[101-bis-e][312] NR_DL1024QAM_Demod_NWM - Version 0.0.10
RAN4

3GPP TSG-RAN WG4 Meeting # 101-bis-e R4-2203104

Electronic Meeting, 17-25 Jan., 2022

Agenda item: 6.6.5.1, 6.6.5.2, 6.6.5.3, 6.6.5.4

Source: Moderator (Ericsson)

Title: Email discussion summary for [101-bis-e][312] NR_DL1024QAM_Demod

Document for: Information

1 Introduction

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

1. General (6.6.5.1)
2. PDSCH requirements (6.6.5.2)
3. SDR requirements (6.6.5.3)
4. CQI requirements (6.6.5.4)

2 Topic #1: General

2.1 Companies' contributions summary

Table 1:

T-doc number	Company	Proposals / Observations
R4-2201427	Ericsson	

R4-2201719	Qualcomm Incorporated	Observation 1: An assumed TX EVM = 2.5% results in an SNR floor of around 32dB. Observation 2: Simulation results obtained with MCS 25 would result in an SNR requirement close or above the SNR floor computed based on the assumed TX EVM. Observation 3: Designing a CQI test targeting a median report of CQI Index 15 can result in a test in which the requirement cannot be tested. Proposal 1: For TX EVM, support Option 2 (2.5%) in the WF, in accordance with the outcome of the BS discussion. Proposal 2: Do not define PDSCH requirements using MCS 25; Proposal 3: If TDLA30-10 is agreed as propagation channel, RAN4 to define PDSCH requirements using MCS=23. Otherwise, if TDLD30-5 is agreed as propagation channel, RAN4 to define PDSCH requirements using MCS=24. Proposal 4: Support using TDLD30-5 as propagation channel for the PDSCH requirements definition; Proposal 5: It is practical to define SDR requirements for 1024 QAM up to and including MCS 25; Proposal 6: For CQI requirements for 1024 QAM FR1, support introducing a test targeting median reported CQI Index 14 and Rank 1.

2.2 Open Issues Summary

No discussion is necessary

2.3 Companies' views collection for 1st round

2.3.1 Open issues

2.4 Summary for 1st round

No discussion is needed for second round.

2.4.1 Open issues

3 Topic #2: PDSCH requirements

3.1 Companies' contributions summary

Table 2:

T-doc number	Company	Proposals / Observations
R4-2200265	Apple	Proposal #1: Use TX EVM as 2% in simulation assumptions for defining PDSCH demod requirements with 1024QAM. *Observation #1: Operating SNR with MCS 24 and 25 with 2RX are high and not feasible to define requirements.* *Observation #2:Performance with TDLD is better than TDLA by 0.5 dB for MCS 23.* Proposal #2: Define PDSCH demod requirements for 1024QAM with MCS23 and TDLA30-10 channel model.
R4-2200376	MediaTek inc.	Proposal 1: Consider TDL-D to define PDSCH requirements for 1024QAM. Proposal 2: Consider PDSCH requirements for 1024QAM with EVM = 2.5% or 2.8%.

R4-2201011	Huawei,HiSilicon	Proposal 1: For 1024QAM performance requirements, follow the BS RF agreement that 2.5% EVM for frequencies equal to or below 4.2 GHz and 2.8% EVM for frequencies above 4.2 GHz. Proposal 2: Select MCS23 and TDLD30-5 for 1024QAM PDSCH requirements. Proposal 3: Add extra margin based on the SNR point for ideal simulation results, besides the impairment margin added by companies.
R4-2201428	Ericsson	Proposal 1: Set MCS23 with TDLA30-10 for PDSCH demodulation requirements with 1024QAM. Proposal 2: Assume Tx EVM = 2.0% for UE demodulation (both PDSCH and SDR) and CQI reporting for DL 1024QAM in FR1. Proposal 3: Schedule PDSCH in the special slots for TDD SCS=30kHz.
R4-2201783	Intel Corporation	Proposal 1: RAN4 to consider Tx EVM equal to 2.5% for 1024QAM PDSCH tests Proposal 2: RAN4 to consider MCS23 for 1024QAM PDSCH tests Proposal 3: RAN4 to consider TDLA30-10 propagation conditions for 1024QAM PDSCH tests

