**3GPP TSG RAN WG1 #105-e R1-21xxxxx**

**e-Meeting, May 10th – 27th, 2021**

**Agenda item:** 7.2.12

**Source:** Moderator (NTT DOCOMO, INC.)

**Title:** Summary on Rel-16 NR TEI related discussion

**Document for:** Discussion and Decision

1. Introduction

This contribution summarizes the discussions and proposals in AI 7.2.12 for Rel-16 NR TEI related discussion.

Based on the discussions summarized in Section 2, following is a part of the suggested email discussions/approvals for AI 7.2.12.

**FL proposal #1 of email discussion/approval:**

**[104b-e-NR-TEI-01] Email discussion/approval on Rel-16 NR TEI related issues**

* **Discuss following proposal and corresponding specification impact**
	+ **The DL/UL collision handling should be supported by a UE capable of such handling for each band within a band combination where the UE supports inter-band simultaneous transmission and reception.**

Companies are encouraged to check above FL proposal and to provide feedback if any in below.

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Based on the discussions summarized in Section 3, the moderator suggests to handle the proposal in [3] regarding uplink power control for M-TRP in eMIMO maintenance agenda instead of 7.2.12

Companies are encouraged to check above FL proposal and to provide feedback if any in below.

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Note that discussions and proposals in AI 7.2.12 related to UL Tx switching ([1], [2], [4] and [7]) are separately handled by other moderator [5].

1. Discussion on Rel-16 NR TEI related issues
	1. Half-duplex operation in CA with unpaired spectrum

Following proposal is made in a contribution.

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| [6] | According to the previous agreements, UE can report the DL/UL collision handling capability for a band or band combination (BC) not supporting simultaneous transmission and reception (simul-RxTx for short) on two carriers within one band or on different bands, and the base station can configure the UE for such collision handling. From UE implementation point of view, although no explicit UE capability, it is naturally understood that even if a UE can support simul-RxTx between bands, the UE cannot support simul-RxTx within each band of that BC respectively.Thus, for a band combination (BC), according to current specifications, a UE * Case a) may, or Case b) may not, support simul-RxTx for inter-band BC, based on *simultaneousRxTxInterBandCA*, and
* When the UE does not report/support *simultaneousRxTxInterBandCA* (Case b), the UE may or may not support collision handling based on *half-DuplexTDD-CA-SameSCS-r16* for the inter-band BC
	+ The UE may also support/report *half-DuplexTDD-CA-SameSCS-r16* for a BC that is intra-band only (i.e. if one of the bands is also an intra-band only BC), according to the recent agreements

As can be seen, it is not clear what is the intended UE reporting for Case a) when a UE supports *simultaneousRxTxInterBandCA* for a BC, and can support *half-DuplexTDD-CA-SameSCS-r16* for each single band only (rather than for inter-band BC which is an advanced UE capability), given that a UE cannot report DL/UL collision handling capability for the BC in this scenario. On the other hand, if the intra band combination is a subset of the above inter-band combination, the UE may be able to report/support DL/UL collision handling then it is not clear whether gNB has correct/same understanding in order for a proper configuration.One example assumes a CA scenario of two bands, with one carrier in band A and two carriers in band B. The UE reports supporting simul-RxTx across band A and B, and the UE doesn’t support simul-RxTx on the two carriers in band B. RAN1 needs to clarify whether the UE can support DL/UL collision handling for the two carriers in band B, especially when the UE can report DL/UL collision handling capability for band B. From our understanding, the UE should be able to handle the DL/UL collision for the carriers in band B in the above example, however the current specification does not seem to allow this. Corresponding specification impact needs to be further discussed after that. ***Proposal:*** *The DL/UL collision handling should be supported by a UE capable of such handling for each band within a band combination where the UE supports inter-band simultaneous transmission and reception.*  |

Based on the above proposal, following point can be discussed in RAN1#105-e meeting.

