**3GPP TSG-RAN WG4 Meeting # 102-e R4-22**

**Electronic Meeting, 21 Feb. – 3Mar., 2022**

**Agenda item:** 10.6.5.1, 10.6.5.2, 10.6.5.3, 10.6.5.4

**Source:** Moderator (Ericsson)

**Title:** Email discussion summary for [102-e][318] NR\_DL1024QAM\_Demod

**Document for:** Information

# Introduction

In this email thread for DL 1024QAM Demod, the following topics will be covered:

1. General (10.6.5.1)
2. PDSCH requirements (10.6.5.2)
3. SDR requirements (10.6.5.3)
4. CQI requirements (10.6.5.4)

# Topic #1: General

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2205085**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205085.zip) | Ericsson | The work plan for UE demodulation requirement part is proposed as follows:   * RAN4#101-e, November 2021 (This meeting)   + Agree with the work plan for UE demodulation requirement part.   + Agree with the scope of UE demodulation and CSI reporting requirements.   + Agree with the initial simulation assumption for UE demodulation and CSI reporting requirements. * RAN4#101bis-e, January 2022   + Collect the initial simulation results for alignment.   + Narrow down the simulation assumption, if necessary, based on the initial simulation results.   + Decide the CR work split. * RAN4#102-e, February 2022   + Collect the simulation results.   + Finalize the test parameters for UE demodulation and CSI reporting requirements. * RAN4#103, May 2022   + Collect the simulation results.   + Agree with the demodulation and CSI reporting requirements based on the simulation results with impairments.   + Endorse the draft CRs for TS38.101-4. |
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## Open Issues Summary

Issue 1-1: Work plan and CR split

* Proposal (Ericsson): Confirm the work plan after Feb meetings
  + RAN4#102-e, February 2022
    - Collect the simulation results.
    - Finalize the test parameters for UE demodulation and CSI reporting requirements.
  + RAN4#103, May 2022
    - Collect the simulation results.
    - Agree with the demodulation and CSI reporting requirements based on the simulation results with impairments.
    - Endorse the draft CRs for TS38.101-4.
* Proposal (Ericsson): Confirm the CR work split

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| Clause | CR | Volunteer company |
| 5.1.1.x  6.1.1.x  [B.2.1.1] (\*) | Applicability of demodulation requirements  Applicability of CSI reporting requirements  [Delay profiles for FR1] | Qualcomm |
| 5.2.2.1.x  5.2.3.1.x  A.3.2.1.x | PDSCH demodulation requirements for FDD (2Rx and 4Rx)  FRC for PDSCH FDD | MediaTek |
| 5.2.2.2.x  5.2.3.2.x  A.3.2.2.x | PDSCH demodulation requirements for TDD (2Rx and 4Rx)  FRC for PDSCH TDD | Apple |
| 6.2.2.1.x  6.2.2.2.x  A.4 | CQI reporting definition under AWGN conditions for FDD (2Rx and 4Rx)  CSI reference measurement channels | Huawei |
| 6.2.3.1.x  6.2.3.2.x  5.5A | CQI reporting definition under AWGN conditions for TDD (2Rx and 4Rx)  Sustained downlink data rate provided by lower layers | Ericsson |

* *Recommended WF*
  + *Confirm the work plan and CR work split*

## Companies’ views collection for 1st round

### Open issues

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| **Company** | **Comments** |
| XXX | Issue 1-1: |
| Ericsson | Issue 1-1:  Support the recommended WF. |
| Qualcomm | Support the WF; |
| Huawei | Support the WF. |
| MediaTek | Support the recommended WF. |
| Intel | Support the WF |

## Summary for 1st round

### Open issues

**Issue 1-1: Work plan and CR split**

* Proposal (Ericsson): Confirm the work plan after Feb meetings
  + RAN4#102-e, February 2022
    - Collect the simulation results.
    - Finalize the test parameters for UE demodulation and CSI reporting requirements.
  + RAN4#103, May 2022
    - Collect the simulation results.
    - Agree with the demodulation and CSI reporting requirements based on the simulation results with impairments.
    - Endorse the draft CRs for TS38.101-4.
* Proposal (Ericsson): Confirm the CR work split

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| Clause | CR | Volunteer company |
| 5.1.1.x  6.1.1.x  [B.2.1.1] (\*) | Applicability of demodulation requirements  Applicability of CSI reporting requirements  [Delay profiles for FR1] | Qualcomm |
| 5.2.2.1.x  5.2.3.1.x  A.3.2.1.x | PDSCH demodulation requirements for FDD (2Rx and 4Rx)  FRC for PDSCH FDD | MediaTek |
| 5.2.2.2.x  5.2.3.2.x  A.3.2.2.x | PDSCH demodulation requirements for TDD (2Rx and 4Rx)  FRC for PDSCH TDD | Apple |
| 6.2.2.1.x  6.2.2.2.x  A.4 | CQI reporting definition under AWGN conditions for FDD (2Rx and 4Rx)  CSI reference measurement channels | Huawei |
| 6.2.3.1.x  6.2.3.2.x  5.5A | CQI reporting definition under AWGN conditions for TDD (2Rx and 4Rx)  Sustained downlink data rate provided by lower layers | Ericsson |

* *Agreement*
  + *Confirm the work plan and CR work split*
  + *No second round discussion*

### CRs/TPs

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| **CR/TP number** | **CRs/TPs Status update recommendation** |
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## Discussion in 2nd round

No need for the 2nd round discussion.

