**3GPP TSG RAN WG1 #119 R1-240xxxx**

**Orlando, US, November 18th – 22nd, 2024**

**Source: Moderator (CATT)**

**Title:** **Summary on STxMP TPMI determination**

**Agenda Item:** **8.1**

**Document for:** **Decision**

# Introduction

In RAN1#119, the following draft CR is submitted on TPMI determination for UL transmissions for STxMP scenarios in TS38.214 [1]:

R1-2409920 Correction on TPMI determination for UL transmissions in 38.214 CATT

This moderator summary aims at collecting the comments from companies regarding the issue in the above contribution.

# Discussion

There are four issues raised in the CR above. The first two parts are about the necessary changes to capture the technical descriptions missed in 38.214. The third part is refining wordings missed/wrongly used in the current spec. The fourth part is about aligning the RRC parameters between 38.331 and 38.214.

Firstly, in current version of 38.214, the clarification on in which cases maxRankSDM, maxRankSDM-DCI-0-2, maxRankSFN or maxRankSFN-DCI-0-2 is applied for multi-panel cases is missed. In this case, following TP is provided to clarify that to configuring the maximum transmission rank of each panel in SDM scheme, *maxRankSDM* is used for PUSCH scheduled with DCI format 0\_1 or 0\_3 and *maxRankSDM-DCI-0-2* is usedfor PUSCH scheduled with DCI format 0\_2, respectively; And to configuring the maximum transmission rank of each panel in SFN scheme, *maxRankSFN* is used for PUSCH scheduled with DCI format 0\_1 or 0\_3 and *maxRankSFN-DCI-0-2* is used for PUSCH scheduled with DCI format 0\_2, respectively:

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| 6.1.1.1 Codebook based UL transmission<Unrelated parts are omitted>The maximum transmission rank may be configured by the higher layer parameter *maxRank* in *pusch-Config* for PUSCH scheduled with DCI format 0\_1 or 0\_3 and *maxRankDCI-0-2* for PUSCH scheduled with DCI format 0\_2*.*When the higher layer parameter *multipanelSchemeSDM* is configured in *pusch-Config*, the maximum transmission rank for each SRS resource set in *srs-ResourceSetToAddModList* with higher layer parameter *usage* in *SRS-ResourceSet* set to 'codebook' may be configured by the higher layer parameter *maxRankSDM* for PUSCH scheduled with DCI format 0\_1 or 0\_3 and the maximum transmission rank for each SRS resource set in *srs-ResourceSetToAddModListDCI-0-2* with higher layer parameter *usage* in *SRS-ResourceSet* set to 'codebook' may be configured by the higher layer parameter *maxRankSDM-DCI-0-2* for PUSCH scheduled with DCI format 0\_2.When the higher layer parameter *multipanelSchemeSFN* is configured in *pusch-Config*, the maximum transmission rank for each SRS resource set in *srs-ResourceSetToAddModList* with higher layer parameter *usage* in *SRS-ResourceSet* set to 'codebook' may be configured by the higher layer parameter *maxRankSFN* in *pusch-Config* for PUSCH scheduled with DCI format 0\_1 or 0\_3 and the maximum transmission rank for each SRS resource set in *srs-ResourceSetToAddModListDCI-0-2* with higher layer parameter *usage* in *SRS-ResourceSet* set to 'codebook' may be configured by the higher layer parameter *maxRankSFN-DCI-0-2* for PUSCH scheduled with DCI format 0\_2.A UE reporting its UE capability of 'partialAndNonCoherent' transmission shall not expect to be configured by either *codebookSubset* or codebookSubsetDCI-0-2 with 'fullyAndPartialAndNonCoherent*'* for two or four antenna ports. <Unrelated parts are omitted> |

