**3GPP TSG RAN WG1 #109-e R1-220XXXX**

**e-Meeting, May 9th – 20th, 2022**

**Agenda item:** 8.1.1

**Source:** Moderator (ZTE)

**Title:** Moderator Summary #0 for Maintenance on Rel-17 Multi-Beam

**Document for:** Discussion and Decision

## Introduction

The following email thread is assigned for email discussion on maintenance of Rel-17 Multi-Beam, please provide your comments in corresponding sections below

[109-e-R17-MIMO-02] Maintenance on beam management (description of issues in R1-2205130) – Bo (ZTE)

* Issues 1-1, 1-2, 1-7, 1-14, 1-15, 1-20, 1-30, 2-2, 2-3, 2-7, 3-1, 3-3, 3-4, 3-5, 3-7, 3-10, 4-2 by May 18
* Editorial Issues: 1-5, 1-6, 1-11, 1-13, 1-19, 1-31, 2-4, 2-5, 2-8, 3-8, 3-11, 4-1 by May 11

## Summary of High priority (H) issues

### Issue 1 (Rel.17 unified TCI framework)

Table 1 Summary: issue 1

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| --- | --- | --- |
| **#** | **Issue** | **Companies’ views** |
| 1-1 | **TP 1-1**: To endorse the following text proposal for TS 38.213:  **6 Link recovery procedures**  <Unchanged part omitted>  If a UE is provided *TCI-State\_r17* indicating a unified TCI state for the PCell or the PSCell [6, TS 38.214], after ~~X~~28 symbols from a last symbol of a first PDCCH reception in a search space set provided by *recoverySearchSpaceId* where the UE detects a DCI format with CRC scrambled by C-RNTI or MCS-C-RNTI, the UE  - if *AdditionalPCIInfo* is not provided, monitors PDCCH in all CORESETs, and receives PDSCH and aperiodic CSI-RS in a resource from a CSI-RS resource set with same indicated TCI state as for the PDCCH and PDSCH, using the same antenna port quasi co-location parameters as the ones associated with the corresponding index , if any  - transmits PUCCH, PUSCH and SRS that uses a same spatial domain filter with same indicated TCI state as for the PUCCH and the PUSCH, using a same spatial domain filter as for the last PRACH transmission. A power parameter is determined with:  - the RS index for obtaining the downlink pathloss estimate for PUSCH, PUCCH, and SRS transmission  - the values of , , and the PUSCH power control adjustment state are provided by *p0-Alpha-CLID-PUSCH-Set* associated with the lowest value of *ul-powercontrolId-r17* configured for the PCell or the PSCell  - the values of and the PUCCH power control adjustment state are provided by *p0-Alpha-CLID-PUCCH-Set* associated with the lowest value of *ul-powercontrolId-r17* configured for the PCell or the PSCell  - the values of , , and SRS power control adjustment state are provided by *p0-Alpha-CLID-SRS-Set* associated with the lowest value of *ul-powercontrolId-r17* configured for the PCell or the PSCell  <Unchanged part omitted>  If a UE is provided *TCI-State\_r17* indicating a unified TCI state for the PCell or the PSCell and the UE provides BFR MAC CE in Msg3 or MsgA of contention based random access procedure, after ~~X~~28 symbols from the last symbol of the PDCCH reception that determines the completion of the contention based random access procedure as described in [11, TS 38.321], the UE  - if *AdditionalPCIInfo* is not provided, monitors PDCCH in all CORESETs, and receives PDSCH and aperiodic CSI-RS resource in a CSI-RS resource set with same indicated TCI state as for the PDCCH and PDSCH using the same antenna port quasi co-location parameters as the ones associated with the corresponding index , if any  - transmits PUCCH, PUSCH and SRS that uses a same spatial domain filter with same indicated