**3GPP TSG RAN WG1 #101 R1-200xxxx**

**e-Meeting, May 25th – June 5th, 2020**

Source: moderator (vivo)

Title: Feature lead summary on [101-e-NR-eMIMO-ULFPTx-03]

Agenda Item: 7.2.6.4

Document for: Discussion and Decision

1. Introduction

Per guidance from Mr. Chairman, this is to kick-off following email discussion, please provide your views below.

[101-e-NR-eMIMO-ULFPTx-03] Miscellaneous corrections for full power uplink transmission by 5/29 – Rakesh (vivo)

* TP 3-7 under Issue 2, Issue 3 and Issue 4 of the FL summary
1. Remaining issues
	1. Issue 3: on codebook subset restriction
* ***One of the following alternatives is selected on full-coherent codebook subset for Rel-16 UL full power transmission.***
	+ ***Alt 1: full-coherent codebook subset is not supported for mode 0/mode 1/mode 2;***
	+ ***Alt 2: full-coherent codebook subset is supported for mode 0/mode 1/mode 2, with Rel-15 power scaling factor used;***
	+ ***Alt 3: full-coherent codebook subset is supported for mode 0/mode 1/mode 2, with the same power scaling rule as non-/partial-coherent codebook subset, i.e.,***
		- ***For mode 0, the power scaling factor is 1 for all TPMIs;***
		- ***For mode 1, the power scaling factor is the same as Rel-15 scaling factor;***
		- ***For mode 2, the power scaling factor s equals to 1 for full power TPMIs reported by the UE, and s is determined by #non-zero-PUSCH-port divided by #SRS-ports in the SRS resource indicated by SRI for remaining TPMIs .***
	+ ***Alt 4: full-coherent codebook subset is not supported by mode 1; full-coherent codebook subset is supported by mode 0 and mode 2, with the same power scaling rule as non-/partial-coherent codebook subset for mode 0 and mode 2, i.e.,***
		- ***For mode 0, the power scaling factor is 1 for all TPMIs;***
		- ***For mode 2, the power scaling factor s equals to 1 for full power TPMIs reported by the UE, and s is determined by #non-zero-PUSCH-port divided by #SRS-ports in the SRS resource indicated by SRI for remaining TPMIs .***

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| Company | Comment |
| Intel | Support Alt 4.For full coherent codebook subset, all the TPMIs are included. In addition, the power scaling for Mode 1 is the same as legacy Rel-15 processing. Therefore, to apply Mode 1 for full coherent codebook subset seems to be redundant. |
| Apple | Support Alt 4.We don’t think there is mode 1 for full-coherent codebook. |
| QC | Support Alt 3 or 4, with slight preference on Alt 4. As Intel pointed out, full coherent UE supporting Rel-16 mode 1 is same behaviour as Rel-15 full coherent UE. We see this as a redundant functionality too. But it is acceptable to us.  |
| LG | Support Alt4. Agree with Intel and QC that applying Mode 1 for the UE configured with full coherent codebook subset is redundant.  |
| OPPO | Support Alt.4Share the same view as Intel and QC that full-coherent UE supporting mode 1 is the same as Rel-15.  |
| CATT | Support Alt.4. |
| Spreadtrum | Support Alt 3 or Alt 4, but slightly prefer Alt 4.Although full-coherent UE supporting R16 mode seems to be redundant, it is acceptable to us. |
| Huawei, HiSilicon | Support Alt.4. |

* 1. Issue 2 : TPs for correction on power scaling

TP#3

if *ul-FullPowerTransmission* in *PUSCH-Config* is provided and *codebookSubset* in *PUSCH-Config* is set to 'nonCoherent' or 'partialAndNonCoherent', the UE scales $\hat{P}\_{PUSCH,b,f,c}(i,j,q\_{d},l)$ by $s$ where:

- if *ul-FullPowerTransmission* in *PUSCH-Config* is set to *fullpowerMode1*, and each SRS resource in the *SRS-ResourceSet* with *usage* set to 'codebook' has more than one SRS port, $s$ 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 *ul-FullPowerTransmission* in *PUSCH-Config* is set to *fullpowerMode2*

- $s=1$ for full power TPMIs reported by the UE [16, TS 38.306], and $s$ 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 a SRI field in a DCI format scheduling the PUSCH transmission if more than one SRS resource is 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',