Secondly, for codebook based PUSCH transmission scheduled by DCI format 0\_2, the maximum transmission rank is configured by the higher layer parameter *maxRankDCI-0-2.* However, this is missed for multi-panel cases. Therefore, this should be captured. In detail: When *multipanelSchemeSDM* or *multipanelSchemeSFN* is configured and two SRS resource sets are configured in *srs-ResourceSetToAddModListDCI-0-2* with higher layer parameter *usage* in *SRS-ResourceSet* set to 'codebook', for PUSCH transmissions scheduled by DCI format 0\_2, if codepoint "00" or "01" of *SRS Resource Set* *indicator* is indicated, the first TPMI is used to indicate the precoder to be applied over layers {0…v-1}, where v ≤ *maxRankDCI-0-2.*The following TP is provided to clarify this issue (Some wording changes are also captured. Please see the argument in the next paragraph):

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| 6.1.1.1 Codebook based UL transmission<Unrelated parts are omitted>- When codepoint "00" or "01" of *SRS Resource Set* *indicator* is indicated*,* the second SRI and second TPMI are reserved, the first TPMI is used to indicate the precoder to be applied over layers {0…v-1}, where v ≤ *maxRank* or *maxRankDCI-0-2,* where *maxRank* or *maxRankDCI-0-2* is defining the maximum number of layers. <Unrelated parts are omitted>- When codepoint "00" or "01" of *SRS Resource Set* *indicator* is indicated*,* the second SRI and second TPMI are reserved, the first TPMI is used to indicate precoder to be applied over layers {0…v-1}, where v ≤ *maxRank* or *maxRankDCI-0-2*, where *maxRank* or *maxRankDCI-0-2* is defining the maximum number of layers applied over the first SRS resource set or the second SRS resource set..<Unrelated parts are omitted> |

Thirdly, a few of the wordings are refined to align with the current spec. In detail, add “set” in sentence “*maxRank* is defining the maximum number of layers applied over the first SRS resource set or the second SRS resource.” Add “is” behind “*maxRankSFN-DCI-0-2*” in sentence “where v ≤ *maxRankSFN* or *maxRankSFN-DCI-0-2* and *maxRankSFN* or *maxRankSFN-DCI-0-2* defining the maximum number of layers applied over the first SRS resource set and over the second SRS resource set separately.” Change “are” behind “*maxRankSDM-DCI-0-2*” in sentence “where v ≤ *maxRankSDM* or *maxRankSDM-DCI-0-2* and *maxRankSDM* or *maxRankSDM-DCI-0-2* defining the maximum number of layers applied over the first SRS resource set and over the second SRS resource set separately.” to “is” to align with current spec.

Lastly, the misalignments on the names of RRC parameters between 38.331 and 38.214 are revised as: Change *maxRankSdm, maxRankSdm-DCI-0-2, maxRankSfn and maxRankSfn-DCI-0-2* to *maxRankSDM, maxRankSDM-DCI-0-2, maxRankSFN* and *maxRankSFN-DCI-0-2,* respectively. The TP involving the above three parts are summarised as follows:

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| 6.1.1.1 Codebook based UL transmission<Unrelated parts are omitted>When the higher layer parameter *multipanelScheme* is set to 'SDMScheme' and two SRS resource sets are configured in *srs-ResourceSetToAddModList* or *srs-ResourceSetToAddModListDCI-0-2* with higher layer parameter *usage* in *SRS-ResourceSet* set to 'codebook', two SRI(s), and two TPMI(s) are given by the DCI fields of two SRS resource indicator and two Precoding information and number of layers in clause 7.3.1.1.2 and 7.3.1.1.3 of [5, TS 38.212] for DCI format 0\_1 and 0\_2 or given by *srs-ResourceIndicator, srs-ResourceIndicator2,* *precodingAndNumberOfLayers, and precodingAndNumberOfLayers2* in *configuredGrantConfig*: - When codepoint "10" of *SRS Resource Set* *indicator* is indicated or when *srs-ResourceIndicator2 and* precodingAndNumberOfLayers2 are provided*,* the first TPMI is used to indicate the precoder to be applied over layers {0…v1-1}, where v1 is the number of layers indicated by the first TPMI, that corresponds to the SRS resource selected by the corresponding SRI when multiple SRS resources are configured for the applicable SRS resource set or if single SRS resource is configured for the applicable SRS resource set, and the second TPMI is used to indicate the precoder to be applied over layers {v1…. v2+v1-1}, where v2 is the number of layers indicated by the second TPMI, that corresponds to the SRS resource selected by the corresponding SRI when multiple SRS resources are configured for the applicable SRS resource set or if single SRS resource is configured for the applicable SRS resource set, v1 ≤ *maxRankSDM* or *maxRankSDM-DCI-0-2* andv2 ≤ *maxRankSDM* or *maxRankSDM-DCI-0-2* and *maxRankSDM* or *maxRankSDM-DCI-0-2* is defining the maximum number of layers applied over the first and the second SRS resource sets, separately. - When codepoint "00" or "01" of *SRS Resource Set* *indicator* is indicated*,* the second SRI and second TPMI are reserved, the first TPMI is used to indicate the precoder to be applied over layers {0…v-1}, where v ≤ *maxRank* or *maxRankDCI-0-2,* where *maxRank* or *maxRankDCI-0-2* is defining the maximum number of layers applied over the first SRS resource set or the second SRS resource set. - Codepoint "11" of *SRS Resource Set indicator* is reserved. - For one or two TPMI(s), the transmission precoder is selected from the uplink codebook that has a number of antenna ports equal to the higher layer parameter *nrofSRS-Ports* in *SRS-Config* for the indicated SRI(s), as defined in Clause 6.3.1.5 of [4, TS 38.211]. When two TPMIs are indicated, the UE shall expect that the precoder indicated by the first TPMI and the precoder indicated by the second TPMI are mapped to different PUSCH antenna ports.- When two SRIs are indicated, the UE shall expect that the number of SRS antenna ports associated with two indicated SRIs would be the same. When the UE is configured with the higher layer parameter *txConfig* set to 'codebook', the UE is configured with at least one SRS resource. Each of the indicated one or two SRI(s) in slot *n* is associated with the most recent transmission of SRS resource of associated SRS resource set identified by the SRI, where the SRS resource is prior to the PDCCH carrying the SRI. When two SRS resource sets are configured in *srs-ResourceSetToAddModList* or *srs-ResourceSetToAddModListDCI-0-2* with higher layer parameter *usage* in *SRS-ResourceSet* set to 'codebook', the UE is not expected to be configured with different number of SRS resources in the two SRS resource sets.When higher layer parameter *multipanelScheme* set to 'SFNscheme' and two SRS resource sets are configured in *srs-ResourceSetToAddModList* or *srs-ResourceSetToAddModListDCI-0-2* with higher layer parameter *usage* in *SRS-ResourceSet* set to 'codebook', two SRI(s), and two TPMI(s) are given by the DCI fields of two SRS resource indicator and two Precoding information and number of layers in clause 7.3.1.1.2 and 7.3.1.1.3 of [5, TS 38.212] for DCI format 0\_1 and 0\_2 or given by *srs-ResourceIndicator, srs-ResourceIndicator2,* *precodingAndNumberOfLayers, and precodingAndNumberOfLayers2* in *configuredGrantConfig*: - When codepoint "10" of *SRS Resource Set* *indicator* is indicated or when *srs-ResourceIndicator2 and* precodingAndNumberOfLayers2 are provided*,* the first TPMI is used to indicate precoder to be applied over layers {0…v-1} and the second TPMI is used to indicate the precoder to be applied over layers {0…v-1}, where v ≤ *maxRankSFN* or *maxRankSFN-DCI-0-2* and *maxRankSFN* or *maxRankSFN-DCI-0-2* is defining the maximum number of layers applied over the first SRS resource set and over the second SRS resource set separately. - When codepoint "00" or "01" of *SRS Resource Set* *indicator* is indicated*,* the second SRI and second TPMI are reserved, the first TPMI is used to indicate precoder to be applied over layers {0…v-1}, where v ≤ *maxRank* or *maxRankDCI-0-2*, where *maxRank* or *maxRankDCI-0-2* is defining the maximum number of layers applied over the first SRS resource set or the second SRS resource set.<Unrelated parts are omitted> |