### CRs/TPs comments

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| **CR/TP number** | **Comments collection** |
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## Summary of 2nd round

# Topic #2: PDSCH requirements

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2203760**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203760.zip) | Apple | ***Observation #1:*** *There is no significant performance improvement with TDLD channel over TDLA.*  ***Observation #2:*** *TDLD is LOS channel more suitable for FR2 conditions.*  **Proposal #2: Define PDSCH demod requirements for 1024QAM with TDLA30-10 channel model.** |
| R4-2205086 | Ericsson | Summary of PDSCH simulation results for DL 1024QAM in FR1 |
| [**R4-2205087**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205087.zip) | Ericsson | **Proposal: Set TDLD30-5 for PDSCH demodulation requirements with 1024QAM.** |
| [**R4-2205748**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205748.zip) | Huawei,HiSilicon | 1. Select TDLD30-5 for 1024QAM PDSCH requirements. 2. Add extra 1dB margin for 2Rx requirements besides the impairment margin added by companies. |
| [**R4-2205904**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205904.zip) | MediaTek inc. | **Draft CR** |
| [**R4-2205905**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205905.zip) | MediaTek inc. | ***Proposal 1***: Consider TDLD 30-5 to define PDSCH requirements for 1024QAM. |
| [**R4-2206001**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2206001.zip) | Intel Corporation | Simulation results |
| [**R4-2206075**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2206075.zip) | Qualcomm Incorporated | **Observation 1: SNR requirement should be kept low, if possible, to avoid Tx EVM floor and introduction of large extra margins.**  **Proposal 1: For PDSCH requirements Propagation Channel, support Option 1: TDLD30-5.** |

## Open Issues Summary

**Issue 2-1: Propagation channel model**

* Previous agreements

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| --- |
| *Consider following options:*   * *Option 1: TDLA30-10* * *Option 2: TDLD30-5* |

* Proposals
  + Option 1: TDLA30-10 (Apple)
  + Option 2: TDLD30-5 (Qualcomm, Ericsson, Huawei, MTK)
* Recommended WF
  + *Discuss further based on the simulation summary.*

**Issue 2-2: Whether to add extra margin on top of the impairment margin**

* Previous agreements

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| * Discuss later after RAN4 derive SNR test point to achieve 70% of max Tput based on the impairment |

* Proposals
  + Option 1: Add extra 1dB margin for 2Rx requirements besides the impairment margin added by companies (Huawei)
* Recommended WF
  + *The moderator suggests discussing the extra margin value after deciding the channel model and summarizing the impairment results.*

## Companies’ views collection for 1st round

### Open issues

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| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 2-1:  Issue 2-2:  … |
| Ericsson | Issue 2-1:  Reviewing the draft simulation summary below, the average of alignment results of TDLD30-5 is about 1dB smaller than that of TDLA30-10. In order to avoid extra RF margin, we prefer to set TDLD30-5 (Option 2).  <https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_102-e/Inbox/Drafts/%5B102-e%5D%5B318%5D%20NR_DL1024QAM_Demod/Simulation%20results/draft%20R4-2205086%20simulation%20summary%201024QAM%20v00.xlsx>  Issue 2-2:  **To @Huawei:** RAN4 have added extra margin of 0.8dB for FR1 256QAM on top of the average of impairment results. Are you proposing to set 1.0dB instead of 0.8dB? |
| Apple | **Issue 2-1: Propagation channel model**  We think LOS channel is more suitable for FR2 conditions. Other than the operating SNR, can proponents of TDLD please clarify why TDLD is preferred for 1024QAM in FR1?  **Issue 2-2: Whether to add extra margin on top of the impairment margin**  Based on Ericsson’s clarification, we are fine to add 1 dB margin for final requirements derivation, if that’s the intention. |
| Qualcomm | **Issue 2-1**  We support using TDLD channel, which helps keep a lower SNR requirement. If TDL-A is chosen, we are worried about adding potential extra margin;  **Issue 2-2**  We are also fine with 1dB additional margin for 1024QAM in place of the 0.8dB used for 256QAM. |
| Huawei | **Issue 2-1: Propagation channel model**  Option 2. TDLD30-5 is more consistent with the application scenarios based on WID.  **Issue 2-2: Whether to add extra margin on top of the impairment margin**  To ensure enough impairment margin, we propose to consider additional 1dB margin besides the 0.8dB margin. However, we are also OK to add 1dB margin to replace to 0.8dB margin. |
| MediaTek | **Issue 2-1: Propagation channel model**  Prefer Option 2 with lower SNR requirements.  **Issue 2-2: Whether to add extra margin on top of the impairment margin**  We are also fine to add one 1dB extra margin besides the impairment margin. |
| Intel | **Issue 2-1: Propagation channel model**  Ok with both options. Slightly prefer Option 2.  **Issue 2-2: Whether to add extra margin on top of the impairment margin**  We are ok to add 1dB margin instead of 0.8dB margin. |
| Ericsson2 | **Issue 2-1: Propagation channel model**  **To @Apple:**  As you pointed out, TDLD30 was introduced to specify the PDSCH demodulation requirements with 256QAM in FR2.  For 1024QAM in FR1, as WID RP-213654 mentioned in Justification, it is assumed to be configured in high SNR better channel condition (e.g., LOS or LOS-like channels).   |  | | --- | | In Release-15, 3GPP introduced DL 1024QAM for LTE to enhance the network throughput further for UE, which has the possibility to provide some enhancements in FR1 scenarios with sufficiently high DL SINR and better channel conditions (e.g., LOS or LOS-like channels), with no mobility or very low mobility environment. Therefore, DL 1024QAM in FR1 can be specified for static links such as for fixed wireless access (FWA) links. |   This is one of the reasons we are supporting to use TDLD30. |
| Apple2 | Thanks for the clarification. We are fine to go with TDLD for PDSCH demod requirements. |

