**3GPP TSG RAN WG1 #109-e R1-220xxxx**

**e-Meeting, May 9th – 20th, 2022**

**Source: Moderator (Intel Corporation)**

**Title: Moderator Summary for Rel. 17 NR FeMIMO Maintenance on HST**

**Agenda item: 8.1.2**

**Document for: Discussion and Decision**

# Introduction

The document contains summary of maintenance issues and text proposals (TPs) on enhancements for HST-SFN deployment based on the following email thread assignment:

[109-e-R17-MIMO-06] Maintenance on HST (description of issues in R1-220XXXX) – Avik (Intel)

* Issues 1, 2, 8 and 9 by May 18
* Editorial Issue 11 by May 11

The summary of the preparation phase with description of issues can be found in **R1-2205145**. The following is the summary of high priority issues 1, 2, 8 and 9 and editorial 11 identified during the preparation phase.

# High Priority Issues

* 1. Issue 1

This issue is for capturing agreements stating combination of SFN PDCCH scheme 1 and single-TRP PDSCH is supported, and the combination of SFN PDCCH TRP-based pre-compensation and single-TRP PDSCH is not supported. The following is the summary if issue 1 from the preparation phase.

**Table 1 Summary of Issue 1**

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| **#** | **Issue (summary of CR proposal)** | **Company inputs (if any)** |
|  | In 38.214 Section 5.1, capture agreements stating combination of SFN PDCCH scheme 1 and single-TRP PDSCH is supported, and the combination of SFN PDCCH TRP-based pre-compensation and single-TRP PDSCH is not supported   * Alt-1: TP to capture related behavior in R1-2203506 (vivo), R1-2203302 (Spreadtrum)   + *If a UE is configured with sfnSchemePdcch set to 'sfnSchemeA' for a DL BWP and activated with two TCI states by MAC CE, and the UE does not report its capability of [nonSfnPdsch-sfnPdcch], the UE does not expect to be indicated with one TCI state in a codepoint of the DCI field 'Transmission Configuration Indication' in DCI format 1\_1/1\_2.*   + *If a UE is configured with sfnSchemePdcch set to 'sfnSchemeB' for a DL BWP and activated with two TCI states by MAC CE, the UE does not expect to be indicated with one TCI state in a codepoint of the DCI field 'Transmission Configuration Indication' in DCI format 1\_1/1\_2.* * Alt-2: TP to capture related behavior in R1-2204977 (Qualcomm)   + *If a UE is configured with sfnSchemePdcch set to 'sfnSchemeA' for a DL BWP and CORESET is activated with two TCI states by MAC CE, and the UE does not report its capability of [nonSfnPdsch-sfnPdcch], the UE shall be configured with sfnSchemePdsch set to 'sfnSchemeA'.*   + *If a UE is configured with sfnSchemePdcch set to 'sfnSchemeB' for a DL BWP and CORESET is activated with two TCI states by MAC CE, the UE shall be configured with sfnSchemePdsch set to 'sfnSchemeB'.*   FL Note: This issue was extensively discussed in the last meeting. Since the agreements do not seem to be reflected in current specification, it seems to be a valid issue. Companies can provide further inputs along with preference of TPs proposed in the alternatives. | **Alt-1:**   * **Support:** vivo, Spreadtrum, Apple, OPPO, Huawei/HiSi, Ericsson, Xiaomi, ZTE, CATT, Samsung, DOCOMO, Lenovo * **Not Support:**   **Alt-2:**   * **Support:** Qualcomm * **Not Support:** |

### Round-1

Given the summary from the preparation phase, Alt-1 seems to be the super-majority view. Therefore, the following is the FL proposal for this round based on the TP provided in R1-2203506:

**TP#1:**

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| **TS 38.214**  **5.1 UE procedure for receiving the physical downlink shared channel**  < Unchanged parts are omitted >  When a UE is configured with higher layer parameter *sfnSchemePdsch* set to either *'*sfnSchemeA*'* or *'*sfnSchemeB*'* for a DL BWP and  - if the UE reports its capability of [*dynamicSFN*], the UE is indicated with one or two TCI state(s) in a codepoint of the DCI field *'Transmission Configuration Indication'* in DCI format 1\_1/1\_2, or  - otherwise, the UE is not expected to be indicated with one TCI state per any of TCI codepoint by MAC CE, and the UE is indicated with two TCI states in a codepoint of the DCI field *'Transmission Configuration Indication'* in DCI format 1\_1/1\_2, and  the UE procedure for receiving the PDSCH upon detection of a PDCCH follows clause 5.1 and the QCL assumption for the PDSCH as defined in clause 5.1.5.  When a UE is configured with both *sfnSchemePdsch* and *sfnSchemePdcch*, the UE shall expect that *sfnSchemePdsch* and *sfnSchemePdcch* are set to the same scheme, either *'*sfnSchemeA*'* or *'*sfnSchemeB*'*.  If a UE is configured with sfnSchemePdcch set to 'sfnSchemeA' for a DL BWP and activated with two TCI states by MAC CE, and the UE does not report its capability of [nonSfnPdsch-sfnPdcch], the UE does not expect to be indicated with one TCI state in a codepoint of the DCI field 'Transmission Configuration Indication' in DCI format 1\_1/1\_2.  If a UE is configured with sfnSchemePdcch set to 'sfnSchemeB' for a DL BWP and activated with two TCI states by MAC CE, the UE does not expect to be indicated with one TCI state in a codepoint of the DCI field 'Transmission Configuration Indication' in DCI format 1\_1/1\_2.  < Unchanged parts are omitted > |

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| **Company** | **Comment** |
| Moderator | This issue has been extensively discussed in the previous meeting and there was no consensus. The situation is clear in this meeting i.e., Alt-1 has super majority view, therefore the FL proposal is to agree to TP#1. Companies can provide views and further comments on TP#1 |
| OPPO | Support Alt-1. |
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* 1. Issue 2

The issue is for support of dynamic switching of sTRP and SFN scheme for PDSCH when PDCCH is not configured with SFN. The summary of Issue 2 from preparation phase is provided in Table 2.

**Table 2 Summary of Issue 2**

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| **#** | **Issue (summary of CR proposal)** | **Company inputs (if any)** |
|  | UE not capable of sTRP / SFN dynamic switching   * Alt-1: When SFN is configured for PDSCH and not configured for PDCCH, dynamic switching between single TRP and SFN should be supported * Alt-2: When SFN is configured for PDSCH and not configured for PDCCH, TCI field may be present in DCI formats 1\_1 and 1\_2 for a UE that is not capable of dynamic switching   FL Note: This issue was extensively discussed in the last meeting with no conclusion. Initial FL assessment is that this may be an essential issue for Rel-17. Companies can provide input if they think otherwise. | **Alt-1**   * **Support:** ZTE, Huawei/HiSi, Ericsson, ZTE, DOCOMO * **Not Support:** QC, Samsung   **Alt-2**   * **Support:** Lenovo, Apple, OPPO, Xiaomi, LGE, CATT, vivo, Spreadtrum * **Not Support:** QC, Samsung |

### Round-1

Based on the inputs in the preparation phase, the following alternatives are proposed and inputs from companies are invited for down selection of the alternatives. Alt-1 and Alt-2 are based on the alternatives in Table 2 and Alt-3 is based on inputs from Qualcomm and Samsung who did not agree with either alternative.

**Proposal#2**

When SFN is configured for PDSCH and not configured for PDCCH

* **Alt-1**: Dynamic switching between single-TRP and SFN should be supported
* **Alt-2**: Support of dynamic switching between single-TRP and SFN is based on UE capability and TCI field may be present in DCI formats 1\_1 and 1\_2 for a UE that is not capable of dynamic switching
* **Alt-3**: Support of dynamic switching between single-TRP and SFN is based on UE capability and is independent of SFN configuration of PDCCH

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| **Company** | **Comment** |
| Moderator | Alt-1 and Alt-2 are based on the alternatives in Table 2 and Alt-3 is based on inputs from Qualcomm and Samsung who did not agree with either alternative and suggested that dynamic switching between sTRP and SFN should not depend on the SFN configuration of PDCCH. This issue can benefit from further discussion. Once the alternatives are down-selected, an appropriate TP will be further discussed. |
| OPPO | Support Alt-2. |
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* 1. Issue 8

Issue 8 is for TCI state assumption for CORESETs associates with CSS Type 0/0A/1/2. The summary from preparation phase is provided in Table 3.