### **Discussion point #1**

* **Discuss following proposal and corresponding specification impact**
	+ **The DL/UL collision handling should be supported by a UE capable of such handling for each band within a band combination where the UE supports inter-band simultaneous transmission and reception.**
1. Discussion on other issues
	1. Enhancement on uplink power control for M-TRP

Following proposals are made in contributions.

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| [3] | Default close loop index for different CORESETPoolIndexAccording to current 38.213[2], if *SRI-PUSCH-PowerControl* is not provided by RRC or SRI is not included in a DCI, only single close loop index  should be assumed by UE for the PUSCH. For a UE indicating support of FG 16-2a-3, additional scheduling restriction will be introduced for the following cases:* Once DCI format 0\_0 is scheduled for *CORESETPoolIndex*=0 (*l*=0), the DCI format can’t be scheduled by *CORESETPoolIndex*=1, and only close loop index *l*=1 can be configured for PUSCH associated with *CORESETPoolIndex*=1.
* If UE reports capability of single SRS resource in the SRS resource set for codebook (*maxNumberSRS-ResourcePerSet* equal to 1), SRI will not be included in any UL grant. In this case, only PUSCH associated with one value of *CORESETPoolIndex* can be scheduled, which means multi-DCI based M-TRP transmission can’t be supported for uplink.
* In FR1, gNB is not likely to configure *SRI-PUSCH-PowerControl* or multiple SRS resources for beam selection in the SRS resource set for codebook. Without SRI in DCI or *SRI-PUSCH-PowerControl*, only PUSCH associated with one value of *CORESETPoolIndex* can be scheduled by gNB.

In a summary, for a UE supporting out-of-order operation for uplink, PUSCHs scheduled by different *CORESETPoolIndex* can hardly be supported especially in FR1, since the same default close loop index is defined for different *CORESETPoolIndex*. There is not such restriction for UEs not supporting this FG. The restriction makes the FG 16-2a-3 meaningless and support of it becomes a block to support PUSCH scheduled with different *CORESETPoolIndex*. To avoid such unreasonable restriction on scheduling, different default close loop indexes should be defined for different *CORESETPoolIndex*. That is, if *SRI-PUSCH-PowerControl* is not provided or SRI is not included in a DCI, close loop index *l*=0 and *l*=1 should be respectively applied to PUSCHs associated with *CORESETPoolIndex*=0 *and CORESETPoolIndex*=1.It also avoids the same close loop index for PUSCHs targeting different TRPs and allows TRP specific closed loop power control. The mechanism can be directly extended to PUCCH to avoid similar issue considering *PUCCH-SpatialRelationInfo* is optional.**Proposed TP for 38.213 (PUSCH):**

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| 7.1.1 UE behaviour*(omitted part)*-  if the UE is configured with *twoPUSCH-PC-AdjustmentStates* and  if the UE is not configured with *twoPUSCH-PC-AdjustmentStates* or if the PUSCH transmission is scheduled by a RAR UL grant as described in Clause 8.3- For a PUSCH (re)transmission configured by *ConfiguredGrantConfig*, the value of  is provided to the UE by *powerControlLoopToUse*- If the UE is provided *SRI-PUSCH-PowerControl*, the UE obtains a mapping between a set of values for the SRI field in a DCI format scheduling the PUSCH transmission and the  value(s) provided by *sri-PUSCH-ClosedLoopIndex* and determines the  value that is mapped to the SRI field value- If the PUSCH transmission is scheduled by a DCI format that does not include an SRI field, or if an *SRI-PUSCH-PowerControl* is not provided to the UE, *l*=1 if the PUSCH is scheduled by a PDCCH received in a CORESET which is configured with *CORESETPoolIndex* equal to 1  otherwise.- If the UE obtains one TPC command from a DCI format 2\_2 with CRC scrambled by a TPC-PUSCH-RNTI, the  value is provided by the closed loop indicator field in DCI format 2\_2 |

