**3GPP TSG-RAN WG4 Meeting # 107 R4-2309949**

**Incheon, KR, May 22nd – May 26th , 2023**

**Agenda item:** 5.4

**Source:** Moderator (Samsung)

**Title:** Topic summary for [107][204] NR\_feMIMO

**Document for:** Information

# Introduction

This topic summary covers the contributions submitted under the following AI for Rel-17 FeMIMO RRM maintenance:

* 5.2.3.1 RRM core requirements
* 5.2.3.2 RRM performance requirements

# Topic #1: Core part maintenance

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2308209 | vivo | Observation 1 In R17 unified TCI, especially for the inter-cell BM scenario, the UL TCI only provides UL TX spatial filter information, and UL timing is determined based on the DL reference timing.  Proposal 1 The mechanism on how does UE support the scenario where the source RS of DL TCI and UL TCI are from different TRP should be discussed in RAN1 in the scope of R18.  Proposal 2 RAN4 solves issue 1-1-3 in R4-2303145 only by removing the last sentence in square bracket in 8.16.5 of TS 38.133.  Observation 2 In R17 unified TCI framework, it is a possible scenario that UL TCI, i.e. spatial Tx info of the UE is switched by MAC CE, but PL-RS is maintained, i.e. it is possible that NM = 0.  Proposal 3 For the definition of maintained PL-RS, revise the 1st bullet and the 3rd bullet to the following:  ‘- The target PL-RS is associated with or included in the UL or joint TCI states in the old TCI list for PUSCH/PUCCH/SRS transmissions  - There are no more than 4 different RS configured as PL-RS per serving cell among all active UL (or joint) TCI states for PUSCH/PUCCH/SRS transmissions  - The target pathloss reference signal remains detectable during TCI state switching period  - SNR of the target pathloss reference signal≥-3dB’  Observation 3 In legacy R16 requirements, Rx beam sweeping is not specified for SSB-based measurements for time-frequency tracking and PL-RS update, no matter the SSB is configured for L1-RSRP/L1-SINR measurement or not, since the Rx beam for this SSB reception is already considered as known. For L1-RSRP measurements requirements, the Rx beam sweeping is considered for the worst case, and is not applicable to the case when a tighter requirement is applied.  Proposal 4 MAC-CE based UL TCI state switching delay requirements agreed in RAN4 101-bis-e can be applicable to the case when the PL-RS is the SSB which is configured for L1-RSRP measurements. The note in 8.16.3 should be removed.  Proposal 5 Introduce scheduling restrictions for the cases when UE simultaneously receive SSB and PDSCH/PDCCH, while SSB is associated to a PCI different from the PCI to which the active TCI of PDSCH/PDCCH is associated. RRM requirements do not apply for these cases. |
| R4-2308692 | Huawei, HiSilicon | Proposal 1: For MAC-CE based UL TCI state switching, a longer UL TCI state switch delay is expected when an SSB is indicated as PL-RS in UL TCI state in FR2.  Proposal 2: If no consensus can be achieved, we suggest that there are no requirements when SSB is indicated as PL-RS in UL TCI state in FR2. |
| R4-2308732 | ZTE Corporation | Proposal 1: Under mTRP scenario, if source RS in UL TCI state is not in the DL active TCI list, the acquisition of time and frequency tracking should be addressed. Performing additional time/frequency tracking is necessary or we can check with RAN1.  Proposal 2: For the case when SSB is indicated as PL-RS in UL TCI state for FR2, which means the source RS is the SSB or QCL-Ded with the SSB. It should be emphasized once more that beam alignment is the precondition based on previous agreements. So not additional Rx beam sweeping is necessary. We prefer to reuse the existing delay requirement of MAC CE based UL TCI state switch. However to move forward, a compromised solution is needed, e.g. allowing a clear but not too long additional latency.  Proposal 3: Based on RAN1 agreements, RAN1 has specified that the PDCCH/PDSCH should be rate matched around the L1 SSB within the same PCI. So no need to clarify anything more in RAN4 specification.  Proposal 4: For the inter-TRP with different PCI case, we are fine to introduce the PDCCH/PDSCH rate matching. |
| R4-2308755 | Nokia, Nokia Shanghai Bell | Proposal 1: If source DL-RS associated with the indicated UL TCI state is unknown (e.g. it is not in the DL active TCI list), additional time for time/frequency tracking should be allowed for the indicated UL TCI state.  Proposal 2: UE shall track time and frequency of the associated DL RS for an UL TCI state when the UL state is in the active TCI state list.  Proposal 3: Check with RAN1 if UE is required to do DL time tracking for an UL TCI state in the active TCI state list.  Definition of ‘maintained PL-RS’  Proposal 4: The PL-RS is maintained provided UE is not having more than 4 different PL-RS for all activated UL TCI states for PUSCH, PUCCH and SRS transmissions.  Proposal 5: Agree on the TP for PL-RS maintained for Release 17.  MAC-CE based UL TCI state switching delay when SSB is indicated as PL-RS in UL TCI state for FR2  Proposal 6: There shall be no beam sweeping for PL-RS measurements in FR2 if the PL-RS is SSB (assuming UE is having no more than 4 different PL-RS). |
| R4-2309373 | Apple | Proposal #1: Do not define requirements for the case if source RS in UL TCI state is not in DL active TCI state list.  Proposal #2: When PL-RS in UL TCI state switch is SSB in FR2, longer delay is expected.  Proposal #3: If no consensus is reached in RAN4 for SSB based PL-RS measurement in FR2, no requirements  Proposal #4: Define maintained PL-RS as:  - PL-RS is maintained provided:  - the target PL-RS is associated with or included in the UL or joint TCI states in the active TCI list for PUSCH/PUCCH/SRS transmissions  - There are no more than 4 different RS configured as PL-RS per serving cell for all active UL TCI states (UL or joint TCI state) for PUSCH/PUCCH/SRS transmissions  - The target pathloss reference signal remains detectable during TCI state switching period  - SNR of the target pathloss reference signal≥-3dB  - The associated SSBs with the target pathloss reference signal remain detectable during the TCI state switching period.  - SNR of the associated SSB ≥-3dB |
| R4-2309581 | Ericsson | Proposal 1: RAN4 not to define requirements for the case source RS in UL TCI state is not in DL active TCI state list.  Proposal 2: RAN4 to reuse the existing delay requirement of MAC CE based UL TCI state switch  Proposal 3: RAN4 to not agree on ‘if the TCI state of the PDSCH /PDCCH is associated to the SSB of the cell with different PCI, UE is not expected to receive PDSCH/PDCCH on the symbols corresponding to the SSB indexes configured for L1-RSRP measurement on the serving cell’  Proposal 4: RAN4 to introdcue L1-RRSP requirements for TSSB\_CDP = TSMTCperiod  Proposal 5: RAN4 to introduce equal sharing between SC and NSC L1-RSRP |
| R4-2309743 | Samsung | Proposal 1: If source RS in UL TCI state is not in the DL active TCI list, Do not define requirements for the case if source RS in UL TCI state is not in DL active TCI state list.  Proposal 2: For MAC-CE based UL TCI state switching delay when SSB is indicated as PL-RS in UL TCI state for FR2, we support Proposal 1. |

