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

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

**Agenda item:** 7.2.6.3.

**Source:** Moderator (LG Electronics)

**Title:** Summary of email thread [101-e-NR-eMIMO-MB1-01]

**Document for:** Discussion and Decision

# Introduction

This contribution summaries discussion in email thread [101-e-NR-eMIMO-MB1-01]

# Background and Summary of Proposal

For the feature of default beam/PL RS, it has been agreed that this feature is supported for UEs supporting beam correspondence.

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| **Agreement@RAN1#98**  At least for UEs supporting beam correspondance, if spatial relation info for dedicated-PUCCH/SRS, except for SRS with usage = 'BeamManagement', is not configured in FR2, a default spatial relation for dedicated-PUCCH/SRS is applied   * FFS: Detail on the default spatial relation   **Agreement@RAN1#98**  At least for UEs supporting beam correspondence, if spatial relation info for dedicated-PUCCH/SRS, except for SRS with usage = 'BeamManagement', is not configured in FR2, the applied default spatial relation for the dedicated-PUCCH/SRS is down-selected from the followings in RAN1#98bis   * Alt.1: default TCI state or QCL assumption of PDSCH (e.g. the most recent slot and the lowest CORESET ID) * Alt.2: one of an active TCI state of CORESET   + FFS: details of which TCI state * Alt.3: TCI state of scheduling PDCCH for A-SRS/PUCCH, and default TCI state or QCL assumption of PDSCH for other than A-SRS/PUCCH * Alt.4: CORESET#0 QCL assumption * Alt.5: pathloss reference RS   + FFS: details of which pathloss reference RS * FFS: whether to apply the above for UEs not supporting beam correspondence   **Agreement@RAN1#99**  The following working assumption is confirmed with revision in red  The default spatial relation for dedicated-PUCCH/SRS for a CC in FR2, at least when no pathloss RSs are configured by RRC is determined by   * ~~Default TCI state or QCL assumption of PDSCH, i.e.,~~ * in case when CORESET(s) are configured on the CC, the TCI state / QCL assumption of the CORESET with the lowest ID, or   + The PL RS to be used is the QCL-TypeD RS of the same TCI state / QCL assumption of the CORESET with the lowest ID   + Note: The PL RS should be periodic RS * in case when any CORESETs are not configured on the CC, the activated TCI state with the lowest ID applicable to PDSCH in the active DL-BWP of the CC * Above applies at least for UEs supporting beam correspondence * Above applies at least for the single TRP case * ~~FFS: Details on UE behavior in the absence of the activated TCI state~~ * ~~FFS: Details on default spatial relation in multicarrier scenario~~ * ~~FFS: Details on which RS to use for pathloss measurement~~ * ~~FFS: Details on how to handle this issue in case pathloss RSs are configured~~ |

This condition has been implemented for PUCCH in TS38.213 as captured below.

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| 9.2.2 PUCCH Formats for UCI transmission  \*\*\* Unchanged text is omitted \*\*\*  If a UE  - reports *beamCorrespondenceWithoutUL-BeamSweeping*,  - is not provided *pathlossReferenceRSs* in *PUCCH-PowerControl*,  - is provided *enableDefaultBeamPlForPUCCH*, 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. |

However, the condition has not been implemented for SRS. OPPO proposed to add this condition to SRS part in TS38.214, as captured below.

Proposal from OPPO: Adopt the following TP of TS 38.214

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| 6.2.1 UE sounding procedure  \*\*\* Unchanged text is omitted \*\*\*  When a UE reports *beamCorrespondenceWithoutUL-BeamSweeping* and the higher layer parameter *enableDefaultBeamPlForSRS* is set 'enabled', and if the higher layer parameter *spatialRelationInfo* for the SRS resource, except for the SRS resource with the higher layer parameter *usage* in SRS-ResourceSet set to 'beamManagement' or for the SRS resource with the higher layer parameter *usage* in SRS-ResourceSet set to 'nonCodebook' with configuration of *associatedCSI-RS* or for the SRS resource configured by the higher layer parameter [SRS-for-positioning], is not configured in FR2 and if the UE is not configured with higher layer parameter(s) *pathlossReferenceRS*, the UE shall transmit the target SRS resource  - with the same spatial domain transmission filter used for the reception of the CORESET with the lowest *controlResourceSetId* in the active DL BWP in the CC.  - with the same spatial domain transmission filter used for the reception of the activated TCI state with the lowest ID applicable to PDSCH in the active DL BWP of the CC if the UE is not configured with any CORESET in the CC  \*\*\* Unchanged text is omitted \*\*\* |

