**3GPP TSG RAN #104**

**Shanghai, China, June 17th – 20th, 2024**

**Title: Moderator Summary for Rel-19 MIMO Issues**

**Source: RAN1 Chair (Samsung)**

# Introduction

This document covers RAN#104 discussions on the following contributions related to NR MIMO Phase 5.

* RP-241194 Views on the scope of Rel-19 MIMO WI Qualcomm Incorporated
* RP-241207 Views on scope of Rel-19 NR MIMO Phase 5 CMCC
* RP-241358 Rel-19 MIMO Scope MediaTek Inc.

Specifically, the following issues are discussed.

* Support of two TAs as part of enhancement for asymmetric DL sTRP/UL mTRP deployment scenarios
* SRS port grouping as part of CSI enhancement
* Partial-coherent UL codebook for 3Tx multi-panel
* Open loop based UL precoder cycling

# Two TAs

Two TAs was introduced into RAN1 as part of Rel-18 MIMO. In Rel-18, this feature is supported by means of indicating two TAs using separate DCIs for each TA value. In Rel-19, RAN1 discussed the support of this feature as part of enhancement for asymmetric DL sTRP/UL mTRP deployment scenarios. Unlike the Rel-18 scenario where each TRP can indicate its TA value using separate DCIs, in the asymmetric DL sTRP/UL mTRP scenario, one of the TRPs cannot transmit on the downlink. Therefore, two TAs would need to be supported using a single DCI if this feature is supported in Rel-19.

The companies involved in the RAN1#117 discussion had strong positive views on the support of two TAs in Rel-19. Some companies voiced that this feature would be critical in making asymmetric DL sTRP/UL mTRP deployment scenario practically useful. Note however that there was at least one company who did not agree that two TAs is within scope of Rel-19.

The moderator requests interested companies to provide their views on the support of two TAs as part of Rel-19 MIMO.

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| **Company** | **Comments** |
| Samsung | The support for 2TA for asymmetric DL/UL is essential to ensure that the technology is applicable not only when a UE is right at the middle of two UL TRPs. The current 2TA support is not applicable due to the association of each TAG with CoresetPoolIdx (inherent for M-DCI, specified in Rel-18). Since this is an essential component, it is clearly within the scope of objective #5 in Rel-19 MIMO PH5 WID.  In this sense, the support for 2TA for asymmetric DL/UL doesn’t belong to “up-scoping” and therefore doesn’t need any WID update to continue the work in RAN1.  Re the TP proposed in RP-241194, we appreciate and concur with the spirit although the TP requires more discussion in RAN1#118. The current TP not only removes the outcome of Rel-18 MIMO 2TA support (note that 2TA for M-DCI still has many use cases – no reason to remove it from the spec), but is also incomplete. At the same time, the proposal discussed in RAN1#117 suffices at this stage since there is no Rel-19 CR available yet.  [From rapporteur perspective] While it was argued that there is no explicit description on this objective, it can be argued that there is no explicit statement that rules this out either. Such proposals, therefore, must be contribution-driven to be considered in scope – despite the higher priority assigned to topics that are explicitly described in the WID. Given the good progress for asymmetric DL/UL, the support for 2TA warrants timely discussion starting in RAN1#117.  Therefore, we see no need for further RAN action or additional guidance on this issue especially since RAN1 has provided guidance to further study/evaluate this proposal until RAN1#118 for potential adoption. If RAN1 is able to converge in RAN1#118, whether this needs ratification in RAN#105 can be further discussed. |
| Apple | This was proposed as one of the Rel-19 MIMO WID objectives during the Rel-19 MIMO WID discussion. However, this was not agreed to be included in Rel-19 MIMO WID. This is our understanding of the matter of fact. So, strictly speaking, it is out of scope.  However, we have note from the last RAN1#107 meeting “Companies are encouraged to consider above for further discussion in RAN1#118". As results, we are open to keep the topic under discussion in RAN1#118 as study.  We think it is better to have official discussion in September RAN plenary meeting RAN#105 on whether to adopt this as normative objective. |
| **Google** | In our view, 2TA is not within the scope. On the other hand, we acknowledge that 2TA on top of DPS operation can make the system work better for asymmetric DL/UL scenario, but it is not essential. Besides, we failed to see why 2TA on top of any single-DCI based mTRP scheme can help. |
| **Vodafone** | 2TA seems to be essential for the feature to work, so we don’t see this as upscoping the work. |

# SRS port grouping

SRS port grouping was proposed as a mean to enable the use of 128 ports under TDD system with practical UE implementation in acquiring CSI [1]. UE receiver antenna ports are divided into two low dimensional antenna groups, where each antenna group corresponds to a low dimensional CSI acquisition and PDSCH reception. For example, a UE with 8 RX antenna ports could divide these ports into two groups – 4 RX antenna ports per group. Compared to the case of generating CSI for 8 RX antenna ports, the required UE complexity for generating two sets of CSIs for the two groups of antenna ports (4 RX antenna ports per group) would be reduced.

The companies involved in the RAN1#117 discussion had strong positive views on the support of SRS port grouping in Rel-19. However, there was at least one company who did not agree that this feature is within scope of Rel-19. Given the situation, guidance from RAN1 chair was to further consider SRS port grouping for possible conclusion in RAN1#118.

The moderator requests interested companies to provide their views on the support of SRS port grouping as part of Rel-19 MIMO.