TCI state as for the PUCCH and PUSCH, using a same spatial domain filter as for the last PRACH transmission. A power parameter is determined with:  - the RS index for obtaining the downlink pathloss estimate for PUSCH, PUCCH, and SRS transmission  - the values of , , and the PUSCH power control adjustment state are provided by *p0-Alpha-CLID-PUSCH-Set* associated with the lowest value of *ul-powercontrolId-r17* configured for the PCell or the PSCell  - the values of and the PUCCH power control adjustment state are provided by *p0-Alpha-CLID-PUCCH-Set* associated with the lowest value of *ul-powercontrolId-r17* configured for the PCell or the PSCell  - the values of , , and SRS power control adjustment state are provided by *p0-Alpha-CLID-SRS-Set* associated with the lowest value of *ul-powercontrolId-r17* configured for the PCell or the PSCell  <Unchanged part omitted>  If a UE is provided *TCI-State\_r17* indicating a unified TCI state, after ~~X~~28 symbols from a last symbol of a PDCCH reception with a DCI format scheduling a PUSCH transmission with a same HARQ process number as for the transmission of the first PUSCH and having a toggled NDI field value, the UE  - monitors PDCCH in all CORESETs, and receives PDSCH and aperiodic CSI-RS in a resource from a CSI-RS resource set using the same antenna port quasi co-location parameters as the ones associated with the corresponding index , if any  - transmits PUCCH, PUSCH and SRS that uses a same spatial domain filter with same indicated TCI state as for the PUCCH and PUSCH, using a same spatial domain filter as the one corresponding to , if any. A power parameter is determined with:  - the RS index for obtaining the downlink pathloss estimate for PUSCH, PUCCH, and SRS transmission  - the values of , , and the PUSCH power control adjustment state are provided by *p0-Alpha-CLID-PUSCH-Set* associated with the lowest value of *ul-powercontrolId-r17* configured for the corresponding SCell  - the values of and the PUCCH power control adjustment state are provided by *p0-Alpha-CLID-PUCCH-Set* associated with the lowest value of *ul-powercontrolId-r17* configured for the corresponding SCell  - the values of , , and SRS power control adjustment state are provided by *p0-Alpha-CLID-SRS-Set* associated with the lowest value of *ul-powercontrolId-r17* configured for the corresponding SCell  <Unchanged part omitted>  **FL Note**: Rel-15/16 UL power control setting may not be configured in unified TCI framework in Rel-17, and consequently we may need to identify the default setting in the pool of RRC UL power control setting for unified TCI. The following as proposed by some proponents is unclear, according to my best knowledge.  …, where a power determined as described in clause 7.1.1, 7.2.1 and 7.3.1 with , , , and  So, let’s try TP2 in R1-2203257 firstly with some modification. The other issue, e.g., updating closed loop value, can be discussed in the second round. | **Support/fine**: QC, Apple, ZTE, vivo, Huawei/HiSilicon  **Not support:** SS |
