**3GPP TSG RAN WG1 #110 R1-220xxxx**

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

**Source: Moderator (Intel Corporation)**

**Title: Moderator Summary for Rel. 17 NR FeMIMO –**

**Maintenance on HST-SFN (Round 1)**

**Agenda item: 8.1**

**Document for: Discussion and Decision**

# Introduction

A moderator summary of maintenance issues related to Rel-17 FeMIMO HST-SFN based on contributions submitted to RAN1#110 is provided below. Based on offline Round 0 discussion and online discussion, three issues are considered for Round 1 discussion as below.

# Maintenance Issues

* 1. Issue 1: CORESET#0 Activated with 2 TCI States

Three companies ZTE [1], Lenovo [2] and vivo [3] have provided draft CRs for this issue. The issue is related to UE behavior for PDCCH reception in Type 0/0A/2 CSS sets associated with CORESET#0 which has been activated with two TCI states. The proposals in [2, 3] suggest using the first TCI state, while the proposal in [1] suggests using both TCI states. If this issue is treated in RAN1#110, companies need to decide between two alternatives as summarized below.

* + 1. [Closed] Round 0

Table 1: Summary of Issue 1

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| **Issue (summary of CR proposal)** | **Initial FL assessment** | **Company inputs (if any)** |
| When Type 0/0A/2-PDCCH CSS is associated with CORESET#0 which is activated with two TCI states:   * **Alt-1**: the first TCI state should be applied for PDDCH reception (Draft CRs in [2], [3]) * **Alt-2**: both TCI states should be applied for PDCCH reception (Draft CR in [1]) | **Discuss in RAN1#110** | * **Discuss:** Google, OPPO, Nokia, Samsung, Lenovo, LG, DOCOMO, ZTE, QC, vivo * **Not Discuss:** [Apple]   Additional company views on listed alternatives -  **Alt-1:**   * **Support:** OPPO, Nokia, SS, Lenovo, LGE, vivo, DOCOMO * **Object:** Apple, ZTE   **Alt-2:**   * **Support:** Apple, ZTE, DOCOMO * **Object:** |

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| **Company Name** | **Company inputs (if any)** |
| Mod | This issue was extensively discussed in the last two meetings, but no consensus was reached. Several companies commented that no specification change is necessary. On the other hand, one company commented that the following agreement will be reverted if UE behavior for this case is not defined.  **Agreement**  For the response to RAN2 LS (in R1-2200886), the following is agreed   |  | | --- | | Question: RAN2 would like to ask whether “Enhanced TCI state indication for UE specific PDCCH MAC CE” can be applied to CORESET zero or not. |   RAN1 response: There is no restriction in RAN1 on whether enhanced TCI state indication for UE specific PDCCH MAC CE can be applied to CORESET zero.  Mr. Chairman recommended this to be considered in RAN1#110. Keeping previous discussion in mind, initial FL recommendation is to discuss and conclude on this issue in RAN1#110. This assessment can be updated based on company inputs. Furthermore, companies are encouraged to provide additional feedback on the listed alternatives as well as their view on whether the above agreement is indeed reverted if no additional UE behavior is defined. |
| Google | Support to discuss this issue. But we would like to clarify the UE behavior for Type3 CSS and USS as well. It seems unreasonable to apply different UE behaviors for different types of SSs as the SSs may overlap. |
| OPPO | Support to discuss the issue and prefer Alt-1. |
| Nokia | Support to discuss the issue, and support Alt-1. |
| Samsung | Support to discuss and we are fine with Alt-1. |
| Apple | If we do not discuss this issue, Alt-2 is the outcome (current specification).  We just need to check if there is enough objection of Alt-1, and we object Alt-1 |
| Lenovo | Support to discuss this issue. We think monitoring behavior including monitoring occasion needs being clarified in case of two TCI states activated in CORESET#0. Both Alt-1 and Alt-2 needs specification. We support Alt-1 on account of system realization complexity and compatibility to legacy UEs. |
| LG | Support Alt-1. |
| Docomo | Support to discuss. We can be flexible with either Alt.1 or Alt.2. |
| ZTE | Support Alt-2 and also object Alt-1. |
| QC | fine to discuss and conclude on a resolution of this issue. |
| vivo | Support to discuss the issue and prefer Alt-1. |
| Mod | Based on companies’ inputs, this issue will be discussed further in RAN1#110. The company views so far are updated in Table 1.  Note that based on discussion from last meeting that there is a case when CORESET#0 associated with SS#0 in Type 0/0A/2 CSS is activated with two TCI states, the UE behaviour is not defined. As a result, if we do not agree anything, Alt-2 cannot be assumed to be default behaviour in this case. Therefore, from FL perspective, we need to address this case in this meeting and companies are encouraged to further provide their views. |
| Mod2 | Based on offline discussion, the following offline proposal should be further discussed in the online session  **Offline Proposal 1:**  **When Type 0/0A/2-PDCCH CSS is associated with CORESET#0 which is activated with two TCI states:**   * **Alt-1: the first TCI state should be applied for PDDCH reception (Draft CRs in [2], [3])**   + Support: OPPO, Nokia, SS, Lenovo, LGE, vivo, DOCOMO   + Object: Apple, ZTE * **Alt-2: both TCI states should be applied for PDCCH reception (Draft CR in [1])**   + Support: Apple, ZTE, DOCOMO   + Object: |

