**3GPP TSG-RAN WG4 Meeting # 98-bis-e R4-210XXXX**

**Electronic Meeting, 12th – 20th April, 2021**

**Agenda item:** 9.6

**Source:** Moderator (Ericsson)

**Title:** Email discussion summary for [100-e][311] NR\_DL1024QAM\_BSRF

**Document for:** Information

# Introduction

For the 1024QAM BS RF core part, two main issues remain to be resolved; firstly, whether 1024QAM is applicable for all BS classes or whether it is applicable for LA and MR but not WA. Secondly the EVM value. Discussions and simulations have been provided for these issues. System simulations provide a background for the BS class and link simulations for the EVM decisions.

Some of the proposals for EVM are linked to the discussion on BS classes. Nonetheless, it is proposed to discuss the two issues in parallel. For the EVM, the performance and implementation implications can be discussed and if needed, EVM considering the scenario with/without WA BS class can be proposed.

The target for the meeting should be to finalize both the applicable class and the EVM.

# Topic #1 BS class applicability and EVM

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2113951 | Ericsson, Nokia, Nokia Shanghai Bell, Verizon, KDDI, SoftBank, NTT DOCOMO, AT&T, SK Telecom, T-Mobile USA | **Observation 1: Higher over modulation can be used as opportunistic when channel conditions are favorable.**  **Observation 2: Deployment scenarios would change from LTE to NR if 1024 QAM does not support same BS classes in both generations.**  **Observation 3: 5G should not be less maximum throughput compared to 4G when similar technology basis is concerned.**  **Proposal:** Selection Option 1 in [1]. Define 1024QAM RF requirements for all BS classes |
| R4-2111976 | CATT | Simulation results  **Observation 1: The crossover SNR for rank 1 with 3% TX EVM and 2.5 TX EVM in TDL-A is 31.35dB and 28.54dB respectively.**  **Observation 2: The throughput gain of 1024QAM compared to 256QAM for rank 1 with 3% TX EVM and 2.5% TX EVM in TDL-A is 16.8% and 22.6% respectively.**  **Observation 3: The 2.5% TX EVM compared to 3% TX EVM can achieve 3dB SNR gain and 6% throughput gain.**  **Proposal 1: To define BS TX EVM requirement for 1024QAM as 2.5~3%.** |
| R4-2113047 | Huawei | **Observation: from link level simulation, 3% TX EVM can provide observed gain for 1024 QAM compared to 256 QAM.** |
| R4-2113487 | Nokia | ***Observation 1: Simulation results for 1024QAM show higher throughput compared to 256QAM for higher, but still reasonable SNR conditions and reasonable EVM requirements.***  ***Observation 2: Simulation results for 1024QAM show that 3% Tx EVM reduces performance in many simulation cases, in some even below 256QAM.*** |
| R4-2113952 | Ericsson | **Observation: Analysis shows that at least 20% of users can benefit from 1024 QAM even in WA BS class.**  **Proposal 1: Wide Area BS should not be excluded from introduction of DL 1024 QAM in NR FR1.** |
| R4-2111977 | CATT | **Proposal 1: EVM requirement should be determined based on link level simulation and implementation for NR.**  **Proposal 2: Option 2: 1024QAM applicable to MR BS and LA BS, but not applicable for WA BS class is preferred unless a performance gain for 1024-QAM in WA deployment scenario is observed.** |
| R4-2113048 | Huawei, CMCC | In this contribution, we provide consideration on the support of 1024-QAM. We propose to further discuss the following 3 options.  Option 1: 1024QAM applicable to MR BS and LA BS, but not applicable for WA BS class.  Option 2: 1024QAM is applicable for all BS classes but the EVM requirements is not defined for Macro BS.  Option 3: 1024QAM is applicable for all BS classes and 3 % TX EVM is proposed for DL 1024 QAM |
| R4-2113488 | Nokia | ***Proposal 1: It is proposed to agree option 1 i.e. to apply 1024QAM to all BS classes.***  ***Proposal 2: It is proposed use 2.5% as Tx EVM requirement for 1024QAM*** |
| R4-2114184 | Intel | *Observation 1: From link level results we can conclude:*  *TDL-A channel*   * + - *MIMO rank 1: sufficient performance improvement is observed for SNR > 26-29 dB depending on EVM conditions.*     - *MIMO rank 2:*        * *for Rx EVM = 3% there is no performance improvement for SNR < 35dB*       * *for Rx EVM < 3% small performance improvement can be observed for SNR > 31-35dB depending on EVM conditions.*   *TDL-D channel*   * + - *MIMO rank 1: sufficient performance improvement is observed for SNR > 25 dB*     - *MIMO rank 2: sufficient performance improvement is observed for SNR > 30-34 dB depending on EVM conditions*   *Observations 2:**From analysis of required Tx EVM value to achieve benefits of 1024QAM we can conclude that the 1024QAM performance in case of Tx EVM 2.5% is slightly better than in case of Tx EVM 3% for rank 1 and sufficiently better for rank 2.*  **Proposal 1: Define Tx EVM requirements equal to 2.5%**  *Observations #3: From analysis on testability of DL 1024QAM we can conclude:*   * + - *SNR operating point is rather sensitive to Tx/Rx EVM value*     - *DL 1024QAM can not be tested for rank 2 + MCS 26. For rank 2 + MCS 25 and rank 1 + MCS 26 the 70% of max T-put is achievable only under conditions of low Tx and Rx EVM* |
| R4-2114214 | ZTE | **Proposal 1:** to start with scenarios (LA, MR) where no coverage issue or power back off is not needed to support 1024QAM firstly.  **Proposal 2**: propose the EVM requirement for NR 1024QAM as 2.5%. |
| R4-211978 | CATT | **Proposal 1: EVM test requirement for 1024QAM should equal to the EVM requirement for 1024QAM in TS 38.104 + 1%.**  **Proposal 2: To define the following test model for 1024 QAM**   * + - **NR-FR1-TM2b with single 1024QAM PRB allocation**     - **NR-FR1-TM3.1b with all 1024QAM PRBs allocation.**   **Proposal 3: To support up to three rated output power declaration for 1024QAM capable BS.**  **Moderator note: These issues should be decided in the conformance phase. Companies are welcome to take the proposals into account and provide feedback, but it is proposed to not make any decision on conformance issues this meeting.** |

