3GPP TSG-RAN WG1 Meeting #113 R1-23xxxxx

Incheon, Korea, May 22 – 26, 2023

Agenda Item: 9.17

Source: Ericsson

Title: Editor’s summary on draft CR 38.211 for NR\_MIMO\_evo\_DL\_UL-Core

Document for: Discussion, Decision

# 1 Introduction

This document is intended to facilitate the review process of the draft CR 38.211 for NR\_MIMO\_evo\_DL\_UL-Core.

# 2 Discussion – first round

Please provide your comments on **the latest version of the draft CR on 38.211** available in this folder.

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| **Company** | **Comment** |
| QC | We thank Stefan very much for putting together the CR for Rel-18 MIMO for 38.211. In the following, we share some comments/suggestions.1. Regarding “Table 6.3.1.5-8: Precoding matrix type A with 8 antenna groups for single-layer transmission using eight antenna ports. Up to 8 layers are supported with transform precoding disabled and up to one layer with transform precoding enabled”: the highlighted part seems inaccurate. Like the subsequent sentence explained, up to 8 layers can be supported with transform precoding disabled.
2. Regarding “Table 6.3.1.5-9: Precoding matrix type B with one antenna group for single-layer transmission using eight antenna ports with transform precoding disabled”: this table can be applied to single-layer transmission with transform precoding enabled, similar to Table 6.3.1.5-8. The same comment applies to Table 6.3.1.5-17.
3. In section 6.4.1.1.3 and Section 7.4.1.1.2, the following equation seems not working for enhanced type 1 and type 2, if I don’t miss anything.

For enhanced type 1 and 2, it looks to me that we need where . The reason we need double the scaling factor before n is because now the range of is doubled. Again, I may be wrong about the above. Please feel free to correct me.1. Regarding the following update in 6.4.1.4.2, we have two comments/questions.

The cyclic shift for antenna port if the higher-layer parameter XXX\_TDM is not configured is given as ,* 4.a) The equations seem not aligned with the agreement (or legacy equation in spec). In agreement , we have “For port , ” where . There are some differences between the above and the agreement, which might leads to different outcome from the equation in the agreement. Although I did not check, but it seems no reason to deviate from the agreement, unless I missed something.

4.b) Why the first equation (/4) is applied to ? If I recall correctly, 4 comb offsets, i.e., is agreed with comb-8 SRS, i.e., 8. With 8, should be 6. So, in my view, the first equation (with modification to take care of previous comment) should apply to . But again, maybe I missed something, Please feel free to correct me.  |
| **OPPO** | 1. The power scaling among TDMed SRS ports has been specified in 38.213. It is not needed to consider additional power boosting in 6.4.1.4.3 (Mapping to physical resources) for
2. For Table 6.4.1.1.3-5, when single symbol is configured, the antenna ports are {0-3, 8-11} for etype 1 DMRS and {0-5, 12-17} for etype 2 DMRS. The same for PDSCH DMRS.

**Table 6.4.1.1.3-5: PUSCH DM-RS frequency index and time index .**

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| --- | --- | --- | --- | --- |
| **DM-RS multiplexing**  | **DM-RS duration** |  |  | **Supported antenna ports**  |
| **Configuration type 1** | **Configuration type 2** |
| Basic | single-symbol DM-RS | 0, 1 | 0 | 0 – 3 | 0 – 5  |
| double-symbol DM-RS | 0, 1 | 0, 1 | 0 – 7  | 0 – 11 |
| Enhanced | single-symbol DM-RS | 0, 1, 2, 3 | 0 | 0 – 3, 8 - 11 | 0 – 5, 12 - 17 |
| double-symbol DM-RS | 0, 1, 2, 3 | 0, 1 | 0 – 15 | 0 – 23  |