**Table 3 Summary of Issue 8**

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| **#** | **Issue (summary of CR proposal)** | **Company inputs (if any)** |
| 8. | SFN for CORESETS associated with CSS Type 0/0A/1/2   * Alt-1: UE doesn’t expect PDCCH candidates in CSS type 0/0A/1/2 to be associated with CORESET activated with two TCI states. * Alt-2: Apply only the first TCI state for PDCCH reception * Alt-3: Apply both TCI states for PDCCH reception   FL Note: This issue was extensively discussed in previous meetings with no consensus. Companies can provide further inputs. Please also provide inputs on alternatives listed | **Alt-1:**   * **Support:** Qualcomm, OPPO * **Not Support:**   **Alt-2:**   * **Support:** vivo, Nokia/NSB, Lenovo, OPPO, Huawei/HiSi, LGE, Samsung, DOCOMO * **Not Support:**   **Alt-3:**   * **Support:** ZTE * **Not Support:** |

### Round-1

Based on the discussion in the preparation phase, the majority view is to support Alt-2, i.e., apply only the first TCI state for PDCCH reception and the first round FL proposal is as follows:

**Proposal#3**

A CORESET activated with two TCI states can be associated with CSS Type 0/0A/1/2 and the first TCI state is applied for PDCCH reception.

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| **Company** | **Comment** |
| Moderator | This issue was extensively discussed in the last meeting without consensus so the FL proposal for the first round is to adopt the majority view. Companies are encouraged to provide their views and a TP can be discussed in later rounds |
| OPPO | We prefer Alt-2 which is majority. |
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* 1. Issue 9

This issue is for TCI state assumption of CORESET#0 when configured with two TCI states. The summary of the preparation phase discussion is provided in Table 4.

**Table 4 Summary of Issue 9**

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| **#** | **Issue (summary of CR proposal)** | **Company inputs (if any)** |
| 9. | CORESET#0 configured with two TCI states   * Alt-1: Only one TCI state should be used for CSS reception * Alt-2: Both TCI states should be used for CSS reception   FL Note: This issue is based on reply-LS to RAN2 in the last meeting. Further inputs from companies are needed. | **Alt-1:**   * **Support:** OPPO, QC, ZTE, DOCOMO, vivo, Lenovo * **Not Support:**   **Alt-2:**   * **Support:**, LGE * **Not Support:** |

### Round-1

Based on the discussion in the preparation phase, it seems that Alt-1 has majority view and is therefore proposed in the first round of discussions.

**Proposal#4**

If CORESET#0 is configured with two TCI states, only one TCI state should be used for CSS reception.

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| **Company** | **Comment** |
| Moderator | Companies can provide further views on the initial FL proposal and an appropriate TP can be discussed in later rounds. |
| OPPO | Support Alt-1. |
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# Editorial Issue

* 1. Issue 11

This issue was brought up in [20] and all companies agreed in the preparation phase that this is an editorial issue.

**Table 5 Summary of Issue 11**

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| **#** | **Issue (summary of CR proposal)** | **Company inputs (if any)** |
| 9. | In clause 5.2.1.5.1, the text description for specifying the TCI state for the reception of the aperiodic CSI-RS when the CORESET with lowest ID is indicated with two TCSI states has extra “if” wording that should be deleted.  FL Note: This seems to be an editorial update. | **Agree with E:** Apple, Oppo, Huawei/HiSilicon, Ericsson, Qualcomm, ZTE, LGE, CATT, vivo, Spreadtrum, Samsung, DOCOMO, Lenovo |

Based on the input from preparation phase, the following TP from [20] is proposed

