**3GPP TSG RAN meeting #89e RP-20xxxx**

**Electronic Meeting, 14 – 18 Sep., 2020**

**Agenda item:** 9.1.2

**Source:** Moderator (Intel Corporation)

**Title:** Email discussion summary for Rel-17 Demodulation working area

**Document for:** Information

# Introduction

In RAN#88e meeting the work areas of RAN4 R17 non-spectrum related WI/SIs was endorsed in [1]. One of the working area is Rel-17 Demodulation. Before RAN#89E, the email discussion for this working area was triggered and the summary was provided in [2].

# Topic #1: UE Demodulation/CSI requirements

## Initial round

### Candidate objectives

The following candidate objectives were identified based on pre-plenary e-mail discussion:

**Objective 1-1: UE interference-aware receivers for Scenario a): Inter-cell interference**

* + - Type of requirements:
    - Define PDSCH demodulation requirements
    - Further decide whether to introduce the corresponding CQI reporting requirements during the WI
    - SCS and slot duration
    - Scenario 1: Slot-based transmission and aligned SCS among cells
    - [Scenario 2: Non-slot-based transmission and/or different SCSs among cells]
    - Further discuss the assumptions for requirements definition
    - Reference receiver:
    - For scenario 1: MMSE-IRC with DMRS based interference covariance estimation
      * Note: use the DRMS for target UE’s PDSCH.
    - [For scenario 2: MMSE-IRC. Interference covariance estimation method is FFS]
    - Target frequency: FR1
    - Rx antenna number: 2Rx and 4Rx
    - Interference profile
    - Reuse LTE interference profiles as a starting point
    - Other interference profiles are not precluded
    - TRS/CSI-RS/DMRS configuration
    - Further discuss and decide whether TRS/CSI-RS are collided among cells during the WI
    - Further discuss and decide whether DMRS is colliding with TRS/CSI-RS of interfering cell during the WI
    - [Further discuss and decide whether suppression or cancellation on interfering cell’s CSI-RS/TRS is needed during the WI]
    - As baseline, avoid network assistance and/or restriction.

**Objective 1-2: UE interference-aware receivers for Scenario b): Inter-layer interference for SU-MIMO**

* + Phase I: Study on the reference receiver structure for (iterative) soft IC and evaluate the performance benefit over R-ML, by taking into account the implementation complexity and processing delay
    - Phase II: Define the requirements if needed based on the outcome of phase I
    - Target frequency: FR1, FR2
    - Number of data layers: up to 4 for FR1; 2 for FR2
    - Rx antenna number: 2Rx and 4Rx for FR1; 2Rx for FR2
    - Modulation order and spatial correlation level: further discuss and decide during the WI

**Objective 1-3: UE interference-aware receivers for Scenario c): Intra-cell inter-user interference for MU-MIMO**

* + - Phase I: Evaluate the performance under practical MU-MIMO interference profile for the candidate reference receiver including MMSE-IRC receiver.
    - Further discuss and decide the interference covariance estimation method during the WI
    - Phase II: Define the requirements if needed based on the outcome of phase I
    - Target frequency: FR1
    - Rx antenna number: 2Rx and 4Rx for FR1

**Objective 1-4: NR PDSCH demodulation requirements for handling neighboring cell CRS in LTE-NR coexistence scenarios**

* + - Candidate reference receivers include neighboring cell CRS-IC [and LLR de-weighting]
    - Further discuss and decide if network assistance information including cell ID, number of ports, MBSFN configuration of the neighbouring cell is required

**Objective 1-5: Demodulation requirements for Rel-15 multi-TRP DPS TX**

* + - Demodulation requirements for Rel-15 multi-TRP DPS TX scheme under normal propagation conditions

