**3GPP TSG RAN WG1 #112bis-e DRAFT R1-2303814**

**e-Meeting, April 17th – April 26th, 2023**

**Agenda item:** 9.1.1.1

**Source:** Moderator (MediaTek)

**Title:** Moderator summary on extension of unified TCI framework (Round 2)

**Document for:** Discussion and Decision

# Introduction

In RAN#94e, the Rel-18 WID of MIMO evolution for downlink and uplink is approved. In the approved WID, extension of unified TCI framework is a part of the RAN1 objectives, and the detailed scope of this agenda item (AI 9.1.1.1) includes the following highlighted objectives:

|  |
| --- |
| **RAN1:**1. Specify extension of Rel-17 Unified TCI framework for indication of multiple DL and UL TCI states focusing on multi-TRP use case, using Rel-17 unified TCI framework.
2. Study, and if needed, specify the following items to facilitate simultaneous multi-panel UL transmission for higher UL throughput/reliability, focusing on FR2 and multi-TRP, assuming up to 2 TRPs and up to 2 panels, targeting CPE/FWA/vehicle/industrial devices (if applicable)
	* UL precoding indication for PUSCH, where no new codebook is introduced for multi-panel simultaneous transmission
		+ The total number of layers is up to four across all panels and total number of codewords is up to two across all panels, considering single DCI and multi-DCI based multi-TRP operation.
	* UL beam indication for PUCCH/PUSCH, where unified TCI framework extension in objective 2 is assumed, considering single DCI and multi-DCI based multi-TRP operation
		+ For the case of multi-DCI based multi-TRP operation, only PUSCH+PUSCH, or PUCCH+PUCCH is transmitted across two panels in a same CC.
3. Study, and if justified, specify the following
	* Two TAs for UL multi-DCI for multi-TRP operation
	* Power control for UL single DCI for multi-TRP operation where unified TCI framework extension in objective 2 is assumed.

For the case of simultaneous UL transmission from multiple panels, the operation will only be limited to the objective 6 scenarios. |

# Plan

Based on the contributions from companies [1]-[32], the followings are provided in this document:

* Summary of companies’ views on each of open issues raised by interested companies, where the open issues are categorized as follow:
	+ Issue 1 – General issue for unified TCI extension
	+ Issue 2 – TCI state update and activation
	+ Issue 3 – How to inform UE which indicated TCI state(s) that UE shall apply to target channel/signal
	+ Issue 4 – UL power control for UL MTRP operation
	+ Issue 5 – PDSCH-CJT Tx scheme
	+ Issue 6 – Beam failure recovery
* Observations and recommended proposals based on the summary of companies’ views

# Contact Person

For potential offline discussion, companies/delegates are encouraged to enter the contact information in the table below:

Table 0 Contact Information

|  |  |  |
| --- | --- | --- |
| **Company** | **Point(s) of contact** | **Email address(es)** |
| Apple | Hong  | hhe5@apple.com |
| CEWiT | Vishakha Singh | Vish@cewit.org.in |
| CMCC | Yan | liyanwx@chinamobile.com |
| Ericsson | Claes | Claes.tidestav@ericsson.com |
| FGI | Cubie | wanchen.lin@fginnov.com |
| Fraunhofer IIS/HHI | Sutharshun | sutharshun.varatharaajan@iis.fraunhofer.de |
| Fujitsu | Jian | zhangjian1288@fujitsu.com |
| Futurewei | Zhigang | zrong@futurewei.com |
| Google | Alex | alexliou@google.com |
| Huawei, HiSilicon | Keyvan | Keyvan.zarifi@huawei.com |
| Hyundai | Jeongsu Lee | Jeongsu.lee@hyundai.com |
| Intel | Avik | avik.sengupta@intel.com |
| InterDigital | Jonghyun | jonghyun.park@interdigital.com |
| Lenovo | Bingchao Liu | liubc2@lenovo.com |
| LG | Jaehoon | jhoon.chung@lge.com |
| MediaTek | Darcy | darcy.tsai@mediatek.com |
| MediaTek | Rebecca | rebecca.chen@mediatek.com |
| NEC | Peng | guan\_peng@nec.cn |
| NTT DOCOMO | Yuki | yuki.matsumura@docomo-lab.com |
| NTT DOCOMO | Weiqi | sunwq@docomolabs-beijing.com.cn |
| OPPO | Jeffrey | caojianfei@oppo.com |
| Panasonic | Khalid | khalid.zeineddine@eu.panasonic.com |
| Qualcomm | Yan | yanzhou@qti.qualcomm.com |
| Samsung | Dalin | dalin.zhu@samsung.com |
| Sharp | Taka | fukui.takahisa@sharp.co.jp |
| Spreadtrum | Qiyishu Li | qiyishu.li@unisoc.com |
| vivo | Yang | songyang@vivo.com |
| Xiaomi | Mingju LI | limingju@xiaomi.com |
| ZTE | Bo | gao.bo1@ZTE.com.cn |
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# Proposal to be discussed in the online session

# Discussion

# Issue 1 – General issue for unified TCI extension

Table 1-1 Summary for Issue 1

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| --- | --- | --- |
| **#** | **Issue** | **Companies’ view and Recommended Proposal** |
| 1.1 | Support of inter-cell (M-DCI based) MTRP operation | **Agreement**If the UE is configured with SSB-MTC-AdditionalPCI and receives TCI state activation command (MAC-CE) that activates a set of joint/DL /UL TCI state(s) specific to each coresetPoolIndex value for M-DCI based MTRP in unified TCI framework extension, the activated joint/DL/UL TCI state(s) specific to one coresetPoolIndex value is associated with the serving cell PCI and the activated joint/DL /UL TCI state(s) specific to another coresetPoolIndex value can be associated with a PCI other than the serving cell PCI . * Note: How to implement above in specification is up to spec editor
 |
| 1.2 | Support of inter-cell S-DCI based MTRP operation | Question 1: In Rel-18 unified TCI framework extension, whether to support inter-cell S-DCI based MTRP?* Yes: Samsung, Apple (if time permits), Intel (open), FGI (if time permits)
* No: vivo, QC, CMCC, OPPO, Xiaomi, Google, Nokia, CMCC, ZTE, Spreadtrum, Panasonic, Futurewei, Huawei/HiSilicon, Sharp, NEC, Fujitsu, CATT, Docomo, Lenovo

FL note: Based on feedback from companies, it seems majority think it is not proper to introduce new MTRP scheme in this AI at this moment, and I will not recommend any proposal (for conclusion/agreement) in this meeting if situation is not changed. |
| 1.3 | Common beam for PDCCH/PDSCH | Question 1: In Rel-17 unified TCI framework, it can be guaranteed that PDCCH and respective PDSCH follow the common beam for DL reception. In Rel-18 unified TCI framework extension, it is possible that PDCCH and respective PDSCH follow different beams for DL reception if they apply different indicated joint/DL TCI states. Then, whether specification should restrict that two indicated joint/DL TCI states must be associated with different TRPs, i.e., following different beams for PDCCH and PDSCH is only allowed for MTRP operation? If yes, proponents can elaborate more on how to enable the restriction.* Yes: Samsung, NEC, ZTE
* No: Google, Futurewei, CATT, vivo, Panasonic, Panasonic, Ericsson, Lenovo, OPPO
* Not critical: Docomo, Huawei/HiSilicon
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# Issue 2 – TCI state update and activation

Table 2-1 Summary for Issue 2

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| **#** | **Issue** | **Companies’ view and Recommended Proposal** |
| 2.1 | (S-DCI) Switching between STRP and MTRP based on the existing TCI field | **Conclusion**On unified TCI framework extension for S-DCI based MTRP operation, there is no consensus to support dynamic switching between single-TRP operation and multi-TRP operation for channels/signals based on the number of TCI states mapped to the received TCI codepoint in DCI format 1\_1/1\_2* FFS: How to switch between Rel-17 sTRP operation and Rel-18 mTRP operation
 |
| 2.2 | (S-DCI) Combinations of joint/DL/UL TCI states that can be mapped to a TCI codepoint of the existing TCI field, and corresponding UE behaviors | **Agreement**On unified TCI framework extension for S-DCI based MTRP operation, support the followings:* For a serving cell configured with joint DL/UL TCI mode, a full-set or any sub-set of {first joint TCI state, second joint TCI state} can be mapped to a TCI codepoint of the existing TCI field in a DCI format 1\_1/1\_2 by TCI state activation command (MAC-CE)
* For a serving cell configured with separate DL/UL TCI mode, a full-set or any sub-set of {first DL TCI state, first UL TCI state, second DL TCI state, second UL TCI state} can be mapped to a TCI codepoint of the existing TCI field in a DCI format 1\_1/1\_2 by TCI state activation command (MAC-CE)
* TCI state activation command (MAC-CE) should indicate that each joint/DL/UL TCI state mapped to a TCI codepoint is the first or second joint/DL/UL TCI state (detail on how to indicate above is up to RAN2 design)
* The first/second indicated joint/DL/UL TCI state(s) is updated according to the corresponding first/second joint/DL/UL TCI state(s) mapped to the TCI codepoint received by the UE
	+ If the UE receives a TCI codepoint mapped with a sub-set of {first joint TCI state, second joint TCI state} or {first DL TCI state, first UL TCI state, second DL TCI state, second UL TCI state}, the UE shall update the first/second indicated joint/DL/UL TCI state(s) according to the first/second joint/DL/UL TCI state(s) in the subset and keep other indicated first/second joint/DL/UL TCI state(s) that is not updated by the received TCI codepoint
* A CC is operated in Rel-18 unified TCI framework extension for S-DCI based MTRP if the UE receives an Rel-18 TCI state activation command (MAC-CE) for S-DCI based MTRP operation in the CC
* ~~[Conclusion: UE expects mTRP operation after applying the TCI states activation command of Rel-18 MAC CE. UE expects the first indicated TCI state codepoint is for mTRP operation.]~~
* ~~[Conclusion: To distinguish S-DCI based mTRP schemes from sTRP: for S-DCI, there is more than one DL/joint-TCI state activated for at least one TCI codepoint.]~~
 |
| 2.3 | (S-DCI) How to indicate/determine each activated joint/DL/UL TCI state in TCI state activation command (MAC-CE) corresponds to the first or second joint/DL/UL TCI state |
| 2.4 | Timeline to update the indicated joint/DL/UL TCI state(s) | **Agreement** On unified TCI framework extension, the Rel-17 timeline for updating the indicated joint/DL/UL TCI state(s) is retained, i.e., the indicated joint/DL/UL TCI state(s) applied to the DL reception or UL transmission in each slot is updated based on the Rel-17 beam application time |
| 2.5 | (CA) Common TCI state ID activation/update for a CC list comprised of a mix of STRP CC(s) and MTRP CC(s) | **Question 1: Whether a CC list can be comprised of a mix of STRP CC(s) and MTRP CC(s)?*** **Yes: OPPO, Spreadtrum, IDC, Huawei/HiSilicon, Hyundai, Google, MediaTek, Docomo, vivo, CATT, LG, Fujitsu, Apple**
* **No: Xiaomi, QC, NEC, CMCC, FGI**

**Question 2: Whether a CC list can be comprised of a mix of S-DCI based MTRP CC(s) and M-DCI based MTRP CC(s)?*** **Yes: OPPO, IDC, Huawei/HiSilicon, Hyundai, Google, Docomo, CATT, LG**
* **No: Xiaomi, Spreadtrum, QC, NEC, CMCC, ZTE, vivo, FGI, MediaTek, Apple**

**FL note: Based on feedback to above two questions, more companies are supportive to a CC list including the mix of STRP CC(s) and MTRP CC(s), however, views on support a CC list including the mix of S-DCI based MTRP CC(s) and M-DCI based MTRP CC(s) are quite diverse. Based on above observations, the following proposal is recommended:****Proposal 2.5:** On unified TCI framework extension, support the following cases for CA operation:* A set of CCs configured for common TCI state ID activation/update can include CC(s) operating in S-DCI based MTRP
* A set of CCs configured for common TCI state ID activation/update can include CC(s) operating in M-DCI based MTRP
* A set of CCs configured for common TCI state ID activation/update can include CC(s) operating in STRP and CC(s) operating in S-DCI based MTRP
	+ FFS: How to support common TCI state ID activation/update for this case
* A set of CCs configured for common TCI state ID activation/update can include CC(s) operating in STRP and CC(s) operating in M-DCI based MTRP
	+ FFS: How to support common TCI state ID activation/update for this case
* FFS: A set of CCs configured for common TCI state ID activation/update can include CC(s) operating in S-DCI based MTRP and CC(s) operating in M-DCI based MTRP
* FFS: A set of CCs configured for common TCI state ID activation/update can include CC(s) operating in STRP, CC(s) operating in S-DCI based MTRP, and CC(s) operating in M-DCI based MTRP

Support: Intel, IDC, Ericsson, Docomo, CATT, Fujitsu, NEC, Sharp, Huawei/HiSilicon, Spreadtrum, Futurewei, Apple, LG, ZTE, Nokia, Google, vivo, OPPOConcern: CMCC, Samsung, QC, FGI, Lenovo |
| 2.7 | (CA) Reference TCI state list configuration | **FL note: At least to my understanding, if RAN1 doesn’t preclude this in Rel-18 for unified TCI extension, it will be naturally supported. Thus, the issue is about whether we should preclude this feature from Rel-18 unified TCI extension, and whether any enhancement is needed if this feature is not precluded from Rel-18 unified TCI extension.****Question 1: Whether a CC operating in STRP can apply the TCI state configuration(s) from a reference CC operating in MTRP, or a CC operating in MTRP can apply the TCI state configurations from a reference CC operating in STRP?*** **Yes: OPPO, Sharp, Futurewei, ZTE, Google, Nokia**
* **No: QC, Samsung**

**Question 2: If the answer to Q1 is “Yes”, whether any enhancement is needed?*** **Yes:**
* **No:**
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Table 2-2 Company input for Issue 2

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| **Company** | **Input to Round 2 summary** |
| Mod V00 | Issue 2.2/2.3: The highlight part, the last item is suggested based to my understanding on the intension from companies during online discussion. I think this behavior has spec impact, thus it should be captured as a part of agreement instead of conclusion. Please check and share your view.Issue 2.5: Proposal 2.5 is updated to make it clear. Plan to discuss it online. Any further input, if any, is welcome. |
| Xiaomi  | **Issue 2.2/2.3**We are fine with the new added sub-bullet. But it doesn’t solve the problem in the case of there is no other indicated TCI state to keep. We suggest to add the following FFSFFS: how to avoid the case that there is no other indicated TCI state to keep[Mod] I suggest focusing on how to finalize the wording of the highlight part. This is already an agreement, and any issue can be discussed later.**Issue 2.5**We are fine with proposal 2.5. but we suggest to add the following note:Note: it doesn’t imply that UE can be configured with two CC lists that one CC list includes at least one S-DCI based MTRP CC and the other CC list includes at least one M-DCI based MTRP CC.[Mod] Why does this proposal preclude above configuration? |
| vivo | **Issue 2.3:** For the highlighted part, we don’t think it is a good solution, because it implies that the codepoint mapped with subset of TCI states would have different interpretations depending on other codepoints, i.e., if there is not any codepoint mapped with full set of TCI states, then the codepoint means a STRP operation; otherwise, it is to update the subset of TCI states. It is quite strange. Actually, all codepoints mapped with one joint/DL/UL TCI state can be realized by the Rel-17 Unified TCI States Activation/Deactivation MAC CE. We think another option can be considered as a clear solution.Another Alt: Rel-17 Unified TCI States Activation/Deactivation MAC CE is used to indicate STRP operation, and Rel-18 newly introduced TCI state activation MAC CE is used to indicate S-DCI based MTRP operation.Note: Rel-18 newly introduced TCI state activation MAC CE at least contains one codepoint mapped with full set of {first joint TCI state, second joint TCI state} for joint DL/UL TCI mode or {first DL TCI state, first UL TCI state, second DL TCI state, second UL TCI state} for separate DL/UL TCI mode.[Mod] CapturedBesides, we think the conclusion: “UE expects mTRP operation after applying the TCI states activation command of Rel-18 MAC CE. UE expects the first indicated TCI state codepoint is for mTRP operation” is valid.**Proposal 2.5:** We support the proposal in principle, but “can include” may imply other types of CC can also be included in. Thus, we suggest following updates:**Updated Proposal 2.5:** On unified TCI framework extension, support the following cases for CA operation:* ~~A set of~~ CCs operating in S-DCI based MTRP configured for common TCI state ID activation/update ~~can include CC(s) operating in S-DCI based MTRP~~
* ~~A set of~~ CCs operating in M-DCI based MTRP configured for common TCI state ID activation/update ~~can~~ ~~include CC(s) operating in M-DCI based MTRP~~
* ~~A set of CCs~~ CC(s) operating in STRP and CC(s) operating in S-DCI based MTRP configured for common TCI state ID activation/update ~~can include CC(s) operating in STRP and CC(s) operating in S-DCI based MTRP~~
	+ FFS: How to support common TCI state ID activation/update for this case
* ~~A set of CCs~~ CC(s) operating in STRP and CC(s) operating in M-DCI based MTRP configured for common TCI state ID activation/update ~~can include CC(s) operating in STRP and CC(s) operating in M-DCI based MTRP~~
	+ FFS: How to support common TCI state ID activation/update for this case
* FFS: ~~A set of CCs~~ CC(s) operating in S-DCI based MTRP and CC(s) operating in M-DCI based MTRP configured for common TCI state ID activation/update ~~can include CC(s) operating in S-DCI based MTRP and CC(s) operating in M-DCI based MTRP~~
* FFS: ~~A set of CCs~~ CC(s) operating in STRP, CC(s) operating in S-DCI based MTRP, and CC(s) operating in M-DCI based MTRP configured for common TCI state ID activation/update ~~can include CC(s) operating in STRP, CC(s) operating in S-DCI based MTRP, and CC(s) operating in M-DCI based MTRP~~

[Mod] Do you mean a list “can include A” may imply that the list “can include B”, “can include C”, … ? Sorry I don’t quite get the logic… |
| Docomo | Issue 2.3: For the highlighted part, we agree with vivo’s comment. It is not clear if all TCI codepoint indicates one TCI state, it means sTRP or mTRP (i.e. one TCI is indicated and the other TCI is remained). Hence, we believe vivo’s another Alt should be clear solutionAnother Alt: Rel-17 Unified TCI States Activation/Deactivation MAC CE is used to indicate STRP operation, and Rel-18 newly introduced TCI state activation MAC CE is used to indicate S-DCI based MTRP operation.Proposal 2.5: OK.Issue 2.7: Same as R17, both CC-common TCI pool configuration and CC-specific TCI pool configuration should be supported in R18. It is not proper to preclude operation which was possible in previous release. |
| Nokia | Issue 2.2/2.3: FineIssue 2.5: Fine |
| Mod V07 | Issue 2.2/2.3: The highlight part is updated according to the suggestion from companies |
| LG | Issue 2.2/2.3: The previous version by FL is preferred, and is it correct understanding that Rel-17/18 TCI activation command by MAC-CE is differentiated from the indicated TCI state(s) in TCI codepoint? |
| ZTE | Issue 2.2/2.3: We share the same views as LG. It’s wired that we use “if … receives an Rel-18 TCI state activation commend…” for distinguishing different mode. As you see, the gNB may reuse the legacy MAC-CE again, and then the corresponding UE behavior becomes unclear.Proposal 2.5: Support. |
| Intel | **Issue 2.2/2.3**: For the first highlighted part, we do not prefer to use wording in current form. Previous wording is preferred and is in line with legacy case i.e., mTRP is assumed when at least one TCI codepoint is mapped to two TCI states. **Proposal 2.5:** OK**Issue 2.7:** Question 1 - Yes |
| QC | For 2.2/2.3, not support the wording. Receiving TCI activation does not mean it is in mTRP mode. Suggest the following wording.A CC is operated in Rel-18 unified TCI framework extension for S-DCI based MTRP if UE maintains more than one join TCI states, more than one DL TCI states, or more than one UL TCI states For Proposal 2.5, suggest add FFS for the following two options. Our concern is that the FFS could be complicated depending on flexibility.* A set of CCs configured for common TCI state ID activation/update can include CC(s) operating in STRP and CC(s) operating in S-DCI based MTRP
	+ FFS: How to support common TCI state ID activation/update for this case
* A set of CCs configured for common TCI state ID activation/update can include CC(s) operating in STRP and CC(s) operating in M-DCI based MTRP
	+ FFS: How to support common TCI state ID activation/update for this case
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# Issue 3 – How to inform UE which indicated TCI state(s) that UE shall apply to target channel/signal

A plan for discussion in this meeting on the TCI selection scheme for each target channel/signal and remaining issues is provided in the following table, including both S-DCI and M-DCI based MTRP operation:

Table 3-0 Summary of TCI selection scheme for each target channel/signal in S-DCI/M-DCI based MTRP operation

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| --- |
| **S-DCI based MTRP operation** |
| **Channel/signal** | **Conclusion** | **TCI selection scheme** |
| PDCCH | Yes | RRC configuration (first/second/both/none) per CORESET (FFS: whether to reuse Rel-17 rule/parameter, discussed in Issue 3.1) |
| PDSCH scheduled/activated by DCI format 1\_1/1\_2 if the [TCI selection field] is present in DCI format 1\_1/1\_2 | Yes | [TCI selection field] in DCI format 1\_1/1\_2 (FFS: details including whether/how to use the codepoint “11” and the applying/mapping order if applies both, discussed in Issue 3.9) |
| PDSCH scheduled/activated by DCI format 1\_1/1\_2 if the [TCI selection field] is not present in DCI format 1\_1/1\_2 | No | Discussed in Issue 3.2 |
| PDSCH scheduled/activated by DCI format 1\_0 (including DG and SPS) | No | Discussed in Issue 3.3 |
| PDSCH scheduled/activated by DCI format 1\_1/1\_2 before threshold if the UE doesn’t support the capability of two default beams for S-DCI based MTRP in FR2 | No |  |
| PUSCH scheduled/activated by DCI format 0\_1/0\_2 (including DG and Type2 CG) | Yes | The existing SRS resource set indicator in DCI format 0\_1/0\_2 (FFS: behaviors for SDM and SFN based PUSCH Tx schemes for the codepoint "10" and/or “11”) |
| PUSCH scheduled/activated by DCI format 0\_0 (including DG and Type2 CG) | Yes | Apply the first indicated joint/UL TCI state |
| Type1 CG-PUSCH | Yes | RRC configuration (first/second/both/none) per Type1 CG configuration (FFS: behaviors for SDM and SFN based PUSCH Tx schemes if applies both) |
| PUCCH | Yes | RRC configuration (first/second/both/none) per PUCCH resource/resource group (FFS: the applying/mapping order if applies both) |
| AP CSI-RS for CSI/BM | No | Discussed in Issue 3.7 |
| SRS for CB/NCB/AS and AP SRS for BM | No | Discussed in Issue 3.8 |
| **M-DCI based MTRP operation** |
| **Channel/signal** | **Conclusion** | **TCI selection scheme** |
| PDCCH | Yes | According to *coresetPoolIndex* value |
| PDSCH scheduled/activated by DCI format 1\_0/1\_1/1\_2 | Yes | According to *coresetPoolIndex* value corresponding to scheduling PDCCH |
| PUSCH scheduled/activated by DCI format 0\_0/0\_1/0\_2 (including DG and Type2 CG) | Yes | According to *coresetPoolIndex* value corresponding to scheduling PDCCH |
| PUCCH | No | RRC configuration (first/second) per PUCCH resource/resource group (FFS: whether to support Opt3 and/or Opt4) |
| Type1 CG-PUSCH | No | Discussed in Issue 3.11 |
| AP CSI-RS for CSI/BM | No |  |
| SRS for CB/NCB/AS and AP SRS for BM | No |  |

Table 3-2 Summary for Issue 3

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| **#** | **Issue** | **Companies’ view and Recommended Proposal** |
| 3.1 | (S-DCI) PDCCH, whether Rel-17 rule/parameter is reused when provide the RRC configuration for TCI selection | **FL note: PLEASE note that this issue has been discussed in several meetings. If no consensus can be reached, we may conclude the status in this meeting.****Proposal 3.1:** On unified TCI framework extension for S-DCI based MTRP:* If a CORESET other than a CORESET with index 0 is associated only with USS sets and/or Type3-PDCCH CSS sets, the CORESET is configured by RRC to apply the first one, the second one, or both of the indicated joint/DL TCI states to PDCCH reception on the CORESET
* If a CORESET other than a CORESET with index 0 is associated at least with CSS sets other than Type3-PDCCH CSS sets and *followUnifiedTCIstate* = 'enabled' is configured for the CORESET, the CORESET is configured by RRC to apply the first one, the second one, or both of the indicated joint/DL TCI states to PDCCH reception on the CORESET
* If a CORESET with index 0 is configured with *followUnifiedTCIstate* = 'enabled':
	+ If the CORESET is associated with SS#0 for Type 0/0A/2 CSS sets, the CORESET is configured by RRC to apply the first one or the second one of the indicated joint/DL TCI states to PDCCH reception on the CORESET
	+ Otherwise, the CORESET is configured by RRC to apply the first one, the second one, or both of the indicated joint/DL TCI states to PDCCH reception on the CORESET

Support/fine: OPPO, vivo, QC, Xiaomi, Nokia, Samsung, ZTE, LG, CMCC, Apple, Futurewei, Spreadtrum, Huawei/HiSilicon, Sharp, NEC, Fujitsu, CATT, Docomo, Panasonic, IDC, Intel, MTK, FGI, Lenovo, TCLConcern: Ericsson**Proposal 3.1.A:** On unified TCI framework extension for S-DCI based MTRP:* If a CORESET other than a CORESET with index 0 is associated only with USS sets and/or Type3-PDCCH CSS sets, the CORESET is configured by RRC to apply the first one, the second one, or both of the indicated joint/DL TCI states to PDCCH reception on the CORESET
* If a CORESET other than a CORESET with index 0 is associated at least with CSS sets other than Type3-PDCCH CSS sets, the CORESET is configured by RRC to apply the first one, the second one, both, or none of the indicated joint/DL TCI states to PDCCH reception on the CORESET
* For a CORESET with index 0:
	+ If the CORESET is associated with SS#0 for Type 0/0A/2 CSS sets, the CORESET is configured by RRC to apply the first one, the second one, or none of the indicated joint/DL TCI state to PDCCH reception on the CORESET
	+ Otherwise, the CORESET is configured by RRC to apply the first one, the second one, both, or none of the indicated joint/DL TCI states to PDCCH reception on the CORESET

Note: RAN1 already agrees to use RRC configuration to inform that the UE shall apply the first one, the second one, both, or none of the indicated joint/DL TCI states to a CORESET in S-DCI based MTRPNote: RRC configuration design including whether to reuse *followUnifiedTCIstate* is up to RAN2 designSupport/fine: Ericsson, Xiaomi, LG, CMCC, vivo, QCConcern: ZTE, Futurewei, Fujitsu, Huawei/HiSilicon |
| 3.2 | (S-DCI) PDSCH scheduled/activated by DCI format 1\_1/1\_2 if the [TCI selection field] is not present in DCI format 1\_1/1\_2 | **Proposal 3.2 (RRC):** On unified TCI framework extension for S-DCI based MTRP, for PDSCH reception scheduled/activated by DCI format 1\_1/1\_2 configured w/o the [TCI selection field], using RRC configuration to inform that the UE shall apply the first, the second, or both indicated joint/DL TCI states to the scheduled/activated PDSCH reception* If the UE is in FR1, or the UE supports the capability of two default beams for S-DCI based MTRP in FR2, above applies regardless of the offset between the reception of the scheduling DCI format 1\_1/1\_2 and the scheduled/activated PDSCH reception
* If the UE doesn’t support the capability of two default beams for S-DCI based MTRP in FR2, above applies when the offset between the reception of the scheduling DCI format 1\_1/1\_2 and the scheduled/activated PDSCH reception is equal to or larger than a threshold

Support/fine: OPPO, Apple, Futurewei, Huawei/HiSilicon, Sharp, NEC, MTK, Docomo, Ericsson, Panasonic, Intel, FGIConcern: vivo, QC, Xiaomi, Nokia, LG, CMCC, Fujitsu, CATT, IDC, ZTE**Proposal 3.2.A (Both):** On unified TCI framework extension for S-DCI based MTRP, for PDSCH reception scheduled/activated by DCI format 1\_1/1\_2 configured w/o the [TCI selection field], the UE shall apply both indicated joint/DL TCI states to the scheduled/activated PDSCH reception* If the UE is in FR1, or the UE supports the capability of two default beams for S-DCI based MTRP in FR2, above applies regardless of the offset between the reception of the scheduling DCI format 1\_1/1\_2 and the scheduled/activated PDSCH reception
* If the UE doesn’t support the capability of two default beams for S-DCI based MTRP in FR2, above applies when the offset between the reception of the scheduling DCI format 1\_1/1\_2 and the scheduled/activated PDSCH reception is equal to or larger than a threshold

Support/fine: Xiaomi, OPPO, ZTE, Futurewei, Docomo, MTK, Lenovo, Nokia, QCConcern: Sharp, FGI, LG |
| 3.3 | (S-DCI) PDSCH scheduled/activated by DCI format 1\_0 (including DG and SPS) | Alt1: If the UE is configured with PDSCH-SFN/PDSCH-CJT, the UE shall apply both indicated joint/DL TCI states to PDSCH reception scheduled/activated by DCI format 1\_0. Otherwise, the UE shall apply the first indicated joint/DL TCI state to PDSCH reception scheduled/activated by DCI format 1\_0.* Support: CMCC, Docomo, Panasonic, Xiaomi, Spreadtrum, Sharp

Alt2: The UE shall apply the first indicated joint/DL TCI state to PDSCH reception scheduled/activated by DCI format 1\_0.* Support: Huawei/HiSilicon (at least for non-SFN/CJT), Fujitsu, Nokia, Qualcomm, vivo (at least for non-SFN/CJT), OPPO, LG, IDC, Intel, CATT, Fujitsu, Futurewei, LG, FGI

Alt3: Using RRC configuration to inform that the TCI selection for PDSCH reception scheduled/activated by DCI format 1\_0* Support: Ericsson, Docomo, OPPO, Apple, Sharp, FGI

Alt4: The UE shall apply the same joint/DL TCI state(s) that is applied to the PDCCH reception with the scheduling/activation DCI to the scheduled/activated PDSCH reception* Support: Samsung, ZTE, Google, Spreadtrum, NEC, FGI

**FL note: It seems more discussions are needed for issue, please input your preference and view on this issue. Some companies prefer to have the same TCI selection scheme for Issue 3.2 and Issue 3.3.** |
| 3.4 | (S-DCI) PUSCH scheduled/activated by DCI format 0\_0 (including DG and Type2 CG) | **Agreement**On unified TCI framework extension for S-DCI based MTRP, the UE shall apply the first indicated joint/UL TCI state to PUSCH transmission(s) scheduled/activated by DCI format 0\_0 (including DG and Type2 CG) |
| 3.5 | (S-DCI) Type1 CG-PUSCH | **Agreement**On unified TCI framework extension for S-DCI based MTRP, an RRC configuration is provided to a Type1 CG configuration to inform that the UE shall apply the first, the second, or both indicated joint/UL TCI states to the corresponding CG-PUSCH transmission* If the first or the second indicated joint/UL TCI state is applied, the UE shall apply the first or the second indicated joint/UL TCI state to all PUSCH antenna port(s) of corresponding PUSCH transmission occasions(s)
* If both indicated joint/UL TCI states are applied:
	+ For TDM based PUSCH Tx scheme, the UE shall apply the first indicated joint/UL TCI state to the PUSCH transmission occasions(s) associated with the first SRS resource set for CB/NCB, and the second indicated joint/UL TCI state to the PUSCH transmission occasions(s) associated with the second SRS resource set for CB/NCB
	+ FFS: SDM and SFN based PUSCH Tx schemes
 |
| 3.6 | (M-DCI) PUCCH | **Agreement**On unified TCI framework extension for M-DCI based MTRP, support at least Opt2 for PUCCH transmission, and Opt1 is not supported* Note: Opt3 and Opt4 are not precluded
 |
| 3.7 | (S-DCI) AP CSI-RS for CSI/BM | **Proposal 3.7:** On unified TCI framework extension for S-DCI based MTRP, an RRC configuration can be provided in *CSI-AssociatedReportConfigInfo* of *CSI-AperiodicTrigger State* for each aperiodic CSI-RS resource set for CSI/BM to inform that the UE shall apply the first or the second indicated joint/DL TCI state to the aperiodic CSI-RS resource set if the aperiodic CSI-RS resource set is configured to follow unified TCI state* For an aperiodic CSI-RS resource set configured with two Resource Groups for NCJT CSI and configured to follow unified TCI state, if above RRC configuration is not provided to the aperiodic CSI-RS resource set, the UE shall apply the first indicated joint/DL TCI state to the CSI-RS resource(s) in Group 1 and the second indicated joint/DL TCI state to the CSI-RS resource(s) in Group 2.

Above applies at least if the offset between the last symbol of the PDCCH carrying the triggering DCI and the first symbol of the aperiodic CSI-RS resources in the aperiodic CSI-RS resource set is equal to or larger than a threshold (if the threshold is needed)Support/fine: OPPO, Xiaomi, Nokia, LG, CMCC, Apple, Sharp, CATT, Docomo, IntelConcern: vivo, ZTE (sub-bullet), Google, Ericsson (sub-bullet), Panasonic, QC**Proposal 3.7.A:** On unified TCI framework extension for S-DCI based MTRP, an RRC configuration can be provided in *CSI-AssociatedReportConfigInfo* of *CSI-AperiodicTrigger State* for each CSI-RS resource in each aperiodic CSI-RS resource set to inform that the UE shall apply the first or the second indicated joint/DL TCI state to the CSI-RS resource if the aperiodic CSI-RS resource set for CSI/BM is configured to follow unified TCI state* Above applies at least if the offset between the last symbol of the PDCCH carrying the triggering DCI and the first symbol of the aperiodic CSI-RS resources in the aperiodic CSI-RS resource set is equal to or larger than a threshold (if the threshold is needed)

Support/fine: OPPO, ZTE, Futurewei, Google, Sharp, LG, CMCC, Docomo, Lenovo, Nokia, TCL, QC, PanasonicConcern: Xiaomi, vivo, Huawei/HiSilicon, Samsung |
| 3.8 | (S-DCI) SRS for CB/NCB/AS and AP SRS for BM | Opt1: For a P/SP/AP SRS resource set for CB/NCB/AS or an AP SRS resource set for BM, if the SRS resource set is configured to follow unified TCI state, using RRC configuration to inform the TCI selection for the SRS resource setOpt2: If two SRS resource sets for CB/NCB are configured, and if the two SRS resource sets for CB/NCB are configured to follow unified TCI state, the UE shall apply the first indicated joint/UL TCI state to the first SRS resource set for CB/NCB (the one with lower resource set ID) and the second indicated joint/UL TCI state to second SRS resource set for CB/NCB. Otherwise, Opt1 is adopted.Support Opt1 only: Apple, Ericsson, Qualcomm, vivo, Google, ZTE, NEC, Fujitsu, CATT, IntelSupport Opt1+Opt2: OPPO, Panasonic, Xiaomi, CMCC, Docomo, Futurewei, TCL**FL note: Based on comments to Opt1 and Opt2, Proposal 3.8 is recommended as a potential compromise:****Proposal 3.8:** On unified TCI framework extension for S-DCI based MTRP, for a P/SP/AP SRS resource set for CB/NCB/AS or an AP SRS resource set for BM, if the SRS resource set is configured to follow unified TCI state, using RRC configuration to inform that the UE shall apply the first or the second indicated joint/UL TCI state to the SRS resource set* If two SRS resource sets for CB/NCB are configured and the two SRS resource sets for CB/NCB are configured to follow unified TCI state, and if above RRC configurations are not provided to the two SRS resource sets for CB/NCB, the UE shall apply the first indicated joint/UL TCI state to the first SRS resource set for CB/NCB (the one with lower resource set ID) and the second indicated joint/UL TCI state to second SRS resource set for CB/NCB.

Support all the proposal: Xiaomi, Futurewei, Sharp, CMCC, Docomo, Lenovo, NokiaSupport the main bullet: ZTE, LG, vivo, Samsung, QCNot support the main bullet: Huawei |
| 3.9 | (S-DCI) PDSCH scheduled/activated by DCI format 1\_1/1\_2, details of the [TCI selection field] in DCI format 1\_1/1\_2 | Question 1: Whether to use the codepoint “11” of the [TCI selection field]?* Yes: CMCC, FGI, LGE, Spreadtrum, vivo, ZTE, Docomo (for TDM)
* No (reserved): ITRI, Samsung, OPPO, QC, Xiaomi, Nokia, Sharp, Docomo (for SDM/SFN), Intel, Huawei/HiSilicon, Ericsson

**Conclusion 3.9:** On unified TCI framework extension for S-DCI based MTRP, there is no consensus to use the codepoint “11” of the [TCI selection field], i.e., the codepoint “11” is reserved.Question 2: Presence of the [TCI selection field] is RRC-configured per CORESET, per BWP, per serving cell, or others?* Per CORESET: CMCC, ZTE, NEC, CATT
* Per BWP: vivo (per DCI format 1\_1/1\_2), QC, Xiaomi, Nokia, Docomo, Panasonic, Intel, Apple, Huawei/HiSilicon, FGI, Lenovo

**Agreement**On unified TCI framework extension for S-DCI based MTRP, the presence of the [TCI selection field] can be RRC-configured per DL BWP* FFS: Whether the presence of the [TCI selection field] can be configured individually for DCI format 1\_1 and DCI format 1\_2 in the same DL BWP
 |
| 3.10 | How to handle the case that the spatial Tx filter(s) determined from the indicated joint/UL TCI state(s) applied to a PUSCH transmission is different from the spatial Tx filter(s) used for the SRS transmission corresponding to the SRS resource(s) indicated to the PUSCH transmission | Alt1-1: The UE uses the spatial Tx filter(s) determined from the indicated joint/UL TCI state(s) applied to the PUSCH transmission in this case, and an agreement for this behavior is preferred.* Support: ZTE

Alt1-2: Based on current agreement, the UE uses the spatial Tx filter(s) determined from the indicated joint/UL TCI state(s) applied to the PUSCH transmission in this case, and no additional handling is needed.* Support: vivo, Ericsson, ZTE

Alt2: The UE uses the spatial Tx filter(s) used for the SRS transmission corresponding to the SRS resource(s) indicated to the PUSCH transmission in this case, i.e., the indicated joint/UL TCI state(s) for the PUSCH transmission is ignored* Support: ZTE, NEC

Alt3: The case can be avoided by NW implementation, i.e., no additional handing in specification to this case is needed* Support: Docomo, Huawei/HiSilicon, OPPO, Spreadtrum, QC, CMCC, Xiaomi, Google, Apple, Sharp, Futurewei, CATT, FGI
* Concern: ZTE

**FL note: I tend to agree with that Alt1-1 would be naturally outcome based on current RAN1 agreements, and most of companies believe i.e., no additional handing in specification to this case is needed. Therefore, it could be beneficial to have a conclusion and close this issue.****Conclusion 3.10:** On unified TCI framework extension for S-DCI based MTRP, for a PUSCH transmission, the UE shall apply the spatial Tx filter(s) determined from the indicated joint/UL TCI state(s) applying to the PUSCH transmission regardless of whether the determined spatial Tx filter(s) is the same or different from the spatial Tx filter(s) used for the SRS transmission(s) corresponding to the SRS resource(s) indicated to the PUSCH transmission |
| 3.11 | (M-DCI) Type1 CG-PUSCH | **Proposal 3.11:** On unified TCI framework extension for M-DCI based MTRP, an RRC configuration is provided to a Type1 CG configuration to inform that the UE shall apply the first or the second indicated joint/UL TCI state to the corresponding CG-PUSCH transmission, where the first and the second indicated joint/DL TCI states correspond to the indicated joint/UL TCI states specific to *coresetPoolIndex* value 0 and value 1, respectively. |

Table 3-3 Company input for Issue 3

|  |  |
| --- | --- |
| **Company** | **Input to Round 1 summary** |
| Mod V00 | * Please share your view to the alternative proposals (i.e., Proposal 3.X.A) in Issue 3
* Please check new proposals and conclusion recommended for Issue 3.8 and 3.9
 |
| Xiaomi | **Proposal 3.1 or 3.1.A**Either one is ok for us, it can be up to RAN2**Proposal 3.2 or 3.2.A**Prefer 3.2.A since RRC is not needed.**Proposal 3.7 or 3.7.A**Prefer 3.7 since RRC configuration per resource is not needed.**Proposal 3.8**Support  |
| OPPO | **Proposal 3.2.A**: Fine to remove the involvement of RRC configuration on this UE behavior. **Proposal 3.7.A**: Fine with the update. |
| ZTE | **Proposal 3.1.A:** We can NOT support it. Clearly, we need to provide the indicator of “following unified TCI” individually, and otherwise the legacy procedure of MAC-CE level of s-DCI and sTRP switching can NOT be achieved. **Proposal 3.2.A:** Support.**Proposal 3.7.A:** Support. **Proposal 3.8:** Support the main bullet, and the sub-bullet seems unnecessary.  |
| Futurewei | **Proposal 3.1.A:** Not support. We prefer Proposal 3.1.**Proposal 3.2.A:** We are open to support it. **Proposal 3.7.A:** Support in principle.**Proposal 3.8:** Support. |
| Google | **Proposal 3.7.A:** Support.  |
| Sharp | **Proposal 3.1.A:** We prefer to keep followUnifiedTCIstate, while it is not needed technically. However, it is helpful for reusing the current spec that both followUnifiedTCIstate and RRC parameter for TCI selection are configured.**Proposal 3.2.A:** We have a concern about Proposal 3.2.A. If the UE doesn’t support the capability of two default beams for S-DCI based MTRP, we think both indicated joint/DL TCI states should not be applied to PDSCH. Furthermore, since STRP PDSCH cannot be used, Proposal 3.2.A has less flexibility than Proposal 3.2. In our view, only Alt 1 or Alt 2 + Alt 3 are acceptable.**Proposal 3.7.A:** We are fine with Proposal 3.7.A.**Proposal 3.8:** We are fine with Proposal 3.8. |
| QC | For issue 3.1, prefer 3.1.AFor proposal 3.8, not support. We think Option 1 should be enough. No need additional implicit rules for this case |
| Mod V10 | Conclusion 3.10 is added, please check |
| LG | Proposal 3.1/3.1A: Either is fineProposal 3.7A: SupportProposal 3.8: Support the main bullet. |
| CMCC | Proposal 3.1.A: supportProposal 3.2.A: not support. Is this intending to mean that PDSCH scheduled/activated by DCI format 1\_1/1\_2 configured w/o the [TCI selection field] will be always transmitted in M-TRP transmission scheme.Proposal 3.7.A: we prefer Proposal 3.7. RRC configuration per-resource will increase the signaling complexity, if most companies are fine with Proposal 3.7.A, we are acceptable for this compromised proposal.Proposal 3.8, Proposal 3.9, Proposal 3.10, Proposal 3.11: support. |
| FGI | **Proposal 3.2.A:** Not support. Support proposal 3.2.**Conclusion 3.10:** It seems that the conclusion is based on the alternative 1, which is not the majority view? |
| Docomo | **Proposal 3.1/3.1.A**: We are fine with either. Our understanding is the following* Proposal 3.1 introduces new RRC parameter of e.g. *index-r18* = {1st, 2nd, both} in addition to *followUnifiedTCIstate*.
* Proposal 3.1A introduces new RRC parameter of e.g. *followUnifiedTCIstate-r18* = {1st, 2nd, both} without *followUnifiedTCIstate*.

From RRC signaling overhead perspective, we believe Proposal 3.1A should be slightly better.Our understanding of benefit of Proposal 3.1 is that if MAC CE indicates one indicated TCI, UE should fall back to Rel.17 mode, which rely on *followUnifiedTCIstate* in R17 spec. For Proposal 3.1, we don’t need to change these RAN1 spec. We agree with “if MAC CE indicates one indicated TCI, UE should fall back to Rel.17 mode”. But, if we agree Proposal 3.1A, we can update the current RAN1 spec, for example “If either *followUnifiedTCIstate* or *followUnifiedTCIstate-r18* is configured, …”, the same functionality is obtained by Proposal 3.1A (although, we need additional agreement to enable this).**Proposal 3.2/3.2A:** Support3.2, but we can accept 3.2A. For 3.2A, if gNB want to switch sTRP or mTRP, gNB can use MAC CE to change the number of indicated TCI states. Hence, RRC parameter may be not necessary.**Issue 3.3:** We suggest to enable the same operation as R17, i.e. DCI format 1\_0 can schedule SFN-PDSCH.**Proposal 3.7:** As Docomo/Intel commented in the 1st round, we should consider when UE does not support buffering two default beam and if the triggering offset < threshold. Proposal 3.7 makes the triggering DCI to switch 1st or 2nd indicated TCI to the triggered A-CSI-RS, and when UE does not support buffering two default beam and if the triggering offset < threshold, UE can only receive A-CSI-RS with a fixed beam. Hence, we suggest to add the following, same as PDSCH (the same modification should be applied to Proposal 3.7A).**Proposal 3.7:** On unified TCI framework extension for S-DCI based MTRP, an RRC configuration can be provided in *CSI-AssociatedReportConfigInfo* of *CSI-AperiodicTrigger State* for each aperiodic CSI-RS resource set for CSI/BM to inform that the UE shall apply the first or the second indicated joint/DL TCI state to the aperiodic CSI-RS resource set if the aperiodic CSI-RS resource set is configured to follow unified TCI state* The above applies if the UE is in FR1, or the UE supports the capability of two default beams for S-DCI based MTRP in FR2 regardless of threshold, or the UE does not support the capability of two default beams for S-DCI based MTRP in FR2 when the triggering offset is equal to or larger than a threshold.
* For an aperiodic CSI-RS resource set configured with two Resource Groups for NCJT CSI and configured to follow unified TCI state, if above RRC configuration is not provided to the aperiodic CSI-RS resource set, the UE shall apply the first indicated joint/DL TCI state to the CSI-RS resource(s) in Group 1 and the second indicated joint/DL TCI state to the CSI-RS resource(s) in Group 2.
* If the UE does not support the capability of two default beams for S-DCI based MTRP in FR2 when the triggering offset is less than a threshold, UE shall apply the first indicated joint/DL TCI state to the CSI-RS resource(s).

**Proposal 3.8:** OK**Conclusion 3.10**: We are fine, but we think it is better to make it RAN1 agreement, because it should be captured in spec, if agreed. |
| vivo | **Issue 3.1:** Both Proposal 3.1 and Proposal 3.1.A can achieve the same functionality. Perhaps we can add a sub-bullet to say it is up to RAN2 to design the RRC parameters.**Issue 3.2:** Still prefer Alt2. Each of Proposal 3.2 and Proposal 3.2.A is too complicated, the applied TCI state(s) depends on too many factors. A simple and neat solution is desired. For Proposal 3.2.A, the applied TCI state(s) varies depending on the scheduling offset.Besides, we think a unified solution for both absence of [TCI selection field] and DCI format 1\_0 is highly desired. Alt2 is a proper way to go.**Issue 3.7:** Don’t support. Regarding RRC configuration per CSI-RS resource, the CSI-RS resource in a CSI-RS resource set/resource group associated with a TRP should have a common TCI state, thus RRC configuration per CSI-RS resource set/resource group is enough.As a common design for AP CSI-RS configured to follow unified TCI states including group-based beam reporting and NCJT CSI reporting, RRC configurations can be provided for each CSI-RS resource set or resource group. Thus we have another proposal.**Proposal 3.7.B:** On unified TCI framework extension for S-DCI based MTRP, an RRC configuration can be provided in *CSI-AssociatedReportConfigInfo* of *CSI-AperiodicTrigger State* for each aperiodic CSI-RS resource set or Resource group for CSI/BM to inform that the UE shall apply the first or the second indicated joint/DL TCI state to the aperiodic CSI-RS resource set or Resource group if the aperiodic CSI-RS resource set is configured to follow unified TCI state**.****Proposal 3.8:** If only one SRS resource set for CB/NCB/AS/BM is configured, the SRS resource set should be able to apply either of the two indicated joint/UL TCI states, which has been the only case in Rel-16 MTRP. One SRS resource set shared between TRPs can save the configuration of SRS resource sets for each individual TRP. Therefore, if the RRC configuration is not provided, the AP SRS can apply the indicated joint/UL TCI state corresponding to the indicated joint/DL TCI state applied to the CORESET carrying the triggering DCI at least for the case of only one SRS resource set for CB/NCB configured. Re FL’s comment: “legacy behavior can be enabled by “NOT” following unified TCI state.” it is not very flexible due to frequent SRS TCI State Indication MAC CE if the SRS transmission just needs to follow the unified TCI states.**Updated Proposal 3.8:** On unified TCI framework extension for S-DCI based MTRP, for a P/SP/AP SRS resource set for CB/NCB/AS or an AP SRS resource set for BM, if the SRS resource set ~~is~~ can be configured to follow unified TCI state, using RRC configuration to inform that the UE shall apply the first or the second indicated joint/UL TCI state to the SRS resource set* If one AP SRS resource set for CB/NCB is configured and the AP SRS resource set for CB/NCB is configured to follow unified TCI state, and if above RRC configuration is not provided to the AP SRS resource set for CB/NCB, the AP SRS shall apply the indicated joint/UL TCI state corresponding to the CORESET carrying the triggering DCI.
* If two SRS resource sets for CB/NCB are configured and the two SRS resource sets for CB/NCB are configured to follow unified TCI state, and if above RRC configurations are not provided to the two SRS resource sets for CB/NCB, the UE shall apply the first indicated joint/UL TCI state to the first SRS resource set for CB/NCB (the one with lower resource set ID) and the second indicated joint/UL TCI state to second SRS resource set for CB/NCB.
 |
| Fujitsu | **Proposal 3.1.A:** Not support. We prefer Proposal 3.1. |
| Lenovo | Proposal 3.1/3.1A: We prefer 3.1Proposal 3.2/3.2A: We have agreed to switch STRP and MTRP by MAC CE, for the case in main bullet, we prefer 3.2A. Proposal 3.7/3.7A: Support 3.7AProposal 3.8: Support FL proposal.Conclusion 3.10: Support. |
| Nokia | **Proposal 3.1:** FineIssue 3.2:Support **Prososal 3.2.A**Issue 3.7:Support **Proposal 3.7.A**Issue 3.8:**Proposal 3.8** fine. |
| Samsung | Proposal 3.2/3.2A, we do not support the two sub-bullets, which are not relevant to this issue. These should be discussed under UE feature sessions, otherwise we just make unnecessary presumptions on UE behaviors. [Mod] I think this UE behavior should be discussed before the UE feature discussion. I think it should be fine since we already agreed that the behavior if the offset is less than a threshold is discussed separately regardless the DCI field is present or absent.**Agreement**On unified TCI framework extension for S-DCI based MTRP, a DCI field in DCI format 1\_1/1\_2 that schedules/activates PDSCH reception is used to determine which one or both of the indicated joint/DL TCI states shall be applied to the scheduled/activated PDSCH reception* The presence of the DCI field is configurable by RRC; when the DCI field is not present in DCI format 1\_1/1\_2, the UE shall apply the default indicated joint/DL TCI state(s) to PDSCH reception
	+ FFS: Details on the default indicated joint/DL TCI state(s) to PDSCH reception
* FFS: The DCI field is a new indicator field or an existing field (e.g., the existing TCI field)
* FFS: Regardless the DCI field is present or not present, how to apply the indicated joint/DL TCI state(s) to PDSCH reception if the offset between the reception of the DCI format 1\_1/1\_2 and the corresponding PDSCH reception is less than a threshold

FFS: How to apply the indicated joint/DL TCI state(s) to PDSCH reception scheduled/activated by DCI format 1\_0.Above applies for the case where PDSCHs scheduled by the same DCI.Support Proposal 3.7. We do not see the need to introduce separate configurations for each resource as in Proposal 3.7A. For Proposal 3.7, we suggest to change “if above RRC configuration is not provided to the aperiodic CSI-RS resource set” to “according to the above RRC configuration (design details up to RAN2)” as whether the RRC configuration is provided or not or set to a particular value should be up to RAN2.Proposal 3.8: Opt1 only, i.e., the main sentence, should suffice. |
| Huawei, Hisilicon | **Proposal 3.1 vs. 3.1.A:** Not support 3.1.A. We strongly prefer original Proposal 3.1 as per our discussion in Round0 and the discussion in Section 2.2.1 of R1-23022370. **Proposal 3.2 vs. 3.2.A:** We prefer original 3.2 as it is more flexible than 3.2.A.**Proposal 3.7 vs. 3.7.A**: We cannot accept 3.7.A since it unnecessarily increases the RRC overhead (RRC parameter would be configured per resource instead of per resource set). We can accept Proposal 3.7 without the newly-added lines in red. Note that, in legacy releases, the timeline/conditions for applying QCL assumption to PDSCH (Provided in 5.1.5 of 38.214) is quite different from the timeline/conditions for applying QCL assumption to AP CSI-RS (provided in Clause 5.2.1.5.1 and 5.2.1.5.1a of 38.214) and the agreement that we had for PDSCH regarding the QCL application timeline cannot be applied verbatim to AP CSI-RS. We suggest to remove the red lines from the Proposal. **Proposal 3.8:** Not support in this form. Our views in first round is not captured accurately. We did not say support both Opt1+Opt2.We think a rule should be followed for CB/NCB SRS to ensure that the QCL assumption of CB/NCB SRS and the corresponding PUSCH is the same. In all other cases, RRC parameter may be used. We suggest the following:**Proposal 3.8 (modified):** On unified TCI framework extension for S-DCI based MTRP, for a P/SP/AP SRS resource set for ~~CB/NCB/~~AS or an AP SRS resource set for BM, if the SRS resource set is configured to follow unified TCI state, us~~ing~~ RRC configuration to inform that the UE shall apply the first or the second indicated joint/UL TCI state to the SRS resource setIf two P/SP/AP SRS resource sets for CB/NCB are configured and the two SRS resource sets for CB/NCB are configured to follow unified TCI state, ~~and if above RRC configurations are not provided to the two SRS resource sets for CB/NCB,~~ the UE shall apply the first indicated joint/UL TCI state to the first SRS resource set for CB/NCB (the one with lower resource set ID) and the second indicated joint/UL TCI state to second SRS resource set for CB/NCB. **Conclusion 3.10:** Just to make sure we understand the intention of the conclusion correctly: Does the conclusion say that, in the case of conflict, the spatialRelationInfo of SRS is ignored and, for the transmission of SRS, UE uses the same beam as the corresponding PUSCH?[Mod] No, this conclusion implies the UE still transmit SRS based on the spatial relation or TCI state indicated/configured to the SRS.  |
| Docomo | Proposal 3.7 vs. 3.7.A:Re Huawei’s comment, indeed the scheduling/triggering threshold is different between PDSCH/A-CSI-RS, default QCL assumption for scheduling/triggering < threshold is always the same between PDSCH and A-CSI-RS in all releases. This is because UE may receive PDSCH/A-CSI-RS before finishing DCI decoding (< thresold), and UE should buffer received signal with a certain/fixed QCL assumption to prepare the case PDSCH/A-CSI-RS may or may not be scheduled/triggered. From UE perspective, UE does not know which one of PDSCH or A-CSI-RS will be scheduled/triggered when the offset < threshold. Hence UW should apply the same buffering behavior between PDSCH and A-CSI-RS. If not, it makes mandate UE to buffer with at least two QCL assumption (one for PDSH and one for A-CSI-RS). Hence, the red part (same as PDSCH) is needed for A-CSI-RS, as well as PDSCH scheduled by any DCI format. |
| vivo | As another alternative, Proposal 3.7.B can be updated also with the restriction given by the note.**Proposal 3.7.B:** On unified TCI framework extension for S-DCI based MTRP, an RRC configuration can be provided in *CSI-AssociatedReportConfigInfo* of *CSI-AperiodicTrigger State* for each aperiodic CSI-RS resource set or Resource group for CSI/BM to inform that the UE shall apply the first or the second indicated joint/DL TCI state to the aperiodic CSI-RS resource set or Resource group if the aperiodic CSI-RS resource set is configured to follow unified TCI state**.*** If the UE is in FR1, or the UE supports the capability of two default beams for S-DCI based MTRP in FR2, above applies regardless of the triggering offset
* If the UE doesn’t support the capability of two default beams for S-DCI based MTRP in FR2, above applies when the triggering offset is equal to or larger than a threshold
	+ FFS: UE behavior when the triggering offset is less than a threshold
* Note: when two CSI-RS resource sets for enhanced group-based beam reporting and two resource groups for NCJT CSI are configured, two indicated joint/DL TCI states are configured to apply to the two CSI-RS resource sets/resource groups respectively.

[Mod] The intension of main bullet is clear to me, which introduces per Resource group configuration. However, the intension of the note is unclear to me, why it is needed?Conclusion 3.10: Support with minor typo correction.**Conclusion 3.10:** On unified TCI framework extension for S-DCI based MTRP, for the case if the spatial Tx filter(s) determined from the indicated joint/UL TCI state(s) applied to a PUSCH transmission is different from the spatial Tx filter(s) used for the SRS transmission corresponding to the SRS resource(s) indicated to the PUSCH transmission, the UE shall apply the spatial Tx filter(s) determined from the indicated joint/UL TCI state(s) to the PUSCH transmission.* No additional handling in specification to this case is needed

[Mod] Thanks for the correction |
| QC | For 3.1, proposal 3.1.A is our 1st preference, and proposal 3.1 is our 2nd preferenceFor 3.2, support proposal 3.2.AFor 3.7, support proposal 3.7,A, change to not support for proposal 3.7For 3.8, support only main bullet of Proposal 3.8For 3.10, support conclusion 3.10 |
| Apple  | **For P3.1,** after comparing P3.1A and P3.1, we prefer P3.1A, which is more aligned with earlier RAN1 agreement. In our understanding, the new RRC parameter is functionally replacing the ‘*followUnifiedTCIstate’* with providing more dimensions/granularities as there is two TRPs. For this case, the new parameter is sufficient for the new function without need of ‘legacy’ parameter. This is what P3.1A achieves, which is much cleaner and simpler formulation. It would be helpful if proponent companies can explain why P3.1 is better than P3.1A.  |
| Huawei, Hisilicon2 | **@FL:** Thanks for your reply regarding conclusion 3.10. If we understood correctly, the conclusion says that if there is any conflict between Spatial Tx beam of RS and the indicated TCI, SRS uses its own beam and PUSCH keeps using the indicated TCI (i.e., the conflict stays. There won’t be any conflict resolution). Is this understand is correct? [Mod] Yes, your above understanding is correct |
| vivo | @FL: [Mod] The intension of main bullet is clear to me, which introduces per Resource group configuration. However, the intension of the note is unclear to me, why it is needed?The note in Proposal 3.7.B is to assure two different TCI states are indicated to two resource sets/groups. If we don’t have such restriction, each of the two resources/groups may be indicated the same TCI state. |
| Panasonic | I just updated Panasonic’s stance on the proposals in section 4 to be brought online **Proposal 3.2 (RRC):** Support**Proposal 3.7:** Not support**Proposal 3.7.A:** Support |
| **Company** | **Input to Round 2 summary** |
| Mod V00 | * Issue 3.1: I will kick off an email discussion for this issue on Monday to check whether we can reach consensus on Proposal 3.1 or Proposal 3.1.A. If not, I will conclude the situation that there is no consensus.
* Issue 3.2: Down-selection between Proposal 3.2 and Proposal 3.2.A, plan to discuss in GTW session. Any further input, if any, is welcome.
* Issue 3.3: Since outcome of Issue 3.2 may impact this issue, postpone to the next meeting.
* Issue 3.7: Down-selection between Proposal 3.7 and Proposal 3.7.A, plan to discuss in GTW session. Any further input, if any, is welcome.
* Issue 3.8: Plan to discuss in GTW session. Any further input, if any, is welcome.
* Issue 3.10: Please check Conclusion 3.10
* Issue 3.11: Please check Proposal 3.11
 |
| Xiaomi | **Proposal 3.1 or 3.1.A**Either one is ok for us, it can be up to RAN2**Proposal 3.2 or 3.2.A**We check other companies’ comments, and find there are two understandings on the PDSCH transmission scheme of this proposal. The first understanding is that it is for UE operating in S-DCI based MTRP on PDSCH reception (e.g., PDSCH scheme 1, 2, 3, SFN PDSCH). The second understanding is that it is for UE operating in S-DCI based MTRP on any one channel, i.e., at least one TCI codepoint activated by MAC CE maps to TCI states of two TRPs, but for PDSCH, it can be S-TRP or M-TRP operation. Based on the first understanding, we prefer proposal 3.2.A. since there is no reason for RRC to configure one TCI state for S-DCI based MTRP PDSCH. And if the first understanding is right, we suggest the following update on the main bullet: ‘configured’ can be applied for PDSCH scheme 1, 2, 3, or SFN, while indicated can be applied for SDM.[Mod] Based on previous RAN1 agreement and conclusion, UE shall maintain two indicated TCI states when operates in unified TCI extension for S-DCI case. Then, whether PDSCH reception is perform based on STRP or MTRP Tx schemes will depend on the received codepoint of the [TCI selection field] if configured, RRC configuration if 3.2 is adopted, or always based on MTRP Tx schemes of 3.2.A is adopted.**Proposal 3.2.A (Both):** On unified TCI framework extension for S-DCI based MTRP, for UE configured/indicated with PDSCH scheme 1, 2, 3, or SFN-PDSCH, for PDSCH reception scheduled/activated by DCI format 1\_1/1\_2 configured w/o the [TCI selection field], the UE shall apply both indicated joint/DL TCI states to the scheduled/activated PDSCH reception Based on the second understanding, only some PDSCH transmission scheme need additional RRC. Since if the PDSCH is configured with PDSCH scheme 2,3, SFN PDSCH, or DMRS port are indicated in two CDM groups, UE will apply both indicated TCI state. [Mod] Why UE must apply both indicated TCI states in these cases? Whether to perform reception based on MTRP schemes is still based the number of indicated TCI states applied to the reception.And for S-TRP, only the first indicated TCI state will be used. It means only for PDSCH scheme 4, additional RRC is needed to inform the first one or two indicated TCI state.Can FL clarify which one is the common understanding? If the common understanding is the second understanding, we are fine to support proposal 3.2 with the following note since for such cases additional RRC is not needed.**Proposal 3.2 (RRC):** On unified TCI framework extension for S-DCI based MTRP, for PDSCH reception scheduled/activated by DCI format 1\_1/1\_2 configured w/o the [TCI selection field], using RRC configuration to inform that the UE shall apply the first, the second, or both indicated joint/DL TCI states to the scheduled/activated PDSCH reception* Note: If configured/indicated with PDSCH scheme 1, 2, 3 or SFN PDSCH, UE shall apply both indicated joint/DL TCI states to the scheduled/activated PDSCH reception directly.

