**3GPP TSG RAN WG1 #100bis R1-200xxxx**

**e-Meeting, April 20th – 30th, 2020**

Source: moderator (vivo)

Title: Feature lead summary on ULFPTx-03

Agenda Item: 7.2.6.4

Document for: Discussion and Decision

1. Summary

Following email thread is assigned for discussion:

[100b-e-NR-eMIMO-ULFPTx-03] Email discussion on Issue #4 in R1-2002746: TP for power scaling for Mode2. By 4/24 and corresponding TP (if any) by 4/30 – Rakesh (vivo)

1. Discussion on issue 4[1]
   1. Issue 4: TP for power scaling for Mode2
      1. TP1

**TS 38.213**

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7.1 Physical uplink shared channel

For a PUSCH transmission on active UL BWP , as described in Clause 12, of carrier  of serving cell , a UE first calculates a linear value  of the transmit power , with parameters as defined in Clause 7.1.1. For a PUSCH transmission scheduled by a DCI format or configured by *ConfiguredGrantConfig* or *semiPersistentOnPUSCH*, if *txConfig* in *PUSCH-Config* is set to 'codebook',

- ….. set to 'nonCoherent' or 'partialAndNonCoherent', the UE scales by where:

- ….

- ….. for full power TPMIs reported by the UE [16, TS 38.306] corresponding to the value of *codebookSubset*, ~~and~~ is the ratio of a number of antenna ports with non-zero PUSCH transmission power over a number of SRS ports for the remaining TPMIs and corresponding *codebookSubset*, where the number of SRS ports is associated with the ~~a~~ SRS resource indicated by SRI if more than one SRS resource~~s are~~ is configured in the *….* set to 'codebook', or the number of SRS ports is associated with the SRS resource if only one SRS resource is configured in the *….* set to 'codebook', and

- if *….*is not provided,

- else, if each SRS resource in the *…*set to 'codebook' has more than one SRS port, the UE scales the linear value by the ratio of the number of antenna ports with a non-zero PUSCH transmission power to the maximum number of SRS ports supported by the UE in one SRS resource.

The UE splits the power equally across the antenna ports on which the UE transmits the PUSCH with non-zero power.

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Please provide your views/comments in the table below

