**3GPP TSG RAN WG1 Meeting #106-e R1-210xxxx**

**e-Meeting, August 16h – 27th, 2021**

**Source: Moderator (ZTE)**

**Title: Email Discussion Summary of [106-e-NR-eMIMO-02]**

**Agenda item: 7.2.6**

**Document for:** **Discussion/Decision**

# Introduction

During RAN1#106-e, one contribution was submitted to discuss and clarify the ambiguity issue for default path-loss and spatial relation for multi-slot PUCCH transmission [1]. During the preparation phase, companies agreed to discuss this issue in RAN1#106-e meeting.

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| [106-e-NR-eMIMO-02] MB.1 (spatial setting for multi-slot PUCCH) by August 20 – Bo (ZTE)  [R1-2106538](file:///D:\Documents\3GPP%20documents\RAN1\TSGR1_106-e\Docs\R1-2106538.zip) Clarification on default spatial setting of PUCCH with multiple slots ZTE |

This summary is trying to collect/summarize companies’ input and draw potential TP based on companies’ input.

# Discussion

## Background introduction

In RAN1#101-e, the following agreement was reached for clarifying UE behavior of determining default spatial relation and PL-RS based on the first PUCCH slot.

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| **Agreement**   * For multiple slots PUCCH, a spatial relation/PL RS is commonly applied across the PUCCH slots, where the spatial relation/PL RS is determined by the first PUCCH slot. |

But, in the current spec, the above agreed UE behavior for multi-slot PUCCH transmission has NOT been specified correctly, i.e., being based on first PUCCH slot is missing.

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| TS 38.213 7.2.1 UE behaviour - If the UE  - is not provided *pathlossReferenceRSs*, and  - is not provided *PUCCH-SpatialRelationInfo,* and  - is provided *enableDefaultBeamPL-ForPUCCH*, and  - is not provided coresetPoolIndex value of 1 for any CORESET, or is provided coresetPoolIndex value of 1 for all CORESETs, in ControlResourceSet and no codepoint of a TCI field, if any, in a DCI format of any search space set maps to two TCI states [5, TS 38.212]  the UE determines a RS resource index providing a periodic RS resource configured with *qcl-Type* set to '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 PUCCH transmission over multiple slots, a same applies to the PUCCH transmission in each of the multiple slots. |

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| TS 38.213 9.2.2 PUCCH Formats for UCI transmission If a UE  - is not provided *pathlossReferenceRSs* in *PUCCH-PowerControl*,  - is provided *enableDefaultBeamPL-ForPUCCH*, and  - is not provided *PUCCH-SpatialRelationInfo*, and  - is not provided coresetPoolIndex value of 1 for any CORESET, or is provided coresetPoolIndex value of 1 for all CORESETs, in ControlResourceSet and no codepoint of a TCI field, if any, in a DCI format of any search space set maps to two TCI states [5, TS 38.212]  a spatial setting for a PUCCH transmission from the UE is same as a spatial setting for PDCCH receptions by the UE in the CORESET with the lowest ID on the active DL BWP of the PCell. For a PUCCH transmission over multiple slots, a same spatial setting applies to the PUCCH transmission in each of the multiple slots. |

It can lead to unnecessary ambiguity about spatial setting/PL-RS determination for PUCCH in case that the activated TCI state for CORESET with lowest index is applied starting from a slot of the multiple slots of PUCCH. For instance, as collected from companies in preparation phase, the same qd for all slots means beam activation time should NOT present in middle of the slots

* In other words, unnecessary NW restriction for TCI state update of the CORESET may be required in order to avoid the above ambiguity. Specifically, if a new activated TCI state for the CORESET is applied starting from slot n, then any PUCCH with multiple slots can NOT be transmitted in the slot n.

## Companies’ input

According to the contribution [1] and the already agreement mentioned above, clarifying that for multiple slots of PUCCH, the applied same spatial setting is determined in the first slot of the multiple slots seems essential and necessary. Besides, one typo in Clause 7.3.1 should be corrected.

Then, the following TP is provided for TS 38.213.