Meanwhile, DOCOMO and Ericsson pointed out that all UEs should report *beamCorrespondenceWithoutUL-BeamSweeping* and the support or non-support of this feature is defined by a separated UE capability, i.e. FG16-1c(Default spatial relation). Therefore, DOCOMO suggested to replace this condition to a related UE capability as below and Ericsson proposed to delete this condition for PUCCH in TS38.213.

**Proposal from DOCOMO: Adopt the following TP in TS38.213 section 9.2.2**

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| 9.2.2 PUCCH Formats for UCI transmission  […]  If a UE  - ~~reports~~ indicates a capability to support *~~beamCorrespondenceWithoutUL-BeamSweeping~~* [*DefaultSpatialRelation*],  - is not provided *pathlossReferenceRSs* in *PUCCH-PowerControl*,  - is provided *enableDefaultBeamPlForPUCCH*, 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.  […] |

**Proposal from Ericsson: Adopt the following TP in TS38.213 section 9.2.2**

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| --- omitted ---  If a UE  -  - is not provided *pathlossReferenceRSs* in *PUCCH-PowerControl*,  - is provided *enableDefaultBeamPlForPUCCH*, and  - is not provided *PUCCH-SpatialRelationInfo*,  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.  --- omitted --- |

For this issue, LG proposed to clarify this condition in the UE feature that FG16-1c(Default spatial relation) is supported only for UEs that reports component 1 of the FG2-20(beam correspondence) as ‘1’, and then delete the condition for PUCCH in TS38.213.

**Proposal from LG: Clarify that FG16-1c(Default spatial relation) is supported only for UEs that reports component 1 of the FG2-20(beam correspondence) as ‘1’, and then, adopt the following TP in TS38.213.**

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| 9.2.2 PUCCH Formats for UCI transmission  \*\*\* Unchanged text is omitted \*\*\*  If a UE  ~~- reports~~ *~~beamCorrespondenceWithoutUL-BeamSweeping~~*~~,~~  - is not provided *pathlossReferenceRSs* in *PUCCH-PowerControl*,  - is provided *enableDefaultBeamPlForPUCCH*, 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. |

# Discussion

Based on the proposals from tdocs, four different approaches are identified for this issue.

* Alt1: Capture the condition that the feature of default spatial relation/PL RS is supported for UEs supporting beam correspondence for SRS in TS38.214
  + For Alt1, the TP from OPPO can be a starting point.
* Alt2: Capture the condition that FG16-1c(Default spatial relation) is supported only for UEs that reports component 1 of the FG2-20(beam correspondence) as ‘1’ in the UE feature, and delete the condition for PUCCH from TS38.213, i.e., TP from LG for TS38.213.
* Alt3: Replace the condition for PUCCH to FG16-1c(Default spatial relation)
  + For Alt3, the TP from DOCOMO can be a starting point
* Alt4: Delete the condition for PUCCH from TS38.213, i.e., TP from Ericsson for TS38.213.

