**3GPP TSG RAN WG1 #103-e R1-200xxxx**

**e-Meeting, October 26th – November 13th, 2020**

**Agenda item:** 7.2.6

**Source:** Moderator (vivo)

**Title:** [103-e-NR-eMIMO-04] Maintenance and TPs for UL Full-Power

**Document for:** Discussion and Decision

Issue1: Draft CR UL.2

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| Following TP can be starting point.**Text proposal for 38.214 v16.3.0**6.2.3.1 UE PT-RS transmission procedure when transform precoding is not enabled< Unchanged parts are omitted >For partial-coherent and non-coherent codebook-based UL transmission, the actual number of UL PT-RS port(s) is determined based on TPMI and/or number of layers which are indicated by *Precoding information and number of layers* field in DCI format 0\_1 and DCI format 0\_2 or configured by higher layer parameter *precodingAndNnumberOfLayers*:- if the UE is configured with the higher layer parameter *maxNrofPorts* in *PTRS-UplinkConfig* set to 'n2', the actual UL PT-RS port(s) and the associated transmission layer(s) are derived from indicated TPMI as:- PUSCH antenna port 1000 and 1002 in indicated TPMI share PT-RS port 0, and PUSCH antenna port 1001 and 1003 in indicated TPMI share PT-RS port 1 except for the cases that *ul-FullPowerTransmission* is configured to *fullpowerMode1*, and TPMI=2 in Table 6.3.1.5-1, or one of the TPMI 12-15 in Table 6.3.1.5-2 and Table 6.3.1.5-3 in [4, TS 38.211] is indicated.- UL PT-RS port 0 is associated with the UL layer 'x' of layers which are transmitted with PUSCH antenna port 1000 and PUSCH antenna port 1002 in indicated TPMI, and UL PT-RS port 1 is associated with the UL layer 'y' of layers which are transmitted with PUSCH antenna port 1001 and PUSCH antenna port 1003 in indicated TPMI, where 'x' and/or 'y' are given by DCI parameter *PTRS-DMRS association* as shown in DCI format 0\_1 and DCI format 0\_2 described in Clause 7.3.1 of [5, TS38.212].- For the cases that *ul-FullPowerTransmission* is configured to *fullpowerMode1*, and TPMI=2 in Table 6.3.1.5-1, or one of the TPMI 12-15 in Table 6.3.1.5-2 and Table 6.3.1.5-3 in [4, TS 38.211] is indicated, PUSCH antenna port 1000, 1001, 1002 and 1003 in the indicated TPMI share PT-RS port 0.< Unchanged parts are omitted > |

Draft CR UL.2, option 2 (R1-2007819)

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| For partial-coherent and non-coherent codebook-based UL transmission, the actual number of UL PT-RS port(s) is determined based on TPMI and/or number of layers which are indicated by *Precoding information and number of layers* field in DCI format 0\_1 and DCI format 0\_2 or configured by higher layer parameter *precodingAndNnumberOfLayers*:- if the UE is configured with the higher layer parameter *maxNrofPorts* in *PTRS-UplinkConfig* set to 'n2', the actual UL PT-RS port(s) and the associated transmission layer(s) are derived from indicated TPMI as:- PUSCH antenna port 1000 and 1002 in indicated TPMI share PT-RS port 0, and PUSCH antenna port 1001 and 1003 in indicated TPMI share PT-RS port 1 except for the cases that *ul-FullPowerTransmission-r16* is set to '*fullpowerMode1*', and TPMI=2 in Table 6.3.1.5-1, or one of the TPMI 12-15 in Table 6.3.1.5-2 and Table 6.3.1.5-3 in [4, TS 38.211] is indicated.- UL PT-RS port 0 is associated with the UL layer 'x' of layers which are transmitted with PUSCH antenna port 1000 and PUSCH antenna port 1002 in indicated TPMI, and UL PT-RS port 1 is associated with the UL layer 'y' of layers which are transmitted with PUSCH antenna port 1001 and PUSCH antenna port 1003 in indicated TPMI, where 'x' and/or 'y' are given by DCI parameter *PTRS-DMRS association* as shown in DCI format 0\_1 and DCI format 0\_2 described in Clause 7.3.1 of [5, TS38.212]. - For the cases that *ul-FullPowerTransmission-r16* is set to '*fullpowerMode1*', and TPMI=2 in Table 6.3.1.5-1, or one of the TPMI 12-15 in Table 6.3.1.5-2 and Table 6.3.1.5-3 in [4, TS 38.211] is indicated, the actual number of UL PT-RS port is 1, where UL PT-RS port 0 is associated with the layer of the UL transmission. |

