3GPP TSG RAN Rel-18 workshop
Electronic Meeting, June 28 - July 2, 2021

RWS-210375

Views on RAN4 Rel-18 scope

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Views on RAN4 Rel-18 Package Approval Process

RAN #91e agreements on RAN4 Rel-18 Timelines

RAN4 Rel-18 WI package approval timelines were decided in RAN #91e (RP-210770) and RAN4-led proposals were agreed to be discussed in June – December 2021 jointly with RAN1-3 proposals

- Working towards RAN1/2/3/4 Rel-18 Package Approval
  - RAN#93 (September) to further consolidate RAN1/2/3/4 proposals led by the respective Convenors
    - RAN4-led proposals addressed in this phase are the new areas (not dependent on Rel-17 work finalization)
- Working towards completing RAN4 Rel-18 Package Approval
  - RAN#94 (December) can potentially approve item(s) on RAN4-led new areas
  - RAN4 impacts of RAN1/2/3-led items are included in the WI/SI sheets at the December approval
    - RAN4 leadership can then determine the available RAN4 capacity for RAN4-led items
    - Some RAN4 capacity needs to be reserved for RAN4-led items!
  - Further RAN4-led proposals that are dependent on Rel-17 finalization are to be worked on in Q1/2022
    - Structured email discussions to be set up in Q1/2022
  - RAN#95 (March) to approve the rest of the RAN4 core work package for Rel18

Views on RAN4 Rel-18 package approval process (1)

Approval timelines

- The most part of Rel-17 RAN4-led study and work items were approved in Sep/Dec 2020. A limited scope extension was made in March 2021.
- The RAN4 work on Rel-17 was kicked-off in Q4'2020, while the work on most of RAN1/2-led items started in Q2'2021
- Approval of the RAN4 Rel-18 package in 9 months after Rel-17 scope update and in the early stage of Rel-17 work may not be the most productive approach, at least for Non-spectrum items
- Proposal #1: Move RAN4 package approval for non-spectrum work items to March 2022

"New" vs "Old" items

- Based on RAN#91e decisions, early discussions on RAN4 proposals shall focus on *"… new areas (not dependent on Rel-17 work finalization)"*. RAN4 "new areas" are within scope of the Rel-18 Workshop.
- No hard boundary between "New" and "Old" items was provided and it may cause much ambiguity
- Staggering the new/old discussions and approvals may eventually lead to prioritizing the "new" topics to be approved in Dec 2021 and not address the industry interests in a fair manner
- The decisions on RAN4 package content should consider the industry prioritization across the full set of topics.
- Proposal #2: After the Rel-18 workshop, do not apply any differentiation or prioritization between "new" & "old" topics.

Views on RAN4 Rel-18 package approval process (2)

Approval process split into multiple meetings

- Rel-17 RAN4 package approval was split over a very long period, which resulted in more challenging RAN4 work planning
- Further split of Rel-18 approval process over several meetings may lead to the same situation
- Proposal #3: Minimize the split of RAN4 WI package approval for non spectrum items across multiple meetings

Handling of urgent requests

- Based on Rel-16/Rel-17 experience new urgent market requests may arise after approval of the RAN4 work package
- Proposal #4: A certain amount of RAN4 TUs shall be reserved to accommodate urgent market requests

Spectrum & Non-spectrum item handling

- RAN4 spectrum items address urgent operator needs and focus on spectrum related areas
- Typically, spectrum and non-spectrum items have dedicated TU budgets
- Given a potentially large amount of spectrum items, it can be more convenient to split the approval of spectrum/non-spectrum items to different meetings
- Proposal #5: Approval of RAN4 Spectrum & Non-spectrum Rel-18 WIs packages may be split into different meetings
- It is quite typical that new Spectrum WIs requests arise once the package is approved. It is recommended to put clear deadlines for possible additions
- Proposal #6: Allow a multi-stage (e.g., 2-3) Spectrum WIs package approval during the release with a 6 months period (e.g., Dec 21 / June 22 / Dec 22)

Summary

Proposal #1: Move RAN4 package approval for non-spectrum work items to March 2022

Proposal #2: After the Rel-18 workshop, do not apply any differentiation or prioritization between “new” & “old” topics.