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| CATT | Comment 1: In section 6.4.1.1.3 and section 7.4.1.1.2, mapping equation is not working for enhanced configuration type 1 and type 2, as mentioned by QC. Except for the modification from QC, taking CDM group 0 as an example, the equation should also ensure that DMRS occupies the 1st, 2nd, 7th, and 8th REs in one RB for enhanced configuration type 2. Therefore, the following modification is suggested. |
| Fraunhofer IIS/HHI | Thanks Stefan for the effort in compiling the draft CR. We have a couple of comments on the formula for DMRS mapping in 6.4.1.1.3 and 7.4.1.1.2. The FD-OCC length is doubled in release 18. However, just doubling the range of modifies the resource mapping of configuration type 1 and type 2. Per the following agreements, we believe that only the FD-OCC length is modified, but the REs that the DMRS is mapped to is retained for a given CDM group for both legacy DMRS configurations (relevant parts highlighted in red).[110bis-e] AgreementConfirm the working assumption in RAN1#110 with the following update:* To increase the number of DMRS ports for PDSCH/PUSCH, support at least Opt.1 (introduce larger FD-OCC length than Rel.15 (e.g. 4 or 6)).
	+ ~~FFS: FD-OCC length for Rel.18 DMRS type 1 and type 2.~~
	+ FFS: Whether it is needed to handle potential performance issues of Opt 1. For example, study if there is performance loss in case of large delay spread scenario. If needed, how (e.g. additionally support other options).

[110] Agreement* For enhanced FD-OCC length for DMRS of PDSCH/PUSCH, support the following FD-OCC length:
	+ For Rel.18 DMRS type 1, down select from the following in RAN1#110bis-e:
		- Opt.1-1: Length 6 FD-OCC is applied to 6 REs of DMRS within a PRB within an CDM group
		- Opt.1-2: Length 4 FD-OCC is applied to 4 REs of DMRS within a PRB or across consecutive PRBs within an CDM group
	+ For Rel.18 DMRS type 2:
		- Length 4 FD-OCC is applied to 4 REs of DMRS within a PRB within an CDM group
		- FFS: Support of length 6 FD-OCC

[110bis-e] AgreementFor enhanced FD-OCC length for DMRS of PDSCH/PUSCH for Rel.18 eType 1 DMRS, support* Opt.1-2: Length 4 FD-OCC is applied to 4 REs of DMRS within a PRB or across consecutive PRBs within an CDM group

Moreover, the following RRC configurations agreed in R1-2306244 indicate the application of enhanced Rel. 18 DMRS:

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| Parameter | Description | Value range |
| enhanced-dmrs-Type\_r18 | Selection of the enhanced DMRS type to be used for DL (see TS 38.211 [16], clause 7.4.1.1.1). If the field is absent, the UE uses DMRS type 1 or DMRS type 2 depending on *dmrs-Type*. If the field is present, the UE uses DMRS eType 1 if *dmrs-Type* is absent. If the field is present, the UE uses DMRS eType 2 if *dmrs-Type* is present.  | {enabled} |
| enhanced-dmrs-Type\_r18 | Selection of the DMRS type to be used for UL (see TS 38.211 [16], clause 6.4.1.1.3). If the field is absent, the UE uses DMRS type 1 or DMRS type 2 depending on dmrs-Type. If the field is present, the UE uses DMRS eType 1 if dmrs-Type is absent. If the field is present, the UE uses DMRS eType 2 if dmrs-Type is present.  | {enabled} |

Therefore, we propose the following changes (text in red is newly added/modified). Modifiations to 6.4.1.1.3 (the highlights in yellow capture the length-4 FD-OCC used in Rel. 18): * if transform precoding is not enabled,
	+ If higher layer parameter *enhanced-dmrs-Type\_r18* is not configured,
	+ If higher layer parameter *enhanced-dmrs-Type\_r18* is configured,

Modifications to 7.4.1.1.2 (the highlights in yellow capture the length-4 FD-OCC used in Rel. 18): If higher layer parameter *enhanced-dmrs-Type\_r18* is not configured,If higher layer parameter *enhanced-dmrs-Type\_r18* is configured,We believe that these changes capture the agreements well and in a concise manner across both DMRS configurations, without modifying the resource mapping used for legacy configuration types (only FD-OCC mapping is modified). Feel free to correct if there is anything wrong in the above text.  |
| CATT2 | **UL 8Tx****Comment 1 (Section 6.1.3.5):** Regarding the table for precoding matrix for 8 antenna ports codebook based transmission with Ng = 8, we prefer to list all precoding matrixes directly, and set the range of TPMI index to be 0-255.**SRS****Comment 1 (Section 6.4.1.4.2):** Regarding the determination of for comb 4 and comb 8, the following formula were agreed in RAN1 #113 meeting. We suggest to using the agreed formula by replacing *kTC*with its quantity (i.e., 2 for comb and for ) in the spec.