R4-2201719	Qualcomm Incorporated	Observation 1: An assumed TX EVM = 2.5% results in an SNR floor of around 32dB. Observation 2: Simulation results obtained with MCS 25 would result in an SNR requirement close or above the SNR floor computed based on the assumed TX EVM. Observation 3: Designing a CQI test targeting a median report of CQI Index 15 can result in a test in which the requirement cannot be tested. Proposal 1: For TX EVM, support Option 2 (2.5%) in the WF, in accordance with the outcome of the BS discussion. Proposal 2: Do not define PDSCH requirements using MCS 25; Proposal 3: If TDLA30-10 is agreed as propagation channel, RAN4 to define PDSCH requirements using MCS=23. Otherwise, if TDLD30-5 is agreed as propagation channel, RAN4 to define PDSCH requirements using MCS=24. Proposal 4: Support using TDLD30-5 as propagation channel for the PDSCH requirements definition; Proposal 5: It is practical to define SDR requirements for 1024 QAM up to and including MCS 25; Proposal 6: For CQI requirements for 1024 QAM FR1, support introducing a test targeting median reported CQI Index 14 and Rank 1.

3.2 Open Issues Summary

Issue 2-1: Tx EVM

– Previous agreements:

Table 3:

Consider following options:
− Option 1: 2.0%
− Option 2: 2.5%
− Option 3: 2.8%
Note: The assumed Tx EVM should be same or less than the BS Tx EVM requirements.

- Proposals
  - Option 1: 2.0% (Ericsson, Apple)
  - Option 2: 2.5% (Qualcomm, MTK, Intel)
  - Option 3: 2.8% (MTK)
  - Option 4: 2.5% for frequencies equal to or below 4.2GHz and 2.8% EVM for frequencies above 4.2 GHz (Huawei)

- Recommended WF
  - *Discuss further*

Issue 2-2: MCS and channel model for PDSCH requirement

- Previous agreements:

Table 4:

Consider following options:
− Option 1: MCS23
− Option 2: MCS24
− Option 3: MCS25

- Proposals
  - Option 1: MCS 23 with TDLA30-10 (Ericsson, Apple, Intel)
  - Option 2: MCS 24 with TDLD30-5 (QC)
  - Option 3: MCS 23 with TDLD30-5 (Huawei)

- Recommended WF
  - *Discuss further*

Issue 2-3: TDD UL/DL configuration

- Previous agreements

Table 5:

TDD: *7D1S2U, with S=6:4:4* *FFS to schedule PDSCH in the special slots*

- Proposals
    - Option 1: Schedule PDSCH in the special slots for TDD SCS=30kHz (Ericsson)

- Recommended WF
    - *Agree with option 1*

Issue 2-4: Whether to add extra margin on top of the impairment margin

- Previous agreements

Table 6:

N/A

- Proposals
    - Option 1: Yes (Huawei)

- Recommended WF
    - *Discuss further*

3.3 Companies' views collection for 1st round

3.3.1 Open issues

Feedback Form 1: Companies' views collection for PDSCH requirement

1 – Ericsson Japan K.K.

Issue 2-1: Tx EVM

Since Tx EVM assumption we are discussing is to verify UE demodulation performance, we don't need to exactly align with BS Tx requirements which assume the worst case. Traditionally Tx EVM assumed for UE demodulation requirements are lower than BS Tx EVM requirements, e.g., **3.0%** for 256QAM UE demod vs **3.5%** BS Tx requirements.

We should point out the BS Tx EVM was discussed based on the max CBW, like 100MHz for TDD in BS RF core part. We expect TE can achieve lower Tx EVM for UE demod test because we assuem 40MHz for TDD and 10MHz for FDD.

Please also note than test equipment does not need to realized the exactly same Tx EVM value we are assuming. We expect the actual Tx EVM during the UE demod test is lower than the assumption.

But we are ok to set **2.5% (Option 2)** considering the input from TE vendors in the last meeting. However it does not make sense to assume 2.8% because it is higher than BS Tx requirements.

Issue 2-2: MCS and channel model for PDSCH requirement

According to the simulation results summary MCS23 TDLD30-10 requires the lowest SNR to achieve 70%. Considering the RF impairment and margin, we are ok to choose **MCS23 + TDLD30-5.**

Issue 2-3: TDD UL/DL configuration

Support the recommended WF.

Issue 2-4: Whether to add extra margin on top of the impairment margin

It can be discussed after we agree MCS and channel model. However if we choose MCS/channel model so that the final SNR (i.e., average of impairment results) is around 28-29dB, we don't expect we need to add extra margin as same as LTE 1024QAM requirements.

2 – HiSilicon Technologies Co. Ltd

Issue 2-1: Tx EVM

We prefer Option 4. In last meeting, some TE vendor has feedback in last meeting that they prefer to follow the BS agreement and to not further tighten the requirement since high SNR values is expected which will require higher output power thus potentially worsen the signal quality from the gNodeB emulator. Therefore, 2.5% EVM should be selected for frequency less than 4.2GHz and 2.8% EVM should be selected for frequency greater than 4.2GHz.