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| Company/organization | comments |
| OPPO | Not needed. For 4 Tx ports, a non-coherent UE will report UE capability via 2 bits and a partial-coherent UE will use 4 bits. In the tdoc proposing the above-mentioned TP, UE may use 6 bits, where 2 of which report capability for non-coherent operation and the other 4 bits report capability for partial coherent operation. From our understanding, the tdoc misunderstood the agreement. |
| CMCC | It seems that companies have different understandings regarding the following agreements. In our understanding, for 2Tx UE reporting ‘non-coherent’ capability in 2-13, UE can report 2-port TPMI(s) in *codebookSubset = nonCoherent* that can support full power transmission. For 4Tx UE reporting ‘non-coherent’ capability in 2-13, UE can report 2-port and/or 4-port TPMI(s) in *codebookSubset = nonCoherent* that can support full power transmission. For 4Tx UE reporting ‘partial/non-coherent’ capability in 2-13, UE can report 2-port TPMI(s) in *codebookSubset = nonCoherent* and/or 4-port TPMI(s) in *codebookSubset = nonCoherent* and/or 4-port TPMI(s) in *codebookSubset = partialandNonCoherent* that can support full power transmission. We think we should first clarify whether this understanding is correct or not, then we can decide whether this TP is needed or not.  **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 |
| Samsung | Not needed.  In our view, a UE reports only one TPMI group (not multiple) depending on number of ports and its capability (non-coherent or partial-coherent). Based on this understanding, we also think this TP is not needed. |
| CATT | Not needed. Non-coherent TPMIs are included in the full power TPMI groups for 4Tx partial-coherent. It is not necessary for a 4Tx partial-coherent UE to report full power TPMI groups for *codebookSubset* = nonCoherent and *codebookSubset* = partialAndNonCoherent respectively. |
| Apple | Not needed |
| ZTE | We think TP1 is not needed with the following reason.  The UE reports full power TPMIs according to its UE capability, and each TPMI should be supported full power transmission for the UE. Besides, UE with partial-coherent ports can use both of partial-coherent and non-coherent TPMIs to enable full power transmission. Therefore, we think TP1 is redundant and not needed. |
| LG | Not needed |
| Intel | We are open for discussion and slightly prefer with the text proposal. For partial coherent UE with 4 Tx, the UE may report full power TPMIs of partial coherent codebook subset with 4 ports and also report full power TPMIs of noncoherent codebook subset with 2 ports if it supports antenna virtualization. |
| Spreadtrum | Not needed |
| DOCOMO | We have similar view as CMCC. We need to first align our understanding on previous agreements. In particular, as per our understanding, there are few cases to be considered as follows:   * Case A: 2Tx UE (non-coherent)   + 2-port TPMI group reporting (2bits) * Case B: 4Tx UE (non-coherent)   + Option B-1 (total 2bits): 4-port non-coherent TPMI group reporting (2bits)   + Option B-2 (total 4bits): 2-port TPMI group reporting (2bits) + 4-port non-coherent TPMI group reporting (2bits)   + Option B-3: Either reporting option1 or option2 is up to UE implementation * Case C: 4Tx UE (partial-coherent)   + Option C-1 (total 4bits): 4-port partial-coherent TPMI group reporting (4bits)   + Option C-2 (total 6bits): 2-port TPMI group reporting (2bits) + 4-port partial-coherent TPMI group reporting (4bits)   + Option C-3 (total 8bits): 2-port TPMI group reporting (2bits) + 4-port non-coherent TPMI group reporting (2bits) + 4-port partial-coherent TPMI group reporting (4bits)   + Option C-4: Any one of reporting option1, option2 or option3 is up to UE implementation   We understand previous agreements as option B-2 and option C-2. As a result, we think the TP is needed. |
| Huawei, HiSilicon | For Mode-2, multiple SR resources with different number of ports can be configured, so there can be different TPMI groups reported from UE for different SRS resources with different number of ports.For example, UE may report 2 ports TPMIs for full power, and report 4 port TPMIs for full power at the same time. This understanding is aligned with CMCC.  However, for 4Tx, UE may have capability of partial coherent, then both of 4-port partial coherent and 4-port non-coherent codebook subsets can be used. Whether need to report full power TPMIs per codebook subset? In our understanding, it is not necessary, since the codebook subset of non-coherent is a subset of partial coherent. No need to report TPMIs for non-coherent and partial coherent separately.  So, here, the same understanding with Intel, we only need to clarify the following:  ***UE may report different TPMI groups for different SRS resources with different number of ports.*** |
| QC | Our understanding on this issue is that, a 4 Tx UE needs to do two TPMI grouping reports, one report for 4 ports SRS resource, one report for 2 ports SRS resource.  Regarding the TP itself, we are not sure what does “corresponding *codebookSubset*” mean in the TP. Does it mean different codebook size, i.e., 2 ports codebook vs 4 ports codebook, or different codebook type, i.e., noncoherent vs partialcoherent vs full coherent, or the combination of both? |
| Ericsson | Given the feedback above, we agree the TP is not needed to address which codebook subsets a full power TPMI is associated with.  Regarding how to handle which TPMIs are full power as a function of SRI, our understanding is that the existing text should be sufficient since a precoding matrix is associated with a specific number of ports.  If & how to report full power TPMIs for 2 ports in a 4 port UE Mode 2 UE with 4 port full power TPMIs should be handled in the UE capability discussions. |
| vivo | Not needed. |
| InterDigital | Not needed, we have a similar view as Ericsson. |

**Observation:**

Majority of companies expressed that this TP is not needed, on the other hand full power TPMIs reporting for 2 ports and 4 ports when multiple SRS is configured with different number for ports is UE capability related discussion.

* + 1. TP2

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- if ULFPTxModes in PUSCH-Config is set to Mode1, and each SRS resource in the SRS-ResourceSet with usage set to 'codebook' has more than one SRS port', is the ratio of a number of antenna ports with non-zero PUSCH transmission power over the maximum number of SRS ports supported by the UE in one SRS resource, or

