

[101-bis-e][321] NR_RedCap_Demod_NWM - Version 0.0.4
RAN4

R4-2202977

3GPP TSG-RAN WG4 Meeting #101-bis-e

Electronic Meeting, 17th – 25th January, 2022

Agenda item: 6.20.4, 6.20.1 (R4-2200407)

Source: Moderator (Ericsson)

Title: Email discussion summary for [101-bis-e][321] NR_RedCap_Demod_NWM

Document for: Information

1 Introduction

This email discussion discusses the following topics:

- Scope of UE demodulation requirements for RedCap
- Scope of UE CSI reporting requirements for RedCap
- BS demodulation requirements related to RedCap

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

2.1 Companies' contribution summary

Table 1: Companies' contribution summary

T-doc number	Company	Proposals / Observations
R4-2201435	Ericsson	Work plan for UE demodulation requirements for RedCap

R4-2200281	Apple	<p>Proposal 1: For reduced capability devices introduce requirements with 1RX for FDD 10MHz CBW and TDD 20MHz CBW.</p> <p>Proposal 2: For reduced capability devices capable of 2 RX introduce requirement in TDD with 20MHz CBW.</p> <p>Proposal 3: For UE demodulation requirements further discuss on defining the following requirements for Red Cap UE:</p> <ul style="list-style-type: none"> - Minimum requirements for PDSCH Mapping Type A - Minimum requirements for PDSCH Mapping Type A and CSI-RS overlapped with PDSCH - Minimum requirements for PDSCH Mapping Type A and LTE-NR coexistence - PDCCH minimum requirements with 1 Tx Antenna - PDCCH minimum requirements with 2 Tx Antenna - PDCCH Minimum requirements for power saving - PBCH minimum requirements <p>Proposal 4: For CSI reporting requirements further discuss and define the following requirements for Red Cap UE:</p> <ul style="list-style-type: none"> - CQI reporting requirements in AWGN with Table 2 - CQI reporting in fading channel for wideband CQI - CQI reporting in fading channel for subband CQI - Single PMI with 2TX TypeI-SinglePanel Codebook - Single PMI with 4TX TypeI-SinglePanel Codebook
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R4-2200382	MediaTek inc.	<p>Observation 1: In TS38.101-4, there are no test cases considering 1 Rx branch for PDCCH, PDSCH and CSI requirements.</p> <p>Observation 2: For FR1, the conventional BW used for TDD is 40MHz, which is larger than the maximum bandwidth 20MHz.</p> <p>Proposal 1: Define PDSCH, PDCCH and CSI requirements for RedCap.</p>
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R4-2200406	Nokia, Nokia Shanghai Bell	<p>Observation 1: Big UE demodulation and CSI performance impacts are expected from introducing the feature reduced number of UE Rx/Tx antennas, as requirements are not yet defined for 1Rx.</p> <p>Observation 2: Potential big UE demodulation and CSI performance impacts are expected from introducing the feature half-duplex FDD operation. At least we observe that what is needed to be defined is UL-DL pattern and configuration and the number of slots between PDSCH and corresponding HARQ ACK information.</p> <p>Observation 3: UE demodulation and CSI performance impacts are expected from introducing reduced maximum UE bandwidth feature. Part of this impact can be captured when designing tests for reduced number of UE Rx/Tx antennas and half-duplex FDD operation features.</p> <p>Observation 4: 2Rx CQI, PMI and RI reporting definition tests in conducted mode targeting TDD FR1, are using 40 MHz bandwidth in TDD making a RedCap UE unable to do these tests, i.e., Table 6.3.2.2.1-1 in [2].</p> <p>Observation 5: UE demodulation and CSI performance minor impacts are expected from introducing reduced maximum number of DL MIMO layers feature. This impact can be captured when designing tests for reduced number of UE Rx/Tx antennas and half-duplex FDD operation features, i.e, 1Rx requirements are in any case limited to 1 layer, and requirements with >2 layers are not applicable to redcap UEs.</p> <p>Observation 6: UE demodulation and CSI performance impact is expected from introducing the feature relaxed maximum modulation order. To minimize specification impact the relaxed maximum modulation order impact could be captured in the applicability of requirements for mandatory UE features without a need to define new</p>
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R4-2200816	CMCC	<p>Proposal 1: it is proposed to specify following cases for PDSCH, PDCCH and PBCH:</p> <ul style="list-style-type: none"> - 2Rx for 20MHz FR1 TDD 30KHz - 1Rx for 10MHz FR1 FDD 15KHz - 1Rx for 20MHz FR1 TDD 30KHz - 1Rx for 100MHz FR2 120KHz <p>Proposal 2: it is proposed to specify following cases for PDSCH, PDCCH and PBCH:-</p> <ul style="list-style-type: none"> - 2Rx for 20MHz FR1 TDD CQI, PMI and RI - 1Rx for 10MHz FR1 FDD CQI, PMI - 1Rx for 20MHz FR1 TDD CQI, PMI - 1Rx for 100MHz FR2 CQI, PMI <p>Proposal 3: it is proposed to specify all modulation orders for Rel-17 RedCap demodulation requirements, i.e. QPSK, 16QAM, 64QAM and 256QAM.</p>
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R4-2200994	Huawei, HiSilicon	<p>Proposal 1: Rel-15 test cases can be used as baseline for Redcap UE with considering of reducing test cases and work effort.</p> <p>Proposal 2: All test should cover both 1RX and 2RX to apply for Redcap UEs supporting different maximum MIMO layers.</p> <p>Proposal 3: Define PDSCH performance requirements for Red-Cap UE as per the test cases listed in Table 2.</p> <p>Proposal 4: Define PDCCH performance requirements Use Table 3 for Redcap UE.</p> <p>Proposal 5: define PBCH performance requirements only for 1RX as listed in Table 4.</p> <p>Proposal 6: Not test SDR test.</p> <p>Proposal 7: Consider CQI test in AWGN channel and fading channel with wideband reporting and not consider CQI test with sub-band reporting, PMI and RI tests.</p> <p>Proposal 8: Define the requirements for CQI test with AWGN channel as listed in Table 5 and Define the requirements for CQI test with fading channel as listed in Table 6.</p> <p><i>Moderator: Refer R4-2200994 for the tables.</i></p>
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R4-2201436	Ericsson	<p>Proposal 1: RAN4 defines the UE demodulation and CSI reporting requirements for RedCap UE with:</p> <ul style="list-style-type: none"> - Number of receive antennas: 1Rx and 2Rx - Both FR1 and FR2 - Modulation order: Up to 64QAM - No requirements for CA, EN-DC, NE-DC, and NR-DC scenarios <p>Proposal 2: RAN4 defines the RedCap UE demodulation requirements with:</p> <ul style="list-style-type: none"> - FR1 HD-FDD: SCS=15kHz and CBW=10MHz - FR1 TDD: SCS=30kHz and CBW=20MHz - FR2 TDD: SCS=120kHz and CBW=100MHz <p>Proposal 3: Define the UE demodulation requirements of PDSCH, SDR, PDCCH, and PBCH with 1Rx/2Rx.</p> <p>Proposal 4: HD-FDD SCS=15kHz uses the DL/UL pattern with ‘DDDDU’, where ‘D’ denotes a DL slot and ‘U’ denotes a UL slot.</p> <ul style="list-style-type: none"> - The number of slots between PDSCH and corresponding HARQ-ACK information for slot index i ($i = \{0, 1, \dots, 9\}$) per frame is: <ul style="list-style-type: none"> o 4 if $\text{mod}(i, 5) = 0$ o 3 if $\text{mod}(i, 5) = 1$ o 2 if $\text{mod}(i, 5) = 2$ o 6 if $\text{mod}(i, 5) = 3$ <p>Proposal 5: For UE demodulation requirements for RedCap with HD-FDD SCS=15kHz, PDCCH/PDSCH are scheduled with the assumption 14 symbols are</p>
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R4-2201605	Intel Corporation	<p>Proposal 1: Define 1 Rx FR1 and FR2 demodulation requirements for PBCH, PDCCH and PDSCH for testing of 1 Rx RedCap UEs.</p> <p>Proposal 2: Define 1 Rx FR1 and FR2 CQI reporting requirements for testing of 1 Rx RedCap UEs.</p> <p>Proposal 3: Reuse subset of existing Rel-15 2 Rx FR1 FDD and FR2 demodulation (PBCH, PDCCH and PDSCH) and CSI requirements (CQI, PMI and RI) for testing of 2 Rx RedCap UEs.</p> <p>Proposal 4: Further discuss how to define 2 Rx FR1 TDD requirements for testing of 2 Rx RedCap UEs and discuss the following options:</p> <ul style="list-style-type: none"> – Option 1: Define 2 Rx FR1 TDD demodulation (PBCH, PDCCH and PDSCH) and CSI requirements (CQI, PMI and RI) with channel bandwidth equal to or less than 20 MHz. – Option 2: Apply 1 Rx FR1 TDD demodulation requirements using specific antenna connection. Define only 2 Rx FR1 TDD CSI requirements for scenario with channel bandwidth equal to or less than 20 MHz. <p>Proposal 5: Define RedCap requirements for one SCS/CBW combination per FR per duplex mode: for example, 15 kHz/10 MHz - FR1 FDD, 30 kHz/20 MHz – FR1 TDD and 120 kHz/100 MHz – FR2.</p> <p>Proposal 6: Consider the following set of 1 Rx RedCap requirements as starting point:</p> <ul style="list-style-type: none"> – PDSCH: <ul style="list-style-type: none"> ○ 3 tests for Type A mapping: QPSK <ul style="list-style-type: none"> – TDLB100-400, 16QAM – TDLC300-100, 64QAM – TDLA30-10
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R4-2201720	Qualcomm Incorporated	<p>Observation 1: The maximum BW for FR1 RedCap UEs is 20 MHz. Existing demodulation requirements defined with higher BW cannot be directly tested.</p> <p>Observation 2: The minimum number of RX Branches for RedCap UEs is 1. Existing demodulation requirements for a higher number of RX Branches cannot be directly reused for FR1 RedCap UEs with only 1 Rx branch.</p> <p>Observation 3: Demodulation Requirements for single RX devices (1RX Branch) are not defined in 38.101-4.</p> <p>Observation 4: Most of FR1 FDD Demodulation Requirements in [2] for 2RX UEs are defined using a BW of 10MHz;</p> <p>Observation 5: Most of FR1 TDD Demodulation Requirements in [2] are defined using a BW of 40MHz;</p> <p>Proposal 1: RAN4 to discuss introduction of 1RX demodulation requirements for RedCap UEs. For this purpose, a sub-selection of the existing (i.e., defined for 2RX UEs) Demodulation requirements can be used as a starting point, considering the additional simulation alignment and testing loads the new requirements will introduce.</p> <p>Proposal 2: RAN4 to discuss applicability of existing Demodulation requirements for 2RX UEs to RedCap UEs which support 2RX Branches. In order to keep 2RX requirements aligned with 1RX, as starting point the same sub-selection of existing tests can be chosen.</p> <p>Proposal 3: RAN4 to discuss introduction of FR1 TDD demodulation requirements for RedCap UEs which support 2RX, with BW equal or smaller to the largest supported BW of 20 MHz as defined in the WID. In order to keep 2RX requirements aligned with 1RX, as starting point the same sub-selection of existing tests can be chosen.</p>
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2.2 Open issues and companies views' collection on 1st round

