3GPP TSG RAN WG4 Meeting #110

Athens, Greece, February 26th – March 1st, 2024

R4-2402444

Views on Rel-19 RAN4 Demodulation topics

Agenda Item:	14
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Introduction

The general views on RAN4 Rel-19 SI/WI package are provided in R4-2402441

In the following slides we provided views on:

- Candidate RRM/Demod topics identified in RAN #102 in RP-233951
- Potential scope and objectives of RRM/Demod WIs

The following objectives are proposed to be prioritized for Rel-19 demodulation work

	Prioritized objectives/scope	Comments
WI: Demodulation enhancements	• **BS MMSE-IRC** for uplink inter-cell interference • **Enhanced MIMO channel models** with spatial components for UE and BS requirements • [**UE CRI reporting** requirements with multiple CSI-RS configured for FR1]	An umbrella WI is recommended to continue the evolution of Demodulation enhancements with [2] RD TU per meeting. The WI scope shall ensure a balance between BS and UE requirements.

Views on RAN #102 candidate topics

Views on RAN #102 candidate topics

Summary (RAN#102)	Intel views
UE PERFORMANCE REQUIREMENTS	
UE performance requirements with **inter cell and with intra-cell inter-use interference for 8Rx** CPE/FWA/vehicle/industrial devices	**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.
DL 1024QAM + 4layers for indoor scenario for 4Rx UE and 8Rx CPE/FWA/vehicle/industrial devices	**Low priority.** The performance of high order modulations is already verified via SDR tests and no strong motivation for extra requirements.
UE CRI reporting requirements with multiple CSI-RS configured with priority on FR1	**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.
Enhanced UE CSI reporting requirements with R-ML receiver for SU-MIMO with study on whether the UE with R-ML report incorrect CSI	**Low priority.** The justification for additional CSI reporting requirements is unclear. The existing requirements should be capable to sufficiently cover R-ML receivers.

Views on RAN #102 candidate topics

Summary (RAN#102)	Intel views
BS PERFORMANCE REQUIREMENTS	
MMSE-IRC receiver for uplink taking LTE interference profile as starting point. • FFS on other interference profile.	High priority ✓ 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	
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	High priority ✓ 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

BS MMSE-IRC for inter-cell interference

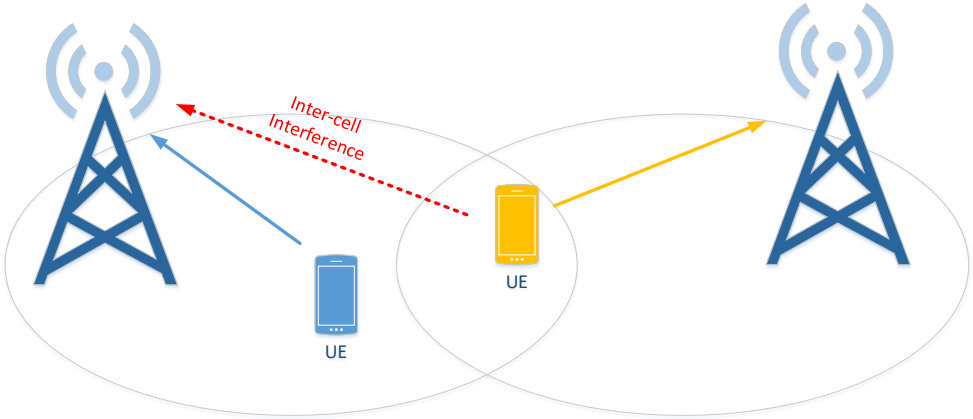
Motivation

- 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 can be prioritized

Candidate objectives

- *Define **BS MMSE-IRC demodulation requirements** for inter-cell interference scenarios for SU-MIMO cases*
  - *Study NR UL inter-cell interference profiles. LTE interference profiles can be used as a starting point*
  - *Focus on FR1 scenarios*

UL inter-cell interference



Typical UL DIP/INR values
for 85% DIP CDF based on TR 36.884

	HomoNet		HetNet	
	DIP	INR	DIP	INR
Interf UE1	-1.11	7.29	-0.43	12.38
Interf UE2	-10.91	-2.51	-13.78	-0.97

Demodulation Evolution

Enhanced Channel Models with spatial features

Motivation

- 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 uplink and downlink, 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.
- Both identified alternatives including CDL channel models or extended/modified TDL models can be considered, and down-selection can be performed in the study stage based on test feasibility studies
- 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 downlink and uplink performance characterization with realistic modeling of spatial characteristics*
  - *Further study between CDL and extended TDL channel models*
  - *Study test feasibility of new channel models*
  - *Consider both FR1 and FR2 scenarios*

Demodulation Evolution

Work Item Objectives

1. Define BS MMSE-IRC demodulation requirements for inter-cell interference scenarios for SU-MIMO cases
   - Study NR UL inter-cell interference profiles. LTE interference profiles can be used as a starting point
   - Focus on FR1 scenarios
2. Study and specify enhanced MIMO channel models for UE and BS performance characterization with realistic modeling of spatial characteristics
   - Further study CDL and extended TDL channel models
   - Study test feasibility of new channel models
   - Consider both FR1 and FR2 scenarios
3. Define **UE CRI reporting** requirements with multiple configured CSI-RS for FR1

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