**3GPP TSG-RAN WG4 Meeting # 111 R4-2408018**

**Fukuoka City, Fukuoka, Japan, 20th ‒ 24th, 2024**

**Agenda item:** 7.19.4

**Source:** Moderator (Samsung)

**Title:** Topic summary for [111][221] NR\_MIMO\_evo\_DL\_UL

**Document for:** Information

# Introduction

This topic summary covers the contributions submitted under the following AI for RRM of Rel-18 MIMO evolution for downlink and uplink:

* 7.19.1 RRM core requirements maintenance
* 7.19.2 RRM performance requirements
* 7.19.2.1 RRM performance requirements for TDCP
* 7.19.2.2 Other RRM performance requirements

# Topic #1: RRM core requirements maintenance

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2407253 | Apple | 2TA with multi-DCI multi-TRP  Observation #1: The downlink reference signals associated with a coresetPoolIndex is very ambiguous.  Observation #2: The downlink reference signals associated with a coresetPoolIndex in the RRC configured TCI state list could be up to 64 or 128 downlink RS.  The UE is not expected to maintain timing for all the DL reference signals in the RRC configured TCI list.  Observation #3: UE is not expected to maintain timing for all DL reference signals in the RRC configured TCI state list.  Observation #4: UE is expected to maintain timing for all active DL and joint TCI states  Observation #5: The active TCI state list is associated with a coresetPoolIndex  Observation #6: The downlink timing reference could be any RS in the active DL or Joint TCI state list.  Observation #7: The downlink timing reference could be RS QCLed to any RS in the active DL or Joint TCI state list.  Proposal #1: The downlink timing reference for the uplink signal is the first detected path among the downlink reference signals in the active DL or joint TCI state or QCLed to the downlink reference signals in the active TCI state associated with the coresetPoolIndex.  Observation #8: If the reference cell for timing (as defined in legacy) is also configured with multi-DCI multi-TRP transmission, the same definition can be used.  Observation #9: The reference cell for timing (as defined in legacy) need not always be configured with multi-DCI multi-TRP transmission.  Proposal #2: For case when reference cell is configured with multi-DCI transmission scheme, the same reference cell as legacy is the reference cell for both TRPs.  Proposal #3: For case when the reference cell is not configured with multi-DCI for cells in pTAG, for coresetPoolIndex0 reference is SpCell; The reference cell for coresetPoolIndex1 is any activated SCell with multi-DCI, or cell with different PCI in case of no activated SCell with multi-DCI.  Proposal #4: For cells in sTAG the reference cell is any activated SCell configured with intra-cell multi-DCI transmission, or any activated SCell configured with inter-cell multi-DCI if no activated SCell with intra-cell multi-DCI transmission.  Proposal #5: The timing requirements with 2 TA for multi-DCI multi-TRP are applicable to PUSCH, PUCCH, SRS and PDCCH ordered PRACH.  Proposal #6: The downlink timing reference for PRACH transmission triggered by PDCCH order in intra-cell multi-DCI multi-TRP operation is the same as the downlink timing reference of the uplink signals associated with the same coresetPoolIndex as the PDCCH order if PRACH association indicator is 0, and that of the other coresetPoolIndex if PRACH association indicator is 1.  Multi-DCI mTRP  Observation #10: The reception or PDSCH carrying MAC CE or MAC CE decoding is only known at the UE  Observation #11: RAN4 defines minimum requirements and extra delay on both TRPs is fine.  Proposal #7: For multi-DCI multi-TRP DL TCI state switch, OL=1 if SSB overlaps or adjacent to SSB from other TRP in FR2 and SSB periodicity is equal to or less than that of other TRP, 0 otherwise.  Proposal #8: In case extra delay of 1 SSB period for adjacent or overlapping SSBs on both TRPs is not agreeable, open to consider coresetPoolIndex based extra delay.  Observation #12: For 2TA case UE has 2 TAG and 2 DL reference timing associated with each TAG.  Observation #13: The TCI states(s) for each coresetPoolIndex are associated with a TAG.  Observation #14: The UE needs use the DL reference timing for associated with corresponding coresetPoolIndex for UL timing.  Observation #15: The DL reference timing RS should be in the activeDL or point TCI state list.  Observation #16: For joint TCI state, the UE would track timing since its needed for DL reception and is already considered in the DL switching requirements.  Observation #17: For separate UL TCI state switch additional time is needed – if the there is no reference timing associated with the coresetPoolIndex.  Proposal #9: For multi-DCI multi-TRP with 2TA for separate UL TCI state switch, additional time for DL timing reference tracking should be added in case no timing reference associated with the same coresetPoolIndex. |
| R4-2407848 | Xiaomi | Observation 1: When two MAC CE arrives at different time slot, UE may not receive data with old TCI state which is overlapped with RSs from another TRP within n+ THARQ + for FR2 and FR1 with different numerology case.  Observation 2: when two MAC CE based UL TCI state switch command are received, it’s possible that UE has finished TCI state switch for TRP1 but UE will still perform pathloss measurement for TRP2. scheduling restriction for data with new TCI state is still needed.  Proposal 1: For mDCI, define scheduling restriction for DL and UL TCI state switch, i.e. The UE is not expected to transmit or receive data on the SSB or CSI-RS symbols used for T/F measurement or pathloss measurement for FR1 with different SCS and FR2. |