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| Company  | comments |
| CATT | Support to resolve this issue, with option 2 (c.f. R1-2007819) added above. In our view there are two issues to be resolved: 1. The number of PTRS ports is 1, when rank-1 full-coherent transmission is scheduled.
2. PTRS port 0 is associated with the scheduled UL layer. Our understanding is that 38.214 intends to specify the “*association between PTRS and transmission layer*”, as the 1st paragraph in the current specification reads. Similarly in the 2nd paragraph (current specification) what is specified is the association between “UL PTRS port 0 to UL layer”. Hence specifying PTRS/layer association is consistent with the current specification.

Comment 2@QC/Apple: RAN1 had the following agreement in RAN1#89, where one DMRS port is associated to one PTRS port. * Support association between one PTRS port and one DMRS port per DMRS port group

So the case you mentioned of one DMRS port associated with two PTRS ports is neither part of the RAN1 agreement, nor supported by the current spec. As a matter of fact, given your view that “*… the two PTRS ports use the same DMRS sequence and same RE mapping*”, there is indeed, only one, PTRS port. This needs to be correctly captured in 214, as the current specification doesn’t cover this case. Comment 3@Nokia: The exception addressed by the CR is only for rank-1 full-coherent transmission, e.g. TPMI=2 in Table 6.3.1.5-1, or one of the TPMI 12-15 in Table 6.3.1.5-2 and Table 6.3.1.5-3 in [4, TS 38.211].Comment 4@Ericsson/Samsung: As the 1st paragraph states, the association is between “actual UL PT-RS port(s) and the associated transmission layer(s) …. TPMI”. From implementation perspective what matters to NW is what REs are used for DMRS tracking (e.g. PT-RS ports, not SRS/PUSCH ports 1000-1003), and that’s why the current spec (2nd paragraph) states “UL PT-RS port 0 is associated with the UL layer 'x'….”. The reference to PUSCH port 1000-1003 in the 2nd paragraph is just an intermediate step used to derive the UL layer. We would not oppose option 1 if that’s the majority preference, although we do believe option 2 is the actual intention in deriving implementation behavior.  |
| Huawei, HiSilicon | Supportive on the proposal. The issue of mismatch between full power Mode-1 and 2-Port PTRS need to be addressed. In current spec, the mapping between PTRS ports and DMRS ports are one-to-one in FDM manner, where the RE mapping of PTRS ports is shown in 6.4.1.2.2.1 in TS 38.211. There is no such case that 2-port PTRS mapping to the one DMRS port in current spec. For the full coherent precoding $\left[1 1 j j\right]$, only 1 port PTRS can be used, shown in 38.214:*“If a UE has reported the capability of supporting full-coherent UL transmission, the UE shall expect the number of UL PT-RS ports to be configured as one if UL-PTRS is configured.”*So, it is ambiguity for supporting two-PTRS ports for the new introduced precoding $\left[1 1 j j\right]$ in Mode-1 full power transmission.Both TPs are fine for us. The intention is to address the ambiguity for Full power Mode-1.Comment to QC and ZTE: The TP/CR is to support the case with 2-port PTRS for Mode-1, not to restrict anything. For ZTE mentioned case, i.e., two PTRS ports and 1 DMRS ports for Mode-1, is not clear for the use case and benefits, since Mode-1 is with rank-1 diversity transmission (such as CDD) on the antenna ports, where phase shifting between antenna ports for non/partil-coherent case is much more problematic than phase noise. Even there is a use case, to support the mapping, we also need some specification changes, since the mapping of 2-port PTRS to 1-port DMRS is not supported in current spec. Runhua also provided the previous agreement.Reply to Nokia: The mapping issue is for rank-1 case, since only one DMRS port for Rank-1 but with two PTRS ports. For non/partial-coherent precodings, such as [1 0 1 0], only part of antennas will be used for UL transmission, so only one of PTRS port-0 or PTRS port-1 will be used in rank-1 transmission, then the one-to-one mapping between PTRS port and DMRS port is clear enough. However, for Mode-1, the coherent precodings, such as [1 1 j j], are introduced, the mapping between antenna ports and PTRS ports or PTRS port and DMRS port is ambiguity in current spec as we mentioned. For rank-2, there are two PTRS ports (2-port PTRS) and two DMRS ports, the current spec is also clear with one-to one mapping between PTRS and DMRS ports. So, no need any updates. |
