feasible as SNR testing point in FR2. 2) The reported median CQI accuracy for wideband fading scenario at 17dB SNR is quite unreliable.
* **Moderator’s observation:**
  + Observation 1: different metrics are used to judge whether 256QAM can be “covered” in both AWGN and fading conditions.
    - For AWGN condition: two kinds of metrics are used in the simulation:

|  |  |  |  |
| --- | --- | --- | --- |
| Metrics | E/// | CTC | HW |
| SNR achieving median CQI 11 | 16dB | 18dB | 19dB |
| Lowest SNR achieving median CQI 12 | 17dB | 20dB | 20dB |

* + - For fading condition: three kinds of metrics are used in the simulation:

|  |  |  |  |
| --- | --- | --- | --- |
| Metric | E/// | CTC | HW |
| 256QAM can be reported with > 50% probability, i.e., median CQI is 12 | 17dB |  |  |
| 256QAM can be reported with 36% probability |  | 16dB |  |
| SNR that 256QAM can be achieved with 0.1 BLER and with fixed CQI 12 |  |  | 20.74dB |

* + Observation 2: on additional margin
    - In Huawei and E///’s paper, ~ 3dB margin is considered, similar to PDSCH normal requirements. Does it mean ~3dB will be added in the final SNR test point in 38.101-4 on top of the simulation results?
    - Note: in Rel-15 CQI requirements, ~ 3dB margin is not added in the final SNR test point in 38.101-4.
* Recommended WF
  + Encourage comment/feedback on the above observations in the 1st round.

|  |  |
| --- | --- |
| **Company** | Comments collection for 1st round |
| XXX |  |
| China Telecom | Accurate CQI reporting is very important for link throughput improvement. If the performance of UE reporting CQI corresponding 256QAM cannot be verified, the usage of 256QAM will remain uncertain in real networks. In our view, the importance of 256QAM CQI reporting requirements is even higher than SDR requirements. Regarding the testability issue, as seen in the moderator summary, different metrics are used to judge whether 256QAM can be “covered” by different companies. With our proposed metric, 256QAM can be covered and the SNR points are testable. |
| Qualcomm | * + For AWGN condition:   We are open to discuss.   * + For fading condition:   We support option 2. |
| Huawei | In Rel-15 CQI requirements, we perform simulation to select the SNR value and there is no simulation results for alignment. There is no problem for 16QAM and 64QAM in Rel-15 since 16QAM and 64QAM can still be tested. However, considering impairment margin, if we run simulation to get the results that CQI 12 can be reported at 20dB, then in the real test scenario with same SNR that is 20dB, CQI 11 or smaller value is expected to be reported. Therefore, to ensure that 256QAM can be tested, extra 3dB margin is needed. |
| Ericsson | For AWGN:  our results show that CQI12 which corresponds to 256QAM modulation order is only achievable after SNR17 which is simulated without impairments in consideration. Furthemore, A lower bound on the CQI may need to be used to ensure that the UE does not report below CQI12 which would necessitate even higher SNR. Additionally, we need to test the SNR at two point in order to verify correct operation in AWGN condition, therefore we think it’s unfeasible to test CQI requirements under AWGN conditions.  For Fading:  In fading conditions our results show that at least SNR17 is needed to report CQI12. Our results are also ideal and without any impairment margin considered. As pointed out by R&S in the demodulation part of this thread, this SNR is well above what is discussed as being testable in RAN5. For fading conditions, we need to wait until RAN5 has concluded on the testable SNR limit under fading scenario. |

**Issue 3-2: SNR testing point**

* *Agreement in RAN4 #96e (R4-2012666, WF)*
  + *If it is agreed to define FR2 CQI reporting for CQI table 2, consider the following test parameters:*
    - *SNR testing point for the higher SNR:*
    - *For AWGN condition:*
* *Option 1: 19/20 dB*
* *Other options are not precluded.*
  + - *For fading condition:*
* *Option 1: 17/18 dB*
* *Other options are not precluded.*
  + - *Decide in the next meeting based on more simulation results.*
* Proposal
  + Option 1: 19/20 dB for AWGN, 17/18 dB for fading condition (CTC)
* Recommended WF
  + Encourage feedback from more companies.

|  |  |
| --- | --- |
| **Company** | Comments collection for 1st round |
| XXX |  |
|  |  |

## Companies views’ collection for 1st round

### Open issues

Provided under each issue.

## 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 |  |  |

## 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”* |