| R4-2408422 | Samsung | Proposal 1: For initial access RACH, the timing requirements with 2 TA for multi-DCI multi-TRP are not applicable. Two TA is configured later than this procedure.  Proposal 2: For other type of RACH such as CFRA, the timing requirements with 2 TA for multi-DCI multi-TRP are applicable.  Proposal 3: For CFRA PRACH triggered by PDCCH order, the DL reference timing is associated to the coresetPoolIndex.  Proposal 4: For mDCI mTRP, OL is revised as:   * if the first SSB which after decoding the MAC-CE overlaps or adjacent to the first SSB which after decoding another MAC-CE from other TRP in FR2 and SSB periodicity is equal to that of other TRP * If the MAC CE arrived first, OL=0; Otherwise OL=1 * If the first SSB which after decoding the MAC-CE overlaps or adjacent to the first SSB which after decoding another MAC-CE from other TRP in FR2 and SSB periodicity is less than that of other TRP, OL=1 * Otherwise, OL=0   Proposal 5: For joint TCI state, the UE is not expected to transmit on UL based on the target TCI state before UE completes the DL and UL TCI state switch. The DL timing can always be achieved by DL TCI. No additional DL RS tracking time for UL TCI state switching.  For separate UL TCI state switch:   * If the DL beams are changed as well and DL TCI is not in the active list, the previous DL timing cannot be used. Additional DL RS tracking time for UL TCI state switching is needed as:   + Known case: THARQ + + TOk-ref (Tfirst-SSB-DLRef + OL\*T SSB-DLRef + 2ms)+NM\*( Tfirst-PL-RS + 4\*Ttarget\_PL-RS + 2ms)   + Unknown case: THARQ + + TL1-RSRP + TOuk-ref (Tfirst-SSB-DLRef + OL\*T SSB-DLRef + 2ms)+ Tfirst-PL-RS + 4\*Ttarget\_PL-RS + 2ms   + TOk-ref = 1 if there is no active DL TCI-State for DL timing reference associated with the same coresetPoolIndex * For other cases, no additional DL tracking is needed. |
| R4-2408567 | Huawei, HiSilicon | Observation 1: Per RAN1 spec, UL TCI state is only for UL Tx spatial filtering assumption.  Observation 2: There are following drawbacks if UE uses DL RS UL TCI states as UL reference timing:   * UE needs to maintain two DL reference timing, one for DL reception and another one for UL transmission. * NW may experience different arriving time for different UE. * The TCI state switching time will be longer.   Proposal 1: No additional DL RS tracking time for UL TCI state switching since UL TCI is only for UL TX spatial filtering determination per RAN1 spec.  Proposal 2: The timing requirements for mTCI with Two TA are suggested to be updated as follows:  “change in R4-2408568” |
| R4-2409139 | Nokia | Observation 1: RAN1 has agreed for two TAs to assume only CFRA procedure for RACH.  Proposal 1: The timing requirements with two TAs for multi-DCI multi-TRP are not applicable to contention based random access (CBRA). CBRA follow legacy requirements.  Proposal 2: Update timing requirements for 2 TA’s for PDCCH ordered CFRA in accordance with RAN1 LS.  Observation 1: Current agreement for MAC CE-based mDCI mTRP TCI switching does not cover the case when the SSB periodicity is the same for both target TCI states.  Proposal 3: Confirm option in the Way Forward for Issue 1-2-2 in RAN4#110bis:  a. if the first SSB which after decoding the MAC-CE overlaps or adjacent to the first SSB which after decoding another MAC-CE from other TRP in FR2 and SSB periodicity is equal to that of other TRP  i. If the MAC CE arrived first, OL=0; Otherwise OL=1  b. If the first SSB which after decoding the MAC-CE overlaps or adjacent to the first SSB which after decoding another MAC-CE from other TRP in FR2 and SSB periodicity is less than that of other TRP, OL=1  c. Otherwise, OL=0 |
| R4-2409378 | MediaTek Inc. | Proposal 1: The timing requirements with 2 TAs for mDCI are not applicable to initial access from RRC\_IDLE. It’s applicable to CBRA at least for RACH trigger by PDCCH order.  Proposal 2: For mDCI mTRP TCI state switching, how to handle the overlapped or adjacent case are up to UE implementation.  Proposal 3: For mDCI mTRP, if UE supporting two TAs, do not consider additional DL RS tracking time for UL TCI state switching delay requirement.  Proposal 4: The legacy evaluation delay of RLM/BFD/CBD is applicable to RTD>CP case in FR1. The legacy RLM, BFD and CBD requirements are not applicable to RTD>CP case in FR2. |
| R4-2409718 | Ericsson | Proposal 1: RAN4 to adapt the following as text for reference point in timing requirements   * 1. For multi-DCI based multi-TRP operation with two TAs, UE initial transmission timing error requirements specified in this clause is applicable for each TAG and shall be met for each TAG separately. For PUCCH/PUSCH/SRS, the reference point described in this clause for each TAG is the first detected path (in time) of the corresponding downlink reference signal (s) associated with one of the activated *UL-TCIState* or *DLorJointTCIState (if unifiedTCI-StateType is indicated as Joint)* [TS 38.331] with same TAG. For the PDCCH order-based RACH, the reference point described in this clause is the first detected path of the SSB associated with PDCCH order.   Proposal 2: No additional DL RS tracking time is needed for UL TCI state switching. |