**TP#5:**

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| **TP for 38.214 Section 5.2.1.5.1**  ----------------Unchanged part omitted------------------------  - else if a UE is configured with *sfnSchemePdcch* set to *'*sfnSchemeA', it is not configured with *enableTwoDefaultTCI-States,* and the two TCI states are activated for the CORESET by the activation command as described in clause 6.1.3.x of [10, TS 38.321]  - if there is any other DL signal with an indicated TCI state in the same symbols as the CSI-RS, the UE applies the QCL assumption of the other DL signal also when receiving the aperiodic CSI-RS. The other DL signal refers to PDSCH scheduled with an offset larger than or equal to the threshold *timeDurationForQCL,* as defined in [13, TS 38.306], periodic CSI-RS, semi-persistent CSI-RS, aperiodic CSI-RS in a *NZP-CSI-RS-ResourceSet* scheduled with offset larger than or equal to the UE reported threshold *beamSwitchTiming* when the reported value is one of the values {14,28,48} and when *enableBeamSwitchTiming* is not provided or the *NZP-CSI-RS-ResourceSet* is configured with the higher layer parameter *trs-Info* , aperiodic CSI-RS in a *NZP-CSI-RS-ResourceSet* configuredwith the higher layer parameter *repetition* set to 'off' or configured without the higher layer parameters *repetition* and *trs-Info* scheduled with offset larger than or equal to 48 when the UE provides *beamSwitchTiming-r16* and *enableBeamSwitchTiming* is provided, aperiodic CSI-RS in a *NZP-CSI-RS-ResourceSet* configuredwith the higher layer parameter *repetition* set to 'on' scheduled with offset larger than or equal to the UE reported threshold *beamSwitchTiming-r16* and *enableBeamSwitchTiming* is provided;  - else ~~if~~, the UE applies the first one of two TCI states indicated for the CORESET with the lowest CORESET ID in the latest slot within the active BWP of the cell in which the CSI-RS is to be received when receiving the aperiodic CSI-RS,  ----------------Unchanged part omitted------------------------ |

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| **Company** | **Comment** |
| Moderator | Companies are encouraged to indicate if there is any issue with TP#5. |
| OPPO | Support. |
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# References

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|  | R1-2203106 | Remaining issues on enhancements for Multi-TRP deployment | Huawei, HiSilicon |
|  | R1-2203259 | Remaining issues on multi-TRP deployment | ZTE |
|  | R1-2203302 | Remaining issues on multi-TRP deployment | Spreadtrum Communications |
|  | R1-2203422 | Maintenance issues on Rel-17 M-TRP enhancements | CATT |
|  | R1-2203506 | Maintenance on enhancements for multi-TRP Deployment | vivo |
|  | R1-2203644 | Remaining issues for Multi-TRP Deployment | Ericsson |
|  | R1-2203674 | Discussion on remaining issues for multi-TRP deployment | NEC |
|  | R1-2203765 | Maintenance of Enhancements for Multi-TRP Deployment | Langbo |
|  | R1-2203772 | Remaining issues on HST-SFN deployment enhancement | xiaomi |
|  | R1-2203856 | Maintenance on Rel-17 multi-TRP and HST-SFN | Samsung |
|  | R1-2203949 | Maintenance on enhancements for mTRP deployment | OPPO |
|  | R1-2204138 | Text proposal on multi-TRP deployment | LG Electronics |
|  | R1-2204170 | Remaining issues on multi-TRP deployment | Lenovo |
|  | R1-2204193 | Remaining issues for mTRP PUSCH | ASUSTeK |
|  | R1-2204200 | Remaining Issues on Multi-TRP Enhancement | Apple |
|  | R1-2204336 | Remaining issues on enhancements for Multi-TRP Deployment | NTT DOCOMO, INC. |
|  | R1-2204536 | Maintenance of enhancements for Multi-TRP Deployment | Nokia, Nokia Shanghai Bell |
|  | R1-2204683 | Maintenance of Rel-17 beam management for multi-TRP | MediaTek Inc. |
|  | R1-2204764 | MIMO Enhancements for Multi-TRP Deployment | Intel Corporation |
|  | R1-2204977 | Remaining Details for Multi-TRP Operation | Qualcomm Incorporated |