Based on the discussions above, following questions are raised as follows:

## Q1: Do you agree that the issue raised in the first part is valid? If yes, do you agree with the draft CR?

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| **Company** | **Agree or Not Agree** | **Comments** |
| ZTE | Valid issue | We suggest the following version to make this concise:

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| 6.1.1.1 Codebook based UL transmission<Unrelated parts are omitted>The maximum transmission rank may be configured by the higher layer parameter *maxRank*, *maxRankSDM* or *maxRankSFN* in *pusch-Config* for PUSCH scheduled with DCI format 0\_1 or 0\_3 and *maxRankDCI-0-2*, *maxRankSDM-DCI-0-2* or *maxRankSFN-DCI-0-2* for PUSCH scheduled with DCI format 0\_2*.*A UE reporting its UE capability of 'partialAndNonCoherent' transmission shall not expect to be configured by either *codebookSubset* or codebookSubsetDCI-0-2 with 'fullyAndPartialAndNonCoherent*'* for two or four antenna ports. <Unrelated parts are omitted> |

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| vivo |  | ZTE’s proposal above looks fine |
| Ericsson |  | Agree there is missing text for DCI 0\_2, but not sure why this needs to be added. Given the change for Q2, why is the new text needed? Also, DCI 0\_3 does not support SFN or SDM STxMP. |
| Mod |  | 6.1.1.1 Codebook based UL transmission<Unrelated parts are omitted>The maximum transmission rank may be configured by the higher layer parameter *maxRank* in *pusch-Config* for PUSCH scheduled with DCI format 0\_1 or 0\_3 and *maxRankDCI-0-2* for PUSCH scheduled with DCI format 0\_2*.*When the higher layer parameter *multipanelSchemeSDM* is configured in *pusch-Config*, the maximum transmission rank for each SRS resource set in *srs-ResourceSetToAddModList* with higher layer parameter *usage* in *SRS-ResourceSet* set to 'codebook' may be configured by the higher layer parameter *maxRankSDM* for PUSCH scheduled with DCI format 0\_1 and the maximum transmission rank for each SRS resource set in *srs-ResourceSetToAddModListDCI-0-2* with higher layer parameter *usage* in *SRS-ResourceSet* set to 'codebook' may be configured by the higher layer parameter *maxRankSDM-DCI-0-2* for PUSCH scheduled with DCI format 0\_2.When the higher layer parameter *multipanelSchemeSFN* is configured in *pusch-Config*, the maximum transmission rank for each SRS resource set in *srs-ResourceSetToAddModList* with higher layer parameter *usage* in *SRS-ResourceSet* set to 'codebook' may be configured by the higher layer parameter *maxRankSFN* in *pusch-Config* for PUSCH scheduled with DCI format 0\_1 and the maximum transmission rank for each SRS resource set in *srs-ResourceSetToAddModListDCI-0-2* with higher layer parameter *usage* in *SRS-ResourceSet* set to 'codebook' may be configured by the higher layer parameter *maxRankSFN-DCI-0-2* for PUSCH scheduled with DCI format 0\_2.A UE reporting its UE capability of 'partialAndNonCoherent' transmission shall not expect to be configured by either *codebookSubset* or codebookSubsetDCI-0-2 with 'fullyAndPartialAndNonCoherent*'* for two or four antenna ports. <Unrelated parts are omitted> |

## Q2: Do you agree that the issue raised in the second part is valid? If yes, do you agree with the draft CR?

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| **Company** | **Agree or Not Agree** | **Comments** |
| ZTE | Ok |  |
| vivo | Ok  |  |
| Ericsson | Agree | Second box with proposed changes above is OK. |
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## Q3: Do you agree that the issue raised in the third part is valid? If yes, do you agree with the draft CR?

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| **Company** | **Agree or Not Agree** | **Comments** |
| ZTE | Ok |  |
| vivo | Ok  |  |
| Ericsson | Agree | For the third box above with proposed changes, the changes beyond those proposed in Q2 seem to be editorial and correct. |
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## Q4: Do you agree that the issue raised in the fourth part is valid? If yes, do you agree with the draft CR?