2.2.1 Sub-topic #1-1: Work plan

Issue 1-1-1: Work plan for RedCap demodulation performance part

Recommended WF: Collect comments for work plan proposed in R4-2201435

Feedback Form 1: Issue 1-1-1: Collect comments for work plan proposed in R4-2201435

1 – Nokia France Nokia, Nokia Shanghai Bell: We agree with the suggested work plan.
2 – Intel Corporation SAS Work plan looks fine for us.
3 – Qualcomm Technologies Int We are fine with the proposed work plan
4 – Apple GmbH We are fine with the proposed work plan.
5 – HiSilicon Technologies Co. Ltd We are fine with the proposed work plan.
6 – MediaTek Inc. We are OK with the proposed work plan.

2.2.2 Sub-topic #1-2: Configuration for UE demodulation and CSI reporting requirements

Issue 1-2-1: Number of Rx antennas, CBW, frequency range

Proposals related to the test setup for RedCap UE demodulation and CSI reporting requirements

- For reduced capability devices introduce requirements with 1RX for FDD 10MHz CBW and TDD 20MHz CBW (Apple).
- For reduced capability devices capable of 2 RX introduce requirement in TDD with 20MHz CBW (Apple)
- Update the applicability of requirements for different number of Rx antenna ports to include 1 Rx for redcap UEs. (Nokia)

- For UE demodulation and CSI performance requirements we propose to revisit all the tests defined for 2Rx for both FDD and TDD and extend the specification for 1Rx. (Nokia)
- it is proposed to specify following cases for PDSCH, PDCCH and PBCH (CMCC):
 - o 2Rx for 20MHz FR1 TDD 30KHz
 - o 1Rx for 10MHz FR1 FDD 15KHz
 - o 1Rx for 20MHz FR1 TDD 30KHz
 - o 1Rx for 100MHz FR2 120KHz
- it is proposed to specify following cases for PDSCH, PDCCH and PBCH (CMCC):
 - o 2Rx for 20MHz FR1 TDD CQI, PMI and RI,
 - o 1Rx for 10MHz FR1 FDD CQI, PMI,
 - o 1Rx for 20MHz FR1 TDD CQI, PMI,
 - o 1Rx for 100MHz FR2 CQI, PMI,
- All test should cover both 1RX and 2RX to apply for Redcap UEs supporting different maximum MIMO layers (Huawei, HiSilicon)
- RAN4 defines the UE demodulation and CSI reporting requirements for RedCap UE with (Ericsson):
 - o Number of receive antennas: 1Rx and 2Rx, Both FR1 and FR2
- RAN4 defines the RedCap UE demodulation requirements with (Ericsson):
 - o FR1 HD-FDD: SCS=15kHz and CBW=10MHz, FR1 TDD: SCS=30kHz and CBW=20MHz, FR2 TDD: SCS=120kHz and CBW=100MHz
- Define 1 Rx FR1 and FR2 demodulation requirements for PBCH, PDCCH and PDSCH for testing of 1 Rx RedCap UEs. (Intel)
- Define 1 Rx FR1 and FR2 CQI reporting requirements for testing of 1 Rx RedCap UEs. (Intel)
- Reuse subset of existing Rel-15 2 Rx FR1 FDD and FR2 demodulation (PBCH, PDCCH and PDSCH) and CSI requirements (CQI, PMI and RI) for testing of 2 Rx RedCap UEs (Intel)
- Further discuss how to define 2 Rx FR1 TDD requirements for testing of 2 Rx RedCap UEs and discuss the following options: (Intel)
 - o Option 1: Define 2 Rx FR1 TDD demodulation (PBCH, PDCCH and PDSCH) and CSI requirements (CQI, PMI and RI) with channel bandwidth equal to or less than 20 MHz.
 - o Option 2: Apply 1 Rx FR1 TDD demodulation requirements using specific antenna connection. Define only 2 Rx FR1 TDD CSI requirements for scenario with channel bandwidth equal to or less than 20 MHz.
- Define RedCap requirements for one SCS/CBW combination per FR per duplex mode: for example, 15 kHz/10 MHz - FR1 FDD, 30 kHz/20 MHz – FR1 TDD and 120 kHz/100 MHz – FR2. (Intel)

- RAN4 to discuss introduction of 1RX demodulation requirements for RedCap UEs. For this purpose, a sub-selection of the existing (i.e., defined for 2RX UEs) Demodulation requirements can be used as a starting point, considering the additional simulation alignment and testing loads the new requirements will introduce. (Qualcomm)
- RAN4 to discuss applicability of existing Demodulation requirements for 2RX UEs to RedCap UEs which support 2RX Branches. In order to keep 2RX requirements aligned with 1RX, as starting point the same sub-selection of existing tests can be chosen (Qualcomm).
- RAN4 to discuss introduction of FR1 TDD demodulation requirements for RedCap UEs which support 2RX, with BW equal or smaller to the largest supported BW of 20 MHz as defined in the WID. In order to keep 2RX requirements aligned with 1RX, as starting point the same sub-selection of existing tests can be chosen. (Qualcomm)

Recommended WF: Moderator recommends the following high level WF for RedCap UE performance part based on the proposals above.

- Define UE demodulation and CSI reporting requirements with the following configurations:
 - 1Rx
 - FDD CBW=10MHz in FR1
 - TDD CBW=20MHz in FR1
 - TDD CBW=100MHz in FR2
 - 2Rx
 - FDD CBW=10MHz in FR1
 - TDD CBW=20MHz in FR1
 - TDD CBW=100MHz in FR2
 - Keep 2RX requirements aligned with 1RX
 - Reuse the parameters from Rel-15 as much as possible to reduce the simulation work

Feedback Form 2: Issue 1-2-1: Collect comments on the recommended WF above

1 – Ericsson Japan K.K.

In general, we support to define the UE demodulation requirements and CSI reporting requirements for RedCap UE with:

- 1Rx: FDD CBW=10MHz in FR1, TDD CBW=20MHz in FR1, and TDD CBW=100MHz in FR2
- 2Rx: FDD CBW=10MHz in FR1, TDD CBW=20MHz in FR1, and TDD CBW=100MHz in FR2

We can discuss the detailed test cases for 1Rx UE and how to define the requirements for 2Rx UE.