* + 1. Round 1

**Proposed Conclusion 1:**

CORESET#0 cannot be activated with two TCI states when associated with SS#0 in Type 0/0A/2 CSS

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| **Company Name** | **Company inputs (if any)** |
| Mod | Based on the online discussion, from FL perspective, it seems difficult to converge one alternative for Issue 1. We have two Options as follows:   * **Option 1**: One option could be to accept Alt-1 of Offline Proposal 1 as default UE behavior with Alt-2 of Offline Proposal 1 as UE optional feature. * **Option 2**: Take the proposed conclusion which addresses the current gap in specification.   Companies can provide further comments in Round 1 on whether they are OK with either option. If we cannot take Option 1, Option 2 is the default, and we will go with this option to avoid further repeated discussion.  If we go with Option 2, vivo has also commented that we may need to send an LS to RAN2 to clarify this restriction. Please comment on the necessity to send an LS to RAN2. |
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* 1. Issue 2: Default QCL Assumption

One company, Samsung, has provided a draft CR on default QCL assumptions for prioritizing PDCCH reception when associated CORESET overlaps with SFN-PDSCH [4]. The summary of proposed changes is provided below.

* + 1. [Closed] Round 0

Table 2: Summary of Issue 2

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| **Issue (summary of CR proposal)** | **Initial FL assessment** | **Company inputs (if any)** |
| Draft CR for TS 38.214 Section 5.1.5 provided in [4]:  **Summary of change**: For the SFN PDSCH received by two default beams, if the ‘QCL-TypeD’ in both of the TCI states corresponding to the lowest codepoint among the TCI codepoints containing two different TCI states is different from that of the PDCCH DM-RS with which they overlap in at least one symbol, the UE is expected to prioritize the reception of PDCCH associated with that CORESET. This also applies to the intra-band CA case (when PDSCH and the CORESET are in different component carriers). | **Discuss in RAN1#110** | * **Discuss (9):** Google, Samsung, Apple, Lenovo, DOCOMO, CATT, QC, ZTE, vivo * **Not Discuss (5):** OPPO, Spreadtrum, Nokia/NSB, LGE |