| QC | Disagree with the proposal. No TP/CR is needed.  This issue has been discussed in last meeting. We don’t see the point to repeat the discussion in this meeting. But since the issue is in email discussion, we share our view as below.Based on current specification, the two PTRS ports are mapped to one identical DMRS port. Current spec has no issue. The CR is not needed. A little bit more explanation as below.Let’s take this example: in full power mode 1, for a 4-Tx partial coherent UE, if gNB schedule 1 layer Tx on DMRS port 0 and TPMI is [1, 1, 1, 1]^T. Based on following current spec, PTRS port 0 is associate to DMRS port 0 and PTRS port 1 is associate to DMRS port 0. Since the two PTRS ports are associated to an identical DMRS port, the two PTRS ports use the same DMRS sequence and same RE mapping. So there is no problem. -     PUSCH antenna port 1000 and 1002 in indicated TPMI share PT-RS port 0, and PUSCH antenna port 1001 and 1003 in indicated TPMI share PT-RS port 1-    UL PT-RS port 0 is associated with the UL layer [x] of layers which are transmitted with PUSCH antenna port 1000 and PUSCH antenna port 1002 in indicated TPMI, and UL PT-RS port 1 is associated with the UL layer [y] of layers which are transmitted with PUSCH antenna port 1001 and PUSCH antenna port 1003 in indicated TPMI, where [x] and/or [y] are given by DCI parameter PTRS-DMRS association as shown in DCI format 0\_1 described in Clause 7.3.1 of [5, TS38.212]. |
| Intel | Support to resolve the issue.We share similar view with CATT and Huawei. The current spec is not clear and needs clarification. |
| Apple | No TP/CR is needed. The outcome is the same with or without TP/CR. |
| LG | Support to resolve the issue. We agree with CATT, Intel and Huawei’s observation that current spec is not clear. |
| OPPO | Support to make a clarification with TP/CR since the current spec is not clear |
| ZTE | No TP/CR is needed.From our perspective, 2 PT-RS ports are still needed to the multi-port non/ partial-coherence UEs in Mode 1 with Rank1 based transmission, because the phase variations caused by phase noise in the oscillators also will harm the performance of the related PUSCH transmission, especially in FR2 and where the phase noise tends to be higher. Correspondingly, the above draft CRs will cause some redundant restrictions. Besides, we share the same view with QC/Apple that the current spec is clear and not broken. Thus, we fail to see that any TP/CR is needed at here. |
| Nokia, NSB | Support the intention. However, this text below is not quite clear: “For the cases that *ul-FullPowerTransmission-r16* is set to '*fullpowerMode1*', and TPMI=2 in Table 6.3.1.5-1, or one of the TPMI 12-15 in Table 6.3.1.5-2 and Table 6.3.1.5-3 in [4, TS 38.211] is indicated, the actual number of UL PT-RS port is 1, where UL PT-RS port 0 is associated with the layer of the UL transmission.”For rank-1 Tx, this text seems okay. For rank-2 Tx with 2 layers, which spec is supporting for fullpowerMode1, how to interpret “where UL PT-RS port 0 is associated with the layer of the UL transmission.”? |
| Ericsson | Support to resolve the issue. If two PT-RS essentially merge to one when one layer is transmitted, the behavior is not clear for us: if/how do they combine?Option 1 seems a little more precise, and so we slightly prefer it. |
| Samsung | There seems to be ambiguity in UE behavior. So, we are OK to clarify this, and Option 1 is preferred.  |
| MediaTek | It looks TP/CR and what QC said result in the same actual transmission, just different with 1 or 2 PTRS port(s). If that is the intention and no further concern that have to use 2-port PTRS, we’re okay with the proposal to make it clear. Okay for both options.  |

Observation1: majority of companies support introducing the CR, in this case there two slightly different TPs. 2 companies view the CR is not needed.

Issue2: Draft LS UL.4

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| Proposed text for draft LS to RAN2.In RAN1#102-e, the FG 16-5c-3 was agreed with “Candidate component values: any of {2-port {2-bit bitmap}, one of 4-port non-coherent {G0~G3}, one of 4-port partial-coherent {G0~G6}}” which was included in the UE features list in R1-2007326. In RAN1#98, following agreement was made**Agreement**For mode 2, in case of non-coherent with 2 ports, support following TPMI indication for rank 1 which support UL full power transmission:* Rank 1: support {TPMI=0} and {TPMI=1}
* FFS: Details on UE capability signalling

In RAN1#99, following agreements were made**Agreement**For 2 ports, number of bits to indicate TPMI(s) which can deliver UL full power: * 2 bits (bitmap)
* Whether is this capability reporting is optional or not will be discussed as part of UE capability discussions

**Agreement**For 4 ports, number of bits to indicate TPMI(s) which can deliver UL full power:* + Non Coherent 2 bits
	+ Partial coherent 4 bits
		- Additional entries on top of existing entries may be added to table 1 and table 2
	+ Whether is this capability reporting is optional or not will be discussed as part of UE capability discussions

Table 1.