 **Proposal 3.7 or 3.7.A**Prefer 3.7 since RRC configuration per resource is not needed.**Proposal 3.8**Support **Conclusion 3.10** Support **Proposal 3.11**Support  |
| vivo | **Issue 3.7:** Can we add another option, Proposal 3.7.B, for future down-selection as we commented several times.**Proposal 3.7.B:** On unified TCI framework extension for S-DCI based MTRP, an RRC configuration can be provided in *CSI-AssociatedReportConfigInfo* of *CSI-AperiodicTrigger State* for each aperiodic CSI-RS resource set or Resource group for CSI/BM to inform that the UE shall apply the first or the second indicated joint/DL TCI state to the aperiodic CSI-RS resource set or Resource group if the aperiodic CSI-RS resource set is configured to follow unified TCI state**.**[Mod] I didn’t mean to ignore your proposal. However, when I check the comments from companies, it seems no second company supporting Proposal 3.7.B.**Issue 3.8:** We should consider the case “If one AP SRS resource set for CB/NCB is configured and the AP SRS resource set for CB/NCB is configured to follow unified TCI state, and if above RRC configuration is not provided to the AP SRS resource set for CB/NCB” to make the proposal complete.**Conclusion 3.10:** Generally fine. Just one question on “for a PUSCH transmission that applies the indicated joint/UL TCI state(s)”, is there any case that PUSCH doesn’t apply the indicated joint/UL TCI state(s)? If not, can we delete this part?**Proposal 3.11:** Support. |
| Docomo | **Issue 3.2/3.3:** If UE does not support buffering with two default beams, and if the scheduling offset < threshold, the same behavior should be applied to Issue 3.2/3.3. For other cases, different options are possible for different cases.**Conclusion 3.9:** We prefer to postpone it in next meeting. |
| CMCC | Issue 3.2: We are fine with Proposal 3.2.AConclusion 3.10: Support Proposal 3.11: Support |
| Sharp | Proposal 3.2/3.2.A: We can accept Proposal 3.2.A if how to fallback to STRP is clear.If the TCI field indicates one TCI state, and/or if the UE reserves only one indicated TCI state, how does the UE apply both indicated joint/DL TCI states? If the UE fallback to STRP, at least “if any” should be added to the main bullet.Furthermore, we could understand switching between STRP and MTRP modes by the comments of Docomo/Lenovo. If fallback to STRP mode, Rel-17 unified TCI framework can be enabled by MAC CE.Mod] It should be clear that this proposal applies when unified TCI framework extension for S-DCI based MTRP is operated, why we need to consider Rel-17 unified TCI framework at the same time?Additionally, in our view, “the capability of two default beams for S-DCI based MTRP” is a capability to buffer the received signal by using both indicated joint/DL TCI states. In Proposal 3.2.A, the UE apply both indicated TCI states, if any, and we think that implies to support the capability of two default beams for S-DCI based MTRP. Namely, since whether TCI selection field is provided is determined by RRC, we don’t see the necessity of waiting for DCI decoding.[Mod] Applying both indicated TCI states for PDSCH reception doesn’t always mean the UE support the PDSCH transmitted by SDM/SFN/FDM. Applying both indicated TCI states for PDSCH reception is possible to be used for TDM, and the UE doesn’t have to support two default beams in this case.Our 1st preference is Proposal 3.2, but we are OK with the following proposal:**Proposal 3.2.A (Both):** On unified TCI framework extension for S-DCI based MTRP, for PDSCH reception scheduled/activated by DCI format 1\_1/1\_2 configured w/o the [TCI selection field], the UE shall apply both indicated joint/DL TCI states, if any, to the scheduled/activated PDSCH reception* ~~If the UE is in FR1, or the UE supports the capability of two default beams for S-DCI based MTRP in FR2, above applies regardless of the offset between the reception of the scheduling DCI format 1\_1/1\_2 and the scheduled/activated PDSCH reception~~
* ~~If the UE doesn’t support the capability of two default beams for S-DCI based MTRP in FR2, above applies when the offset between the reception of the scheduling DCI format 1\_1/1\_2 and the scheduled/activated PDSCH reception is equal to or larger than a threshold~~
 |
| Nokia | Issue 3.2: Support **Proposal 3.2.A**. RRC configuration in Proposal 3.2 is not needed and it makes operation less flexible. **Conclusion 3.9:** Ok.**Conclusion 3.10**: Ok.**Proposal 3.11:** Ok.  |
| Panasonic | Proposal 3.3: This difference between Alt1 and Alt 2 is just the SFN/CJT case. So perhaps they can be merged by adding an FFS in Alt 2 for CJT and SFN case. Proposal 3.7/3.7A: In release 17, RRC configured field qcl-info and qcl-info2 are defined per resource and if they are absent, it would follow the indicated TCI states. So if we are going to use RRC configuration, then why not enable indication at the resource level that would also take care of the Group-based reporting and NCJT CSI measurement. Also the sub-bullet for NCJT in 3.7 is not clear and seems redundant. Isn’t “configured to follow unified TCI state” means “above RRC configuration is not provided”? |
| LG | **Proposal 3.2A:** Concern on the proposal. It means that the PDSCH is operated only on MTRP and what is the clear rationale compared to such as Alt selecting only the 1st indicated TCI state? To our understanding, it is the case where TCI selection field is not present, it would be better to align the solution as same as by fallback DCI for PUSCH (agreed to use 1st indicated TCI state) and PDSCH (not agreed but with majority to use 1st indicated TCI state) |
| ZTE | **Issue 3.2:** Considering the agreement in last GTW, we already have the corresponding MAC-CE, and we can change the first/second TCI state(s) with sufficient flexibility. Based on that, we do not identify the motivation of why an RRC signaling need to introduced. One more thing is: if RRC configured ‘always’ first TCI state is used, for instance, why we still call it S-DCI scheme. **Conclusion 3.10**: Support. Otherwise, UE behavior becomes unclear. Considering the current spec is still pending, we may have an agreement, and then “FFS: whether there is spec impact or not”. **Proposal 3.11**: Support. |
| Intel | **Issue 3.1:** We are OK with **Proposal 3.1.A**. Leave the details to RAN2**Issue 3.2:** We support **Proposal 3.2.A.** We don’t think the RRC configuration is necessary. We only agreed to it when 3.2.A was not on the table. Please change our views in the table.**Conclusion 3.10:** OK**Proposal 3.11:** OK |
| QC | 3.1: prefer proposal 3.1.A3.2: prefer proposal 3.2.A3.7: prefer proposal 3.7.A3.10, fine for the conclusion 3.103.11, support proposal 3.11 |
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# Issue 4 – UL power control for UL MTRP operation

Table 4-1 Summary for Issue 4

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| --- | --- | --- |
| **#** | **Issue** | **Companies’ view and Recommended Proposal** |
| 4.1 | UL PC for S-DCI based STxMP (including SDM/SFN based PUSCH Tx and SFN based PUCCH Tx) | **Agreement**On unified TCI framework extension, if an indicated joint/UL TCI state(s) applies to a PUSCH/PUCCH/SRS transmission occasion(s) or antenna port(s), the UE shall determine UL Tx power for the PUSCH/PUCCH/SRS transmission occasion(s) or antenna port(s) based on the UL PC parameter setting for PUSCH/PUCCH/SRS, if any, and the PL-RS included in the indicated joint/UL TCI state* FFS: For STxMP, the maximum Tx power when the UE determines UL Tx power for the PUSCH/PUCCH transmission occasion(s) or antenna port(s) (discussed after receiving RAN4 reply on UE power limitation for STxMP in FR2)
* FFS: Default UL PC parameter setting(s) if one or both of indicated joint/UL TCI states applied to PUSCH/PUCCH/SRS transmission occasion(s) or antenna port(s) does/do not include the UL PC parameter setting(s) for PUCCH/PUSCH/SRS

**FL note: Based above RAN1 agreement, for PUSCH/PUCCH STxMP, UE would determine two UL Tx power values based on the UL PC parameter settings and the PL-RS associated with the two indicated joint/UL TCI states. However, it is unclear (based on current spec+agreement) that UE should determine the two UL power values based on one single UE-configured maximum output power value (PCMAX,f,c) defined in current spec or two UE-configured maximum output power values. During the RAN1 discussion in this meeting, the following three alternatives are identified:*** **Alt1: The UE determines two UL Tx power values for the PUSCH/PUCCH STxMP based on one single UE-configured maximum output power value (PCMAX,f,c) defined in current spec [8-1, TS 38.101-1], [8-2, TS 38.101-2] and [8-3, TS 38.101-3]**
* **Alt2: The UE determines two UL Tx power values for PUSCH/PUCCH STxMP based on two UE-configured maximum output power values (if per-panel/TCI UE-configured maximum output power value is introduced by RAN4)**
* **Alt3: The UE determines two UL Tx power values for PUSCH/PUCCH STxMP based on two UE-configured maximum output power values (if per-panel/TCI UE-configured maximum output power value is introduced by RAN4), and the sum of two UL Tx power values for PUSCH/PUCCH STxMP should not exceed the UE-configured maximum output power value (PCMAX,f,c) defined in current spec [8-1, TS 38.101-1], [8-2, TS 38.101-2] and [8-3, TS 38.101-3]**

**However, some companies have concern that it may be too early to discuss this issue in RAN1 since whether to introduce two UE-configured maximum output power values for STxMP. Some companies suggest we can send an LS that captures above three alternatives to RAN4 and check RAN4’s view on them. Thus, I’d like to check with you:****Question 1: Should we send an LS that captures above three alternatives to RAN4 and check RAN4’s view on these alternatives?*** **Yes:**
* **No:**

**Note: There is RAN1 spec impact even we go with Alt1 in the end since the formula for UL Tx power determination in current RAN1 spec is defined per PUSCH/PUSCH Tx occasion, which is not sufficient at least for S-DCI based PUCCH/PUSCH STxMP.****TS 38.213 UL PC for PUSCH**If a UE transmits a PUSCH on active UL BWP $b$ of carrier $f$ of serving cell $c$ using parameter set configuration with index $j$ and PUSCH power control adjustment state with index $l$, the UE determines the PUSCH transmission power $P\_{PUSCH,b,f,c}(i,j,q\_{d},l)$ in PUSCH transmission occasion $i$ as**TS 38.213 UL PC for PUCCH**If a UE transmits a PUCCH on active UL BWP $b$ of carrier $f$ in the primary cell $c$ using PUCCH power control adjustment state with index $l$, the UE determines the PUCCH transmission power $P\_{PUCCH,b,f,c}(i,q\_{u},q\_{d},l)$ in PUCCH transmission occasion $i$ as |
| 4.2 | Power allocation for STxMP (including both S-DCI and M-DCI based STxMP) | **FL note: According to the RAN4 LS reply on UE power limitation for STxMP [2], both per-UE and per-panel power limitation are feasible and should be applied to a same UE for STxMP. To meet/enable the per-UE power limitation, one question is raised as follows:** **Question 1: Whether prioritization for Tx power allocation/reduction is needed for STxMP so that the total UE Tx power for transmissions on serving cells in the frequency range wouldn’t exceed a total power limitation, e.g.,** $\hat{P}\_{CMAX}(i)$ **used in TS 38.213 (clause 7.5) and defined in TS 38.101?*** Yes: Nokia, MediaTek, Panasonic, ZTE, OPPO, QC, LG, Xiaomi, Apple, Sharp, Lenovo, Huawei/HiSilicon
* No: vivo (concern on the target condition), Intel, Samsung, Ericsson
 |

Table 4-2 Company input for Issue 4

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| --- | --- |
| **Company** | **Input to Round 2 summary** |
| Mod V00 | Please provide your answer and view to Question 1 in Issue 4.1 |
| Xiaomi | No, this should be decided by RAN1. First, as we commented in RAND 0, based on the LS reply from RAN4, it is feasible to introduce a total power limitation over all panels and/or power limitation per panel/TCI for them. But whether a total power limitation over all panels and per panel/TCI power limitation should be introduced is up to RAN1. After RAN1 makes decision, they will define the corresponding power limitation(s) based on RAN1’s agreement.Secondly, a total power limitation over all panels in Assumption 2 is different from the current per UE power limitation, (PCMAX,f,c) which is defined based on regulation compliance. RAN4 confirm that existing UE RF requirements, (PCMAX,f,c), should be considered in STxMP. While whether a total power limitation should be further discussed. If it is necessary, RAN4 will define it.

|  |
| --- |
| ***Question 3:*** *In either of Assumption1 or Assumption 2, whether the total power limitation per UE over all UE panels used for STxMP or the sum of per-panel power limitation for STxMP can be different from (greater than) the existing power limitation for a given power class?*Answer: RAN4 confirm that existing UE RF requirements are framed so standards compliance implies regulation compliance (clause 6.5x in TS38.101-2). For any additional limitation like the sum over all panels of the per-panel power limitation for STxMP, would be defined in RAN4 if necessary. |

In short, it is feasible to introduce a total power limitation over all panels and/or power limitation per panel/TCI from RAN4’s perspective. While, whether these two kinds of power limitations are necessary or not should be decided by RAN1. After we reach an agreement about it, we can make down selection among the three alternatives above accordingly. |
| vivo | Issue 4.1: Q1. Fine to send an LS to RAN4 if the majority think so. |
| NTT Docomo | No. In our understanding in the earlier LS from RAN4, it is already clear that any of the three alternatives is feasible. It should be RAN1 to downselect one from them.  |
| Nokia | Although we don’t see the need to send another LS to RAN4 as of now, we would be fine with it if the majority supports it.RAN1 should continue discussions on the various alternatives listed by FL.On Question 1, we don’t see why some companies have concern regarding power reduction need. Power reduction prioritization is already in legacy for the CA case (as also mentioned by FL). Considering the legacy power reduction operation as a baseline, we would now need to account for the presence of Rel-18 STxMP.  |
| LG | Issue 4.1: Similar view with Docomo and Xiaomi that it seems clear that the alternatives are feasible based on LS reply from RAN4. |
| ZTE | We can be flexible if having majority companies support. But, considering only two meetings left, we may try to handle this issue in RAN1.  |
| Intel  | Don’t think we need an LS |
| QC | Prefer no LS. No time for iterations. RAN1 can decide first and inform RAN4 to check feasibility later |

# Issue 5 – PDSCH-CJT Tx scheme

Table 5-1 Summary for Issue 5

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| --- | --- | --- |
| **#** | **Issue** | **Companies’ view and Recommended Proposal** |
| 5.1 | Switching between PDSCH-CJT Tx scheme and other S-DCI based PDSCH Tx scheme(s) | **Agreement**On unified TCI framework extension for S-DCI based MTRP, PDSCH-CJT Tx scheme is RRC-configured, and dynamic switching between PDSCH-CJT and other S-DCI based PDSCH Tx schemes is not supported |
| 5.2 | QCL type(s)/assumption(s) if two indicated joint TCI states are applied to PDSCH-CJT | Alt1: PDSCH DMRS port(s) is QCLed with the DL RSs of both indicated joint TCI states with respect to QCL-TypeA* Support: Huawei, Spreadtrum, OPPO, Ericsson, Xiaomi, CATT, Qualcomm, Nokia, Docomo, CMCC, Lenovo, NEC, LG, Intel, Samsung, Sharp
* Concern: ZTE

Alt2: PDSCH DMRS port(s) is QCLed with the DL RSs of both indicated joint TCI states with respect to QCL-TypeA except for QCL parameters {Doppler shift, Doppler spread} of the second indicated joint TCI state* Support: Huawei, ZTE, Ericsson, Xiaomi, Qualcomm, Docomo, CMCC, Samsung
* Concern:

Alt3: PDSCH DMRS port(s) is QCLed with the DL RS of the first indicated joint TCI state with respect to QCL-TypeA and QCLed with the DL RS of the second indicated joint TCI state with respect to QCL-TypeB* Support: ZTE, Ericsson
* Concern: QC, Samsung

**FL note: Based on feedback from companies, all the alternatives have their use cases. Thus, Proposal 5.2 is recommended. Note that since this is not an essential issue in this AI, it is unlikely to treat it in the GTW discussion. I hope we can converge through the offline discussion.****Proposal 5.2:** On unified TCI framework extension for S-DCI based MTRP, the following three alternatives are supported for PDSCH-CJT applying both indicated joint TCI states (if the UE supports two indicated joint/DL states for PDSCH-CJT):* Alt1: PDSCH DMRS port(s) is QCLed with the DL RSs of both indicated joint TCI states with respect to QCL-TypeA
* Alt2: PDSCH DMRS port(s) is QCLed with the DL RSs of both indicated joint TCI states with respect to QCL-TypeA except for QCL parameters {Doppler shift, Doppler spread} of the second indicated joint TCI state
* Alt3: PDSCH DMRS port(s) is QCLed with the DL RS of the first indicated joint TCI state with respect to QCL-TypeA and QCLed with the DL RS of the second indicated joint TCI state with respect to QCL-TypeB

Introduce a UE capability on which alternative(s) is supported, and either one of above alternatives can be configured by RRC according to the UE capabilitySupport: ZTE, Huawei/HiSilicon, Docomo, Ericsson, Lenovo, Nokia, Samsung, OPPO, CMCCConcern: QC **FL note: Based on current situation that companies don’t compromise on Proposal 5.2, I suggest one alternative proposal to support “at least” Alt2, at least no concern on it. Please note that if there is nothing agreed for this issue, PDSCH-CJT Tx scheme may not be supported in Rel-18.****Proposal 5.2.A:** On unified TCI framework extension for S-DCI based MTRP, support at least Alt2 for PDSCH-CJT applying both indicated joint TCI states (if the UE supports two indicated joint/DL states for PDSCH-CJT):* Alt2: PDSCH DMRS port(s) is QCLed with the DL RSs of both indicated joint TCI states with respect to QCL-TypeA except for QCL parameters {Doppler shift, Doppler spread} of the second indicated joint TCI state

Support: Lenovo, Docomo, CMCCConcern: Huawei/HiSilicon |

Table 5-2 Company input for Issue 5

|  |  |
| --- | --- |
| **Company** | **Input to Round 2 summary** |
| Mod V00 | Can company compromise on Proposal 5.2 or Proposal 5.2.A, please? |
| CMCC | Proposal 5.2 is also fine for us. |
| Intel | We think Alt-1 has more support and should be used for a compromise if selecting one alternative. |
| QC | Fine for Proposal 5.2.A, although unclear why Alt1 cannot be supported as well. For Alt3, our concerns are re-copied below1. Study of CJT PDSCH enhancement is not in TCI WID
	1. Companies should have agreed sim scenarios and type to carry out evaluations like R17 SFN, R18 STxMP, not like CJT PDSCH, which has no agenda for its EVM assumptions.
	2. Allowing to discuss CJT in TCI is already a big compromise, no further enhancement is preferred without agreed EVM
	3. However, we are open to study CJT enhancement in R19
2. We are not clear on the modeling/scenario of Alt3 evaluation, and hence cannot justify its effectiveness especially for large TRP delay difference
	1. E.g. how to model the delay compensation at gNB, by applying phase shifts across SBs, or by adjusting TRP Tx timing? Zero discussion in TCI so far
	2. Also, what is the max delay difference among TRPs allowed for CJT? X times larger than CP?
3. CJT TRPs with small delay difference should be the baseline, which may not need Alt3
	1. Only TRPs with DL Rx timing within CP is considered in R16/17 mTRP. So there should be plenty deployment scenarios without the need of Alt3
4. For CJT TRPs with large delay difference, there can be simple alternative to Alt3
	1. For example, if both Doppler and delay need to be compensated, NW can indicate a single TCI, whose Doppler/Delay properties are used for both TRPs after compensation
5. Finally, we think LLS is the rigorous tool to model the channel estimation
	1. Thanks for the SLS results, but we are unclear how SLS can model the channel estimation
 |
| QC2 | Updated our view: We do not support both Proposal 5.2 and Proposal 5.2.A. In our view, Alt1 should be the baseline, and we can live with Alt1 + Alt2, but not Alt3. First, one critical issue for CJT PDSCH is how the phase coherence among mTRPs can be maintained. This issue is not well studied, and we think neither Alt2 nor Alt3 can effectively ensure phase coherence. Second, CSF may need to consider jointly if Alt3 is used, e.g. CSI-RSs from different TRPs for CSF may also need to be delay pre-compensated with similar rule. Third, if both Doppler and Delay pre-compensation are beneficial, 1 TCI should be enough, since UE only looks at the info from 1st TCI. Without those unclear issues/benefits/alternatives, we prefer Alt1 or at most Alt1+Alt2 for R18. Open to more solid study in R19 |
|  |  |
|  |  |

# Issue 6 – Beam failure recovery

Table 6-1 Summary for Issue 6

|  |  |  |
| --- | --- | --- |
| **#** | **Issue** | **Companies’ view and Recommended Proposal** |
| 6.1 | Implicit BFD-RS determination for S-DCI based MTRP | **Proposal 6.1:** On unified TCI framework extension for S-DCI based MTRP, if the UE is provided the first candidate beam RS list ($\overbar{q}\_{1,0}$) and the second candidate beam RS set ($\overbar{q}\_{1,1}$) but not explicitly provided the first BFD-RS set ($\overbar{q}\_{0,0}$) and the second BFD-RS set ($\overbar{q}\_{0,1}$) for TRP-specific BFR and if both first and second indicated joint/DL TCI states are configured by RRC to be applied to CORESETs for PDCCH reception except PDCCH-SFN, the UE determines the BFD-RS for the first and second BFD-RS sets from the first and second indicated joint/DL TCI states, respectively.* FFS: The case if any CORESET is configured to apply both first and second indicated joint/DL TCI states for PDCCH-SFN
* FFS: Whether and how to handle the case if one or both of the first and second indicated joint/DL TCI states is/are NOT configured by RRC to be applied to CORESET(s) for PDCCH reception

Support/fine: OPPO, QC, Xiaomi, Samsung, ZTE, LG, Apple, Futurewei, Spreadtrum, MTK, Huawei/HiSilicon, CATT, vivo, Docomo, Ericsson, Intel, FGI, Lenovo, TCLConcern: Google**FL note: Note that since this is not an essential issue in this AI, it is unlikely to treat it in the GTW discussion. I hope we can converge through the offline discussion.** |
| 6.2 | Enhancement to beam update after NW response to TRP-specific BFR request | **Agreement**On unified TCI framework extension for M-DCI based MTRP, after NW response to TRP-specific BFR request to a BFD-RS set associated with a coresetPoolIndex value, QCL assumption/spatial Tx filter/PL-RS for channel(s)/signal(s) that applies the indicated joint/DL /UL TCI state specific to the coresetPoolIndex value are updated according to the new beam (qnew) corresponding to the BFD-RS set.**Question 1: Do we need similar enhancement for S-DCI based MTRP?*** **Yes: Docomo, ZTE, Intel, FGI, Xiaomi, vivo**
* **No:**
 |
| 6.3 | Enhancement to beam reporting for STxMP | **FL note: After discussed with FL of STxMP, we prefer to handle this issue in the AI 9.1.4.1. For the discussion on this issue, please refer to AI 9.1.4.1.** |

Table 6-2 Company input for Issue 6

|  |  |
| --- | --- |
| **Company** | **Input to Round 2 summary** |
| Mod V00 | * If company change your mind for Proposal 6.1, please let me know.
* Please provide your answer and view to Question 1 in Issue 6.2
 |
| Xiaomi | For issue 6.2, yes.  |
| vivo | **Issue 6.2:** Q1: yes. |
| Docomo | **Issue 6.2:** Q1: yes. After mTRP BFR, UE should update two indicated TCIs to q\_new corresponding to the BFD-RS set. |
| Nokia | Issue 6.2: Yes. |
| ZTE | Issue 6.2: Yes.  |
| Intel | Issue 6.2: Yes |
| QC | Issue 6.2 Q1: Yes |
|  |  |

# Other issue

If there is any important issue not captured in the discussion of previous meetings, company can input to Table 7-1.

Table 7-1 Company inputs for other issue

|  |  |
| --- | --- |
| **Company** | **Input** |
| ZTE | As agreed in RAN1#112, the maximum Tx power when the UE determines UL Tx power for the PUSCH/PUCCH transmission occasion(s) or antenna port(s) is to be discussed after receiving RAN4 reply on UE power limitation. Since RAN4 has provided their answers in R4-2303494, we prefer to prioritize the discussion about the following UL PC related issues for STxMP.

|  |
| --- |
| **Agreement:**On unified TCI framework extension, if an indicated joint/UL TCI state(s) applies to a PUSCH/PUCCH/SRS transmission occasion(s) or antenna port(s), the UE shall determine UL Tx power for the PUSCH/PUCCH/SRS transmission occasion(s) or antenna port(s) based on the UL PC parameter setting for PUSCH/PUCCH/SRS, if any, and the PL-RS included in the indicated joint/UL TCI state* FFS: For STxMP, the maximum Tx power when the UE determines UL Tx power for the PUSCH/PUCCH transmission occasion(s) or antenna port(s) (discussed after receiving RAN4 reply on UE power limitation for STxMP in FR2)
* FFS: Default UL PC parameter setting(s) if one or both of indicated joint/UL TCI states applied to PUSCH/PUCCH/SRS transmission occasion(s) or antenna port(s) does/do not include the UL PC parameter setting(s) for PUCCH/PUSCH/SRS
 |

Additionally, according to RAN4 reply, both the per-panel power limitation and per-UE power limitation are feasible and shall be applied to a same UE. With both assumptions being applied, we need to further consider the cases of exceeding the power limitation for STxMP UL transmission, such as the sum of calculated transmission power for both two panels exceeds the per-UE power limitation, or the calculated transmission power of at least one panel exceeds the per-panel power limitation. Therefore, we suggest to add the following sub-bullet for further study.* FFS: power scaling/allocating mechanism in case of exceeding the power limitation for STxMP UL transmission
 |
| Huawei, HiSilicon | CC group-based TCI indication is a key issue of unified TCI framework since R17. This has been discussed in previous meetings without much progress. No matter mixed or separate CC grouping is supported in Rel-18 or not, CC group-based TCI indication should be discussed and supported in mTRP-based uTCI framework in Rel-18. Since there are only three remaining meetings, we suggest to prioritize it in this meeting.  |
| Docomo | Although, it is captured in the following agreement to study, we’d like to emphasize BFR is important in FR2 operation. After NW response of TRP specific BFR request, joint/DL/UL TCI state(s) and TPC assumptions should be updated for both Single-DCI based and Multi-DCI based M-TRP. If not, after BFR completion, UE cannot receive PDCCH with new beam, and it gNB cannot update indicated TCI state by MAC CE/DCI.**Agreement**On unified TCI framework extension, study the following enhancements for TRP-specific BFR:* Implicit BFD-RS determination based on the indicated joint/DL TCI states for S-DCI based MTRP
* Enhancement to beam update after NW response to TRP-specific BFR request
 |
| FGI | Agree with HW that the discussion for CC group-based TCI indication has been pending for few meetings, so we could prioritize the discussion this meeting. |
| Intel | We need to have some agreements in place for switching between sDCI mTRP schemes since now, we use the new DCI indicator field for TCI state update. The legacy method of using the #TCI states and the #DMRS CDM groups will not work depending on how sTRP switching is handled. Good to prioritize and conclude on this issue along with Proposal 2.1[Mod] To my understanding to current agreements, the new DCI indicator field is used for TCI selection instead of TCI state update, and the new DCI indicator field can enable the dynamic switching between sTRP and mTRP.We are also open to discuss BFR issue highlighted by Docomo. |
| Samsung | TCI signaling enhancements for SDCI MTRP are needed. As we may end up of having fullset and numerous subset TCI states combinations, we see the need of increasing the maximum number of MAC CE activated TCI codepoint. Otherwise, the beam indication flexibility would be highly restricted. Then, method to support indicating more TCI codepoints in DCI without increasing the TCI field size and DCI payload can be specified. |

# Appendix: Agreements/conclusions before/in RAN1#112b-e

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| --- |
| **RAN1#112b-e** |
| Hope we will have 10+ agreements here |
| **RAN1#112** |
| **Agreement**On unified TCI framework extension for S-DCI based MTRP, a 2-bit [TCI selection field] can be configured by RRC to be present in a DCI format 1\_1/1\_2 that schedules/activates PDSCH reception (including dynamic PDSCH and SPS PDSCH) according to the followings:* If the DCI format 1\_1/1\_2 indicates codepoint "00" for the [TCI selection field], the UE shall apply the first one of two indicated joint/DL TCI states to all PDSCH DMRS port(s) of corresponding PDSCH transmission occasions(s) scheduled/activated by the DCI format 1\_1/1\_2
* If the DCI format 1\_1/1\_2 indicates codepoint "01" for the [TCI selection field], the UE shall apply the second one of two indicated joint/DL TCI states to all PDSCH DMRS port(s) of corresponding PDSCH transmission occasions(s) scheduled/activated by the DCI format 1\_1/1\_2
* If the DCI format 1\_1/1\_2 indicates codepoint "10" for the [TCI selection field], the UE shall apply both indicated joint/DL TCI states to the PDSCH reception scheduled/activated by the DCI format 1\_1/1\_2
* FFS: Whether and how to use the codepoint "11" of the [TCI selection field]

If the UE is in FR1, or the UE supports the capability of two default beams for S-DCI based MTRP in FR2 regardless of threshold, above apply to PDSCH reception(s) scheduled/activated by the DCI format 1\_1/1\_2. * Note: If the UE supports the capability of two default beams for S-DCI based MTRP in FR2, UE uses both indicated joint/DL TCI states to buffer the received signal before a threshold.

If the UE doesn’t support the capability of two default beams for S-DCI based MTRP in FR2, above apply to the scheduled/activated PDSCH reception when the offset between the reception of the scheduling DCI format 1\_1/1\_2 and the scheduled/activated PDSCH reception is equal to or larger than a threshold* FFS: How to apply the indicated joint/DL TCI state(s) to the scheduled/activated PDSCH reception if the offset between the reception of the scheduling DCI format 1\_1/1\_2 and the scheduled/activated PDSCH reception is less than a threshold in FR2

FFS: Detail of the capability of two default beams for S-DCI based MTRP FFS: The threshold value**Agreement**On unified TCI framework extension for S-DCI based MTRP, when two SRS resource sets for CB/NCB are configured, support the followings for PUSCH transmission scheduled/activated by a DCI format 0\_1/0\_2 (including DG and Type2 CG):* If the DCI format 0\_1/0\_2 indicates codepoint "00" for the existing SRS resource set indicator, the UE shall apply the first indicated joint/UL TCI state to all PUSCH antenna port(s) of corresponding PUSCH transmission occasions(s)
* If the DCI format 0\_1/0\_2 indicates codepoint "01" for the existing SRS resource set indicator, the UE shall apply the second indicated joint/UL TCI state to all PUSCH antenna port(s) of corresponding PUSCH transmission occasions(s)
* If the DCI format 0\_1/0\_2 indicates codepoint "10" or “11” for the existing SRS resource set indicator:
	+ For TDM based PUSCH Tx scheme, the UE shall apply the first indicated joint/UL TCI state to the PUSCH transmission occasions(s) associated with the first SRS resource set for CB/NCB, and the second indicated joint/UL TCI state to the PUSCH transmission occasions(s) associated with the second SRS resource set for CB/NCB (note: the association between an SRS resource set for CB/NCB and PUSCH transmission occasions(s) is defined according to TS 38.214)
	+ FFS: SDM and SFN based PUSCH Tx schemes

FFS: The case that the spatial Tx filter(s) determined from the indicated joint/UL TCI state(s) applied to a PUSCH transmission is different from the spatial Tx filter(s) used for the SRS transmission corresponding to the SRS resource(s) indicated to the PUSCH transmission**Agreement**On unified TCI framework extension, if an indicated joint/UL TCI state(s) applies to a PUSCH/PUCCH/SRS transmission occasion(s) or antenna port(s), the UE shall determine UL Tx power for the PUSCH/PUCCH/SRS transmission occasion(s) or antenna port(s) based on the UL PC parameter setting for PUSCH/PUCCH/SRS, if any, and the PL-RS included in the indicated joint/UL TCI state* FFS: For STxMP, the maximum Tx power when the UE determines UL Tx power for the PUSCH/PUCCH transmission occasion(s) or antenna port(s) (discussed after receiving RAN4 reply on UE power limitation for STxMP in FR2)
* FFS: Default UL PC parameter setting(s) if one or both of indicated joint/UL TCI states applied to PUSCH/PUCCH/SRS transmission occasion(s) or antenna port(s) does/do not include the UL PC parameter setting(s) for PUCCH/PUSCH/SRS

**Agreement**On unified TCI framework extension for M-DCI based MTRP, down-select from the following options for PUCCH transmission:* Opt1: A *coresetPoolIndex* value can be provided per PUCCH resource/resource group, and the UE shall apply the indicated joint/UL TCI state specific to the *coresetPoolIndex* value to the corresponding PUCCH transmission
* Opt2: An RRC configuration can be provided per PUCCH resource/resource group to inform that the UE shall apply the first or the second indicated joint/UL TCI state to the corresponding PUCCH transmission, where the first and the second indicated joint/DL TCI states correspond to the indicated joint/UL TCI states specific to *coresetPoolIndex* value 0 and value 1, respectively.
* Opt3: For a PUCCH transmission triggered by PDCCH on a CORESET when the UCI in the PUCCH transmission carries HARQ-ACK information only, the UE shall apply the indicated joint/UL TCI state specific to a *coresetPoolIndex* value to the PUCCH transmission, where the *coresetPoolIndex* value is determined from the one associated with the CORESET. Otherwise, either Opt1 or Opt2 is adopted.
	+ FFS: Whether Opt3 applies only when the UE is not provided with *ackNackFeedbackMode* = *joint*
* Opt4: For a PUCCH transmission with an LRR trigged for either the first BFD-RS set ($\overbar{q}\_{0,0}$) or the second BFD-RS set ($\overbar{q}\_{0,1}$) when the UE is provided only one or two *schedulingRequestID-BFR* configuration, the UE shall apply the indicated joint/UL TCI state specific to a *coresetPoolIndex* value to the PUCCH transmission, where the *coresetPoolIndex* value is 1 when the LRR is trigged for the first BFD-RS set ($\overbar{q}\_{0,0}$) and the *coresetPoolIndex* value is 0 when the LRR is trigged for the second BFD-RS set ($\overbar{q}\_{0,1}$). Otherwise, either Opt1 or Opt2 is adopted.

Note: Either Opt1 or Opt2 must be supported**Agreement**On unified TCI framework extension for S-DCI based MTRP, down-select at least one of the followings for PDSCH reception scheduled/activated by DCI format 1\_1/1\_2 configured w/o the [TCI selection field]:* Alt1: Using RRC configuration to inform that the UE shall apply the first one, the second one, or both of two indicated joint/DL TCI states to the scheduled/activated PDSCH reception
* Alt2: The UE shall apply the first one of two indicated joint/DL TCI state(s) to the scheduled/activated PDSCH reception
* Alt3: The UE shall apply both of two indicated joint/DL TCI states to the scheduled/activated PDSCH reception
* Alt3A: The UE shall apply the same joint/DL TCI state(s) that is applied to the PDCCH reception with the scheduling/activation DCI to the scheduled/activated PDSCH reception
* Alt4: Which indicated joint/DL TCI state(s) is/are applied to the scheduled/activated PDSCH reception is determined according to the existing TCI field of the most recently applied beam indication DCI

Above applies at least if the offset between the reception of the scheduling DCI format 1\_1/1\_2 and the scheduled/activated PDSCH reception is equal to or larger than a threshold (if the threshold is needed) |
| **RAN1#111** |
| **Agreement**On unified TCI framework extension for S-DCI based MTRP, in one beam indication instance, the existing TCI field in DCI format 1\_1/1\_2 (with or without DL assignment) can indicate joint/DL/UL TCI state(s) for one or both of the two TRPs in a CC/BWP or a set of CCs/BWPs in a CC list* FFS: Increase on the size of the TCI field
* Note: The term TRP is used only for discussion purpose in RAN1 and whether/how to capture this is FFS

**Agreement**On unified TCI framework extension for S-DCI based MTRP, a DCI field in DCI format 1\_1/1\_2 that schedules/activates PDSCH reception is used to determine which one or both of the indicated joint/DL TCI states shall be applied to the scheduled/activated PDSCH reception* The presence of the DCI field is configurable by RRC; when the DCI field is not present in DCI format 1\_1/1\_2, the UE shall apply the default indicated joint/DL TCI state(s) to PDSCH reception
	+ FFS: Details on the default indicated joint/DL TCI state(s) to PDSCH reception
* FFS: The DCI field is a new indicator field or an existing field (e.g., the existing TCI field)
* FFS: Regardless the DCI field is present or not present, how to apply the indicated joint/DL TCI state(s) to PDSCH reception if the offset between the reception of the DCI format 1\_1/1\_2 and the corresponding PDSCH reception is less than a threshold

FFS: How to apply the indicated joint/DL TCI state(s) to PDSCH reception scheduled/activated by DCI format 1\_0.Above applies for the case where PDSCHs scheduled by the same DCI.**Agreement** On unified TCI framework extension for S-DCI based MTRP, use RRC configuration to inform that the UE shall apply the first one, the second one, or both of the indicated joint/UL TCI states to a PUCCH resource/group* Note: Detail of the RRC configuration is left to RAN2 design

**Agreement**On unified TCI framework extension, PDSCH-CJT is supported as a S-DCI based MTRP schemeNote: Above does not preclude discussions specific to PDSCH-CJT design in the unified TCI framework**Agreement**On unified TCI framework extension for S-DCI based MTRP, use an indicator field (could be reusing an existing DCI field or introducing a new DCI field) in the DCI format 0\_1/0\_2 to inform which joint/UL TCI state(s) indicated by MAC-CE/DCI the UE shall apply to PUSCH transmission scheduled/activated by the DCI format 0\_1/0\_2**Agreement**On unified TCI framework extension, down-select at least one of the following alternatives for PDSCH-CJT applying both indicated joint TCI states (if the UE supports two indicated joint/DL states for PDSCH-CJT):* Alt1: PDSCH DMRS port(s) is QCLed with the DL RSs of both indicated joint TCI states with respect to QCL-TypeA
* Alt2: PDSCH DMRS port(s) is QCLed with the DL RSs of both indicated joint TCI states with respect to QCL-TypeA except for QCL parameters {Doppler shift, Doppler spread} of the second indicated joint TCI state
* Alt3: PDSCH DMRS port(s) is QCLed with the DL RS of the first indicated joint TCI state with respect to QCL-TypeA and QCLed with the DL RS of the second indicated joint TCI state with respect to QCL-TypeB

**Agreement**On unified TCI framework extension for M-DCI based MTRP, the same configuration/rule used in Rel-17 unified TCI framework (for determining whether the UE shall apply the indicated joint/DL TCI state to PDCCH on a CORESET and respective PDSCH) is reused to determine whether the UE shall apply the indicated joint/DL TCI state specific to a *coresetPoolIndex* value to PDCCH on a CORESET associated with the same *coresetPoolIndex* value and PDSCH scheduled/activated by the PDCCH.**Agreement**On unified TCI framework extension for M-DCI based MTRP, the UE shall apply the indicated joint/UL TCI state specific to a *coresetPoolIndex* value to PUSCH transmission scheduled/activated by PDCCH (including DG-PUSCH and Type2 CG-PUSCH) on a CORESET that is associated with the same *coresetPoolIndex* value**Agreement**On unified TCI framework extension for S-DCI based MTRP, a new indicator field is supported as the DCI field in DCI format 1\_1/1\_2 that schedules/activates PDSCH reception to determine which one or both of the indicated joint/DL TCI states shall be applied to the scheduled/activated PDSCH reception* FFS: Detail design of the new indicator field
 |
| **RAN1#110b-e** |
| **Conclusion** On unified TCI framework extension in Rel-18, there is no consensus to support simultaneous configuration of both joint and separate DL/UL TCI modes in a serving cell**Conclusion**On unified TCI framework extension in Rel-18, there is no consensus to support separate RRC-configured TCI state list(s) for each of TRPs**Agreement**On unified TCI framework extension for M-DCI based MTRP:* The existing TCI field in a DCI format 1\_1/1\_2 (with or without DL assignment) associated with one *coresetPoolIndex* value can indicate the joint/DL/UL TCI state(s) specific to the same *coresetPoolIndex* value
	+ FFS: The UE shall apply the indicated joint/DL/UL TCI state(s) specific to a *coresetPoolIndex* value to channel(s)/signal(s) that have explicit or implicit association with the same *coresetPoolIndex* value
* A *coresetPoolIndex* value field is included in TCI state activation command (MAC-CE) to indicate that the mapping between the activated TCI state(s) and the TCI codepoint(s) is specific to which *coresetPoolIndex* value

**Agreement**On unified TCI framework extension for S-DCI based MTRP, to inform the association with the joint/DL TCI state(s) indicated by DCI/MAC-CE for PDCCH repetition, PDCCH-SFN, and PDCCH w/o repetition/SFN, support the following:* Use RRC configuration to inform that the UE shall apply the first one, the second one, both, or none of the joint/DL TCI states indicated by DCI/MAC-CE to a CORESET or a group of CORESETs (if CORESET group configuration is supported)

**Agreement**On unified TCI framework extension for M-DCI based MTRP:* For a serving cell configured with joint DL/UL TCI mode, one joint TCI state can be mapped to a TCI codepoint of the existing TCI field in a DCI format 1\_1/1\_2 (with or without DL assignment)
* For a serving cell configured with separate DL/UL TCI mode, a DL TCI state, an UL TCI state, or a pair of DL and UL TCI states can be mapped to a TCI codepoint of the existing TCI field in a DCI format 1\_1/1\_2 (with or without DL assignment)

**Agreement**On unified TCI framework extension for S-DCI based MTRP, down-select one alternative from the followings in RAN1#111 for PUSCH transmission scheduled/activated by a DCI format 0\_1/0\_2:* Alt1: Use an indicator field (could be reusing an existing DCI field or introducing a new DCI field) in the DCI format 0\_1/0\_2 to inform which joint/UL TCI state(s) indicated by MAC-CE/DCI the UE shall apply to PUSCH transmission scheduled/activated by the DCI format 0\_1/0\_2
* Alt2: PUSCH transmission scheduled/activated by the DCI format 0\_1/0\_2 follows the spatial domain transmission filter(s) used for the SRS resource(s) indicated by the DCI format 0\_1/0\_2
	+ - FFS: PL-RS(s), and UL PC parameter setting(s) (including P0, alpha, and closed loop index) for the PUSCH

**Agreement**On unified TCI framework extension for S-DCI based MTRP, down-select one alternative from the followings in RAN1#111 for PUCCH transmission:* Alt1: Use RRC configuration to inform the association between the indicated joint/UL TCI state(s) and a PUCCH resource/ group
* Alt2: Use RRC configuration to inform the association between a CORESET group and a PUCCH resource/group, and the indicated joint/UL TCI state(s) associated with the CORESET group applies to the PUCCH resource/group associated with the same CORESET group
* Alt3: Use MAC-CE to inform the association between the indicated joint/UL TCI state(s) and a PUCCH resource/group
* Note: the association indicates whether the UE shall apply the first one, the second one, or both of the joint/UL TCI states indicated by DCI/MAC-CE to a PUCCH resource/group

**Agreement**On unified TCI framework extension, up to 2 joint TCI states can be indicated by MAC-CE/DCI and applied to CJT-based PDSCH reception (PDSCH-CJT) in a BWP/CC configured with joint DL/UL TCI mode* Support of 1 or 2 indicated joint TCI states for PDSCH-CJT is up to UE capability
* FFS: QCL type(s)/assumption(s) of the indicated joint TCI state(s) applied to PDSCH-CJT
* Note: On how to inform UE to apply which indicated joint TCI state(s) to target channel(s)/signal(s) in the BWP/CC, it is discussed individually in AI 9.1.1.1

**Agreement** On unified TCI framework extension for M-DCI based MTRP:* The UE shall apply the indicated joint/DL TCI state specific to a *coresetPoolIndex* value to PDCCH on a CORESET that is associated with the same *coresetPoolIndex* value
* The UE shall apply the indicated joint/DL TCI state specific to a *coresetPoolIndex* value to PDSCH scheduled/activated by PDCCH on a CORESET that is associated with the same *coresetPoolIndex* value
* FFS: Other channel(s)/signal(s) that has explicit or implicit association with a *coresetPoolIndex* value
* FFS: Other channel(s)/signal(s) that doesn’t have association with a *coresetPoolIndex* value

Above are applicable to the CORESET(s) that is configured/allowed to follow the indicated joint/DL TCI stateFFS: The configuration/rule to configure/allow CORESET(s) to follow the indicated joint/DL TCI state, including the option to reuse the same configuration/rule as in Rel-17 unified TCI framework**Agreement**On unified TCI framework extension, study the following enhancements for TRP-specific BFR:* Implicit BFD-RS determination based on the indicated joint/DL TCI states for S-DCI based MTRP
* Enhancement to beam update after NW response to TRP-specific BFR request

**Agreement**On unified TCI framework extension for S-DCI based MTRP, down-select one alternative from the followings in RAN1#111:* Alt1: In one beam indication instance, the existing TCI field in DCI format 1\_1/1\_2 (with or without DL assignment) can indicate joint/DL /UL TCI state(s) for one of the two TRPs or both TRPs in a CC/BWP or a set of CCs/BWPs in a CC list
* Alt2: In one beam indication instance, the existing TCI field in DCI format 1\_1/1\_2 (with or without DL assignment) can indicate joint/DL /UL TCI state(s) only specific to one of the two TRPs in a CC/BWP or a set of CCs/BWPs in a CC list
	+ Note: According to the agreement in RAN1#109-e, support of one additional TCI field or a field associating the TCI field to the TRP(s) is not precluded

Note: It has been agreed to use the existing TCI field for TCI state indication for S-DCI based MTRP in RAN1#109eNote: The term TRP is used only for discussion purpose in RAN1 and whether/how to capture this is FFSFFS: The behavior if the UE receives a beam indication DCI that indicates joint/DL/UL TCI state(s) for one TRP |
| **RAN1#110** |
| **Agreement**On unified TCI framework extension, for the target use cases agreed in RAN1#109-e in AI 9.1.1.1, up to 4 TCI states can be indicated in a CC/BWP or a set of CCs/BWPs in a CC list to DL receptions and/or UL transmissions, where these TCI states are indicated/updated by MAC-CE/DCI with the necessary MAC-CE based TCI state activation* FFS: The possible combination(s) of joint/DL/UL TCI states that can be indicated to DL receptions and/or UL transmissions in a BWP/CC/TRP
* Note: This agreement does not imply that there will be more than 2 DL or UL or joint TCI states indicated in a CC/BWP for the target use cases agreed in RAN1#109-e in AI 9.1.1.1
* Note: The maximum number of TCI states that can be indicated to each of the target use cases agreed in RAN1#109-e in AI 9.1.1.1 is remained the same as in Rel-16/17

Note: The maximum number of TCI states that can be indicated simultaneously to CJT-based PDSCH reception and the required type(s) of TCI states (i.e., DL /UL/joint) are independently discussed in this AI**Agreement**On unified TCI framework extension for S-DCI based MTRP, to inform the association with the joint/DL TCI state(s) indicated by DCI/MAC-CE for PDCCH repetition, PDCCH-SFN, and PDCCH w/o repetition/SFN, down-selection at least one alternative from the followings:* Alt1-1: Use RRC parameter(s) in a CORESET configuration to inform the UE whether and/or which indicated joint/DL TCI state(s) shall be applied to the corresponding PDCCH receptions on the CORESET
	+ FFS: Whether only the CORESET(s) that always/can share the unified TCI state as defined in Rel-17 unified TCI framework can be associated with the joint/DL TCI state(s) indicated by DCI/MAC-CE
* Alt1-2: Use an RRC parameter in a CORESET configuration to inform that the CORESET belongs to which CORESET group(s), and the indicated joint/DL TCI state(s) is associated with each CORESET group
	+ FFS: Whether only the CORESET(s) that always/can share the unified TCI state as defined in Rel-17 unified TCI framework can be associated with the CORESET group(s)
	+ FFS: How to associate the indicated joint/DL TCI state(s) with each CORESET group
	+ FFS: The UE applies the indicated joint/DL TCI state(s) to a CORESET according to the CORESET group(s) the CORESET belongs to, or the UE applies the indicated joint/DL TCI state(s) associated with the CORESET group(s) in which the beam indication DCI is received to all PDCCH receptions
* Alt2: The association between a CORESET and the indicated joint/DL TCI state(s) is determined based on a fixed rule, and the UE shall apply the indicated joint/DL TCI state(s) to the corresponding PDCCH receptions on the CORESET
	+ FFS: Whether only the CORESET(s) that always/can share the unified TCI state as defined in Rel-17 unified TCI framework can be associated with the joint/DL TCI state(s) indicated by DCI/MAC-CE
* Alt3: Use MAC-CE to inform the UE whether and/or which indicated joint/DL TCI state(s) shall be applied to the corresponding PDCCH receptions on a CORESET
	+ FFS: Whether only the CORESET(s) that always/can share the unified TCI state as defined in Rel-17 unified TCI framework can be associated with the joint/DL TCI state(s) indicated by DCI/MAC-CE

Switching between multi-TRP and single TRP operation is not precluded**Agreement**On unified TCI framework extension for S-DCI based MTRP, for PUSCH transmission scheduled/activated by a DCI format 0\_1/0\_2, down-selection one alternative from the followings:* Alt1: Use an indicator field (could be reusing an existing DCI field or introducing a new DCI field) in a DCI format 0\_1/0\_2 to inform which joint/UL TCI state(s) indicated by MAC-CE/DCI the UE shall apply to PUSCH transmission scheduled/activated by the DCI format 0\_1/0\_2
* Alt2: PUSCH transmission scheduled/activated by a DCI format 0\_1/0\_2 follows the spatial domain transmission filter(s) used for the SRS resource(s) indicated by the DCI format 0\_1/0\_2
* Alt3: Use an RRC parameter in a CORESET configuration to inform that the CORESET belongs to which CORESET group(s), and the indicated joint/UL TCI state(s) is associated with each CORESET group. When a scheduling/activation DCI format 0\_1/0\_2 is received in a CORESET group, the indicated joint/UL TCI state(s) associated with the CORESET group is applied to PUSCH transmission scheduled/activated by the DCI format 0\_1/0\_2
	+ FFS: Details of CORESET group(s)

FFS: PUSCH transmission scheduled/activated by a DCI format 0\_0 and Type-1 CG-PUSCH**Agreement**On unified TCI framework extension for S-DCI based MTRP, to inform the association with joint/UL TCI state(s) indicated by DCI/MAC-CE for PUCCH transmission, down-selection at least one alternative from the followings:* Alt1: Use RRC configuration to inform the association between the indicated joint/UL TCI state(s) and a PUCCH resource/ group
* Alt2: Use RRC configuration to inform the association between a CORESET group and a PUCCH resource/group, and the indicated joint/UL TCI state(s) associated with the CORESET group applies to the PUCCH resource/group
* Alt3: Use MAC-CE to inform the association between the indicated joint/UL TCI state(s) and a PUCCH resource/group
* Alt4: Use DCI to inform the association between the indicated joint/UL TCI state(s) and a PUCCH resource/group
 |
| **RAN1#109e** |
| **Agreement**On unified TCI framework extension, consider all the intra and inter-cell MTRP schemes specified in Rel-16 and Rel-17* Consider, if STxMP is supported, Rel-18 MTRP scheme(s) with STxMP

**Agreement**On unified TCI framework extension at least for single-DCI based MTRP, the existing TCI field in DCI format 1\_1/1\_2 (with or without DL assignment) can indicate multiple joint/DL/UL TCI states in a CC/BWP or a set of CCs/BWPs in a CC list* FFS: Detail of mapping joint/DL/UL TCI state ID(s) to a TCI codepoint, e.g., possible combinations of joint, DL, and/or UL TCI state IDs that can be mapped to a TCI codepoint
* FFS: Whether to increase the max number of MAC CE activated TCI codepoints, i.e., more than 8 codepoints
* FFS: Whether to increase the max number of TCI field bits, i.e., more than 3 bits
* Note: This doesn't imply that support of one additional TCI field or a field associating the TCI field to the TRP(s) is precluded

Note: The term TRP is used only for the purposes of discussions in RAN1 and whether/how to capture this is FFS**Agreement**On unified TCI framework extension for M-DCI based MTRP, consider the following alternatives for TCI state update:* Alt1: Reuse the same TCI state update scheme for S-DCI based MTRP
* Atl2: Use the existing TCI field in the DCI format 1\_1/1\_2 (with or without DL assignment) associated with one of *CORESETPoolIndex* values to indicate the joint/DL/UL TCI state(s) corresponding to the same *CORESETPoolIndex* value
* Alt3: Use the existing TCI field in any DCI format 1\_1/1\_2 (with or without DL assignment) to indicate all joint/DL/UL TCI states corresponding to both *CORESETPoolIndex* values
	+ Study the association between the indicated joint/DL/UL TCI state(s) and a *CORESETPoolIndex* value
* Alt4: Use the existing TCI field in the DCI format 1\_1/1\_2 (with or without DL assignment) associated with one of *CORESETPoolIndex* values to indicate joint/DL/UL TCI state(s) corresponding to the same or different *CORESETPoolIndex* value.
	+ Study whether the indicated joint/DL/UL TCI state(s) applies to the channels/signals associated with the same *CORESETPoolIndex* value or different *CORESETPoolIndex* value is indicated by DCI

**Agreement**On unified TCI framework extension for S-DCI based MTRP, consider at least the following alternatives to map/associate a joint/DL TCI state to PDCCH reception(s)* Atl1: Use RRC configuration to inform the mapping/association between a configured or indicated joint/DL TCI state and a CORESET or a CORESET group
* Alt2: Use RRC configuration to inform the mapping/association between a configured or indicated joint/DL TCI state and a search space set
* Alt3: Use MAC-CE to inform the mapping/association between an activated or indicated joint/DL TCI state and a CORESET or a CORESET group
* Alt4: Use DCI to inform the mapping/association between an indicated joint/DL TCI state and a CORESET or a CORESET group
* Alt5: Based on a fixed mapping/association rule, e.g., the first indicated joint/DL TCI state always applies to PDCCH receptions

Consider above alternatives for PDCCH repetition, PDCCH-SFN, PDCCH w/o repetition/SFN, and potential support of dynamic switching between S-TRP and M-TRP for PDCCH. It is not precluded to adopt one single alternative or multiple alternatives to support these cases.**Agreement**On unified TCI framework extension, if an indicated joint or UL TCI state applies to a PUSCH/PUCCH transmission occasion at least for S-DCI based PUSCH/PUCCH repetition with TDM and the indicated joint or UL TCI state is associated with an UL PC parameter setting for PUSCH/PUCCH (including P0, alpha for PUSCH, and closed loop index) and a PL-RS, the UE should apply the UL PC parameter setting and the PL-RS for the PUSCH /PUCCH transmission occasion.* FFS: How to extend to other Rel-18 MTRP scheme(s) with STxMP, if supported
* FFS: UL PC enhancement for CB and non-CB SRS in above case

FFS: The applied UL PC parameter setting if one or both indicated joint or UL TCI state(s) is not associated with an UL PC parameter setting (including P0, alpha for PUSCH, and closed loop index) for PUCCH/PUSCH**Agreement**On UE power limitation for STxMP for FR2, send LS to RAN4 to check the followings:* Whether it is feasible to assume power limitation per panel for STxMP (Assumption 1)
* Whether it is feasible to assume a total power limitation per UE over all UE panels used for STxMP (Assumption 2)
* In either of Assumption1 or Assumption 2, whether the total power limitation per UE over all UE panels used for STxMP or the sum of per-panel power limitation for STxMP can be different from (greater than) the existing power limitation for a given power class?
* If both Assumption 1 and Assumption 2 are feasible, whether both assumptions can be applied to a same UE, and what is the relationship between the per-panel power limitation and total power limitation if both are applied (e.g., the sum of per-panel power limitation can be larger than the total power limitation per UE, or should be always the same)?

FFS: Detail of exact LS if agreedNote: Scenarios of above include at least single carrier scenario for FR2Note: Above power limitation includes both total radiated power and EIRPLS to RAN4 is endorsed in R1-2205639. |

# References

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | [R1-2303806](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2303806.zip) | Discussion on unified TCI framework extension for multi-TRP operation | Moderator (MediaTek Inc.) |
| 2 | R1-2302265 | Reply LS on UE power limitation for STxMP in FR2 | RAN4 (vivo) |
| 3 | [R1-2303778](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2303778.zip) | Discussion on unified TCI framework extension for multi-TRP | ITRI |
| 4 | [R1-2303805](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2303805.zip) | Discussion on unified TCI framework extension for M-TRP operation | Hyundai Motor Company |
| 5 | [R1-2303697](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2303697.zip) | Discussion on unified TCI framework extension for multi-TRP | NTT DOCOMO, INC. |
| 6 | [R1-2303359](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2303359.zip) | Unified TCI framework extension for multi-TRP | MediaTek Inc. |
| 7 | [R1-2303372](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2303372.zip) | Discussion on unified TCI framework extension for multi-TRP | Transsion Holdings |
| 8 | [R1-2303393](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2303393.zip) | Discussion on unified TCI framework extension for multi-TRP operation | TCL Communication Ltd. |
| 9 | [R1-2303405](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2303405.zip) | Discussion on unified TCI framework extension for multi-TRP | FGI |
| 10 | [R1-2303516](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2303516.zip) | Discussion on unified TCI framework extension for multi-TRP | Google |
| 11 | [R1-2303467](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2303467.zip) | Unified TCI framework extension for multi-TRP | Apple |
| 12 | [R1-2303665](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2303665.zip) | Discussion on unified TCI framework extension for multi-TRP | NEC |
| 13 | [R1-2303573](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2303573.zip) | Extension of unified TCI framework for mTRP | Qualcomm Incorporated |
| 14 | [R1-2303300](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2303300.zip) | Discussion on Unified TCI framework extension for multi-TRP | CEWiT |
| 15 | [R1-2303216](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2303216.zip) | Discussion on unified TCI framework extension for multi-TRP | CMCC |
| 16 | [R1-2303178](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2303178.zip) | Unified TCI framework extension for multi-TRP | Sharp |
| 17 | [R1-2303110](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2303110.zip) | Views on unified TCI extension focusing on m-TRP | Samsung |
| 18 | [R1-2303068](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2303068.zip) | Unified TCI framework extension for multi-TRP/panel | LG Electronics |
| 19 | [R1-2303005](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2303005.zip) | Unified TCI framework extension for multi-TRP | Nokia, Nokia Shanghai Bell |
| 20 | [R1-2302959](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2302959.zip) | Unified TCI framework extension for multi-TRP | xiaomi |
| 21 | [R1-2302780](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2302780.zip) | Unified TCI Framework for Multi-TRP | Intel Corporation |
| 22 | [R1-2302900](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2302900.zip) | Discussion on unified TCI framework extension for multi-TRP | Fujitsu |
| 23 | [R1-2302585](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2302585.zip) | Discussion on unified TCI framework extension for multi-TRP | Spreadtrum |
| 24 | [R1-2302635](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2302635.zip) | Multi-TRP enhancements for the unified TCI framework | Fraunhofer IIS |
| 25 | [R1-2302723](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2302723.zip) | Discussion of unified TCI framework for multi-TRP | Lenovo |
| 26 | [R1-2302680](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2302680.zip) | Further discussion on unified TCI framework extension for multi-TRP operation | CATT |
| 27 | [R1-2302311](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2302311.zip) | Unified TCI framework extension for multi-TRP | FUTUREWEI |
| 28 | [R1-2302299](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2302299.zip) | Unified TCI Enhancements for MTRP | InterDigital, Inc. |
| 29 | [R1-2302370](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2302370.zip) | Discussion on unified TCI framework extension for multi-TRP | Huawei, HiSilicon |
| 30 | [R1-2302396](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2302396.zip) | Unified TCI framework extension for multi-TRP | Panasonic |
| 31 | [R1-2302416](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2302416.zip) | Enhancements on unified TCI framework extension for multi-TRP | ZTE |
| 32 | [R1-2302411](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2302411.zip) | Unified TCI framework extension for multi-TRP | Ericsson |
| 33 | [R1-2302532](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2302532.zip) | Unified TCI framework extension for multi-TRP | OPPO |
| 34 | [R1-2302469](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_112b-e/Docs/R1-2302469.zip) | Further discussion on unified TCI framework extension for multi-TRP | vivo |