**3GPP TSG-RAN WG4 Meeting # 104-e R4-2214188**

**Electronic Meeting, 15 – 26 August 2022**

**Agenda item:** 9.18.6

**Source:** Moderator (Ericsson)

**Title:** Email discussion summary for [104-e][328] NR\_RedCap\_Demod

**Document for:** Information

# Introduction

This email discussion threads discusses the UE demodulation and CSI reporting requirements for RedCap. The target of the email discussion is summarized as follows:

* 1st round:
  + Solve the remaining open issues
  + Collect the simulation results
  + Collect the comment to draft CRs
* 2nd round:
  + Continue to solve the remaining open issues.
  + Review the revised draft CRs.

It is appreciated that the delegates for this topic put their contact information in the table below.

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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)

# Topic #1: General topics for UE demodulation and CSI reporting requirements

## Companies’ contributions summary

### General (9.18.5)

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2213066 | Nokia, Nokia Shanghai Bell | **Proposal 1:** Specify RedCap operation for FR2-1 only.  **Proposal 2:** Select MCS20 for 256QAM support for RedCap 1Rx UE. |

### PDSCH/SDR requirements (9.19.5.1.1)

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2211831 | Apple | **Proposal 1:** Define an additional PDSCH demodulation requirement for 1Rx 256QAM RedCap UEs set at MCS20. |
| R4-2212892 | Ericsson | **Proposal 1:** Specify the UE demodulation and CSI reporting requirements for 2Rx RedCap UE supporting HD-FDD in FDD bands as well as 1Rx UE. The requirements with HD-FDD should be the same as the corresponding (full-duplex) FDD requirements.  **Proposal 2:** RAN4 defines 256QAM demodulation requirements for 1Rx RedCap UE.  **Proposal 3:** For 1Rx RedCap UE, set MCS20 for 256QAM demodulation requirements. |
| R4-2213067 | Nokia, Nokia Shanghai Bell | **Proposal 1:** Include PDSCH results for alignment and for requirements specification into the simulation summary. |
| R4-2213789 | Huawei, HiSilicon | **Observation 1:** 10ms delay only give BS 1ms to process reported CSI which may be very strict. Furthermore, in Rel-15 TDD PMI test, the time offset between CSI reporting and CSI application is 5ms.  **Proposal 1:** Consider the following CSI feedback pattern:  For CSI requirements, configure the following CSI feedback scheduling pattern applicable for both FD-FDD and HD-FDD   * CQI reporting test in static/fading condition (periodic CSI reporting)   + CSI-RS periodicity and offset: 10/1   + CSI-Report periodicity and offset: 10/9   + CQI/RI/PMI delay: 14ms   PMI reporting tests (aperiodic CSI reporting)   * CSI request: 1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0.   + Reuse the FRC from Rel-15 PMI test (R.PDSCH 1-6.1 FDD). * Aperiodic Report Slot Offset: 3 slots * CQI/RI/PMI delay: 6ms   **Proposal 2:** Define 256QAM PDSCH performance requirements with 1RX UE with MCS22.  **Proposal 3:** Don't introduce RI test.  **Proposal 4:** Name the new section for RedCap performance requirements as “Minimum requirements for RedCap”. |
| R4-2213790 | Huawei, HiSilicon | Simulation results |
| R4-2213904 | MediaTek inc. | **Proposal 1:** Use MCS20 to define 1Rx 256QAM demodulation requirements for RedCap UE. |
| R4-2213964 | Qualcomm Incorporated | **Proposal 1:** According to the results of the alignment simulations, introduce 256QAM Demodulation requirements for RedCap UEs with 1RX using MCS 21 for FR1 FDD (15kHz).  **Proposal 2:** According to the results of the alignment simulations, introduce 256QAM Demodulation requirements for RedCap UEs with 1RX using MCS 21 for FR1 TDD (30kHz). |
| R4-2212889 | Ericsson | Simulation results summary |
| R4-2211835 | Apple | Draft CR: PDSCH demodulation requirements |
| R4-2212890 | Ericsson | Draft CR: Applicability of UE demodulation requirements |
| R4-2213795 | Huawei, HiSilicon | Draft CR: Sustained downlink data rate provided by lower layers |

### PDCCH/PBCH requirements (9.19.5.1.2)

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2211832 | Apple | Simulation results |
| R4-2212893 | Ericsson | Simulation results |
| R4-2213068 | Nokia, Nokia Shanghai Bell | **Proposal 1:** Include PDCCH results for alignment and for requirements specification into the simulation summary. |
| R4-2213069 | Nokia, Nokia Shanghai Bell | **Proposal 1:** Include PBCH results for alignment and for requirements specification into the simulation summary. |
| R4-2213791 | Huawei, HiSilicon | Simulation results |
| R4-2213906 | MediaTek inc. | Not available |
| R4-2213926 | MediaTek inc. | Simulation results |
| R4-2213965 | Qualcomm Incorporated | Simulation results |
| R4-2213794 | Huawei, HiSilicon | Draft CR: PBCH demodulation requirements |
| R4-2213905 | MediaTek inc. | Draft CR: PDCCH demodulation requirements |