## Open issues summary

### Sub-topic 1-1: RRM maintenace of unified TCI

**Issue 1-1-1: Whether UE need to track UL time/frequency if source RS in UL TCI state is not in the DL active TCI list**

Background: in WF in RAN4#106 meeting,

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| **Issue 1-1-3 Whether UE need to track UL time/frequency if source RS in UL TCI state is not in the DL active TCI list**   * To be confirmed:   + [Do not define requirements for the case if source RS in UL TCI state is not in DL active TCI state list] |

* Proposals:
  + Proposal 1: (vivo, Apple, Ericsson, Samsung)
    - Do not define requirements for the case if source RS in UL TCI state is not in DL active TCI state list
  + Proposal 2: (ZTE, Nokia)
    - Additional time for time/frequency tracking should be allowed for the indicated UL TCI state.
    - UE shall track time and frequency of the associated DL RS for an UL TCI state when the UL state is in the active TCI state list.
    - Send LS to check with RAN1

**Issue 1-1-2 Definition of maintained PL-RS**

* Proposals:
  + Proposal 1: (vivo)
    - For the definition of maintained PL-RS, revise the 1st bullet and the 3rd bullet to the following:

‘- The target PL-RS is associated with or included in the UL or joint TCI states in the old TCI list for PUSCH/PUCCH/SRS transmissions

- There are no more than 4 different RS configured as PL-RS per serving cell among all active UL (or joint) TCI states for PUSCH/PUCCH/SRS transmissions

- The target pathloss reference signal remains detectable during TCI state switching period

- SNR of the target pathloss reference signal≥-3dB’

* + Proposal 2: (Nokia)
    - PL-RS is maintained provided:

~~- the target PL-RS is associated with or included in the UL or joint TCI states in the active TCI list for PUSCH/PUCCH/SRS transmissions~~

*-* There are no more than 4 different RS configured as PL-RS per serving cell among all active UL TCI states (UL TCI state or joint) for PUSCH/PUCCH/SRS transmissions

- The target pathloss reference signal remains detectable during TCI state switching period

- SNR of the target pathloss reference signal≥-3dB

- The associated SSBs with the target pathloss reference signal remain detectable during the TCI state switching period

- SNR of the associated SSB ≥-3dB

* + Proposal 3: (Apple)
    - PL-RS is maintained provided:

- the target PL-RS is associated with or included in the UL or joint TCI states in the active TCI list for PUSCH/PUCCH/SRS transmissions

- There are no more than 4 different RS configured as PL-RS per serving cell for all active UL TCI states (UL or joint TCI state) for PUSCH/PUCCH/SRS transmissions

- The target pathloss reference signal remains detectable during TCI state switching period

- SNR of the target pathloss reference signal≥-3dB

- The associated SSBs with the target pathloss reference signal remain detectable during the TCI state switching period.