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| --- | --- |
| 4Tx, nonCoherent | 4Tx, partial coherent (4bit) |
| G0 | G0 |
| G1 | G1 |
| G2 | G2 |
| G3 | G3 |
|  | G4 |
|  | G5 |
|  | G6 |
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Definition of G0~G6 can be found in the table below.Table 2.

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|  | TPMI groups |
| G0 | $\frac{1}{2}\left[\begin{array}{c}1\\0\\0\\0\end{array}\right]$, |
| G1 | $\frac{1}{2}\left[\begin{array}{c}1\\0\\0\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}0\\0\\1\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}\begin{matrix}1&0\end{matrix}\\\begin{matrix}0&0\end{matrix}\\\begin{matrix}0&1\end{matrix}\\\begin{matrix}0&0\end{matrix}\end{array}\right]$, |
| G2 | $\frac{1}{2}\left[\begin{array}{c}1\\0\\0\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}0\\0\\1\\0\end{array}\right],\frac{1}{2}\left[\begin{array}{c}\begin{matrix}1&0\end{matrix}\\\begin{matrix}0&0\end{matrix}\\\begin{matrix}0&1\end{matrix}\\\begin{matrix}0&0\end{matrix}\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}\begin{matrix}1&0\end{matrix}\\\begin{matrix}0&1\end{matrix}\\\begin{matrix}0&0\end{matrix}\\\begin{matrix}0&0\end{matrix}\end{array}\right]$,$\frac{1}{2}\left[\begin{array}{c}\begin{matrix}0&0\end{matrix}\\\begin{matrix}1&0\end{matrix}\\\begin{matrix}0&1\end{matrix}\\\begin{matrix}0&0\end{matrix}\end{array}\right],$ $\frac{1}{2}\left[\begin{array}{c}\begin{matrix}1&0&0\end{matrix}\\\begin{matrix}0&1&0\end{matrix}\\\begin{matrix}0&0&1\end{matrix}\\\begin{matrix}0&0&0\end{matrix}\end{array}\right]$ |
| G3 | $\frac{1}{2}\left[\begin{array}{c}\begin{matrix}1&0\end{matrix}\\\begin{matrix}0&0\end{matrix}\\\begin{matrix}0&1\end{matrix}\\\begin{matrix}0&0\end{matrix}\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}\begin{matrix}1&0\end{matrix}\\\begin{matrix}0&1\end{matrix}\\\begin{matrix}0&0\end{matrix}\\\begin{matrix}0&0\end{matrix}\end{array}\right]$,$\frac{1}{2}\left[\begin{array}{c}\begin{matrix}0&0\end{matrix}\\\begin{matrix}1&0\end{matrix}\\\begin{matrix}0&1\end{matrix}\\\begin{matrix}0&0\end{matrix}\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}\begin{matrix}1&0&0\end{matrix}\\\begin{matrix}0&1&0\end{matrix}\\\begin{matrix}0&0&1\end{matrix}\\\begin{matrix}0&0&0\end{matrix}\end{array}\right]$ |
| G4 | $\frac{1}{2}\left[\begin{array}{c}1\\0\\1\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\-1\\0\end{array}\right],\frac{1}{2}\left[\begin{array}{c}1\\0\\j\\0\end{array}\right]$,$\frac{1}{2}\left[\begin{array}{c}1\\0\\-j\\0\end{array}\right],\frac{1}{2}\left[\begin{array}{c}\begin{matrix}1&0\end{matrix}\\\begin{matrix}0&0\end{matrix}\\\begin{matrix}0&1\end{matrix}\\\begin{matrix}0&0\end{matrix}\end{array}\right]$ |
| G5 | $\frac{1}{2}\left[\begin{array}{c}1\\0\\1\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\-1\\0\end{array}\right],\frac{1}{2}\left[\begin{array}{c}1\\0\\j\\0\end{array}\right]$,$\frac{1}{2}\left[\begin{array}{c}1\\0\\-j\\0\end{array}\right]\frac{1}{2}\left[\begin{array}{c}\begin{matrix}1&0\end{matrix}\\\begin{matrix}0&0\end{matrix}\\\begin{matrix}0&1\end{matrix}\\\begin{matrix}0&0\end{matrix}\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}\begin{matrix}1&0\end{matrix}\\\begin{matrix}0&1\end{matrix}\\\begin{matrix}0&0\end{matrix}\\\begin{matrix}0&0\end{matrix}\end{array}\right]$,$\frac{1}{2}\left[\begin{array}{c}\begin{matrix}0&0\end{matrix}\\\begin{matrix}1&0\end{matrix}\\\begin{matrix}0&1\end{matrix}\\\begin{matrix}0&0\end{matrix}\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}\begin{matrix}1&0&0\end{matrix}\\\begin{matrix}0&1&0\end{matrix}\\\begin{matrix}0&0&1\end{matrix}\\\begin{matrix}0&0&0\end{matrix}\end{array}\right]$ |
