3GPP TSG RAN WG1 #104-e R1-210xxxx

e-Meeting, January 25th – February 5th, 2021

Source: Moderator (OPPO)

Title: Discussions on Issue MT.4

Agenda Item: 7.2.6

Document for: Discussion and Decision

The Issue of MT.4

Apple (R1-2101349) discussed the issue QCL restriction of PDSCH and SSB on the same symbol. In Rel-15, it is specified that the gNB shall ensure that the PDSCH and SSB are QCLed with respect to QCL-TypeD if they are multiplexed in the same symbol, which is specified in the TS 38.214. In M-DCI based mTRP, two PDSCHs could be overlapped in same symbol but with different TCI states and in S-DCI based mTRP, the DMRS of multi-TRP PDSCH could have two different TCI states and thus two different QCL properties. Thus, the text description in current 38.214 would imply that the gNB shall ensure both overlapped PDSCHs are QCLed with the SSB or both of those different TCI states shall be QCLed with the SSB. That restriction could cause some problem. Therefore, Apple proposed to revise the specification in 38.214 considering the multi-TRP PDSCH transmission. Particularly, it is proposed to specify the gNB only need to ensure at least one QCL of the PDSCH are same to that of the SSB, instead of all the PDSCH QCL.

## **Round#1 discussion**

Based on the proposal by Apple, here is the initial proposal for MT.4

**Proposal: Adopt the following TP for 38.214.**

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| 5.1.6.2 DM-RS reception procedure \*\*\* Unchanged text is omitted \*\*\*  If the UE receives the DM-RS for PDSCH and an SS/PBCH block in the same OFDM symbol(s), then the UE may assume that at least one DM-RS port and SS/PBCH block are quasi co-located with 'QCL-TypeD', if 'QCL-TypeD' is applicable. Furthermore, the UE shall not expect to receive DM-RS in resource elements that overlap with those of the SS/PBCH block, and the UE can expect that the same or different subcarrier spacing is configured for the DM-RS and SS/PBCH block in a CC except for the case of 240 kHz where only different subcarrier spacing is supported.  \*\*\* Unchanged text is omitted \*\*\* |

If you have comments, please input below

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| Company | comments |
| QC | Is “one DMRS port” referring to the DMRS in the beginning of the sentence? Does the TP address the case of multi-DCI? i.e., If we have PDSCH1 and PDSCH2 both overlapping with the SSB, the TP above cannot be applied to both PDSCHs. |
| OPPO | We have similar question as QC that whether the TP is applied to both S-DCI and M-DCI based M-TRP? |
| Apple | This “one DMRS port” indicates the one DMRS port from both PDSCH1 and PDSCH2 in QC’s example.  It is applied for both sDCI and mDCI.  To address QC and OPPO’s concern, we can add additional change as follows: 5.1.6.2 DM-RS reception procedure \*\*\* Unchanged text is omitted \*\*\*  If the UE receives the DM-RS for PDSCH(s) and an SS/PBCH block in the same OFDM symbol(s), then the UE may assume that at least one DM-RS port from the PDSCH(s) and SS/PBCH block are quasi co-located with 'QCL-TypeD', if 'QCL-TypeD' is applicable. Furthermore, the UE shall not expect to receive DM-RS in resource elements that overlap with those of the SS/PBCH block, and the UE can expect that the same or different subcarrier spacing is configured for the DM-RS and SS/PBCH block in a CC except for the case of 240 kHz where only different subcarrier spacing is supported.  \*\*\* Unchanged text is omitted \*\*\* |
| MediaTek | Support Apple’s updated TP |
| DOCOMO | Support Apple’s latest revision. |
| Huawei, HiSilicon | The latest change from Apple’s seems to be fine to us, in principle. In our understanding, for the case of Multi-DCI with overlapped PDSCHs and SSB in the same symbol, how to assume given TCI (associated DMRS ports) is up to the UE, from either PDSCH 1 or PDSCH 2. It seems to be the same concept with single-DCI based with two TCI states, with regarding to type D assumption at the UE side. |
| Nokia, NSB | We understand the concern discussed here but do not clearly see the above TPs solving it.  First, it is hard to capture both single DCI and Multi-DCI scenarios with the text mentioning “DMRS for PDSCH(s)”. As you may refer to in the other parts of the spec, these modes have very specific text when the spec describes behaviors.  Second, we should make sure legacy behavior is not impacted.  Third, we should first try to understand what exactly should be covered in an agreement than trying TPs to make things clearer. |
| Samsung | Our view is that Apple’s latest version is fine for us and it can include all cases: multi-TRP transmission (multi-DCI and single-DCI) and single-TRP transmission. However, as Nokia mentioned, since the spec includes the specific text for multi-DCI or single-DCI cases, including the specific text is also fine for us. |
| ZTE | The clarification is good for us. We support the updated TP. |
| vivo | We have similar feeling as Nokia that even the latest update is unclear. After reading the updated proposal, the legacy QCL assumption of DMRS for PDSCH is changed to not mandating all DMRS ports have same QCL as SSB when the DMRS and SSB are in the same symbol. This is obviously different from Rel-16 behavior.  One option is not to update anything, which implies   * For M-DCI-based MTRP, the DMRS for PDSCH from one of the TRPs cannot overlap with SSB. * For S-DCI-based MTRP, the DMRS for PDSCH of scheme 1a, 2a/2b cannot overlap with SSB either.   We can make a conclusion in this meeting. And we think any other updates are optimization for MTRP. |
| LG | We have similar view with vivo. The current specification is not broken, and it seems that the TP provides optimization for MTRP. |
| Ericsson | We have similar views as vivo and LG. |
| Spreadtrum | Share the same view with VIVO, LG and Ericsson. The TP seems to be one optimization not essential. |

