**3GPP TSG RAN WG1 #117 R1-2405346**

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

**Source: Moderator (OPPO)**

**Title: Summary #1 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

Table 1-1 summary of pathloss offset

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| **#**  | **Issue** |
| 1.1 | **Indicating PL offset for PDCCH-order PRACH**:A few Alts were listed for indicating PL offset for PDCCH-order PRACH:

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| **Agreement**Consider and down-select one from the following alts for indicating a PL offset for PDCCH-order PRACH transmission at least for FR1.* Alt1: RRC configures multiple PL offset values in PRACH-Config and PDCCH-order DCI indicates one of them through one DCI field.
* Alt2: PDCCH order DCI indicates one PL offset value
* Alt3: The PL offset associated with one of the indicated joint/UL TCI state for UL TRP in unified TCI framework is applied on the PDCCH-order PRACH transmission
* Alt4: The PDCCH order DCI indicates one TCI state associated with a PL offset and the associated PL offset is applied on the PRACH transmission.
* Alt5: RRC configures one PL offset value for PRACH and the PDCCH order DCI indicates whether this PL offset value is applied on PRACH transmission or not.

Note: Other alternatives are not precluded |

Samsung proposed one more Alt in tdoc:* Alt6: A list of PL offset configurations is configured by RRC in BWP/CC and each PL offset configuration contains one PL offset value and ID. A new field in PDCCH order DCI indicates one of PL offset configurations where each codepoint of the new field is associated with a PL offset configuration. A MAC-CE can update a PL offset value included in a PL offset configuration. After MAC-CE update on a certain PL offset configuration, the updated PL offset value is applied to a codepoint of the new field associated with the PL offset configuration. The PL offset for PRACH transmission is 0 dB when a codepoint is not associated with any of PL offset configuration.

And ETRI proposed two more Alts:* Alt7: RRC configures a list of pre-defined PL offset configurations and PDCCH-order DCI indicates one of them through one DCI field as well as a differential PL offset index/value through another DCI field to transmit the PRACH preamble.
* Alt8: RRC configures a list of PL offset configurations each of which is associated with a joint/UL TCI state and PDCCH-order DCI indicates one of joint/UL TCI states to transmit the PRACH preamble.

Companies’ views are:* Alt1: InterDigital, Intel, ZTE, China Telecom, CATT, Panasonic, Fujitsu, Xiaomi, DCM,
* Alt2: InterDigital, Fujitsu, Nokia, Transsion (2nd),
* Alt3: Spreadtrum, Lenovo, Ericsson, Transsion(1st), OPPO, Nokia, Sharp, QC,
* Alt4: InterDigital, Huawei/HiSilicon, Nokia
* Alt5: vivo, NEC
* Alt6: Samsung
* Alt7: ETRI
* Alt8: ETRI

Mod: Alt1 and Alt3 receives most of the supports. Alt3 requests PRACH to follow the PL offset associated with the indicated TCI state for UL TRP. Alt1 gives more flexibility since there is no dependency on the TCI state/PL offset applied on PUSCH. As commented by some companies, they can provide independent control of PRACH power control, not need to be tied with the current beam on PUSCH. And Alt1 is supported by slightly more companies than Alt3. I would suggest to move forward with Alt1 **Proposal 1.1:** For indicating a PL offset for PDCCH-order PRACH transmission at least for FR1, support Alt1:* Alt1: RRC configures multiple PL offset values in PRACH-Config and PDCCH-order DCI indicates one of them through one DCI field
* FFS: the details of DCI field design.
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| 1.2 | **How to configure/indicate the association between PL offset and joint/UL TCI state:**

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| **Agreement**For the association between PL offset and joint/UL TCI state, consider and down-select one from the following Alts:* Alt1a: One PL offset value is configured in a joint or UL TCI state by RRC only
* Alt1b: One PL offset value is configured in a joint or UL TCI state by RRC. A MAC CE can update the PL offset value(s) for joint or UL TCI state(s).
* Alt2a: A list of PL offset configurations is configured by RRC in BWP/CC and each PL offset configuration contains one PL offset value. One new RRC parameter is introduced in a joint or UL TCI state to indicate one of the configured PL offset configurations.
* Alt2b: A list of PL offset configurations is configured by RRC in BWP/CC and each PL offset configuration contains one PL offset value. One new RRC parameter is introduced in a joint or UL TCI state to indicate one of the configured PL offset configurations. A MAC CE can update the association between a joint or UL TCI state and PL offset configuration
* Alt3: A list of PL offset configurations is configured by RRC in BWP/CC and each PL offset configuration contains one PL offset value. A MAC CE can activate/indicate one PL offset configuration for each activated joint or UL TCI state. In each joint or UL TCI state, the initial PL offset value is 0dB.
* Alt4: A list of PL offset values is provided in a joint or UL TCI state by RRC. Each PL offset value is applied to a corresponding measured PL range.