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| **Company Name** | **Company inputs (if any)** |
| Mod | This issue was discussed in the preparation phase of RAN1#109e and was designated as non-essential. Majority of the companies commented that specification change is not needed and legacy rules from Rel-15/16 for COREST overlapping with PDSCH can be reused.  Since this issue was first brought up in RAN1#109e, initial FL assessment is to discuss the issue in RAN1#110. However, the initial assessment can be updated based on inputs from companies. |
| Google | It seems capture spec already suggests such behavior. If necessary, a conclusion can be considered. |
| OPPO | We also think the CR is not needed and current rule can be reused. |
| Spreadtrum | This issue has been discussed in last meeting. Current spec can work, and it seems that further optimization is not needed. |
| Nokia, NSB | We think this issue can be handled by the existing spec. |
| Samsung | We think at least conclusion would be helpful. As many companies mentioned, we also think that this is not a new feature, and just makes spec clearer, since the UE behavior is not mentioned when SFN PDSCH with default beam is overlapped with CORESET. The case when single-TRP or multi-TRP PDSCH with default beam overlapping with CORESET is already captured in the other paragraphs. |
| Apple | We are fine to discuss aiming at a conclusion |
| Lenovo | We think this issue can be handled by the existing spec. We are fine to make a conclusion to making it clear. |
| LG | No spec change is needed. |
| Docomo | We support the CR. We realized, in the current spec, the specification of “prioritize PDCCH than PDSCH” is not applied to default QCL for SFN, because these are specified in different bullets. We cannot say the existing spec. can handle it. We prefer to specify it, rather than conclusion, to make it clear. |
| CATT | We think making a conclusion is sufficient. |
| ZTE | Ok to reach a conclusion. |
| QC | Fine to discuss a conclusion on this issue. |
| vivo | Ok to discuss a potential conclusion |
| Mod | Based on inputs from companies and DOCOMO’s comment that even though spec captures legacy behavior, some text update may be needed in the relevant section to capture UE behavior, the FL recommendation is to further discuss this topic in RAN1#110. |
| Mod2 | Based on offline discussion, the following is the FL proposal for this topic due lack of any comments/objection.  **Offline Proposal 2: Draft CR for TS 38.214 Section 5.1.5 provided in R1-2206787 should be endorsed.** |

* + 1. Round 1

**Proposal 2: Draft CR for TS 38.214 Section 5.1.5 provided in R1-2206787 should be endorsed.**

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| **Company Name** | **Company inputs (if any)** |
| Mod | Based on online discussion after Round 0, the proposal for Issue 2 is left unchanged. Please comment if the proposal is not acceptable to any company. |
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* 1. Issue 3: Replace “SFN-PDSCH and non-SFN-PDSCH” in TS 38.214

One company, Ericsson, has submitted a draft CR to align terminology of TS 38.214 with UE capability parameters in TS 38.306 [5]. The summary of proposed changes is provided below.

* + 1. [Closed] Round 0

Table 3: Summary of Issue 3

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| **Issue (summary of CR proposal)** | **Initial FL assessment** | **Company inputs (if any)** |
| Draft CR for TS 38.214 Section 5.1.5 provided in [5]:  **Summary of change**: Replace undefined terminology and acronym “SFN PDSCH and non-SFN PDSCH” with proper UE capability parameters from 38.306.  The description “dynamic switching between SFN PDSCH and non-SFN PDSCH” is unclear and can be replaced by UE capability indication ***sfn-SchemeA-DynamicSwitching-r17*** and ***sfn-SchemeB-DynamicSwitching-r17*** defined in 38.306 | **Editorial – Discuss in RAN1#110** | * **Discuss(14):** Google, OPPO, Spreadtrum, Nokia/NSB, Samsung, Apple, Lenovo, LG, DOCOMO, CATT, ZTE, QC, vivo * **Not Discuss:** |