Issue 2-2: MCS and channel model for PDSCH requirement

We prefer to Option 3, considering that the SNR point is lower than other configuration so that it is more feasible for testing, also the propagation condition of TDL-D is more consistent with the application scenarios specified in WID.

Issue 2-3: TDD UL/DL configuration

We are OK with Option 1.

Issue 2-4: Whether to add extra margin on top of the impairment margin

From our understanding, the extra margin should be considered if the ideal SNR point derived from simulation is too high. We can discuss this issue based on detailed SNR point later after the EVM value is selected and the simulation results are aligned.

3 – Qualcomm Technologies Int

Issue 2-1: Tx EVM

For the purpose of Tx EVM to use in the alignment simulations, we support considering Tx EVM = 2.5%

Issue 2-2: MCS and channel model for PDSCH requirement

We support using TDLD30-5 because it results in a lower SNR requirement and a larger margin with respect to Tx EVM.

For this, we are ok to go with either Option 2 or Option 3 (minimum SNR requirement) as well

Issue 2-3: TDD UL/DL configuration

We are fine with option 1;

Issue 2-4: Whether to add extra margin on top of the impairment margin

Once the test parameters are agreed upon, we can discuss an extra margin similarly to the ones introduced for lower modulation orders (16QAM, 64QAM, 256QAM).

However, we do not agree with the methodology proposed by Huawei, because it does not seem to consider that the simulation results provided already take into account the impact of TxEVM (included in the simulation assumptions). So the SNR point we will possibly agree for the requirement should not be considered the 'ideal' baseband SNR necessary to guarantee performances, but it already factors some of the Tx EVM impact.

4 – Apple GmbH

Issue 2-1: Tx EVM

We are fine to use TX EVM of 2.5% for simulation alignment.

Since we define band agnostic requirements we don't see how we can use proposal from Huawei.

Issue 2-2: MCS and channel model for PDSCH requirement

We prefer option 1 based on our simulation results. We don't prefer TDLD channel as it is not suitable in FR1 conditions.

Issue 2-3: TDD UL/DL configuration

We support the recommended WF.

Issue 2-4: Whether to add extra margin on top of the impairment margin

We would like to understand what this means. We typically do add a margin over average impairment results for deriving the requirement SNR to account for span in results. We could decide that during results alignment in pout understanding.

5 – MediaTek Inc.

Issue 2-1: Tx EVM

We are fine to consider 2.5% EVM for simulation alignment.

Issue 2-2: MCS and channel model for PDSCH requirement

We prefer Option 3 with TDL-D channel.

Issue 2-3: TDD UL/DL configuration

Support the recommended WF.

Issue 2-4: Whether to add extra margin on top of the impairment margin

We can discuss this issue after simulation alignment.

6 – Intel Corporation (UK) Ltd

Issue 2-1: Tx EVM

Support Option 2. Agree with comment from Apple – the requirements are defined in band-agnostic manner.

Issue 2-2: MCS and channel model for PDSCH requirement

Support Option 1. Also Ok with Option 3

Issue 2-3: TDD UL/DL configuration

Support the recommended WF.

Issue 2-4: Whether to add extra margin on top of the impairment margin

Our understanding is that the impairment margin which is added on top of alignment results should already include that extra margin, which value is up to the company.

3.4 Summary for 1st round

3.4.1 Open issues

Issue 2-1: Tx EVM

- Proposals
  - Option 1: 2.0% (Ericsson, Apple)
  - Option 2: 2.5% (Qualcomm, MTK, Intel)
  - Option 3: 2.8% (MTK)
  - Option 4: 2.5% for frequencies equal to or below 4.2GHz and 2.8% EVM for frequencies above 4.2 GHz (Huawei)

Tentative agreement

- Check if Option 2 is agreeable?

Issue 2-2: MCS and channel model for PDSCH requirement

- Proposals
  - Option 1: MCS 23 with TDLA30-10 (Apple, Intel)
  - Option 2: MCS 24 with TDLD30-5 (QC)
  - Option 3: MCS 23 with TDLD30-5 (Huawei, Ericsson, QC, MTK, Intel)

Tentative agreement

- Check if option 3 is agreeable?

Issue 2-3: TDD UL/DL configuration

- Proposals
  - Option 1: Schedule PDSCH in the special slots for TDD SCS=30kHz (Ericsson)

Tentative agreement

- Agree on Option 1: Schedule PDSCH in the special slots for TDD SCS=30kHz.
- No need for second round discussion.

Issue 2-4: Whether to add extra margin on top of the impairment margin

- Proposals

- Option 1: Yes (Huawei)

Tentative agreement

- Discuss later after RAN4 derive SNR test point to achieve 70% of max Tput based on the impairment results.
- No need for second round discussion.