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| **Agreement**For an 8-port SRS resource in a SRS resource set with usage ‘codebook’ or ‘antennaSwitching’, when the 8 ports are mapped onto one or more OFDM symbols using legacy schemes (repetition, frequency hopping, partial sounding, or a combination thereof), and when the resource is assigned with comb 4 on 2 comb offsets (=4, ) or comb 8 on 4 comb offsets (=8, ), the cyclic shift positions are completely aligned across the comb offsets on the same OFDM symbol.* For port , .
 |

**Comment 2 (Section 6.4.1.4.2):** It is our view that no matter whether *tdm* is configured for the SRS resource, the cyclic shift for antenna port is determined by , therefore we suggest to moving the condition of “if the higher-layer parameter XXX\_TDM is not configured” to the front of the formula for calculation.**Comment 3 (Section 6.4.1.4.3):**For an SRS resource with *tdm* configured, the quantity of repetition factor R should be if the higher layer parameter *repetitionFactor* is not configured. Therefore we suggest to change the wording

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| The quantity is the repetition factor given by the field *repetitionFactor* if configured, otherwise . |

toThe quantity is the repetition factor given by the field *repetitionFactor* if configured, otherwise . |
| Docomo | **DMRS**1) In section 6.4.1.1.3 and Section 7.4.1.1.2, we agree the modification from 3) of QC. (From FL perspective, this has been discussed in FL proposal 2.7A in Sect.2.7 in [R1-2303885.zip](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_112b-e/Docs/R1-2303885.zip), and most of companies supported FL proposal 2.7A but also commented it should be up to editor.)2) We agree with 2nd comment of OPPO (Both Table 6.4.1.1.3-5 and Table 7.4.1.1.2-5 should be modified)3) the higher-layer parameter “XXX” in sect 7.4.1.1.2 can be updated as the following for now, although *enhanced-dmrs-Type\_r18* is tentative name in RRC parameter list.- basic or enhanced DM-RS multiplexing is controlled by the higher-layer parameter ~~XXX~~ *enhanced-dmrs-Type\_r18* in the *DMRS-DownlinkConfig* IE.4) The same text as 3) should be specified to sect. 6.4.1.1.3 for PUSCH.The frequency-domain index , the time-domain index , and the supported antenna ports are given by Table 6.4.1.1.3-5. - basic or enhanced DM-RS multiplexing is controlled by the higher-layer parameter *enhanced-dmrs-Type\_r18* in the *DMRS-UplinkConfig* IE. |
| Futurewei | **SRS****Comment 1 (Section 6.4.1.4.1):** For , 8 should be added for an 8-port SRS resource. That is, it should be changed to “”.**Comment 2 (Section 6.4.1.4.2):** For the cyclic shift equations when TDM is not configured, they seem correct to us and no change to the editor’s version is needed. Also our understanding is that the cyclic shift equations when TDM is configured will be provided later when RAN1 agrees on the port splitting over the 2 symbols.**Comment 3 (Section 6.4.1.4.3):** For the power scaling equation, it seems that the change made by the editor is necessary to be consistent with 213 when TDM is configured, so no change to the editor’s version is needed.**Comment 4 (Section 6.4.1.4.3):**For the repetition factor R, we agree with CATT2’s Comment 3. |
| Huawei, HiSilicon(8TX) | Comment 1: (section 6.3.1.5), for codebook type with Ng=8, it’s suggested to use TPMI index 0~254 to be aligned with other codebooks.Comment 2: (section 6.3.1.5), for headers for tables 6.3.1.5-{8-24}, “antenna group” is UE implementation, which is not known to gNB. We suggest to use “Ng=1” instead of antenna group, or higher layer parameters such as *codebookType*. |
| Huawei, HiSilicon2(DMRS & SRS) | Thanks Stefan for the great effort! Regarding the modiftcation, we have the following comments:**Comment 1 (DMRS, Section 6.4.1.1.3 & 7.4.1.1.2):**To make the best advantage of the current spec. and editor’s modification, we suggest the following modification:* if transform precoding is not enabled,
	+ If higher layer parameter *enhanced-dmrs-Type\_r18* is not configured,
	+ Otherwise,
	+ Where

Table 6.4.1.1.3-5: PUSCH DM-RS ~~frequency index and~~ time index .

