3GPP TSG RAN4 Meeting #101-e
Electronic Meeting, November 1 - 12, 2021

R4-2118051

Views on RAN4 Rel-18: Demodulation enhancements

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Introduction

Initial discussion on Rel-18 Demodulation enhancements took place in Rel-18 workshop and pre-RAN #93 Rel-18 email discussion [RP-211667].

In this contribution we provide views on candidate topics to be considered for RAN4 Rel-18 work in the UE/BS demodulation requirements area.

- UE advanced receivers
  - MMSE-IRC for time selective inter-cell interference
  - Enhanced DL MU-MIMO receivers based on E-MMSE-IRC or R-ML
  - Enhanced DL multi-DCI multi-TRP receivers
  - Soft IC receivers for DL SU-MIMO
- BS advanced receivers
  - MMSE-IRC for inter-cell interference
- HST FR2 enhancements
- Rel-16 leftovers

UE Advanced Receivers
MMSE-IRC for time selective inter-cell interference

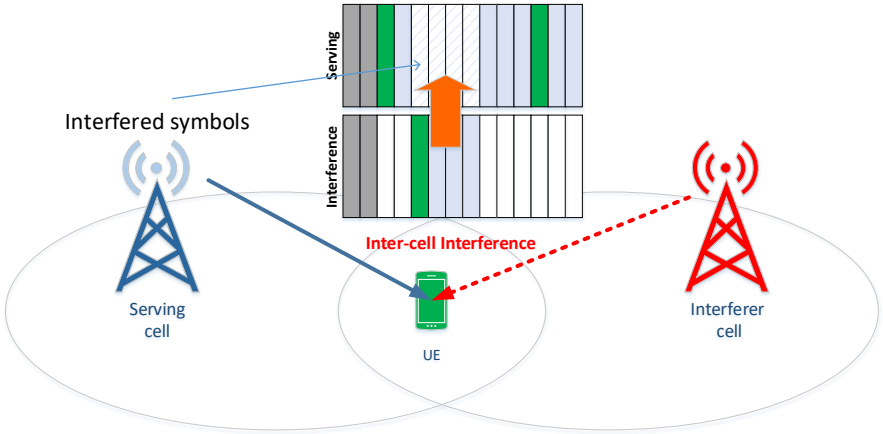
Motivation

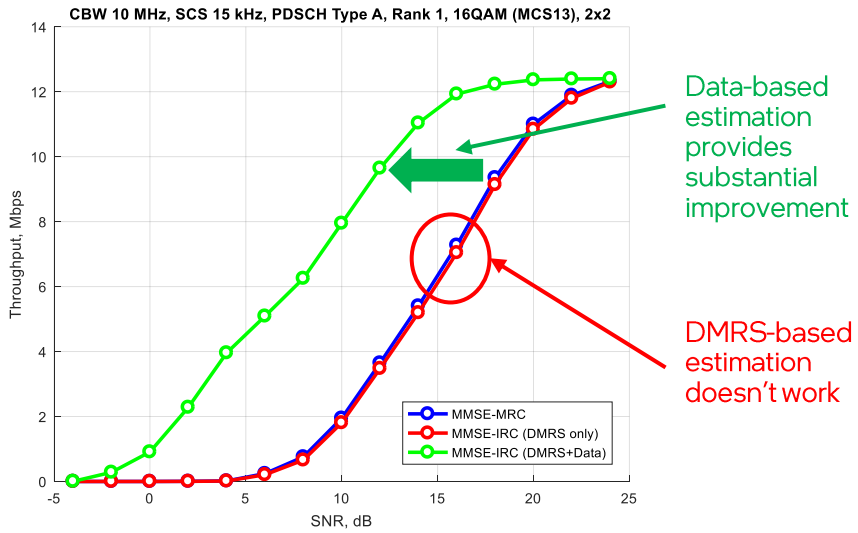
- Baseline UE MMSE-IRC receivers are based on DMRS-based interference estimation and rely on a constant interference structure on a full slot duration
- Time-selective interference can become a bottleneck for DL performance in scenarios with a mix of SCS in different cells and for URLLC scenarios with sub-slot transmissions due to mismatched interference estimate
- The definition of requirements for a time-selective interference with MMSE-IRC with DMRS-based interference-plus-noise covariance matrix estimation is under discussion in Rel-17 Perf Enhancements WI [RP-210920] as the 2nd priority objective
- Enhanced MMSE-IRC receivers with data-based interference estimation or other enhancements can be considered to improve the performance under time-selective interference scenarios

Candidate objectives

- Study and define enhanced UE demodulation requirements for MMSE-IRC **receivers with data-based interference-plus-noise covariance matrix estimation for time-selective NR-NR inter-cell interference handling**
- Study whether additional network assistance is required

