**3GPP TSG RAN WG1 #117 R1-2405347**

**Fukuoka City, Fukuoka, Japan, May 20th – 24th, 2024**

**Source: Moderator (OPPO)**

**Title: Summary #2 on Rel-19 asymmetric DL sTRP/UL mTRP**

**Agenda Item: 9.2.4**

**Document for: Discussion and Decision**

# Introduction

This document summarizes remaining issues proposed in company contributions of AI 9.2.4 for the following objective in Rel-19 WI of NR MIMO Phase 5:

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| 1. Specify enhancement for asymmetric DL sTRP/UL mTRP deployment scenarios, assuming intra-band intra-DU non-co-located mTRP scenarios, without changing existing cell definition or defining a new cell (e.g. UL-only cell), assuming the Rel-17/18 unified TCI framework and fully reusing the legacy QCL/UL spatial relation rules, targeting FR1 and FR2
	1. Two closed-loop PC adjustment states for SRS, both separate from PUSCH; and pathloss offset configurations for pathloss calculation to UL TRP(s), when the pathloss RS is from DL sTRP.
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# Issues for Discussions

## Pathloss Offset

**Proposal 1.3:**

* When a joint/UL TCI state associated with a PL offset with value $G\_{b,f,c}$is applied on a PUSCH transmission, the UE determines the PUSCH transmit power as:

$P\_{PUSCH,b,f,c,k}\left(i,j,q\_{d},l\right)=min\left\{\begin{matrix}P\_{CMAX,f,c,k}\left(i\right)\\P\_{O\\_PUSCH,b,f,c}\left(j\right)+10log\_{10}\left(2^{μ}∙M\_{RB,b,f,c}^{PUSCH}\left(i\right)\right)+α\_{b,f,c}\left(j\right)∙(PL\_{b,f,c}\left(q\_{d}\right)-G\_{b,f,c})+∆\_{TF,b,f,c}\left(i\right)+f\_{b,f,c}\left(i,l\right) \end{matrix}\right\}$

* When a joint/UL TCI state associated with a PL offset with value $G\_{b,f,c}\left(i\right)$ is applied on a PUCCH transmission, the UE determines the PUCCH transmit power as:

$$P\_{PUCCH,b,f,c,k}\left(i,q\_{u},q\_{d},l\right)=min\left\{\begin{matrix}P\_{CMAX,f,c,k}\left(i\right)\\P\_{O\\_PUCCH,b,f,c}\left(j\right)+10log\_{10}\left(2^{μ}∙M\_{RB,b,f,c}^{PUCCH}\left(i\right)\right)+PL\_{b,f,c}\left(q\_{d}\right)-G\_{b,f,c}+∆\_{F\\_PUCCH}\left(F\right)+∆\_{TF,b,f,c}\left(i\right)+g\_{b,f,c}\left(i,l\right) \end{matrix}\right\}$$

* When power control parameters contained in one joint/UL TCI state associated with a PL offset with value $G\_{b,f,c}\left(i\right)$ are applied on a SRS transmission, the UE determines the SRS transmit power as:

$$P\_{SRS,b,f,c}\left(i,q,l\right)=\min\_{}\left\{\begin{matrix}P\_{CMAX,f,c}\left(i\right),\\P\_{O\_{SRS},b,f,c}\left(q\_{s}\right)+10log\_{10}\left(2^{μ}∙M\_{SRS,b,f,c}\left(i\right)\right)+α\_{SRS,b,f,c}\left(q\_{s}\right)∙(PL\_{b,f,c}\left(q\_{d}\right)-G\_{b,f,c})+h\_{b,f,c}\left(i,l\right)\end{matrix}\right.$$

Note: How to capture that is up to the editor.