### CRs/TPs comments collection

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| **CR/TP number** | **Comments collection** |
| [**R4-2205904**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205904.zip) | [Moderator] According to the chairman’s guideline, this draft CR should be postponed to future RAN4 meetings. However companies can comment if any. |
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## Summary for 1st round

### Open issues

**Issue 2-1: Propagation channel model**

* Proposals
  + Option 1: TDLA30-10 (Apple)
  + Option 2: TDLD30-5 (Qualcomm, Ericsson, Huawei, MTK)
* *Agreement*
  + *TDLD30-5 for propagation channel model*
  + *No second round discussion*

**Issue 2-2: Whether to add extra margin on top of the impairment margin**

* *Proposals*
  + Option 1: Add extra 1dB margin for 2Rx requirements besides the impairment margin added by companies (Huawei)
* *Agreement*
  + *Add 1dB additional margin for PDSCH demodulation requirements with 1024QAM*
  + *No second round discussion*

### CRs/TPs

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| **CR/TP number** | **CRs/TPs Status update recommendation** |
| [**R4-2205904**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205904.zip) | Moderator suggests to postpone to RAN4 #103-e meeting. |

## Discussion in 2nd round

No need for the 2nd round discussion.

### CRs/TPs comments

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| **CR/TP number** | **Comments collection** |
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## Summary of 2nd round

# Topic #3: SDR requirements

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2203761**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203761.zip) | Apple | ***Observation #1:*** *With 2RX**the operating SNR with 1 layer is feasible with MCS 23. The operating SNR with 2 layers and 2RX is high for all MCS.*  ***Observation #1:*** *With 4RX**the operating SNR is reasonable for all MCS with 1 layer. The operating SNR with 2 layers is feasible with MCS 23.*  **Proposal #1: For 1024QAM SDR requirements with 2RX use as** **23 for 1 layer, no requirements for 2 layers. The MCS index table is introduced as:**  **MCS indexes for SDR test with 1024QAM for 2Rx**   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  |  |  |  |  |  | | 1 | 10 | 1 | 25 | 23 | 23 | | 1 | 10 | 0.8 | 21 | 21 | | 1 | 10 | 0.75 | 19 | 19 | | 1 | 10 | 0.4 | 9 | 9 |   **Proposal #2: For 1024QAM SDR requirements with 4RX use as** **25 for 1 layer, 23 for 2 layers. The MCS index table is introduced as:**  **MCS indexes for SDR test with 1024QAM for 4Rx**   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  |  |  |  |  |  | | 1 | 10 | 1 | 25 | 25 | 25 | | 1 | 10 | 0.8 | 21 | 21 | | 1 | 10 | 0.75 | 19 | 19 | | 1 | 10 | 0.4 | 9 | 9 | | 2 | 10 | 1 | 25 | 23 | 23 | | 2 | 10 | 0.8 | 21 | 21 | | 2 | 10 | 0.75 | 19 | 19 | | 2 | 10 | 0.4 | 9 | 9 | |
| [**R4-2205088**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205088.zip) | Ericsson | **Proposal: Set the practical MCS for SDR requirements for DL 1024QAM as follows:**   * **2Rx UE:**   + **MCS25 for Rank 1**   + **MCS23 for Rank 2** * **4Rx UE:**    + **MCS25 for Rank 1**   + **MCS24 for Rank 2** |
| [**R4-2205749**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205749.zip) | Huawei,HiSilicon | 1. Select = 25 for rank 1 and 23 for rank 2 for both 2Rx and 4Rx SDR requirements. |
| [**R4-2206002**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2206002.zip) | Intel Corporation | **Proposal 1: MCS index for is 25 for Rank 1 and 23 for Rank 2**. **Therefore, the MCS indexes for 1024QAM SDR tests can be defined as it is shown in Table 3.**  Table 3. MCS indexes for SDR test with 1024QAM   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  |  |  |  |  |  | | 1 | 10 | 1 | 25 | 25 | 25 | | 1 | 10 | 0.8 | 21 | 21 | | 1 | 10 | 0.75 | 19 | 19 | | 1 | 10 | 0.4 | 9 | 9 | | 2 | 10 | 1 | 25 | 23 | 23 | | 2 | 10 | 0.8 | 21 | 21 | | 2 | 10 | 0.75 | 19 | 19 | | 2 | 10 | 0.4 | 9 | 9 | |
| [**R4-2206075**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2206075.zip) | Qualcomm Incorporated | **Proposal 2:** **We are open to consider MCS 24 as practical MCS for SDR requirements;**  **Proposal 3:** **In case of concerns, consider reducing practical MCS to MCS23 for SDR tests with 2RX and Rank 2 only;** |