<p>2 – Nokia France</p> <p>NOKIA: We agree with the WF. However, to reuse the parameters from Rel-15 as much as possible we think that for 2Rx only the case TDD CBW=20MHz in FR1 is relevant for RedCap performance requirements.</p>
<p>3 – China Mobile Com. Corporation</p> <p>For the 2Rx for TDD 20MHz FR1 and TDD 100MHz FR2, existing requirements can be reused. No new requirements are needed.</p>
<p>4 – Intel Corporation SAS</p> <p>Recommended WF is fine for us</p>
<p>5 – Qualcomm Technologies Int</p> <p>We support the recommended WF</p>
<p>6 – Apple GmbH</p> <p>We support the recommended WF. We would like to clarify that for 2RX we already have requirements for FR1 FDD 10MHz and FR2 TDD 100MHz CBW and need not add new requirements.</p>
<p>7 – HiSilicon Technologies Co. Ltd</p> <p>We propose to define 20MHz bandwidth for both FDD and TDD to align the parameters, if UE support maximum defined bandwidth, UE will support all the bandwidth.</p>
<p>8 – MediaTek Inc.</p> <p>Recommended WF is fine for us. We prefer to define 10MHz for FDD case.</p>

Issue 1-2-2: UL/DL pattern used for FDD tests

- Option 1: Use Half-duplex FDD
 - Option 1a: Reusing existing TDD pattern (Nokia)
 - Option 1b: Use DDDDU (Ericsson)
- Option 2: Use Full-duplex FDD ([Huawei, HiSilicon])

Recommended WF: Collect more inputs

Feedback Form 3: Issue 1-2-2: UL/DL pattern used for FDD tests

<p>1 – Ericsson Japan K.K.</p> <p>According to RAN1 decision, ‘Half-duplex FDD operation type A for RedCap UE’ is optional feature with capability signaling, and UE is assumed to support FD-FDD in FDD bands if UE does not support HD-FDD. However we think HD-FDD is one of the important feature for RedCap UE to reduce the UE power consumption and complexity. We should also point out RRM has already agreed to define RRM core</p>
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requirements with HD-FDD. We therefore propose to define UE demodulation and CSI reporting based on HD-FDD for FDD bands. In order to avoid to rerun the simulation for 2RX UEs, however, we are fine to use HD-FDD for 1Rx UE only and we can use FD-FDD for 2Rx UE.

For HD-FDD pattern, we guess Option 1a corresponds to FR1.15-1 (DDDGU) in TS38.101-4. Since the difference between Option 1a and Option 1b is whether we can schedule only 10 symbols in the 4th slot or schedule 14 symbols in the 4th slot, we are open to use either option 1a or 1b.

Our proposal is:

- Use HD-FDD for 1Rx UE, UL/DL pattern is either DDDXU (X=14 DL symbols) or DDDYU (Y=10 DL symbols)
- Use FD-FDD for 2Rx UE

2 – Nokia France

NOKIA: FD-FDD and TDD are the current duplexing modes assumed in the current performance requirements specs. We think that the tests that will results from Issue 1-2-1 should be using FD-FDD and TDD as a first step. Then as a second step and to reduce specification impact we can say that a HD-FDD UE should give similar performance results as a TDD UE (assuming the FDD paired CBW are symmetric and each one of them equal to the TDD CBW). If the previous assumption does not hold because we are missing something then we agree with Ericsson to introduce HD-FDD for 1Rx UE only but in addition to TDD and FD-FDD.

3 – China Mobile Com. Corporation

We prefer to define HD-FDD requirements for 1Rx and 2Rx. If UE is capable of FD-FDD, then it does not need to pass the HD-FDD requirements. Regarding UL/DL patterns, we slightly prefer option 1a to use existing TDD pattern.

4 – Intel Corporation SAS

We share the same view as Nokia. We can focus on requirements definition for FD-FDD and TDD. For testing of HD-FDD, we can further discuss whether TDD requirements can be reused. Coming back to issue 1-2-1, probably we can have different assumptions on channel bandwidth for FD-FDD and HD-FDD.

5 – Qualcomm Technologies Int

We also think that we should focus on a minimum set of full duplex FDD and TDD at this stage to maximize coverage and keep simulation load under control. Splitting HD and FD FDD requirements for 1 and 2 Rx can result in a reduced coverage for UEs that do not support HD-FDD (optional) and further applicability of the requirements should be left FFS.

6 – Apple GmbH

We also think we should focus on minimizing the number of requirements introduced. We can focus on FD-FDD and TDD in the first stage and see how TDD requirements can be applicable to HD-FDD rather than defining a whole new set of requirements for HD-FDD.

7 – HiSilicon Technologies Co. Ltd

We don't support introduce HD-FDD since it is optional for UE and has no impact on performance. We should focus on FD-FDD since it is mandatory for all UEs

8 – MediaTek Inc.

We also think to consider FD-FDD and TDD only to reduce the test cases.

Issue 1-2-3: How to define 2Rx FR1 TDD requirements for testing of 2Rx UE RedCap UEs

- Option 1: Define 2 Rx FR1 TDD demodulation (PBCH, PDCCH and PDSCH) and CSI requirements (CQI, PMI and RI) with channel bandwidth equal to or less than 20 MHz (Intel)
- Option 2: Apply 1 Rx FR1 TDD demodulation requirements using specific antenna connection. Define only 2 Rx FR1 TDD CSI requirements for scenario with channel bandwidth equal to or less than 20 MHz (Intel)
- Option 3: In order to keep 2RX requirements aligned with 1RX, as starting point the same sub-selection of existing tests can be chosen (Qualcomm)

Recommended WF: Collect more inputs

Feedback Form 4: Issue 1-2-3: How to define 2Rx FR1 TDD requirements for testing of 2Rx UE RedCap UEs

1 – Ericsson Japan K.K.

We prefer Option 1/Option 3.

We prefer to select subset of Rel-15 UE demodulation and CSI reporting requirements and modify the channel bandwidth to 20MHz. This means RAN4 need to collect new simulation results with TDD 30kHz with 20MHz for 2Rx RedCap UE. The detailed test cases will be discussed in below.

2 – Nokia France

NOKIA: We prefer Option 1/Option 3. and we think new test with CBW = 20MHz is needed. Regarding test parameters, we can use as much as possible from the parameters defined for the CBW 40MHz tests.

3 – China Mobile Com. Corporation

Option 1 define TDD 2Rx requirements with 20MHz bandwidth.

4 – Intel Corporation SAS

Option 1 is slightly preferred for us.

<p>5 – Qualcomm Technologies Int</p> <p>Support Option 3 and Option 1, but the choice of which requirements should be chosen out of the full set should be discussed in their respective section in this document</p>
<p>6 – Apple GmbH</p> <p>We support option 1 and option 3 to keep the requirements aligned between 2RX and 1RX.</p>
<p>7 – HiSilicon Technologies Co. Ltd</p> <p>We support option 1</p>
<p>8 – MediaTek Inc.</p> <p>Support Option 1.</p>

2.3 Summary of 1st round

Issue 1-1-1: Work plan for RedCap demodulation performance part

– Agreements

- Work plan R4-2201435 is agreeable.

– Recommendation for 2nd round

- No discussion

Issue 1-2-1: Number of Rx antennas, CBW, frequency range

– Tentative agreements

- 1Rx RedCap UE: RAN4 define new UE demodulation and CSI reporting requirements with the following configuration:
 - FDD SCS=15kHz in FR1
 - **Option 1:** CBW=10MHz
 - **Option 2:** CBW=20MHz
 - TDD SCS=30kHz in FR1
 - CBW=20MHz
 - TDD SCS=120kHz in FR2

- CBW=100MHz
- 2Rx RedCap UE:
 - For FDD SCS=15kHz in FR1, RAN4 selects the existing UE demodulation and CSI reporting requirements with CBW=10MHz. No new requirements are introduced.
 - For TDD SCS=120kHz in FR2: RAN4 selects the existing UE demodulation and CSI reporting requirements with CBW=100MHz. No new requirements are introduced.
 - For TDD SCS=30kHz in FR1, RAN4 define new UE demodulation and CSI reporting requirements with **CBW=20MHz**.

– **Recommendation for 2nd round**

- Discuss the tentative agreements and discuss the CBW option for FDD 15kHz for 1Rx UE.

Issue 1-2-2: UL/DL pattern used for FDD tests

Most companies prefer to consider FD-FDD for both 1Rx UE and 2Rx UE because HD-FDD is optional feature for RedCap UE. The moderators proposes the following WF.

– **Tentative agreements:**

- 1Rx RedCap UE
 - Use Full Duplex FDD as the initial simulation assumption.
 - RAN4 discuss further whether to define requirements (e.g., FRC) based on Half Duplex FDD or not. If HD-FDD is used, consider the existing TDD pattern FR1.15-1 (i.e., DDDSU)
- 2Rx RedCap UE
 - Use Full Duplex FDD according to Issue 1-2-1.
 - RAN4 reuses the existing FDD requirements

– **Recommendation for 2nd round**

- Discuss the tentative agreements

Issue 1-2-3: How to define 2Rx FR1 TDD requirements for testing of 2Rx UE RedCap UEs

Most companies support Option 1 and keep the requirements aligned between 2Rx and 1Rx. We propose the following tentative agreements.