Proposal #3: Minimize the split of RAN4 WI package approval for non spectrum items across multiple meetings

Proposal #4: A certain amount of RAN4 TUs shall be reserved to accommodate urgent market requests

Proposal #5: Approval of RAN4 Spectrum & Non-spectrum WIs packages may be split into different meetings

Proposal #6: Allow multi-stage (e.g., 2-3) Spectrum WIs package approval during the release with 6 months period (e.g., Dec 21 / June 22 / Dec 22)

Candidate RAN4 Rel-18 Topics

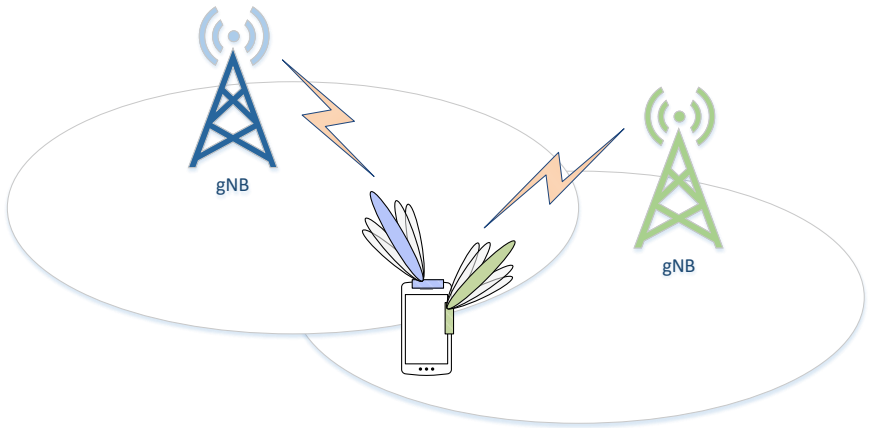
FR2 Multi-Beam Simultaneous Reception

FR2 Multi-Beam Simultaneous Reception

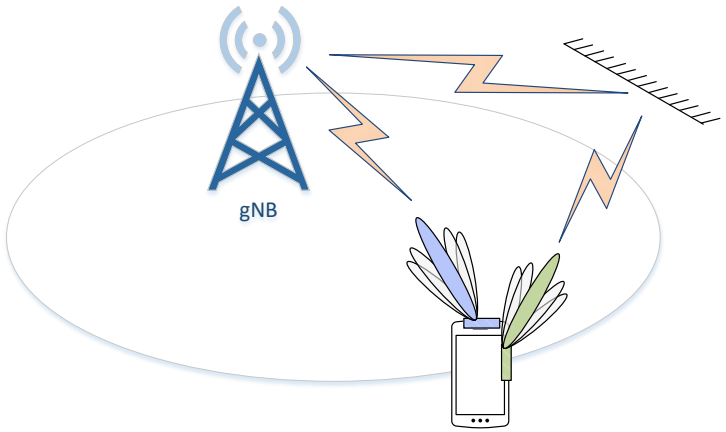
Motivation

- FR2 multi-beam reception is supported from RAN1 perspective for single carrier scenarios
- RAN4 requirements for single carrier case are based on a single panel reception only and the support of multi-beam reception is defined for CA scenarios only
- Rel-16 eMIMO multi-TRP/panel transmissions
  - As a part of Rel-16 NR eMIMO WI a number of enhancements were introduced in order to support more efficient, reliable and robust DL multi-TRP/panel operation.
  - Transmission schemes with simultaneous and non-simultaneous multi-beam reception from multiple TRPs/panels were introduced
  - For FR2 UEs simultaneous reception may require support of simultaneous multi-panel operation with several independent RX beams. A dedicated FR2 UE capability for simultaneous multi-beam reception was introduced (*simultaneousReceptionDiffTypeD-r16*)
  - No RAN4 requirements were defined in Rel-16 & Rel-17 for FR2 UEs including the scenario with simultaneous and non-simultaneous reception
- Rel-16/17 FR2 RF CA with IBM/CBM
  - Support of IBM (Independent Beam Management) and CBM (Common Beam Management) framework with simultaneous reception on different component carriers from the co-located and non-col-located TRPs was defined in RAN4 in Rel-16/17
  - The IBM concept implies simultaneous reception on different UE panels using separate beams on different component carriers