## Open issues summary

### Sub-topic 1-1: Timing requiements for 2 TAs

**Issue 1-1-1: Clarification of uplink timing and coresetPoolIndex**

* Proposals
  + Proposal 1: (Apple)
    - The downlink timing reference for the uplink signal is the first detected path among the downlink reference signals in the active DL or joint TCI state or QCLed to the downlink reference signals in the active TCI state associated with the coresetPoolIndex.
    - For case when reference cell is configured with multi-DCI transmission scheme, the same reference cell as legacy is the reference cell for both TRPs.
    - For case when the reference cell is not configured with multi-DCI for cells in pTAG, for coresetPoolIndex0 reference is SpCell; The reference cell for coresetPoolIndex1 is any activated SCell with multi-DCI, or cell with different PCI in case of no activated SCell with multi-DCI.
    - For cells in sTAG the reference cell is any activated SCell configured with intra-cell multi-DCI transmission, or any activated SCell configured with inter-cell multi-DCI if no activated SCell with intra-cell multi-DCI transmission.
  + Proposal 1b: (Qualcomm)
    - Add “reference” before cell for the cell associated with a coresetPoolIndex having same TAG as the uplink signal
* Recommended WF
  + TBA

**Issue 1-1-2: Applicability of timing requirements for 2 TAs.**

* Proposals
  + Proposal 1: (Apple)
    - Applicable to PUSCH, PUCCH, SRS and PDCCH ordered PRACH
  + Proposal 2: (Samsung)
    - For initial access RACH, the timing requirements with 2 TA for multi-DCI multi-TRP are not applicable. Two TA is configured later than this procedure.
    - For other type of RACH such as CFRA, the timing requirements with 2 TA for multi-DCI multi-TRP are applicable.
  + Proposal 3: (Nokia)
    - The timing requirements with two TAs for multi-DCI multi-TRP are not applicable to contention based random access (CBRA). CBRA follow legacy requirements.
  + Proposal 4: (MediaTek)
    - The timing requirements with 2 TAs for mDCI are not applicable to initial access from RRC\_IDLE. It’s applicable to CBRA at least for RACH trigger by PDCCH order.
  + Proposal 5: (Ericsson)
    - PUCCH/PUSCH/SRS. PDCCH order-based RACH
* Recommended WF
  + Timing requirements for two TAs are applicable for PUCCH/PUSCH/SRS, PDCCH ordered RACH

[Moderator]: Observation from all proposals from companies, the first bullet is agreeable.

However, there is still unclear for details.

PDCCH ordered RACH can be CBRA or CFRA. For PDCCH ordered RACH CFRA, my understanding for Apple/Samsung/Nokia/MediaTek/Ericsson it is applicable.

For PDCCH ordered RACH CBRA, MediaTek supports PDCCH ordered RACH CBRA is applicable as well.

According to RAN1 previous agreements:

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| [**R1-2212589**](file:///C:\Users\yanze.fu\AppData\Local\Temp\Docs\R1-2212589.zip) **Moderator Summary #1 on Two TAs for multi-DCI Moderator (Ericsson)**  From Nov 14th session  Working Assumption  For multi-DCI based inter-cell Multi-TRP operation with two TA enhancement, one additional PRACH configuration is supported for each configured additional PCI   * the additional PRACH configuration is used in a RACH procedure triggered by a PDCCH order for the corresponding configured additional PCI   Agreement  For multi-DCI based Multi-TRP operation with two TA enhancement, support CFRA triggered by PDCCH order for both intra-cell and inter-cell cases.  [**R1-2212862**](file:///C:\Users\yanze.fu\AppData\Local\Temp\Docs\R1-2212862.zip) **Moderator Summary #3 on Two TAs for multi-DCI Moderator (Ericsson)**  From Nov 17th session  Conclusion  For multi-DCI based Multi-TRP operation with two TA enhancement, there is no consensus to support enhancements for CBRA triggered by PDCCH order. |

Check with RAN4 group whether no CBRA triggered by PDCCH order.