– **Tentative agreements:**

- Define 2Rx FR1 TDD demodulation (e.g., PBCH, PDCCH and PDSCH) and CSI requirements (e.g., CQI, PMI and RI) with channel bandwidth equal to 20MHz.

- Keep the requirements aligned between 2Rx and 1Rx.
- **Recommendation for 2nd round**
 - Discuss the tentative agreements

2.4 Discussion on 2nd round

Issue 1-2-1: Number of Rx antennas, CBW, frequency range

Issue 1-2-2: UL/DL pattern used for FDD tests

Issue 1-2-3: How to define 2Rx FR1 TDD requirements for testing of 2Rx UE RedCap UEs

3 Topic #2 UE demodulation requirements

3.1 Companies' contribution summary

See 2.1

3.2 Open issues and companies views' collection on 1st round

3.2.1 Sub-topic #2-1: PDSCH demodulation

Issue 2-1-1: Whether to define PDSCH demodulation requirements

- Option 1: Yes (Apple, MediaTek, CMCC, Huawei, HiSilicon, Ericsson, Intel)

Recommended WF: Define PDSCH demodulation requirements for RedCap UE

Feedback Form 5: Issue 2-1-1: Whether to define PDSCH demodulation requirements

<p>1 – Ericsson Japan K.K.</p>
<p>Support the recommended WF.</p>
<p>2 – Nokia France</p>
<p>NOKIA: We support the proposed WF.</p>

3 – China Mobile Com. Corporation Support the recommended WF
4 – Intel Corporation SAS Support Recommended WF
5 – Qualcomm Technologies Int We are fine with the recommended WF
6 – Apple GmbH We support the recommended WF.
7 – MediaTek Inc. Support the recommended WF.

Issue 2-1-2: Test parameters for PDSCH demodulation requirements

- Proposal 1: PDSCH Mapping Type A, Mapping Type A and CSI-RS overlapped with PDSCH, PDSCH Mapping Type A and LTE-NR co-existence (Apple)
- Proposal 2: Specify all modulation orders for Rel-17 RedCap demodulation requirements, i.e. QPSK, 16QAM, 64QAM and 256QAM (CMCC)
- Proposal 3: (Intel)
 - 1Rx UE: 3 tests for Type A mapping: QPSK – TDLB100-400, 16QAM – TDLC300-100, 64QAM – TDLA30-10, and 1 test for Type B mapping: QPSK – TDLA30-10
 - 2Rx UE: Reuse subset of existing Rel-15 2 Rx FR1 FDD and FR2 PDSCH demodulation and CSI requirements and FFS for FR1 TDD.
- Proposals 4 and 5: See table below

Table 2:

	FR1 FDD	FR1 TDD	FR2 TDD
Proposal 4 (Huawei, HiSilicon) Type A only	QPSK (MCS4), TDLC300-100 256QAM (MCS24), TDLA30-10	64QAM (MCS19), TDLA30-10 256QAM (MCS24), TDLA30-10	64QAM (MCS17), TDLA30-75
Proposal 5 (Ericsson) Type A only	QPSK 1/3, TDLB100-400) 16QAM 0.48, TDLC300-100) 64QAM 0.5, TDLA30-10	QPSK 1/3, TDLB100-400) 16QAM 0.48, TDLC300-100) 64QAM 0.5, TDLA30-10	QPSK 1/3, TDLC60-30) 16QAM 0.48, TDLA30-300) 64QAM 0.46, TDLA30-75

Recommended WF: Collect more inputs for MCS, channel model and rank for PDSCH demodulation requirements for 1Rx and 2Rx.

Feedback Form 6: Issue 2-1-2a: Test parameters for PDSCH demodulation requirements (1Rx UE)

1 – Ericsson Japan K.K.

We propose to define the following PDSCH test cases for 1Rx RedCap UE by reusing the existing setup in TS38.101-4.

- FDD 15kHz
 - o QPSK: Type A, Table 5.2.2.1.1-3 Test 1-1, QPSK 0.30, TDLB100-400, 2Tx, Rank 1, 70%
 - o 16QAM: Type A, Table 5.2.2.1.1-3 Test 1-4, 16QAM 0.48, TDLC300-100, 2Tx, Rank 1, 30%
 - o 64QAM: Type A, Table 5.2.2.1.1-4 Test 2-1, 64QAM 0.5, TDLA30-10, 2Tx, **Rank 1**, 70%
- TDD 30kHz
 - o QPSK: Type A, Table 5.2.2.2.1-3 Test 1-1, QPSK 0.30, TDLB100-400, 2Tx, Rank 1, 70%
 - o 16QAM: Type A, Table 5.2.2.2.1-3 Test 1-4, 16QAM 0.48, TLDC300-100, 2Tx, Rank 1, 30%
 - o 64QAM: Type A, Table 5.2.2.2.1-4 Test 2-1, 64QAM 0.50, TLDA30-1, 2Tx, **Rank 1**, 70%
- TDD 120kHz
 - o QPSK: Type A, Table 7.2.2.2.1-3 Test 1-1, QPSK 0.30, TDLC60-300, 2Tx, Rank 1, 70%
 - o 16QAM: Type A, Table 7.2.2.2.1-4 Test 2-2, 16QAM 0.48, TDLA30-300, 2Tx, **Rank 1**, 70%
 - o 64QAM: Type A, Table 7.2.2.2.1-4 Test 2-6, 64QAM 0.42, TDLA30-75, 2Tx, **Rank 1**, 70%

We are open to define PDSCH with 256QAM if many companies are interested in.

2 – Nokia France

NOKIA: We are fine with the proposed WF.

3 – Intel Corporation SAS

We are fine with the list of tests proposed by Ericsson, However, we suggest to focus on requirements with 70% test metric.

4 – Apple GmbH

We are fine with Ericsson’s proposal. Also agree with Intel that we should only have requirements with 70% max TP.

5 – HiSilicon Technologies Co. Ltd

We propose to define only one MCS per duplex mode per antenna number to reduce the test case. Additionally, we propose to include 256QAM. Hence, we propose the following:

- FR1 FDD: QPSK (MCS4), TDLC300-100; 256QAM (MCS24), TDLA30-10 (Optional)
- FR1 TDD: 64QAM (MCS19), TDLA30-10; 256QAM (MCS24), TDLA30-10 (Optional)
- FR2 TDD: 64QAM (MCS17), TDLA30-75

Feedback Form 7: Issue 2-1-2b: Test parameters for PDSCH demodulation requirements (2Rx UE)

1 – Ericsson Japan K.K.

We propose to define the following PDSCH test cases for 2Rx RedCap UE by reusing the existing setup in TS38.101-4. As we discussed before we need to rerun the simulation for TDD FR1.

- FDD 15kHz
 - o QPSK: Type A, Table 5.2.2.1.1-3 Test 1-1, QPSK 0.30, TDLB100-400, 2Tx, Rank 1, 70%
 - o 16QAM: Type A, Table 5.2.2.1.1-3 Test 1-4, 16QAM 0.48, TDLC300-100, 2Tx, Rank 1, 30%
 - o 64QAM: Type A, Table 5.2.2.1.1-4 Test 2-1, 64QAM 0.5, TDLA30-10, 2Tx, Rank 1, 70%
- TDD 30kHz
 - o QPSK: Type A, Table 5.2.2.2.1-3 Test 1-1, QPSK 0.30, TDLB100-400, 2Tx, Rank 1, 70%
 - o 16QAM: Type A, Table 5.2.2.2.1-3 Test 1-4, 16QAM 0.48, TLDC300-100, 2Tx, Rank 1, 30%
 - o 64QAM: Type A, Table 5.2.2.2.1-4 Test 2-1, 64QAM 0.50, TLDA30-1, 2Tx, Rank 2, 70%
- TDD 120kHz
 - o QPSK: Type A, Table 7.2.2.2.1-3 Test 1-1, QPSK 0.30, TDLC60-300, 2Tx, Rank 1, 70%
 - o 16QAM: Type A, Table 7.2.2.2.1-4 Test 2-2, 16QAM 0.48, TDLA30-300, 2Tx, Rank 2, 70%
 - o 64QAM: Type A, Table 7.2.2.2.1-4 Test 2-6, 64QAM 0.42, TDLA30-75, 2Tx, Rank 2, 70%

We are open to define PDSCH with 256QAM if many companies are interested in.

2 – Ericsson Japan K.K.

One correction FDD 15kHz 64QAM: Type A, Table 5.2.2.1.1-4 Test 2-1, 64QAM 0.5, TDLA30-10, 2Tx should be **rank 2**.