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| DM-RS multiplexing  | DM-RS duration |  |  | Supported antenna ports  |
| Configuration type 1 | Configuration type 2 |
| Basic | single-symbol DM-RS | ~~0, 1~~ | 0 | 0 – 3 | 0 – 5  |
| double-symbol DM-RS | ~~0, 1~~ | 0, 1 | 0 – 7  | 0 – 11 |
| Enhanced | single-symbol DM-RS | ~~0, 1, 2, 3~~ | 0 | 0 – 3, 8 - 11 | 0 – 5, 12 - 17 |
| double-symbol DM-RS | ~~0, 1, 2, 3~~ | 0, 1 | 0 – 15 | 0 – 23  |

Table 7.4.1.1.2-5 can be similarly modified.**Comment 2 (SRS, Section 6.4.1.1.3 & 7.4.1.1.2):**Agree with the Comment 3 from CATT and Comment 1 from Futurewei. |
| NTT DOCOMO (8TX) | For ‘Table 6.3.1.5-8: Precoding matrix type A with 8 antenna groups for single-layer transmission using eight antenna ports’, * the single-layer is not accurate and it can be revised to ‘up to eight-layer’.
* we prefer to set the range of TPMI index to be 0~254.
* for TPMI index for each W, we prefer to set the value range according to layer, i.e., TPMI index 0-7 for v=1, TPMI index 8-35 for v=2, etc.

For ‘Table 6.3.1.5-9’ and ‘Table 6.3.1.5-17’, the tables can be also applied to single-layer transmission with transform precoding enabled. |
| Samsung | Table 6.3.1.5-8* “single-layer” needs to be deleted from the caption “…~~for single-layer transmission~~ …”
* The scaling factor should be .

The TPMI indices for a given rank are not consecutive, e.g. for rank 1, the indices are 1,2,4,8,…,128. It will make the mapping of the codepoint in DCI to TPMI index complicated. In our view, a sequential TPMI indexing for a given rank is better.  |
| ZTE | **Comment #1 (DMRS)**The current DMRS RE mapping formula is NOT aligned with the following agreement. For eType 1 DMRS, based on the agreement, the mapping REs for the first CDM group#0 should be REs {#0 (1st RB), #2 (1st RB), #4 (1st RB), #6 (1st RB)}, and the mapping REs for the second CDM group#0 should be REs {#8 (1st RB), #10 (1st RB), #0 (2nd RB), #2 (2nd RB)}, as illustrated by Figure 1(a). However, based on the current formula, the mapping REs for the second CDM group#0 are REs {#4 (1st RB), #6 (1st RB), #8 (1st RB), #10 (1st RB)}. Besides, there exists a similar issue for eType 2 DMRS. For eType 2 DMRS, the mapping REs for the first CDM group#0 should be REs {#0, #1, #6, #7}, as illustrated by Figure 1(b). However, based on the current formula, the mapping REs for the first CDM group#0 are REs {#0, #1, #2, #3}.  1(a) eType 1 1(b) eType 2Figure 1 DMRS patterns for Rel-18 eType 1 and eType 2

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| **Agreement** (RAN1#110bis-e)For enhanced FD-OCC length for DMRS of PDSCH/PUSCH for Rel.18 eType 1 DMRS, supportOpt.1-2: Length 4 FD-OCC is applied to 4 REs of DMRS within a PRB or across consecutive PRBs within an CDM group |

Based on above, we suggest the following highlighted change in section 6.4.1.1.3. Besides, similar change is also needed in section 7.4.1.1.2.

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| **Proposed change (Section 6.4.1.1.3)**~~- if transform precoding is not enabled,~~ - if transform precoding is not enabled, and if *enhanced-dmrs-Type\_r18* is not configured- if transform precoding is not enabled, and if *enhanced-dmrs-Type\_r18* is configured |

**Comment #2 (SRS)**Regarding the formula of , ports {1000, 1001, 1002, 1003} should be mapped onto the even SRS symbols, hence, the of the even symbols should be }. Therefore, we suggest the following highlighted change.

