

3GPP TSG RAN Meeting #103

Maastricht, Netherlands, March 18-21, 2024

RP-240546

Views on Rel-19 RAN4 Demodulation topics

Agenda Item:

9.1.4.5

Source:

Intel Corporation

Document for:

Discussion & Decision



Introduction

This contribution provides Intel's views on the scope of RAN4 Rel-19 Demodulation-centric objectives taking into consideration discussion and proposals in RAN #102 and RAN #103

- RAN #102: RP-233951 "Moderator's summary for RAN4 Candidate Demodulation/RRM Topics for Rel-19 "
- RAN #103: RP-240019 "Proposed Summary for RAN Rel-19 Package: RAN4 Part" by RAN & RAN4 Chair

In the following slides we provided Intel views on:

- Candidate Demod topics identified in RAN #102 in RP-233951
- Objectives of Demodulation WI based on proposals in RP-240019

Views on RAN #102 candidate topics

Background

RP-233951 Moderator's summary for RAN4 Candidate Demodulation/RRM Topics for Rel-19

Summary/conclusions for Demodulation topics:

- 1 UE performance requirements with inter cel and with intra-cell inter-use interference for 8Rx CPE/FWA/vehicle/industrial devices
 - 1.1 Further check if such objectives can be done in R18 performance
- 2 Further check if 1024QAM + 4layers for indoor scenario for 4Rx UE and 8Rx CPE/FWA/vehicle/industrial devices shall be included in the scope
- 3 UE CRI reporting requirements with multiple CSI-RS configured with priority on FR1
 - 3.1 Further check if any other RRM requirements beyond Demod for FR2 CRI reporting
- 4 Enhanced UE CSI reporting requirements with R-ML receiver for SU-MIMO with study on whether the UE with R-ML report incorrect CSI
- 5 MMSE-IRC receiver for uplink taking LTE interference profile as starting point. FFS on other interference profile.
- 6 Channel model with spatial component for performance requirements with following alternatives for study the test feasibility
 - 6.1 Alternative 1: Extending TDL channel model
 - 6.2 Alternative 2: CDL channel model

Views on RAN #102 candidate topics

Summary (RAN#102)	Intel views
UE PERFORMANCE REQUIREMENTS	
<p>UE performance requirements with inter cell and with intra-cell inter-use interference for 8Rx CPE/FWA/vehicle/industrial devices</p>	<p>Low priority. The receiver structure for 8Rx is same as 4Rx (MMSE-IRC) and there is no strong need for new requirements. As an alternative, 8Rx UEs shall be required to fulfil existing requirements for bands supporting 4Rx.</p>
<p>DL 1024QAM + 4layers for indoor scenario for 4Rx UE and 8Rx CPE/FWA/vehicle/industrial devices</p>	<p>Low priority. The performance of high order modulations is already verified via SDR tests and no strong motivation for extra requirements.</p>
<p>UE CRI reporting requirements with multiple CSI-RS configured with priority on FR1</p>	<p>Medium priority. The existing LTE CRI requirements are mostly functional, and a limited set of NR requirements can be considered without much workload. Demodulation requirements shall be sufficient and there is no need for RRM requirements.</p>
<p>Enhanced UE CSI reporting requirements with R-ML receiver for SU-MIMO with study on whether the UE with R-ML report incorrect CSI</p>	<p>Low priority. The justification for additional CSI reporting requirements is unclear. The existing requirements should be capable to sufficiently cover R-ML receivers.</p>