<p>3 – Nokia France</p> <p>NOKIA: We are fine with the proposed WF.</p>
<p>4 – Intel Corporation SAS</p> <p>We are fine with the list of test proposed by Ericsson. Same time, we suggest to focus on requirements with 70% test metric. Therefore, probably we also need to rerun FR1 FDD with 16QAM.</p>
<p>5 – Apple GmbH</p> <p>We agree with list from Ericsson and also agree with Intel’s comment.</p>
<p>6 – HiSilicon Technologies Co. Ltd</p> <p>We propose to define only one MCS per duplex mode per antenna number to reduce the test case. Additionally, we propose to include 256QAM. Hence, we propose the following:</p> <ul style="list-style-type: none"> - FR1 FDD: QPSK (MCS4), TDLC300-100; 256QAM (MCS24), TDLA30-10 (Optional) - FR1 TDD: 64QAM (MCS19), TDLA30-10; 256QAM (MCS24), TDLA30-10 (Optional) - FR2 TDD: 64QAM (MCS17), TDLA30-75

3.2.2 Sub-topic #2-2: PDCCH demodulation

Issue 2-2-1: Whether to define PDCCH demodulation requirements

- Option 1: Yes (Apple, MediaTek, CMCC, Huawei, HiSilicon, Ericsson, Intel)

Recommended WF: Define PDCCH demodulation requirements for RedCap UE

Feedback Form 8: Issue 2-2-1: Whether to define PDCCH demodulation requirements

<p>1 – Ericsson Japan K.K.</p> <p>Support the recommended WF.</p>
<p>2 – Nokia France</p> <p>NOKIA: We are fine with the proposed WF.</p>
<p>3 – China Mobile Com. Corporation</p> <p>Support the recommended WF.</p>
<p>4 – Intel Corporation SAS</p> <p>Support recommended WF</p>

<p>5 – Qualcomm Technologies Int</p> <p>We are fine with the recommended WF</p>
<p>6 – Apple GmbH</p> <p>We support the recommended WF.</p>
<p>7 – HiSilicon Technologies Co. Ltd</p> <p>We support the recommended WF.</p>
<p>8 – MediaTek Inc.</p> <p>Support the Recommended WF.</p>

Issue 2-2-2: Test setup for PDCCH demodulation requirements

- Proposal 1: AL4 and AL8 (Huawei, HiSilicon)
- Proposal 2: (Intel)
 - 1Rx UE: AL2, AL4, and AL8
 - 2Rx UE: Reuse subset of existing Rel-15 2Rx FR1 FDD and FR2 PDCCH demodulation and FFS for FR1 TDD
- Proposal 3: AL2, AL4, AL8, and AL16 (Ericsson)
- Proposal 4: Further discuss on defining PDCCH minimum requirements for power saving (Apple)

Recommended WF: Define at least AL4 and AL8. Need input whether to define PDCCH with AL2/AL16 and PDCCH with Power saving scenario.

Feedback Form 9: Issue 2-2-2a: Test setup for PDCCH demodulation requirements (1Rx UE)

<p>1 – Ericsson Japan K.K.</p> <p>We are ok to exclude AL2, but we should include AL16 because RRM RLM/BFD requirements will assume AL16 as the transmission parameters.</p> <p>Considering the test coverage for symbol duration, channel model, Tx number, and DCI format, we propose to define the following PDCCH test cases for 1Rx RedCap UE by reusing the existing setup in TS38.101-4:</p> <ul style="list-style-type: none"> - FDD 15kHz <ul style="list-style-type: none"> ○ AL4: Table 5.3.2.1.1-1 Test 4, 1 symbol TDLA30-10, 1Tx, DCI 1_0 ○ AL8: Table 5.3.2.1.2-1 Test 2, 2 symbol, TDLC300-100, 2Tx, DCI 1_1 ○ AL16: Table 5.3.2.1.1-1 Test 5, 2 symbol, TLDA30-10, 1Tx, DCI 1_0
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- TDD 30kHz
 - o AL4: Table 5.3.2.2.1-1 Test 2, 1 symbol, TDLC300-100, 1Tx, DCI 1_1
 - o AL8: Table 5.3.2.2.2-1 Test 1, 1 symbol, TDLC300-100, 2Tx, DCI 1_1
 - o AL16: Table 5.3.2.2.1-1 Test 3, 2 symbol, TDLC300-100, 1Tx, DCI 1_0

- TDD 120kHz
 - o AL4: Table 7.3.2.2.1-1 Test 1-1, 1 symbol, TDLA30-300, 1Tx, DCI 1_1
 - o AL8: Table 7.3.2.2.2-1 Test 2-1, 1 symbol, TLDA30-75, 2Tx, DCI 1_1
 - o AL16, Table 7.3.2.2.2-1 Test 2-2, 2 symbol, TLDA30-75, 2Tx, DCI 1_0

2 – Nokia France

NOKIA: We prefer option 3. Also, we are fine with the recommended WF.

3 – Intel Corporation SAS

We suggest to focus on baseline PDCCH requirements and not to consider Power saving at current stage. We are fine to consider tests for AL4 and 8 from Ericsson's list as starting point. We are open to further discuss definition of requirements for AL16.

4 – Qualcomm Technologies Int

If AL16 is already included in RRM requirements, how would the introduction of dedicated PDCCH requirements increase the test coverage? To keep the number of tests introduced limited, we would support Option 1 and introducing tests for AL4 and AL8.

5 – Apple GmbH

We would like to limit to AL4 and AL8 for PDCCH requirements for RedCap. In our understanding out of sync for RLM and BFD use AL8 for hypothetical PDCCH parameters. But we don't really understand how this impacts demod requirements since the demod requirements are not used to set the thresholds for RLM/BFD.

6 – HiSilicon Technologies Co. Ltd

We propose to define PDCCH requirements only for AL4 and AL8 and separate them into FDD and TDD for FR1 and AL 16 for FR2 since AL16 for FR2 can reuse the existing requirements. Hence, we propose the following:

- FR1: FDD: AL 8
- FR1: TDD: AL 4
- FR2: TDD: AL 16

Feedback Form 10: Issue 2-2-2b: Test setup for PDCCH de-modulation requirements (2Rx UE)

1 – Ericsson Japan K.K.

We propose to define the following PDCCH test cases for 2Rx RedCap UE by reusing the existing setup in TS38.101-4. As we discussed before we need to rerun the simulation for TDD FR1.

- FDD 15kHz

- AL4: Table 5.3.2.1.1-1 Test 4, 1 symbol TDLA30-10, 1Tx, DCI 1_0
- AL8: Table 5.3.2.1.2-1 Test 2, 2 symbol, TDLC300-100, 2Tx, DCI 1_1
- AL16: Table 5.3.2.1.1-1 Test 5, 2 symbol, TLDA30-10, 1Tx, DCI 1_0

- TDD 30kHz

- AL4: Table 5.3.2.2.1-1 Test 2, 1 symbol, TDLC300-100, 1Tx, DCI 1_1
- AL8: Table 5.3.2.2.2-1 Test 1, 1 symbol, TDLC300-100, 2Tx, DCI 1_1
- AL16: Table 5.3.2.2.1-1 Test 3, 2 symbol, TDLC300-100, 1Tx, DCI 1_0

- TDD 120kHz

- AL4: Table 7.3.2.2.1-1 Test 1-1, 1 symbol, TDLA30-300, 1Tx, DCI 1_1
- AL8: Table 7.3.2.2.2-1 Test 2-1, 1 symbol, TLDA30-75, 2Tx, DCI 1_1
- AL16, Table 7.3.2.2.2-1 Test 2-2, 2 symbol, TLDA30-75, 2Tx, DCI 1_0

2 – Nokia France

NOKIA: Comment to Ericsson : Maybe we should specify that rerun the simulation for TDD FR1 with CBW = 20MHz?

3 – Intel Corporation SAS

Same comment as for 1 Rx PDCCH tests.

4 – Qualcomm Technologies Int

See comment in Feedback Form 9: Issue 2-2-a

5 – Apple GmbH

Same comment as for 1RX tests.

6 – HiSilicon Technologies Co. Ltd

We propose to define PDCCH requirements only for AL4 and AL8 and separate them into FDD and TDD for FR1 and AL 16 for FR2 since AL16 for FR2 can reuse the existing requirements. Hence, we propose the following:

FR1: FDD: AL 8

FR1: TDD: AL 4

FR2: TDD: AL 16

3.2.3 Sub-topic #2-3: PBCH demodulation

Issue 2-3-1: Whether to define PBCH demodulation requirements

- Option 1: Yes (Apple, CMCC, Huawei, HiSilicon, Ericsson, Intel)

Recommended WF: Define PBCH demodulation requirements for RedCap UE

Feedback Form 11: Issue 2-3-1: Whether to define PBCH demodulation requirements

<p>1 – Ericsson Japan K.K.</p> <p>Support the recommended WF.</p>
<p>2 – China Mobile Com. Corporation</p> <p>Support the recommended WF.</p>
<p>3 – Intel Corporation SAS</p> <p>Support the recommended WF.</p>
<p>4 – Qualcomm Technologies Int</p> <p>This requirement will not be tested and the simulation load for this WI is already very large, why is it necessary to define PBCH requirements?</p>
<p>5 – Apple GmbH</p> <p>We support the recommended WF.</p> <p>To Qualcomm - although we dont have conformance tests for PBCH we define PBCH decoding requirements with 1RX for completeness.</p> <p>But I think we can limit to one case of known or unknown SSB index for 1RX to reduce the simulation effort we have for this WI.</p>

6 – HiSilicon Technologies Co. Ltd

Support the recommended WF.