### CQI requirements (9.19.5.2.1)

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2211833 | Apple | **Proposal 1:** Introduce CQI/RI/PMI delay of 14ms, along with proposed Resource/Report configuration of [10/1] [10/9] respectively. Delay of 10ms or 14ms is indifferent to UE, implies equivalent performance  **Proposal 2:** Introduce proposed Aperiodic Report Slot Offset 3 slots and CQI/RI/PMI delay of 6ms. |
| R4-2212894 | Ericsson | **Proposal 1:** For the wideband CQI reporting test with CQI table 1 in fading condition, set SNR=6/7dB for lower test points for RedCap 2Rx UE (both FDD 15kHz and TDD 30kHz).  **Proposal 2:** For CQI reporting tests for HD-FDD SCS=15kHz in static/fading condition, configure the following CSI feedback scheduling pattern.   * CSI-RS periodicity and offset: 10/5 * CSI-Report periodicity and offset: 10/9 * CQI/RI/PMI delay: 10ms |
| R4-2213070 | Nokia, Nokia Shanghai Bell | **Proposal 1:** Reuse existing CSI-RS configurations for CQI reporting tests for RedCap.  **Proposal 2:** Reuse value 0 for the overhead parameter for TBS determination from existing CSI RMCs for CQI reporting under static condition.  **Proposal 3:** Adopt new RMCs for CQI reporting under static condition in FR1 based on 52 and 51 RBs as depicted in the table below:  **Proposal 4:** Reuse existing test for CQI reporting under static condition in clause 8.2.2.2.1 and corresponding CSI RMC for RedCap UE in FR2-1.  **Proposal 5:** For the lower SNR test points for CQI reporting under fading condition, select the test points according to the majority view of contributing companies. |
| R4-2213071 | Nokia, Nokia Shanghai Bell | **Proposal 1:** Include CQI reporting results for alignment into the simulation summary. |
| R4-2213792 | Huawei, HiSilicon | Simulation results |
| R4-2213966 | Qualcomm Incorporated | **Proposal 1:** Regarding the tests points for CQI reporting test in fading condition for 2RX, support Option 2: SNR = 6/7 dB;  **Proposal 2:** For CSI Requirements, support Option 1=10ms for CQI/RI/PMI delay;  **Observation 1:** CQI reporting performances in static condition for the same SNR are expected to be similar for 1 RX/Rank=1 and 2 RX/Rank=2.  **Observation 2:** The agreed static channel matrix H = [1 1]; proposed for CQI simulation alignment when using the codebookSubsetRestriction = 000001 results in 3dB SNR gain, summing (with the same phase) 2 TX ports at the TE outpit;  **Observation 3:** The current agreements in [3] regarding the test points for CQI reporting test in static condition for RedCap UEs with 1Rx is not motivated by an expectation in performance but by the combination of choices for Channel Matrix and Codebook Index in the test setup;  **Observation 4:** A careful choice for the Static propagation condition channel matrix for 1 RX UE ;, extracted from Channel matrix already included in 38.101-4, Annex B.1 results in no additional SNR gain with the typical CodebookSubsetRestriction value agreed;  **Proposal 3:** For UE Receiver with 1 RX, define the static channel matrix in the frequency domain as ;  **Proposal 4:** If is used, test points for CQI reporting test in static condition for RedCap UEs with 1 RX are introduced X=0 dB lower than 2 RX (same test point for 1 RX and 2 RX);  **Proposal 5:** Define RI reporting requirements for RedCap 2 RX UEs, reusing test setup, metric and pass fail criteria from Rel.16 NR UEs where applicable;  **Proposal 6:** For RI reporting requirements for RedCap 2 RX in TDD, reuse the same test configuration with the exception of CBW configured 20MHz; |
| R4-2212891 | Ericsson | Draft CR: Applicability of CSI reporting requirements |
| R4-2213072 | Nokia, Nokia Shanghai Bell | Draft CR: CQI reporting requirements under static condition |
| R4-2213797 | Huawei, HiSilicon | Draft CR: Introduction of static propagation condition |
| R4-2213968 | Qualcomm Incorporated | Draft CR: CQI reporting requirements under fading condition |

### PMI/RI requirements (9.19.5.2.2)

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2211834 | Apple | **Proposal 1:** Do not define additional RI reporting requirements for RedCap UE. |
| R4-2212895 | Ericsson | **Proposal 1:** For PMI reporting tests, configure the following CSI feedback scheduling pattern for HD-FDD SCS=15kHz.   * CSI request: 1 in slots i, where mod(i, 5) = 1, otherwise it is equal to 0   + Reuse the FRC from Rel-15 PMI test (R.PDSCH.1-6.1 FDD), i.e., no PDSCH is scheduled where NZP-CSI-RS is transmitted. * Aperiodic Report Slot Offset: 3 slots * PMI delay: 6 ms   **Proposal 2:** If RAN4 define the RI test for 2Rx RedCap UE, defines only one test: throughput gain of follow RI over fix RI=2 in low correlation condition. In this case, apply the same requirements as the existing Rel-15 requirements, that is gamma1 > 1.05 with SNR=20dB. |
| R4-2213073 | Nokia, Nokia Shanghai Bell | **Observation 1:** MIMO operation is not one of the reduced capabilities of the RedCap UE.  **Proposal 1:** Define RI reporting requirements for 2 Rx RedCap UEs.  **Proposal 2:** Limit RI reporting tests to Test 2 for FR1 FDD/TDD and FR2 TDD.  **Proposal 3:** Reuse the RMCs, defined for RedCap CQI reporting under static condition in FR1, for RI reporting in FR1. |
| R4-2213793 | Huawei, HiSilicon | **Observation 1:** For case with FDD 4T1R, the SNR @90% of max TP with follow PMI is 8.4dB. Gama=2.14  **Observation 2:** For case with TDD 4T1R, the SNR @90% of max TP with follow PMI is 3.07 Db. Gama=3.4  **Observation 3:** For case with TDD 4T2R, the SNR @90% of max TP with follow PMI is 4.9 dB. Gama=1.6 |
| R4-2213796 | Huawei, HiSilicon | Draft CR: PMI reporting requirements |
| R4-2213074 | Nokia, Nokia Shanghai Bell | Draft CR: RI reporting requirements |