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| **Company** | **Comments** |
| Samsung | The support for SRS port grouping facilitates alignment between a gNB and a UE on the mapping between SRS ports and CWs when >4 DL layers are assigned to the UE in TDD scenario with lower complexity 8RX receiver (comprising two 4RX basebands). Without this mapping, mismatch between the gNB and the UE would affect CQI calculation and result in throughput loss (demonstrated in RAN1#117). Since this proposal relates to the use of 128 ports in TDD scenarios (e.g. C-band, upper FR1) as well as assumption for CQI calculation with RI>4, this is clearly within the scope of objective #2 in Rel-19 MIMO PH5 WID.  Despite the ongoing effort in RAN4 to specify requirements for 8RX UEs (primarily targeted to CPE devices), it is evident that the required complexity for 8RX UEs can be excessive for handheld devices. This roadblock can be circumvented in some cases by the use of 2 4RX basebands and SRS port grouping -requiring *minor spec enhancement*- ensures proper operation in TDD bands.  [From rapporteur perspective] While it was argued that there is no explicit description on this objective, it can be argued that there is no explicit statement that rules this out either. Such proposals, therefore, must be contribution-driven to be considered in scope – despite the higher priority assigned to topics that are explicitly described in the WID. Given the good progress for CSI, the support for SRS port grouping warrants timely discussion starting in RAN1#117.  Therefore, we see no need for further RAN action or additional guidance on this issue especially since RAN1 has provided guidance to further study/evaluate this proposal until RAN1#118 for potential adoption. If RAN1 is able to converge in RAN1#118, whether this needs ratification in RAN#105 can be further discussed. |
| Apple | This was proposed as one of the Rel-19 MIMO WID objectives during the Rel-19 MIMO WID discussion. However, this was not agreed to be included in Rel-19 MIMO WID. This is our understanding of the matter of fact. So, strictly speaking, it is out of scope.  However, we have note from the last RAN1#107 meeting “Companies are encouraged to evaluate for further discussion in RAN1#118". As results, we are open to keep the topic under discussion in RAN1#118 as study.  We think it is better to have official discussion in September RAN plenary meeting RAN#105 on whether to adopt this as normative objective. |
| Google | In our view, how to calculate the CQI for up to 128 ports is naturally within the scope. To calculate the CQI from part of UE ports or all UE ports should be something that needs to be decided.  Further, we also noticed that in Rel-19 RAN1 has already agreed that the NW can configure UE to measure phase offset for CJT from a UE port associated with an SRS port. Based on the same logic and principle, to calculate CQI from a subset of UE ports should be naturally within the scope. |
| Vodafone | We observed that SRS port grouping degrades the throughput performance. We don’t support SRS port grouping scheme for simplified receiver without a study phase being added in an updated Rel-19 MIMO WID |

# Partial-Coherent UL codebook

Current Rel-19 MIMO WID has the following objective on 3TX enhancement:

1. *Specify non-coherent UL codebook to facilitate 3-antenna-port codebook-based transmissions, without enhancement on UL full power transmission and without enhancement on SRS resource*

The proposal in [2] is to additionally support partial coherent UL codebook in addition to the non-coherent UL codebook. From moderator point of view, this is a clear up scoping of the Rel-19 MIMO objectives.

The moderator requests interested companies to provide their views on the support of partial coherent UL codebook as part of Rel-19 MIMO.

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| **Company** | **Comments** |
| Samsung | We agree with the moderator that this clearly belongs to up-scoping discussion (not in RAN#104, can be discussed in RAN#105). |
| Apple | This was proposed as one of the Rel-19 MIMO WID objectives during the Rel-19 MIMO WID discussion. However, this was not agreed to be included in Rel-19 MIMO WID. This is our understanding of the matter of fact. So, strictly speaking, it is out of scope.  We prefer to discuss this topic, if needed, in September RAN plenary meeting RAN#105, and stop discussion in this RAN#104. |
| Google | We also think partial-coherent UL codebook is clearly out of scope. |
| Vodafone | This seems to be up-scoping. |

# UL precoder cycling

In [3], it is proposed to study open loop based UL precoder cycling scheme to understand its performance benefit and specification impact. From moderator point of view, this is a clear up scoping of the Rel-19 MIMO objectives.

The moderator requests interested companies to provide their views on the support of UL precoder cycling as part of Rel-19 MIMO.

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| **Company** | **Comments** |
| Samsung | We agree with the moderator that this clearly belongs to up-scoping discussion (not in RAN#104, can be discussed in RAN#105).  At the same time, we are supportive of specifying *smaller UL PRG sizes for PUSCH* to enable spec-transparent UL transmit diversity schemes such as UL precoder cycling or small-delay CDD. It is our view that this should be included as high-priority candidate for up-scoping discussion of Rel-19 MIMO PH5 in RAN#105, |
| Apple | This was proposed as one of the Rel-19 MIMO WID objectives during the Rel-19 MIMO WID discussion. However, this was not agreed to be included in Rel-19 MIMO WID. This is our understanding of the matter of fact. So, strictly speaking, it is out of scope.  We prefer to discuss this topic, if needed, in September RAN plenary meeting RAN#105, and stop discussion in this RAN#104. |
| Google | We think UL port cycling is within the scope, but UL precoder cycling could require something more. For codebook based transmission, how to identify the associated SRS ports (including the order for the associated SRS ports) for a PUSCH transmission occasion is an essential issue that needs to be addressed anyway. |
| Vodafone | This seems to be up-scoping. |

# Conclusions

Based on the discussions captured in Sections 2, 3, 4, and 5, moderator makes the following observations/proposals.

TBD

# References

[1] R1-2403945 On 128 CSI-RS ports and UE reporting enhancements Huawei, HiSilicon

[2] RP-241207 Views on scope of Rel-19 NR MIMO Phase 5 CMCC

[3] RP-241194 Views on the scope of Rel-19 MIMO WI Qualcomm Incorporated