3.5 Discussion in 2nd round

No need for second round discussion.

3.6 Summary of 2nd round

4 Topic #3: SDR requirements

4.1 Companies' contributions summary

<table>
<tr><th>T-doc number</th><th>Company</th><th>Proposals / Observations</th></tr>
<tr><td>R4-2200266</td><td>Apple</td><td>Observation #1: The operating SNR with 2 layers and 1024QAM is high for all MCS. The operating SNR with 1 layer is feasible with MCS 23 and MCS 24.
Proposal #1: For SDR requirements with 1 layer with 1024QAM, use $MCS^{j}_{practical}$ as 24.
Proposal #2: Do not introduce SDR requirements with 1024QAM with 2 layers with 2RX.</td></tr>
<tr><td>R4-2201012</td><td>Huawei,HiSilicon</td><td>Proposal 1: Select $MCS^{j}_{practical}$ = 25 for rank 1 and 23 for rank 2.</td></tr>
<tr><td>R4-2201429</td><td>Ericsson</td><td>Proposal 1: Set the practical MCS index for SDR test with 1024QAM is MCS25 for both rank 1 and rank 2.
Proposal 2: Add the following MCS index table in TS38.101-4 Table 5.5A-5.
<table>
<tr><th>Maximum number of PDSCH MIMO layers</th><th>Maximum modulation format</th><th>Scaling factor</th><th>MCS (Upper bound)</th><th>MCS (Practical)</th><th>MCS (Requirements)</th></tr>
<tr><td>1</td><td>10</td><td>1</td><td>25</td><td rowspan="4">25</td><td>25</td></tr>
<tr><td>1</td><td>10</td><td>0.8</td><td>21</td><td>21</td></tr>
<tr><td>1</td><td>10</td><td>0.75</td><td>19</td><td>19</td></tr>
<tr><td>1</td><td>10</td><td>0.4</td><td>9</td><td>9</td></tr>
<tr><td>2</td><td>10</td><td>1</td><td>25</td><td rowspan="2">25</td><td>25</td></tr>
<tr><td>2</td><td>10</td><td>0.8</td><td>21</td><td>21</td></tr>
</table></td></tr>
</table>

Figure 1:

R4-2201784	Intel Corporation	*Observation 1. For the scenario with Rank 1 and 2 Rx antennas SNR operating point is feasible for MCS23.* *Observation 2: For the scenario with Rank 2 and 2 Rx antennas SNR operating point for MCS23 is very high and for MCS24 and MCS25 is even out of simulated SNR range.* **Proposal 1: RAN4 shall not define 1024QAM SDR tests for the scenario with Rank 2 and 2 Rx antennas** *Observation 3: In the scenario with 4 Rx antennas SNR operating point for MCS23 is feasible even for Rank 2.* **Proposal 2: For 1024QAM SDR tests with Rank 2 consider 4 Rx antennas** **Proposal 3: MCS index for $MCS^j_{practical}$ is 23 for Rank 1 and Rank 2. Therefore, the MCS indexes for 1024QAM SDR tests can be defined as it is shown in Table 4.**

Table 4. MCS indexes for SDR test with 1024QAM

v^j_{Layers}	Q^j_m	f^j	$MCS^j_{upperbound}$	$MCS^j_{practical}$	MCS^j_{req}
1	10	1	25	23	23
1	10	0.8	21		21
1	10	0.75	19		19
1	10	0.4	9		9
2	10	1	25	23	23
2	10	0.8	21		21
2	10	0.75	19		19

Figure 2:

4.2 Open Issues Summary

Issue 3-1: Rx for 2 Layers for SDR requirement

- Previous agreements

Table 7:

Define SDR requirements for 1024 QAM with rank 1 and rank 2.

- Proposals
  - Option 1: Do not introduce SDR requirements with 1024QAM with 2 layers with 2RX (Apple, Intel)
    - *Apple: The operating SNR with 2 layers and 1024QAM is high for all MCS. The operating SNR with 1 layer is feasible with MCS 23 and MCS 24*
  - Option 2: 4Rx (Intel)
    - *Intel: For the scenario with Rank 2 and 2 Rx antennas SNR operating point for MCS23 is very high and for MCS24 and MCS25 is even out of simulated SNR range*

- Recommended WF
  - *Discuss further*

undefined

Issue 3-2: MCS index table

- Proposals
  - Option 1: Add the following MCS index table in TS38.101-4 Table 5.5A-5. (Ericsson)