## Open issues summary

### Sub-topic 1-1 Specification structure

**Issue 1-1-1: UE demodulation and CSI reporting requirements for 2Rx RedCap UE supporting HD-FDD in FDD bands**

Open issues and candidate options before e-meeting: FFS for the UE demodulation and CSI reporting requirements for 2Rx RedCap UE supporting HD-FDD in FDD bands

* Proposals (Ericsson)
  + Specify the UE demodulation and CSI reporting requirements for 2Rx RedCap UE supporting HD-FDD in FDD bands as well as 1Rx UE.
  + The requirements with HD-FDD should be the same as the corresponding (full-duplex) FDD requirements.
* Recommended WF
  + Collect comments whether the proposal is acceptable or not.
  + If this is acceptable, revise the draft CR in the 2nd round, if necessary.

**Issue 1-1-2: Section names for RedCap UE demodulation and CSI reporting requirements**

* Proposals (Huawei)
  + Name the new section for RedCap performance requirements as “Minimum requirements for RedCap”.
* Recommended WF
  + Collect comments whether the proposal is acceptable or not.
  + If this is acceptable, revise the draft CR in the 2nd round, if necessary.

**Issue 1-1-3: Applicable FR2 bands for RedCap UE**

* Proposals (Nokia)
  + Specify RedCap operation for FR2-1 only.
* Recommended WF
  + Collect comments whether the proposal is acceptable or not.
  + (Moderator) If this is acceptable, moderator don’t this any update is needed on the draft CR.

## Companies views’ collection for 1st round

### Open issues

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| --- | --- |
| **Company** | **Comments** |
| XXX | **Issue 1-1-1: UE demodulation and CSI reporting requirements for 2Rx RedCap UE supporting HD-FDD in FDD bands**  **Issue 1-1-2: Section names for RedCap UE demodulation and CSI reporting requirements**  **Issue 1-1-3: Applicable FR2 bands for RedCap UE** |
| Ericsson | **Issue 1-1-1: UE demodulation and CSI reporting requirements for 2Rx RedCap UE supporting HD-FDD in FDD bands**  We support the proposal.  From the specification point of view, for PDCCH, PBCH, SDR, CQI and PMI requirements, we can have the common requirements for FD-FDD and HD-FDD.  For PDSCH we need two requirement tables: one for FD-FDD and another for HD-FDD because FD-FDD case reuses the Rel-15 FRC, as shown in our contribution R4-2212892.    See also the applicability rule in R4-2212890 and R4-2212891.  **Issue 1-1-2: Section names for RedCap UE demodulation and CSI reporting requirements**  Generally we are fine with the proposal.  Looking the requirements, we can add ‘for RedCap’ to PDSCH, PDCCH, CQI, and PMI requirements.  We don’t need to add ‘for RedCap’ to SDR and PBCH requirements.  **Issue 1-1-3: Applicable FR2 bands for RedCap UE**  Since RedCap is Rel-17 WI and FR2-2 is also Rel-17 WI, we agree FR2-2 is excluded from the scope of RedCap FR2 UE demodulation requirements. Please also note that UE PC7 is applicable only for FR2 bands n257/258/261.  As the moderator recommended, we don’t think this proposal affects to TS38.101-4. |
| Huawei | **Issue 1-1-1: UE demodulation and CSI reporting requirements for 2Rx RedCap UE supporting HD-FDD in FDD bands**  We prefer to follow the previous agreement that only defining HD-FDD requirements for 1RX UE.  **Issue 1-1-2: Section names for RedCap UE demodulation and CSI reporting requirements**  Support this proposal  **Issue 1-1-3: Applicable FR2 bands for RedCap UE**  OK with proposals from Nokia |
| MediaTek | **Issue 1-1-1: UE demodulation and CSI reporting requirements for 2Rx RedCap UE supporting HD-FDD in FDD bands**  We prefer to only define HD-FDD requirements for 1RX UE.  **Issue 1-1-2: Section names for RedCap UE demodulation and CSI reporting requirements**  We are OK to the proposal.  **Issue 1-1-3: Applicable FR2 bands for RedCap UE**  OK with the proposal to specify RedCap operation for FR2-1 only. |
| Apple | **Issue 1-1-1: UE demodulation and CSI reporting requirements for 2Rx RedCap UE supporting HD-FDD in FDD bands**  We support the proposal since a UE can support 1Rx or 2Rx in HD-FDD in FDD bands. If UE supports HD-FDD and 2RX, we should define requirements for that as well. During the previous meeting the discussion focused only on 1Rx requirements. These should be extended to 2Rx to have complete coverage.  **Issue 1-1-2: Section names for RedCap UE demodulation and CSI reporting requirements**  To avoid the excessive duplication of tables, we proposed in our draft CR to reuse the names already specified in 38.101-4. For 1RX requirements, the entire section needs to be created since no previous requirements had been agreed. For 2RX requirements, since the number of new tests is minimal, we propose to reuse existing sections and only add the incremental tests. The advantage of this is to produce minimum maintenance effort, since new RedCap tests can be unambiguously identified via Test Purpose tables and applicability rules.  We respectfully propose the involved companies to review the draft CR in R4-2211835.  **Issue 1-1-3: Applicable FR2 bands for RedCap UE**  We support the proposal coming from Nokia |

### CRs/TPs comments collection

No CR to be revised.