Another one point is: For CFRA, if it is configured in RRC which related to SSB-index or CSI-RS, whether it is applied?

**Issue 1-1-3: For PDCCH order RACH, uplink timing and DL timings association.**

* Proposals
  + Proposal 1: (Apple, Samsung, Huawei, Nokia, Ericsson, Qualcomm)
    - For intra-cell, all the proposals are aligned with the association in RAN1 LS.
  + Proposal 2: (Qualcomm)
    - For inter-cell,
      * If the PRACH is triggered towards serving cell PCI, the uplink transmission takes place before the reception of the first detected path (in time) of [one of] the corresponding downlink reference signal(s) of the reference cell associated with the *coresetPoolIndex* having the same TAG as that serving cell, where is the first n-TimingAdvanceOffset value,
      * If the PRACH is triggered towards active additional cell PCI, the uplink transmission takes place before the reception of the first detected path (in time) of [one of] the corresponding downlink reference signal(s) of the reference cell associated with the *coresetPoolIndex* having the same TAG as that active additional PCI, where is the second n-TimingAdvanceOffset value.
* Recommended WF
  + Capture in revised CR for timing

### Sub-topic 1-2: eUTCI for mTRPs

**Issue 1-2-1: For mDCI mTRP, OL definition?**

Previous Agreement: OL=1 if SSB overlaps or adjacent to SSB from other TRP in FR2 and SSB periodicity is less than that of other TRP

* Proposals
  + Proposal 1 (Apple)
    - For all the cases: OL=1 if SSB overlaps or adjacent to SSB from other TRP in FR2 and SSB periodicity is less than that of other TRP, 0 otherwise
  + Proposal 2 (Samsung, Nokia)
    - if the first SSB which after decoding the MAC-CE overlaps or adjacent to the first SSB which after decoding another MAC-CE from other TRP in FR2 and SSB periodicity is equal to that of other TRP
      * If the MAC CE arrived first, OL=0; Otherwise OL=1
    - If the first SSB which after decoding the MAC-CE overlaps or adjacent to the first SSB which after decoding another MAC-CE from other TRP in FR2 and SSB periodicity is less than that of other TRP, OL=1
    - Otherwise, OL=0
  + Proposal 3 (MediaTek)
    - how to handle the overlapped or adjacent case are up to UE implementation.

**Issue 1-2-2: For mDCI mTRP, how to specify UL TCI state switching requirements for eUTCI if UE supporting two TAs (RTD<CP and RTD>CP)?**

* Proposals
  + Proposal 1 (Apple, Samsung)
    - Additional time for DL timing reference tracking should be added in conditions.
    - Proposal 1a (Apple)
      * In the condition: no timing reference associated with the same coresetPoolIndex.
    - Proposal 1b (Samsung)
      * For joint TCI state, no additional DL RS tracking time for UL TCI state switching.
      * For separate UL TCI state, If the DL beams are changed as well and DL TCI is not in the active list, the previous DL timing cannot be used. Additional DL RS tracking time for UL TCI state switching is needed as:
        + Known case: THARQ + + TOk-ref (Tfirst-SSB-DLRef + OL\*T SSB-DLRef + 2ms)+NM\*( Tfirst-PL-RS + 4\*Ttarget\_PL-RS + 2ms)
        + Unknown case: THARQ + + TL1-RSRP + TOuk-ref (Tfirst-SSB-DLRef + OL\*T SSB-DLRef + 2ms)+ Tfirst-PL-RS + 4\*Ttarget\_PL-RS + 2ms
        + TOk-ref = 1 if there is no active DL TCI-State for DL timing reference associated with the same coresetPoolIndex
      * For other cases of separate UL TCI state, no additional DL tracking is needed.
  + Proposal 2: (Huawei, MediaTek, Ericsson)
    - No additional DL RS tracking time for UL TCI state switching-

**Issue 1-2-3: Whether to add scheduling restriction of DL and UL TCI state switch for mDCI?**

* Proposals
  + Proposal 1 (Xiaomi)
    - Define scheduling restriction for DL and UL TCI state switch, i.e. The UE is not expected to transmit or receive data on the SSB or CSI-RS symbols used for T/F measurement or pathloss measurement for FR1 with different SCS and FR2. Details in CR R4-2407850

**Issue 1-2-4: RLM/BFD/CBD requirements for mTRP?**

* Proposals
  + Proposal 1 (MediaTek)
    - The legacy evaluation delay of RLM/BFD/CBD is applicable to RTD>CP case in FR1. The legacy RLM, BFD and CBD requirements are not applicable to RTD>CP case in FR2.

