**3GPP TSG-RAN Meeting #89-e RP-200xxx**

**Electronic Meeting, 14 - 18 September, 2020**

**Agenda item:** x.x

**Source:** Moderator (China Telecom)

**Title:** Email discussion summary for RAN4 Rel-17 demodulation scope

**Document for:** Discussion

# Introduction

**Scope:**

According to the work areas of RAN4 R17 non-spectrum related WI/SIs endorsed at RAN #88e [1], this email thread will discuss the RAN4 Rel-17 demodulation scope, based on the initial inputs from [2] - [6].

Meanwhile, the way forward on NR Application Layer Throughput Performance was endorsed at RAN #88e [7], and the detailed objectives and scope on RAN4 study for VRC will also be discussed in this thread.

**Target and time schedule:**

* Companies are invited to provide comments in section 1.2, 2.2, 3.2 4.2, 5.1 and 5.2 (till Sept. 3)
  + - An intermediate summary will be submitted to the August RAN4 meeting.
    - The final summary will be submitted to RAN#89e.
* The corresponding WID and SID update will be submitted to RAN#89e.

# UE advanced receivers

## Companies’ proposals summary

Candidate objectives for UE advanced receivers [2] - [6]:

* Scenario a): Inter-cell interference
  + - Target frequency: FR1 and/or FR2
    - Reference receiver:
* MMSE-IRC with DMRS based interference covariance estimation
* MMSE-IRC with data based interference covariance estimation
  + - Type of requirements: PDSCH and the corresponding CQI reporting requirement
    - Rx antenna number: 2Rx; 4Rx (for FR1 only)
    - Interference profile: LTE interference profiles can be used as a starting point for NR FR1 scenarios
    - Discuss if additional network assistance is required
* Scenario b): Inter-layer interference for SU-MIMO
  + - Target frequency: FR1 and FR2
    - Reference receiver: soft IC
    - Type of requirements: PDSCH and the corresponding CQI reporting requirement
    - Number of data layers: up to 4 for FR1, 2 for FR2
    - Rx antenna number: 2Rx; 4Rx (for FR1 only)
* Scenario c): Intra-cell inter-user interference for MU-MIMO
  + - Target frequency: FR1 and/or FR2
    - Reference receiver: RML, SLIC
    - Type of requirements: PDSCH and the corresponding CQI reporting requirement
    - Rx antenna number: 2Rx; 4Rx (for FR1 only)
    - Discuss if additional network assistance is required

## Companies views’ collection

|  |  |
| --- | --- |
| Company | Comments |
| Company A | xxxx |
| Company B | xxxx |
| Intel | Scenario A): Inter-cell interference:  Support to define the requirements. The NR systems are characterized by interference-limited conditions and inter-cell interference suppression using IRC is required to ensure proper performance in the field. IRC processing is a common approach used on all chipsets for a long time and a limited set of requirements will be beneficial to ensure proper UE implementations. Same time, in comparison to LTE, PDSCH mapping in NR is more flexible (e.g. support of multiple SCS, support of non-slot based transmissions) and can result in specific interference conditions (e.g. time-selective interference). Therefore, different algorithms for covariance matrix estimation can be considered to ensure good IRC performance under various NR scenarios. Also, FR1 scenarios can be prioritized given that initial FR2 deployments are expected to be less interference limited due to Tx/Rx analog beamforming applies at gNB and UE sides and more analysis on interference conditions in FR2 is needed.  Scenario B): Inter-layer interference for SU-MIMO  In NR Rel-15, demodulation requirements with R-ML receiver were introduced for SU-MIMO scenarios. Performance benefits of Soft IC receiver over R-ML are not clear. Therefore, we suggest to study Soft IC performance, first. The outcome of this study will be used to decide whether to define performance requirements for Soft IC receiver.  Scenario C): Intra-cell inter-user interference for MU-MIMO  Using of R-ML or SLIC receiver for MU-MIMO scenarios requires information on dynamic PDSCH parameters of co-scheduled UEs (e.g. resource allocation, modulation and coding scheme). Such network assistance may require changes in DCI (e.g. similar to LTE MUST Case 3) and requires RAN1 involvement and analysis. Before such work is triggered need to check on available time budget in RAN1.  Overall, we recommend RAN4 to prioritize Scenario A) and B) for Rel-17 work. |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