Multi-TRP TX + Multi-beam RX



Multi-panel TX + Multi-beam RX



FR2 Multi-Beam Simultaneous Reception

Motivation

- Further extension of FR2 UE capabilities to support simultaneous reception for a single carrier using multiple RX beams is required to extract full benefits of UE operation in various FR2 scenarios.
- Improved FR2 performance & robustness
  - Support of multi-beam simultaneous reception can increase overall FR2 system throughput
  - Rel-15 spherical coverage requirements are defined for the case of single panel UEs and further improvement of EIS spherical coverage is possible for multi-panel UEs
  - Support of multi-beam simultaneous reception can is helpful to ensure robust UE connectivity to the network
- Improved RRM requirements
  - RX beam search is a bottleneck factor for FR2 RRM requirements
  - RRM performance improvements can be achieved for UEs supporting 2 separate panels with simultaneous processing via reduction of the RX beam search time
  - Support of simultaneous multi-beam reception can also enable DAPS HO operation, which is currently not applicable for FR2

Candidate objectives

- Define enhanced RRM requirements
  - RRM measurement delay reduction
  - FR2-FR2 DAPS HO
- Define enhanced RF requirements
  - New spherical coverage requirements for devices with 2 panels
- Define UE demodulation requirements
  - UE performance requirements to support multi-beam reception for Single/Multi DCI based Multi-TRP schemes under FR2 scenarios
  - Note: requirements for multi-beam single panel non-simultaneous RX can be considered as well
- Study OTA test methodology
  - Further studies on the FR2 OTA testing methodology are required to enable Demodulation testing of UEs for signals coming from 2 different directions (TRPs)
- Target device types
  - Focus on regular handheld UEs.
  - FR2 HST scenarios can benefit from the support of CPE devices with simultaneous multi-beam/panel reception under bi-directional multi-RRH/TRP deployment scenarios

Candidate RAN4 Rel-18 Topics

RRM Enhancements (eFeRRM)

RRM Enhancements

Background

- Multiple RRM enhancements were defined in the scope of Rel-16 and Rel-17
  - Rel-16 NR RRM enhancements WI [RP-201883]
  - Rel-16 NR L3 CSI-RS measurements WI [RP-210590]
  - Rel-17 NR Further RRM enhancements WI [RP-202874]
  - Rel-17 NR MG Enhancements WI [RP-210679]
- Many objectives of Rel-16/17 focus on the introduction of the requirements not covered by initial Release 15
- Many candidate objectives were deprioritized in Rel-16/17 discussion and may be further considered to ensure proper 5G networks operation under various practical scenarios
- A number of additional objectives were identified after the Rel-17 WI scope was stabilized and FFS whether the scope can be considered in Rel-17 [RP-211416]

The work on the definition of RRM requirements shall continue in Rel-18 with the goal to cover additional use cases and scenario to ensure proper 5G networks operation under various practical scenarios

Potential scope of Rel-18 items shall balance between RRM "leftovers" (i.e., items deprioritized in previous releases due to TU constraints) and new RRM areas

Candidate Rel-18 objectives (leftover topics)

- FR1 + FR1 NR-DC RRM requirements
- NeedForGap requirements
- Per-FR gap UE capability enhancement
- CMTC
- RLM enhancements
- TCI state switch enhancements

Further identification and prioritization of the candidate objectives shall take place to ensure Rel-18 addresses the most urgent market requests

RRM Enhancements

FR1 + FR1 NR-DC RRM requirements

Background

- FR1 + FR1 NR-DC band combinations were introduced in R16 timeframe
- A very limited set of RRM requirements was defined in R16. Only MRTD/MTTD requirements were defined.