Other alternatives are not precluded. |

Samsung proposed one more Alt:* Alt5: A list of PL offset configurations is configured by RRC in BWP/CC and each PL offset configuration contains one PL offset value and ID. Each joint or UL TCI state is associated with a PL offset configuration where the association is based on RRC configuration. A MAC-CE can update a PL offset value included in a PL offset configuration. After MAC-CE update on a certain PL offset configuration, the updated PL offset value is applied to all TCI state(s) associated with the PL offset configuration. The PL offset is 0 dB when a TCI state is not associated with any of PL offset configurations

**Panasonic proposed one more Alt:*** Alt6: One PL offset value is configured in a joint or UL TCI state by RRC. The network updates either the pathloss offset value by RRC reconfiguration, or an UL-pow-offset by MAC-CE update such that:

 UL Tx power = DL pathloss + pathloss offset + UL-pow-offsetCompanies’ views are:* Alt1a: Huawei/HiSilicon
* Alt1b: InterDigital, MTK, Spreadtrum, Apple, Intel, Sony, Ericsson(?), LG, Fujitsu, Xiaomi, NEC, Nokia, DCM (2nd), QC, Google
* Alt2a: Intel, vivo,
* Alt2b: InterDigital, MTK, Lenovo, CATT, LG, TCL, Fujitsu, Xiaomi (1st prefer), ETRI (with one more PL offset differential), Transsion, Sharp, DCM(1st), ASUSTeK
* Alt3: InterDigital, ZTE, China Telecom, OPPO, Sharp, ASUSTeK, Transsion
* Alt4: InterDigital, Google (2nd)
* Alt5: Samsung
* Alt6: Panasonic

Mod: Majority companies support either Alt1b and/or Alt2b. My understanding is they can provide the exactly same function, the only difference is control signalling design. It seems to be an down-selection between Alt1b and Alt2b and Alt1b is supported by slightly more companies than Alt2b, and the design of Alt1b is more aligned with the configuration design of PL RS in TCI state. Suggest move forward with Alt1b.**Proposal 1.2:**For the association between PL offset and joint/UL TCI state, support Alt1b:* Alt1b: One PL offset value is configured in a joint or UL TCI state by RRC. A MAC CE can update the PL offset value(s) for joint or UL TCI state(s).
* Alt2b: A list of PL offset configurations is configured by RRC in BWP/CC and each PL offset configuration contains one PL offset value. One new RRC parameter is introduced in a joint or UL TCI state to indicate one of the configured PL offset configurations. A MAC CE can update the association between a joint or UL TCI state and PL offset configuration

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| 1.3 | **Power control formulas with PL offset:**Nokia and MTK discussed how to update the UL power calculation formulas in 38.213 when a TCI state associated with PL offset is applied on PUSCH/PUCCH/SRSMod: That is an essential problem we should make conclusion.**Proposal 1.3:** * When a joint/UL TCI state associated with a PL offset with value $G\_{b,f,c}\left(i\right)$ is applied on a PUSCH transmission, the UE determines the PUSCH transmit power as:

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

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

$$P\_{SRS,b,f,c}\left(i,q,l\right)=\min\_{}\left\{\begin{matrix}P\_{CMAX,f,c}\left(i\right),\\P\_{O\_{SRS},b,f,c}\left(q\_{s}\right)+10log\_{10}\left(2^{μ}∙M\_{SRS,b,f,c}\left(i\right)\right)+α\_{SRS,b,f,c}\left(q\_{s}\right)∙(PL\_{b,f,c}\left(q\_{d}\right)-G\_{PL,b,f,c}\left(i\right))+h\_{b,f,c}\left(i,l\right)\end{matrix}\right.$$Note: How to capture that is up to the editor. FFS: the value range and candidate values of PL offset value |
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| 1.4 | **PHR calculation with PL offset:**DCM and Fujitsu proposed to update PHR calculation formula for Type1 PH Report with application of PL offsetMod: this is an essential problem we need conclusion. We also need to make conclusion on the calculation of Type 3 calculation. **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 $G\_{b,f,c}\left(i\right)$ is applied on this PUSCH transmission, the UE determines the Type 1 PHR as:$$PH\_{type1,b,f,c}\left(i,j,q\_{d},l\right)= P\_{CMAX,f,c}\left(i\right)-\left\{P\_{O\\_PUSCH,b,f,c}\left(j\right)+10log\_{10}\left(2^{μ}⋅M\_{RB,b,f,c}^{PUSCH}(i)\right)+α\_{b,f,c}\left(j\right)⋅(PL\_{b,f,c}\left(q\_{d}\right)-G\_{b,f,c}\left(i\right))+∆\_{TF,b,f,c}\left(i\right)+f\_{b,f,c}\left(i,l\right)\right\}$$* Note: How to capture that is up to the editor.
* FFS Type 1 PHR calculation based on reference PUSCH when including PL offset.

**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 $G\_{b,f,c}\left(i\right)$ is applied on this SRS transmission, the UE determines the Type 3 PHR as:$$PH\_{type3,b,f,c}\left(i,q\_{s}\right)= P\_{CMAX,f,c}\left(i\right)-\left\{P\_{O\\_SRS,b,f,c}\left(j\right)+10log\_{10}\left(2^{μ}⋅M\_{SRS,b,f,c}^{}(i)\right)+α\_{SRS, b,f,c}\left(j\right)⋅(PL\_{b,f,c}\left(q\_{s}\right)-G\_{b,f,c}\left(i\right))+f\_{b,f,c}\left(i\right)\right\}$$* Note: How to capture that is up to the editor.
* FFS Type 3 PHR calculation based on reference SRS when including PL offset.
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| 1.5 | **How to determine the PL offset at gNB side:**Companies provided views on how to calculate/determine the value of PL offset at the NW side. Some companies suggested that can be up to NW implementation. Some companies proposed to study the solutions, e.g., SRS transmission, to facilitate that and some companies proposed to discuss whether spec impact in needed for PL offset measurement in FR2.Mod: This issue was discussed in last meeting and here is the latest version of proposal from last meeting according to the comments received in draft folder. I would suggest we start with this version.**Proposal 1.5:**Study whether/how to facilitate gNB’s determination of the value of PL offset from specification point of view |
| 1.6 | **UL PL and updating**We have the following FFS on UL PL in previous agreements:

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| * + FFS: The UE can update UL PL in a way that new UL PL = current UL PL + an update delta indicated by the NW.
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Companies provided the following views on the FFS:* Support: Sony, QC, NEC
* Not support: MTK, Apple,

Mod: The views seem to be controversial. QC provided a detailed solution for this method in the tdoc. So, I would like make an proposal based on QC’s version:**Proposal 1.6:** Support to update a UL PL for a joint/UL TCI state as follows:* When this joint/UL TCI state is activated and it is not in the current active TCI state list, a UL PL is calculated as: UL PL = PL estimated from DL PL RS – the value of PL offset.
* When this joint/UL TCI state is activated and it is in the current active TCI state list, the UE updates the UL PL as: new UL PL = current UL PL + the updated delta indicated by the NW.
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| 1.7 | **TCI framework configuration**Companies proposed to clarify the configuration of rel17/18 TCI framework for this UL mTRP deployment scenario. Furthermore, Also, companies (Intel, Samsung, Ericsson) proposed to consider/investigate a mixed mode of joint TCI state + UL TCI state for this asymmetric deployment scenario.**Proposal 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 mapped to one DCI codepoint
	+ For FR2: one DL TCI state + one UL TCI state can be mapped to one DCI codepoint.
* 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 mapped to one DCI codepoint.
		- Note: When two joint TCI states are indicated, 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 mapped to one DCI codepoint.