Issue 2-3-2: Test setup of PBCH demodulation requirements

- Option 1: Reuse the existing PBCH test setup for 2Rx with both SS/PBCH block index is known and unknown (Huawei, HiSilicon, Intel)
- Option 2: Reuse the existing PBCH test setup for 2Rx with SS/PBCH block index is unknown (Ericsson)

Recommended WF: Collect more inputs

Feedback Form 12: Issue 2-3-2a: Test setup of PBCH demodulation requirements (1Rx UE)

1 – Ericsson Japan K.K.

We are ok to define PBCH demodulation requirement with 1Rx by reusing the existing 2Rx test setup with both SS/PBCH block index is known and unknown.

2 – Nokia France

NOKIA: We are fine with both options.

3 – China Mobile Com. Corporation

Support option 1.

4 – Intel Corporation SAS

Option 1

5 – Qualcomm Technologies Int

If PBCH requirements are agreed to be introduced, support option 2

6 – Apple GmbH

We support option 2.

7 – HiSilicon Technologies Co. Ltd

Support option 1, we propose to keep the simulation align with 2RX

Feedback Form 13: Issue 2-3-2b: Test setup of PBCH demodulation requirements (2Rx UE)

1 – Ericsson Japan K.K. We are ok to all the exiting PBCH demodulation requirements with 2Rx are applicable for RedCap 2RX UEs. We don't think RAN4 need to rerun the simulations for PBCH for 2Rx.
2 – China Mobile Com. Corporation Agree with Ericsson
3 – Intel Corporation SAS Support comment from Ericsson.
4 – Qualcomm Technologies Int Agree with Ericsson
5 – Apple GmbH Agree with Ericsson.
6 – HiSilicon Technologies Co. Ltd Agree with Ericsson

3.2.4 Sub-topic #2-4: SDR test

Issue 2-4-1: Whether to define SDR test for RedCap UE

- Option 1: Yes (Ericsson)
- Option 2: No (Huawei, HiSilicon)

Recommended WF: Collect more inputs

Feedback Form 14: Issue 2-4-1: Whether to define SDR test for RedCap UE for 1Rx and 2Rx

1 – Ericsson Japan K.K. Option 1. It is important to ensure RedCap UE can achieve peak rate with the given capability even if 1Rx. We should point out for LTE, SDR test is applicable for Cat-1bis (Cat-1 with 1Rx) UE. So we propose the SDR tests are applicable for RedCap UE (both 1Rx and 2Rx).
2 – Nokia France Nokia: We prefer option 1.

<p>3 – China Mobile Com. Corporation</p> <p>Support option 1.</p>
<p>4 – Intel Corporation SAS</p> <p>Option 1 is fine for us. We think that existing SDR test methodology can be reused and we just need to discuss whether to update MCS configuration for 1 Rx RedCap UE testing.</p>
<p>5 – Qualcomm Technologies Int</p> <p>We prefer Option 2, not introduce maximum throughput tests for RedCap</p>
<p>6 – Apple GmbH</p> <p>We dont think any requirements specifically need to be introduced, but we might need to update MCS for 1RX. We are also open to discuss if SDR requirements should apply to Red Cap UEs at all.</p>
<p>7 – HiSilicon Technologies Co. Ltd</p> <p>We prefer Option 2, Redcap UE is designed to reduce the modulation order, number of Rx, MIMO layers and bandwidth, the relative maximum data rate is not the purpose from RAN 1 design. To reduce the test effort, we propose to not define the SDR test.</p>
<p>8 – MediaTek Inc.</p> <p>We prefer Option2.</p>

3.3 Summary of 1st round

Issue 2-1-1: Whether to define PDSCH demodulation requirements

- **Agreements**
 - RAN4 define PDSCH demodulation requirements for RedCap UE.
- **Recommendation for 2nd round**
 - No discussion

Issue 2-1-2a: Test parameters for PDSCH demodulation requirements for 1Rx RedCap UE

- **Tentative agreements**
 - **FDD 15kHz FR1**
 - **Option 1:**
 - QPSK: Type A, Table 5.2.2.1.1-3 Test 1-1, QPSK 0.30, TDLB100-400, 2Tx, Rank 1, 70% max TP

- 16QAM: Type A, Table 5.2.2.1.1-3 Test 1-4, 16QAM 0.48, TDLC300-100, 2Tx, Rank 1, **70%** max TP
 - 64QAM: Type A, Table 5.2.2.1.1-4 Test 2-1, 64QAM 0.5, TDLA30-10, 2Tx, **Rank 1**, 70% max TP
- **Option 2:**
 - QPSK MCS4: Type A, Table 5.2.2.1.1-3 Test 1-2?, QPSK 0.3, TDLC300-100, 2Tx, Rank 1, 70% max TP
 - 256QAM MCS24: Type A, Table 5.2.2.1.1-3 Test 1-3?, 256QAM 0.82, TDLA30-10, 2Tx, Rank 1, 70%max TP
- **TDD 30kHz FR1**
 - **Option 1:**
 - QPSK: Type A, Table 5.2.2.2.1-3 Test 1-1, QPSK 0.30, TDLB100-400, 2Tx, Rank 1, 70% max TP
 - 16QAM: Type A, Table 5.2.2.2.1-3 Test 1-4, 16QAM 0.48, TLDC300-100, 2Tx, Rank 1, **70%** max TP
 - 64QAM: Type A, Table 5.2.2.2.1-4 Test 2-1, 64QAM 0.50, TLDA30-1, 2Tx, **Rank 1**, 70% max TP
 - **Option 2:**
 - 64QAM MCS19: Type A, Table 5.2.2.2.1-4 Test 2-1?, 64QAM 0.50, TLDA30-10, 2Tx, Rank 1, 70% max TP
 - 256QAM MCS24: Type A, Table 5.2.2.1.1-3 Test 1-3?, 256QAM 0.82, TDLA30-10, 2Tx, Rank 1, 70% max TP
- **TDD 120kHz FR2**
 - **Option 1:**
 - QPSK: Type A, Table 7.2.2.2.1-3 Test 1-1, QPSK 0.30, TDLC60-300, 2Tx, Rank 1, 70% max TP
 - 16QAM: Type A, Table 7.2.2.2.1-4 Test 2-2, 16QAM 0.48, TDLA30-300, 2Tx, **Rank 1**, 70% max TP
 - 64QAM: Type A, Table 7.2.2.2.1-4 Test 2-6, 64QAM 0.42, TDLA30-75, 2Tx, **Rank 1**, 70% max TP
 - **Option 2:**
 - 64QAM MCS17: Type A, Table 7.2.2.2.1-4 Test 2-6?, 64QAM 0.42, TDLA30-75, 2Tx, Rank 1, 70%

– **Recommendation for 2nd round**

- Discuss the options

Issue 2-1-2b: Test parameters for PDSCH demodulation requirements for 2Rx RedCap UE

– **Tentative agreements**

- **FDD 15kHz FR1**

- **Option 1:**

- QPSK: Type A, Table 5.2.2.1.1-3 Test 1-1, QPSK 0.30, TDLB100-400, 2Tx, Rank 1, 70% max TP
 - 16QAM: Type A, Table 5.2.2.1.1-3 Test 1-4, 16QAM 0.48, TDLC300-100, 2Tx, Rank 1, **70%** max TP
 - 64QAM: Type A, Table 5.2.2.1.1-4 Test 2-1, 64QAM 0.5, TDLA30-10, 2Tx, Rank 2, 70% max TP

- **Option 2:**

- QPSK MCS4: Type A, Table 5.2.2.1.1-3 Test 1-2?, QPSK 0.30, TDLC300-100, 2Tx, Rank 1, 70% max TP
 - 256QAM MCS24: Type A, Table 5.2.2.1.1-3 Test 1-3?, 256QAM 0.82, TDLA30-10, 2Tx, Rank 1, 70% max TP

- **TDD 30kHz FR1**

- **Option 1:**

- QPSK: Type A, Table 5.2.2.2.1-3 Test 1-1, QPSK 0.30, TDLB100-400, 2Tx, Rank 1, 70% max TP
 - 16QAM: Type A, Table 5.2.2.2.1-3 Test 1-4, 16QAM 0.48, TLDC300-100, 2Tx, Rank 1, **70%** max TP
 - 64QAM: Type A, Table 5.2.2.2.1-4 Test 2-1, 64QAM 0.50, TLDA30-1, 2Tx, Rank 2, 70% max TP

- **Option 2:**

- 64QAM MCS19: Type A, Table 5.2.2.2.1-4 Test 2-1?, 64QAM 0.50, TLDA30-10, 2Tx, Rank 1, 70% max TP
 - 256QAM MCS24: Type A, Table 5.2.2.2.1-3 Test 1-3?, 256QAM 0.82, TDLA30-10, 2Tx, Rank 1, 70% max TP

- **TDD 120kHz FR2**

- **Option 1:**

- QPSK: Type A, Table 7.2.2.2.1-3 Test 1-1, QPSK 0.30, TDLC60-300, 2Tx, Rank 1, 70% max TP
- 16QAM: Type A, Table 7.2.2.2.1-4 Test 2-2, 16QAM 0.48, TDLA30-300, 2Tx, Rank 2, 70% max TP
- 64QAM: Type A, Table 7.2.2.2.1-4 Test 2-6, 64QAM 0.42, TDLA30-75, 2Tx, Rank 2, 70% max TP

- **Option 2:**

- 64QAM MCS17: Type A, Table 7.2.2.2.1-4 Test 2-6?, 64QAM 0.42, TDLA30-75, 2Tx, Rank 1, 70% max TP

- **Recommendation for 2nd round**

- Discuss the options

Issue 2-2-1: Whether to define PDCCH demodulation requirements

- **Agreements**

- RAN4 define PDCCH demodulation requirements for RedCap UE.