**Proposed TP for 38.213 (PUCCH):**

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| 7.2.1 UE behaviour*(omitted part)*-  is a TPC command value and is included in a DCI format 1\_0 or DCI format 1\_1 for active UL BWP  of carrier  of the primary cell  that the UE detects for PUCCH transmission occasion  or is jointly coded with other TPC commands in a DCI format 2\_2 with CRC scrambled by TPC-PUCCH-RNTI [5, TS 36.212], as described in Clause 11.3-  if the UE is provided *twoPUCCH-PC-AdjustmentStates* and *PUCCH-SpatialRelationInfo* and  if the UE is not provided *twoPUCCH-PC-AdjustmentStates* - If the UE is not provided *PUCCH-SpatialRelationInfo,* *l*=1 if the PUCCH is scheduled by a PDCCH received in a CORESET which is configured with *CORESETPoolIndex* equal to 1, *l*=0 otherwise.- If the UE obtains a TPC command value from a DCI format 1\_0 or a DCI format 1\_1 and if the UE is provided *PUCCH-SpatialRelationInfo*, the UE obtains a mapping, by an index provided by *p0-PUCCH-Id*, between a set of *pucch-SpatialRelationInfoId* values and a set of values for *closedLoopIndex* that provide the  value(s). If the UE receives an activation command indicating a value of *pucch-SpatialRelationInfoId*, the UE determines the value *closedLoopIndex* that provides the value of  through the link to a corresponding *p0-PUCCH-Id* index  |

Default pathloss RS for different *CORESETPoolIndex*Based on 38.213 [1], if *SRI-PUSCH-PowerControl* is not provided to a UE or SRI is not included in a DCI, a default pathloss RS, the pathloss RS with *PUSCH-PathlossReferenceRS-Id=0* configured by RRC, will be used for pathloss measurement of PUSCH. If multiple values of *CORESETPoolIndex* are configured, PUSCHs targeting different TRPs will share the same pathloss RS, which would lead to inaccurate pathloss estimation for PUSCH. Similar issue should also be considered for PUCCH associated with different *CORESETPoolIndex* when *PUCCH-SpatialRelationInfo* is not configured. Considering that a PUSCH without indication of *SRI-PUSCH-PowerControl* or SRI and a PUCCH without *PUCCH-SpatialRelationInfo* are common cases in FR1, we propose to support TRP specific pathloss RS for both PUSCH and PUCCH with the following text proposal:**Proposed TP for 38.213:**