FFS: the value range and candidate values of PL offset value

**Proposal 1.4a:** To calculate a Type 1 PHR based on an actual PUSCH transmission,if a joint/UL TCI state associated with a PL offset with value $G\_{b,f,c}$ is applied on this PUSCH transmission, the UE determines the Type 1 PHR as:

$$PH\_{type1,b,f,c}\left(i,j,q\_{d},l\right)= P\_{CMAX,f,c}\left(i\right)-\left\{P\_{O\\_PUSCH,b,f,c}\left(j\right)+10log\_{10}\left(2^{μ}⋅M\_{RB,b,f,c}^{PUSCH}(i)\right)+α\_{b,f,c}\left(j\right)⋅(PL\_{b,f,c}\left(q\_{d}\right)-G\_{b,f,c})+∆\_{TF,b,f,c}\left(i\right)+f\_{b,f,c}\left(i,l\right)\right\}$$

* Note: How to capture that is up to the editor.
* FFS Type 1 PHR calculation based on reference PUSCH when including PL offset.
* FFS: Whether or not PHR triggering conditions in 38.321 need to be modified to account for PL offset.

**Proposal 1.4b:** To calculate a Type 3 PHR based on an actual SRS transmission,if a joint/UL TCI state associated with a PL offset with value $G\_{b,f,c}$ is applied on this SRS transmission, the UE determines the Type 3 PHR as:

$$PH\_{type3,b,f,c}\left(i,q\_{s}\right)= P\_{CMAX,f,c}\left(i\right)-\left\{P\_{O\\_SRS,b,f,c}\left(j\right)+10log\_{10}\left(2^{μ}⋅M\_{SRS,b,f,c}^{}(i)\right)+α\_{SRS, b,f,c}\left(j\right)⋅(PL\_{b,f,c}\left(q\_{s}\right)-G\_{b,f,c})+f\_{b,f,c}\left(i\right)\right\}$$

* Note: How to capture that is up to the editor.
* FFS Type 3 PHR calculation based on reference SRS when including PL offset.
* FFS: Whether or not PHR triggering conditions in 38.321 need to be modified to account for PL offset.

**Proposal 1.5:**

Study whether/how to facilitate gNB’s determination of the value of PL offset from specification point of view

**Updated Conclusion 1.7a**: For the asymmetric DL sTRP/UL mTRP deployment scenario,

* When rel-17 unified TCI/ICBM is configured:
	+ For FR1: one joint TCI state or one DL TCI state + one UL TCI state can be applied to the system
	+ For FR2: one DL TCI state + one UL TCI state can be applied to the system.
* When rel-18 unified TCI is configured:
	+ For FR1: up to two joint TCI states or one DL TCI state + up to two UL TCI state can be applied to the system.
		- Note: When two joint TCI states are applied, the 1st joint TCI state is applied on DL transmission and both joint TCI states can be applied on UL transmissions
	+ For FR2: one DL TCI state + up to two UL TCI states can be applied to the system.

**Updated Proposal 1.7b**: To facilitate the asymmetric DL sTRP/UL mTRP deployment scenario, study whether/how to support a mixed TCI mode of joint TCI state + UL TCI state for FR1 and FR2 additionally:

* In the mixed TCI mode: a joint TCI state + a UL TCI state can be mapped to a TCI field codepoint, and the indicated UL TCI state is applied on UL transmission towards the UL TRP.

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| **Company**  | **Comments** |
| Mod00 | Please share your views/inputs on the issues 1.xRe 1.4b: Samsung commented that 1.4b needs more discussion because they think Type 3 PHR is reported for CC without PUSCH-config and the case of CC without PUSCH-Config is not valid for this UL TRP scenario. I would like to hear your views on this.Re 1.7a: slightly wording. I guess no one comments that the proposal 7.1a is wrong technically and the only concern is whether this conclusion is needed. Some companies did propose to make it clear.Re 1.7b: the views diverged. I think we can conclude to first study this mixed TCI mode for the current moment.  |
| ZTE | **Proposal 1.3 and Proposal 1.4a:** Generally, we think it is immature/unsafe to rush into the formula of PL offset application at the current stage, we suggest to postpone this discussion to Rel-19 maintenance phase. Nevertheless, we think it is worth to discuss all parts of FFS in Proposal 1.3 and Proposal 1.4a, we suggest to discuss them separately due to there is no explicit dependency among them.**Proposal 1.4b:** Not needed. As mentioned by companies in round-1, Type 3 PHR cannot be existed as per the following excerpt in TS 38.213.

