**3GPP TSG-RAN WG4 Meeting #94-e R4-20xxxxx**

**Electronic Meeting, Feb.24th – Mar.6th 2020**

**Agenda item:** 8.20.1

**Source:** Moderator (ZTE Corporation)

**Title:** Email discussion summary for RAN4#94e\_#96\_NR\_2step\_RACH\_Demod

**Document for:** Information

# Introduction

*Briefly introduce background, the scope of this email discussion and provide some guidelines for email discussion if necessary.*

This email thread is assigned to discuss BS demodulation for 2-step RACH.

*List of candidate target of email discussion for 1st round and 2nd round*

* 1st round:
  + Collect views and comments on the listed open issues below
  + Discuss way forward based on the collected views.
* 2nd round: TBA

# Topic #1: General aspects on performance requirements for preamble and MsgA demodulation

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000314 | Samsung | Proposal 1: No BS demodulation requirements for Rel-16 NR 2-step RACH. |
| R4-2000801 | ZTE | Observation: no additional standardization efforts is needed on 2-step RACH preambles. |
| R4-2001183 | Ericsson | Observation 1: Rel-15 PRACH detection requirements are sufficient for ensuring Rel-16 2 step RACH detection performance.  Observation 2: Rel-15 PUSCH demodulation requirements are sufficient for ensuring rel-16 2 step PRACH demodulation performance.  Proposal 1: Do not define any additional demodulation requirements for 2 step PRACH |
| R4-2001491 | Nokia | Proposal 1: Performance requirements should be specified for MsgA, which includes joint PRACH and PUSCH, before RAR/MAC CE based TA compensation.  Observation 6: 2-step RACH supports all the preamble formats from NR Rel-15.  Proposal 5: Choose subset of Rel-15 PRACH preambles for the requirements.  Proposal 11: Define requirements and tests for PRACH preambles 0, A2, and C2 as in Table 1.  Observation 8: Currently 2-step RACH procedure supports interlaced PUSCH in combination with NR-U.  Observation 9: SIB1 signalling also provides support of new 1151 and 571 long PRACH sequences with the 2-step RACH procedure.  Proposal 7: Assuming the usage of long PRACH sequences is not limited to unlicensed operation by the NR-U WI in the coming meetings, specify NR-U scenario for 2-step RACH performance requirements with interlaced PUSCH and new 1151 and 571 long PRACH sequences.  Observation 11: Typical use cases where 2-step RACH have traffic that comprises small RRC messages of 56 bits, e.g. RRCRequest, RRCReestablishmentRequest, and RRCResumeRequest with short I-RNTI, or 72 bits, e.g. RRCResumeRequest with Long I-RNTI. |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 1-1

*Sub-topic description:*

*Open issues and candidate options before e-meeting:*

**Issue 1-1: performance requirements on preamble and MsgA for 2-step RACH**

* Proposals
  + Option 1: Separate performance requirements for preamble detection and MsgA demodulation
  + Option 2: MsgA demodulation performance includes joint preamble and payload
* Recommended WF

### Sub-topic 1-2

*Sub-topic description*

*Open issues and candidate options before e-meeting:*

**Issue 1-2: Are additional preamble detection performance requirements needed?**

* Proposals
  + Option 1: Yes
  + Option 2: No, current Rel-15 preamble detection performance requirements are sufficient
* Recommended WF
  + TBA

### Sub-topic 1-3

*Sub-topic description*

*Open issues and candidate options before e-meeting:*

**Issue 1-3: Are additional demodulation performance requirements for MsgA needed?**

* Proposals
  + Option 1: Yes
  + Option 2: No, current Rel-15 PUSCH demodulation performance requirements are sufficient
* Recommended WF
  + TBA

**Issue 1-4: Should interlaced PUSCH design and long preambles be considered ?**

* Proposals
  + Option 1: No, leave to NR-U WID
  + Option 2: Yes, addressed within 2-step RACH WID
* Recommended WF