## Open Issues Summary

**Issue 3-1: MCS index for 2Rx**

* Previous agreements

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| * Rank 1   + Option 1: MCS25   + Option 2: MCS23 * Rank 2   + Option 1: MCS23   + Option 2: Not define SDR tests |

* Proposals
* Rank 1
  + Option 1: MCS25 (Ericsson, Huawei, Intel, Qualcomm)
  + Option 2: MCS24 (Qualcomm)
  + Option 3: MCS23 (Apple)
* Rank 2
  + Option 1: MCS23 (Ericsson, Huawei, Intel, Qualcomm)
  + Option 2: MCS24 (Qualcomm)
  + Option 3: Not define SDR tests (Apple)
* Recommended WF
  + *Discuss further*

**Issue 3-2: MCS index for 4Rx**

* Previous agreements

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| * Rank 1   + Option 1: MCS25   + Option 2: MCS23 * Rank 2   + Option 1: MCS23   + Option 2: FFS |

* Proposals
* Rank 1
  + Option 1: MCS25 (Apple, Ericsson, Huawei, Intel, Qualcomm)
  + Option 2: MCS24 (Qualcomm)
* Rank 2
  + Option 1: MCS23 (Apple, Huawei, Intel)
  + Option 2: MCS24 (Ericsson, Qualcomm)
* Recommended WF
  + *Set MCS25 for Rank 1 for 4Rx.*
  + *Discuss further for Rank 2 for 4Rx.*