- $s=1$, if a SRS resource with a single port is indicated by a SRI field in a DCI format scheduling the PUSCH transmission when more than one SRS resource is provided in the *SRS-ResourceSet* with *usage* set to 'codebook', or if only one SRS resource with a single port is provided in the *SRS-ResourceSet* with *usage* set to 'codebook', and

- if *ul-FullPowerTransmission* in PUSCH-Config is set to *fullpower*, $s=1$

- if *ul-FullPowerTransmission* in *PUSCH-Config* is provided and set to *fullpower* or *fullpowerMode2*, and *codebookSubset* in *PUSCH-Config* is set to 'fullAndPartialAndNonCoherent', the UE scales $\hat{P}\_{PUSCH,b,f,c}(i,j,q\_{d},l)$ by $s$ where:

- if *ul-FullPowerTransmission* in *PUSCH-Config* is set to *fullpowerMode2*

- $s=1$ for full power TPMIs reported by the UE [16, TS 38.306], and $s$ 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 a SRI field in a DCI format scheduling the PUSCH transmission if more than one SRS resource is 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',

- $s=1$, if a SRS resource with a single port is indicated by a SRI field in a DCI format scheduling the PUSCH transmission when more than one SRS resource is provided in the *SRS-ResourceSet* with *usage* set to 'codebook', or if only one SRS resource with a single port is provided in the *SRS-ResourceSet* with *usage* set to 'codebook', and

- if *ul-FullPowerTransmission* in PUSCH-Config is set to *fullpower*, $s=1$

- else, if each SRS resource in the *SRS-ResourceSet* with *usage* 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.

TP#4

- if *ul-FullPowerTransmission* in *PUSCH-Config* is provided ~~and~~ *~~codebookSubset~~* ~~in~~ *~~PUSCH-Config~~* ~~is set to 'nonCoherent' or 'partialAndNonCoherent'~~, the UE scales $\hat{P}\_{PUSCH,b,f,c}(i,j,q\_{d},l)$ by $s$ where:

- if *ul-FullPowerTransmission* in *PUSCH-Config* is set to *fullpowerMode1*, and *codebookSubset* in *PUSCH-Config* is set to 'nonCoherent' or 'partialAndNonCoherent', and each SRS resource in the *SRS-ResourceSet* with *usage* set to 'codebook' has more than one SRS port, $s$ 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

TP#5

- if *ul-FullPowerTransmission* in *PUSCH-Config* is provided and *codebookSubset* in *PUSCH-Config* is set to 'nonCoherent' or 'partialAndNonCoherent' or 'fullyAndPartialAndNonCoherent', the UE scales $\hat{P}\_{PUSCH,b,f,c}(i,j,q\_{d},l)$ by $s$ where:

TP#6

if *ul-FullPowerTransmission* in *PUSCH-Config* is provided ~~and~~ *~~codebookSubset~~* ~~in~~ *~~PUSCH-Config~~* ~~is set to 'nonCoherent' or 'partialAndNonCoherent'~~, the UE scales $\hat{P}\_{PUSCH,b,f,c}(i,j,q\_{d},l)$ by $s$ where:

TP#7

- if ul-FullPowerTransmission in PUSCH-Config is provided and codebookSubset in PUSCH-Config is set to ' fullyAndPartialAndNonCoherent ', the UE scales $\hat{P}\_{PUSCH,b,f,c}(i,j,q\_{d},l)$ by $s$ where:

- if ul-FullPowerTransmission in PUSCH-Config is set to fullpowerMode2

- $s=1$ for full power TPMIs reported by the UE [16, TS 38.306],

- $s=1$, if an SRS resource with a single port is indicated by a SRI field in a DCI format scheduling the PUSCH transmission when more than one SRS resource is provided in the SRS-ResourceSet with usage set to 'codebook', or if only one SRS resource with a single port is provided in the SRS-ResourceSet with usage set to 'codebook', and

- if ul-FullPowerTransmission in PUSCH-Config is set to fullpower, $s=1$

- else, if each SRS resource in the SRS-ResourceSet with usage 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.