| 1-2 | **Alt-1: Section 7 Uplink Power control in TS 38.213**  < Unchanged parts are omitted >  In the remaining of this clause, if a UE is provided *DLorJoint-TCIState* or *UL-TCIstate* and for an indicated *DLorJoint-TCIState* or *UL-TCIstate* as described in [6, TS 38.214]  - in clauses 7.1.1, 7.2.1, and 7.3.1, the RS index for obtaining the downlink pathloss estimate for PUSCH, PUCCH, and SRS transmission is provided by *PL-RS* associated with or included in the indicated *DLorJoint-TCIState* or *UL-TCIstate* except for SRS transmission that is not provided *useIndicatedTCIState*  - If the *DLorJointTCIState* or *UL-TCIState* configurations are absent in a BWP of the CC, the UE can apply the *PL-RS* associated with or included in the indicated *DLorJointTCIState* or *UL-TCIState* configurations from a reference BWP of a reference CC.  - in clause 7.1.1, if *p0-Alpha-CLID-PUSCH-Set* is provided, the values of , , and the PUSCH power control adjustment state are provided by *p0-Alpha-CLID-PUSCH-Set* associated with the indicated *DLorJoint-TCIState* or *UL-TCIstate*  - in clause 7.2.1, if *p0-Alpha-CLID-PUCCHSet* is provided, the values of and the PUCCH power control adjustment state are provided by *p0-Alpha-CLID-PUCCH-Set* associated with the indicated *DLorJoint-TCIState* or *UL-TCIstate*  - in clause 7.3.1, if *p0-Alpha-CLID-SRS-Set* is provided,  - if *useIndicatedTCIState* is provided for a SRS resource set, the values of , , and SRS power control adjustment state are provided by *p0-Alpha-CLID-SRS-Set* associated with the indicated *DLorJoint-TCIState* or *UL-TCIState*  - else, if *useIndicatedTCIState* is not provided for a SRS resource set and for a first SRS resource from the SRS resource set, the values of , , and SRS power control adjustment state are provided by *p0-Alpha-CLID-SRS-Set* associated with *DLorJoint-TCIState* or *UL-TCIState* of an SRS resource with lowest *SRS-ResourceId* in the SRS resource set and a RS index for obtaining a pathloss estimate for the SRS transmission is provided by PL-RS associated with or included in the indicated *DLorJoint-TCIState* or *UL-TCIState* of an SRS resource with lowest *SRS-ResourceId* in the SRS resource set  **Alt-2: Section 7 Uplink Power control in TS 38.213**  In the remaining of this clause, if a UE is provided *DLorJoint-TCIState* or *UL-TCIstate* and for an indicated *DLorJoint-TCIState* or *UL-TCIstate* as described in [6, TS 38.214]  - in clauses 7.1.1, 7.2.1, and 7.3.1, the RS index for obtaining the downlink pathloss estimate for PUSCH, PUCCH, and SRS transmission is provided by *PL-RS* associated with or included in the indicated *DLorJoint-TCIState* or *UL-TCIstate* except for SRS transmission that is not provided *useIndicatedTCIState*  - in clause 7.1.1, if *p0-Alpha-CLID-PUSCH-Set* is provided, the values of , , and the PUSCH power control adjustment state are provided by *p0-Alpha-CLID-PUSCH-Set* associated with the indicated *DLorJoint-TCIState* or *UL-TCIstate*  - in clause 7.2.1, if *p0-Alpha-CLID-PUCCHSet* is provided, the values of and the PUCCH power control adjustment state are provided by *p0-Alpha-CLID-PUCCH-Set* associated with the indicated *DLorJoint-TCIState* or *UL-TCIstate*  - in clause 7.3.1, if *p0-Alpha-CLID-SRS-Set* is provided,  - if *useIndicatedTCIState* is provided for a SRS resource set, the values of , , and SRS power control adjustment state are provided by *p0-Alpha-CLID-SRS-Set* associated with the indicated *DLorJoint-TCIState* or *UL-TCIState*  - else, if *useIndicatedTCIState* is not provided for a SRS resource set and for a first SRS resource from the SRS resource set, the values of , , and SRS power control adjustment state are provided by *p0-Alpha-CLID-SRS-Set* associated with *DLorJoint-TCIState* or *UL-TCIState* of an SRS resource with lowest *SRS-ResourceId* in the SRS resource set and a RS index for obtaining a pathloss estimate for the SRS transmission is provided by PL-RS associated with or included in the indicated *DLorJoint-TCIState* or *UL-TCIState* of an SRS resource with lowest *SRS-ResourceId* in the SRS resource set  - in clauses 7.1.1, 7.2.1, and 7.3.1, if the *TCI-State\_r17* configurations is absent in a BWP of the CC, the UE can apply the RS index , , , the PUSCH power control adjustment state , , the PUCCH power control adjustment state , , , and SRS power control adjustment state included in the indicated *TCI-StateID\_r17* from a reference BWP of a reference CC.  **Alt-3:**  **Proposal:** For a common TCI state pool shared by multiple CCs, the PC parameters for a selected common TCI state ID on each target BWP/CC can be determined as below   * For the PC parameters except for the PL RS, they can reuse those for the selected common TCI state ID on the reference BWP/CC. * The used PL RS can have the following two alternatives, which can be selected by gNB   + Alt1: Use the same PL RS for the selected common TCI state ID on the reference BWP/CC.   + Alt2: Use the PL RS configured on the target BWP/CC with the same RS ID as the PL RS for the selected common TCI state ID on the reference BWP/CC.   **FL Note**: Besides, the cross-CC PL-RS indication by ‘pathlossReferenceLinking’ as mentioned in TP1 in R1-2203257 can be discussed in the second round. | **Alt-1**: vivo  **Alt-2: Apple, ZTE,** Huawei/HiSilicon, LG  **Alt-3: QC**  **Not support:** SS |
| 1-7 | **TP 1-7**: To endorse the following text proposal for TS 38.213:  **7 Uplink Power control**  < Unchanged parts are omitted >  In the remaining of this clause, if a UE is provided *DLorJoint-TCIState* or *UL-TCIstate* and for an indicated *DLorJoint-TCIState* or *UL-TCIstate* as described in [6, TS 38.214]  - in clauses 7.1.1, 7.2.1, and 7.3.1, the RS index for obtaining the downlink pathloss estimate for PUSCH, PUCCH, and SRS transmission is provided by *PL-RS* associated with or included in the indicated *DLorJoint-TCIState* or *UL-TCIstate* except for SRS transmission that is not provided *useIndicatedTCIState*  - for the case when *AdditionalPCIInfo* is provided, the *PL-RS* is associated with the PCI associated with *DLorJoint-TCIState* or *UL-TCIstate*  - in clause 7.1.1, if *p0-Alpha-CLID-PUSCH-Set* is provided, the values of , , and the PUSCH power control adjustment state are provided by *p0-Alpha-CLID-PUSCH-Set* associated with the indicated *DLorJoint-TCIState* or *UL-TCIstate*  - in clause 7.2.1, if *p0-Alpha-CLID-PUCCHSet* is provided, the values of and the PUCCH power control adjustment state are provided by *p0-Alpha-CLID-PUCCH-Set* associated with the indicated *DLorJoint-TCIState* or *UL-TCIstate*  - in clause 7.3.1, if *p0-Alpha-CLID-SRS-Set* is provided,  - if *useIndicatedTCIState* is provided for a SRS resource set, the values of , , and SRS power control adjustment state are provided by *p0-Alpha-CLID-SRS-Set* associated with the indicated *DLorJoint-TCIState* or *UL-TCIState*  - else, if *useIndicatedTCIState* is not provided for a SRS resource set and for a first SRS resource from the SRS resource set, the values of , , and SRS power control adjustment state are provided by *p0-Alpha-CLID-SRS-Set* associated with *DLorJoint-TCIState* or *UL-TCIState* of an SRS resource with lowest *SRS-ResourceId* in the SRS resource set and a RS index for obtaining a pathloss estimate for the SRS transmission is provided by PL-RS associated with or included in the indicated *DLorJoint-TCIState* or *UL-TCIState* of an SRS resource with lowest *SRS-ResourceId* in