**Companies’ view (to be updated)**

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| Company name | View |
| Ericsson | Support Alt3 – rely on the separate capability.  As noted, all UE must support the beam correspondence tolerances – all UEs support beam correspondence. Although the original intention of FG 2-20 was about supporting beam correspondence, it is not anymore – FG 2-20 is about which test is used to demonstrate beam correspondence. |
| ZTE | Support Alt 4.  We agree that the description of“UE reports beamCorrespondenceWithoutUL-BeamSweeping” is incorrect, after reviewing the contribution from NTT DOCOMO and Ericsson. To simplify the current spec and considering the signaling of “*enableDefaultBeamPlForPUCCH*”, we do not need to additionally specify whether UE supports default beam and pathloss approach, from spec perspective. In Alt3, “a UE indicates a capability to support DefaultSpatialRelation” is a little bit redundant. |
| DOCOMO | Support Alt.3/4, due to the following reasons:   1. The default spatial relation follows to DL-RS, however, this behavior is already supported for all UEs in Rel.15, regardless of the capability of *beamCorrespondenceWithoutUL-BeamSweeping*. For UEs without *beamCorrespondenceWithoutUL-BeamSweeping*, it is up to gNB to configure additional UL beam sweeping; when additional UL beam sweeping is not configured, UE supports the beam correspondence, and the beam correspondence tolerance requirement is 3~3.2dB relaxed than the case additional UL beam sweeping is configured (details are in 6.6.4.1-6.6.4.2 of TS38.101-2). **Hence, all Rel.15 UEs supports the beam correspondence, and gNB has no restriction to configure DL-RS as spatial relation.** 2. Rel.16 gNB have two options for UEs without *beamCorrespondenceWithoutUL-BeamSweeping*.   1) Explicitly configures DL-RS as spatial relation (by Rel.15 spec.) 2) Applies the default spatial relation by (Rel.16 spec.)  Even if RAN1 spec. precludes 2), the operation of 1) is allowed. Hence, if there is concern of the performance of 2), the operation of 1) is inevitable. If UE can also support 2), it is more beneficial for both gNB and UE to reduce MAC CE overhead.   1. Since we are going to **define new UE capability of default spatial relation, UE can report whether to support this feature.** Even if UE cannot support this feature, UE has ability to report as “No”. From standard perspective, there is no need to restrict or assume prerequisite feature of *beamCorrespondenceWithoutUL-BeamSweeping*. |
| Intel | Support Alt 4 or Alt 3.  There are no benefits of the existing BC restriction. It is up to gNB whether to configure the corresponding feature.  RAN4 would have several BC requirements (e.g. based on CSI-RS or SSB) in Rel-16 and would be good to have specification agnostic to this requirements. |
| Intel | Support Alt.4. Also fine with Alt-3 as a second preference.  Agree with other companies that there is no obvious reason to prelude UE that supports beam correspondance without UL beam sweeping. This should be left to NW implementation, by taking into account potential performance gap. |
| Sony | Support Alt.1.  In above Agreements, we interpret the statement “At least for UEs supporting beam correspondence” means the UE which sets the field of UE capability *beamCorrespondenceWithoutUL-BeamSweeping* as “supported”. So according to the Agreements, RAN1 may need to equally treat PUCCH (already captured) and SRS (To be captured). |
| Nokia/NSB | Support Alt. 3 or 4  We don’t see a strict reason to bring such restriction. |
| Qualcomm | Support Alt. 3 or 4. Slightly prefer Alt. 4 |
| Samsung | Support Alt.3. (Also fine with Alt.4 as a second preference.) |
| OPPO | Both Alt 1 and Alt 2 are ok.  Not ok with Alt 3 and 4. |
| CMCC | Support Alt. 3 or 4. Slightly prefer Alt. 4 |
| vivo | Fine with Alt 4. |
| Apple | Support Alt 4 |
| Lenovo/MOT | Support Alt 4. |
| LG | Support Alt 2 or Alt1.  To support the default beam operation, UE should be able to identify the best UL-Tx/DL-Rx beam pair (i.e. supporting BC). Hence, it seems reasonable to capture the agreed condition. |
| Fraunhofer | Support Alt. 4 – conditioning the application of the feature with respect to UE capability as in Alt. 3 is not necessary. |
| Huawei, HiSilicon | Support Alt 4. Concerned on making strong linkage between UE behavior and capability reporting, which may affect forward compatibility (as observed in the thread of TEIs-01 and TEIs-03). It is safe to implicitly assume that NW will not configure UE to operate in a mode that is not supported by this UE. |

# Conclusion (to be updated)

From the email discussion [101-e-NR-eMIMO-MB1-01], xxx

# References

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| --- | --- | --- |
| **TDoc** | **Title** | **Source** |
| [**R1-2003929**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_101-e/Docs/R1-2003929.zip) | Remaining issues on multi beam operation | LG Electronics |
| [**R1-2004048**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_101-e/Docs/R1-2004048.zip) | Remaining issues on Multi-beam Operation Enhancement | OPPO |
| [**R1-2004201**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_101-e/Docs/R1-2004201.zip) | Remaining issues on multi-beam operation | Ericsson |
| [**R1-2004396**](http://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_101-e/Docs/R1-2004396.zip) | Remaining issues on multi-beam operation | NTT DOCOMO, INC |