## Companies’ views collection for 1st round

### Open issues

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| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 3-1:  Issue 3-2:  … |
| Ericsson | Issue 3-1: 2Rx  We support Option 1 for both rank 1/2: MCS 25 for Rank 1 and MCS 23 for Rank 2.    Issue 3-2: 4Rx  We support to set MCS25 for rank 1.  For Rank 2, we think it is feasible to set MCS24 from our simulation results. However we can also accept MCS23 since it is aligned with 2Rx. |
| Apple | **Issue 3-1: MCS index for 2Rx**  Based on our understanding the operating SNR should be ≤ 30dB. With MCS24 the SNR with no impairments is 29.5 dB (from our results) and with impairments will be > 30dB. Hence we proposed MCS 23 for rank 1.  For rank 2 no requirements as the operating SNR is > 30dB.  **Issue 3-2: MCS index for 4Rx**  MCS 25 for rank 1. Okay with recommended WF.  MCS 23 for rank 2 |
| Qualcomm | **Issue 3-1 and Issue 3-2**  With respect to the feedback regarding the SNR results for MCS 24 from Apple, we can see from the PDSCH results submitted to the last meeting RAN4#101-bis-e (R4-2201427) in which many companies also included MCS24 for Rank 1, that only one company has submitted results that were above SNR>30dB, while 4 others have submitted performance below SNR=30dB. But it should be noted that these results were generated for fading channel (TDLA/TDLD), so we can expect better performance for the SDR static single path channel.  We see the concerns regarding MCS25, but from our point of view MCS24 for provides high throughput in SDR scenarios and it is testable for Rank 1 within the testable SNR range (also considering that we are in parallel discussing CQI requirements targeting the same MCS and similar SNR range, including thermal noise), so we should not limit the Rank 1 requirement to MCS23.  We propose to compromise to this combination:  For both 2 and 4 RX:  Rank 1: MCS 24;  Rank 2: MCS 23; |
| Huawei | **Issue 3-1: MCS index for 2Rx**  We support MCS25 for rank1 and MCS23 for rank2 based on our simulation results.  **Issue 3-2: MCS index for 4Rx**  We support MCS25 for rank1 and MCS23 for rank2 based on our simulation results. |
| MediaTek | **Issue 3-1: MCS index for 2Rx**  We are OK to MCS24 for Rank 1. However, for the case of Rank 2, we share the imilar view as Apple that the operating SNR for 85% maximum throughput is around 30 dB. So, we prefer not to define requirements for Rank 2.  **Issue 3-2: MCS index for 4Rx**  We are fine to MCS24/MCS25 for Rank 1 and MCS23 for Rank 2. |
| Intel | **Issue 3-1: MCS index for 2Rx**  Support MCS25 for rank1 and MCS23 for rank2 based on our simulation results.  **Issue 3-2: MCS index for 4Rx**  Support MCS25 for rank1 and MCS23 for rank2 based on our simulation results. |
| Ericsson2 | Regarding the achievable SNR test points provided by the TE, RAN5 TS38.521-4 Table F.1.1.2-2 assumes downlink EVM <= 3% for SDR test, which is equivalent to 30.5dB.   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | |  |  |  | | --- | --- | --- | | Subclause | Maximum Test System Uncertainty | Derivation of Test System Uncertainty | | 5.5.1 FR1 Sustained downlink data rate performance for single carrier | ±0.7 dB, f ≤ 3.0GHz  ±1.0 dB, 3.0GHz < f ≤ 4.2GHz  ±1.5 dB, 4.2GHz < f ≤ 6GHz  Downlink EVM ≤ 3% | 3% EVM is equivalent to a Test system downlink SNR of 30.5dB. The noise from the Test system is then sufficiently below that required for the UE to demodulate the signal with the required % success rate. Under these conditions the UE throughput is limited by the Reference measurement channel and the UE capability, and not by the Test system EVM. | |   Since we have agreed to assume Tx EVM of 2.5% for 1024QAM in NR FR1, the test system downlink SNR becomes 32dB (=20\*log10(1/0.025)). Considering the maximum test system uncertainty (+/-1.5dB), we think we can achieve SNR=30dB at the antenna connector with noiseless condition.  We then propose to discuss MCS based on SNR=30dB at SDR tests. |
| Apple2 | Thanks @Ericsson for the reference. We suggest to capture companies’ results in static channel in the simulation summary to reach conclusion on the practical MCS. We are happy to do it after 1st round discussion. |
| Ericsson3 | We are fine with Apple’s suggestion to collect the simulation results of SDR test.  We will update the simulation summary to capture the companies’ results in the second round in this meeting. |

### CRs/TPs comments collection

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| **CR/TP number** | **Comments collection** |
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## Summary for 1st round

### Open issues

**Issue 3-1: MCS index for 2Rx**

* Proposals
* Rank 1
  + Option 1: MCS25 (Ericsson, Huawei, Intel, Qualcomm)
  + Option 2: MCS24 (Qualcomm)
  + Option 3: MCS23 (Apple)
* Rank 2
  + Option 1: MCS23 (Ericsson, Huawei, Intel, Qualcomm)
  + Option 2: MCS24 (Qualcomm)
  + Option 3: Not define SDR tests (Apple, MTK)
    - Apple&MTK: The operating SNR is > 30dB
* *Tentative agreement*
  + *Continue the discussion on MCS based on the simulation summary and assume SNR = 30dB for 1024QAM SDR test.*

**Issue 3-2: MCS index for 4Rx**

* Proposals
* Rank 1
  + Option 1: MCS25 (Apple, Ericsson, Huawei, Intel, Qualcomm, MTK)
  + Option 2: MCS24 (Qualcomm, MTK)
* Rank 2
  + Option 1: MCS23 (Apple, Huawei, Intel, Qualcomm, MTK, Ericsson)
  + Option 2: MCS24 (Ericsson, Qualcomm)
* *Agreement*
  + *MCS25 for rank1 and MCS23 for rank2*
  + *No second round discussion*

### CRs/TPs

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| **CR/TP number** | **CRs/TPs Status update recommendation** |
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## Discussion in 2nd round

### Open issues

**Issue 3-1: MCS index for 2Rx**

* Proposals
* Rank 1
  + Option 1: MCS25 (Ericsson, Huawei, Intel, Qualcomm)
  + Option 2: MCS24 (Qualcomm)
  + Option 3: MCS23 (Apple)
* Rank 2
  + Option 1: MCS23 (Ericsson, Huawei, Intel, Qualcomm)
  + Option 2: MCS24 (Qualcomm)
  + Option 3: Not define SDR tests (Apple, MTK)
    - Apple&MTK: The operating SNR is > 30dB
* *1st round agreement*
  + *Continue the discussion on MCS based on the simulation summary and assume SNR = 30dB for 1024QAM SDR test.*