Maximum number of PDSCH MIMO layers	Maximum modulation format	Scaling factor	MCS (Upper bound)	MCS (Practical)	MCS (Requirements)
1	10	1	25	25	25
1	10	0.8	21		21
1	10	0.75	19		19
1	10	0.4	9		9
2	10	1	25	25	25
2	10	0.8	21		21

  - Option 2: The MCS indexes for 1024QAM SDR tests can be defined as it is shown in Table 4. (Intel)

- **Table 4. MCS indexes for SDR test with 1024QAM**

v^j_{Layers}	Q^j_m	f^j	$MCS^j_{upperbound}$	$MCS^j_{practical}$	MCS^j_{req}
1	10	1	25	23	23
1	10	0.8	21		21
1	10	0.75	19		19
1	10	0.4	9		9
2	10	1	25	23	23
2	10	0.8	21		21
2	10	0.75	19		19

  - Option 3: For SDR requirements with 1 layer with 1024QAM, use MCSpractical as 24 (Apple)
  - Option 4: Select MCSpractical = 25 for rank 1 and 23 for rank 2 (Huawei)

- Recommended WF
  - *Discuss further*

Figure 3:

4.3 Companies' views collection for 1st round

4.3.1 Open issues

Feedback Form 2: Companies' views collection for SDR requirement

1 – Ericsson Japan K.K.

Issue 3-1: Rx for 2 Layers for SDR requirement

We think Option 4 could be a good compromise, that is,

MCS 25 for rank 1

MCS 23 for rank 2

2 – HiSilicon Technologies Co. Ltd

Issue 3-1: Rx for 2 Layers for SDR requirement

We prefer to consider both 2Rx and 4Rx requirements for rank2.

Issue 3-2: MCS index table

We are OK to define SDR requirements with MCS 25 for rank 1 and MCS 23 for rank 2.

3 – Qualcomm Technologies Int

Issue 3-1: Rx for 2 Layers for SDR requirement

Issue 3-2: MCS index table

On the SDR requirements practical constraints: given that the target of this test is peak throughput capabilities, reducing to single layer for 2 RX or lower MCS, can this still be considered a peak throughput scenario that need an additional test definition? If there are concerns regarding the feasibility of the test we should further consider them

4 – Apple GmbH

Issue 3-1: Rx for 2 Layers for SDR requirement

From simulation results we don't think its practical to define SDR requirements for 2 layers with 2RX given the high operating SNR. We didn't evaluate for 4RX. In the past we have defined MCS practical based on feasible SNR for the number of layers based on simulation results and we should do the same for 1K QAM.

Issue 3-2: MCS index table

For rank 1 MCS_prac = 23

For rank 2 FFS

5 – Intel Corporation (UK) Ltd

Issue 3-1: Rx for 2 Layers for SDR requirement

MCSpractical is defined as the highest practical MCS considering feasible SNR levels. Based on our simulation results, there are no feasible SNR levels for 2 layers with 2Rx, but there are for 4Rx.

Issue 3-2: MCS index table

For rank 1 MCSpractical = 23

For rank 2 MCSpractical =23

4.4 Summary for 1st round

4.4.1 Open issues

Issue 3-1&3-2 MCS index for different Rx

- Proposals:
  - For 2Rx
    - For rank 1:
      - Option 1: 25 (Ericsson, Huawei)
      - Option 2: 23 (Apple, Intel)
    - For rank 2:
      - Option 1: 23 (Ericsson, Huawei)
      - Option 2: Not Define (Apple, Intel)
  - For 4Rx
    - For rank 1:
      - Option 1: 25 (Ericsson, Huawei)
      - Option 2: 23 (Apple, Intel)
    - For rank 2:
      - Option 1: 23 (Ericsson, Huawei, Intel)
      - Option 2: FFS (Apple)

Tentative agreement

- Companies are encouraged to investigate the options above for 2Rx/4Rx considering the assumed Tx EVM.

4.5 Discussion in 2nd round

Issue 3-1&3-2 MCS index for different Rx

- Proposals:
  - For 2Rx
    - For rank 1:
      - Option 1: 25 (Ericsson, Huawei)
      - Option 2: 23 (Apple, Intel)
    - For rank 2:
      - Option 1: 23 (Ericsson, Huawei)
      - Option 2: Not Define (Apple, Intel)
  - For 4Rx
    - For rank 1
      - Option 1: 25 (Ericsson, Huawei)
      - Option 2: 23 (Apple, Intel)
    - For rank 2
      - Option 1: 23 (Ericsson, Huawei, Intel)
      - Option 2: FFS (Apple)

Moderator's recommendation:

- Companies are encouraged to investigate the options above for 2Rx/4Rx considering the assumed Tx EVM

Feedback Form 3: 2nd round feedback on issue 3-1&3-2

1 – Apple GmbH We propose to keep all these options open and decide based on results. Also we should use TX EVM=2.5%. For **Issue 2-1: Tx EVM** we are fine with tentative agreement. For Issue **Issue 2-2: MCS and channel model for PDSCH requirement** we prefer to keep channel model as FFS with options TDLA and TDLD.
2 – Ericsson Japan K.K. **Issue 2-1:** We support the tentative agreement - assume Tx EVM = 2.5%. **Issue 2-2**: We support the tentative agreement - Option 4 (MCS23 and TDLD30-5) considering the required SNR with impairments to achieve 70% of max Tput.