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| **7.7.3 Type 3 PH report**If a UE determines that a Type 3 power headroom report for an activated serving cell is based on an actual SRS transmission then, for SRS transmission occasion C:\Users\10262958\AppData\Local\Temp\ksohtml19728\wps2.png on active UL BWP C:\Users\10262958\AppData\Local\Temp\ksohtml19728\wps3.png of carrier C:\Users\10262958\AppData\Local\Temp\ksohtml19728\wps4.png of serving cell C:\Users\10262958\AppData\Local\Temp\ksohtml19728\wps5.jpg and if the UE is not configured for PUSCH transmissions on carrier C:\Users\10262958\AppData\Local\Temp\ksohtml19728\wps6.png of serving cell C:\Users\10262958\AppData\Local\Temp\ksohtml19728\wps7.jpg and the resource for the SRS transmission is provided by *SRS-Resource*, the UE computes a Type 3 power headroom report as C:\Users\10262958\AppData\Local\Temp\ksohtml19728\wps8.png [dB]where C:\Users\10262958\AppData\Local\Temp\ksohtml19728\wps9.png, C:\Users\10262958\AppData\Local\Temp\ksohtml19728\wps10.png, C:\Users\10262958\AppData\Local\Temp\ksohtml19728\wps11.png, C:\Users\10262958\AppData\Local\Temp\ksohtml19728\wps12.png, C:\Users\10262958\AppData\Local\Temp\ksohtml19728\wps13.png and C:\Users\10262958\AppData\Local\Temp\ksohtml19728\wps14.png are defined in clause 7.3.1 with corresponding values provided by *SRS-ResourceSet*.If the UE determines that a Type 3 power headroom report for an activated serving cell is based on a reference SRS transmission then, for SRS transmission occasion C:\Users\10262958\AppData\Local\Temp\ksohtml19728\wps15.png on UL BWP C:\Users\10262958\AppData\Local\Temp\ksohtml19728\wps16.png of carrier C:\Users\10262958\AppData\Local\Temp\ksohtml19728\wps17.png of serving cell C:\Users\10262958\AppData\Local\Temp\ksohtml19728\wps18.jpg, and if the UE is not configured for PUSCH transmissions on UL BWP C:\Users\10262958\AppData\Local\Temp\ksohtml19728\wps19.png of carrier C:\Users\10262958\AppData\Local\Temp\ksohtml19728\wps20.png of serving cell C:\Users\10262958\AppData\Local\Temp\ksohtml19728\wps21.jpg and a resource for the reference SRS transmission is provided by *SRS-Resource*, the UE computes a Type 3 power headroom report as  C:\Users\10262958\AppData\Local\Temp\ksohtml19728\wps22.png [dB]where C:\Users\10262958\AppData\Local\Temp\ksohtml19728\wps23.png is an SRS resource set corresponding to *SRS-ResourceSetId = 0* for UL BWP C:\Users\10262958\AppData\Local\Temp\ksohtml19728\wps24.png and C:\Users\10262958\AppData\Local\Temp\ksohtml19728\wps25.png, C:\Users\10262958\AppData\Local\Temp\ksohtml19728\wps26.png, C:\Users\10262958\AppData\Local\Temp\ksohtml19728\wps27.png and C:\Users\10262958\AppData\Local\Temp\ksohtml19728\wps28.png are defined in clause 7.3.1 with corresponding values obtained from *SRS-ResourceSetId = 0* for UL BWP C:\Users\10262958\AppData\Local\Temp\ksohtml19728\wps29.png. C:\Users\10262958\AppData\Local\Temp\ksohtml19728\wps30.png is computed assuming MPR=0 dB, A-MPR=0 dB, P-MPR=0 dB and TC =0 dB. MPR, A-MPR, P-MPR and TC are defined in [8-1, TS 38.101-1], [8-2, TS 38.101-2] and [8-3, TS 38.101-3].  |