### Companies’ views collection

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| --- | --- |
| **Company** | **Comments** |
| Apple | Issue 3-1  Based on the results with impairment margin MCS 23 for 1 layer and no requirements for 2 layer.  For 4RX based on the results with impairment margin we should use MCS 24 for 1 layer and MCS 23 for 2 layers. |
| Ericsson | Issue 3-1:  According to the simulation results summary, we tend to agree with Apple the practical MCS indexes should be:  2Rx Rank 1: MCS23  2Rx Rank 2: MCS22 or less  4Rx Rank 1: MCS24  4Rx Rank 2: MCS23  Regarding 2Rx Rank 2, we think it is only the case *fi*=1, we cannot set MCS index, but we can set MCS indexes for fi ={0.4, 0.75, 0.4} where can set MCSuppoerbound.  So Rank 2 Option 3 should be applicable only for *fi*=1. |
| Qualcomm | Based on the submitted simulation results, we are fine with using:  2RX:  Rank 1: MCS23;  Rank 2: No requirement, because it doesn’t seem to make sense to go below MCS23;  4 RX:  Rank 1: MCS 24;  Rank 2: MCS 23; |
| MediaTek | According to the summay of simuation results, we are OK to define requirements with the following MCS index.  2RX:   * Rank 1: MCS23 * Rank 2: No requirement   4 RX:   * Rank 1: MCS 24; * Rank 2: MCS 23; |

### CRs/TPs comments collection

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| **CR/TP number** | **Comments collection** |
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# Topic #4: CQI requirements

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2205089**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205089.zip) | Ericsson | **Proposal 1: Set SNR=29/30dB for 2Rx UE.**  **Proposal 2: Set SNR=26/27dB for 4Rx UE.** |
| [**R4-2205750**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205750.zip) | Huawei,HiSilicon | 1. Select rank1 with 28/29dB for 2Rx and 25/26dB for 4Rx for CQI reporting case. In addition, the extra 6dB margin for 2Rx and 4dB margin for 4Rx should be considered for UE implementation similar as Rel-16 DL FR2 256QAM WI did. |
| [**R4-2205751**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205751.zip) | Huawei,HiSilicon | **Draft CR** |
| [**R4-2205906**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205906.zip) | MediaTek inc. | ***Proposal 1***: Propose to select 28/29dB for 2Rx and 25/26dB for 4Rx for 1024 QAM CQI reporting test case. |
| [**R4-2206075**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2206075.zip) | Qualcomm Incorporated | **Proposal 4: Targeting CQI Index 14, support Option 2 for both 2Rx (29/30dB) and 4 Rx UEs (26/27) dB.**  **Observation 2: Proposed CQI Requirement for 2 RX, which goes up to 30dB SNR, might very close to the considered Tx EVM floor level. RAN4 should discuss whether this can have an impact on the test setup.** |

## Open Issues Summary

**Issue 4-1: Test point for 2Rx UE**

* Previous agreements

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| --- |
| * Option 1: SNR = 28/29dB * Option 2: SNR = 29/30dB * Other options not precluded * Evaluate SNR test point corresponding to CQI index 14 with Tx EVM 2.5% and decide in the next meeting. |

* Proposals
* Option 1: SNR = 28/29dB(Huawei, MTK)
* Option 2: SNR = 29/30dB (Ericsson, Qualcomm)
* Recommended WF
  + *Discuss further*

**Issue 4-2: Test point for 4Rx UE**

* Proposals
* Option 1: SNR = 25/26dB (Huawei, MTK)
* Option 2: SNR = 26/27dB (Ericsson, Qualcomm)
* Recommended WF
  + *Discuss further*

**Issue 4-3: Whether to add extra margin on top of the impairment margin**

* Proposals
  + Option 1: Yes (Huawei)
    - Option 1a: 6dB for 2Rx and 4dB for 4Rx (Huawei)
      * Huawei: The extra 6dB margin for 2Rx and 4dB margin for 4Rx should be considered for UE implementation similar as Rel-16 DL FR2 256QAM WI did.
* Recommended WF
  + *Discuss further*