the SRS resource set  < Unchanged parts are omitted >  **FL Note**: The Rel-17 TCI state applied for SRS can be associated with serving cell PCI or additional PCI different from the serving cell for inter-cell beam indication. For inter-cell case, to align the spatial relation RS in Rel-17 TCI state and the associated PLRS, the PCI information in TCI state configured by RRC can be applied to the PLRS. | **Support/fine**: Apple, vivo  **Not support:** MTK, ZTE (should be split for SSB and CSI-RS), SS, Huawei/HiSilicon, Spreadtrum, LG |
| 1-14 | **TP 1-14**: To endorse the following text proposal for TS 38.214:  **5.1.5 Antenna ports quasi co-location**  < Unchanged parts are omitted >  If a UE receives a higher layer configuration of a single DLorJoint-TCIState or UL-TCIState, that can be used as an indicated TCI state, the UE determines an UL TX spatial filter, if applicable, from the configured TCI state for dynamic-grant and configured-grant based PUSCH and PUCCH, and SRS applying the indicated TCI state.  If a UE is provided *followUnifiedTCIstate-r17* for a CORESET with index 0   * After a random access procedure not initiated by a PDCCH order that triggers a contention-free random access procedure, if no DCI Format or MAC CE indicating a TCI state is received, the UE assumes that DM-RS of PDCCH and DM-RS of PDSCH associated with the CORESET with index 0 are quasi co-located with the SS/PBCH block the UE identified during the random access procedure, and the UE assumes that the UL TX spatial filter, if applicable, for dynamic-grant based PUSCH and PUCCH associated with the CORESET of index 0 is the same as that for a PUSCH transmission scheduled by a RAR UL grant during the initial access procedure. * After the UE receives a DCI Format or MAC CE indicating a TCI state, and after a beam application delay as described in this clause; the UE obtains the QCL assumptions from the indicated [*DLorJoint-TCIState-r17]* TCI state for DM-RS of PDCCH and DM-RS of PDSCH associated with the CORESET with index 0, and the UE determines an UL TX spatial filter, if applicable, from the indicated [*DLorJoint-TCIState-r17]* or [*UL-TCIState-r17]* for a dynamic-grant based PUSCH and PUCCH associated with the CORESET with index 0.   **FL Note**: When CORESET 0 has been configured by RRC to follow the unified TCI state (or not configured to no follow the unified TCI state), the TCI state/quasi-co-location is determined by the indicated (unified) TCI state, or the most recent random access procedure if no unified TCI state has been indicated after the most recent random access procedure. | **Support/fine**: OPPO, Apple, ZTE, SS, Google, Spreadtrum  **Not support:** MTK, QC, vivo (need clarification on scenarios), Huawei/HiSilicon, LG |
| 1-15 | **TP 1-15**: To endorse the following text proposal for TS 38.214:  **5.1.5 Antenna ports quasi co-location**  < Unchanged parts are omitted >  When *tci-PresentInDCI* is set as 'enabled' or *tci-PresentDCI-1-2* is configured for the CORESET, the UE with activated *DLorJointTCIState* or *UL-TCIState* receives DCI format 1\_1/1\_2 providing indicated *DLorJointTCIState* or *UL-TCIState* for a CC or all CCs in the same CC list configured by *simultaneousTCI-UpdateList1-r17, simultaneousTCI-UpdateList2-r17, simultaneousTCI-UpdateList3-r17, simultaneousTCI-UpdateList4-r17*. The DCI format 1\_1/1\_2 can be with or without, if applicable, DL assignment. If the DCI format 1\_1/1\_2/ is without DL assignment, the UE can assume the following:  - CS-RNTI is used to scramble the CRC for the DCI  - The values of the following DCI fields are set as follows:  - RV = all '1's  - MCS = all '1's  - NDI = 0  - Set to all '0's for FDRA Type 0, or all '1's for FDRA Type 1, or all '0's for dynamicSwitch (same as in Table 10.2-4 of [6, TS 38.213]).  If a UE is configured with *CrossCarrierSchedulingConfig* for a serving cell the value of the DCI field ‘*carrier indicator*’ corresponds to the value indicated by *CrossCarrierSchedulingConfig.* The codepoint indicated by the DCI field ‘*Transmission Configuration Indicator*’ is applied to the carrier indicated by the DCI field ‘*carrier indicator*’ and all CCs configured in a same CC list as that carrier, and corresponds to indicated TCI state configured and activated for that carrier and all CCs, respectively.  **FL Note**: For the Rel-17 unified TCI framework, update 38.214 to describe cross carrier beam indication based on the "carrier indicator field" in DCI Format 1\_1 or DCI Format 1\_2 based on the above TP. | **Support/fine**: Apple, SS, Google, Huawei/HiSilicon  **Not support:** MTK, QC, OPPO, ZTE, Spreadtrum, LG |
| 1-20 | **Proposal 1-20: To calculate the Type 1 power headroom based on a reference PUSCH, the UE uses the pathloss reference signal associated with the indicated joint/UL-TCI state.**  **FL Note**: For virtual PHR, we may firstly discuss above proposal from E/// (with some modification in red) on confirming the functionality of virtual PHR calculation in unified TCI for reference PUSCH. After that, we can further review whether/how to draft the corresponding TP in the second round. | **Support/fine**: MTK, Apple, ZTE, vivo, Google  **Not support:** SS, Huawei/HiSilicon |
| 1-30 | **TP 1-30**: To endorse the following text proposal for TS 38.213:  **7 Uplink Power control**  < Unchanged parts are omitted >  - else, if *useIndicatedTCIState* is not provided for a SRS resource set and for a first SRS resource from the SRS resource set, the values of , , and SRS power control adjustment state are provided by *p0-Alpha-CLID-SRS-Set* associated with *DLorJoint-TCIState* or *UL-TCIState* of an SRS resource with lowest *SRS-ResourceId* in the SRS resource set and a RS index for obtaining a pathloss estimate for the SRS transmission is provided by PL-RS associated with or included in the indicated *DLorJoint-TCIState* or *UL-TCIState* of an SRS resource with lowest *SRS-ResourceId* in the SRS resource set. If two SRS resource sets are configured by higher layer parameter *srs-ResourceSetToAddModList* and *srs-ResourceSetToAddModListDCI-0-2*, respectively, and associated with the higher layer parameter usage of value 'codeBook' or 'nonCodeBook', and if *useIndicatedTCIState* is not provided for at least one SRS resource set of the two, UE expects the power control parameters associated with the TCI state of the SRS resources with the lowest *SRS-ResourceId* in the SRS resource set are the same as those applied for the other SRS resource set.  **FL Note**: For unified TCI framework, if *useIndicatedTCIState* is not provided for a SRS resource set, the SRS is not to follow the PC parameters may not be identical for the two SRS resource sets configured by srs-ResourceSetToAddModList and srs-ResourceSetToAddModListDCI-0-2. Therefore, in R1-2204976, it is proposed that we should have identical PC parameters as above two sets. | **Support/fine**: QC, OPPO  **Not support:** MTK, Apple, ZTE, vivo, Huawei/HiSilicon, LG |

Table 2 Additional inputs: issue 1

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| **Company** | **Input** |
| Mod V0 | 1. **Check and update your view in Table 1** 2. **Share more inputs here if needed** |
| MediaTek | Issue 1-7: Only when the PL-RS is an SSB, we need this CR. For CSI-RS, NW can configure the association through the TCI state provided for CSI-RS by implementation.  Issue 1-14: Current spec TS 38.214 already specifies the default behaviors for all PDCCH/PDSCH/PUSCH after initial access and reconfiguration with sync. It is unclear which scenario is missed and why we need to introduce the special handling for CORESET#0 and respective PDSCH/PUSCH.  Issue 1-15: We still don't think this has to be explicitly specified in spec.  Issue 1-30: Note that Rel-17 unified TCI framework cannot support MTRP operation, and corresponding extension will be specified in Rel-18. We don't think two SRS sets and unified TCI will be configured together in Rel-17, and related issues can be better resolved in Rel-18. |
| QC | For TP 1-1, fine for the TP  For issue 1-2, prefer Alt3, which provides same flexibility for PL RS configuration as in R15/16, i.e. the PL RS can be configured on the current serving cell with the UL Tx or from a different serving cell.  For TP 1-7, good to clarify that it is for the case of SSB as the PL RS  For TP 1-14, to our understanding, the TP may not always achieve better performance than the case without this TP, which assumes the channels scheduled by CORESET #0 still stick to the original indicated unified TCI after CORESET #0 beam is reset to the RACH SSB beam. Suppose the best SSB remains unchanged as SSB #0 before and after the RACH, while the indicated TCI corresponds to a refined narrow beam within SSB #0. After performing RACH on SSB #0, it is better for PDSCH/PUSCH/PUCCH to stay on the refined narrow beam, instead of switching to the wide SSB #0 beam together with CORESET #0  For TP 1-15, to our understanding, this is legacy behavior and hence may not be needed. In R15/16, the applied TCI is configured in the CC indicated by the CIF.  For Proposal 1-20, it seems optimization  For TP 1-30, prefer to clarify such that identical PC parameters for the two SRS resource sets for DCI 0\_1 and 0\_2 can be maintained as in R16 |
| OPPO | 1-14: we understand that it is good clarification  1-15: This may not be needed since the proposed specification seems to be redundant. That is what already specified since Rel-15.  1-20: it is not necessary |
| ZTE | 1-2: PL-RS and other PC parameters should be determined based on TCI state in the reference CC/BWP.  Alt 2 which provides a unified scheme for all kinds of PC parameters is preferred.  Regarding Alt3, PL-RS is basically relevant to spatial relation which can be shared among CCs, then it seems no need to obtain PL-RS on a target CC.  1-7: PL-RS can be SSB or CSI-RS, in a given CC. The power used to path loss should be based on a power of SSB. So we may not dress only SSB. But we may need to differentiate the two cases as follows.  - for the case when *AdditionalPCIInfo* is provided and the *PL-RS* is CSI-RS, the *PowerControloffsetSS* of the CSI-RS is based on an SSBassociated with the PCI associated with *DLorJoint-TCIState* or *UL-TCIstate.*  - for the case when *AdditionalPCIInfo* is provided and the *PL-RS* is SSB, the *ss*-*PBCH-BlockPower* of the CSI-RS is based on an SSB associated with the PCI associated with *DLorJoint-TCIState* or *UL-TCIstate.*  1-15: It is a straightforward understanding, may not need to specify.  1-30: To our understanding, the two sets share the same N SRS resources with lowest N SRS-ResourceId, so the issue does not exist. In other words, the necessity of further determining UL power control and spatial filter for the SRS set in *srs-ResourceSetToAddModListDCI-0-2* is unclear for us. |
| Samsung | For **1-1:** After BFR, for PL fine to following q\_new, for PC parameters, follow parameters configured in UL BPW. There is no rationale for follow the smallest ID.  For **1-2:** Use the PC parameters and PL RS foe the common TCI state on the reference BWP. This seems to be the behavior described in the spec. There is no need for any further update.  For **1-7**: We can update the RRC spec, the following IE  PUCCH-PathlossReferenceRS ::= SEQUENCE {  pucch-PathlossReferenceRS-Id PUCCH-PathlossReferenceRS-Id,  referenceSignal CHOICE {  ssb-Index SSB-Index,  csi-RS-Index NZP-CSI-RS-ResourceId  }  additionalPCI-r17 AdditionalPCIIndex-r17  }  There it should be mentioned that the PCI follows that of the TCI state  For **1-14**: In Rel-15/16 the beam associated with CORESET#0 is reset to the beam found with CBRA until a new TCI state is activated by MAC CE as described in 38.213. We believe that we should agree on a similar behaviour in Rel-17 for the unified TCI state framework.  