**Proposal 1.5:** Fine to further study even though we think it should be up to gNB implementation.**Proposal 1.7a:** Agree to FL’s assessment and the refinement for clarification.**Proposal 1.7b:** Not needed. It deviates from the statement in WID that “… assuming the Rel-17/18 unified TCI framework and fully reusing the legacy QCL/UL spatial relation rules…”. |
| QC | **Proposal 1.3/1.4**: Regarding the PC formula and PHR formula, agree with ZTE that this can be discussed during R19 maintenance phase. Regarding the second FFS under proposal 1.4, i.e., “FFS: Whether or not PHR triggering conditions in 38.321 need to be modified to account for PL offset.”, the PHR triggering condition is RAN2 issue, it is strange to FFS this in RAN1.**Proposal 1.5:** Support.**Updated proposal 1.7a**: Regarding the Note, this is something new. We’d like to put this as FFS.**Updated proposal 1.7b**: The current Rel.17 and Rel.18 TCI framework can already work well. We don’t see the need to introduce a new TCI framework which is out of the scope. |
| Nokia | Proposal 1.3: we supportProposal 1.4a: we support. We think the triggering conditions need to be updated. We suggest updating the FFS as “ FFS: Type1 PHR Triggering conditions when the PHR is intended for the UL TRP in the asymmetric deployment’’Proposal 1.4b: We support. We think the triggering conditions need to be updated. We suggest updating the FFS as “ FFS: Type 3 PHR Triggering conditions when the PHR is intended for the UL TRP in the asymmetric deployment’’Proposal 1.5: It is up to the network implementation. we are ok with exploringProposal 1.7a: we are fine with itProposal 1.7b we are fine with it |
| Samsung | **Proposal 1.3/1.4:** Support in principle, but it is better up to editor. The only thing we can agree is that whether PL offset value is non-negative value or not, and configuration granularity, which is partially agreed on PL offset associated with TCI state for PUSCH, PUCCH, and SRS which is per BWP/CC.**Proposal 1.4b:** Not support. Our understanding is that Type 3 PHR is reported in a UL carrier in a serving cell when PUSCH-config is not provided, but now we consider UL TRP where there is no DL transmission, then it does not make sense without PUSCH configuration in this scenario. We didn’t see the necessity of this proposal.**Proposal 1.5:** We are fine.**Proposal 1.7a:** We are fine.**Proposal 1.7b:** We are fine with further discussion. |
| Ericsson | Proposal 1.3, 1.4a, 1.4b:We support FL’s intension, but we think the specification text details need more careful study. At this phase, it is not clear with all possible signaling which can update PL offset and accordingly which indices are necessary.Proposal 1.5We are fine to further study even we think the determination of PL offset is up to gNB implementation. Proposal 1.7aThis should be a proposal instead of conclusion. And we support the FL proposal.Proposal 1.7bWe support the FL proposal. |
| Docomo | **Proposal 1.3/1.4a/1.4b:** Support. It cannot be up to editor. We need to decide the value range of PL-offset, and it needs a common understanding that PL-offset is applied as PL-PL-offset or PL+PL-offset.**Proposal 1.7a:** It should be agreement. We think the agreement has impact to the following text.

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| 5.1.5 Antenna ports quasi co-location[…]When a UE is configured with *dl-OrJointTCI-StateList* and is having two indicated *TCI-states*, if the UE receives a TCI codepoint mapped with a sub-set of first and second *TCI-State(s)* and/or a sub-set offirst and second *TCI-UL-State(s)*, the UE shall update the first/second *TCI-State(s)* and/or first/second *TCI-UL-State(s)* mapped to the TCI codepoint, when applicable, and keep the previously indicated first/second *TCI-State(s)* and/or first/second *TCI-UL-State(s)* that is/are not updated by the TCI codepoint. |

