3GPP TSG-RAN WG1 Meeting #110 R1-22xxxxx

Toulouse, France, August 22nd – 26th, 2022

Agenda Item: 9.1.1.2

Source: Moderator (Ericsson)

Title: Moderator Summary on Two TAs for multi-DCI

Document for: Discussion

1 Introduction

During RAN#94e, a new WID for Rel-18 MIMO evolution for DL and UL was agreed [26]. The highlighted Part of objective 7 is relevant for this AI:

1. Study, and if justified, specify the following
	* Two TAs for UL multi-DCI for multi-TRP operation
	* *Power control for UL single DCI for multi-TRP operation where unified TCI framework extension in objective 2 is assumed.*

For the case of simultaneous UL transmission from multiple panels, the operation will only be limited to the objective 6 scenarios.

In this documents, proposals submitted to Agenda 9.1.1.2 are summarized and discussed.

# 2 Two TAGs vs one TAG

In RAN1#109-e, the following agreement was made with regards to how many TAGs to configure within a serving cell:

Agreement

For multi-DCI based multi-TRP operation, down-select one of the two alternatives:

* Alt 1: configure two TAGs within a serving cell
* Alt 2: consider two TAs within one TAG within a serving cell

The following is a summary of company views:

* Support Alt 1 **(19)**: Huawei/HiSilicon, Qualcomm, ZTE, vivo, FUTUREWEI, MediaTek, Apple, Intel, CATT, Ericsson, Xiaomi, Sharp, NTT Docomo, CMCC, Google, Lenovo, TCL, Spreadtrum, Transsion
* Support Alt 2 **(4)**: Samsung, OPPO, Interdigital, NEC
* Defer Decision **(2)**: Nokia/NSB, LGE

*FL Comment: A large majority of companies prefer to support two TAGs per serving cell. Based on this, FL suggestion is to see if we can agree Alt 1.*

***Proposal 1: For multi-DCI based multi-TRP operation with two TAs, support configuring two TAGs within a serving cell.***

*Companies are asked to provide their views below:*

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| **Company Name** | **Comments** |
| Google | We support FL’s proposal.  |
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# 3 Two TACs vs One TAC

In RAN1#109-e, the following agreement was made with regards to how many TACs the network signals:

Agreement

Enhancement on two TAs for UL multi-DCI for multi-TRP operation is supported in Rel-18.

Note 1: whether (1) the network signals two TACs or (2) the network signals one TAC and the UE deriving the second TA can be further studied.

Note 2: evaluations can be considered on as-needed basis.

The following is a summary of the proposals from different companies:

* Support network signalling of two TACs **(7)**: Qualcomm, Ericsson, ZTE, CATT, CMCC, NEC, Transsion
* Support network signalling one TAC and UE deriving the second TA **(2)**: Samsung, vivo

*FL Comment: One open question is whether we should study or support the possibility of network signaling one TAC and the UE deriving the second TA. One scenario mentioned by vivo [2] for allowing the UE to derive the second TA is the case where 2nd TRP has associated PUCCH transmission but does not have SRS/PUSCH transmission.*

*This issue depends on the outcome of Proposal 1 and can be discussed once Proposal 1 is resolved.*

# 4 Two vs One reference timing

In RAN1#109-e, the following agreement was made with regards to how many reference timings are to be considered:

Agreement

For multi-DCI multi-TRP operation with two TAs, study the following alternatives:

* Alt 1:  two reference timings are considered
* Alt 2:  one reference timing is considered

Note: reference timing above is the timing of the DL reception

The following is a summary of company views:

* Support Alt 1 **(13)**: Huawei/HiSilicon, Qualcomm, Nokia/NSB, vivo, Futurewei, Apple, Ericsson, Xiaomi, Sharp, CMCC, Interdigital, TCL, Transsion
* Support Alt 2 **(9)**: ZTE, Samsung, MediaTek, OPPO, LGE, CATT, NTT Docomo, NEC, Spreadtrum

*FL Comment: There is no strong majority support for either alternatives. FL would like to ask companies comment on if they have strong concerns on either Alt 1 or Alt 2. Please provide technical reason for your concern.*

***Question: Companies are asked to comment if they have strong concerns on either Alt 1 or Alt 2. Please provide technical reason for your concern.***

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| **Company Name** | **Comments** |
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# 5 Two vs One Timing Advance Offset