**Objective 1-6: Demodulation/CSI reporting requirements for downlink 8Rx antennas**

* + - Define channel model for downlink 8Rx antennas
    - Specify the antenna configuration and MIMO channel correlation matrices for 8Rx antennas
    - Specify the static channel model
    - Define PDSCH demodulation requirements for the rank lower than or equal to 4.
    - Further discuss and decide whether to define PDSCH demodulation requirements for the rank higher than 4 in fading channel.
    - Base on combinations of rank and MCS that can achieve the maximum configured throughput.
    - Define SDR requirements for 8Rx
    - Define CSI reporting requirements for 8Rx.
    - No PDCCH demodulation requirement is expected for 8Rx.
    - Considering the test coverage of 8Rx, test applicability rule is needed to define
    - Define applicability rule of existing performance requirements for 8Rx capable UEs.
    - After finalizing the single carrier requirements, the following CA scenarios will be specified
    - Intra-band contiguous CA with 2CC and 8Rx with up to 8-layers supported per CC
    - Inter-band CA with 8Rx/8-layers supported on one or two contiguous CCs on the identified operating bands, and with 2Rx or 4Rx supported on the other CC(s).
    - Note 1: if agreeable to be included in Rel-17 package, the RF/RRM impact needs to be included in the FR1 RF/RRM work areas.

**Objective 1-7: Requirements for non-colocated scenario for intra-band non-contiguous EN-DC/NR-CA (e.g. band 42, n77/n78)**

* + First investigate the applicable MRTD and power imbalance level, considering the network deployment scenario and UE implementation feasibility.
  + Define PDSCH demodulation performance requirement based on the applicable MRTD and power imbalance values.
  + Introduce a UE capability report that indicates the support of dual Rx chain in a band of interest
  + Note 1: if agreeable to be included in Rel-17 package, the RF/RRM impact needs to be included in the FR1 RF/RRM work areas.

### Companies views’ collection

Companies are encouraged to provide comments on the suggested refinement of the individual WI objectives in the table below:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Company A | Objective 1-1: UE interference-aware receivers for Scenario a): Inter-cell interference  Objective 1-2: UE interference-aware receivers for Scenario b): Inter-layer interference for SU-MIMO  Objective 1-3: UE interference-aware receivers for Scenario c): Intra-cell inter-user interference for MU-MIMO  Objective 1-4: NR PDSCH demodulation requirements for handling neighboring cell CRS in LTE-NR coexistence scenarios  Objective 1-5: Requirements for Rel-15 multi-TRP DPS TX scheme  Objective 1-6: Demodulation/CSI reporting requirements for downlink 8Rx antennas  Objective 1-7: Requirements for non-colocated scenario for intra-band non-contiguous EN-DC/NR-CA (e.g. band 42, n77/n78) |
| Verizon | We should prioritize the objectives 1-1 and 1-3 in Rel-17.  As the objectives of Rel-17 UE demodulation, the FR2 4Rx should be in scope based on the available RAN1 and RAN2 (multi-TRP) specs requirements in Rel-16. |
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### Summary and recommendation for further discussion

## Intermediate round

## Fine-tuning round

# Topic #2: BS Demodulation requirements

## Candidate objectives

**Objective 2-1: BS interference-aware receivers for Scenario a): Inter-cell interference**

* + - Type of requirements: PUSCH requirement
    - Reference receiver:
    - As starting point, use MMSE-IRC with DMRS based interference covariance estimation
    - FFS Soft-IC/CW-IC for cell sectors belonging to the same site
    - Target frequency: FR1
    - Rx antenna number: further discuss and decide in the WI
    - Interference profile
    - Reuse LTE interference profiles as a starting point
    - Other interference profiles are not precluded
    - As baseline, avoid network assistance and/or restriction.