Issue 3-1/3-2: We are ok to evaluate MCS of SDR tests further per Rx with Tx EVM 2.5% and come back in the next meeting.
3 – MediaTek Inc. **Issue 2-1:** We support the tentative agreement, Tx EVM = 2.5%. **Issue 2-2**: We support the tentative agreement, Option 3: MCS 23 with TDLD30-5. **Issue 3-1/3-2**: We also prefer to keep it open and use Tx EVM 2.5% for evaluation in the next meeting.
4 – Qualcomm Technologies Int **Issue 2-1:** We support the tentative agreement for TX EVM = 2.5%. **Issue 2-2**: We support using TDLD because it seems to allow us to define a lower SNR requirement with better margin with respect to TX EVM and avoid introducing high relaxation margin. So we support MCS 23 with TDLD30-5. **Issue 3-1/3-2**: We would like to discuss this in the next meeting after further evaluation.

4.6 Summary for 2nd round

Issue 2-1Tx EVM

- Proposals
  - Option 1: 2.0%
  - Option 2: 2.5%
  - Option 3: 2.8%
  - Option 4: 2.5% for frequencies equal to or below 4.2GHz and 2.8% EVM for frequencies above 4.2 GHz

2nd round agreements:

- Option 2: 2.5%

Issue 2-2 MCS and channel model for PDSCH requirement

- Proposals
  - Option 1: MCS 23 with TDLA30-10
  - Option 2: MCS 24 with TDLD30-5
  - Option 3: MCS 23 with TDLD30-5

2nd round agreements:

- MCS: MCS23
- Channel model:
  - Option 1: TDLD30-5
  - Option 2: TDLA30-10

Issue 3-1&3-2 MCS index for different Rx

- Proposals:
  - For 2Rx
    - For rank 1:
      - Option 1: 25
      - Option 2: 23
    - For rank 2:
      - Option 1: 23
      - Option 2: Not Define
  - For 4Rx
    - For rank 1:
      - Option 1: 25
      - Option 2: 23
    - For rank 2:
      - Option 1: 23
      - Option 2: FFS

2nd round agreements:

- Evaluate above MCS with EVM 2.5% and decide based on the simulation results in the next meeting.

5 Topic #4: CQI requirements

5.1 Companies' contributions summary

Table 8:

T-doc number	Company	Proposals / Observations
R4-2201013	Huawei,HiSilicon	CQI15 cannot be reported as median CQI for both rank1 and rank2, and CQI14 cannot be reported as median CQI for and rank2. Select rank1 with 29/30dB for 2Rx and 26/27dB for 4Rx for CQI reporting case. In addition, the extra margin should be considered for UE implementation similar as Rel-16 DL FR2 256QAM WI did.
R4-2201430	Ericsson	Observation 1: With Tx EVM 2.5%, the required SNR for CQI index 14 with rank 1 is 29dB. Observation 2: With Tx EVM 2.5%, the required SNR for CQI index 14 with rank 2 is 33dB. Observation 3: With Tx EVM 2.0%, the required SNR for CQI index 14 with rank 1 is 28dB. Observation 4: With Tx EVM 2.0%, therequired SNR for CQI index 14 with rank 2 **is** 31dB. Proposal 1: Configure rank 1 for CQIdefinition test for DL 1024QAM CQI table. Proposal 2: Set SNR=28/29dB for 2Rx UE. Proposal 3: Set SNR=25/26dB for 4Rx UE.

R4-2201719	Qualcomm Incorporated	Observation 1: An assumed TX EVM = 2.5% results in an SNR floor of around 32dB. Observation 2: Simulation results obtained with MCS 25 would result in an SNR requirement close or above the SNR floor computed based on the assumed TX EVM. Observation 3: Designing a CQI test targeting a median report of CQI Index 15 can result in a test in which the requirement cannot be tested. Proposal 1: For TX EVM, support Option 2 (2.5%) in the WF, in accordance with the outcome of the BS discussion. Proposal 2: Do not define PDSCH requirements using MCS 25; Proposal 3: If TDLA30-10 is agreed as propagation channel, RAN4 to define PDSCH requirements using MCS=23. Otherwise, if TDLD30-5 is agreed as propagation channel, RAN4 to define PDSCH requirements using MCS=24. Proposal 4: Support using TDLD30-5 as propagation channel for the PDSCH requirements definition; Proposal 5: It is practical to define SDR requirements for 1024 QAM up to and including MCS 25; Proposal 6: For CQI requirements for 1024 QAM FR1, support introducing a test targeting median reported CQI Index 14 and Rank 1.