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| **Company Name** | **Company inputs (if any)** |
| Mod | This is a valid issue and should be editorial. Initial FL assessment is to discuss this issue in RAN1#110. |
| Google | OK to discuss it. |
| OPPO | Fine with it. |
| Spreadtrum | Ok |
| Nokia, NSB | Fine for clarification. |
| Samsung | Support to discuss. |
| Apple | We are fine with the proposed change |
| Lenovo | Support to discuss. We have a similar question with Ericsson whether we need similar editorial updating for “if the UE supports **DCI scheduling without TCI field**” (in the if part of this paragraph) and “else if the UE does not support **DCI scheduling without TCI field**” (in the else if part the next paragraph) with wording for UE capability. |
| LG | Ok |
| Docomo | OK. |
| CATT | Support to discuss. |
| ZTE | Ok. |
| QC | Fine to discuss. |
| vivo | ok |
| Mod | Based on companies’ inputs, FL recommendation is to discuss this issue. The draft CR in [5] can be used as a starting point.  Companies can also respond to comments from Lenovo. |
| Mod2 | Based on offline discussion, the following is the offline proposal from FL:  **Offline Proposal 3: Further discuss Issue 3 in RAN1#110.**  **@Lenovo**: please provide a TP based on your concern and I can draft a new CR based on the CR in [5] and new additions, if any. |
| Lenovo2 | Based on TS38.331, optional RRC signalling *sfn-DefaultDL-BeamSetup-r17* is introduced for indicating UE capability default DL beam setup for SFN. For this capability, it supports 1. PDSCH reception using default beam for Rel-17 enhanced SFN scheme when PDSCH is scheduled with offset less than threshold; 2. PDSCH reception using default beam for Rel-17 enhanced SFN scheme when TCI field is not present in DCI when PDSCH is scheduled with offset equal or larger than the threshold, if applicable; 3. aperiodic CSI-RS reception using default beam for Rel-17 enhanced SFN scheme when scheduling offset is less than threshold. To align 38.214 description on “UE supports DCI scheduling without TCI field” and 38.331 description on UE capability, we propose the following TP based on Ericsson’s text proposal for CR:  <Unchanged parts are omitted>  When a UE is configured with both *sfnSchemePdcch* and *sfnSchemePdsch* scheduled by DCI format 1\_0 or by DCI format 1\_1/1\_2, if the time offset between the reception of the DL DCI and the corresponding PDSCH of a serving cell is equal to or greater than a threshold *timeDurationForQCL* if applicable:  - if the UE supports *sfn-DefaultDL-BeamSetup-r17* for the case of DCI scheduling without TCI field, the UE assumes that the TCI state(s) or the QCL assumption(s) for the PDSCH is identical to the TCI state(s) or QCL assumption(s) whichever is applied for the CORESET used for the reception of the DL DCI within the active BWP of the serving cell regardless of the number of active TCI states of the CORESET. If the UE does not support *sfn-SchemeA-DynamicSwitching-r17* or *sfn-SchemeB-DynamicSwitching-r17*, the UE should be activated with the CORESET with two TCI states.  - else if the UE does not support *sfn-DefaultDL-BeamSetup-r17* for the case of DCI scheduling without TCI field, the UE shall expect TCI field present when scheduled by DCI format 1\_1/1\_2.  <Unchanged parts are omitted> |

* + 1. Round 1

**Proposal 3: Accept the text proposal in [Issue-3] Draft Editorial CR for TR 38.214 Section 5.1.5**

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| **Company Name** | **Company inputs (if any)** |
| Mod | A draft CR based on the inputs from Ericsson and Lenovo is uploaded in drafts/HST-SFN/Issue-3 folder. Please review and comment if the CR is acceptable to all companies. |
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* 1. [Closed] Issue 4: BFD-RS Selection for SFN Mode

One company, Nokia/NSB, has submitted a draft CR for TS 38.213 for BFD-RS selection when operating in SFN mode [6]. The summary of the issue is provided below.

Table 4: Summary of Issue 4

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| **Issue (summary of CR proposal)** | **Initial FL assessment** | **Company inputs (if any)** |
| Draft CR for TS 38.213 Section 6 provided in [6]:  **Summary of change**: For implicit configuration of BFD-RS, if the UE is configured with a CORESET with two TCI states and CORESET with single TCI state, and the number of determined BFD-RS exceed the maximum number, UE determines to select one BFD-RS (corresponding to TCI states) for each CORESET | **Do not discuss in RAN1#110** | * **Discuss (4):** Nokia/NSB, LGE, Lenovo * **Not Discuss (10):** Google, OPPO, Spreadtrum, Samsung, Apple, DOCOMO, ZTE, CATT, QC, vivo |