## Companies views’ collection for 1st round

### Open issues

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| --- | --- |
| **Company** | **Comments** |
| Samsung | Sub topic 1-1:  Issue 1-1: performance requirements on preamble and MsgA for 2-step RACH  Prefer: separate requirement with Msg A PRACH and Msg PUSCH if requirement needed  If RAN4 has identify the impact on demodulation performance of 2-step RACH based on the RAN1 feature, separate requirement with MsgA PRACH and MsgA PUSCH ( option 1) is preferred, we do not prefer to define the joint requirement with related preamble and Mag A.  MsgA PRACH is transmitted with preamble. With detection of preamble, the resource unit for MsgA PUSCH is indicated based on the mapping rule. There is no impact on the receiver process of MagA PUSCH.  From RAN4 demodulation requirement perspective, we do not define the joint requirements for each channel. Similarly for, PDCCH and PUSCH. The resource allocation, MCS,.HARQ information for PUSCH are carried with DCI 0-0 or 0-1  Generally, the working point of PUSCH is higher than PDCCH. From the test perspective, RAN4 always assume the detection of PDCCH is correct, when we test the requirement of PUSCH or PDSCH.  In that sense, we prefer option 1 if requirement are needed.  Sub topic 1-2:  Issue 1-2: Are additional preamble detection performance requirements needed?  Prefer option 2, no additional preamble detection performance  Based on the objective of 2-step RACH, the preamble design is only reusing the NR Rel-15 NR PRACH design. In Rel-15, RAN4 has specified the requirement of PRACH with related long and short PRACH preamble sequences. So, we think there is no new PRACH requirement.  Sub topic 1-3:  Issue 1-3: Are additional demodulation performance requirements for MsgA needed?  Prefer option 2, No, additional demodulation requirement, current Rel-15 PUSCH demodulation performance requirements are sufficient  Based on the RAN1 agreement of 2-step RACH, the MsgA PUSCH reuses the existing UL physical layer. In NR Rel-15, we have already specified the PUSCH requirement based RAN1 feature covering the different waveform, DMRS structure, TDRA, and MCS. In our view, we think the PUSCH requirement for NR 2 step RACH can be verified with Rel-15 NR PUSCH requirement  Issue 1-4: Should interlaced PUSCH design and long preambles be considered?  Prefer option 1. leave to NR-U WID  Regarding the interlace design, it should be applicable for unlicensed operation in Rel-16 NR-U WI.  Since the core part of NR-U is still on going, in our view, whether to define the requirement for interlaced PUSCH should be discussed in the performance part of NR-U.  Similarly with eLAA in LTE, RAN1 has also designed interlaced PUSCH design. The requirement of interlaced PUSCH is specified under WI of eLAA.  Meanwhile, the interlaced design is also considered for other channel in NR-U, such as PUCCH. Therefore, we prefer to discuss requirement for the related interlaced design in NR-U WI. |

### 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.*

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| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
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| YYY | Company A |
| Company B |
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## Summary for 1st round

### Open issues

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

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

*Recommendations on WF/LS assignment*

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|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
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### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

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| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #2: Aspects on MsgA demodulation

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000314 | Samsung | Proposal 1: No BS demodulation requirements for Rel-16 NR 2-step RACH. |
| R4-2000801 | ZTE | Proposal: RAN4 to take into account Table-1 to specify BS demodulation performance requirements for 2-step RACH single user case. |
| R4-2001183 | Ericsson | Proposal 1: Do not define any additional demodulation requirements for 2 step PRACH |
| R4-2001491 | Nokia | Observation 1: One important aspect of 2-step RACH performance is that PUSCH Msg3 should be decoded before time-alignment compensation feedback.  Observation 2: The MsgB may contain successRAR, fallbackRAR, and backoff indicator. The fallbackRAR response is used, if MsgA PRACH was successfully received, but MsgA PUSCH not. The case of the fallbackRAR is already implicitly tested in the existing 4-step RACH procedures. For that reason, when test procedure is considered, MsgA transmission should be considered successful only if the gNB answers/transmits a successRAR message using MsgB.  Observation 10: Retransmissions of MsgA do not increment the redundancy version number of PUSCH as defined in clause 8.1A of 38.213 [3]. Therefore, the missed detection rate statistics should not be influenced by the choice of the number of retransmissions msgA-TransMax.  Proposal 2: The performance requirement should consider only MsgA transmissions that trigger a successRAR response on MsgB as correctly demodulated.  Proposal 8: Use as evaluation metric the SNR at which the joint PRACH/PUSCH missed detection rate is below 1%. Fallback to 4-step procedure is considered as an error.  Proposal 9: Evaluation metric should consider all the transmissions and retransmissions of MsgA for the calculation of the missed detection rate.  Observation 3: PO slot time allocation is determined based on a time-offset configuration with respect to the RO (msgAPUSCH-timeDomainOffset), which is between 1 to 32 slots [8].  Observation 4: More than one UE may be using the same PUSCH resource, depending on the configured preamble to PRU mapping. A one to one mapping can be possible, if the number of configures PRACH occasions is not larger than the number of configured PUSCH occasions.  Observation 5: The 2-step RACH objectives of the WI [1] include BS demodulation requirements for a PUSCH resource assigned to single UE only.  Proposal 4: Define requirements and test cases where only one PRACH preamble is mapped to one PRU, or N\_pre = N\_pru.  Observation 7: MsgA PUSCH supports MCSs from 38.214 [6] Table 6.1.4.1-1 for DFT-s-OFDM and Table 5.1.3.1-1 for CP-OFDM.  Proposal 6: Focus on CP-OFDM and MCS index IMCS = 2.  Proposal 10: Define requirements and tests for transport block sizes of 56 bits.  Proposal 12:One possible configuration of the 2-step RACH feature, that fulfils our previous observations and proposal, is detailed in Table 2. It can serve as a basis for discussion for simulation alignment. |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 2-1 handling of TA

*Sub-topic description:*

Although the performance part of 2-step RACH is only for single user case, how to handle TA during demodulating MsgA is one of the key points to discuss.