5.2 Open Issues Summary

Issue 4-1: Rank for new CQI definition tests for 1024QAM

– Previous agreements

Table 9:

Rank:

- *Option 1: 1*
- *Option 2: 2*

- Proposals
  - Option 1: 1(Ericsson, Huawei, Qualcomm)

- Recommended WF
  - *Check if rank 1 is acceptable*

Issue 4-2: Test point for 2Rx UE

- Proposals
  - Option 1: SNR = 28/29dB(Ericsson)
  - Option 2: SNR = 29/30dB (Huawei)
  - Option 3: Introducing a test targeting median reported CQI Index 14 and Rank 1 (Qualcomm)
    - *Qualcomm: Designing a CQI test targeting a median report of CQI Index 15 can result in a test in which the requirement cannot be tested.*

- Recommended WF
  - *Discuss further*

Issue 4-3: Test point for 4Rx UE

- Proposals
  - Option 1: SNR = 25/26dB (Ericsson)
  - Option 2: SNR = 26/27dB (Huawei)
  - Option 3: Introducing a test targeting median reported CQI Index 14 and Rank 1 (Qualcomm
    - *Qualcomm: Designing a CQI test targeting a median report of CQI Index 15 can result in a test in which the requirement cannot be teste*

- Recommended WF
  - *Discuss further*

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

- Proposals
  - Option 1: Yes (Huawei)

- Recommended WF
  - *Discuss further*

5.3 Companies' views collection for 1st round

5.3.1 Open issues

Feedback Form 4: Companies' views on CQI requirement

1 – Ericsson Japan K.K.

Issue 4-1: Rank for new CQI definition tests for 1024QAM

Support the recommended WF, rank 1.

Issue 4-2: Test point for 2Rx UE

We prefer to assume lower SNR, so Option 1, SNR = 28/29dB.

Issue 4-3: Test point for 4Rx UE

We prefer Option 1: SNR = 25/26dB

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

If we set SNR so that SNR=28/29dB for 2Rx, we don't think we need to add extra margin as same as LTE 1024QAM CQI test.

2 – HiSilicon Technologies Co. Ltd

Issue 4-1: Rank for new CQI definition tests for 1024QAM

We are OK with Option 1.

Issue 4-2: Test point for 2Rx UE

We prefer Option 2 to ensure at least 1024QAM (CQI index 14) is reported.

Issue 4-3: Test point for 4Rx UE

We prefer Option 2 to ensure at least 1024QAM (CQI index 14) is reported.

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

We prefer Option 1 that extra margin should be considered same as FR2 256QAM WI. 1024QAM can be reported for the ideal SNR discussed in Issue 4-2 and Issue 4-3 during the simulation. However, the UE cannot report 1024QAM during the real testing based on the ideal SNR since impairment factor is not considered, then we are not sure whether it is still meaningful to define 1024QAM CQI reporting requirements.

3 – Qualcomm Technologies Int

Issue 4-1: Rank for new CQI definition tests for 1024QAM

Support Option 1

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

As we have commented on the SDR tests, if there are concerns on whether UE will report or not 1024QAM because of the test setup and feasible SNR, we also think we should further discuss whether it is productive or meaningful to introduce dedicated CQI reporting requirements.

4 – Apple GmbH

Issue 4-1: Rank for new CQI definition tests for 1024QAM

Rank 1 is acceptable to us.

Issue 4-2: Test point for 2Rx UE, Issue 4-3: Test point for 4Rx UE

We propose to discuss based on simulation results.

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

We need to choose an operating point accounting for implementation margin. We are not very clear about the extra margin on top of implementation margin for CQI reporting requirements.

5 – MediaTek Inc.

Issue 4-1: Rank for new CQI definition tests for 1024QAM

We are OK with Option 1.

5.4 Summary for 1st round

5.4.1 Open issues

Issue 4-1: Rank for new CQI definition tests for 1024QAM

- Proposals:
  - Option 1: 1(Ericsson, Huawei, Qualcomm, Apple, MTK)

Tentative agreement

- Agree on Option 1: rank 1 for new CQI definition tests for 1024QAM.
- No need for second round discussion.