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| Company | Comment |
| Intel | Support TP #3.But we can discuss the detailed TP after consensus is reached on Issue #3. |
| Apple | We need to conclude on whether SRS enhancement is allowed for mode 2 operation for full-coherent codebook.TP#3 or TP#4 are okay if we allowTP#7 is okay if we don’t allow |
| QC | These 5 TPs are very similar to each other in spirit. We prefer TP 3, or 4, 5, as they are more concise. But we are open to discuss down select to which one after issue 3 is settled.  |
| LG | We also think corresponding TP should be discussed after making a decision on issue 3.  |
| OPPO | If we agree Alt.4 for Issue 2, then it is expected there will some description on the configuration restriction somewhere in the spec. Given that, TP 6 is more concise.  |
| Spreadtrum | We can discuss it after making a decision on issue 3. |
| Huawei, HiSilicon | Support TP#4 or TP#3.Since TP#5/6 is with Mode-1 for full-coherent codebook subset, TP#7 is rule out non-full power transmission for the full-coherent codebook subset for Mode-2.  |

* 1. Issue 4: on SRS resource configuration in Mode2

38.214

\*\*\* Unchanged text is omitted \*\*\*

For codebook based transmission, the UE may be configured with a single *SRS-ResourceSet* with *usage* set to 'codebook' and only one SRS resource can be indicated based on the SRI from within the SRS resource set. Except when higher layer parameter *ul-FullPowerTransmission* is set to '*fullpowerMode2*' and *codebookSubset* in *PUSCH-Config* is not set to ' *fullyAndPartialAndNonCoherent* ', the maximum number of configured SRS resources for codebook based transmission is 2. If aperiodic SRS is configured for a UE, the SRS request field in DCI triggers the transmission of aperiodic SRS resources.

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.

The DM-RS antenna ports $\left\{\tilde{p}\_{0},…,\tilde{p}\_{v-1}\right\}$ in Clause 6.4.1.1.3 of [4, TS38.211] are determined according to the ordering of DM-RS port(s) given by Tables 7.3.1.1.2-6 to 7.3.1.1.2-23 in Clause 7.3.1.1.2 of [5, TS 38.212].

Except when higher layer parameter *ul-FullPowerTransmission* is set to ' *fullpowerMode2*' and *codebookSubset* in *PUSCH-Config* is not set to ' *fullyAndPartialAndNonCoherent* ', when multiple SRS resources are configured by *SRS-ResourceSet* with *usage* set to 'codebook', the UE shall expect that higher layer parameters *nrofSRS-Ports* in *SRS-Resource* in *SRS-ResourceSet* shall be configured with the same value for all these SRS resources.

When higher layer parameter *ul-FullPowerTransmission* is set to ' *fullpowerMode2*' and *codebookSubset* in *PUSCH-Config* is set to *'nonCoherent'* or *'partialAndNonCoherent'*,

- the UE can be configured with one SRS resource or multiple SRS resources with same or different number of SRS ports within an SRS resource set with *usage* set to ‘*codebook*’.

- up to 2 different spatial relations can be configured for all SRS resources in the SRS resource set with usage set to ‘codebook’ when multiple SRS resources are configured in the SRS resource set.

- subject to UE capability, a maximum of 2 or 4 SRS resources are supported in an SRS resource set with *usage* set to ‘codebook’

\*\*\* Unchanged text is omitted \*\*\*

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| Company | Comment |
| Intel | We are fine with the motivation to restrict the SRS configuration same as Rel-15 for full coherent codebook subset.The TP can be discussed next week. |
| Apple | We can first agree on whether SRS enhancement is needed for full coherent codebook with Mode 2 operation and then discuss the TP. The purpose of the TP is not to allow SRS enhancement for full coherent codebook with Mode 2 operationFull coherent codebook automatically provides the antenna virtualization which is essentially what mode 1 uses, but in a more comprehensive way due to the coherent capability. It does not have strong motivation to require UE to send additional SRS resource to perform similar antenna virtualization. Furthermore, when UE is capability coherent transmission, coherent beam forming is a more effective solution for antenna virtualization.  |
| QC | We have a question for clarification: Why exclude full coherent UE to operate in mode 2 via antenna virtualization? Although there might be no strong motivation to do so, but if a full coherent UE, say with 20dBm+20dBm PAs, want to do antenna virtualization to virtualize into a single port, why disallow it? |
| LG | Similar sprit for issue 3, we slight prefer not to restrict the SRS configuration only for full coherent codebook subset. But, we are open for further discussion.  |
| OPPO | This restriction seems not necessary |
| CATT | Slightly prefer not to introduce such restriction. |
| Spreadtrum | Not needed. |
| Huawei, HiSilicon | The restriction is not necessary. |

# References

[1] R1-2003402, “Feature lead summary on ULFPTx”, vivo, RAN1#101-e