**Proposal 1.7b:** We are fine. |
| vivo | **Proposal 1.3/1.4a:** We share similar views as QC and ZTE. It is better to discuss these proposals in mountainous phase. **Proposal 1.5:** Support.**Updated Conclusion 1.7a**: the first bullet can be conclusion for no spec impact is required. The second bullet should be a proposal. Further clarify one of two indicated joint TCI states is used for DL reception and the indicated one DL TCI state is the only DL TCI state instead of updating one of two indicated DL TCI states. We propose the following change:

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| **Updated Conclusion 1.7a**: For the asymmetric DL sTRP/UL mTRP deployment scenario, * When rel-17 unified TCI/ICBM is configured:
	+ For FR1: one joint TCI state or one DL TCI state + one UL TCI state can be applied to the system
	+ For FR2: one DL TCI state + one UL TCI state can be applied to the system.

**Updated proposal 1.7a**:* When rel-18 unified TCI is configured:
	+ For FR1: up to two joint TCI states or one DL TCI state + up to two UL TCI state can be applied to the system.
		- Note: When two joint TCI states are applied, the 1st joint TCI state is applied on DL transmission and both joint TCI states can be applied on UL transmissions
	+ For FR2: one DL TCI state + up to two UL TCI states can be applied to the system.
	+ Note: one DL TCI state means only one DL TCI state is applicable.
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 **Updated proposal 1.7b**: Not support. There is no need to introduce mixed mode. The benefit is unclear. |
| ETRI | Proposal 1.3/1.4a/1.4b: Support.Proposal 1.5: Support. How to determine the PL offset at gNB side is crucial for commercial service of this WID at least in FR2, as it is closely related to interference boosting, *out-of-synchronization,* and *unknown UL-only TRP*. For example, when a UE transmits UL signals to UL-only TRPs with the Tx power (calculated from the Macro TRP), out-of-synchronization happens because the UE does not know the locations of the UL-only TRPs. To address these out-of-synchronization and unknown UL-only TRPs, there are two solutions. Each of the 1st and 2nd solutions is for the UE to transmit the PRACH preambles and SRSs, respectively, which are headed to the pre-defined directions to find the UL-only TRPs. We prefer to the 1st solution which is robust against out-of-synchronization due to using very long CP. On the other hand, the SRSs transmission synchronized to Macro TRP may be out of uplink synchronization to some UL-only TRPs that are in the vicinity of the UE, which indicates that reusing SRS with usage BM is not enough.Proposal 1.7a: Support. |

## Closed-loop PC for SRS

**Proposal 2.1**: Support to use DCI format 1\_1 and 0\_1 to indicate TPC command for SRS CLPC adjustment states of Rel19:

* FFS the detailed DCI field design, e.g., introduce 1-bit state indicator and 2-bit TPC command, DCI format 1\_1 without DL assignment.

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| **Company**  | **Comments** |
| Mod00 | Please share your views/inputs on the issues 2.1 |
| ZTE | Support. |
| QC | Not support. Using DCI 1\_1/1\_0 is not efficient considering the increased DCI overhead and limited range of TPC command. |
| Nokia | Proposal 2.1: we support |
| Samsung | Not support. DCI format 2\_3 is enough to indicated TPC command. |
| Ericsson | Support. We’d like to get more discussion on DCI 1\_1/0\_1 because DCI 2\_3 will degrade the system performance on PDCCH capacity and PDSCH throughput. Separate SRS power control via DCI 1\_1 is more efficient for asymmetric deployment. comparing with the benefits on performance gained by DCI 1\_1/0\_1 supporting separate SRS CLPC, the overhead issue of adding 3 bits to the DCI 1\_1/0\_1 is of much less concern. |
| Docomo | Support. |
| vivo | Don’t support. The motivation is unclear. |

## Others

**Proposal 3.1**: To fulfil the asymmetric DL sTRP/UL mTRP deployment scenarios, support two TAs for single DCI based multi-TRP/panel and single TRP.

* Reuse Rel-18 specification of two TA for multi-DCI based multi-TRP/panel and remove the restriction that *coresetPoolIndex* needs to be configured.