- **Recommendation for 2nd round**

- No discussion

Issue 2-2-2a: Test setup for PDCCH demodulation requirements for 1Rx RedCap UE

- **Tentative agreements**

- Not define PDCCH with Power saving scenario

- **FDD 15kHz FR1**

- **Option 1:** AL8 only
- **Option 2:** AL4 and AL8
- **Option 3:** AL4, AL8 and AL16
- **Option 4:** AL2, AL4, AL8, and AL16

- **TDD 30kHz FR2**

- **Option 1:** AL4 only

- **Option 2:** AL4 and AL8
 - **Option 3:** AL4, AL8 and AL16
 - **Option 4:** AL2, AL4, AL8, and AL16
- **TDD 120kHz FR2**
 - **Option 1:** AL16 only
 - **Option 2:** AL4 and AL8
 - **Option 3:** AL4, AL8 and AL16
 - **Option 4:** AL2, AL4, AL8, and AL16
- **Recommendation for 2nd round**
 - Discuss the options

Issue 2-2-2b: Test setup for PDCCH demodulation requirements for 2Rx RedCap UE

- **Agreements**
 - Apply the same configuration as 1Rx UE tests in issue 2-2-2a
- **Recommendation for 2nd round**
 - No discussion

Issue 2-3-1: Whether to define PBCH demodulation requirements

- **Agreements**
 - RAN4 define PBCH demodulation requirements for RedCap UE.
- **Recommendation for 2nd round**
 - No discussion

Issue 2-3-2a: Test setup of PBCH demodulation requirements for 1Rx RedCap UE

As we discussed in Rel-15, although RAN4 don't have conformance tests for PBCH, RAN4 define PBCH decoding requirements with 1RX for completeness. But some companies want to limit to the scenario SSB index is known to reduce the simulation efforts.

- **Tentative agreements**

- RAN4 define PBCH demodulation requirements by reusing the existing PBCH test setup for 2Rx with **SS/PBCH block index is unknown**
- For the case with **SS/PBCH block index is known**:
 - **Option 1**: RAN4 define the case with SS/PBCH block index is known for 1Rx UE
 - **Option 2**: RAN4 don't define the case with SS/PBCH block index is known for 1Rx UE
- **Recommendation for 2nd round**
 - Discuss the options

Issue 2-3-2b: Test setup of PBCH demodulation requirements for 2Rx RedCap UE

- **Agreements**
 - All the exiting PBCH demodulation requirements with 2Rx are applicable for RedCap 2Rx UE
- **Recommendation for 2nd round**
 - No discussion

Issue 2-4-1: Whether to define SDR test for RedCap UE

- **Tentative agreements**
 - **Option 1**: Existing SDR test methodology can be reused for RedCap 1Rx/2Rx UE. Discuss whether to update MCS configuration and common test parameters for 1 Rx RedCap UE testing
 - **Option 2**: Not introduce SDR tests for RedCap 1Rx/2Rx UE
- **Recommendation for 2nd round**
 - Discuss the options

3.4 Discussion on 2nd round

Issue 2-1-2a: Test parameters for PDSCH demodulation requirements for 1Rx RedCap UE

Issue 2-1-2b: Test parameters for PDSCH demodulation requirements for 2Rx RedCap UE

Issue 2-2-2a: Test setup for PDCCH demodulation requirements for 1Rx RedCap UE

Issue 2-3-2a: Test setup of PBCH demodulation requirements for 1Rx RedCap UE

Issue 2-4-1: Whether to define SDR test for RedCap UE

4 Topic #3 CSI reporting requirements

4.1 Companies' contribution summary

See 2.1

4.2 Open issues and companies views' collection on 1st round

4.2.1 Sub-topic #3-1: CQI reporting test

Issue 3-1-1: Whether to define CQI reporting tests for both static condition and fading condition

- Option 1: Yes (Apple, Nokia, Huawei, HiSilicon, [MediaTek], Ericsson, Intel)

Recommended WF: Define CQI reporting tests for both static condition and fading condition. For the fading condition define at least wideband CQI reporting test.

Feedback Form 15: Issue 3-1-1: Whether to define CQI reporting tests for both static condition and fading condition for 1Rx and 2Rx

1 – Ericsson Japan K.K.

Support the recommended WF. We propose to define the following tests for both 1Rx and 2Rx by reusing the exiting test cases in TS38.101-4.

- FDD 15kHz, 10MHz in FR1
 - o Table 6.2.2.1.1.1-1 for static
 - o Table 6.2.2.1.2.1-1 for wideband fading
- TDD 30kHz, 20MHz in FR1
 - o Table 6.2.2.2.1.2-1 for static
 - o Table 6.2.2.2.2.1-1 for wideband fading
- TDD 120kHz, 100MHz in FR2
 - o Table 8.2.2.2.1.1-1 for static
 - o Table 8.2.2.2.2.1-1 tests 1/2 for wideband fading

We also propose to use CQI table 1.

<p>2 – Nokia France</p> <p>NOKIA: We are fine with the recommended WF.</p>
<p>3 – China Mobile Com. Corporation</p> <p>Support the recommended WF.</p>
<p>4 – Intel Corporation SAS</p> <p>Support recommended WF.</p>
<p>5 – Qualcomm Technologies Int</p> <p>Support the recommended WF</p>
<p>6 – Apple GmbH</p> <p>Support recommended WF and Ericsson’s proposal. Do we need to define new 2RX tests with CQI table 1 that we have defined based on CQI table 2 since 256QAM is optional for RedCap UEs?</p>
<p>7 – HiSilicon Technologies Co. Ltd</p> <p>Support the recommended WF</p>
<p>8 – MediaTek Inc.</p> <p>Support the recommended WF.</p>

Issue 3-1-2: Whether to define subband CQI reporting tests in fading condition

- Option 1: Yes (Apple, Intel)
- Option 2: No (Huawei, HiSilicon, Ericsson)

Recommended WF: Need more inputs

Feedback Form 16: Issue 3-1-2: Whether to define subband CQI reporting tests in fading condition for 1Rx and 2Rx

<p>1 – Ericsson Japan K.K.</p> <p>Option 2.</p> <p>Since the maximum CBW for FR1 is 20MHz, it is sufficient to define wideband CQI reporting test only for 1Rx and 2Rx. It also helps to reduce the test cases.</p> <p>Note the existing FR2 CQI tests uses wideband CQI test only. We don’t need to add new test configuration for RedCap.</p>
<p>2 – Intel Corporation SAS</p> <p>Both options are fine for us. Existing FR1 FDD requirements with 10 MHz CBW are defined for both</p>

sub-band and wideband reporting. However, to reduce the work load, we are fine to focus on wideband requirements.
3 – Qualcomm Technologies Int Support Option 2
4 – Apple GmbH We are fine with option 2.
5 – HiSilicon Technologies Co. Ltd Option 2
6 – MediaTek Inc. Support Option 2.

Issue 3-1-3: CQI table used for CQI reporting tests

- Option 1: Use Table 1 (64QAM table) (Huawei, HiSilicon, Ericsson)

Recommended WF: Use CQI Table 1 for RedCap CQI reporting requirements.

Feedback Form 17: Issue 3-1-3: Used CQI table

1 – Ericsson Japan K.K. Support the recommended WF. Since 256QAM is the optional feature for RedCap UE, we need to redefine CQI reporting with CQI Table 1 (64QAM) for both 1Rx/2Rx.
2 – Nokia France NOKIA: We are fine with the recommended WF.
3 – China Mobile Com. Corporation Support the recommended WF.
4 – Intel Corporation SAS Support recommended WF.
5 – Qualcomm Technologies Int Support Option 1
6 – Apple GmbH we support the recommended WF.