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| **Company** | **Agree or Not Agree** | **Comments** |
| ZTE | Ok |  |
| vivo | Ok  |  |
| Ericsson |  | Not clear to me what the fourth set of changes is.  |
| Mod |  | Clarification to Ericsson that this part is about the alignment on the names of RRC parameters, which is included the second box. |

# Proposal for online discussion

Based on the comments so far, the following two proposals are drafted:

***Proposal 1: Adopt the following TP to 38.214:***

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| 6.1.1.1 Codebook based UL transmission<Unrelated parts are omitted>The maximum transmission rank may be configured by the higher layer parameter *maxRank* in *pusch-Config* for PUSCH scheduled with DCI format 0\_1 or 0\_3 and *maxRankDCI-0-2* for PUSCH scheduled with DCI format 0\_2*.*When the higher layer parameter *multipanelSchemeSDM* is configured in *pusch-Config*, the maximum transmission rank for each SRS resource set in *srs-ResourceSetToAddModList* with higher layer parameter *usage* in *SRS-ResourceSet* set to 'codebook' may be configured by the higher layer parameter *maxRankSDM* for PUSCH scheduled with DCI format 0\_1 or 0\_3 and the maximum transmission rank for each SRS resource set in *srs-ResourceSetToAddModListDCI-0-2* with higher layer parameter *usage* in *SRS-ResourceSet* set to 'codebook' may be configured by the higher layer parameter *maxRankSDM-DCI-0-2* for PUSCH scheduled with DCI format 0\_2.When the higher layer parameter *multipanelSchemeSFN* is configured in *pusch-Config*, the maximum transmission rank for each SRS resource set in *srs-ResourceSetToAddModList* with higher layer parameter *usage* in *SRS-ResourceSet* set to 'codebook' may be configured by the higher layer parameter *maxRankSFN* in *pusch-Config* for PUSCH scheduled with DCI format 0\_1 or 0\_3 and the maximum transmission rank for each SRS resource set in *srs-ResourceSetToAddModListDCI-0-2* with higher layer parameter *usage* in *SRS-ResourceSet* set to 'codebook' may be configured by the higher layer parameter *maxRankSFN-DCI-0-2* for PUSCH scheduled with DCI format 0\_2.A UE reporting its UE capability of 'partialAndNonCoherent' transmission shall not expect to be configured by either *codebookSubset* or codebookSubsetDCI-0-2 with 'fullyAndPartialAndNonCoherent*'* for two or four antenna ports. <Unrelated parts are omitted> |

***Proposal 2: Adopt the following TP to 38.214:***

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| 6.1.1.1 Codebook based UL transmission<Unrelated parts are omitted>When the higher layer parameter *multipanelScheme* is set to 'SDMScheme' and two SRS resource sets are configured in *srs-ResourceSetToAddModList* or *srs-ResourceSetToAddModListDCI-0-2* with higher layer parameter *usage* in *SRS-ResourceSet* set to 'codebook', two SRI(s), and two TPMI(s) are given by the DCI fields of two SRS resource indicator and two Precoding information and number of layers in clause 7.3.1.1.2 and 7.3.1.1.3 of [5, TS 38.212] for DCI format 0\_1 and 0\_2 or given by *srs-ResourceIndicator, srs-ResourceIndicator2,* *precodingAndNumberOfLayers, and precodingAndNumberOfLayers2* in *configuredGrantConfig*: - When codepoint "10" of *SRS Resource Set* *indicator* is indicated or when *srs-ResourceIndicator2 and* precodingAndNumberOfLayers2 are provided*,* the first TPMI is used to indicate the precoder to be applied over layers {0…v1-1}, where v1 is the number of layers indicated by the first TPMI, that corresponds to the SRS resource selected by the corresponding SRI when multiple SRS resources are configured for the applicable SRS resource set or if single SRS resource is configured for the applicable SRS resource set, and the second TPMI is used to indicate the precoder to be applied over layers {v1…. v2+v1-1}, where v2 is the number of layers indicated by the second TPMI, that corresponds to the SRS resource selected by the corresponding SRI when multiple SRS resources are configured for the applicable SRS resource set or if single SRS resource is configured for the applicable SRS resource set, v1 ≤ *maxRankSDM* or *maxRankSDM-DCI-0-2* andv2 ≤ *maxRankSDM* or *maxRankSDM-DCI-0-2* and *maxRankSDM* or *maxRankSDM-DCI-0-2* is defining the maximum number of layers applied over the first and the second SRS resource sets, separately. - When codepoint "00" or "01" of *SRS Resource Set* *indicator* is indicated*,* the second SRI and second TPMI are reserved, the first TPMI is used to indicate the precoder to be applied over layers {0…v-1}, where v ≤ *maxRank* or *maxRankDCI-0-2,* where *maxRank* or *maxRankDCI-0-2* is defining the maximum number of layers applied over the first SRS resource set or the second SRS resource set. - Codepoint "11" of *SRS Resource Set indicator* is reserved. - For one or two TPMI(s), the transmission precoder is selected from the uplink codebook that has a number of antenna ports equal to the higher layer parameter *nrofSRS-Ports* in *SRS-Config* for the indicated SRI(s), as defined in Clause 6.3.1.5 of [4, TS 38.211]. When two TPMIs are indicated, the UE shall expect that the precoder indicated by the first TPMI and the precoder indicated by the second TPMI are mapped to different PUSCH antenna ports.- When two SRIs are indicated, the UE shall expect that the number of SRS antenna ports associated with two indicated SRIs would be the same. When the UE is configured with the higher layer parameter *txConfig* set to 'codebook', the UE is configured with at least one SRS resource. Each of the indicated one or two SRI(s) in slot *n* is associated with the most recent transmission of SRS resource of associated SRS resource set identified by the SRI, where the SRS resource is prior to the PDCCH carrying the SRI. When two SRS resource sets are configured in *srs-ResourceSetToAddModList* or *srs-ResourceSetToAddModListDCI-0-2* with higher layer parameter *usage* in *SRS-ResourceSet* set to 'codebook', the UE is not expected to be configured with different number of SRS resources in the two SRS resource sets.When higher layer parameter *multipanelScheme* set to 'SFNscheme' and two SRS resource sets are configured in *srs-ResourceSetToAddModList* or *srs-ResourceSetToAddModListDCI-0-2* with higher layer parameter *usage* in *SRS-ResourceSet* set to 'codebook', two SRI(s), and two TPMI(s) are given by the DCI fields of two SRS resource indicator and two Precoding information and number of layers in clause 7.3.1.1.2 and 7.3.1.1.3 of [5, TS 38.212] for DCI format 0\_1 and 0\_2 or given by *srs-ResourceIndicator, srs-ResourceIndicator2,* *precodingAndNumberOfLayers, and precodingAndNumberOfLayers2* in *configuredGrantConfig*: - When codepoint "10" of *SRS Resource Set* *indicator* is indicated or when *srs-ResourceIndicator2 and* precodingAndNumberOfLayers2 are provided*,* the first TPMI is used to indicate precoder to be applied over layers {0…v-1} and the second TPMI is used to indicate the precoder to be applied over layers {0…v-1}, where v ≤ *maxRankSFN* or *maxRankSFN-DCI-0-2* and *maxRankSFN* or *maxRankSFN-DCI-0-2* is defining the maximum number of layers applied over the first SRS resource set and over the second SRS resource set separately. - When codepoint "00" or "01" of *SRS Resource Set* *indicator* is indicated*,* the second SRI and second TPMI are reserved, the first TPMI is used to indicate precoder to be applied over layers {0…v-1}, where v ≤ *maxRank* or *maxRankDCI-0-2*, where *maxRank* or *maxRankDCI-0-2* is defining the maximum number of layers applied over the first SRS resource set or the second SRS resource set.<Unrelated parts are omitted> |

# Reference

1. R1-2409919 Discussion on UE capability for SRS antenna switching CATT