## Draft CRs

|  |  |  |  |
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| **T-doc number** | **Company** | **Proposals / Observations** |  |
| R4-2407254 | Apple | CR on DL reference timing for 2TA | Overlapped with R4-2407458/R4-2408568/R4-2409140/R4-2409719 |
| R4-2407255 | Apple | CR for eUTCI state switching requirements |  |
| R4-2407458 | Qualcomm Incorporated | (NR\_MIMO\_evo\_DL\_UL-Core) draft CR on UL timing requirement for mDCI based mTRP with two TAGs | Overlapped with R4-2407254/R4-2408568/R4-2409140/R4-2409719 |
| R4-2407850 | Xiaomi | DraftCR on scheduling restriction for TCI state switch in mDCI |  |
| R4-2408568 | Huawei, HiSilicon | Draft CR on timing requirements for R18 MIMO | Overlapped with R4-2407254/R4-2407458/ R4-2409140/R4-2409719 |
| R4-2409140 | Nokia | Draft CR corrections of timing requirements for two TAs | Overlapped with R4-2407254/R4-2407458/ R4-2408568/R4-2409719 |
| R4-2409379 | MediaTek Inc. | Draft CR on core maintenance of NR\_MIMO\_evo\_DL |  |
| R4-2409719 | Ericsson | Draft CR to TS 38.133 on UL Transmit timing for MIMO Evolution. | Overlapped with R4-2407254/R4-2407458/ R4-2408568/R4-2409140 |
| R4-2409781 | Samsung | Big CR on core maintenance of NR\_MIMO\_evo\_DL\_UL |  |

# Topic #2: RRM performance requierement for TDCP

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2407256 | Apple | Observation #1: The TDCP measurement error is less when correlation value is larger than 0.9 and SNR is 15 or 20dB for TDLA30 channel.  Observation #2: Correlation value < 0.9 corresponds to <100Hz with 15KHz SCS and < 200Hz with 30KHz SCS.  Observation #3: Correlation value is 0.29 with 15KHz SCS and 0.79 with 30KHz SCS.  Observation #4: It is not feasible to introduce test case with 300Hz Doppler for either FDD or TDD.  Proposal #1: Define TDCP accuracy test case with 100Hz Doppler with 15KHz SCS, 200Hz Doppler for 30KHz SCS.  Proposal #2: Define TDCP accuracy test case at SNR 20dB for both low and high Doppler test case.  Observation #5: With Option 2 we determine X1 and X2 based on baseline 1 sample measurement.  Observation #6: The resulting measurement with filtering or advanced processing should only reduce the variance and still meet the requirement based on X1 X2.  Proposal #3: Define TDCP accuracy test case with the following test metrics:   |  |  |  |  | | --- | --- | --- | --- | | **Doppler** | **SCS (KHz)** | **X1, X2** | **Y (%)** | | 10 | 15 | [0, 6] | 70 | | 10 | 30 | [0, 7] | 70 | | 100 | 15 | [4, 12] | 70 | | 200 | 30 | [4, 12] | 70 | |
| R4-2407459 | Qualcomm Incorporated | Proposal 1: TDCP test cases are defined as follows:  • Test configurations:   * 15kHz SCS based FDD and 30kHz SCS based TDD * TDL-A30 (delay spread = 30ns) * SNR = 20dB for both FDD and TDD * Doppler spread: Down select one case between Case H1 and Case H2 *  Case L: 10Hz for both FDD and TDD *  Case H1: 300Hz for both FDD and TDD *  Case H2: 100Hz for FDD and 200Hz for TDD   • Requirements:   * For Case L: CDP at X1 is higher than 90% *  For 15kHz SCS based FDD, X1 = 1 *  For 30kHz SCS based TDD, X1 = 2 * For Case H1 (if agreed): CDP at X2 is lower than 10% *  For 15kHz SCS based FDD, X2 = 8 *  For 30kHz SCS based TDD, X2 = 4 * For Case H2 (if agreed): CDP at X2 is lower than 10% *  For 15kHz SCS based FDD, X2 = 2 *  For 30kHz SCS based TDD, X2 = 2 |
| R4-2408423 | Samsung | Proposal 1: TC1: low (10Hz) for both 15kHz and 30kHz; TC2: high (300Hz) for both 15kHz and 30kHz.  Proposal 2:  Observation by our results, for report index of SCS30kHz, SNR = 20dB:   * low doppler condition (10Hz), 90% of the reported index is less than 6 (within [0 6]) * high doppler condition (300Hz), 90% of the reported index is larger than 9 (within [9 15]), 10% of the reported index is lower than 9.   To cover most of the results from different companies (summarized in RAN4#109 meeting), a margin is added as:   * low doppler condition, 90% of the reported index is less than 6 (within [0 6]) * high doppler condition, 90% of the reported index is larger than 6 (within [7 15]), 10% of the reported index is lower than 6.   Proposal 3: The statistical testing in RAN5 38.533 can be reused if success ratio is still 90%. |
| R4-2408569 | Huawei, HiSilicon | Proposal 1: The test metric for TDCP is defined as follows:  15 KHz   * 10 Hz doppler:   10 dB SNR: The reported index shall be within [5,13] with 80% pass rate.  20 dB SNR: The reported index shall be within [0,8] with 80% pass rate.   * 300 Hz doppler:   10 dB SNR: The reported index shall be within [8,15] with 80% pass rate.  20 dB SNR: The reported index shall be within [6,15] with 80% pass rate.  30 KHz   * 10 Hz doppler:   10 dB SNR: The reported index shall be within [5,13] with 80% pass rate.  20 dB SNR: The reported index shall be within [0,8] with 80% pass rate.   * 300 Hz doppler:   10 dB SNR: The reported index shall be within [7,15] with 80% pass rate.  20 dB SNR: The reported index shall be within [3,14] with 80% pass rate. |
| R4-2409380 | MediaTek Inc. | Proposal 1: Define TDCP test cases as follows:  - For low doppler, 90% of reported TDCP values should be larger than a certain value (CDF 10% is used to determine the value).  - For high doppler, 90% of reported TDCP values should be less than a certain value (CDF 90% is used to determine the value).  Proposal 2: Define test cases with SNR=20 dB for both lower doppler and higher doppler.  Proposal 3: For test case with higher doppler, use 100Hz for 15kHz SCS and 200Hz for 30kHz SCS. |
| R4-2409629 | Nokia | Observation 1: TDCP spread for 100 Hz for 15 KHz SCS, and 200 Hz for 30 KHz SCS Doppler is about 8 quantization levels.  Proposal 1: Adopt 300 Hz for TC2 (high Doppler case).  Observation 2: TDCP spread for high Doppler case is reduced with 10 dB SNR.  Proposal 2: RAN4 to configure the SNR of test cases as  a. 20 dB for TC1  b. 10 dB for TC2.  Observation 3: Use of 5th and 95th percentiles can result in quantization levels 0 and 15.  Proposal 3: For the test design, define decision levels as  a. Lower Doppler: pass criteria is TCDP > X1 for 90 % of the samples.  b. High Doppler: pass criteria is TCDP < X2 for 90 % of the samples.  c. X1 is defined as quantized maximum value among the 90th percentile among all companies excluding outliers.  d. X2 is calculated as quantized minimum value among the 10th percentile among all companies excluding outliers.  e. A result is considered as outlier if it deviates from the average of the other companies by 3 or more quantization levels. |
| R4-2409720 | Ericsson | Proposal 1: For the test metric, both option 1 and 2 will work well based on the X1 and X2 values. RAN4 to choose between option 1 or 2 based on the values chosen for X1, X2.  Proposal 2: RAN4 to agree on the following test configuration  • Freq: 3.5 GHz  • Doppler and SNR combinations: (10Hz, 20 dB), (300Hz, 10 dB) |