Time-selective NR-NR inter-cell interference



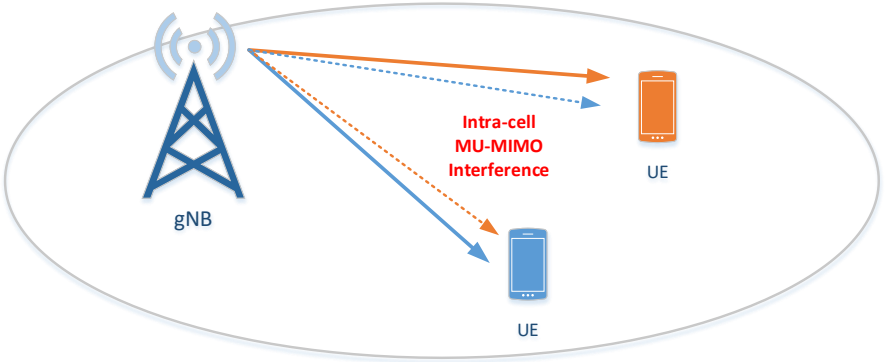


UE Advanced Receivers
Enhanced DL MU-MIMO receivers

Motivation

- Definition of DL MU-MIMO performance requirements is under discussion in Rel-17 Enhanced Perf WI [RP-210920]. A basic MMSE-IRC receiver with serving signal demodulation and DMRS-based interference covariance matrix estimation is prioritized in Rel-17
- In LTE MUST WI several receiver enhancements including E-MMSE-IRC and R-ML were studied and defined to improve the performance for MU-MIMO DMRS-based TMs (MUST Case 3) exploiting the knowledge of co-scheduled UE parameters (presence and modulation)

DL MU-MIMO Interference



- Rel-15 NR design guarantees alignment of DMRS parameters and PRG grids across co-scheduled UEs (TS 38.214 5.1.6.2)
- Enhanced receivers like LTE MUST Case 3 can be studied with the goal to further improve the demodulation performance for DL MU-MIMO scenarios
  - Enhanced MMSE-IRC (E-MMSE-IRC) receivers with joint serving & interference signal demodulation exploiting the knowledge on co-scheduled UE presence
  - R-ML receivers exploiting the knowledge on co-scheduled UE modulation

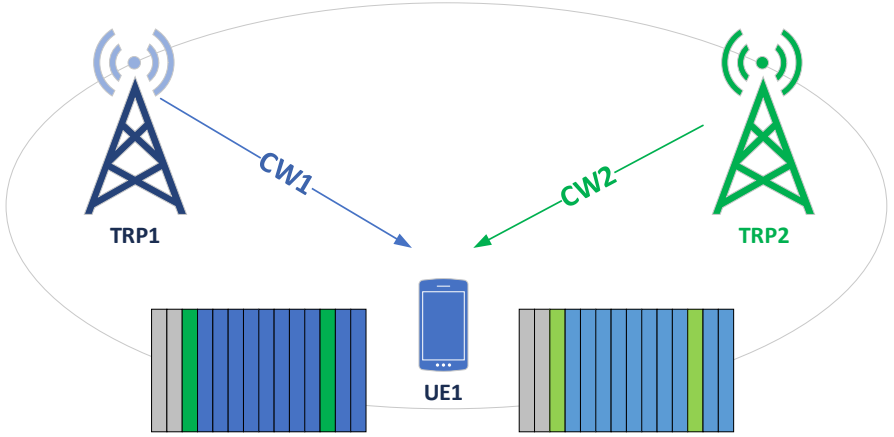
Candidate objectives

- Study the performance benefits and feasibility of **enhanced DL MU-MIMO receivers including** E-MMSE-IRC and R-ML and required network assistance.

UE Advanced Receivers
Enhancements for other scenarios

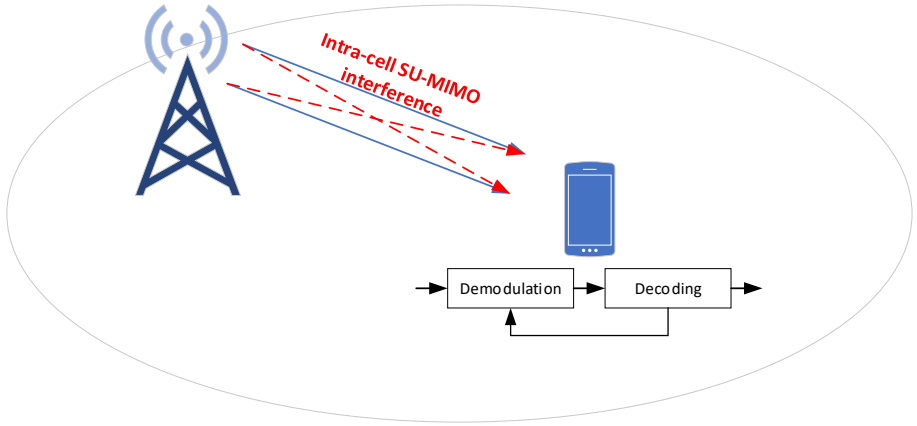
Enhanced DL multi-DCI multi-TRP receivers

- Motivation: Rel-16 eMIMO requirements for multi-DCI multi TRP scenario are defined for scenarios with non-overlapping PDSCH allocation and MMSE-IRC receiver. IC receiver can be used to improve PDSCH performance for multi-DCI multi TRP scenario with overlapping or partially overlapping PDSCH allocations.
- Candidate objectives: Study performance benefits of IC receiver for multi-DCI multi TRP scenario and define UE demodulation requirements