## Companies’ views collection for 1st round

### Open issues

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| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 4-1:  Issue 4-2:  Issue 4-3:  … |
| Ericsson | Issue 4-1/4-2/4-3:  We think Issues 4-1/4-2/4-3 discussed together.  When RAN4 discussed the SNR test points for FR2 CQI reporting test with 256QAM CQI table in fading condition, the simulation results showed the SNR test points for CQI index corresponding to 256QAM is 17-19dB without impairment.  The final SNR test points to 20/21dB considering the impairment margin due to high SNR points, as commented by Huawei.   |  | | --- | | * *Agreements on the GTW session* * For the higher SNR:   + [20/21] dB   + Note: Above SNR test points agreed with the consideration of impairment margin due to high SNR points with 256QAM reporting configuration |   We are open to set SNR test points by assuming the impairment margin, however 6dB/4dB for 2Rx/4Rx is too much because the final requirements become around 35dB for 2Rx tests.  Since this CQI reporting test does not measure the reported CQI index values, we would like to keep the SNR test points around 30dB, although UE may not report the CQI index corresponding to 1024QAM.  So we propose to set SNR=30/31dB for 2Rx and 27/28dB for 4Rx.  (Cf. LTE sets SNR=28/29dB for PUCCH 1-0 static)  We would like to listen other companies view. |
| Apple | We understand Huawei’s comment about impairment margin, but don’t understand why we should have 6 and 4 dB impairment margin. We think 3 dB should be reasonable for 1024QAM.  Based on companies’ results Ericsson’s proposal seems reasonable. But we would like to check if >30dB SNR is possible. Is there is some limitation in testability? We would like to further check and confirm. |
| Qualcomm | The testability of the CQI requirement for 2RX is something that we should discussed. In fact the proposed 30dB, or more if we consider an implementation margin, is close to the assumed Tx EVM floor and this could have a ceiling effect on the CQI reporting from the UE.  First, we do not think we should introduce a large margin because this could potentially have two negative effects, one to bring UEs in the regime of CQI Index 15 if Tx EVM is lower than assumed, and two, to effectively saturate the measured CQI if Tx EVM corresponds to the assumptions and thus would make the test ineffective because of the SNR flooring (every UE implementation would potentially pass);  Considering that the test passing condition is not tied to the UE reporting CQI Index 14 but only to consistent and correct reporting by the UE, and that we can probably expect a Tx EVM from the TE to be lower than the worst case (2.5%) assumed in our simulation, we might be safe with the current proposals, but we would also like to hear other company’s opinion on this.  In any case we should first discuss the requirement and after that, the extra margin to be added on top. |
| Huawei | The equivalent SNR at the UE side contains the extra SNR added by channel simulator and the impact of EVM.  To ensure UE can report 1024QAM during the test, we propose to add 6dB and 4dB extra margin to make the equivalent margin at the UE side equal to about 3dB.  We think it is feasible to set the SNR larger than 30dB since the SNR is refer to the extra SNR added by channel simulator, the equivalent SNR is still lower than 30dB at the UE side.    If we cannot ensure UE reporting 1024QAM during the test, we think maybe it is better to not define such cases since it is duplicated test comparing the existing case. |
| MediaTek | We share the similar view with Qualcomm that it may cause some negative effects if too large margin is introduced. We should prevent UE to report the ighest CQI Index 15 and then fail the test. |
| Ericsson2 | We have the same comments as SDR test. According to the Tx EVM assumption of 2.5% for 1024QAM in FR1, we propose to assume the test system can provide SNR test point up to 30dB.  Considering this limitation, the SNR test points for 2Rx should be SNR=29/30dB or 30/31dB. |

### CRs/TPs comments collection

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| --- | --- |
| **CR/TP number** | **Comments collection** |
| [**R4-2205751**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205751.zip) | [Moderator] According to the chairman’s guideline, this draft CR should be postponed to future RAN4 meetings. However companies can comment if any. |
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## Summary for 1st round

### Open issues

**Issue 4-1: Test point for 2Rx UE**

* Proposals
* Option 1: SNR = 28/29dB(Huawei, MTK)
* Option 2: SNR = 29/30dB (Ericsson, Qualcomm)
* *Tentative agreement*
  + *This is the common understanding SNR corresponding to CQI index 14 for 1024QAM table is around 28-30dB for 2Rx UE without impairment margin.*
  + *Discuss the final requirements considering the impairment margin and SNR levels provided by TE.*

**Issue 4-2: Test point for 4Rx UE**

* Proposals
* Option 1: SNR = 25/26dB (Huawei, MTK)
* Option 2: SNR = 26/27dB (Ericsson, Qualcomm)
* *Tentative agreement*
  + *This is the common understanding SNR corresponding to CQI index 14 for 1024QAM table is around 26-28dB for 4Rx UE without impairment margin.*
  + *Discuss the final requirements considering the impairment margin and SNR levels provided by TE.*

**Issue 4-3: Whether to add extra margin on top of the impairment margin**

* Proposals
  + Option 1: Yes (Huawei)
    - Option 1a: 6dB for 2Rx and 4dB for 4Rx (Huawei)
      * Huawei: The extra 6dB margin for 2Rx and 4dB margin for 4Rx should be considered for UE implementation similar as Rel-16 DL FR2 256QAM WI did.
* *Tentative agreement*
  + *Discuss together with Issue 4-2 and 4-3.*

### CRs/TPs

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| **CR/TP number** | **CRs/TPs Status update recommendation** |
| [**R4-2205751**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205751.zip) | Moderator suggests to postpone to RAN4 #103-e meeting. |