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| 7.2.1 UE behaviour <----------------------Unchanged parts are omitted--------------->  - If the UE  - is not provided *pathlossReferenceRSs*, and  - is not provided *PUCCH-SpatialRelationInfo,* and  - is provided *enableDefaultBeamPL-ForPUCCH*, and  - is not provided coresetPoolIndex value of 1 for any CORESET, or is provided coresetPoolIndex value of 1 for all CORESETs, in ControlResourceSet and no codepoint of a TCI field, if any, in a DCI format of any search space set maps to two TCI states [5, TS 38.212]  the UE determines a RS resource index providing a periodic RS resource configured with *qcl-Type* set to '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 PUCCH transmission over multiple slots, a same as determined by the first slot of the multiple slots applies to the PUCCH transmission in each of the multiple slots.  <----------------------Unchanged parts are omitted---------------> 7.3.1 UE behaviour <----------------------Unchanged parts are omitted--------------->  -  is a downlink pathloss estimate in dB calculated by the UE using RS resource index as described in clause 7.1.1 for the active DL BWP of serving cell and SRS resource set [6, TS 38.214]. The RS resource index is provided by *pathlossReferenceRS* associated with the SRS resource set and is either an *ssb-Index* providing a SS/PBCH block index or a *csi-RS-Index* providing a CSI-RS resource index. If the UE is provided *enablePL-RS-UpdateForPUSCH-SRS*, a MAC CE [11, TS 38.321] can provide by *SRS-PathlossReferenceRS-Id* a corresponding RS resource index for aperiodic or semi-persistent SRS resource set  - If the UE is not provided *pathlossReferenceRS* or *SRS-PathlossReferenceRS-Id*, or before the UE is provided dedicated higher layer parameters, the UE calculates  using a RS resource obtained from an SS/PBCH block with same SS/PBCH block index as the one the UE uses to obtain *MIB*  - If the UE is provided *pathlossReferenceLinking*, the RS resource is on a serving cell indicated by a value of *pathlossReferenceLinking*  <----------------------Unchanged parts are omitted---------------> 9.2.2 PUCCH Formats for UCI transmission <----------------------Unchanged parts are omitted--------------->  If a UE  - is not provided *pathlossReferenceRSs* in *PUCCH-PowerControl*,  - is provided *enableDefaultBeamPL-ForPUCCH*, and  - is not provided *PUCCH-SpatialRelationInfo*, and  - is not provided coresetPoolIndex value of 1 for any CORESET, or is provided coresetPoolIndex value of 1 for all CORESETs, in ControlResourceSet and no codepoint of a TCI field, if any, in a DCI format of any search space set maps to two TCI states [5, TS 38.212]  a spatial setting for a PUCCH transmission from the UE is same as a spatial setting for PDCCH receptions by the UE in the CORESET with the lowest ID on the active DL BWP of the PCell. For a PUCCH transmission over multiple slots, a same spatial setting as determined by the first slot of the multiple slots applies to the PUCCH transmission in each of the multiple slots.  <----------------------Unchanged parts are omitted---------------> |

Please provide company’s view in the table below.

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| Company | Comment |
| Apple | Support the CR |
| Intel | We are OK with CR to make spec clearer |
| Spreadtrum | Ok with the CR, which makes spec much clearer. |
| Samsung | Support the proposal. |
| Ericsson | Not needed. Since there is no ambiguity on the spatial relation of PUCCH for the first slot with respect to the timing, there is no alternative. |
| Lenovo/MotM | Prefer to have a conclusion since this is a common understanding. |
| OPPO | No strong preference. Both changing the spec based on the proposed CR and no changing are ok. |
| Samsung2 | After considering Ericsson’s comment, it seems obvious and the CR is not needed. |
| LG | Ok with the typo correction.  Re clarifying the first slot, we don’t have strong view on fixing the spec as proposed or not since we also think that there is no other option to implement this other than the way of proposed TP. Making a conclusion as suggested by Lenovo/MotM is not needed since we already have a clear agreement. |
| Qualcomm | We also think the CR is not needed. The wording seems clear. |
| ZTE | @Ericsson, Samsung and Qualcomm: In our views, the motivation of the CR is to avoid the ambiguity that 'the same across all the slots' is based on UE mechanism (i.e., spatial relation determined by the first slot is applied to multi-slot) or NW restriction (i.e., the 'effective/activated' spatial relation for a multi-slot PUCCH is the same (i.e., remains) across all the slots, as one company mentioned in the preparation phase.  Clearly, the already agreement corresponds to the former. But, the reason why the interpretation can be misunderstood as the latter is due to the fact that the 'being based on the first slot' is missing in the current spec. So, they can assume that the UE behavior is still to determine spatial relation per slot even for multi-slot PUCCH transmission.  @Spreadtrum, Lenovo/MotM, OPPO and LGE, Thank you so much for being flexible. In general, we think that fixing the spec as proposed (based on the already agreement) looks better for making spec readable. |
| DOCOMO | We see the agreement is not fully captured. We are fine with the CRs.  This issue may be a corner case, because the default spatial is derived from the QCL assumption of the lowest CORESET ID, and it does not change slot by slot, except PDCCH TCI state is updated. But, we discussed it and made an agreement in RAN1#101e. We don’t have reason to object to capture it, because it was explicitly agreed. |
| Huawei, HiSilicon | Ok with the change |
| CATT | Fine with the change. |

# Summary

The following potential TP is updated based on the companies’ input.

**Draft TP**

# Reference

[1] R1-2106538, Clarification on default spatial setting of PUCCH with multiple slots, ZTE