## Summary

# BS advanced receivers

## Companies’ proposals summary

Candidate objectives for BS advanced receivers [4] - [6]:

* Scenario a): Inter-cell interference
  + - Target frequency: FR1 and/or FR2
    - Reference receiver:
* MMSE-IRC with DMRS based interference covariance estimation
  + - Type of requirements: PUSCH requirement
    - Rx antenna number: 2Rx; 4Rx and 8Rx (for FR1 only)
    - Interference profile: LTE interference profiles can be used as a starting point for NR FR1 scenarios
    - Discuss if additional network assistance is required
* Scenario b): Inter-layer interference for SU-MIMO
  + - Target frequency: FR1 and FR2
    - Reference receiver: soft IC
    - Type of requirements: PUSCH requirement
    - Number of data layers: 2 for FR1 and FR2
    - Rx antenna number: 2Rx; 4Rx and 8Rx (for FR1 only)
* Scenario c): Intra-cell inter-user interference for MU-MIMO
  + - Target frequency: FR1 and/or FR2
    - Reference receiver: Hard-IC (hard L-CWIC), hybrid-IC (mixing hard-IC and soft-IC) as defined in NOMA TR 38.812
    - Type of requirements: PUSCH requirement
    - Rx antenna number: 2Rx; 4Rx and 8Rx (for FR1 only)

## Companies views’ collection

|  |  |
| --- | --- |
| Company | Comments |
| Company A | xxxx |
| Company B | xxxx |
| Nokia, Nokia Shanghai Bell | It is our opinion that no specific receiver structures should be forced to be implemented via the WID. The detailed structure for any and all scenarios should be up to implementation.  For baseline evaluations we see it useful to aim for the LTE advanced receiver (MMSE-IRC + codeword-level interference cancellation), if such an alignment is found to be required.  The WID should make it clear that the inclusion of interference aware receivers is subject to consensus on the usefulness of such requirements. |
| Intel | Scenario A): Inter-cell interference  Similar to UE part, we support introduction of such requirements.   * Prefer to focus on FR1 scenarios since interference in FR2 is expected to be a less common scenario. * Number of RX antennas can be a part of WI discussion. * No need to discuss network assistance for gNB requirements.   Scenario B): Inter-layer interference for SU-MIMO  Support further studies in RAN4. Similar to UE part, further studies on the performance/complexity trade-offs are required before making final conclusions on the proper receiver architecture. Also, we suggest to include R-ML as one of reference receivers.  Scenario C): Intra-cell inter-user interference for MU-MIMO  We think that using of IC receivers is beneficial for MU-MIMO performance. More analysis is needed on performance benefits and complexity of different receiver designs before agreement on reference receiver for requirements definition. Study stage is recommended. |
|  |  |
|  |  |
|  |  |
|  |  |

## Summary

# BS FR1 PUSCH 256QAM

## Companies’ proposals summary

Candidate objective [4] [5]:

* Define PUSCH demodulation requirements for FR1 256QAM

## Companies views’ collection

|  |  |
| --- | --- |
| Company | Comments |
| Company A | xxxx |
| Company B | xxxx |
| Nokia, Nokia Shanghai Bell | We are positive towards the inclusion of FR1 256QAM PUSCH demodulation requirements. It is our understanding that minimal mobility is to be assumed, and realistic phase noise modelling is left up to the contributing entities. |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

## Summary

# Link adaptation throughput requirements

## Companies’ proposals summary

Candidate objectives [7] [8]:

* Study the feasibility of defining requirements with link adaptation
  + - Analyze in which scenarios absolute physical layer throughput requirement can be defined
      * Use currently defined RI test setup in 38.101-4 as baseline
      * Use the parameters suggested by RAN5 in R5-195422 as baseline
        + Other scenarios are not precluded if above parameters are not found feasible
* Possible RAN4 work plan
  + - Initial Simulation Assumptions
      * Reuse test parameters used in existing Rank Indication test cases in 38.101-4 as much as possible.
    - Alignment of results
      * Companies to present simulation results, multiple rounds of simulation might be needed
      * Refinement of simulation assumptions if needed
    - Conclusion
      * Tests to be declared feasible for the scenarios in which there is good alignment between results
      * Feasibility to be concluded if results from multiple companies are within +/- X % (e.g. 5%) of average LA throughput

## Companies views’ collection

|  |  |
| --- | --- |
| Company | Comments |
| Company A | xxxx |
| Company B | xxxx |
| Intel | Agree that RAN4 needs to first assess feasibility of defining requirements with link adaptation. Test setup with PMI/CQI/RI adaptation can be used as a starting point to to identify whether it is feasible to achieve reasonable alignment among the companies for scenarios with variation of multiple CSI parameters. If it will be not feasible then we can consider fixing some of the parameters (e.g. fix RI).  Subject to the outcome of the studies, RAN4 can provide further inputs to RAN5 on feasibility of LA requirements.  The work can be started in RAN4 subject to available budget for Demod topics. Q4’20 is expected to be heavily loaded with R16 performance part. Recommend start this work in 2021. |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

## Summary

# Other new proposals

## New proposal on UE demodulation requirements

|  |  |
| --- | --- |
| Company | Comments |
| Company A | xxxx |
| Company B | xxxx |
| Intel | We suggest to consider the following scenarios in the Rel-17 timeframe, which already supported from Rel-15 and Rel-16:   * Requirements for Rel-15 multi-TRP TX scheme. DPS (Dynamic Point Selection) scheme is supported from Rel-15. At current stage, DPS is considered for HST deployment. Also, more advanced Rel-16 multi-TRP TX schemes are considered under Rel-16 eMIMO WI. Same time, there are no requirements for DPS Tx scheme for normal propagation conditions. Therefore, we propose to include such requirements in Rel-17 scope for UE Demod. * Requirements for Rel-16 Multi-TRP TX scheme. At current stage, as a part of Rel-16 eMIMO WI, it was agreed to introduce requirements for Multi DCI and Single DCI based eMBB multi-TRP/panel Tx schemes. Same time, it is still under discussion whether to introduce requirements for single-DCI based URLLC multi-TRP Tx schemes 1a, 2a, 2b, 3 and 4. Therefore, if these Tx schemes will be not covered by Rel-16 eMIMO WI due to limited timelines then we suggest to include these schemes in the Rel-17 scope. |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

## New proposal on BS demodulation requirements

|  |  |
| --- | --- |
| Company | Comments |
| Company A | xxxx |
| Company B | xxxx |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

## Summary

# Conclusions

# References

1. RP-201331, Work areas of RAN4 R17 non-spectrum related WI/SIs, RAN4 Chairman (FUTUREWEI), RAN #88e, 29 June - 3 July 2020.
2. RP‑200615, Motivation paper of new WID on performance requirements for UE advanced receiver in Rel-17, Huawei Technologies Japan K.K, RAN #88e, 29 June - 3 July 2020.
3. RP‑200616, New WID proposal: Performance requirements for UE advanced receiver in Rel-17, Huawei Technologies Japan K.K, RAN #88e, 29 June - 3 July 2020.
4. RP‑200729, Motivation for further enhancement on NR demodulation performance requirements, China Telecom, RAN #88e, 29 June - 3 July 2020.
5. RP‑200730, New WID: Further enhancement on NR demodulation performance, China Telecom, RAN #88e, 29 June - 3 July 2020.
6. RP‑201118, Views on Rel-17 NR Demodulation requirements, Intel Corporation, RAN #88e, 29 June - 3 July 2020.
7. RP-201377, Way forward on NR Application Layer Throughput Performance Work in RAN4, Qualcomm Incorporated, RAN #88e, 29 June - 3 July 2020.
8. RP-201001, Way forward on NR Application Layer Throughput Performance Work in RAN4, Qualcomm Incorporated, RAN #88e, 29 June - 3 July 2020.