## Open issues summary

### Sub-topic 2-1

[Background]: In RAN4#110-bis meeting, it is agreed as:

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| Agreements for the test case definition:   * Define the same test case for both 15kHz with FDD and 30kHz with TDD in the same sub-clause. * Channel models: TDL-A30 * Doppler:   + Two TCs with low and high Doppler     - TC1: low (10) for both 15kHz and 30kHz     - TC2: high       * Option 1: high (300)       * Option 2: 100 for 15kHz SCS, and 200 for 30kHz SCS   + BW:     - 10MHz for FDD and TDD   + SNR:     - Option 1: 20dB for TC1     - Option 2: 10dB or 20dB for TC2   + The distance between two TRSs: 1 * Report index: Bring CR for both options, make decision in the next meting   + Option 1:     - lower Doppler: CDP at X1 is higher than Y1 = [90] %     - high Doppler: CDP at X2 is lower than Y2= [10] %     - X1, X2, Y1, and Y2 can be different for TDD and FDD   + Option 2:     - [X1, X2] for Y2= FFS |

**Issue 2-1-1: Test metric of TDCP test cases:**

* Proposals

In below table:

Use TC1 for low doppler condition+15kHz SCS FDD

Use TC2 for low doppler condition+30kHz SCS TDD

Use TC3 for high doppler condition+15kHz SCS FDD

Use TC4 for high doppler condition+30kHz SCS TDD

|  |  |  |  |
| --- | --- | --- | --- |
|  | Doppler (Hz) | SNR | Report index |
| Apple | TC1: 10 | 20 | [0, 6] for Y2=70% |
| TC2: 10 | [0, 7] for Y2=70% |
| TC3: 100 | [4, 12] for Y2=70% |
| TC4: 200 | [4, 12] for Y2=70% |
| Qualcomm | TC1: 10 | 20 | CDP is higher than 90% at X1= 1 |
| TC2: 10 | CDP is higher than 90% at X1= 2 |
| Down select from:  300Hz for TC3 and TC4  100Hz for TC3 and 200Hz for TC4 | 300Hz for TC3 and TC4:   * CDP is lower than 10% at   + X2 = 8 (TC3)   + X2 = 4 (TC4)   100Hz for TC3 and 200Hz for TC4:   * CDP is lower than 10% at   + X2 = 2 (TC3)   X2 = 2 (TC4) |
| Samsung | TC1: 10 | 20 |  |
| TC2: 10 | Reported TDCP is less than 6 for 90% tests |
| TC3: 300 |  |
| TC4: 300 | Reported TDCP is higher than 6 for 90% tests |
| Huawei | TC1: 10 | 10 | [5,13] with Y2=80% |
| 20 | [0,8] with Y2=80% |
| TC2: 10 | 10 | [5,13] with Y2=80% |
| 20 | [0,8] with Y2=80% |
| TC3: 300 | 10 | [8,15] with Y2=80% |
| 20 | [6,15] with Y2=80% |
| TC4: 300 | 10 | [7,15] with Y2=80% |
| 20 | [3,14] with Y2=80% |
| MediaTek | TC1:10 | 20 | 90% of reported TDCP values should be larger than a certain value (CDF 10% is used to determine the value). |
| TC2:10 |
| TC3:100 | 90% of reported TDCP values should be less than a certain value (CDF 90% is used to determine the value). |
| TC4:200 |
| Nokia | TC1: 10 | 20 | pass criteria is TCDP > X1 for 90 % of the samples.   * 1. X1 is defined as quantized maximum value among the 90th percentile among all companies excluding outliers. |
| TC2: 10 |
| TC3: 300 | 10 | pass criteria is TCDP < X2 for 90 % of the samples.   * 1. X2 is calculated as quantized minimum value among the 10th percentile among all companies excluding outliers. |
| TC4: 300 |
| Ericsson | TC1: 10 | 20 | Choose one from option 1 and option 2 |
| TC2: 10 |
| TC3: 300 | 10 |
| TC4: 300 |

## Draft CRs

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2407257 | Apple | Draft CR for TDCP mapping |
| R4-2409721 | Ericsson | Draft CR to 38.133 on TDCP tests |