- if ULFPTxModes in PUSCH-Config is set to Mode2, when for full power TPMIs reported by the UE [16, TS 38.306], and is the ratio of a number of antenna ports with non-zero PUSCH transmission power over a number of SRS ports for remaining TPMIs, where the number of SRS ports is associated with a SRS resource indicated by SRI if more than one SRS resources are configured in the SRS-ResourceSet with usage set to 'codebook', or the number of SRS ports is associated with the SRS resource if only one SRS resource is configured in the SRS-ResourceSet with usage set to 'codebook', or when full power TPMIs are not reported by the UE, is the ratio of the number of antenna ports with a non-zero PUSCH transmission power to the number of SRS ports is associated with a SRS resource indicated by SRI if more than one SRS resources are configured in the *SRS-ResourceSet* with usage set to ‘codebook’ and the indicated SRS resource has more than one SRS port, or

- if ULFPTxModes in PUSCH-Config is not provided,

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Please provide your views/comments in the table below

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| Company/organization | comments |
| OPPO | Not needed as there is no issue. The wording “for remaining TPMIs” is very clear. |
| CMCC | We also think the part added can be covered by the remaining TPMIs case. |
| Samsung | Not needed, same view as OPPO, since the text “the remaining TPMIs” is equivalent to “TPMIs are not reported by the UE” |
| CATT | Not needed. How to determine for non-reported TPMIs is clear in current specification. When there is no full power TPMI reported, all the TPMIs are “remaining TPMIs”. |
| Apple | Not needed |
| ZTE | We think TP2 is not needed.  As some companies hold the same view, this TP is redundant with the text “remaining TPMIs”. |
| LG | Not needed |
| Intel | We think in the current spec, the power scaling for one port SRS is missing for Mode 2 operation. In this case, there is no TPMI at all. We suggest the following text change.  - if ULFPTxModes in PUSCH-Config is set to Mode1, and each SRS resource in the SRS-ResourceSet with usage set to 'codebook' has more than one SRS port', is the ratio of a number of antenna ports with non-zero PUSCH transmission power over the maximum number of SRS ports supported by the UE in one SRS resource  - if ULFPTxModes in PUSCH-Config is set to Mode2,   * for full power TPMIs reported by the UE [16, TS 38.306], and is the ratio of a number of antenna ports with non-zero PUSCH transmission power over a number of SRS ports for remaining TPMIs, where the number of SRS ports is associated with a SRS resource indicated by SRI if more than one SRS resources are configured in the SRS-ResourceSet with usage set to 'codebook', or the number of SRS ports is associated with the SRS resource if only one SRS resource is configured in the SRS-ResourceSet with usage set to 'codebook', * , if the SRS resource with single port is indicated by SRI when more than one SRS resources are configured in the SRS-ResourceSet with usage set to 'codebook' or if only one SRS resource is configured in the SRS-ResourceSet with usage set to 'codebook' which has single port   - if ULFPTxModes in PUSCH-Config is not provided, |
| Spreadtrum | The TP is not needed.  Indeed, the power scaling for 1-port SRS is missing for mode2. We agree with Intel’s revision. |
| DOCOMO | We do not support. In our understanding, the current wording “for remaining TPMIs” captures the complement set. |
| Huawei, HiSilicon | Not needed. The same understanding with OPPO, Samsung, CATT and ZTE, where the non-report TPMI case is already included in remaining TPMIs. |
| QC | The TP is not need. Current spec is clear enough. |
| Ericsson | The TP is not needed. Agree that the remaining TPMIs are those that do not support full power, which can be all TPMIs.  Agree with Intel’s proposal to clarify 1 port for Mode 2. |
| vivo | Based on our understanding, the description ‘ for full power TPMIs reported by the UE [16, TS 38.306], and is the ratio of a number of antenna ports with non-zero PUSCH transmission power over a number of SRS ports for remaining TPMIs’ only cover the case of Mode2 with multiple SRS resources and each with same SRS ports are configured in the SRS resource set, the case of Mode2 with multiple SRS resources and each with different SRS ports are configured in the SRS resource set is not included. Therefore, the TP is needed, and also depending on UE feature discussion.  In addition, a UE can only work in Mode1 or Mode2 or Mode0, the remaining change is also needed, and also depending on UE feature discussion. |
| InterDigital | Not needed. In our view, the context in the proposed text is already covered by the case represented by “remaining TPMIs” in the current spec. |

**Observation:**

Majority of companies expressed that this TP is not needed, Intel pointed out that power scaling for the case of 1 port SRS configured in Mode 2 is missing.