## 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:* |

### CRs/TPs

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

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

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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)

# Topic #2: UE demodulation requirements

## Companies’ contributions summary

See 1.1

## Open issues summary

### Sub-topic 2-1 PDSCH demodulation requirements

**Issue 2-1-1: Define 256QAM demodulation requirements for 1Rx RedCap UE in FR1 or not. If defined, what is the MCS?**

* Proposals
  + Option 1: Define 256QAM demodulation requirements for 1Rx RedCap UE in FR1
    - Option 1a (Nokia, Apple, Ericsson, MediaTek): MCS 20
    - Option 1b: (Qualcomm): MCS 21
    - Option 1c (Huawei): MCS 22
* Recommended WF
  + Define 256QAM demodulation requirements for 1Rx RedCap UE in FR1.
  + Most companies prefer to set MCS20. Moderator would like to ask if MCS20 is acceptable or not.

## Companies views’ collection for 1st round

### Open issues

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| --- | --- |
| **Company** | **Comments** |
| XXX | **Issue 2-1-1: Define 256QAM demodulation requirements for 1Rx RedCap UE in FR1 or not. If defined, what is the MCS?** |
| Ericsson | **Issue 2-1-1: Define 256QAM demodulation requirements for 1Rx RedCap UE in FR1 or not. If defined, what is the MCS?**  We support Option 1a, MCS20.  If we look the companies simulation results, required SNR for MCS20 with 1Rx is close to the SNR with 2Rx 256QAM requirements.  **Issue 2-1-1: Define 256QAM demodulation requirements for 1Rx RedCap UE in FR1 or not. If defined, what is the MCS?**  We support option 1c but also can compromise to option 1a |
| MediaTek | **Issue 2-1-1: Define 256QAM demodulation requirements for 1Rx RedCap UE in FR1 or not. If defined, what is the MCS?**  We share the same view as Ericsson and support Option 1a, MCS20. |
| Apple | **Issue 2-1-1: Define 256QAM demodulation requirements for 1Rx RedCap UE in FR1 or not. If defined, what is the MCS?**  We maintain our position of using MCS20 for 1RX 256QAM demodulation requirement. We share the same observation by stated above by Ericsson. |

### CRs/TPs comments collection

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2211835 (Apple) | **Title: Draft CR PDSCH demodulation requirements for RedCap** |
| Ericsson:  Section name mismatch between 5.2.1.1.1 and 5.2.1.2.1. Maybe 5.2.1.1.1 should be “Minimum requirements for RedCap UEs”  For 2Rx, according to WF R4-2210672, we suggest to create the dedicated sub-clauses for RedCap 2Rx UEs, e.g.,  5.2.2.1.16 Minimum requirements for RedCap UEs (for FDD)  5.2.2.2.17 Minimum requirements for RedCap UEs (for TDD)   |  |  |  | | --- | --- | --- | | 5.2 | PDSCH demodulation requirements |  | | 5.2.1 | 1RX requirements |  | | 5.2.1.1 | FDD |  | | 5.2.1.1.1 | Minimum requirements for RedCap UEs | New section | | 5.2.1.2 | TDD |  | | 5.2.1.2.1 | Minimum requirements for RedCap UEs | New section | | 5.2.2 | 2RX requirements |  | | 5.2.2.1 | FDD |  | | 5.2.2.1.X | Minimum requirements for RedCap UEs | New section | | 5.2.2.2 | TDD |  | | 5.2.2.2.X | Minimum requirements for RedCap UEs | New section |   For FDD, we also need to define new FRCs corresponding to HD-FDD pattern DDDSU, according to the conclusion of Issue 1-1-1. |
| Huawei:  1 May be the section 5.2.1.x is lost which is refer to FDD or TDD.  2 We propose to change name of 5.2.1.1.1 to be “Minimum requirements for RedCap”, change the name of 5.2.1.2.1 to be “Minimum requirements for RedCap ” rather than “Minimum requirements for RedCap UE”  3 For 2RX, we propose to change the section name “Minimum requirements for RedCap” rather than “Minimum requirements for RedCap UE”. We can create a new section for RedCap, we also propose to add “HD-FDD” in parameter table.  Apple:  Our main concern while creating this draft CR was to avoid excessive overhead and duplication of tables. For 1RX requirements, the entire section is entirely new, but for 2RX requirements, we can reuse the sections by via Test Purpose tables and applicability rules. |
|  |
| R4-2212890 (Ericsson) | **Title: draft CR: Applicability of RedCap UE demodulation requirements** |
| Ericsson: Update the clause numbers and test numbers. |
| Huawei: We propose to change all “RedCap UE” to “”RedCap” |
|  |
| R4-2213795 (Huawei, HiSilicon) | **Title: draftCR for introduction on sustained downlink data rate provided by lower layers for RedCap** |
| Ericsson: This is the agreements from the last meeting:   * For FR1, define SDR requirements with configuration 1T1R for UE supporting 1 layer and 2T2R for UE supporting 2 layers. * For FR2, define SDR requirements for 2 layers only with configuration 2T2R   Based on the agreements, we prefer to add the antenna configuration in Tables as follows.  **Table 5.5A-1: Common test parameters for FDD and TDD component carriers**   |  |  |  |  | | --- | --- | --- | --- | | Propagation condition | |  | Static propagation condition  No external noise sources are applied | | Antenna configuration | 1 layer CCs |  | 1x2 or 1x4 | | 2 layers CCs |  | 2x2 or 2x4 | | 4 layers CCs |  | 4x4 | | Antenna configuration for RedCap UE | 1 layer |  | 1x1 | | 2 layers |  | 2x2 | | Physical signals, channels mapping and precoding | |  | As specified in Annex B.4.1 |   **Table 7.5A.1-1: Test parameters for FR2 TDD**   |  |  |  |  | | --- | --- | --- | --- | | Propagation condition | |  | Static propagation condition  No external noise sources are applied | | Antenna configuration | 1 layer CCs |  | 1x2 | | 2 layers CCs |  | 2x2 | | Antenna configuration for RedCap UE | 1 layer |  | 1x2 | | 2 layers |  | 2x2 | | Physical signals, channels mapping and precoding | |  | As specified in Annex B.4.1 |   Then we can remove the following sentences:  - ‘For RedCap, antenna configuration is 1x1 for UE supporting 1 layer and 2x2 for UE supporting 2 layers’ from 5.5.1  - ‘For RedCap, antenna configuration is 2x2 for UE supporting 2 layers’ from 7.5.1. |
| Huawei: @Ericsson. In Rel-15 SDR test, MIMO layers can be different per band. for 2RX UE, MIMO layers are fixed to be 2 or depends on capability reporting per band? If MIMO layers is fixed to be 2, we propose to keep the current wording and add the following:”The MIMO layers is 2 for UE supporting 2 layers and 1 for UE supporting 1” since it is different from Rel-15 SDR test. If MIMO layers depends on capability per band, it is same as Rel-15 SDR test and we support your suggestion. |
|  |
| R4-2213794 (Huawei, HiSilicon) | **Title: Draft CR Introduction of PBCH performamce requirements for RedCap** |
| Ericsson:  ‘Note 1: The test case is also applicable for RedCap’ is not necessary from Tables 5.4.2.1-2, 5.4.2.1-3, 7.4.2.2-2, and 7.4.2.2-3, because the applicable tests for RedCap are specified in Applicability rule in R4-2212890. |
| Huawei: OK with Ericsson’s proposal |
|  |
| R4-2213905 (MediaTek inc.) | **Title: Draft CR to TS38.101-4, addition of PDCCH requirements for RedCap UEs** |
| Ericsson:  What is the difference between R.PDCCH.2-1.5 TDD and R.PDCCH.2-1.6 TDD?  If both FRCs are same, we only need to define one FRC and it can be used from 1Rx and 2Rx requirements. |
| MediaTek: Thanks for the comments from Ericsson. We agree that R.PDCCH.2-1.5 TDD can be used for both 1Rx and 2Rx requirements. We will modify it in the later revision. |
|  |