# Topic #3: Other RRM perforamnce requierement

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2407258 | Apple | Observation #1: UE supporting separate TCI should also support joint TCI.  Observation #2: Based on UE capability, tests with separate DL / UL TCI are redundant or will not be used.  Observation #3: If applicability rule is defined as UE supporting both joint and separate TCI are tested for DL and UL TCI state switch, then UE would need to be tested with 2 tests, while it could have been tested with one to verify the same performance.  Based on the above observations, we think only joint TCI state switch case for sDCI mTRP is sufficient.  Proposal #1: Only introduce test cases for sDCI mTRP with joint TCI state switch.  Observation #4: For sDCI transmission scheme, we have only defined requirements for dual TCI state switch.  Observation #5: There are no requirements for single to dual TCI state switch for eUTCI with sDCI.  Proposal #2: Introduce test cases with dual TCI state switch for sDCI mTRP.  Observation #6: The test cases for sDCI mTRP dual TCI switch should be for configurations that don’t require simultaneous reception in DL or simultaneous transmission in UL.  Observation #7: sDCI TDM transmission scheme doesn’t require simultaneous reception in DL  Observation #8: PUSCH repetition scheme doesn’t require simultaneous transmission in UL  Proposal #3: RAN4 introduce performance test cases for sDCI mTRP with joint dual TCI state switch configured with sDCI TDM transmission scheme on DL, PUSCH repetition on UL. |
| R4-2408424 | Samsung | Proposal 1: For UE transmit timing from two TRPs TCs, define different configurations of Test 1/2/3/4 in the same TC.  Test 1: non DRX; RTD<CP  Test 2: non DRX; RTD>CP  Test 3: DRX; RTD<CP  Test 4: DRX; RTD>CP  For UE not support the capability of “rxTimingDiff-r18”, the UE is only required to be tested in Test1 and Test3.  For UE supports the capability of “rxTimingDiff-r18”, the UE is only required to be tested in Test2 and Test4.  Proposal 2: The DL timing is changed for one TRP while another TRP keeps the DL timing unchanged. Or two DL timing are changed for two TRPs with different values.  Proposal 3: For the test configuration of TCI state switching in mTRP, dual TCI state switching can be used. Setup 3 of AoA can be reused as baseline. Two probes of two AoAs are configured in TDM. |
| R4-2409142 | Nokia | Proposal 1: Define the test cases for the two TAs feature including:  a. A setup with two TRPs, each sending its own TA command;  b. An adjustable timing delay between the two TRPs.  Observation 1: There is no need to test MRTD and MTTD requirements. On the other hand, as we will unavoidably have a RTD because the setup will have two TRPs, the test cases need to guarantee that MRTD requirements are not violated.  Proposal 2: As a UE can operate with two TAs only if the RTD does not exceed the MRTD, the test cases for the two TAs feature need to be designed such that the adjustable timing delay between the two TRPs does not violate the MRTD at the UE.  Proposal 3: Define the test cases for the two TAs feature including two MRTD configurations, assuming either MRTD > CP or MRTD = CP; a UE will only run one of the two configurations depending on whether it supports MRTD > CP or MRTD = CP.  Proposal 4: For sDCI mTRP, if a UE supports unified TCI with separate DL/UL TCI states, it is tested only for TC1 (Separate DL TCI state switch) and TC2 (Separate UL TCI state switch).  Proposal 5: For sDCI mTRP, if a UE supports unified TCI only with joint DL/UL TCI states, it is tested only for TC3 (Joint TCI state switch).  Proposal 6: For sDCI mTRP, define a new AoA setup with three active probes.  Proposal 7: For sDCI mTRP, define test cases considering “single to dual” TCI state switching. |
| R4-2409381 | MediaTek Inc. | Proposal 1: Do not define test cases of separate TCI state switching for both DL and UL in sDCI mTRP. |
| R4-2409722 | Ericsson | Proposal 1: sDCI based MAC CE based unified TCI state switching should be tested for joint TCI state switching for single to dual TCI state switching. |

