3GPP TSG RAN WG1 #102 R1-200xxxx

e-Meeting, August 17th – 28th, 2020

Source: Moderator (OPPO)

Title: Discussion in Email Thread #6

Agenda Item: 7.2.6

Document for: Discussion and Decision

1. Introduction

Rel-16 enhancement on MIMO WID includes objectives of enhancing multi-TRP/Panel transmission with ideal and non-ideal backhaul. During the work of rel-16, designs for multiple-PDCCH based and single-PDCCH based multi-TRP/Panel transmission were discussed and specified. This document provides the discussion eMIMO email thread#4:

* [102-e-NR-eMIMO-06] Default QCL for AP CSI-RS

# Default TCI state for AP CS-RS in multi-TRP

2.1 Multi-DCI based system

vivo [1], ZTE [2], Apple [9], NTT DOCOMO [14], Qualcomm [15], Nokia [16] provided proposal for determining the default QCL for AP CSI-RS when the scheduling offset is less than threshold in multi-DCI based M-TRP system. While, LGE [11] suggest that we shall discuss default beam behavior of AP CSI-RS in Rel-17.

Based on the proposals in those contributions, a draft proposal for AP CSI-RS resource in multi-DCI based multi-TRP system is provided:

**Proposal 1: In multi-DCI based multi-TRP system, if the scheduling offset between the last symbol of the PDCCH carrying the triggering DCI and the first symbol of the aperiodic CSI-RS resources is less than threshold *beamSwitchTiming*, the UE determines the QCL assumption for AP CSI-RS resource as follows:**

* **If there is any other DL signal with indicated TCI state in the same symbols as the AP CSI-RS and the other DL signal is associated with the same *CORESETPoolIndex* as the PDCCH triggering the AP CSI-RS, the UE shall apply the QCL assumption of the indicated TCI state of the other DL signal.**
* **Otherwise, the UE applies the default PDSCH TCI state in multi-DCI system, i.e., the QCL parameter(s) of the CORESET associated with a monitored search space with the lowest *controlResourceSetId* among CORESETs, which are configured with the same value of *CORESETPoolIndex* as the PDCCH triggering that AP CSI-RS, in the latest slot in which one or more CORESETs associated with the same value of CORESETPoolIndex as the PDCCH triggering that Ap CSI-RS.**
* **Note: The above behaviour is only applied to a UE supporting the feature of default QCL assumption per *CORESETPoolIndex*. For a UE not supporting the feature of default QCL assumption per *CORESETPoolIndex*, rel15 behaviour is applied.**

**Please input your views and comments on the draft proposal:**

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| Company | Views and comments |
| MediaTek | Support |
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2.2 Single-DCI based system

vivo [1], ZTE [2], Apple [9], Ericsson [12], NTT DOCOMO [14], Qualcomm [15] and Nokia [16] proposed solution for determining the default QCL for AP CSI-RS when the scheduling offset is less than threshold in single-DCI based M-TRP system. And LGE[11] suggests to discuss that in rel17.

The proposals in the contributions [1][2][9][12][14][15] and [16] diverged. Different methods are proposed for both cases of when there is other known DL signal with indicated TCI states and when there is no other known DL signals with indicated TCI state(s). The methods proposed in the contributions are summarized in the following alternatives listed in the following draft proposal 2.

**Proposal 2: In singe-DCI based multi-TRP system if the scheduling offset between the last symbol of the PDCCH carrying the triggering DCI and the first symbol of the aperiodic CSI-RS resources is less than threshold *beamSwitchTiming*, the UE determines the QCL assumption for AP CSI-RS resource as follows**