In RAN1#109-e, the following agreement was made with regards to how many *n-TimingAdvanceOffset* values per serving cell are to be considered in Rel-18:

Agreement

For multi-DCI multi-TRP operation with two TAs, study the following alternatives further in Rel-18:

* Alt 1: one *n-TimingAdvanceOffset* value per serving cell
* Alt 2: two *n-TimingAdvanceOffset* value per serving cell

Company views are summarized as follows:

* Support Alt 1 **(12)**: Nokia/NSB, vivo, Samsung, Futurewei, OPPO, LGE, CATT, Ericsson, Xiaomi, Sharp, NTT Docomo, Spreadtrum
* Support Alt 2 **(6)**: Huawei/HiSilicon, Qualcomm, Apple, ZTE, NEC, TCL

*FL comment: Proponents of Alt 1 argue that the same duplex mode and frequency range are expected in a multi-DCI multi-TRP scenario and hence one n-TimingAdvanceOffset* *is sufficient. Some proponents of Alt 2 argue that the duplex mode may be different between the two TRPs involved in multi-DCI multi-TRP operation.*

***Question: Companies are asked to provide their view on the following:***

* ***Are there use cases why two n-TimingAdvanceOffset values per serving cell are needed?***

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# 6 Association between TAs and UL channels/signals

In RAN1#109-e, the following agreement was made:

Agreement

**Two TA enhancement for uplink multi-DCI based multi-TRP operation are applicable to** at least**:**

* **TDM based multi-DCI uplink transmission**
* **simultaneous multi-DCI uplink transmission (if simultaneous uplink multi-DCI uplink transmission is supported in Agenda 9.1.4.1)**
* **Note: Whether two TA enhancement is applicable to other schemes is a separate discussion, which is not in the scope of AI 9.1.1.2.**

***FL Comment: One open issue is how to associate each TA to UL channels/signals. Two different options were proposed by multiple companies:***

Option 1: Associate TA to TCI-state/spatial relation **(10 companies)**

 Supported by Huawei/HiSilicon, Samsung, MediaTek, LGE, ZTE, Intel, CATT, Ericsson, Google, Transsion

Option 2: Associate TA to CORESETPoolIndex **(8 companies)**

Supported by Qualcomm, ZTE, vivo, Apple, Xiaomi, Lenovo, Spreadtrum, Transsion

*Taking into account the above input, the following is proposed:*

***Proposal 2: For associating TAs to UL channels/signals for multi-DCI based multi-TRP operation, downselect one of the options:***

* ***Option 1: Associate TA to TCI-state/spatial relation***
* ***Option 2: Associate TA to CORESETPoolIndex***

***FFS: detailed association (e.g., whether implicit association or explicit association)***

*Companies are asked to provide their views below:*

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| **Company Name** | **Comments** |
| Google | We support Option 1. It’s not clear to us how Option 2 can work for some preconfigured UL channels/RSs (i.e., those not scheduled/triggered by CORESETs). Regarding detailed association, we believe it falls into RAN2’s expertise no matter which option is agreed finally.  |
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# 7 Overlap Handling

Several companies discuss the issue of how to handle overlapping of two consecutive UL slots when two different TA values are used in multi-DCI multi-TRP operation:

* Huawei/HiSilicon [9] propose to introduce scheduling constraint in time domain to avoid overlap of two consecutive UL slots with different TA values
* Qualcomm [5] proposes to study further how to address the case when two different UL signals/channels overlap in time due to multi-TRP operation with two TAs.
* ZTE [1] proposes to introduce scheduling restriction gap in which UE does not expect to transmit any UL signals/channels
* ZTE [1] further proposes to reduce the transmission duration of one of the slots rather than shortening the later slot as in legacy.
* vivo [2] proposes to study how to handle overlapped channels/signals due to two TAs applied to different TRPs
* CATT [3] proposes similar dropping rule as legacy when the UE supports TDM multi-DCI based PUSCH transmission. CATT proposes to allow overlapped transmission in case the UE supports NR Rel-18 STxMP transmission.
* NEC [19] supports a time gap between consecutive PUSCH transmission occasions applying different TAs.