Candidate objectives

- Specify RRM requirements for FR1 + FR1 NR-DC
  - Number of serving carriers requirement
  - PSCell addition and release delay requirement
  - PSCell change and conditional PSCell change delay requirements
  - Scheduling availability of UE during RLM and BFD
  - CSSF for NR-DC
- Study possibility of release independence from R16

NeedForGap requirements

Background

- RAN2 introduced NeedForGapInfoNR capability in TEI16
- RAN4 impact is non-trivial for UEs capable of no-gap measurements
- RAN4 consensus is that measurement requirements need to be updated, however it is unclear whether the topic can fit Rel-17 scope

Candidate objectives (if not adopted in Rel-17)

- Specify interruption due to retuning the vacant chain
- Impacts on RRM measurement requirements with gaps
  - CSSF
  - Measurement period
  - Scheduling restrictions
- Study possibility of release independence from R16

RRM Enhancements

Per-FR gap indication enhancement

Background

- In Rel-16 RAN4 discussed enhancements in indicating UE per-FR gap capabilities. Per-BC indication of per-FR gap capabilities was proposed by several companies
- No final conclusions were reached, and companies indicated interest to continue the work to study UE baseband constraints

Candidate objectives

- Enhance indication of UE per-FR gap capabilities
- Study Per-BC indication of per-FR gap capabilities impacts
  - All DL interruptions involving FR1+FR2 BC
  - Delay at activation of multiple DL Scells
  - Delay at all kinds of BWP switch on multiple CCs
  - Additional delay of measurement reporting upon SRS carrier switch
  - Autonomous gaps
- Other indication is not precluded

CMTC

Background

- CMTC concept for L3 CSI-RS based measurements has been proposed since R16
- Group consensus is that CMTC is beneficial to both UE and network in terms of efficient measurement configuration for UE mobility

Candidate objectives

- CMTC configurations
  - CMTC lengths, periodicities and offsets
  - Multiple CMTC configurations
- CSI-RS measurement requirement updates with CMTC

RRM Enhancements

TCI state switch enhancement

Background

- In Rel-16 TCI switching requirement, there was a time gap where UE is not required to receive DL data; it will have impact on the throughput performance in case the first SSB arrives relatively later
- RAN4 is to further discuss if UE behavior can be enhanced to receive DL data during the time gap of Tfirst-SSB

Candidate objectives

- Enhancement to maintain the UE reception and transmission during the period (or part of period) of MAC CE based TCI switching
- Enhancement to maintain the UE reception and transmission during the period (or part of period) of RRC based TCI switching

RLM enhancement

Background

- The second IS/OOS BLER has already been supported in RAN1 since R15. However, it cannot be correctly implemented since no corresponding RAN4 requirements
- RAN4 is to specify the second RLM BLER pair for voice traffic