<p>7 – HiSilicon Technologies Co. Ltd</p> <p>we support the recommended WF.</p>
<p>8 – MediaTek Inc.</p> <p>Support the recommended WF.</p>

4.2.2 Sub-topic #3-2: PMI reporting test

Issue 3-2-1: Whether to define PMI reporting tests

- Option 1: Yes (Apple, Nokia, CMCC, [MediaTek])
- Option 2: No (Huawei, HiSilicon, Ericsson)
- Option 3: Yes for 2Rx UE, No for 1Rx UE (Intel)

Recommended WF: Need more inputs

Feedback Form 18: Issue 3-2-1: Whether to define PMI reporting tests for 1Rx and 2Rx

<p>1 – Ericsson Japan K.K.</p> <p>We don't think PMI reporting requires are needed for 1Rx UE. We are open for 2Rx UE, but it should be limited to single PMI with 4Tx and 8Tx requirements.</p>
<p>2 – Nokia France</p> <p>NOKIA: From the definition of the minimum performance requirements of PMI reporting in TS 38.101-4 section 6.3 we do not see a reason to exclude 1Rx nor 2Rx RedCap UEs from this test. However, we fully understand that PMI reporting requires additional processing complexity at the UEs. Hence, we are open to the proposal of considering only 4Tx and 8Tx PMI reporting.</p>
<p>3 – China Mobile Com. Corporation</p> <p>Support option 1. Define requirements for both 1Rx and 2Rx.</p>
<p>4 – Intel Corporation SAS</p> <p>Options 1 and 3 are fine for us. To reduce the test scope, we can focus on requirements with Single PMI and 4 or 8 Tx antennas (8 Tx is slightly preferred).</p>
<p>5 – Qualcomm Technologies Int</p> <p>Support Option 2</p>
<p>6 – Apple GmbH</p> <p>We are fine with not defining PMI reporting requirements for RedCap UEs with 1 RX.</p>

7 – HiSilicon Technologies Co. Ltd

We propose to not define the PMI requirements,since Base station is not always using reported PMI to select the precoding matrix.

8 – MediaTek Inc.

We can support Option 3 to consider 2Rx only.

4.2.3 Sub-topic #3-3: RI reporting test

Issue 3-3-1: Whether to define RI reporting tests for RedCap 2Rx UEs

- Option 1: Yes (Nokia, CMCC, Intel, [MediaTek])
- Option 2: No (Huawei, HiSilicon, Ericsson)

Recommended WF: Need more inputs

Feedback Form 19: Issue 3-3-1: Whether to define RI reporting tests for RedCap 2Rx UEs

1 – Ericsson Japan K.K.

We are open for 2Rx UE.

However the existing RI reporting requirements are set based on CQI Table 2 (256QAM). Do the proponent companies assume to use the optional CQI table 2 or rerun the simulation by changing to CQI table 1 for RedCap?

2 – China Mobile Com. Corporation

We support option 1 for 2Rx. Rerun the simulation if needed.

3 – Intel Corporation SAS

We think that RI requirements should be covered and rerunning with CQI table 1 is needed.

4 – Qualcomm Technologies Int

Support Option 2

5 – Apple GmbH

We dont need to introduce RI reporting for Red Cap UEs with 2RX.

6 – HiSilicon Technologies Co. Ltd

Support option 2

7 – MediaTek Inc.

Prefer Option 1.

4.3 Summary of 1st round

Issue 3-1-1: Whether to define CQI reporting tests for both static condition and fading condition for 1Rx and 2Rx

– **Agreements**

- Define CQI reporting tests for both static condition and fading condition.
- For the fading condition define at least wideband CQI reporting test.

– **Recommendation for 2nd round**

- No discussion

Issue 3-1-2: Whether to define subband CQI reporting tests in fading condition

– **Agreements**

- Not to define subband CQI reporting tests in fading condition for RedCap 1Rx/2Rx UE

– **Recommendation for 2nd round**

- No discussion

Issue 3-1-3: CQI table used for CQI reporting tests

– **Tentative agreements**

- Use CQI table 1 for RedCap UE CQI reporting requirements.
- Discuss whether to define new 2Rx tests for FR1 FDD with CQI table 1 or not.

- **Option 1:** Yes (Need new requirements)
- **Option 2:** No (In this case it is applicable only for RedCap 2Rx UE capable of 256QAM)

– **Recommendation for 2nd round**

- Discuss whether to define new 2Rx tests also for FR1 FDD with CQI table 1 or not.

Issue 3-2-1: Whether to define PMI reporting tests

- **Tentative agreements**
 - **Option 1:** Yes for both 1Rx UE and 2Rx UE
 - **Option 2:** No for both 1Rx UE and 2Rx UE
 - **Option 3:** Yes for 2Rx UE, No for 1Rx UE
 - For 2Rx UE, limited to single PMI with 4Tx and 8Tx requirements
- **Recommendation for 2nd round**
 - Discuss the options

Issue 3-3-1: Whether to define RI reporting tests for RedCap 2Rx UEs

- **Tentative agreements**
 - **Option 1:** Yes and rerun the simulation with CQI table 1
 - **Option 2:** No
- **Recommendation for 2nd round**
 - Discuss the options

4.4 Discussion on 2nd round

Issue 3-1-3: CQI table used for CQI reporting tests

Issue 3-2-1: Whether to define PMI reporting tests

Issue 3-3-1: Whether to define RI reporting tests for RedCap 2Rx UEs

5 Topic #4 BS demodulation requirements

5.1 Companies' contribution summary

Table 3: Companies' contribution summary

T-doc number	Company	Proposals / Observations

R4-2200407	Nokia, Nokia Shanghai Bell	<p>Observation 1: If the requirements decided in the cov_enh WI are in line, i.e., are applicable and testable, in redcap devices, then the redcap WI does not have any BS demodulation impact.</p> <p>Proposal 1: RAN4 to decide, if the cov_enh WI can be relied upon to produce applicable and testable BS demodulation performance requirements for the redcap WI. Depending on outcome, it can be required to include BS demodulation on the agenda in future meetings, to follow the coverage enhancement developments.</p>
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5.2 Open issues and companies views' collection on 1st round

5.2.1 Sub-topic #4-1: Impact to BS demodulation requirements due to RedCap WI

Issue 4-1-1: Whether RAN4 defines PUSCH demodulation requirements with coverage enhancement features considering RedCap UE (e.g., reduced UE UL BW)

Recommended WF: Collect companies view

Feedback Form 20: Whether RAN4 defines PUSCH demodulation requirements with coverage enhancement features considering RedCap UE

1 – Ericsson Japan K.K.

The discussion on whether there is a need to develop requirements for PUSCH with repetition should be taken in the Coverage Enhancement WI performance part. To avoid duplication, we should not have a parallel discussion here in RedCap WI.

In case requirements are defined in Coverage Enhancements WI, there could be some discussion on whether to develop requirements for a smaller BS bandwidth. However, considering that the PUSCH applicability rule states that the BS is only tested with its maximum supported bandwidth, it does not seem obvious that any requirement is needed for RedCap (since it would only be useful for a BS that only supports the reduced BW in UL and no other bandwidth).

We propose not to discuss PUSCH requirements in RedCap WI.

<p>2 – Nokia France</p> <p>NOKIA: We agree with the proposal not to discuss PUSCH requirements in RedCap WI. However, we should keep an eye on Coverage Enhancements WI in case some new tests or performance requirements impact the RedCap WI.</p>
<p>3 – Intel Corporation SAS</p> <p>We suggest not to discuss PUSCH requirements for coverage enhancements in RedCap WI and cover them in dedicated WI.</p>
<p>4 – HiSilicon Technologies Co. Ltd</p> <p>Same views with Intel</p>

5.3 Summary of 1st round

Issue 4-1-1: Whether RAN4 defines PUSCH demodulation requirements with coverage enhancement features considering RedCap UE (e.g., reduced UE UL BW)

– **Agreements**

- Not to discuss PUSCH requirements for coverage enhancements in RedCap WI. Companies should monitor Coverage Enhancements WI in case some new tests or performance requirements impact the RedCap WI

– **Recommendation for 2nd round**

- No discussion

5.4 Discussion on 2nd round (if applicable)

6 Recommendations for Tdocs

6.1 1st round

Table 4: New Tdocs requests

Title	Source	Comments
WF on RedCap demodulation and CQI reporting requirements	Ericsson	Capture the all the agreements and remaining open issues.

6.2 2nd round

Table 5: Recommendation of Tdocs

Tdoc number	Title	Source	Recommendation	Comments
R4-210xxxx	CR on ...	XXX	Agreeable, Re-vised, Merged, Postponed, Not Pursued	

7 Appendix

– Please add your contact information in the feedback form below as follows:

- Company, Name, Email address

Feedback Form 21: Contact information

1 – Intel Corporation SAS Intel Corporation, Dmitry Belov, dmitry.belov@intel.com
2 – Qualcomm Technologies Int Qualcomm, Pier Vallese: pvallese@qti.qualcomm.com
3 – Apple GmbH Apple Manasa Raghavan manasa.raghavan@apple.com