3GPP TSG-RAN WG4 Meeting #102-e R4-22xxxxx

E-meeting, 21 February – 3 March, 2022

**Agenda item:** **10.12.2.1.1**

**Source: Intel Corporation**

**Title: WF on general and PDSCH demodulation requirements for inter-cell interference MMSE-IRC**

**Document for:** **Approval**

# Introduction

This document provides the way forward on general and PDSCH demodulation requirements for inter-cell interference MMSE-IRC.

# Common test parameters for scenario 1

## Network type

* Previous meeting status
	+ Option 1: Only consider synchronized network
	+ Option 2: Include FDD asynchronized network type with applicability rule:
		- For 2Rx/4Rx UE that only support FDD mode, we can have 1 HomNet test for aync scenario and 1 HetNet test for sync scenario.
		- For 2Rx/4Rx UE that support both FDD and TDD modes, we can have 1 test for HomNet FDD async and 1 test for HetNet TDD sync respectively.
* Agreement
	+ Only consider synchronized network

## SSB configuration

* Previous meeting status
	+ Option 1: Use SSB Option 1 (All SSBs are in the same time/frequency resources) for all test
	+ Option 2: Use SSB Option 2 (Serving cell SSB and interference cell(s) SSB(s) are in the different time/frequency resources) for all test
	+ Option 3: Use different assumptions for different deployment scenarios: SSB Option 1 for homogeneous deployment assumptions and SSB Option 2 for heterogeneous deployment assumptions
* Agreement
	+ Use different assumptions for different deployment scenarios: SSB Option 1 for homogeneous deployment assumptions and SSB Option 2 for heterogeneous deployment assumptions

# Interference model for scenario 1

## INR values for HetNet deployment assumptions

* Previous meeting status
	+ Use INRs 11.39 and 5.45 dB in case of 2 interference cells are modelled
	+ Select one of the following options for scenario with 1 interference cell
		- Option 1: INR 4.84 dB.
		- Option 2: INR 7.58 dB
* Agreement
	+ Use INR 7.58 dB in case of 1 interference cell is modelled

## Number of explicitly modeled interference cells

* Previous meeting status
	+ Option 1: 1 interference cell for all tests
	+ Option 2: 2 interference cells for all tests
	+ Option 3: Use different assumptions for different deployment scenarios: 2 interference cells for homogeneous deployment assumptions and 1 interference cell for heterogeneous deployment assumptions
* Agreement
	+ Use different assumptions for different deployment scenarios: 2 interference cells for homogeneous deployment assumptions and 1 interference cell for heterogeneous deployment assumptions

## Time and frequency offsets for synchronized network with 30 kHz SCS

* Previous meeting status
	+ Option 1: The serving cell is 3 us for interfering cell 1 and -1 us for interfering cell 2 (in case modeled)
	+ Option 2: The serving cell is 1 us for interfering cell 1 and -0.25 us for interfering cell 2 (in case modeled)
	+ Other options are not precluded
	+ Companies are encouraged to bring simulation results for both options next meeting to identify whether significant performance difference can be observed
* Agreement
	+ The serving cell is 1.5 us for interfering cell 1 and -0.5 us for interfering cell 2 (in case modeled)

## Interference modelling in PDCCH region

* Previous meeting status
	+ Option 1: NR interference model to have unallocated RE’s in control region filled with QPSK randomly modulated symbols with random precoding for the number of antenna ports in the requirement scenario.
	+ Option 2: No interference signal in PDCCH region
	+ Option 3: Assume PDCCH transmission from interference cells
* Way Forward
	+ Considered options
		- Option 1: Reuse the LTE PDSCH IRC testing approach. NR interference model to have unallocated RE’s in control region filled with QPSK randomly modulated symbols with random precoding for the number of antenna ports in the requirement scenario.
		- Option 2: Assume PDCCH transmission from interference cells
		- Option 3: Assume PDCCH transmission from interference cells and use non-overlapping PDCCH configurations. Use parameters in Table 2-4 from R4-2205789 as PDCCH configurations
		- Option 4: Assume Option 3 when SSB is non-colliding and Option 2 when SSB is colliding.
	+ Companies are encouraged to check the impact of PDCCH decoding on PDSCH performance
	+ Companies are encouraged to check whether there are any RRM related issues (RLM, RLF) for one of considered options