*Based on the input, the following is proposed:*

***Proposal 3: For multi-DCI based multi-TRP operation with two TAs, study how to handle overlapping part in consecutive UL slots, where the study includes:***

* ***whether to introduce scheduling restriction in overlapping part in consecutive UL slots***
* ***whether to introduce dropping rules***
* ***whether specification impact is need, or if the issue can be handled via implementation***
* ***whether to allow overlapped transmission in case the UE supports STxMP transmission (if STxMP feature is agreed in NR Rel-18)***

*Companies are asked to provide their views below.*

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| **Company Name** | **Comments** |
| Google | We support FL’s proposal.  |
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# 8 Timing Alignment Timers

Several companies propose to support separate timing alignment timers per TRP when two different TA values are used in multi-DCI multi-TRP operation:

* ZTE [1] proposes support for configuring time alignment timer per TRP for TAGs within a serving cell
* OPPO [23] proposes to support up to 2 TA *TimeAlignmentTimer*’s for multi-TRP within a TAG
* Google [18] proposes two time alignment timers corresponding to two TA values are separately configured for a serving cell

*Based on the input, the following is proposed:*

***Proposal 4: For multi-DCI based multi-TRP operation with two TAs, support two time alignment timers corresponding to the two TAs***

* ***FFS: configuration details***

*Companies are asked to provide their views below.*

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| **Company Name** | **Comments** |
| Google | We support FL’s proposal. However, to make it clear, we suggest the following revision. ***Proposal 4: For multi-DCI based multi-TRP operation with two TAs, support two time alignment timers corresponding to the two TAs for a serving cell**** ***FFS: configuration details***
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# 9 Impact on PDCCH order

Several companies propose studying potential impact of two TAs for multi-DCI multi-TRP scenario on PDCCH order.

* Qualcomm [5] proposes to study the impact of two TAs per CC to RACH triggered by PDCCH order
* Nokia/NSB [4] mention two possibilities for multi-TRP multi-DCI with two TAs:
	1. Allowing a PDCCH order from a first TRP to trigger PRACHs towards the two TRPs at a time
	2. Allowing TRP specific PDCCH order where each TRP can send a corresponding PDCCH order to trigger PRACH transmission towards that TRP
* ZTE [1] proposes to support PDCCH order based random access as starting point
* vivo [2] proposes to support TRP-specific RACH triggered by PDCCH order for both intra-cell and inter-cell mTRP
* NTT Docomo [15] proposes that PDCCH ordered RACH can be triggered to obtain per TRP TA
* Futurewei [8] proposes to support PDCCH order triggering PRACH transmission to obtain second TA
* OPPO [23] proposes to support updating TA per TRP in CFRA procedure where TRP is indicated implicitly through CORESETPoolIndex that transmits PDCCH order
* CATT [3] proposes PDCCH order triggering to acquire 2nd TA corresponding to 2nd TRP

*Based on the input, the following is proposed:*

***Proposal 5: For multi-DCI based multi-TRP operation with two TAs, study impact of two TAs per serving cell to RACH triggered by PDCCH order.***

* ***Further details of enhancements needed (if any)***

*Companies are asked to provide their views below.*

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| **Company Name** | **Comments** |
| Google | We support FL’s proposal.  |
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# 10 Other Issues

If there are other issues which are not captured in the previous sections, companies are welcome to propose them in the following table. Based on interest and time-permitting, we can try to discuss a subset of the issues during meeting week.

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| **Company Name** | **Comments** |
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# 11 References

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[2] R1-2206025, vivo, “Discussion on two TAs for multi-DCI-based multi-TRP operation”, RAN1#110, August 2022.

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[5] R1-2207216, Qualcomm Incorporated, “Supporting two TAs for multi-DCI based mTRP”, RAN1#110, August 2022.

[6] R1-2206867, LG Electronics, “Two TAs for multi-TRP panel”, RAN1#110, August 2022.

[7] R1-2206811, Samsung, “Views on two TAs for m-DCI”, RAN1#110, August 2022.

[8] R1-2205748, FUTUREWEI, “Enhancements to support two TAs for multi-DCI”, RAN1#110, August 2022.

[9] R1-2205880, Huawei, HiSilicon, ”Study on TA enhancement for UL M-TRP transmission”, RAN1#110, August 2022.

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[18] R1-2206485, Google, “Discussion on two TAs for multi-DCI”, RAN1#110, August 2022.

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[23] R1-2206264, OPPO, “Two TAs for multi-DCI”, RAN1#110, August 2022.

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