**3GPP TSG-RAN WG4 Meeting # 111 R4-2410138**

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

**Agenda item:** 7.19.4

**Source:** Moderator (Samsung)

**Title:** Ad-hoc minutes for NR\_MIMO\_evo\_DL\_UL WI

**Document for:** Information

# Introduction

This Ad-hoc minutes is to cover the below issues:

# Topic: RRM performance part

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

* Proposals
	+ Proposal 1: (Apple, Samsung)
		- Dual to Dual TCI state switching: ~~4 AoAs and active probes in TDM manner~~
			* Proposal 1a: (Apple)
				+ TDM transmission scheme for DL
				+ PUSCH repetition for UL
	+ Proposal 2: (Ericsson, Nokia)
		- Single to dual TCI state switching

Chair’s session on Monday:

Companies to further check the test feasibility of Proposal 1, and come back to the issue in the Wednesday MIMO adhoc.

**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

Discussion Issue 3-1-2 & Issue 3-1-3 together.

Discussion:

Nokia: we share the similar proposal for 3 active probes.

Nokia: should we specify the table for the exact angular offset.

Ericsson: what we should mentioned is just “3 active probes” but no other.

Apple: we need the relative offset between the probes.

Agreement:

Define the 3 AoA setup with three active probes.

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

Nokia: if the reference signal from two TCIs come from the same probe, then it is possible to have 4 TCIs.

Ericsson: in multi-RX, there are beam pair. But here, we don’t think there is need for beam pair. If there is no need to find the beam pair. It is possible to have 4 probes.

Apple: it is still hard to find the beams even there is no beam pair for UE to meet the RF spherical coverage requirements.

Nokia: for multi-RX, it is much harder. For 3 probes proposal, it can resoved the testability issue and possible.

Agreement:

4 TCIs state in the test.

During T1:

probe 1: TCI#0, RS#0 ~~in active list~~

probe 2: TCI#1, RS#1 ~~in active list~~

During T2

 Probe 1: TCI#2, RS#2

 Probe 3: TCI#3, RS#3

**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

Discussion:

Ericsson: how is RTD> CP test? By configuration?

Samsung: In our CR, there are different timing offset of different configurations.

Agreement:

Define the test cases for the two TAs feature including two MRTD configurations, assuming either MRTD > CP or MRTD < CP

For UE supports the capability of “rxTimingDiff-r18”, the UE is only required to be tested in configuration with RTD>CP.

For UE not support the capability of “rxTimingDiff-r18”, the UE is only required to be tested in configuration with RTD<CP.

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

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

|  |
| --- |
| 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
 |

* 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 TC4100Hz 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 |

Agreement:

* Lower Doppler: reported TDCP index is no bigger than a certain value (e.g., 6), with 90% propability
* Higher Doppler
	+ For TC4, use 300Hz
	+ For TC3, further discuss whether to use 100Hz or 300Hz together with the threshold for the report index.

Discussion:

# Topic: RRM core part maintenance

### Timing requiements for 2 TAs

**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 CFRA

[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:

|  |
| --- |
| [**R1-2212589**](file:///C%3A%5CUsers%5Cyanze.fu%5CAppData%5CLocal%5CTemp%5CDocs%5CR1-2212589.zip) **Moderator Summary #1 on Two TAs for multi-DCI Moderator (Ericsson)**From Nov 14th sessionWorking AssumptionFor 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

AgreementFor 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%3A%5CUsers%5Cyanze.fu%5CAppData%5CLocal%5CTemp%5CDocs%5CR1-2212862.zip) **Moderator Summary #3 on Two TAs for multi-DCI Moderator (Ericsson)**From Nov 17th sessionConclusionFor 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?

Discussion:

Apple: if the coresetPoolindex is not configured, it is not two TAGs.

Ericsson: the DL timing can from the SSB index indication from TRP.

Apple: the DL timing is defined as the DL timing associated with coresetPoolIndex but not the SSB.

Ericsson: coresetPoolIndex is only for PDCCH. Like SRS, there is no coresetPoolIndex association.

Agreement:

* Timing requirements for two TAs are applicable for PUCCH/PUSCH/SRS, intra-cell PDCCH ordered RACH CFRA.
* FFS on inter-cell PDCCH ordered RACH CFRA.
* FFS on other uplink transmission

**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
	+ Proposal 2: Ericsson:
		- corresponding downlink reference signal(s) of the cell associated with one of the activated *DLorJointTCIState* [TS 38.331] with same TAG
* Recommended WF
	+ TBA

Discussion:

Ericsson: remove the association of the coresetPoolIndex.

Apple: there is association of coresetPoolIndex and TAG.

Nokia: the modification of timing requiements are too complicated. Consider how to improve in the draft.

Samsung: maybe by creating additional sub-clause.

Nokia: it might cause other issue. Let’s further check in CR.

**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 $N\_{TA offset}×T\_{c}$ 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 $N\_{TA offset}$ is the first n-TimingAdvanceOffset value,
			* If the PRACH is triggered towards active additional cell PCI, the uplink transmission takes place $N\_{TA offset}×T\_{c}$ 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 $N\_{TA offset}$ is the second n-TimingAdvanceOffset value.

### 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 + $3N\_{slot}^{subframe,µ}$ + TOk-ref (Tfirst-SSB-DLRef + OL\*T SSB-DLRef + 2ms)+NM\*( Tfirst-PL-RS + 4\*Ttarget\_PL-RS + 2ms)
				+ Unknown case: THARQ + $3N\_{slot}^{subframe,µ}$ + 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.