## **Round#2 discussion**

From the round #1 dicussion, the updated TP by Apple are supported by MediaTek, DOCOMO, Huawei, HiSilicon, Samsung, ZTE, OPPO, QC(?) OPPO (?) but Nokia, vivo, LG, Ericsson, Spreadtrum do not support it.

From my understanding, if we do not update the spec, the spec would impose the following restriction to the system:

* In M-DCI mTRP system, when two PDSCHs from two different TRP overlap with an SS/PBCH block in the same OFDM symbol, the gNB shall ensure both PDSCHs are QCLed with that SS/PBCH block.
* In S-DCI mTRP system, when one PDSCH with two TCI states overlap with an SS/PBCH block in the same OFDM symbol, the gNB shall ensure both TCI states are QCLed with that the SS/PBCH block.

Those seems to be big limitation on scheduling. The updated TP by Apple seems to be feasible way forward. Thus the updated TP is porposed for further discussion.

**Proposal: Adopt the following TP for 38.214.**

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| 5.1.6.2 DM-RS reception procedure \*\*\* Unchanged text is omitted \*\*\*  If the UE receives the DM-RS for PDSCH(s) and an SS/PBCH block in the same OFDM symbol(s), then the UE may assume that at least one DM-RS port from the PDSCH(s) and SS/PBCH block are quasi co-located with 'QCL-TypeD', if 'QCL-TypeD' is applicable. Furthermore, the UE shall not expect to receive DM-RS in resource elements that overlap with those of the SS/PBCH block, and the UE can expect that the same or different subcarrier spacing is configured for the DM-RS and SS/PBCH block in a CC except for the case of 240 kHz where only different subcarrier spacing is supported.  \*\*\* Unchanged text is omitted \*\*\* |