## Open issues summary

### Sub-topic 3-1

**Issue 3-1-1: Test cases for FR2 separate DL/UL TCI state switching**

* Proposals
  + Proposal 1: (Apple, MediaTek)
    - Do not define the test case for FR2 separate DL/UL state switching
  + Proposal 2: (Nokia)
    - Use applicable rules.
      * If UE supports separate DL/UL TCI states, it is tested only for Separate DL TCI state switch and Separate UL TCI state switch
      * If UE supports only joint TCI states, it is tested only for Joint TCI state switch

**Issue 3-1-2: Test configuration of for s-DCI mTRP cases:**

* Proposals
  + Proposal 1: (Apple, Samsung)
    - Dual TCI state switching
      * Proposal 1a: (Apple)
        + TDM transmission scheme for DL
        + PUSCH repetition for UL
  + Proposal 2: (Ericsson, Nokia)
    - Single to dual TCI state switching

**Issue 3-1-3: AoA setup for s-DCI mTRP cases:**

* Proposals
  + Proposal 1: (Samsung)
    - Setup 3 of AoA can be reused as baseline. Two probes of two AoAs are configured in TDM.
  + Proposal 2: (Nokia)
    - Define a new AoA setup with three active probes

**Issue 3-1-4: Test configuration of two TA timing test cases:**

* Proposals
  + Proposal 1: (Samsung)
    - For UE transmit timing from two TRPs TCs, define different configurations of Test 1/2/3/4 in the same TC.
      * Test 1: non DRX; RTD<CP
      * Test 2: non DRX; RTD>CP
      * Test 3: DRX; RTD<CP
      * Test 4: DRX; RTD>CP
    - For UE not support the capability of “rxTimingDiff-r18”, the UE is only required to be tested in Test1 and Test3.
    - For UE supports the capability of “rxTimingDiff-r18”, the UE is only required to be tested in Test2 and Test4.
    - The DL timing is changed for one TRP while another TRP keeps the DL timing unchanged. Or two DL timing are changed for two TRPs with different values.
  + Proposal 2: (Nokia)
    - Define the test cases for the two TAs feature including:
      * a. A setup with two TRPs, each sending its own TA command;
      * b. An adjustable timing delay between the two TRPs.
    - As a UE can operate with two TAs only if the RTD does not exceed the MRTD, the test cases for the two TAs feature need to be designed such that the adjustable timing delay between the two TRPs does not violate the MRTD at the UE.
    - Define the test cases for the two TAs feature including two MRTD configurations, assuming either MRTD > CP or MRTD = CP; a UE will only run one of the two configurations depending on whether it supports MRTD > CP or MRTD = CP.
* Recommended WF
  + Some general rules in Proposal 1 and Proposal 2 are similar. Check CR R4-2407675 and R4-2407776 directly

## Draft CRs

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2407675 | Samsung | Draft CR on test cases of UE transmit timing from two TRPs in FR1 |
| R4-2407776 | vivo | draft CR on test cases for FR2 UE transmit timing from two TRPs |
| R4-2407849 | Xiaomi | DraftCR on TC for MAC CE based DL separate dual TCI state activation in sDCI |
| R4-2408570 | Huawei, HiSilicon | Draft CR on TC for FR1 TCI state switching for mDCI with two TA |
| R4-2409143 | Nokia | TC: sDCI mTRP, FR2 separate UL TCI state switching |
| R4-2409382 | MediaTek Inc. | TC for sDCI MAC-CE based joint dual TCI state switching |

Suggested issues to online discussion:

Issue 3-1-1

Issue 3-1-2

Issue 2-1-1

Issue 3-1-3

Issue 1-2-2

Issue 1-2-1

Issue 1-1-1

Issue 1-1-2