# Receiver assumptions for scenario 1

## TRS-IC/IM processing

* Previous meeting status
	+ Further discuss whether to add in the simulation assumptions the clarification that no TRS interference cancellation/mitigation is considered for inter-cell MMSE-IRC requirements definition
	+ No such clarification will be added in the TS 38.101-4
	+ Interested companies are encouraged to check with performance for scenarios with and without TRS-IC/IM
* Agreement
	+ How to handle TRS interference for colliding case up to UE implementation, from RAN4 performance requirements and simulation perspective, the baseline assumption is without consideration of TRS interference cancellation/mitigation.
	+ Note: No performance difference observed for the cases of TRS with and without interference based on the simulations from several companies for the scenario specified in RAN4 for inter-cell MMSE-IRC requirements.

# Requirements for scenario 2

## Definition of requirements

* Previous meeting status
	+ Further discuss whether to define requirements for scenario 2
	+ For information, interested companies can check proposals 8-10 from R4-2200512 and comments in Sections 1.3.1.7 – 1.3.1.10 from R4-2203109
* Way forward
	+ Option 1: Do not define requirements for Scenario 2
	+ Option 2
		- Don’t consider the scenarios with Serving DMRS not overlapping with inter-cell interference signal in Rel-17 WI.
		- Define the PDSCH demodulation MMSE-IRC requirements for Scenario 2 with inter-cell interference under the following conditions (one or both):
			* Only DMRS symbol(s) and a few data symbol(s) are interfered by ICI
			* Non-slot based PDSCH transmission for the serving cell

Agreement: Option 1

# UE feature list, capability signalling and release independence

* ~~Previous meeting status~~
	+ ~~Option 1: No need to introduce new UE feature, requirements release independent from Rel-15~~
	+ ~~Option 2: Optional without UE capability signalling and applicable from Rel-17~~
	+ ~~Option 3: Optional without UE capability signalling and applicable from Rel-15~~
	+ ~~Option 3a: Optional without UE capability signalling for Rel-15/16 UE and mandatory from Rel-17~~
	+ ~~RAN4 will make decision on RAN4#102-e meeting with above options~~
* Agreement: Optional without UE capability signaling for Rel-15/16 UE and mandatory from Rel-17
	+ Details
		- Define one new UE feature, which is optional without capability signaling for Rel-15/16 and mandatory without capability from Rel-17. The details are in Annex.
		- Define MMSE-IRC requirements in Rel-17 38.101-4 without applicability rule.
		- Requirements are release independent from Rel-15. Add clarification in 38.307 that MMSE-IRC requirements are optional for Rel-15 and 16 UEs and can only be executed based on UE declaration to support MMSE-IRC.

# References

1. R4-2203008 “Way Forward on general and PDSCH demodulation requirements for inter-cell interference MMSE-IRC”, Intel Corporation, RAN4 #101-bis-e, January 2022.
2. R4-2120707 “Way Forward on general and PDSCH demodulation requirements for inter-cell interference MMSE-IRC”, Intel Corporation, RAN4 #101-e, November 2021.
3. R4-2115730 “Way Forward on general and PDSCH demodulation requirements for inter-cell interference MMSE-IRC”, Intel Corporation, RAN4 #100-e, August 2021.
4. R4-2108664 “Way Forward on general and PDSCH demodulation requirements for inter-cell interference MMSE-IRC”, Intel Corporation, RAN4 #99-e, May 2021.

# Annex. UE feature for MMSE-IRC

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| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Need for the gNB to know if the feature is supported** | **Applicable to the capability signalling exchange between UEs (V2X WI only)”.** | **Consequence if the feature is not supported by the UE** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | **Need of FDD/TDD differentiation** | **Need of FR1/FR2 differentiation** | **Capability interpretation for mixture of FDD/TDD and/or FR1/FR2** | **Note** | **Mandatory/Optional** |
| x-1 | MMSE-IRC receiver for scenarios with inter-cell and intra-cell inter-user interference | Support of MMSE-IRC processing for scenarios with inter-cell and intra-cell inter-user interference |   | No | No | UE can’t apply mitigation of inter-cell and intra-cell inter-user interference | Per UE | No | FR1 only | N/A |   | Optional without capability signalling for Rel-15 and Rel-16Mandatory without capability signalling from Rel-17 |