## 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:* |

### 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)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

# Topic #3: CSI reporting requirements

## Companies’ contributions summary

See 1.1

## Open issues summary

### Sub-topic 3-1 CQI reporting requirements

**Issue 3-1-1: CQI feedback scheduling pattern in static/fading condition (periodic CSI reporting) for both FD-FDD and HD-FDD**

* Proposals
  + Option 1 (Huawei, Apple, Nokia):
    - CSI-RS periodicity and offset: **10/1**
    - CSI-Report periodicity and offset: 10/9
    - CQI/RI/PMI delay: **14ms**
  + Option 2 (Qualcomm, Nokia):
    - CSI-RS periodicity and offset: **10/1**
    - CSI-Report periodicity and offset: 10/9
    - CQI/RI/PMI delay: **10ms**
  + Option 3 (Ericsson):
    - CSI-RS periodicity and offset: **10/5**
    - CSI-Report periodicity and offset: 10/9
    - CQI/RI/PMI delay: **10ms**
* Recommended WF
  + The differences among options are the slot offset of CSI-RS resource for CSI acquisition and CQI/RI/PMI delay.
  + Three companies prefer Option 1. Moderator would like to ask companies if there any technical concern for **Option 1**.

**Issue 3-1-2: Lower test points for CQI reporting test in fading condition for 2Rx (FR1 FDD and TDD)**

* Proposals
  + Option 1 (Ericsson, Qualcomm): SNR=6/7 dB
    - Option 1a (Nokia): select the test points according to the majority view
* Recommended WF
  + Set SNR=6/7dB for lower test points for CQI reporting test in fading condition for 2Rx

**Issue 3-1-3: Static channel matrix used for 1Rx UE and SNR test points for CQI reporting tests**

**Agreement from the last meeting:** Define the codebookSubsetRestriction for 2T1R to avoid the equivalent channel matrix is 0. Set codebookSubsetRestriction to 000001 if H = [1 1] is used. Set test points for CQI reporting test in static condition for 1Rx is XdB lower than 2Rx case, where X=3dB.

* Proposals
  + Option 1 (Qualcomm):
    - Set the static channel matrix in the frequency domain as .
    - If is used, set the same SNR test points for 1Rx and 2Rx UE CQI reporting tests in static condition, that is X=0dB.
  + Option 2 (Current assumption):
    - Set the static channel matrix in the frequency domain as .
    - Keep X=3dB.
* Recommended WF
  + Collect the companies view on the proposal by Qualcomm.