| G6 | $\frac{1}{2}\left[\begin{array}{c}1\\0\\1\\0\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}1\\0\\-1\\0\end{array}\right],\frac{1}{2}\left[\begin{array}{c}1\\0\\j\\0\end{array}\right]$,$\frac{1}{2}\left[\begin{array}{c}1\\0\\-j\\0\end{array}\right]$,$ \frac{1}{2}\left[\begin{array}{c}0\\1\\0\\1\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\-1\end{array}\right],\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\j\end{array}\right]$,$\frac{1}{2}\left[\begin{array}{c}0\\1\\0\\-j\end{array}\right]$$\frac{1}{2}\left[\begin{array}{c}\begin{matrix}1&0\end{matrix}\\\begin{matrix}0&1\end{matrix}\\\begin{matrix}0&0\end{matrix}\\\begin{matrix}0&0\end{matrix}\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}\begin{matrix}1&0\end{matrix}\\\begin{matrix}0&0\end{matrix}\\\begin{matrix}0&1\end{matrix}\\\begin{matrix}0&0\end{matrix}\end{array}\right]$, $\frac{1}{2}\left[\begin{array}{c}\begin{matrix}1&0\end{matrix}\\\begin{matrix}0&0\end{matrix}\\\begin{matrix}0&0\end{matrix}\\\begin{matrix}0&1\end{matrix}\end{array}\right]$,$\frac{1}{2}\left[\begin{array}{c}\begin{matrix}0&0\end{matrix}\\\begin{matrix}1&0\end{matrix}\\\begin{matrix}0&1\end{matrix}\\\begin{matrix}0&0\end{matrix}\end{array}\right]$,$\frac{1}{2}\left[\begin{array}{c}\begin{matrix}0&0\end{matrix}\\\begin{matrix}1&0\end{matrix}\\\begin{matrix}0&0\end{matrix}\\\begin{matrix}0&1\end{matrix}\end{array}\right], \frac{1}{2}\left[\begin{array}{c}\begin{matrix}0&0\end{matrix}\\\begin{matrix}0&0\end{matrix}\\\begin{matrix}1&0\end{matrix}\\\begin{matrix}0&1\end{matrix}\end{array}\right],\frac{1}{2}\left[\begin{array}{c}\begin{matrix}1&0&0\end{matrix}\\\begin{matrix}0&1&0\end{matrix}\\\begin{matrix}0&0&1\end{matrix}\\\begin{matrix}0&0&0\end{matrix}\end{array}\right]$ |

RAN1 concluded that the definition of G0~G6 TPMI groups should be captured in 38.306.Action to RAN2:RAN1 respectfully ask RAN2 to take above into account.  |

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| Company  | comments |
| CATT | OK with the LS |
| Huawei, HiSilicon | OK |
| QC | The LS looks fine.  |
| Intel | Fine with the draft. |
| Apple | OK |
| LG | Support |
| OPPO | Ok |
| ZTE | Support |
| Nokia, NSB | support |
| Ericsson | OK |
| Samsung | OK |
| MediaTek | OK |

Observation2: there is consensus among companies on text for LS to RAN2.

Issue3: Draft CR in R1-2008676

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| Company  | comments |
| CATT | OK |
| Huawei, HiSilicon | OK |
| QC | The CR looks fine |
| Intel | OK |
| Apple | OK |
| LG | Fine with CR. |
| OPPO | Ok |
| ZTE | Support |
| Nokia, NSB | ok |
| Ericsson | OK |
| Samsung | OK |
| MediaTek | OK |

Observation3: there is consensus among companies to support the draft CR.

# References

[1] R1-2008140, “Summary for Rel.16 NR eMIMO maintenance”, RAN1#103-e