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| **Company Name** | **Company inputs (if any)** |
| Mod | This issue has been discussed in previous meetings with no consensus among companies. Therefore, initial FL assessment is to not treat this issue in RAN1#110. The initial assessment can be updated based on company inputs. |
| Google | This looks to be an optimization. |
| OPPO | It can be up to UE implementation. |
| Spreadtrum | Agree with FL |
| Nokia,NSB | This needs to be clarified for NW scheduling. |
| Samsung | Agree with FL. |
| Apple | In the previous handling of the CR, it is agreed to not have such optimization even for Rel-15. If we open up this discussion, we need to first address the Rel-15 issue, since we can have 4 CORESETs but UE is only supposed to handle at most 2 BFD RS. |
| Lenovo | We think it can be up to UE implementation but are open for discussion. |
| LG | Need to be discussed |
| Docomo | Agree with FL. |
| CATT | Agree with FL. |
| ZTE | Agree with FL. |
| QC | Agree with FL assessment |
| vivo | Agree with FL assessment |
| Mod | Based on companies’ input, this issue will not be discussed in RAN1#110.  **Offline Proposal 4: Issue 4 will not be further discussed in RAN1#110.** |

* 1. [Closed] Issue 5: NBI Resource Pair for SFN Mode

One company, Nokia/NSB, has submitted a draft CR for TS 38.213 for NBI-RS configuration for SFN operation [7]. The summary of proposed changes is provided below.

Table 5: Summary of Issue 5

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| **Issue (summary of CR proposal)** | **Initial FL assessment** | **Company inputs (if any)** |
| Draft CR for TS 38.213 Section 6 provided in [7]:  **Summary of change**: The UE can be configured with additional information for an SCell that indicates a candidate beam or a candidate beam pair (pairs) that support SFN operation. If the UE indicates candidate beam pair for beam failure that supports SFN operation, the UE can continue with SFN operation after BFR | **Do not discuss in RAN1#110** | * **Discuss (4):** Nokia/NSB, Lenovo, DOCOMO * **Not Discuss (9):** Google, Spreadtrum, Samsung, Apple, LGE, CATT, ZTE, QC, vivo |

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| **Company** | **Company inputs (if any)** |
| Mod | This issue has been discussed in previous meetings with no consensus among companies. Therefore, initial FL assessment is to not treat this issue in RAN1#110. The initial assessment can be updated based on company inputs. |
| Google | This looks to be an optimization. |
| Spreadtrum | Agree with FL |
| Nokia, NSB | We think this is good to have. |
| Samsung | Agree with FL. |
| Apple | We do not prefer to discuss it since it is a new functionality. |
| Lenovo | We support it since it is useful for supporting SFN transmission after BFR. |
| LG | Agree with FL. |
| Docomo | We support the CR. It is useful for SFN operation. |
| CATT | Agree with FL. |
| ZTE | Agree with FL. |
| QC | Agree with FL assessment |
| vivo | Agree with FL assessment |
| Mod | **Offline Proposal 5: Issue 5 will not be further discussed in RAN1#110.** |

# Proposals for Online Discussion

TBD

# References

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| --- | --- | --- | --- |
|  | R1-2205934 | Draft CR on CSS for Multi-TRP HST-SFN | ZTE |
|  | R1-2206222 | Draft CR on monitoring Type0/0A/1/2 PDCCH CSS with HST deployment in TS38.213 | Lenovo |
|  | R1-2206717 | Draft CR on SFN-based CORESET#0 issue for HST-SFN | vivo |
|  | R1-2206787 | Draft CR on default QCL assumption in HST-SFN | Samsung |
|  | R1-2207133 | Draft CR on QCL assumption for SFN PDSCH | Ericsson |
|  | R1-2207539 | Draft CR 38.213 BFD-RS Selection in SFN Operation Mode | Nokia, Nokia Shanghai Bell |
|  | R1-2207540 | Draft CR 38.213 New Beam Identification Resource Pair for SFN Operation Mode | Nokia, Nokia Shanghai Bell |