Issue 4-2: Test point for 2Rx UE

- Proposals:
  - Option 1: SNR = 28/29dB(Ericsson)
  - Option 2: SNR = 29/30dB (Huawei)
  - Option 3: Introducing a test targeting median reported CQI Index 14 and Rank 1 (Qualcomm)
    - *Qualcomm: Designing a CQI test targeting a median report of CQI Index 15 can result in a test in which the requirement cannot be tested.*

Tentative agreement

- Introducing a test targeting median reported CQI Index 14 and Rank 1
- Companies are encouraged to investigate the test points considering the assumed Tx EVM.

Issue 4-3: Test point for 4Rx UE

- Proposals
  - Option 1: SNR = 25/26dB (Ericsson)
  - Option 2: SNR = 26/27dB (Huawei)
  - Option 3: Introducing a test targeting median reported CQI Index 14 and Rank 1 (Qualcomm
    - *Qualcomm: Designing a CQI test targeting a median report of CQI Index 15 can result in a test in which the requirement cannot be tested*

Tentative agreement

- Introducing a test targeting median reported CQI Index 14 and Rank
- Companies are encouraged to investigate the test points considering the assumed Tx EVM.

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

- Proposals
  - Option 1: Yes (Huawei)

Tentative agreement

- Discuss later after RAN4 identified the SNR test points.
- No need for second round discussion.

5.5 Discussion in 2nd round

Issue 4-2: Test point for 2Rx UE

- Proposals:
  - Option 1: SNR = 28/29dB(Ericsson)
  - Option 2: SNR = 29/30dB (Huawei)

Moderator's recommendation:

- Companies are encouraged to investigate the test points considering the assumed Tx EVM.

Feedback Form 5: 2nd round feedback on issue 4-2

1 – Apple GmbH We need to decide on SNR based on results.
2 – Ericsson Japan K.K. We prefer lower SNR test points, i.e., Option 1. However this is the first meeting, we are ok that interested companies evaluate the SNR test point corresponding to CQI index 14 with Tx EVM 2.5% and decided in the next meeting.

3 – Qualcomm Technologies Int We are fine with further discussing the SNR points for SDR requirement;

Issue 4-3: Test point for 4Rx UE

- Proposals:
  - Option 1: SNR = 25/26dB (Ericsson)
  - Option 2: SNR = 26/27dB (Huawei)

Moderator's recommendation:

- Companies are encouraged to investigate the test points considering the assumed Tx EVM

Feedback Form 6: 2nd round feedback on issue 4-3

1 – Apple GmbH We need to decide on SNR based on simulation results. We already have agreement to use SNR targeting reported CQI of 14.
2 – Ericsson Japan K.K. We prefer lower SNR test points, i.e., Option 1. However this is the first meeting, we are ok that interested companies evaluate the SNR test point corresponding to CQI index 14 with Tx EVM 2.5% and decided in the next meeting.
3 – Qualcomm Technologies Int We are fine with further discussing the SNR points for SDR requirement;

6 Summary for 2nd round

Issue 4-2: Test point for 2Rx UE

- Proposals:
  - Option 1: SNR = 28/29dB
  - Option 2: SNR = 29/30dB

2nd round agreements:

- Option 1: SNR = 28/29dB

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

Issue 4-3: Test point for 4Rx UE

- Proposals
  - Option 1: SNR = 25/26dB
  - Option 2: SNR = 26/27dB

2nd round agreements:

- Option 1: SNR = 25/26dB
- Option 2: SNR = 26/27dB
- Other options not precluded
- Evaluate SNR test point corresponding to CQI index 14 with Tx EVM 2.5% and decide in the next meeting

7 Recommendations for Tdocs

7.1 1st round

New Tdoc:

Table 10:

Tdoc	Title	Source	Comment
R4-220xxxx	Way forward for NR DL1024QAM demodulation and CQI reporting requirements	Ericsson	Including the simulation assumption

7.2 2nd round

Table 11:

Tdoc	Title	Source	Comments	Recommendation
R4-2203044	Way forward for NR DL1024QAM demodulation and CQI reporting requirements	Ericsson	Including the simulation assumption	Agreeable

8 Annex

Contact information

Feedback Form 7: Contact information

1 – Ericsson Japan K.K. Ericsson, Kazuyoshi Uesaka, kazuyoshi.uesaka@ericsson.com
2 – HiSilicon Technologies Co. Ltd Huawei, HiSilicon, Zehan Zhao, zhaozehan@hisilicon.com
3 – Qualcomm Technologies Int Qualcomm, Pier Vallese: pvallese@qti.qualcomm.com
4 – Apple GmbH Apple Manasa Raghavan manasa.raghavan@apple.com

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)