*Open issues and candidate options before e-meeting:*

**Issue 2-1: Should TA be considered for specifying MsgA demodulation performance requirements?**

* Proposals
  + Option 1: Yes, multiple UEs may contest for the same resources with different TAs
  + Option 2: No, the timing is known after BS detects the preamble
* Recommended WF
  + TBA

### Sub-topic 2-2 DMRS configuration

*Sub-topic description*

All 4 different DMRS configurations are supported for 2-step RACH including *pos1* and *pos2*. The existing Rel-15 PUSCH demodulation performance requirements assume DMRS *pos1*. Since there is contention among UEs in 2-step RACH, the demodulation of MsgA may require more reliable channel estimation. Furthermore, if the additional DMRS configuration is not indicated, the default *pos2* is assumed.

*Open issues and candidate options before e-meeting:*

**Issue 2-2: Whether or not to specify performance requirements for additional DMRS configuration pos2 ?**

* Proposals
  + Option 1: Yes
  + Option 2: No
* Recommended WF
  + TBA

Notes: other parameters related to MsgA demodulation, e.g., MCS, payload information bits, are subject to the outcome of the 1-st round discussion

## Companies views’ collection for 1st round

### Open issues

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| **Company** | **Comments** |
| Samsung | Sub topic 2-1:  Issue 2-1: Should TA be considered for specifying MsgA demodulation performance requirements?  Prefer option 2, no TA considered for single UE to MsgA demodulation performance  The requirement of PUSCH specified in Rel-15 NR is based on single UE. From RAN4 perspective, for a single UE based, the TA for each UE can be derived from the PRACH preamble detection, then BS can adjust the TA for MsgA demodulation performance requirement.  While for multi-UE case, in order to handle the intra-cell/inter-cell interference, the TA should be considered for interference modeling. RAN4 has considered the multi-UE and  Considering it is no objective in the WI of 2-step RACH to specify the requirement with advanced receiver to handle the interference, we do not think it is necessary to modeling TA for specifying MsgA demodulation performance requirement.  Sub topic 2-2:  Issue 2-2: Whether or not to specify performance requirements for additional DMRS configuration pos2?  Prefer option 2, no addition DMRS configuration.  Based the objective of 2 step RACH, there is no changed with physical layer structure. In NR Rel-15, we have already specified the PUSCH requirement based RAN1 feature covering the different waveform, DMRS structure, TDRA, and MCS.  For the DMRS configuration, as indicated with RAN1 agreement   * + msgA-dmrs-AdditionalPosition, ENUMERATED{pos0, pos1, pos3}, indicates the position for additional DM-RS. If the field is absent, the UE applies value ‘pos2’.   The DMRS can be configured with different position based on the deployment scenario. From RAN4 perspective, it is not practical to verify and specify the requirement of all the RAN1 feature.  Meanwhile, in terms of functionality verification of DMRS pos2, we have specified the related requirement in the HST WI. Current PUSCH demodulation performance requirements are sufficient. No need to additional requirement and test. |

### 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.*

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| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
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| YYY | Company A |
| Company B |
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## Summary for 1st round

### Open issues

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

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

*Suggestion on WF/LS assignment*

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|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 |  |  |

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #3: Test aspects for 2-step RACH performance requirements

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000314 | Samsung |  |
| R4-2000801 | ZTE |  |
| R4-2001183 | Ericsson |  |
| R4-2001491 | Nokia | Proposal 3: Define test setup with msgAPUSCH-timeDomainOffset = 5, to aligned with previously used default TDD UL-DL patterns.  Observation 12: 2-step RACH is not a mandatory feature.  Proposal 13: 2-step RACH requirements are to be marked as optional.  Proposal 14: 2-step RACH test applicably is to be based on manufacturer declaration. |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

The test aspects will be further elaborated subject to the outcome of the 1-st round discussion.

### Sub-topic 1-1 Applicability

*Sub-topic description:*

*Open issues and candidate options before e-meeting:*

**Issue 3-1: test applicability**

* Proposals
  + Option 1: Vendor declaration based
  + Option 2: …
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

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| --- | --- |
| **Company** | **Comments** |
| Samsung | Sub topic 1-1:  Issue 3-1: test applicability  Prefer to vendor declaration based.  Since 2-step is not mandatory feature, the related requirement for BS side is optional and can be declared by manufacturer. |

### 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.*

|  |  |
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| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
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| YYY | Company A |
| Company B |
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## Summary for 1st round

### Open issues

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

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

*Recommendations on WF/LS assignment*

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|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
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### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

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| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |