**3GPP TSG RAN WG1 #110bis-e R1-2210380**

**e-Meeting, October 10th – 19th, 2022**

**Agenda item:** 9.1.1.1

**Source:** Moderator (MediaTek)

**Title:** Moderator summary on extension of unified TCI framework (Round 1)

**Document for:** Discussion and Decision

# Introduction

In RAN#94e, the Rel-18 WID of MIMO evolution for downlink and uplink is approved [1]. 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 [2]-[33], 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 framework for unified TCI extension
	+ Issue 2 – TCI state update and activation
	+ Issue 3 – How to associate the indicated TCI state(s) with each target channel/signal
	+ Issue 4 – UL power control for UL MTRP
	+ Issue 5 – Beam reporting and beam failure recovery
* Observations and recommended proposals based on the summary of companies’ views

This FL summary (Round 1) is prepared for our 2nd GTW discussion (Thursday 10/13 @12:00 UTC) and the 1st check point for email endorsement (Friday 10/14). Please upload your inputs to the corresponding draft folder, if any, **by Thursday 10/13 @10:00 UTC.**

# Contact Person

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

Table 0 Contact Information

|  |  |  |
| --- | --- | --- |
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# Discussion

# Issue 1 – General framework for unified TCI extension

Table 1-1 Summary for Issue 1

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| --- | --- | --- |
| **#** | **Issue** | **Companies’ views** |
| 1.3 | RRC-configured TCI state lists | Alt1: Reuse Rel-17 design (i.e., one list for joint/DL TCI states and another list for UL TCI states)* Support: Apple (S-DCI), Ericsson, CATT (S-DCI), Fujitsu, Panasonic, MediaTek, Qualcomm, OPPO, Huawei/HiSilicon, IDC, Futurewei, LG, vivo, TransHold, Nokia, Intel, CMCC, Samsung, Xiaomi

Alt2: Introduce TRP-specific TCI state list(s)* Support: Apple (M-DCI), CATT (M-DCI), ZTE, Spreadtrum, TCL, Google, Docomo (M-DCI), NEC
 |

**Proposal 1.A**: On unified TCI framework extension, support simultaneous configuration of both joint and separate DL/UL TCI modes in a serving cell

* FFS: Signaling for the configuration

**Support/fine: QC, vivo, Xiaomi, Panasonic, Apple**

**Not support: ZTE, OPPO, Google, Spreadtrum**

**Conclusion 1.A:** 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

**Support/fine: vivo, ZTE, OPPO, MTK, Google, Spreadtrum**

**Not support:**

**Proposal 1.B**: On unified TCI framework extension, up to 4 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

* FFS: QCL type(s)/assumption(s) of the indicated joint TCI state(s) applied to PDSCH-CJT
* Note: As in Rel-17, the indicated joint TCI state(s) can be applied to UL transmission only when applicable
* Note: On how to associate the indicated joint TCI state(s) with target channel(s)/signal(s) in the BWP/CC, it is discussed individually in AI 9.1.1.1

**Support/fine: vivo, ZTE(4/2), MTK, Futurewei**

**Not support: QC, OPPO, Xiaomi(2), Apple**

**Proposal 1.B.1**: 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 2 indicated joint TCI states for PDSCH-CJT is a UE optional feature, which can be reported by a UE when the UE is configured with R18 CJT CSI report
* FFS: QCL type(s)/assumption(s) of the indicated joint TCI state(s) applied to PDSCH-CJT
* Note: As in Rel-17, the indicated joint TCI state(s) can be applied to UL transmission only when applicable
* Note: On how to associate the indicated joint TCI state(s) with target channel(s)/signal(s) in the BWP/CC, it is discussed individually in AI 9.1.1.1

**Support/fine: ZTE, QC, Apple,**

**Not support:**

**Conclusion 1.C:** 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

**Support/fine: QC, vivo, Xiaomi, ZTE, OPPO, MTK, Google, Futurewei**

**Not support:**

Table 1-2 Company inputs for Issue 1

|  |  |
| --- | --- |
| **Company** | **Input** |
| Mod | * **Please share your view on Proposal 1.A and Conclusion 1.A. Note that we will not have any GTW discussion for this issue, and we need to conclude in this meeting, as mentioned by Mr. Chairman. If companies still have concern on Proposal 1.A, Conclusion 1.A will be the outcome in the end of this meeting.**
* **Please share your view on Proposal 1.B. Regarding the concern on the UE-compensation of Doppler shift or other QCL parameters, from FL’s perspective, it can be addressed when further define the QCL type(s)/assumption(s) of the indicated joint TCI state(s) applied to PDSCH-CJT (e.g., Doppler shift can be removed from the QCL assumption).**
* **For the concern on joint TCI state in Proposal 1.B, there is no reason to configure separate DL/UL TCI mode in FR1 (which is Rel-18 CJT targets to), thus we can focus on joint DL/UL TCI mode, where TCI states can be indicated to both DL Rx and UL Tx. However, joint TCI state can be applied to UL Tx only when applicable, which is already defined in Rel-17 spec. A note is added for clarification.**
* **For Proposal 1.B, regarding how to associate the indicated joint TCI states with channels/signals other than PDSCH, this can be discussed as a part of Issue 3 in this AI (including PDSCH). A note is added for clarification.**
* **Given the majority view on Issue 1.3, Conclusion 1.C is recommended for this issue**
 |
| QC | For Proposal 1.A, support. We believe per-TRP MPE issue can happen frequently, i.e. a single TRP may be locked by human most of time, not bothFor Proposal 1.B, not support. How the 4 TCIs are used is unclear. Without any solid study on the performance, we prefer only 1 TCI for R18 CJT, i.e. TRPs should be at similar locations.**Proposal 1.B**: On unified TCI framework extension for S-DCI based MTRP, * up to 2 joint TCI states can be indicated by MAC-CE/DCI in a CC configured with joint DL/UL TCI mode if UE is not configured with CSI report for R18 mTRP CJT
* up to 1 joint TCI state can be indicated by MAC-CE/DCI in a CC configured with joint DL/UL TCI mode if UE is configured with CSI report for R18 mTRP CJT

To HW, agree that R17 SFN also has similar issue, which can be mitigated by delay/frequency diversity to our understanding. However, those diversity methods may not be applicable to CJT especially when multiple streams are precoded and the selling point of CJT is the phase combining gain. The PDSCH CJT performance is never carefully evaluated so far, and we do believe it shall not be pushed too aggressively in R18. Fine to consider 4 TCI in R19 after more careful evaluation. For Conclusion 1.C, fine for it. |
| vivo | **Proposal 1.A** or **Conclusion 1.A,** we are fine to go with either one. Perhaps a compromise could be to support simultaneous configuration of both joint and separate DL/UL TCI modes for M-DCI based MTRP in a serving cell.**Proposal 1.B**: we are generally fine. With regards to companies’ concern, we can make it a working assumption for companies to provide more evaluation results. From the system point of view, if only one TCI state is indicated, probably UE-specific TRS would cause large amount of TRS overhead because different UEs may be served by different TRPs and CJT is targeting more UEs to be served simultaneously.**Conclusion 1.C**: support. |
| Xiaomi | **Proposal 1.A and Conclusion 1.A**We prefer proposal 1.A, and suggest to update ‘configuration’ into ‘indication’. Since we are not intended to propose separate TCI state list for M-TRP. We intend to propose indication of joint TCI state for one TRP and separate DL/UL TCI state for the other TRP by MAC CE/DCI. As for TCI list configured by RRC, two TCI list will be needed. One list for joint/DL TCI state, and the other one list for UL TCI state. But dynamically change between joint TCI mode and separate DL/UL TCI mode can be realized by MAC CE or DCI. Some companies propose to use separate TCI state in both TRP in this case, but the MAC CE overhead will be higher. Thus the following updated proposal 1.A can support the per-TRP MPE with low MAC CE overhead for TCI state indication. **Proposal 1.A**: On unified TCI framework extension, support simultaneous ~~configuration~~ indication of both joint and separate DL/UL TCI modes in a serving cell* FFS: Signaling for the ~~configuration~~ indication

**[Mod] In this proposal, we are discussing about the TCI update modes that can be supported within one CC. How to provide TCI state list(s) if a CC is configured with joint and separate TCI update modes simultaneously can be further discussed. To my understanding, Rel-17 design should be sufficient, i.e., one list for joint or DL TCI sates and one list for UL TCI state.****Proposal 1.B**We slightly prefer to support up to 2 TCI states for all M-TRP schemes to reduce the spec impact. If up to 4 TCI states is supported for PDSCH-CJT, the association of TCI state for PDCCH/PUCCH/PUSCH should be further enhanced.**Conclusion 1.C**Support |
| ZTE | **Proposal 1.A and Conclusion 1.A**As mentioned during online, we have concerns on proposal 1.A. Technically speaking, the proponent’s companies’ views are much relevant to gNB configuration/indication flexibility and TRP-specific MPE. Then, to be honest, we can NOT be convinced according to the above reasons. * + Separate TCI state configuration can be assumed as a superset of joint TCI, which means that if having separate TCI state configuration, any target(s) of simultaneous joint and separate TCI indication can be achieved well.
	+ After that, MPE is much relevant to relative location between UE and phone. It is very confusing why, for long-term duration (due to RRC configuration), one TRP is good but another is bad in terms of MPE. If not, that means we can not save any RRC configuration signaling even if having this proposal 1.A.

Therefore, we suggest to go with Conclusion 1.A (simple and efficient, good for backward compatibility).**Proposal 1.B**For moving forward this issue (in Rel-18 rather than Rel-19 ^ ^), we have the following suggestions:* + #1 Instead of having 4 joint TCI states, just support up to 2 joint TCI state. That means that we do not need do much efforts from signaling perspective;
	+ #2 In technical, we share the same views with QC that some pre-compensation is needed, e.g., Doppler shift and average delay. But it is relevant to scenarios, and for motionless UE or intra-site case, some pre-compensation may not be needed. So, we may have the following subbullet
		- QCL type(s)/assumption(s) of the indicated joint TCI state(s) applied to PDSCH-CJT can be configurable (by explicit or implicit manner, e.g., SFT-Scheme-2)
		- Support >1 joint TCI for CJT is an optional UE feature.

**[Mod] I’m not sure 2 could be common ground. Let’s try anyway, please check Proposal 1.B.1.****Proposal 1.C**Definitely not our preference, but even if going like this way, we may make some modification for clarification.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 |
| OPPO | **Proposal 1.A:** not support.In our understanding, the target use case for the mixed mode is to address the MPE issue. When configuring UTCI states, NW cannot predict in advance which TRP will be involved with MPE and the other TRP will not. Simple solution for this unawareness is to configure separate UL/DL TCI states for both TRPs. Moreover, if the first sub-bullet is removed in updated Proposal 1.A, one TRP can be configured with both joint and separate TCI states. This is beyond the consensus of Rel.17 UTCI design for STRP. Conclusion pasted below for reference. And besides flexibility, we fail to see other strong motivation to change the UTCI framework even for STRP.**Conclusion**On Rel-17 unified TCI framework, for a UE configured with both joint TCI and separate DL/UL TCI, configuration of joint TCI or separate DL/UL TCI is based on RRC signaling* There is no consensus in RAN1 on how to support dynamic switching (either MAC-CE or codepoint based)

 **Conclusion 1.A:** okay.**Proposal 1.B**: not support.Thanks to FL for the explanation on using the joint TCI states in the proposal. In Proposal 2.B, it seems one codepoint of TCI field in DCI could contain a DL TCI state only. Anyway, that’s not quite essential. Regarding the main bullet, we used to think even single TCI state (containing one TRS) would serve the UE for all involved MTRP, therefore no need to increasing the maximum number to 4. When compared to up to 2 for all other MTRP schemes, it would complicate the signalling design and overhead. Moreover, by checking the discussion related to Doppler shift and/or average delay of PDSCH-CJT, we are not sure whether pre-compensation in freq./time domain should be enhanced (like compensation for PDSCH SFN Scheme B in frequency domain) in AI 9.1.1.1. It seems our purpose is just to extend UTCI framework for at least stable MTRP schemes. We are reluctant to introduce new MTRP scheme (e.g. PDSCH-CJT with specified time/freq. compensation analogous to PDSCH SFN Scheme B) here. If that’s the case, we still hold the thought that 1 TCI state would be workable, and up to 2 can be acceptable to be aligned with other MTRP schemes. **Conclusion 1.C:** okay. |
| Panasonic | We support **Proposal 1.A**. Moreover, **conclusion 1.A** should not include m-DCI. |
| MediaTek | **Proposal 1.A** or **Conclusion 1.A:** We are open to Proposal 1.A, however, if no consensus, we also prefer to go with Conclusion 1.A.**Proposal 1.B**: We still have concern on introduce a new MTRP scheme for CJT, which leads to larger specification effort (QCL assumptions, co-existence with other MTRP schemes, configuration, etc.). We can support up to 4 TRPs for CJT by extension of PDSCH-SFN.**Conclusion 1.A:** Okay. |
| Google | **Proposal 1.A** and **Conclusion 1.A**: We support Conclusion 1.A. We share the same concerns as ZTE. Even that TRP-specific MPE is a valid use case, how come network can predict that and configure the mixed configuration? In addition, as ZTE mentioned, separate TCI state mode is a superset of joint TCI state mode. Then, why we need to have mixed configuration? We also observe that proponents of Proposal 1.A seem to have different views on detailed design, where some prefer RRC, and others prefer dynamic signal. We suggest taking Conclusion 1.A to avoid complicating the whole design. **Conclusion 1.C**: We can live with it for progress.  |
| Panasonic | We are okay with Conclusion 1.A. But perhaps FL can see if companies can agree with proposal 1.A for multi-DCI, perhaps more lenient stance from opponents.  |
| Fraunhofer IIS/HHI | **Proposal 1.A and Conclusion 1.A:** We agree with ZTE’s observations on the use of just the separate TCI configuration instead of simultaneous configuration of joint and separate TCI. Support Conclusion 1.A.**Proposal 1.B:** OK**Conclusion 1.C:** support |
| QC | For proposal 1.B.1, for the sake of progress, we can accept up to 2 TCI with 1 TCI as UE capability. We don’t think we should spend time to optimize signaling for scheme with almost no careful evaluation. We also prefer to clarify the 1-TCI capability should be applied when CJT is enabled, e.g. when UE reports the mTRP CJT CSI. **Proposal 1.B.1**: 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* Applying more than one indicated joint TCI states to PDSCH-CJT is ~~an UE optional feature~~ UE capability, which is applied when UE is configured with R18 mTRP CJT CSI report

**[Mod] Captured** |
| Futurewei | **Proposal 1.A** and **Conclusion 1.A:** We are open to Proposal 1.A. We are also fine with Conclusion 1.A if there is no consensus to support Proposal 1.A.**Proposal 1.B:** Support. **Conclusion 1.C:** Support. |
| Mod | * **Please share your view on Proposal 1.A and Conclusion 1.A. Note that we will not have any GTW discussion for this issue, and we need to conclude in this meeting, as mentioned by Mr. Chairman. If companies still have concern on Proposal 1.A, Conclusion 1.A will be the outcome in the end of this meeting.**
* **Please share your view on Proposal 1.B. Regarding the concern on the UE-compensation of Doppler shift or other QCL parameters, from FL’s perspective, it can be addressed when further define the QCL type(s)/assumption(s) of the indicated joint TCI state(s) applied to PDSCH-CJT (e.g., Doppler shift can be removed from the QCL assumption).**
	+ **For the concern on joint TCI state in Proposal 1.B, there is no reason to configure separate DL/UL TCI mode in FR1 (which is Rel-18 CJT targets to), thus we can focus on joint DL/UL TCI mode, where TCI states can be indicated to both DL Rx and UL Tx. However, joint TCI state can be applied to UL Tx only when applicable, which is already defined in Rel-17 spec. A note is added for clarification.**
	+ **Regarding how to associate the indicated joint TCI states with channels/signals other than PDSCH, this can be discussed as a part of Issue 3 in this AI (including PDSCH). A note is added for clarification.**
* **Please share your view on Proposal 1.B.1, which could be a compromise.**
* **Given the majority view on Issue 1.3, Conclusion 1.C is recommended for this issue**
 |
| Spreadtrum | **Proposal 1.A and Conclusion 1.A:** Support to go with Conclusion 1.A**Conclusion 1.C**: fine for it |
| Apple  | **Proposal 1.B:** We can NOT agree on this proposal. One debatable motivation for 4 TCI-states is to reduce TRS overhead at the gNB. However, it should not come at the cost of significantly increased complexity at UE side. To support 4 TCI-state, compared to 1 TRS/TCI-state, UE needs to increase TRS sampling buffer four times for PDP estimation, which is very costly considering the wide BW of TRS. In addition, the processing complexity at the UE is another problem to select one estimated TO/FO from multiple TRS estimations. **Proposal 1.B.1:** Can address our concern on UE complexity. We can live with Proposal 1.B.1.  |

# Issue 2 – TCI state update and activation

Table 2-1 Summary for Issue 2

|  |  |  |
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| **#** | **Issue** | **Companies’ views** |
| 2.3 | For S-DCI based MTRP, whether to introduce/re-interpret DCI field(s) other than the existing TCI field for TCI state update | Alt1: Use only the existing TCI field for TCI state update* Support: Apple, CATT, CEWiT, Fraunhofer, Futurewei, Intel, Lenovo, Nokia, OPPO, Qualcomm, Sharp, Spreadtrum, vivo, InterDigital, Xiaomi

, * Concern: Huawei/HiSilicon

Alt2: Use the existing TCI field and one additional DCI field (could be reusing an existing DCI field or introducing a new DCI field) for TCI state update* Support: Huawei/HiSilicon, Ericsson, FGI, Google, Samsung
* Concern:
 |

**Proposal 2.A:** 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

**Support/fine: QC, vivo, Xiaomi, Sharp, ZTE, OPPO, Panasonic, MTK, Futurewei**

**Not support:**

**Conclusion 2.C:** On unified TCI framework extension Rel-18, there is no consensus to support a DCI field other than the existing TCI field (could be reusing an existing DCI field or introducing a new DCI field) for TCI state indication for S-DCI based MTRP

* Note: It has been agreed to use the existing TCI field for TCI state indication for S-DCI based MTRP in RAN1#109e
* Note: Whether to introduce a DCI field other than the existing TCI field to inform which joint/DL TCI state(s) indicated by MAC-CE/DCI that the UE shall apply to PDSCH reception is discussed individually in AI 9.1.1.1

**Support/fine: QC, vivo, Xiaomi, Sharp, OPPO, MTK, Panasonic, Futurewei**

**Not support: ZTE**

Table 2-2 Company inputs for Issue 2

|  |  |
| --- | --- |
| **Company** | **Input** |
| Mod | * **Please check the revised Proposal 2.A. We can focus on the main bullet first, then discuss the FFS later (which may be handled in Issue 3 later).**
* **Please check Proposal 2.B, which is quite stable according to feedback.**
* **Given the majority view, Conclusion 2.C is recommended.**
 |
| QC | For Proposal 2.A, supportFor Proposal 2.B, supportFor Conclusion 2.C, support |
| vivo | **Proposal 2.A:** support**Proposal 2.B:** support**Conclusion 2.C:** support |
| Xiaomi | Support Proposal 2.A, 2.B and Conclusion 2.C |
| Sharp | Support Proposal 2.A, 2.B and Conclusion 2.C |
| ZTE | **Proposal 2.A:** support in principle. ‘without DL assignment’ can be discussed separately.**Proposal 2.B:** support**Conclusion 2.C:** It is unclear for us. What’s the relationship between this conclusion and proposal 3.A? If my understanding is correct, in Proposal 3.A, super majority companies want to have an indicator field for selecting one of indicated TCI state for scheduled PDSCH reception.**[Mod] This conclusion is independent from Proposal 3.A, which precludes additional field for TCI state indication instead TCI state(s) selection/association discussed in Proposal 3.A. To avoid confusion, a note is added.** |
| OPPO | **Proposal 2.A:** support.**Proposal 2.B:** support.If Conclusion 1.A (no configuration on mixed mode of joint and separate TCI states) can be made, then the codepoint of mixed mode under FSS should be removed.**Conclusion 2.C:** okay. |
| Panasonic | We support **Proposal 2.A, Proposal 2.B**. Confused a bit about the placement of **Conclusion 2.C** in this section, but in general we support it.  |
| MediaTek | Support Proposal 2.A, 2.B and Conclusion 2.C.Regarding Conclusion 2.C, to our understanding, it is concluded for TCI state indication, not for TCI state association (i.e., TCI states are indicated but how to associate with target channel like PDSCH). |
| Google | **Proposal 2.A**: We still think cross-TRP beam indication should be supported via DCI indication. The additional effort would be minor. **Proposal 2.B**: We support it in principle. However, we think the FFS bullet can be removed. We don’t need to list a FFS that we don’t even know whether it would be supported. **Conclusion 2.C**: We suppose this means no consensus to support another one TCI field? **[Mod] This conclusion is independent from Proposal 3.A, which precludes additional field for TCI state indication instead TCI state(s) selection/association discussed in Proposal 3.A. To avoid confusion, a note is added.** |
| Mod | * **Please check the revised Proposal 2.A. We can focus on the main bullet first, then discuss the FFS later (which may be handled in Issue 3 later).**
* **Please check Proposal 2.B, which is quite stable according to feedback.**
* **Given the majority view, Conclusion 2.C is recommended. A note is added to clarify whether to introduce a DCI field other than the existing TCI field to inform which joint/DL TCI state(s) indicated by MAC-CE/DCI that the UE shall apply to PDSCH reception is discussed individually in AI 9.1.1.1.**
 |
| Panasonic | As expressed above, we support Conclusion 2.C |
| Futurewei | **Proposal 2.A:** Support.**Proposal 2.B:** Support.**Conclusion 2.C:** Fine with the conclusion if no consensus can be achieved. |
| Mod | * **Please check the revised Proposal 2.A. We can focus on the main bullet first, then discuss the FFS later (which may be handled in Issue 3 later).**
* **Given the majority view, Conclusion 2.C is recommended. A note is added to clarify whether to introduce a DCI field other than the existing TCI field to inform which joint/DL TCI state(s) indicated by MAC-CE/DCI that the UE shall apply to PDSCH reception is discussed individually in AI 9.1.1.1.**
* **Proposal 2.B is moved to the email thread for endorsement**
 |
| Apple  | **Conclusion 2.C:** Fine.  |
|  |  |
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# Issue 3 – How to associate the indicated TCI state(s) with each target channel/signal

Table 3-1 Summary for Issue 3

|  |  |  |
| --- | --- | --- |
| **#** | **Issue** | **Companies’ views** |
| 3.1 | PDSCH reception for S-DCI based MTRP, how to inform the association with joint/DL TCI state(s) indicated by DCI/MAC-CE | Alt1: Use a DCI format 1\_1/1\_2 to inform which indicated joint/DL TCI state(s) that the UE shall apply to PDSCH reception* Support: Qualcomm, ZTE, MediaTek (indicator field other than existing TCI field), Google, vivo, Xiaomi, CMCC, Spreadtrum, NEC, Huawei/HiSilicon, Docomo, OPPO, Fraunhofer, Futurewei, InterDigital, Sharp, LG, Fujitsu, CATT, FGI, Apple, Intel, Lenovo, Nokia, Transsion
* Concern: MediaTek (existing TCI field), Samsung

Alt2: Use RRC parameter(s) to inform which indicated joint/DL TCI state(s) that the UE shall apply to PDSCH reception* Support: MediaTek (per CORESET), Samsung, Ericsson
* Concern: Qualcomm, ZTE, MediaTek (per *PDSCH-Config*), vivo, OPPO

**FL note: Proposal 3.A is recommended for this issue. For opponents of DCI-based scheme if a new indicator field is introduced, one concern is a new application/switching time and default behavior before the application/switching time may be needed. Proponents of DCI-based scheme could share your view on how to address this concern. For opponents of RRC-based scheme, the main concern is it may be too slow for the switching between different TRPs or between STRP and MTRP. Proponents of RRC-based scheme could share your view on how to address this concern (only one company proposes that RRC-based scheme still can enable dynamic switching if different TCI associations are provided to different CORESETs, respectively).**  |
| 3.2 | PDCCH reception for S-DCI based MTRP, down-selection from the alternatives agreed in RAN1#110 | Alt1-1 (RRC)* Support: Qualcomm, MediaTek, vivo, NEC, DOCOMO, Huawei/HiSilicon, Sharp, Fujitsu, CATT, FGI, Apple, CATT, Ericsson, Intel, Lenovo, TCL, Transsion
* Concern:

Alt1-2 (RRC with CORESET group)* Support: ZTE, vivo, CMCC, Spreadtrum, Samsung, Fraunhofer, Futurewei, LG, TCL
* Concern:

Alt2 (Fixed rule)* Support: OPPO, Futurewei, Fujitsu, CEWiT, Fujitsu, Lenovo, Nokia
* Concern:

Alt3 (MAC-CE)* Support: Google, Xiaomi, Huawei/HiSilicon, InterDigital
* Concern:

**FL note: According to contributions, majority prefer to use RRC configuration to provide the TCI association (Alt1-1 and Alt1-2). However, whether to introduce CORESET group configuration is still quite controversial, even their purposes are the same (inform the UE whether and which indicated joint/DL TCI state(s) shall be applied to PDCCH). Since RAN2 will design the corresponding RRC configuration anyway, I’d like to suggest leaving these details to RAN2, and RAN1 can conclude what functionality need to be achieved by the RRC configuration. Proposal 3.B is recommended for this issue.** |
| 3.3 | PUSCH transmission scheduled/activated by a DCI format 0\_1/0\_2 for S-DCI based MTRP, down-selection from the alternatives agreed in RAN1#110 | Alt1 (DCI)* Support: Qualcomm, MediaTek, Google, vivo, Xiaomi, CMCC, Spreadtrum, DOCOMO, OPPO, Sharp, LG, Fujitsu, CATT, FGI, Apple, Intel, ITRI, Lenovo, TCL, Transsion
* Concern: Samsung

Alt2 (SRS)* Support: ZTE, NEC, Fraunhofer, Futurewei, FGI, Ericsson, Nokia, Panasonic, Huawei/HiSilicon
* Concern: MediaTek (how to support UL PC)

Alt3 (RRC with CORESET group)* Support:
* Concern:

**FL note: Proposal 3.C is recommended for this issue with precluding Alt3. For proponents of Alt2 point of view, at least the UL beam alignment between PUSCH transmission and associated SRS transmission can be always guaranteed. However, it is unclear that how to indicate UL PC based on Alt2. Note that one scheme to indicate UL PC** **at least for S-DCI based PUSCH repetition with TDM has already been agreed in RAN1#109e.**  |
| 3.4 | PUCCH transmission for S-DCI based MTRP, down-selection from the alternatives agreed in RAN1#110 | Alt1 (RRC)* Support: Qualcomm, MediaTek, vivo, OPPO, Fraunhofer, Futurewei, Sharp, LG, Fujitsu, CATT, FGI, Apple, Ericsson, Intel, Lenovo, TCL, Huawei/HiSilicon, Transsion
* Concern:

Alt2 (RRC with CORESET group)* Support: ZTE, CMCC, Spreadtrum, Samsung, Fraunhofer
* Concern:

Alt3 (MAC-CE)* Support: Google, Xiaomi, DOCOMO, Futurewei, InterDigital, ITRI, Huawei/HiSilicon
* Concern:

Alt4 (DCI)* Support: DOCOMO
* Concern:

**FL note: Proposal 3.D is recommended for this issue with precluding Alt4** |

**Proposal 3.A:** On unified TCI framework extension for S-DCI based MTRP, down-select one alternative from the followings in RAN1#111 for PDSCH reception:

* Alt1: Use a DCI format 1\_1/1\_2 to inform which joint/DL TCI state(s) indicated by MAC-CE/DCI that the UE shall apply to PDSCH reception
	+ FFS: Informed by the existing TCI field or an indicator field other than the existing TCI field (could be reusing an existing DCI field or introducing a new DCI field) in the DCI format 1\_1/1\_2
	+ FFS: Applying to the PDSCH reception(s) scheduled/activated by the DCI format 1\_1/1\_2 or all PDSCH receptions after the DCI format 1\_1/1\_2
	+ FFS: Application time for applying the indicated joint/DL TCI state(s) informed by the DCI format 1\_1/1\_2
	+ FFS: Only DCI format 1\_1/1\_2 with DL assignment can inform the TCI association, or both DCI format 1\_1/1\_2 with and without DL assignment can inform the TCI association
* Alt2: Use RRC configuration to inform which joint/DL TCI state(s) indicated by MAC-CE/DCI that the UE shall apply to PDSCH reception
	+ FFS: The RRC configuration is provided to a PDSCH-Config or a CORESET/CORESET group

**Support/fine: QC, MTK, Futurewei, vivo, Google, Panasonic, Nokia, Lenovo, ZTE, Apple, OPPO, Fujitsu, Spreadtrum, FGI, Huawei, NEC, CMCC, Intel, DOCOMO, CATT, LG, CEWiT, Fraunhofer, Transsion, Xiaomi, Sharp**

**Not support: Ericsson, Samsung**

**Proposal 3.B:** 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

Note: Detail of the RRC configuration and whether/how to introduce CORESET group configuration are left to RAN2 design

**Support/fine: QC, MTK, Futurewei, vivo, ZTE, Fujitsu, Samsung, Spreadtrum, FGI, NEC, CMCC, Intel, LG, CEWiT, Fraunhofer, Ericsson, Transsion, Xiaomi, Sharp, Google**

**Not support: Panasonic, Nokia, OPPO**

Table 3-2 Company inputs for Issue 3

|  |  |
| --- | --- |
| **Company** | **Input** |
| Mod | * **Please share your view on Proposal 3.A - 3.D, if any.**
* **Regarding Proposal 3.B, could proponents of RRC-based scheme response to opponents (please check comments from Panasonic, Nokia, OPPO) why the TCI association cannot be based on a fixed rule?**
* **Regarding whether to introduce CORESET group in Proposal 3.B, leaving it to RAN2 is one way to progress, especially this may be just an RRC signaling design which doesn’t cause impact to RAN1 behavior.**
* **Proposal 3.A, 3.C and 3.D are quite stable, even some companies prefer to make downs-election in this meeting.**
 |
| QC | For Proposal 3.A, prefer Alt1For Proposal 3.B, support. For the fixed rule, we think even without PDCCH repetition/SFN, there is still benefit to associated different TCIs with different CORESETs to improve reliability. This is the baseline as in R15, i.e. different CORESETs can have different beams.For Proposal 3.C, support Alt 1. Similar concern as MTK for PUSCH PC parameters for Alt2.For Proposal 3.D, support Alt 1, which should be sufficient.  |
| vivo | **Proposal 3.A:** support and prefer Alt1.**Proposal 3.B:** support.We have concerns on fixed rule. * For PDCCH (CORESET) without repetition or SFN, the CORESET should be able to apply either one of the two indicated TCI states, as the flexibility provided by Rel-16.
* For PDCCH repetition, how to implement STRP based PDCCH repetition when two TCI states are indicated which is supported in Rel-17?
* For SFN, the sfnSchemePDCCH is configured per cell. If the fixed rule is applied, then all CORESETs will be in SFN when two TCI states are indicated which is not expected.

**Proposal 3.C:** support and prefer Alt1.**Proposal 3.D:** support and prefer Alt1. |
| Xiaomi | **Proposal 3.A:** support and prefer Alt 1**Proposal 3.B:** fine for progress**Proposal 3.C:** support and prefer Alt 1**Proposal 3.D:** support and prefer Alt 3 |
| Sharp | Proposal 3.A: We prefer Alt 1Proposal 3.B: Agree with FL’s suggestion and we support the proposal.Proposal 3.C: We prefer Alt 1.Proposal 3.D: We prefer Alt 1. |
| ZTE | **Proposal 3.A:** Support and prefer Alt 1**Proposal 3.B:** Support**Proposal 3.C:** Support and prefer Alt2. If going with Alt1, we have to discuss the following issue:* What’s the UE behavior, when the spatial domain transmit filter provided by TCI-State configurations is mismatched with the spatial domain filter of the SRS resource indicated by SRI

**Proposal 3.D:** Support and prefer Alt2. The CORESET group can be assumed as a configurable ID/anchor for enabling this association. Then, we may have the same note for Alt2, like* 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
	+ Note: Detail of the RRC configuration and how to introduce CORESET group configuration, e.g., a configurable ID, are left to RAN2 design

**[Mod] Since Proposal 3.B has not been agreed yet, let’s keep the original wording for now.** |
| Panasonic | **We support Proposal 3.C and 3.D**As for **Proposal 3.B**,For the unified TCI framework, a CORESET if *followUnifiedTCIstate* is configured, uses the “indicated TCI state” else, configured TCI state of the CORESET is applied. This should allow ‘to associate different TCIs with different CORESETs to improve reliability,’ as per Qualcomm’s remark. If *followUnifiedTCIstate* is configured for multiTRP, we think the UE follows a predefined rule to map the two indicated TCI states to the two CORESETs. This is our understanding of ‘fixed rule.’Moreover, perhaps some clarification of Proposal 3B would be appreciated. Our understanding of Proposal 3B, is instead of ‘*followUnifiedTCIstate*’, the CORESET will be RRC configured with an index field that points to one of the 4 TCI states indicated to the UE. We would like to ask what happens when the indicated TCI states are updated, do you have to update the pointer index in the RRC config of the CORESET? This is our concern about this proposal.**For Proposal 3.A**, * For Alt2, we have the same concern as proposal 3.B: What happens when update the indicated TCI states are updated, do we need to update the pointer index in the RRC config? What is the implication on **dynamic switching?**
* For Alt1, Samsung’s remark above makes sense to us. Here we would like to mention that one of the alternatives discussed in RAN1#110 was
	+ *Alt3: Reuse the existing TCI field in a DCI format 1\_1/1\_2, i.e., the UE shall apply the joint/DL TCI state(s) mapped to the TCI codepoint indicated by the DCI format 1\_1/1\_2 to PDSCH reception scheduled/activated by the DCI format 1\_1/1\_2 if the PDSCH reception is scheduled/activated after the beam application time as defined in Rel-17*

It seems like a reasonable alternative to Alt1. Here we would like to mention that we still did not discuss how to update the indicated TCI states upon receiving a TCI codepoint, which was raised by some companies in their contributions, and can be an issue that affects the design of multiTRP PDSCH.  |
| MediaTek | We are fine with these proposals.On Proposal 3.B, we share similar view with vivo. For sTRP operation, the flexibility of transmitting PDCCH from either one of the TRPs should be supported, which has been supported even in Rel-15. For PDCCH repetition, to our understanding, there is no restriction that two CORESETs associated with the link SS sets have to be indicated with different TCI states. For PDCCH-SFN, even PDCCH-SFN is configured in a CC, it doesn’t mean all PDCCHs have to be transmitted with SFN. Re comment from Panasonic, we don’t think it is a good idea to reuse Rel-15/16 signaling to provide TCI state for PDCCH, especially it is an UE optional feature in Rel-17 unified TCI.. |
| Google | We support **Proposal 3.A**, **3.C** and **3.D**. **Proposal 3.B**: RRC configuration is not our preference, but we can go with majority. However, fixed rule seems to have issues, especially PDCCH-SFN. In Rel-17, a CORESET is used for SFN if *sfnSchemePDCCH* is configured and two TCIs are activated for the CORESET. In Rel-18, if no association/relation of two TCIs is indicated for a CORESET, how UE understands the CORESET is for SFN and consequently apply the so called rule?  |
| Futurewei | **Proposal 3.A:** Support and we prefer Alt. 1. **Proposal 3.B:** We are ok with the proposal.**Proposal 3.C:** Support the proposal and we prefer Alt. 2. **Proposal 3.D:** Support and we are ok with either Alt 1 or Alt 3. |
| Mod | * **Please share your view on Proposal 3.A and 3.B, if any.**
* **Regarding Proposal 3.B, could proponents of RRC-based scheme response to opponents (please check comments from Panasonic, Nokia, OPPO) why the TCI association cannot be based on a fixed rule?**
* **Regarding whether to introduce CORESET group in Proposal 3.B, leaving it to RAN2 is one way to progress, especially this may be just an RRC signaling design which doesn’t cause impact to RAN1 behavior.**
* **Proposal 3.C and 3.D are moved to the email thread for endorsement**
 |
| Apple  | **Proposal 3.B:** We appreciate FL clarification. With the assumption of pure RAN2 ASN.1 design (e.g., reducing signaling overhead) and no further RAN1 spec impact, we can live with the Proposal 3.B.  |
|  |  |

# Issue 4 – UL power Control for UL MTRP

Void

# Issue 5 – Beam reporting and beam failure recovery

Table 5-1 Summary for Issue 5-1

|  |  |  |
| --- | --- | --- |
| **#** | **Issue** | **Companies’ views** |
| 5.1 | Enhancement to TRP-specific BFR under unified TCI framework | Implicit BFD-RS determination based on the indicated joint/DL TCI states for S-DCI based MTRP* Support: CATT, InterDigital, vivo, Nokia, ZTE, Samsung, Huawei/HiSilicon
* Concern:

Enhancement to beam update after NW response to the TRP-specific BFR request* Support: Qualcomm, vivo, InterDigital, Nokia, ZTE, Samsung, CATT
* Concern:

**FL note: Lower priority in this meeting** |
| 5.2 | Enhance/extend group-based reporting to support STxMP | Support: Qualcomm, Docomo, ZTE, vivo, Nokia, Samsung, Xiaomi, CATTConcern: OPPO, Huawei/HiSilicon**FL note: Lower priority in this meeting** |
| 5.3 | Enhance/extend Rel-17 UE capability index reporting to support STxMP | Support: Qualcomm, OPPO, Docomo, NEC, ZTE, InterDigital, LG, Nokia, CMCC, Samsung, Xiaomi, CATTConcern: Huawei/HiSilicon**FL note: Lower priority in this meeting** |
| 5.4 | Prefer to discuss Issue 5.2 and 5.3 in which AIs | Prefer to discuss in AI 9.1.1.1: QC, OPPOPrefer to discuss in AI 9.1.4.1: Ericsson |

Table 5-2 Company inputs for Issue 5

|  |  |
| --- | --- |
| **Company** | **Input** |
| Mod | **Since it is unclear whether to handle Issue 5.2 and 5.3 in this AI or in AI 9.1.4.1, I’d loke to check companies’ view on this. Please update your preference in Table 5-1 for Issue 5.4.** |
| QC | For 5.2 and 5.3, they are beam related and might be good to be discussed in 9.1.1.1. The definition of 9.1.4.1 is mainly on “UL precoding indication for multi-panel transmission”, which does not cover any beam related enhancement |
| vivo | Agree with QC. |
| Xiaomi | For 5.2&5.3, these beam issues seem to be more related to Rel-18 STxMP, so we think it would be good to discuss in 9.1.4.1 together with other issues for STxMP. |
| ZTE | We share the same views as QC and vivo. In our views, for current 9.1.4.1, it is just a subset of STxMP and only relevant to UL precoding indication, i.e., modulation/demodulation.  |
| OPPO | Similar view as QC that for STxMP, the beam-related issue should be discussed along with UTCI framework in AI 9.1.1.1.  |
|  |  |
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# Appendix: Agreements before/in RAN1#110bis-e

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| --- |
| **RAN1#110bis-e** |
|  |
| **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 | RP-213598 | New WID: MIMO Evolution for Downlink and Uplink | Samsung |
| 2 | [R1-2209888](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2209888.zip) | Discussion on unified TCI framework extension for multi-TRP | NTT DOCOMO, INC. |
| 3 | [R1-2209568](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2209568.zip) | Views on unified TCI framework extension for multi-TRP | Apple |
| 4 | [R1-2209547](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2209547.zip) | Multi-TRP enhancements for the unified TCI framework | Fraunhofer IIS, Fraunhofer HHI |
| 5 | [R1-2209540](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2209540.zip) | Discussion on unified TCI framework extension for multi-TRP | Google |
| 6 | [R1-2209492](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2209492.zip) | Unified TCI framework extension for multi-TRP | MediaTek Inc. |
| 7 | [R1-2209414](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2209414.zip) | Discussion on unified TCI framework extension for multi-TRP | FGI |
| 8 | [R1-2209379](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2209379.zip) | Unified TCI framework extension for multi-TRP | Sharp |
| 9 | [R1-2209256](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2209256.zip) | Unified TCI framework extension for multi-TRP | xiaomi |
| 10 | [R1-2209320](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2209320.zip) | Discussion on unified TCI framework extension for multi-TRP | CMCC |
| 11 | [R1-2209008](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2209008.zip) | Discussion on unified TCI extension for MTRP | Fujitsu |
| 12 | [R1-2209039](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2209039.zip) | Unified TCI Framework for Multi-TRP | Intel Corporation |
| 13 | [R1-2209138](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2209138.zip) | Discussion on unified TCI framework extension for multi-TRP | NEC |
| 14 | [R1-2209165](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2209165.zip) | Discussion on unified TCI framework extension for multi-TRP | Transsion Holdings |
| 15 | [R1-2208945](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2208945.zip) | On unified TCI framework extension for multi-TRP operation | CATT |
| 16 | [R1-2208891](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2208891.zip) | Unified TCI framework extension for multi-TRP/panel | LG Electronics |
| 17 | [R1-2208702](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2208702.zip) | Discussion on unified TCI framework extension for multi-TRP operation | TCL Communication Ltd. |
| 18 | [R1-2208676](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2208676.zip) | Unified TCI framework extension for multi-TRP | Ericsson |
| 19 | [R1-2208740](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2208740.zip) | Discussion of unified TCI framework for multi-TRP | Lenovo |
| 20 | [R1-2208792](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2208792.zip) | Unified TCI framework extension for multi-TRP | OPPO |
| 21 | [R1-2208626](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2208626.zip) | Discussion on unified TCI framework extension for multi-TRP | vivo |
| 22 | [R1-2208539](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2208539.zip) | Discussion on unified TCI framework extension for multi-TRP | Spreadtrum Communications |
| 23 | [R1-2208493](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2208493.zip) | On Unified TCI Extension for MTRP | InterDigital, Inc. |
| 24 | [R1-2208502](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2208502.zip) | Enhancements on unified TCI framework extension for multi-TRP | ZTE |
| 25 | [R1-2208439](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2208439.zip) | Discussion on unified TCI framework extension for multi-TRP | Huawei, HiSilicon |
| 26 | [R1-2208373](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2208373.zip) | Unified TCI framework extension for multi-TRP | FUTUREWEI |
| 27 | [R1-2209712](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2209712.zip) | Views on unified TCI extension focusing on m-TRP | Samsung |
| 28 | [R1-2209967](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2209967.zip) | Extension of unified TCI framework for mTRP | Qualcomm Incorporated |
| 29 | [R1-2210061](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2210061.zip) | Unified TCI framework extension for multi-TRP | Nokia, Nokia Shanghai Bell |
| 30 | [R1-2210029](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2210029.zip) | Discussion on unified TCI framework extension for multi-TRP | ITRI |
| 31 | [R1-2210018](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_110b-e/Docs/R1-2210018.zip) | Unified TCI framework extension for multi-TRP | PANASONIC |
| 32 | R1-2210104 | Discussion on Unified TCI framework extension for multi-TRP | CEWiT |