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| 7.1.1 UE behaviour*(omitted part)*- If the PUSCH transmission is scheduled by a DCI format 0\_0, and if the UE is provided a spatial setting by *PUCCH-SpatialRelationInfo* for a PUCCH resource with a lowest index for active UL BWP  of each carrier  and serving cell , as described in Clause 9.2.2, the UE uses the same RS resource index  as for a PUCCH transmission in the PUCCH resource with the lowest index- If - the PUSCH transmission is scheduled by a DCI format 0\_0 and the UE is not provided a spatial setting for a PUCCH transmission, or - the PUSCH transmission is scheduled by a DCI format 0\_1 that does not include a SRI field, or - *SRI-PUSCH-PowerControl* is not provided to the UE,  the UE determines a RS resource index  with a respective *PUSCH-PathlossReferenceRS-Id* value being equal to one if the PUSCH is scheduled by a PDCCH received in a CORESET which is configured with *CORESETPoolIndex* equal to 1, and *PUSCH-PathlossReferenceRS-Id* value being equal to zero otherwise, where the RS resource is either on serving cell or, if provided, on a serving cell indicated by a value of *pathlossReferenceLinking*- If - the PUSCH transmission is scheduled by a DCI format 0\_0, - the UE is not provided PUCCH resources for the active UL BWP, and- the UE is provided *enableDefaultBeamPlForPUSCH0\_0*  the UE determines a RS resource index  providing a periodic RS resource with 'QCL-TypeD' in the TCI state or the QCL assumption of a CORESET with the lowest index in the active DL BWP of the scheduling cell for the serving cell- If - the PUSCH transmission is scheduled by a DCI format 0\_0, - the UE is not provided a spatial setting for PUCCH resources on the active UL BWP of the primary cell [11, TS 38.321], and- the UE is provided *enableDefaultBeamPlForPUSCH0\_0*  the UE determines a RS resource index  providing a periodic RS resource with 'QCL-TypeD' in the TCI state or the QCL assumption of a CORESET with the lowest index in the active DL BWP of the primary cell- For a PUSCH transmission configured by *ConfiguredGrantConfig,* if *rrc-ConfiguredUplinkGrant* is included in *ConfiguredGrantConfig*, a RS resource index  is provided by a value of *pathlossReferenceIndex* included in *rrc-ConfiguredUplinkGrant* where the RS resource is either on serving cell or, if provided, on a serving cell indicated by a value of *pathlossReferenceLinking*- For a PUSCH transmission configured by *ConfiguredGrantConfig* that does not include *rrc-ConfiguredUplinkGrant*, the UE determines a RS resource index  from a value of *PUSCH-PathlossReferenceRS-Id* that is mapped to a SRI field value in a DCI format activating the PUSCH transmission. If the DCI format activating the PUSCH transmission does not include a SRI field, the UE determines a RS resource index  with a respective *PUSCH-PathlossReferenceRS-Id* value being equal to one if the PUSCH is scheduled by a PDCCH received in a CORESET which is configured with *CORESETPoolIndex* equal to 1, and *PUSCH-PathlossReferenceRS-Id* value being equal to zero otherwise, where the RS resource is either on serving cell or, if provided, on a serving cell indicated by a value of *pathlossReferenceLinking*If the UE is provided *enablePLRSupdateForPUSCHSRS*, a mapping between *sri-PUSCH-PowerControlId* and *PUSCH-PathlossReferenceRS-Id* values can be updated by a MAC CE as described in [11, TS38.321]- For a PUSCH transmission scheduled by a DCI format that does not include a SRI field, or for a PUSCH transmission configured by *ConfiguredGrantConfig* and activated, as described in Clause 10.2, by a DCI format that does not include a SRI field, a RS resource index  is determined from the *PUSCH-PathlossReferenceRS-Id* mapped to *sri-PUSCH-PowerControlId* = 0*(omitted part)*7.2.1 UE behaviour *(omitted part)*- If *PUCCH-SpatialRelationInfo* includes *servingCellId* indicating a serving cell, the UE receives the RS for resource index  on the active DL BWP of the serving cell- If the UE is provided *pathlossReferenceRSs* and is not provided *PUCCH-SpatialRelationInfo*, the UE obtains the *referenceSignal* value in *PUCCH-PathlossReferenceRS* from the *pucch-PathlossReferenceRS-Id* with index 1 in *PUCCH-PathlossReferenceRS* if the PUCCH is scheduled by a PDCCH received in a CORESET which is configured with *CORESETPoolIndex* equal to 1, and the UE obtains the *referenceSignal* value in *PUCCH-PathlossReferenceRS* from the *pucch-PathlossReferenceRS-Id* with index 0 in *PUCCH-PathlossReferenceRS* otherwise, where the RS resource is either on a same serving cell or, if provided, on a serving cell indicated by a value of *pathlossReferenceLinking* |

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Since the proposal is not related to any agreed TEI-16 but related to M-TRP which has been mainly discussed in eMIMO, the moderator suggests to handle this proposal in eMIMO maintenance agenda instead of 7.2.12 same as last meeting.

Reference

[1] R1-2104325 Remaining Issues of Rel-16 UL Tx Switching ZTE

[2] R1-2104653 Remaining issues for 1Tx-2Tx switching Qualcomm Incorporated

[3] R1-2104730 Enhancement on uplink power control for M-TRP OPPO

[4] R1-2104731 Text Proposals for Tx Switching between Two Uplink Carriers OPPO

[5] R1-2104858 Summary of Rel-16 uplink Tx switching Moderator (China Telecom)

[6] R1-2105524 Discussion on half duplex operation for TDD CA Huawei, HiSilicon

[7] R1-2105925 Discussion on the remaining problems of supporting Tx switching between two uplink carriers Huawei, HiSilicon