Soft IC receivers for DL SU-MIMO

- Motivation: DL SU-MIMO requirements are defined for MMSE-IRC and R-ML receivers. Further possible performance enhancement are possible in case of using of IC receivers.
- Candidate objectives: Study performance benefits of Soft IC receiver for DL SU-MIMO scenario



UE Advanced Receivers
MMSE-IRC for inter-cell interference

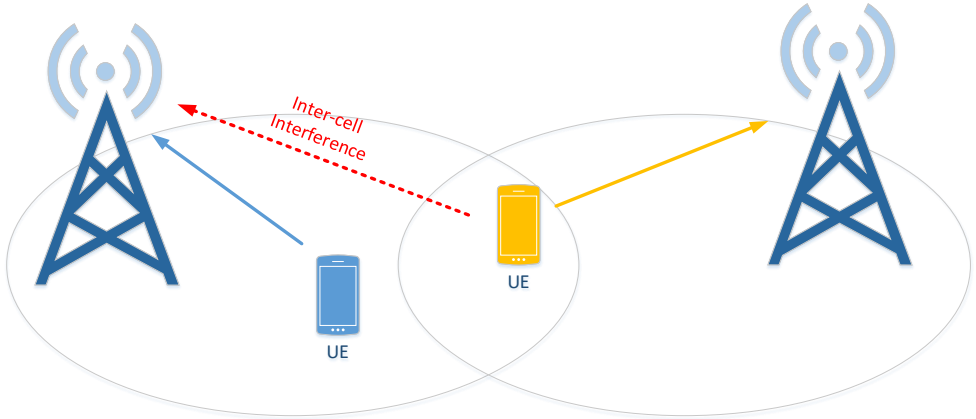
Motivation

- Existing BS 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 (see typical LTE profiles on the right)
- In RAN #89e (RP-202092) the definition MMSE-IRC for inter-cell interference was discussed and received a strong support, but was eventually deprioritized

Candidate objectives

- Study typical NR UL inter-cell interference profiles
- Define BS MMSE-IRC demodulation requirements for inter-cell interference scenarios
- Focus on FR1 deployment 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

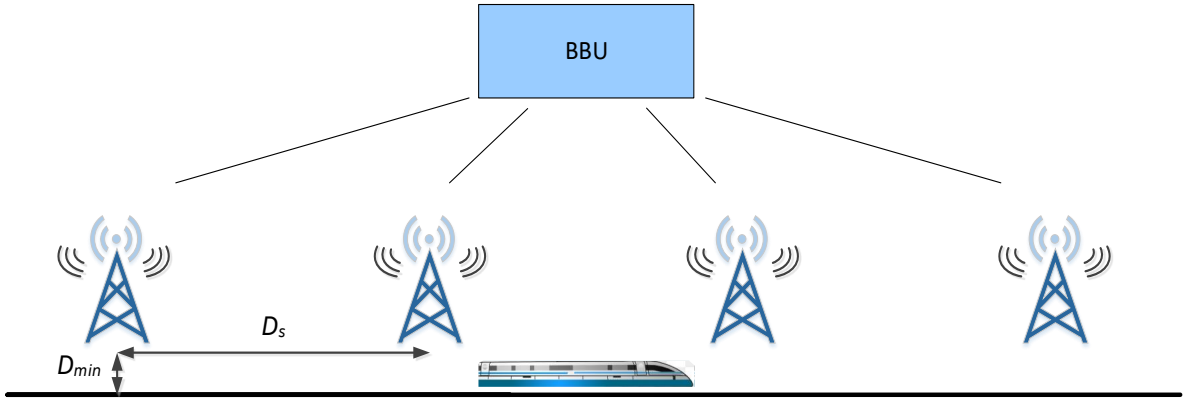
FR2 HST Enhancements

Motivation

- Rel-17 HST FR2 requirements are specified only for single carrier operation.
- To increase DL throughput for limited number of CPEs per train and provide sufficient QoS for UEs inside the train carrier aggregation (CA) will be used in practice.
- Current CA requirements cover only normal low speed scenarios and HST FR1 deployments.

Candidate objectives

- Specify the **UE demodulation requirements for HST FR2 CA scenario** with the target speed up to 350 km/h and carrier frequency up to 30 GHz.



Rel-16 Leftovers

Motivation

- Some Rel-16 features/scenarios were deprioritized from performance requirements definition perspective due to limited timeframe in Rel-16
- Scope of demodulation performance requirements covering Rel-16 features should be extended to guarantee proper baseband operation and reliable performance:

Candidate requirements

- Rel-16 eMIMO WI
  - PDSCH requirements with two UE rate matching CRS patterns in multi-DCI Tx scheme
- Rel-16 IAB WI
  - IAB-DU HARQ soft combining requirements (IAB-DU 30% throughput requirements)
  - IAB-DU UL requirements for high velocity scenarios
  - IAB-MT PDSCH CA requirements
  - Enhanced IAB-MT receiver requirements (R-ML)
  - URLLC requirements

Note: topics can be treated in Rel-17 as well

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