* **If there is any other DL signal with indicated TCI state in the same symbols as AP CSI-RS:**
  + **Alt-a1: The UE applies the TCI-state(s) of the other signal to buffer the AP CSI-RS. When the other signal is a PDSCH with one or two TCI states: if the indicated TCI state is same one of the indicated TCI-state(s) of the other signal, the UE use the indicated TCI state to measure CSI; otherwise, the UE use the 1st of the TCI state(s) of other signal to measure CSI**
    - vivo, NTT DOCOMO
  + **Alt-a2: The UE applies QCL assumption of the other signal. When the other signal is a PDSCH indicated with two TCI states, the UE applies the first TCI state of those two TCI states.**
    - ZTE, Nokia
  + **Alt-a3: The UE applies QCL assumption of the other signal. When the other signal is a PDSCH with two TCI states, if the PDSCH is scheme 1a/2a/2b, the UE applies the 1st TC state on AP CSI-RS with odd Id and 2nd TCI state on AP CSI-RS with even Id; if the PDSCH is scheme 3/scheme 4, the UE applies the QCL assumption of the overlapping PDSCH occasion.**
    - Ericsson**.**
* **Otherwise**
  + **Alt-b1: The UE applies the two TCI states corresponding to the lowest DCI codepoint among those mapped to two TCI states.**
    - Apple
  + **Altb-b2: The UE uses the two TCI states corresponding to the lowest DCI codepoint among those mapped to two TCI states buffer the AP CSI-RS resource. If the indicated TCI state is same to one of those two default TCI states, the UE use the AP CSI-RS buffered with the indicated TCI state to measure CSI; otherwise, the UE use the AP CSI-RS buffered with the 1st default TCI state to measure CSI.**
    - vivo, NTT DOCOMO
  + **Alt-b3: If the indicated TCI sate for AP-CSI-RS is same to one those two default PDSCH TCI states, the UE applies the TCI state indicated by the DCI; otherwise, the UE applies the first of those two default DPSCH TCI states.**
    - ZTE
  + **Alt-b4: For AP CSI-RS resource with Odd Id, the UE applies the first one of those two default PDSCH TCI states. For AP CSI-RS with Even Id, the UE applies the second one of those two default PDSCH TCI states.**
    - Ericsson.
  + **Alt-b5: The UE applies the indicated TCI state which is identical to one of default PDSCH TCI states, i.e., those two TCI states corresponding to the lowest DCI codepoint among the TCI codepoints mapped to two TCI states.**
    - Qaulcomm
  + **Alt-b6: The UE applies the first one of two TCI states corresponding to the lowest DCI codepoint among those mapped to two TCI states.**
    - Nokia

Please input your views and comments on those alternatives:

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| Company | Views and comments |
| MediaTek | If there is any other DL signal with indicated TCI state, our first preference is Alt-a1, and Alt-a2 is our second preference. Nevertheless, distinguishing “buffer” and “measure” is less important to us.  Our understanding is that when Alt-a1 or Alt-a2 is applied to a TDM scheme, the other signal would be one PDSCH transmission occasion and thus there is only one TCI state. If it is not a common understanding, we may consider the following based on Alt-a3:  **The UE applies QCL assumption of the other signal. When the other signal is a PDSCH with two TCI states:**  **1) For schemes 1a/2a/2b, if the indicated TCI state is same one of the indicated TCI-state(s) of the other signal, the UE applies the indicated TCI state; otherwise, the UE use the 1st of the TCI state(s) of other signal;**  **2) For schemes 3/4, the UE applies the QCL assumption of the overlapping PDSCH transmission occasion.**  If there is no other DL signal with indicated TCI state, our first preference is Alt-b3. Also, Alt-b2, Alt-b5, Alt-b6 are acceptable. |
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1. Reference
2. [R1-2005354](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_102\Docs\R1-2005354.zip) Remaining issues on Multi TRP operation vivo
3. [R1-2005451](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_102\Docs\R1-2005451.zip) Maintenance of Multi-TRP enhancements ZTE
4. [R1-2005819](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_102\Docs\R1-2005819.zip) Maintenance on multi-TRP operation Lenovo, Motorola Mobility
5. [R1-2005853](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_102\Docs\R1-2005853.zip) Corrections to multi TRP Intel Corporation
6. [R1-2005975](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_102\Docs\R1-2005975.zip) Text proposals for enhancements on multi-TRP and panel Transmission OPPO
7. [R1-2006117](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_102\Docs\R1-2006117.zip) On Rel.16 multi-TRP/panel transmission Samsung
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10. [R1-2006494](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_102\Docs\R1-2006494.zip) Remaining issues on Multi-TRP enhancement Apple
11. [R1-2006588](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_102\Docs\R1-2006588.zip) Discussion on remaining issues of multi-TRP/panel transmission CATT
12. [R1-2006593](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_102\Docs\R1-2006593.zip) Text proposals on enhancements on multi-TRP/panel transmission LG Electronics
13. [R1-2006688](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_102\Docs\R1-2006688.zip) Remaining issues on single-DCI based Multi-TRP Ericsson
14. [R1-2006689](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_102\Docs\R1-2006689.zip) Remaining issues on multi-DCI based Multi-TRP Ericsson
15. [R1-2006700](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_102\Docs\R1-2006700.zip) Remaining issues on multi-TRP/panel transmission NTT DOCOMO, INC.
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17. [R1-2006842](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_102\Docs\R1-2006842.zip) Maintenance of Rel-16 Multi-TRP operation Nokia, Nokia Shanghai Bell