## Discussion in 2nd round

### Open issues

**Issue 4-1: Test point for 2Rx UE**

* Proposals
* Option 1: SNR = 28/29dB(Huawei, MTK)
* Option 2: SNR = 29/30dB (Ericsson, Qualcomm)
* *1st round agreement*
  + *This is the common understanding SNR corresponding to CQI index 14 for 1024QAM table is around 28-30dB for 2Rx UE without impairment margin.*
  + *Discuss the final requirements considering the impairment margin and SNR levels provided by TE.*

**Issue 4-2: Test point for 4Rx UE**

* Proposals
* Option 1: SNR = 25/26dB (Huawei, MTK)
* Option 2: SNR = 26/27dB (Ericsson, Qualcomm)
* *1st round agreement*
  + *This is the common understanding SNR corresponding to CQI index 14 for 1024QAM table is around 26-28dB for 4Rx UE without impairment margin.*
  + *Discuss the final requirements considering the impairment margin and SNR levels provided by TE.*

**Issue 4-3: Whether to add extra margin on top of the impairment margin**

* Proposals
  + Option 1: Yes (Huawei)
    - Option 1a: 6dB for 2Rx and 4dB for 4Rx (Huawei)
      * Huawei: The extra 6dB margin for 2Rx and 4dB margin for 4Rx should be considered for UE implementation similar as Rel-16 DL FR2 256QAM WI did.
* *1st round agreement*
  + *Discuss together with Issue 4-2 and 4-3.*

### Companies’ views collection

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Issue 4-1 ~ 4-3  The maximum testable SNR is 30 dB. So we introduce 2RX requirements with 29/30dB and 4RX with 26/27 dB. It cannot be guaranteed if UE reports CQI 14/15 corresponding to 1024QAM in actual test set up due to impairments. At least based on companies’ results, UE would report CQI ≥ 14 at these SNR. |
| Ericsson | Issue 4-1 ~ 4-3.  We agree with Apple.  SNR=29/30dB for 2Rx and SNR=26/27dB for 4Rx according to the TE limitation with Tx EVM 2.5%. |
| Qualcomm | We support using 29/30dB for 2RX and 26/27dB for 4 RX; |
| MediaTek | As there are only few comapnies provide simulation results, maybe we can determine between two options in the next meeting. |

### CRs/TPs comments collection

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| **CR/TP number** | **Comments collection** |
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# Recommendations for Tdocs

## 1st round

Existing Tdoc:

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| --- | --- | --- | --- |
| **Tdoc number** | **Source** | **Recommendation** | **Comments** |
| [R4-2205085](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205085.zip) | Ericsson | Noted |  |
| [R4-2203760](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203760.zip) | Apple | Noted |  |
| R4-2205086 | Ericsson | Noted |  |
| [R4-2205087](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205087.zip) | Ericsson | Noted |  |
| [R4-2205748](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205748.zip) | Huawei,HiSilicon | Noted |  |
| [R4-2205904](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205904.zip) | MediaTek inc. | Noted |  |
| [R4-2205905](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205905.zip) | MediaTek inc. | Noted |  |
| [R4-2206001](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2206001.zip) | Intel Corporation | Noted |  |
| [R4-2206075](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2206075.zip) | Qualcomm Incorporated | Noted |  |
| [R4-2203761](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203761.zip) | Apple | Noted |  |
| [R4-2205088](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205088.zip) | Ericsson | Noted |  |
| [R4-2205749](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205749.zip) | Huawei,HiSilicon | Noted |  |
| [R4-2206002](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2206002.zip) | Intel Corporation | Noted |  |
| [R4-2205089](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205089.zip) | Ericsson | Noted |  |
| [R4-2205750](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205750.zip) | Huawei,HiSilicon | Noted |  |
| [R4-2205751](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205751.zip) | Huawei,HiSilicon | Noted |  |
| [R4-2205906](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205906.zip) | MediaTek inc. | Noted |  |

New Tdoc:

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| --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Comments** |
| R4-2xxxxxx | Way forward for NR  DL1024QAM demodulation  and CQI reporting  requirements | Ericsson |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics incl. existing and new tdocs.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. For new LS documents, please include information on To/Cc WGs in the comments column
4. Do not include hyper-links in the documents

## 2nd round

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| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
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Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. Do not include hyper-links in the documents

# Annex

Contact information

|  |  |  |
| --- | --- | --- |
| **Company** | **Name** | **Email address** |
| Ericsson | Kazuyoshi Uesaka | kazuyoshi.uesaka@ericsson.com |
| Apple | Manasa Raghavan | Manasa.raghavan@apple.com |
| Qualcomm | Pierpaolo Vallese | pvallese@qti.qualcomm.com |
| MediaTek | Licheng Lin | licheng.lin@mediatek.com |
|  |  |  |
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Note:

1. Please add your contact information in above table once you make comments on this email thread.
2. If multiple delegates from the same company make comments on single email thread, please add you name as suffix after company name when make comments i.e. Company A (XX, XX)