Candidate objectives

- Specify the second IS/OOS BLER pair for VoNR service

Candidate RAN4 Rel-18 Topics

UE/BS Interference Mitigation Receivers

UE Demodulation
MMSE-IRC for time selective inter-cell interference

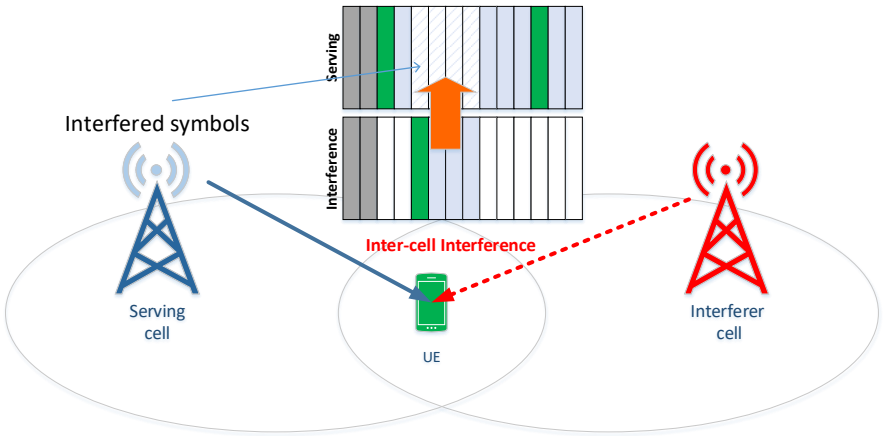
Motivation

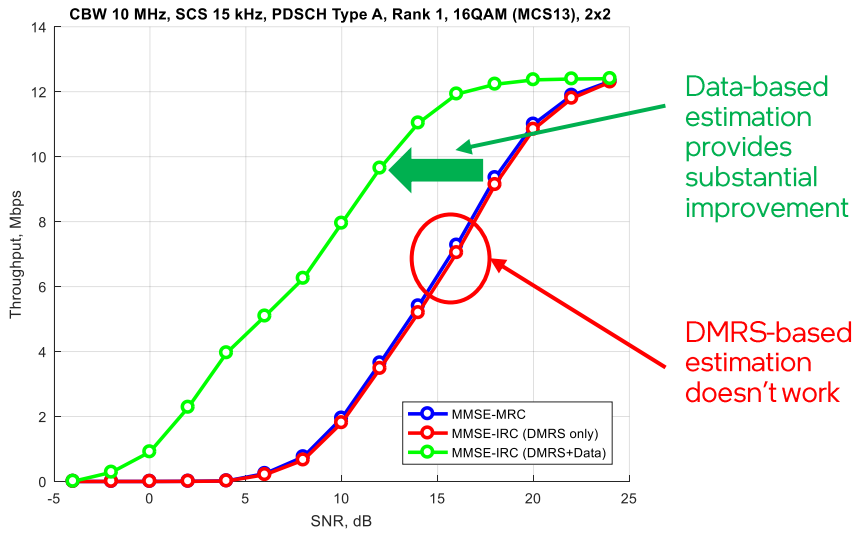
- Baseline UE MMSE-IRC receivers are based on DMRS-based interference estimation and assume constant interference structure on the full slot duration
- Time-selective interference can become a bottleneck for DL performance in scenarios with a mix of SCS in different cells and for URLLC scenarios with 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



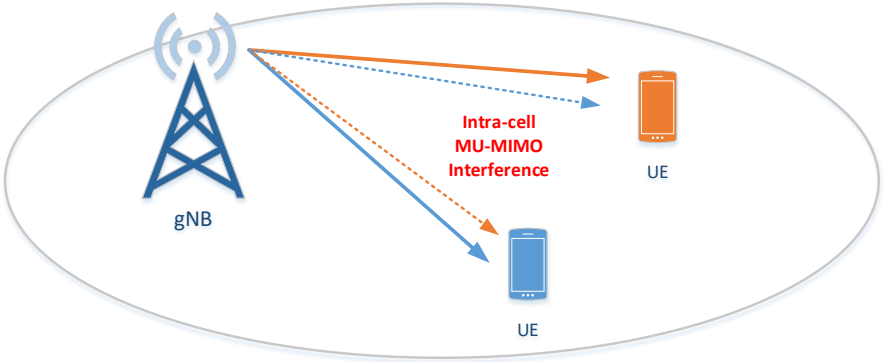


UE Demodulation
Enhanced DL MU-MIMO receivers

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 Rel-18 objectives

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

BS Demodulation
MMSE-IRC for inter-cell interference

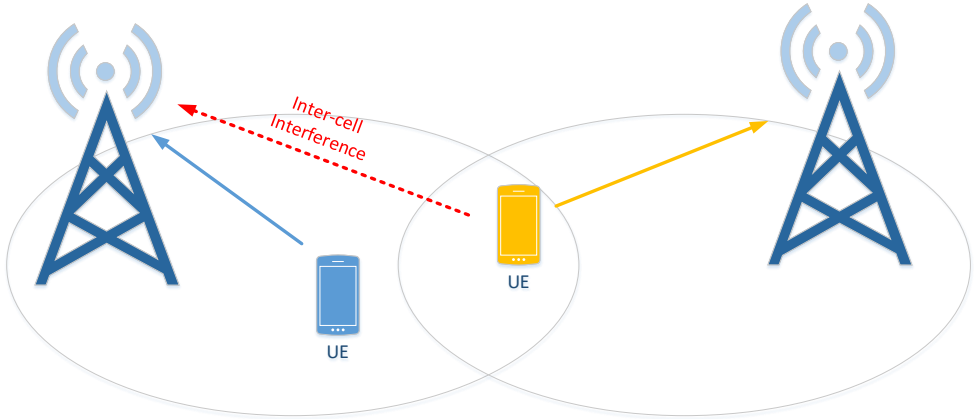
Motivation

- 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 Rel-18 objectives

- Study typical NR UL inter-cell interference profiles
- Define BS MMSE-IRC demodulation requirements for inter-cell interference scenarios for SU-MIMO cases
- 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

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