Views on RAN #102 candidate topics

Summary (RAN#102)	Intel views
BS PERFORMANCE REQUIREMENTS	
<p>MMSE-IRC receiver for uplink taking LTE interference profile as starting point.</p> <ul style="list-style-type: none"> • FFS on other interference profile. 	<p>High priority</p> <ul style="list-style-type: none"> ✓ The objective is important to ensure proper BS performance ✓ LTE interference profiles can be taken as baseline and additional interference profiles can be further studied and introduced in the WI stage
GENERAL TOPICS	
<p>Channel model with spatial component for performance requirements with following alternatives for study the test feasibility</p> <ul style="list-style-type: none"> • Alternative 1: Extending TDL channel model • Alternative 2: CDL channel model 	<p>High priority</p> <ul style="list-style-type: none"> ✓ The direction is important to ensure good in-field performance of UE and gNB. ✓ Both identified alternatives can be considered, and down-selection can be performed in the study stage ✓ Recommend study stage only in Rel-19 timeframe to limit the scope.

WI: Demodulation Evolution

Demodulation Evolution WI

RP-240019 “Proposed Summary for RAN Rel-19 Package: RAN4 Part”

Demod

📶 References: [RP-233951](#)

📶 Potential objectives:

- To start from Q3'2024
- UE performance requirements with inter cell and with intra-cell inter-use interference for 8Rx CPE/FWA/vehicle/industrial devices
 - ~~Further check if such objectives can be done in R18 performance~~
- MMSE-IRC receiver for uplink taking LTE interference profile as starting point. **FFS on other interference profile.**
- ~~Further check if 1024QAM + 4layers for indoor scenario for 4Rx UE and 8Rx CPE/FWA/vehicle/industrial devices shall be included in the scope~~
- ~~UE CRI reporting requirements with multiple CSI-RS configured with priority on FRI~~
 - ~~Further check if any other RRM requirements beyond Demod for FR2 CRI reporting~~
- ~~Enhanced UE CSI reporting requirements with R-ML receiver for SU-MIMO with study on whether the UE with R-ML report incorrect CSI~~
- **Channel model with spatial component for performance requirements with following alternatives for study the test feasibility**
 - **Alternative 1: Extending TDL channel model**
 - **Alternative 2: CDL channel model**
 - **For this bullet, can the contents be clearly defined during March/RAN#103?**

Demodulation Evolution WI

Views on WI scope in RP-240019

The proposed Demodulation WI scope in RP-240019 includes the following objectives

1. UE performance requirements with inter cell and with intra-cell inter-use interference for 8Rx CPE/FWA/vehicle/industrial devices
2. MMSE-IRC receiver for uplink taking LTE interference profile as starting point.
3. Channel model with spatial component for performance requirements

Intel views

- The proposed WI scope (Obj 1 and 2) provides a good balance between UE and BS performance requirements
- The additional candidate objective on “**Channel model with spatial component ...**” is marked as tentative and is expected to be discussed in more details RAN #103 meeting with the purpose to identify clear objectives. Taking into account a high-level of interest from the ecosystem and a strong operator support [WF RP-240254], we recommend including the channel model objective in the WI scope in RAN#103 in addition to objectives 1 and 2.

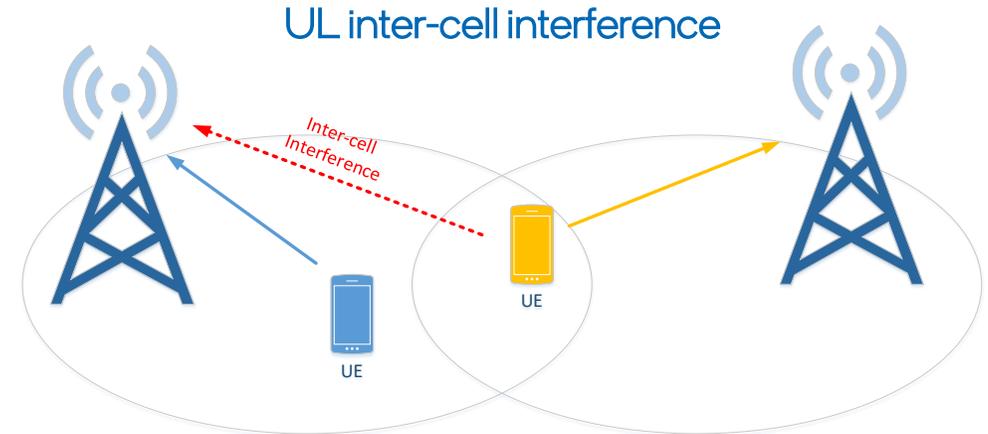
Proposal #1: Include additional study objective on ““Channel model with spatial component ...” in the scope of Rel-19 Demodulation WI or create a separate dedicated SI.