**Proposal 1.7b**: To facilitate the asymmetric DL sTRP/UL mTRP deployment scenario, support a mixed TCI mode of joint TCI state + UL TCI state for FR1 and FR2 additionally:* A joint TCI state + a UL TCI state can be mapped to a DCI codepoint,
* The indicated UL TCI state is applied on UL transmission towards the UL TRP.
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Table 1-2: Company input for Issues 1.x

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| **Company**  | **Comments** |
| Mod00 | Please share your views/inputs on the issues 1.x |
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## Closed-loop PC for SRS

Table 2-1 summary of closed-loop PC for SRS

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| **#**  | **Issue** |
| 2.1 | **DCI format 1\_1/0\_1 indicating TPC for SRS CLPC adjustment states:**Regarding whether to additionally support using DCI format 1\_1 or 0\_1 to indicate TPC command for SRS CLPC adjustment states, the views provided in the contributions are:* Support: ZTE, China Telecom, Sharp, DCM, Google, Ericsson
* Not support: MTK, Huawei/HiSilicon, Spreadtrum, vivo, Lenovo, CATT, Xiaomi, OPPO,

**Proposal 2.1**: Support to use DCI format 1\_1 and 0\_1 to indicate TCP 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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| 2.2 | **Configure the ‘mode’ of two SRS CLPC adjustment states**Companies proposed to introduce configuration parameter to indicate there are two SRS CLPC adjustment states in one BWP/CC.Mod: We do need one RRC parameter to indicate that there are two SRS CLPC adjustment states in one CC**Proposal 2.2:** Introduce a new RRC parameter per BWP/CC to indicate that two SRS CLPC adjustment states are configured for SRS in a BWP/CC |
| 2.3 | **Starting bit of a block in DCI format 2\_3**Companies (Samsung, Lenovo) proposed to extend the range of start bit of a block in DCI format 2\_3. Per current spec, the starting bit position of each block in DCI 2\_3 is configured as follows:

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| SRS-TPC-CommandConfig ::= SEQUENCE {startingBitOfFormat2-3 INTEGER **(1..31)** OPTIONAL, -- Need RfieldTypeFormat2-3 INTEGER (0..1) OPTIONAL, -- Need R...,[[startingBitOfFormat2-3SUL INTEGER (1..31) OPTIONAL -- Need R]]} |

For two SRS CPLC adjustment states in Rel19, 1-bit indicator field is introduced in DCI format 2\_3. Thus, the block size is increased and the range of start bit defined in rel18 might not be sufficient. Samsung proposed to increase it from 31 to 45.**Proposal 2.3**: In Rel-19, the value range of starting bit of block in DCI format 2-3 is extended from 1~31 to 1~45. |
| 2.4 | **SRS not configured with any TCI state**Companies proposed to study how to determine the PL offset and/or one of the rel19 SRS CLPC adjustment states for SRS resource when the SRS is not configured/indicated with any TCI state.Mod: In rel-19, as in previous agreement, the PL offset and rel19 SRS CLPC adjustment states is indicated to SRS through TCI state. Under the unified TCI framework, when the SRS resource set is not provided with *followUnifiedTCI-StateSRS* and the SRS resource with lowest ID in that set is not provided with a TCI state, the UE might not be able to obtain the PL offset and one of the SRS CLPC adjustment states at this case. Furthermore, not only these two new PC parameters, all the existing PC parameters and PL RS cannot be obtained. However, I am not sure this case happens in the unified TCI framework. To avoid that, the gNB can make sure there is always an available TCI state through at least providing a TCI state to the SRS resource with the lowest ID when the SRS set is not provided with *followUnifiedTCI-StateSRS.* **Proposal 2.4:** * Study how to apply PL offset for SRS resource set when the SRS resource set is not configured with TCI state
* Study how to apply one of the Rel-19 SRS CLPC adjustment states for SRS resource set when the SRS resource set is not configured with TCI state
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Table 2-2: Company input for Issues 2.x

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| **Company**  | **Comments** |
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## Others

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| **#**  | **Issue** |
| 3.1 | **2TA for asymmetric DL sTRP/UL mTRP**The following companies proposed or consider to extend the 2TA feature of rel18 to the asymmetric DL sTRP/UL mTRP scenarios in Rel-19:* InterDigital, Intel, Samsung, vivo, ZTE, China Telecom, Sony, Ericsson, Nokia, DCM

ZTE and China Telecom provided SLS results of uplink propagation delay difference to show the necessity of 2TAs for this deployment scenario.Mod: supporting 2TA seems to be essential to make the asymmetric UL mTRP scenario work.**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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Table 2-3: Company input for Issues 3.x

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| **Company**  | **Comments** |
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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