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| **Company**  | **Comments** |
| Mod00 | Please share your views/inputs on the issues 3.1 |
| ZTE | Support. |
| QC | This is out-of-scope and should be first discussed in RAN plenary. |
| Nokia | Proposal 3.1: we support |
| Samsung | Support, which is an essential feature for asymmetric MTRP scenario. |
| Docomo | Support. This is necessary enhancement for asymmetric HetNet scenario. |
| vivo | We can live with the proposal if it is discussed together with other upscoping issues. |
| ETRI | Support. This is an essential feature to address out-of-synchronization between UE and some UL-only TRPs. |
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# Proposals for Online Discussion

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# Contributions in RAN1#117

1. R1-2403849 Discussion on Rel-19 Asymmetric mTRP Operation InterDigital, Inc.
2. R1-2403903 Enhancement for asymmetric DL sTRP/UL mTRP scenarios MediaTek Inc.
3. R1-2403947 Enhancements for asymmetric DL sTRP/UL mTRP scenarios Huawei, HiSilicon
4. R1-2403984 Enhancements for asymmetric DL/UL scenarios Intel Corporation
5. R1-2404022 Enhancements for asymmetric DL sTRP/UL mTRP scenarios Spreadtrum Communications
6. R1-2404111 Views on Rel-19 asymmetric DL sTRP/UL mTRP scenarios Samsung
7. R1-2404173 Discussion on asymmetric DL sTRP/UL mTRP scenarios vivo
8. R1-2404242 Discussion on enhancements for asymmetric DL sTRP/UL mTRP scenarios ZTE, China Telecom
9. R1-2404280 Enhancements for asymmetric DL sTRP/UL mTRP Apple
10. R1-2404339 Enhancement for asymmetric DL sTRP/UL mTRP scenarios Lenovo
11. R1-2404397 Views on asymmetric DL sTRP/UL mTRP scenarios CATT
12. R1-2404424 Discussion on enhancements for asymmetric DL sTRP/UL mTRP scenarios China Telecom, ZTE
13. R1-2404452 Discussion on enhancement for asymmetric DL sTRP/UL mTRP scenarios CMCC
14. R1-2404476 "Enhancement for Asymmetric DL sTRP/UL mTRP Scenarios " Panasonic
15. R1-2404496 Enhancement for asymmetric DL sTRP/UL mTRP scenarios Sony
16. R1-2404532 Enhancement for asymmetric DL sTRP UL mTRP scenarios Ericsson
17. R1-2404553 Discussions on asymmetric DL sTRP/UL mTRP scenarios LG Electronics
18. R1-2404568 Discussion on asymmetric DL sTRP/UL mTRP scenarios TCL
19. R1-2404590 Discussion on UL-only mTRP operation Fujitsu
20. R1-2404614 Discussion on enhancement for asymmetric DL sTRP/UL mTRP scenarios Xiaomi
21. R1-2404658 Discussion on enhancements for asymmetric DL sTRP and UL mTRP scenarios NEC
22. R1-2404771 Discussion on asymmetric DL sTRP and UL mTRP operation ETRI
23. R1-2404815 Discussion on enhancements for asymmetric DL sTRP/UL mTRP scenarios Transsion Holdings
24. R1-2404885 Enhancements on asymmetric DL sTRP/UL mTRP scenarios OPPO
25. R1-2404921 Enhancement for asymmetric DL sTRP/UL mTRP scenarios Nokia
26. R1-2404973 Enhancement for asymmetric DL sTRP/UL mTRP scenarios Sharp
27. R1-2405038 Discussion on enhancement for asymmetric DL sTRP/UL mTRP scenarios NTT DOCOMO, INC.
28. R1-2405151 Enhancement for asymmetric DL sTRP and UL mTRP deployment scenarios Qualcomm Incorporated
29. R1-2405188 Discussion on asymmetric DL sTRP and UL mTRP ASUSTeK
30. R1-2405272 Discussion on enhancement for asymmetric DL sTRP and UL mTRP scenarios Google