Demodulation Evolution WI

BS MMSE-IRC for inter-cell interference

Intel views

- The existing BS demodulation requirements are defined for noise limited conditions and do not allow verification of BS interference rejection capabilities under practical conditions.
- Interference-limited conditions are quite typical for 5G deployments and support of MMSE-IRC processing is important to guarantee good performance in the field.
- The likelihood of interference limited conditions is higher for NR comparing to LTE due to denser deployments and wider adoption of HPUEs
- To reduce the workload the work on FR1 and inter-cell interference can be prioritized. The intra-cell scenarios can be handled with the 2nd priority.
- The work can focus on PUSCH demodulation requirements
- The work on the identification of realistic NR UL interference profiles shall be a part of the WI. The LTE interference profiles in TR 36.884 can be used as a starting point.
- The work is expected to be conducted from Q3'24 till Q4'25



Candidate objectives

Define MMSE-IRC receiver-based UL SU-MIMO demodulation requirements with inter-cell [and intra-cell] interference

- *Study and define realistic NR UL interference profiles.*
- *Note: LTE interference profiles in TR 36.884 can be used as a starting point.*
- *Focus on FR1 scenarios*

Demodulation Evolution WI

Enhanced Channel Models with spatial components

Intel views

- The existing 3GPP RAN4 channel models based on TDL approach and are observed to have limitations in modelling MIMO performance due to lack of rank deficiency in the channel. The TDL models are not well-applicable for the realistic emulation of spatial performance for SU-MIMO and MU-MIMO use cases, and it is difficult to predict the in-field performance.
- The same arguments apply for both DL/UL, including massive MIMO deployments
- A generic channel model with spatial differentiation can be helpful to emulate realistic network conditions and performance in conformance requirements for both downlink and uplink.
- The proposed enhanced channel models can be used as the basis for requirements definition for 5G-A and 6G
- TR 38.827 can provide a simple, testable, repeatable framework for spatial channel modelling requirements based on CDL framework
- To reduce the workload, it is possible to focus on channel model definition in Rel-19 timeframe, while actual performance requirements can be considered at a later stage

Candidate objectives

Study and specify enhanced MIMO channel models for DL and UL performance characterization with realistic modeling of spatial characteristics

- *Use the spatial channel models in TR 38.827 as the basis and identify any necessary changes.*
- *Study test feasibility of new channel models including test complexity and achievable results uncertainty*
- *Consider both FR1 and FR2 scenarios*

Demodulation Evolution

Work Item Objectives

The proposed Demodulation WI objectives are provided below

Core part:

1. Study and specify enhanced MIMO channel models for DL and UL performance characterization with realistic modeling of spatial characteristics
 - Use the spatial channel models in TR 38.827 as the basis and identify any necessary changes.
 - Study test feasibility of new channel models including test complexity and achievable results uncertainty
 - Consider both FR1 and FR2 scenarios

Performance part:

1. Define MMSE-IRC receiver-based UL SU-MIMO demodulation requirements with inter-cell [and intra-cell] interference
 - Study and define realistic NR UL interference profiles.
Note: LTE interference profiles in TR 36.884 can be used as a starting point.
 - Focus on FR1 scenarios
2. Define MMSE-IRC receiver-based DL demodulation requirements with inter-cell and with intra-cell inter-user interference for 8Rx CPE/FWA/vehicle/industrial devices for FR1

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