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| **Proposed change (Section 6.4.1.4.2)**The quantity is given by- if the higher-layer parameter XXX\_TDM is configured- otherwise |

**Comment #3 (UL 8Tx)**There is a typo in Table 6.3.1.5-8, we suggest the following highlighted change to fix it.

|  |  |  |  |  |
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| **Proposed change (Section 6.3.1.5)**Table 6.3.1.5-8: Precoding matrix type A with 8 antenna groups for single-layer transmission using eight antenna ports. Up to 8 layers are supported with transform precoding disabled and up to one layer with transform precoding enabled.

|  |  |
| --- | --- |
| TPMI index |  |
| 1 – 255 | where column of W, , ~~is~~ has an element 1 on the row corresponding to the port on which layer is to be transmitted, and element 0 in all other rows, ,and TPMI index = , where if a layer is to be transmitted on port and otherwise |

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**Comment #4 (UL 8Tx)**In Tables 6.3.1.5-9 ~ 6.3.1.5-24, the definition of “Precoding matrix type B” and “Precoding matrix type C” are NOT given in the modified spec. Therefore, we suggest the following highlighted change (taking Table 6.3.1.5-9 and Table 6.3.1.5-17 for examples).

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| **Proposed change (Section 6.3.1.5)**Table 6.3.1.5-9: Precoding matrix type B with one antenna group and N1,N2 = (4, 1) for single-layer transmission using eight antenna ports with transform precoding disabled.Table 6.3.1.5-17: Precoding matrix type C with one antenna group and N1,N2 = (2, 2) for single-layer transmission using eight antenna ports with transform precoding disabled. |

**Comment #5 (UL 8Tx)**The normalization coefficients of the TPMIs corresponding to indices 6 and 7 in Table 6.3.1.5-19 are not correct. Therefore, we suggest the following highlighted change.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Proposed change (Section 6.3.1.5)**Table 6.3.1.5-19: Precoding matrix type C with one antenna group for three-layer transmission using eight antenna ports with transform precoding disabled.

|  |  |
| --- | --- |
| TPMI index | (ordered from left to right in increasing order of TPMI index) |
| 0 – 3 |  |  |  |  |
| 4 – 7 |  |  |  |  |

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| vivo | **SRS**Regarding the formula of cyclic shift assignment for SRS ports, we share the same view with QC and CATT. We suggest to use the formula in the previous agreement, and some misalignments of the conditions should also be fixed as following.

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| **Agreement**For an 8-port SRS resource in a SRS resource set with usage ‘codebook’ or ‘antennaSwitching’, when the 8 ports are mapped onto one or more OFDM symbols using legacy schemes (repetition, frequency hopping, partial sounding, or a combination thereof), and when the resource is assigned with comb 4 on 2 comb offsets (=4, ) or comb 8 on 4 comb offsets (=8, ), the cyclic shift positions are completely aligned across the comb offsets on the same OFDM symbol.* For port , .
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**DMRS**The DMRS mapping equation is not working for enhanced configuration type 1 and type 2. The revision of CATT or ZTE seems a clear solution. |
| Apple | **8 Tx****Comment 1 (Section 6.3.1.3)**The complex-valued modulation symbols for each of the codewords to be transmitted shall be mapped onto up to eight ~~four~~ layers according to Table 7.3.1.3-1. |
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Editor’s response:

* The equations in 6.4.1.1.3 and 7.4.1.1.2 were obviously incorrect as pointed out by several companies; I have revised them and separated basic and enhanced multiplexing
* The description of the non-coherent codebook in Table 6.3.1.5-8 has been refined to get indices from 0 and upwards, sorted such that all rank 1 entries comes before rank 2 entries, etc.
* The term ‘antenna group’ need to be refined. The term is not defined (in 211), neither is Ng=1. Linking it to an RRC parameter seems difficult as there is no notion of codebook subsets, hence identifying coherence from the current RRC parameters seems difficult. Try to resolve this at the next RAN1 meeting (a comment is added to the draft CR).
* Some companies wanted to change the SRS cyclic shift formula in different ways. All the proposals seem to give the same result, hence it is more of an editorial issue and no need to change the current expression.
* Table captions, antenna ports numbers, and various typos pointed out by different companies have been corrected.
* Not that four layers in 6.3.1.3 is correct as it is per codeword (two codewords gives eight layers)

# 2 Discussion – second round

Please provide your comments on **the latest version of the draft CR on 38.211** available in this folder.

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| **Company** | **Comment** |
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