**Issue 3-1-4: Mapping of CQI index to information bit payload**

* Proposals (Nokia)
  + FR1:
    - Reuse value 0 for the overhead parameter for TBS determination
    - Set 52RB for 10MHz/15kHz and 51RB for 20MHz/30kHz.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| TBS Scheme | | | | TBS.1-1 | TBS.1-2 | TBS.1-X1 | TBS.1-X2 | TBS.1-X3 | TBS.1-X4 |
| MCS table | | | | 64QAM | | | | | |
| Number of allocated PDSCH resource blocks | | | | 66 | 66 | 52 | 52 | 51 | 51 |
| Number of consecutive PDSCH symbols | | | | 12 | 12 | 12 | 12 | 12 | 12 |
| Number of PDSCH MIMO layers | | | | 1 | 2 | 1 | 2 | 1 | 2 |
| Number of DMRS Res (Note 1) | | | | 24 | 24 | 24 | 24 | 24 | 24 |
| Overhead for TBS determination | | | | 6 | 6 | 0 | 0 | 0 | 0 |
| Available RE-s | | | | 7590 | 7590 | 6240 | 6240 | 6120 | 6120 |
| CQI index | Spectral efficiency | MCS index | Modulation | Information Bit Payload per Slot | | | | | |
| 0 | OOR | OOR | OOR | N/A | N/A | N/A | N/A | N/A | N/A |
| 1 | 0.2344 | 0 | QPSK | 1800 | 3624 | 1480 | 2976 | 1480 | 2856 |
| 2 | 0.2344 | 0 | 1800 | 3624 | 1480 | 2976 | 1480 | 2856 |
| 3 | 0.3770 | 2 | 2856 | 5640 | 2408 | 4744 | 2408 | 4616 |
| 4 | 0.6016 | 4 | 4480 | 8968 | 3752 | 7424 | 3752 | 7296 |
| 5 | 0.8770 | 6 | 6528 | 13064 | 5504 | 11016 | 5376 | 10760 |
| 6 | 1.1758 | 8 | 8712 | 17928 | 7296 | 14600 | 7168 | 14344 |
| 7 | 1.4766 | 11 | 16QAM | 11016 | 22032 | 9224 | 18432 | 8968 | 17928 |
| 8 | 1.9141 | 13 | 14344 | 28680 | 12040 | 24072 | 11784 | 23568 |
| 9 | 2.4063 | 15 | 17928 | 35856 | 15112 | 30216 | 14600 | 29192 |
| 10 | 2.7305 | 18 | 64QAM | 20496 | 40976 | 16896 | 33816 | 16896 | 33816 |
| 11 | 3.3223 | 20 | 25104 | 50184 | 20496 | 40976 | 20496 | 40976 |
| 12 | 3.9023 | 22 | 29192 | 58384 | 24576 | 49176 | 24072 | 48168 |
| 13 | 4.5234 | 24 | 33816 | 67584 | 28168 | 56368 | 27656 | 55304 |
| 14 | 5.1152 | 26 | 38936 | 77896 | 31752 | 63528 | 31240 | 62504 |
| 15 | 5.5547 | 28 | 42016 | 83976 | 34816 | 69672 | 33816 | 67584 |
| Note 1: Number of DMRS Res includes the overhead of the DM-RS CDM groups without data  Note 2: PDSCH is not scheduled on slots containing CSI-RS for tracking, CSI-RS for CSI acquisition and CSI-RS for beam refinement or slots which are not full DL  Note 3: PDSCH is not scheduled on slots containing PBCH, i.e. slot#0 per 20ms periodicity  Note 4: Spectral efficiency is based on MCS Table defined in Table 5.1.3.1-1 of TS 38.214 [12]  Note 5: TBS.1-3, TBS.1-4, TBS.1-5 and TBS.1-6 are applicable to RedCap UE. | | | | | | | | | |

* + FR2
    - Reuse existing test for CQI reporting under static condition in clause 8.2.2.2.1 and corresponding CSI RMC for RedCap UE in FR2-1
* Recommended WF
  + Companies are encouraged to review the mapping of CQI index to information bit payload proposed by Nokia.

### Sub-topic 3-2 PMI reporting requirements

**Issue 3-2-1: PMI feedback scheduling pattern (aperiodic CSI reporting) for both FD-FDD and HD-FDD**

* Proposals (Huawei, Apple, Ericsson)
  + CSI request: 1 in slots I, where mod(i, 5) = 1, otherwise it is equal to.
    - Reuse the FRC from Rel-15 PMI test (R.PDSCH 1-6.1 FDD)
  + Aperiodic Report Slot Offset: 3 slots
  + CQI/RI/PMI delay: 6ms
* Recommended WF
  + Agree with the proposal