## Open issues summary

### Sub-topic 1-1: Whether 1024QAM requirement should be applied for WA BS class

Sub-topic description: The aim of this sub-topic is to collect comments on the system results regarding gain in wide area scenarios and make a decision on the applicable class.

Open issues and candidate options before e-meeting:

**Issue 1-1: Gain for wide area scenario**

Under this issue, the observations on the gains of 1024QAM for WA class should be discussed.

* Observations
  + Observation 1: No gain (Huawei)
  + Observation 2: Gain for at least 20% of users (Ericsson)
* Recommended WF
  + Please comment on your views on the results, considering the simulation parameters, methodology and results themselves.

**Issue 1-2: Whether to exclude WA scenario**

This issue aims to decide on whether to include the WA scenario. Considerations raised by companies include the gains, comparison to LTE (for which 1024QAM is applicable) and technical challenges that exist for NR but not LTE (e.g. bandwidths, spectrum utilization etc.). Feedback on the issues highlighted by companies in their contributions is welcome.

* Proposals
  + Option 1: Exclude WA scenario (Huawei, CMCC, ZTE, CATT if no gain)
  + Option 2: Include WA scenario, but no EVM requirement for WA (Huawei, CMCC)
  + Option 3: Include WA scenario, with EVM requirement 3% (for all classes) (Huawei, CMCC)
  + Option 4: Include WA scenario (Ericsson, Nokia, Verizon, KDDI, SoftBank, NTT DOCOMO, AT&T, SK Telecom, T-Mobile USA)
* Recommended WF
  + Please discuss, comment and motivate a preferred conclusion

### Sub-topic 1-2 EVM requirement for 1024QAM

This sub-topic aims to conclude on the EVM requirement for 1024QAM. Link level simulations have been provided and companies are requested to review and comment on these as part of the discussion.

Open issues and candidate options before e-meeting:

**Issue 1-3: EVM requirement**

* Proposals
  + Option 1: 3% (Huawei, CMCC)
  + Option 2: Not defined for WA class, TBC for MR, LA class (Huawei, CMCC)
  + Option 3: 2.5% (Nokia, Intel, ZTE, Ericsson)
  + Option 4: 2.5~3% (CATT)
* Recommended WF
  + Please discuss and motivate a conclusion for the EVM requirement. Refer to link simulation results (including comments to other companies link simulation results) as needed. It is recognized that the EVM discussion is linked to the BS class discussion, so if you prefer propose values for the two cases of (i) 1024 QAM applicable for all classes or (ii) 1024QAM not applicable for WA class.

## Companies views’ collection for 1st round

### Open issues

Sub topic 1-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |

Sub topic 1-2

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |

Sub topic 1-3

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |

### CRs/TPs comments collection

*For close-to-finalize WIs and maintenance work, comments collections can be arranged for TPs and CRs. For ongoing WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2113049 | CR for TS 38.104: 1024QAM, Huawei |
| Moderator: Issues 1-1, 1-2 and 1-3 need to be solved to approve the CR. Companies are welcome to provide feedback here, but the CR will only be proposed to be approved if all of the open issues are resolved. Feedback to the CR is nonetheless useful since if the open issues are resolved, the CR could be approved this meeting. |
|  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

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

### CRs/TPs

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

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

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

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

### CRs/TPs

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

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

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

# Topic #2: UE related documents

This topic handles the remaining UE issue and CR

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2111979 | CATT | **Proposal 1: The MCS index 23 in 1024QAM mcs table can be adopted for RMCs for maximum input level for 1024QAM.**  **Moderator note: RMC should be decided in the conformance phase. Companies are welcome to take the proposal into account and provide feedback, but it is proposed to not make any decision on conformance issues this meeting.**  **CATT: The RMC is for definition of maximum input level requirement which is still FFS in the 38.101-1 CR. Not sure this should be handle in conformance phase rather than core part?** |

## Open issues summary

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2113050 | Draft CR for TS 38.101-1: Introduction of maximum input level for 1024QAM for NR FR1 (Huawei) |
| Company A |
|  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

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

### CRs/TPs

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

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

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

# Recommendations for Tdocs

## 1st round

**New tdocs**

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

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Notes:

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

## 2nd round

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-210xxxx | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-210xxxx | LS on … | ZZZ | Agreeable, Revised, Noted |  |
|  |  |  |  |  |

Notes:

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

# Annex

Contact information

|  |  |  |
| --- | --- | --- |
| **Company** | **Name** | **Email address** |
|  |  |  |

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)