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| Company | comments |
| Apple | To address Nokia’s concern, we provided the following alternative TP. Either TP is fine to us.  If we keep current restriction, gNB cannot schedule mTRP based PDSCH for many slots – almost all slots with SSB. Usually the two PDSCHs should be received by different beams. 5.1.6.2    DM-RS reception procedure \*\*\* Unchanged text is omitted \*\*\*  If the UE receives the DM-RS for PDSCH and an SS/PBCH block in the same OFDM symbol(s), then the UE may assume that the DM-RS and SS/PBCH block are quasi co-located with 'QCL-TypeD', if 'QCL-TypeD' is applicable. Furthermore, the UE shall not expect to receive DM-RS in resource elements that overlap with those of the SS/PBCH block, and the UE can expect that the same or different subcarrier spacing is configured for the DM-RS and SS/PBCH block in a CC except for the case of 240 kHz where only different subcarrier spacing is supported.  If at least one TCI codepoint indicates two TCI states and the UE receives the DM-RS for PDSCH and an SS/PBCH block in the same OFDM symbol(s), then the UE may assume that at least one DM-RS port for the PDSCH and SS/PBCH block are quasi co-located with 'QCL-TypeD', if 'QCL-TypeD' is applicable.  If the UE is configured by higher layer parameter *PDCCH-Config* that contains two different values of *CORESETPoolIndex* in different *ControlResourceSets*, and the UE receives the DM-RS for PDSCH(s) and an SS/PBCH block in the same OFDM symbol(s), then the UE may assume that at least one DM-RS port for the PDSCH(s) and SS/PBCH block are quasi co-located with 'QCL-TypeD', if 'QCL-TypeD' is applicable.  \*\*\* Unchanged text is omitted \*\*\* |
| CATT | Support Apple’s update in principle. |
| Nokia, NSB | Looks ok. |
| QC | Both TPs (the TP in proposal and latest one suggested by Apple) would be fine to us. |
| Lenovo/MotM | Apple’s updated TP looks good to us. |
| Spreatrum | The update is fine to us. |
| vivo | Just one question on M-DCI based MTRP case, why “the UE may assume that at least one DM-RS port for the PDSCH(s) and SS/PBCH block are quasi co-located with 'QCL-TypeD'”?  In our understanding, for M-DCI based MTRP the DMRS for the PDSCH scheduled by one TRP can be QCLed with the SSB. So can we change it to:  If the UE is configured by higher layer parameter PDCCH-Config that contains two different values of CORESETPoolIndex in different ControlResourceSets, and the UE receives the DM-RS for PDSCH(s) and an SS/PBCH block in the same OFDM symbol(s), then the UE may assume that the DM-RS port for the PDSCH(s) associated with at least one value of coresetPoolIndex and SS/PBCH block are quasi co-located with 'QCL-TypeD', if 'QCL-TypeD' is applicable. |

## **Final Proposal**

The final proposal is:

**Proposal: Adopt the following TP for 38.214.**

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| 5.1.6.2 DM-RS reception procedure \*\*\* Unchanged text is omitted \*\*\*  If the UE receives the DM-RS for PDSCH and an SS/PBCH block in the same OFDM symbol(s), then the UE may assume that the DM-RS and SS/PBCH block are quasi co-located with 'QCL-TypeD', if 'QCL-TypeD' is applicable. Furthermore, the UE shall not expect to receive DM-RS in resource elements that overlap with those of the SS/PBCH block, and the UE can expect that the same or different subcarrier spacing is configured for the DM-RS and SS/PBCH block in a CC except for the case of 240 kHz where only different subcarrier spacing is supported.  If at least one TCI codepoint indicates two TCI states and the UE receives the DM-RS for PDSCH and an SS/PBCH block in the same OFDM symbol(s), then the UE may assume that at least one DM-RS port for the PDSCH and SS/PBCH block are quasi co-located with 'QCL-TypeD', if 'QCL-TypeD' is applicable.  If the UE is configured by higher layer parameter PDCCH-Config that contains two different values of CORESETPoolIndex in different ControlResourceSets, and the UE receives the DM-RS for PDSCH(s) and an SS/PBCH block in the same OFDM symbol(s), then the UE may assume that at least one DM-RS port for the PDSCH(s) and SS/PBCH block are quasi co-located with 'QCL-TypeD', if 'QCL-TypeD' is applicable.  \*\*\* Unchanged text is omitted \*\*\* |