### Sub-topic 3-3 RI reporting requirements

**Issue 3-3-1: Whether to define RI reporting requirements for RedCap 2Rx uEs**

* Proposals
  + Option 1: Define RI reporting requirements
    - Option 1a (Nokia, Ericsson): Apply Test 2 only.
    - Option 1b (Qualcomm): Apply 3 tests.
    - RI reporting is the mandatory capability for RedCap UE. It is necessary to verify 2 Rx RedCap UE reports the appropriate MIMO rank.
  + Option 2 (Huawei, Apple): Not define RI reporting requirements
    - To reduce the testing burden on a low-complexity device.
    - RI reporting test is only applicable for 2Rx UE and 2 layers which is still subject to the reported UE capability.
    - Performance gain with following RI is limited according to the exiting RI requirements, and in some cases, the negative performance gain can be observed
* Recommended WF
  + Collect views from companies. To avoid repeating the same discussion, the moderator would like to address the arguments above.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | **Issue 3-1-1: CQI feedback scheduling pattern in static/fading condition (periodic CSI reporting) for both FD-FDD and HD-FDD**  **Issue 3-1-2: Lower test points for CQI reporting test in fading condition for 2Rx (FR1 FDD and TDD)**  **Issue 3-1-3: Static channel matrix used for 1Rx UE and SNR test points for CQI reporting tests.**  **Issue 3-1-4: Mapping of CQI index to information bit payload**  **Issue 3-2-1: PMI feedback scheduling pattern (aperiodic CSI reporting) for both FD-FDD and HD-FDD**  **Issue 3-3-1: Whether to define RI reporting requirements for RedCap 2Rx uEs** |
| Ericsson | **Issue 3-1-1: CQI feedback scheduling pattern in static/fading condition (periodic CSI reporting) for both FD-FDD and HD-FDD**  We are ok with Option 1.  **Issue 3-1-2: Lower test points for CQI reporting test in fading condition for 2Rx (FR1 FDD and TDD)**  Support the recommended WF.  **Issue 3-1-3: Static channel matrix used for 1Rx UE and SNR test points for CQI reporting tests.**  The existing 2T2R channel matrix used for CQI reporting test is to provide the orthogonal channel suitable for reporting CQI index with rank 2. For 1Rx case, it only requires reporting CQI index with rank 1, we have no strong view either [1 1] or [1 j].  We slight prefer to keep the original proposal (i.e., Option 2) to avoid to rerun the simulation to verify the performance.  **Issue 3-1-4: Mapping of CQI index to information bit payload**  We also have the same table. Support this table.  **Issue 3-2-1: PMI feedback scheduling pattern (aperiodic CSI reporting) for both FD-FDD and HD-FDD**  Support the recommended WF.  **Issue 3-3-1: Whether to define RI reporting requirements for RedCap 2Rx uEs**  We support Option 1a.  We tend to agree the Rank 2 reporting functionality cannot be verified with PDSCH/SDR or CQI/PMI reporting tests, and RI reporting is the mandatory feature even for RedCap.  On the other hand, we also understand the concern on the increase of the number of tests for RedCap uEs.  Since the proponents of RI test are mainly interested in rank 2 reporting functionality, our compromised proposal is to reuse Test 2 (follow RI / fix RI=1 at high SNR test point) only. |
| Huawei | **Issue 3-1-1: CQI feedback scheduling pattern in static/fading condition (periodic CSI reporting) for both FD-FDD and HD-FDD**  Option 1  **Issue 3-1-2: Lower test points for CQI reporting test in fading condition for 2Rx (FR1 FDD and TDD)**  Option 1 is OK for us  **Issue 3-1-3: Static channel matrix used for 1Rx UE and SNR test points for CQI reporting tests.**  We prefer [1 1] to follow previous agreements.  **Issue 3-1-4: Mapping of CQI index to information bit payload**  OK with this table  **Issue 3-2-1: PMI feedback scheduling pattern (aperiodic CSI reporting) for both FD-FDD and HD-FDD**  Support the recommended WF.  **Issue 3-3-1: Whether to define RI reporting requirements for RedCap 2Rx uEs**  Option 2. |
| MediaTek | **Issue 3-1-1: CQI feedback scheduling pattern in static/fading condition (periodic CSI reporting) for both FD-FDD and HD-FDD**  Apple mentioned in the Todc “Delay of 10ms or 14ms is indifferent to UE, implies equivalent performance”. However, according to the simulation results provided by Ericsson, there is performance difference for delay of 14ms and 10 ms. Therefore, we propose that companies can provide simulations in the next meeting to check if the performance degradation can be acceptable and then determine the delay.  **Issue 3-1-2: Lower test points for CQI reporting test in fading condition for 2Rx (FR1 FDD and TDD)**  Support the recommended WF.  **Issue 3-1-3: Static channel matrix used for 1Rx UE and SNR test points for CQI reporting tests.**  We have no strong view for both Options. The proposal from Qualcomm is OK to us but we slightly prefer keeping the previous agreements to avoid rerunning the simulation.  **Issue 3-1-4: Mapping of CQI index to information bit payload**  OK with the proposed Table.  **Issue 3-2-1: PMI feedback scheduling pattern (aperiodic CSI reporting) for both FD-FDD and HD-FDD**  OK with the recommended WF.  **Issue 3-3-1: Whether to define RI reporting requirements for RedCap 2Rx uEs**  Prefer option 2 as RI reporting test is only applicable for 2Rx UE and 2 layers. |
| Apple | **Issue 3-1-1: CQI feedback scheduling pattern in static/fading condition (periodic CSI reporting) for both FD-FDD and HD-FDD**  Our proposal is based on 10/1 and 10/9 as CSI Resource and Report Periodicity/Offset respectively. We support the majority view on 14ms of delay, Option 1, but we may also consider a 10ms delay. This, since the issue between 14ms or 10ms is only a slight performance difference of the test setup. This does not produce any actual burden to the UE. We want to note that the performance difference reported by Ericsson is rather minor, and that it also corresponds to a different CSI Resource Periodicity.  **Issue 3-1-2: Lower test points for CQI reporting test in fading condition for 2Rx (FR1 FDD and TDD)**  We support the recommended WF.  **Issue 3-1-3: Static channel matrix used for 1Rx UE and SNR test points for CQI reporting tests.**  We have no strong view on these options. It would be better to keep the previous agreement to avoid re-running simulations and avoid extending the discussion.  **Issue 3-1-4: Mapping of CQI index to information bit payload**  We support the table proposed by Nokia.  **Issue 3-2-1: PMI feedback scheduling pattern (aperiodic CSI reporting) for both FD-FDD and HD-FDD**  We agree with the recommended WF.  **Issue 3-3-1: Whether to define RI reporting requirements for RedCap 2Rx uEs**  We remain in our position of Option 2 of not defining RI reporting requirements. |