- SNR of the associated SSB ≥-3dB

**Issue 1-1-3 MAC-CE based UL TCI state switching delay when SSB is indicated as PL-RS in UL TCI state for FR2**

* Proposals:
  + Proposal 1: (vivo, ZTE, Nokia, Ericsson)
    - Reuse the existing delay requirement of MAC CE based UL TCI state switch. Remove the note in 8.16.3.
  + Proposal 2: (Huawei, Apple, Samsung)
    - longer UL TCI state switch delay is expected when an SSB is indicated as PL-RS in UL TCI state in FR2.
    - If no consensus can be achieved, we suggest that there are no requirements when SSB is indicated as PL-RS in UL TCI state in FR2.
  + Proposal 3: (ZTE)
    - To move forward, a compromised solution is needed, e.g. allowing a clear but not too long additional latency.

### Sub-topic 1-2: RRM maintenace of ICBM

**Issue 1-2-1 Whether need clarification or update in RAN4 spec when PDCCH/PDSCH and SSB associated different PCI are overlapped on the same RE**

Background: in WF in RAN4#106 meeting,

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| **Issue 1-7-1 Whether need clarification or update in RAN4 spec when PDCCH/PDSCH and SSB associated different PCI are overlapped on the same RE**   * To be confirmed:   - [If the TCI state of the PDSCH /PDCCH is associated to the SSB of the cell with different PCI,   * + - UE is not expected to receive PDSCH/PDCCH on the symbols corresponding to the SSB indexes configured for L1-RSRP measurement on the serving cell]. |

* Proposals:
  + Proposal 1: (vivo)
    - Introduce scheduling restrictions for the cases when UE simultaneously receive SSB and PDSCH/PDCCH, while SSB is associated to a PCI different from the PCI to which the active TCI of PDSCH/PDCCH is associated. RRM requirements do not apply for these cases.
  + Proposal 2: (ZTE)
    - For the inter-TRP with different PCI case, we are fine to introduce the PDCCH/PDSCH rate matching.
  + Proposal 3: (Ericsson)
    - Do not agree to introduce scheduling restriction “if the TCI state of the PDSCH /PDCCH is associated to the SSB of the cell with different PCI, UE is not expected to receive PDSCH/PDCCH on the symbols corresponding to the SSB indexes configured for L1-RSRP measurement on the serving cell”

**Issue 1-2-2: Whether to specify L1-RSRP requirements when TSSB\_CDP = TSMTCPeriod?**

* Proposals:
  + Proposal 1: (Ericsson)
    - RAN4 to introdcue L1-RRSP requirements for TSSB\_CDP = TSMTCperiod
    - RAN4 to introduce equal sharing between SC and NSC L1-RSRP.

## CRs

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| **T-doc number** | **Company** | **Title** |
| R4-2308210 | vivo | CR on maintenance of feMIMO RRM requirement in R17 |
| R4-2308211  (Cat-A) | vivo | CR on maintenance of feMIMO RRM requirement in R18 |
| R4-2308693 | Huawei, HiSilicon | CR on maintaining RRM requirements for NR FeMIMO R17 |
| R4-2308694  (Cat-A) | Huawei, HiSilicon | CR on maintaining RRM requirements for NR FeMIMO R17 |
| R4-2308756 | Nokia, Nokia Shanghai Bell | CR for definition of PL-RS maintained and time tracking for unified TCI |
| R4-2308757  (Cat-A) | Nokia, Nokia Shanghai Bell | CR for definition of PL-RS maintained and time tracking for unified TCI |
| R4-2309374 | Apple | CR for Unified TCI State switching requirements |
| R4-2309375  (Cat-A) | Apple | CR for Unified TCI State switching requirements (Rel-18) |
| R4-2309582 | Ericsson | CR on maintenance of FeMIMO |
| R4-2309583 | Ericsson | CR on maintenance of FeMIMO |

# Topic #2: Performance Part maintenance

## CRs

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| **T-doc number** | **Company** | **Title** |
| R4-2307137 | Qualcomm Incorporated | CR on R17 TRP specific BFD testcase correction |
| R4-2307138  (Cat-A) | Qualcomm Incorporated | CR (CAT-A) on R17 TRP specific BFD testcase correction |