**Objective 2-2: BS interference-aware receivers for Scenario b): Inter-layer interference for SU-MIMO**

* + - Type of requirements: PUSCH requirement
    - Candidate reference receiver:
    - Soft IC
    - SL-IC
  + Evaluate the performance gain for different reference receivers, by taking into account the implementation complexity
    - Target frequency: FR1, FR2
    - Number of data layers: 2 for FR1 and FR2
    - Rx antenna number: 2Rx, 4Rx and 8Rx for FR1; 2Rx for FR2

**Objective 2-3: BS interference-aware receivers for Scenario c): Intra-cell inter-user interference for MU-MIMO**

* + - Type of requirements: PUSCH requirement
    - Reference receiver:
    - As starting point, use CWIC
    - FFS hybrid-IC (mixing hard-IC and soft-IC)
    - Target frequency: FR1
    - Rx antenna number: 2Rx, 4Rx and 8Rx for FR1

**Objective 2-4: BS FR1 PUSCH 256QAM demodulation requirements**

* + - Define PUSCH demodulation requirements for FR1 256QAM

## Initial round

### Companies views’ collection

Companies are encouraged to provide comments on the individual WI objectives in the table below:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Company A | Objective 2-1: BS interference-aware receivers for Scenario a): Inter-cell interference  Objective 2-1: BS interference-aware receivers for Scenario b): Inter-layer interference for SU-MIMO  Objective 2-3: BS interference-aware receivers for Scenario c): Intra-cell inter-user interference for MU-MIMO  Objective 2-4: BS FR1 PUSCH 256QAM demodulation requirements |
| Verizon | We would prioritize the objectives 2-1, 2-3 and 2-4 in Rel-17. |
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### Summary and recommendation for further discussion

## Intermediate round

## Fine-tuning round

# Topic #3: Objectives prioritization

## Initial round

### Candidate objectives

**UE Demodulation/CSI (see detailed objectives description in Topic #2)**

* Objective 1-1: UE interference-aware receivers for Scenario a): Inter-cell interference
* Objective 1-2: UE interference-aware receivers for Scenario b): Inter-layer interference for SU-MIMO
* Objective 1-3: UE interference-aware receivers for Scenario c): Intra-cell inter-user interference for MU-MIMO
* Objective 1-4: NR PDSCH demodulation requirements for handling neighboring cell CRS in LTE-NR coexistence scenarios
* Objective 1-5: Requirements for Rel-15 multi-TRP DPS TX scheme
* Objective 1-6: Demodulation/CSI reporting requirements for downlink 8Rx antennas
* Objective 1-7: Requirements for non-colocated scenario for intra-band non-contiguous EN-DC/NR-CA (e.g. band 42, n77/n78)

**BS Demodulation (see detailed objectives description in Topic #3)**

* Objective 2-1: BS interference-aware receivers for Scenario a): Inter-cell interference
* Objective 2-1: BS interference-aware receivers for Scenario b): Inter-layer interference for SU-MIMO
* Objective 2-3: BS interference-aware receivers for Scenario c): Intra-cell inter-user interference for MU-MIMO
* Objective 2-4: BS FR1 PUSCH 256QAM demodulation requirements

**Link adaptation requirements (see detailed objectives description in Topic #2)**

* Objective 3-1: Link adaptation throughput requirements

### Companies views’ collection

Companies are encouraged to provide views on the support and prioritization of the candidate objectives takin into account RAN4 workload and system impacts.

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| Whether support on proposals | **1-1** | **1-2** | **1-3** | **1-4** | **1-5** | **1-6** | **1-7** | **2-1** | **2-2** | **2-3** | **2-4** | **3-1** | **FR2 4Rx** |
| Company A |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Verizon | Yes |  | Yes |  |  |  |  | Yes |  | Yes | Yes |  | Yes |
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| Note: Please use “x” to indicate the support on proposals. | | | | | | | | | | | | |  |

Companies are encouraged to provide additional comments (if any) on the support and prioritization of the candidate objectives in the table below:

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| --- | --- |
| **Company** | **Comments** |
| Company A | TBA |
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### Summary and recommendation for further discussion

# References

[1] RP-201331 “Work areas of RAN4 R17 non-spectrum related WI/SIs”, RAN4 Chair, RAN#88e.

[2] RP‑201967 “Email discussion summary for RAN4 Rel-17 demodulation scope”, China Telecom, RAN#89e