### CRs/TPs comments collection

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2212891 (Ericsson) | **Title: draft CR: Applicability of RedCap UE CSI reporting requirements** |
| Ericsson: Update the clause numbers. |
|  |
|  |
| R4-2213072 (Nokia, Nokia Shanghai Bell) | **Title: Channel quality reporting for RedCap under static condition** |
| Ericsson:  As it is proposed in WF R4-2210672, not use suffix ‘B’. We suggest to use the following section numbers for CQI reporting requirements in static condition.   |  |  |  | | --- | --- | --- | | 6.2.1 | 1RX requirements |  | | 6.2.1.1 | FDD |  | | 6.2.1.1.1 | CQI reporting definition under AWGN conditions |  | | 6.2.1.1.1.1 | Minimum requirement for periodic CQI reporting for RedCap | New section | | 6.2.1.2 | TDD |  | | 6.2.1.2.1 | CQI reporting definition under AWGN conditions |  | | 6.2.1.2.1.1 | Minimum requirement for periodic CQI reporting for RedCap | New section | | 6.2.2 | 2RX requirements |  | | 6.2.2.1 | FDD |  | | 6.2.2.1.1 | CQI reporting definition under AWGN conditions |  | | 6.2.1.1.1.4 | Minimum requirement for periodic CQI reporting for RedCap | New section | | 6.2.2.2 | TDD |  | | 6.2.2.2.1 | CQI reporting definition under AWGN conditions |  | | 6.2.2.2.1.5 | Minimum requirement for periodic CQI reporting for RedCap | New section |   Regarding the HD-FDD, since we agreed to configure the common CSI reporting configurations for both full-duplex FDD and HD-FDD, one requirement (e.g., 6.2.1.1.1.1) can cover both FD-FDD and HD-FDD. See R4-2213968 as the example.  Also we **don’t** need to define HD-FDD UL-DL pattern below.    For example, if you look eMTC requirements in TS36.101, the requirements are set for both HD-FDD and FD-FDD, but no HD-FDD pattern is specified in the spec. The test parameters (e.g., CSI-RS periodicity/offset and CSI-Report periodicity/offset) are sufficient. See R4-2213796 also as another example. |
|  |
|  |
| R4-2213797 (Huawei, HiSilicon) | **Title: draftCR for introduction on static propagation condition** |
| Ericsson: It depends on the conclusion from Issue 3-1-3. |
|  |
|  |
| R4-2213968 (Qualcomm Incorporated) | **Title: draftCR for RedCapUE CQI Fading Reporting Requirements** |
| Ericsson:  Regarding the section numbers, to align with other requirements, we suggest to changes as follows.  <1Rx>  6.2.1.1.2 CQI reporting under fading conditions ~~for RedCap UEs~~  6.2.1.1.2.1 Minimum requirement for wideband CQI reporting for RedCap UEs  6.2.1.2.2 CQI reporting under fading conditions ~~for RedCap UEs~~  6.2.1.2.2.1 Minimum requirement for wideband CQI reporting for RedCap UEs  <2Rx>  ~~6.2.2.1.3 CQI reporting under fading conditions for RedCap UEs~~  6.2.2.1.1.4 Minimum requirement for wideband CQI reporting for RedCap UEs  ~~6.2.2.2.3 CQI reporting under fading conditions for RedCap UEs~~  6.2.2.2.2.4 Minimum requirement for wideband CQI reporting for RedCap UEs  Same comment as R4-2213072, we **don’t** need to define HD-FDD UL-DL pattern below.    For example, if you look eMTC requirements in TS36.101, the requirements are set for both HD-FDD and FD-FDD, but no HD-FDD pattern is specified in the spec. The test parameters (e.g., CSI-RS periodicity/offset and CSI-Report periodicity/offset) are sufficient. See R4-2213796 also as another example. |
| Huawei: Please change “RedCap UE” to “RedCap”. |
| MediaTek: The CQI table is “Table 1”. Also, we might use 5/0 for CSI-Report periodicity and offset in Table 6.2.1.1.2.1-1 as we only consider HD-FDD for 1Rx UE now. |
| R4-2213796 (Huawei, HiSilicon) | **Title: draftCR for introduction on reporting of Precoding Matrix Indicator (PMI) for RedCap** |
| Ericsson:  ‘Test 1 is also applicable for RedCap.’ is not necessary from 6.3.2.1.1, because it is captured in the applicability rule in R4-2212891.  ‘Test 2 is also applicable for RedCap.’ is not necessary from 8.3.2.2.1, because it is captured in the applicability rule in R4-2212891.  It looks many cells are empty in FRC R.PDSCH.2-8.4 TDD, e.g. information bits, code blocks, channel bits. Please fix it. |
| Huawei: Thanks, we will update it. |
| MediaTek: The antenna configuration for 1Rx is 4x1 ULA high. |
| R4-2213074 (Nokia, Nokia Shanghai Bell) | **Title: Rank Indicator reporting for RedCap** |
| Moderator: Depends on the conclusion on Issue 3-3-1. |
|  |
|  |

## 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:* |

### 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)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |  |
| --- | --- | --- | --- |
| **New Tdoc number** | **Title** | **Source** | **Comments** |
|  | WF on … | YYY |  |
|  | LS on … | ZZZ | To: RAN\_X; Cc: RAN\_Y |
|  |  |  |  |

**Existing tdocs**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Tdoc number** | **Revised to** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-22xxxxx |  | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Tdoc number** | **Revised to** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-22xxxxx |  | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-22xxxxx |  | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-22xxxxx |  | LS on … | ZZZ | Agreeable, Revised, Noted |  |
|  |  |  |  |  |  |

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