**Proposal:**

* Discuss following TP

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<unchanged part omitted>

if ULFPTxModes in PUSCH-Config is set to Mode2,

* for full power TPMIs reported by the UE [16, TS 38.306], and is the ratio of a number of antenna ports with non-zero PUSCH transmission power over a number of SRS ports for remaining TPMIs, where the number of SRS ports is associated with a SRS resource indicated by SRI if more than one SRS resources are configured in the SRS-ResourceSet with usage set to 'codebook', or the number of SRS ports is associated with the SRS resource if only one SRS resource is configured in the SRS-ResourceSet with usage set to 'codebook',
* , if the SRS resource with single port is indicated by SRI when more than one SRS resources are configured in the SRS-ResourceSet with usage set to 'codebook' or if only one SRS resource is configured in the SRS-ResourceSet with usage set to 'codebook' which has single port

<unchanged part omitted>

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* + 1. TP3

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if ULFPTxModes in PUSCH-Config is set to Mode2, for full power TPMIs reported by the UE [16, TS 38.306] corresponding to the value of *codebookSubset*, and is the ratio of a number of antenna ports with non-zero PUSCH transmission power over a number of SRS ports for remaining TPMIs corresponding to the value of *codebookSubset*, where the number of SRS ports is associated with a SRS resource indicated by SRI or *srs-ResourceIndicator* for type 1 configured grant if more than one SRS resources are configured in the SRS-ResourceSet with usage set to 'codebook', or the number of SRS ports is associated with the SRS resource if only one SRS resource is configured in the SRS-ResourceSet with usage set to 'codebook', and

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Please provide your views/comments in the table below

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| Company/organization | comments |
| OPPO | There are two part for this TP   1. The first part “corresponding to the value of codebookSubset” is similar to TP1. Thus we suggest to split TP3, the first part should be merged to TP1 and only discuss the second part in TP3 2. The second part “or *srs-ResourceIndicator* for type 1 configured grant”. We support it. |
| CMCC | We support this TP. For ease of discussion, we also think this TP could be split into two parts. The first part could be discussed together with TP1. |
| Samsung | Agree with OPPO, the first part is included in TP1 and hence not needed. We are also with the second part. |
| CATT | 1. The first revision that is the same as in TP 1 is not needed.  2. The second revision is not needed. In TS38.214, it has been explicitly clarified that SRI can be given by DCI fields of SRS resource indicator or given by *srs-ResourceIndicator* in *rrc-ConfiguredUplinkGrant*. |
| Apple | We are fine with the second part “or srs-ResourceIndicator for type 1 configured grant”. |
| ZTE | We think TP3 is not needed.  Hold the same view as CATT, this TP is redundant with the text in TS 38.214 section 6.1.1.1. |
| LG | Agree with CATT. TP3 is not needed. |
| Intel | Generally, we are fine with the proposal. |
| Spreadtrum | Agree with CATT, the TP is not needed. |
| DOCOMO | We support the second TP “or *srs-ResourceIndicator* for type 1 configured grant”. |
| Huawei, HiSilicon | We support to add “or *srs-ResourceIndicator* for type 1 configured grant” to make it clear. |
| QC | Agree with OPPO that the first change in the TP should be discussed together with TP1.  We are OK with the second change in the TP, i.e., addition of “or *srs-ResourceIndicator* for type 1 configured grant”, although we don’t think it is essential. |
| Ericsson | For the first change, it does overlap with TP1, and we are OK to discuss it there.  We are OK with the second change in the TP to make the text more clear / readable. However, we do see CATT’s point. In 38.214, the text below seems most relevant:  The UE shall transmit PUSCH using the same antenna port(s) as the SRS port(s) in the SRS resource indicated by the DCI format 0\_1 or 0\_2 or by *configuredGrantConfig* according to clause 6.1.2.3.  This text should apply to Mode 2. However, cases where SRI is provided by higher layers seem to be specifically called out in general in 38.213 and SRI is generally thought of as the field in DCI. |
| vivo | The first part is similar to TP1, it is not needed.  The second part is not needed, since it has been specified in TS 38.214. |
| InterDigital | Not needed, have a similar view as stated by CATT. |

**Observation:**

Majority of companies expressed that this TP is not needed, correction pertaining type 1 configured grant is already specified in 38.214.

# References

[1] R1-2002746, Summary of prep email discussion on ULFPTx, RAN1#100b-e