After a CBRA, the beam associated with the PDCCH DMRS of CORESET#0 and associated channels (e.g., PDSCH, PUCCH, PUSCH being scheduled by CORESET#0) are reset to the beam found during CBRA until a new beam is indicated. Other CORESETs and associated channels continue to use the unified TCI state.  For **1.15**: We have agreed to include the “carrier indicator” field in DCI Format 1\_1 and 1\_2 used for beam indication with and without DLA. For companies that are saying that this is already covered in the specs, can you please point to where this is already include. We think that this behavior currently is unspecified in the specs.  For **1-20**: Not essential (optimization). Since this has been discussed before, propose to conclude no consensus and no support  For **1-30**: Not clear if this is really need for Rel-17, where unified TCI framework doesn’t support mTRP. This can anyway be guaranteed by network implementation if needed. |
| vivo | For TP 1-2, support Alt-1.  For UL PC parameters other than PLRS, it is not necessary to determine these PC parameters based on a reference BWP of a reference CC. If the Rel-17 TCI state configuration is absent in a BWP of the CC, these PC parameters also can be configured on the BWP of the CC.  However, for PLRS, it should be clarified the PLRS determination follows the rule of QCL-TypeD RS in the indicated TCI state for CA case to align the spatial relation RS and the associated PLRS.  For TP 1-7, the Rel-17 TCI state applied for SRS can be associated with serving cell PCI or additional PCI different from the serving cell for inter-cell beam indication. However, there is no PCI information for the PLRS associated with the Rel-17 TCI state. It is unclear which PCI is associated with the PLRS associated with the indicated TCI state. For inter-cell case, it is needed to align the PCI of spatial relation RS in Rel-17 TCI state and the PCI of PLRS associated with the Rel-17 TCI state. To align the spatial relation RS in Rel-17 TCI state and the associated PLRS, the PCI information in TCI state configured by RRC can be applied to the PLRS. If the PLRS is an SSB, the PCI associated with the indicated TCI state is associated with the SSB.  For TP 1-15, the intended behavior with current specification is exactly what the proposal wants to achieve. Seems not necessary to further clarify. Fine if the majority wants to make this even clearer.  For TP 1-20, we are fine to align the common understanding for current spec 38.213 section 7.  In 38.213 section 7 of Rel-17 spec, if the unified TCI is configured and indicated for PUSCH, the remaining parameters (including P0, alpha and the power control adjustment state) in 7.1.1 should be determined based on the PC parameters associated the indicated TCI state. This means that the PC parameters associated with the indicated Rel-17 TCI state is used instead of the parameters defined in Rel15/16 as above.  For TP 1-30, in current spec 38.212, for two configured SRS resource sets, the other configurations are same, expect for the higher layer parameters ‘*srs-ResourceSetId*’ and ‘*srs-ResourceIdList*’. The same configuration of the parameter *useIndicatedTCIState* should be provided for two SRS resource sets but not for at least one SRS resource set. The condition in this TP can be modified as follows:  If two SRS resource sets are configured by higher layer parameter *srs-ResourceSetToAddModList* and *srs-ResourceSetToAddModListDCI-0-2*, respectively, and associated with the higher layer parameter usage of value 'codeBook' or 'nonCodeBook', and if *useIndicatedTCIState* is not provided for the two ~~at least one~~ SRS resource sets ~~of the two~~, UE expects the power control parameters associated with the TCI state of the SRS resources with the lowest *SRS-ResourceId* in the SRS resource set are the same as those applied for the other SRS resource set.  If the two SRS resource sets are configured to not follow the indicated TCI state, it can be clarified that the power control parameters associated with the TCI state of the SRS resource with the lowest *SRS-ResourceId* in a SRS resource set are the same as those applied for the other SRS resource set, or the power control parameters associated with the TCI state of the SRS resource with the lowest *SRS-ResourceId* in the SRS resource set configured by higher layer parameter *srs-ResourceSetToAddModList* are applied for the two SRS resource sets. |
| Google | **Issue 1-14**: We support the TP in general. However, we have some comments as below:   * We think this TP should be captured in 38.213 since it’s more related to CORESET index 0. * “DCI Format” should be replaced with “DCI format 1\_1/1\_2” to align SPEC language. * [*DLorJoint-TCIState-r17*] and [*UL-TCIState-r17*] should be *DLorJoint-TCIState* and *UL-TCIState*.   **Issue 1-15**: We support the TP and share similar views with Samsung. In our understanding, legacy SPEC only captures how to determine TCI state of cross-carrier scheduled PDSCH. It’s not clear whether it can apply to Rel-17 unified TCI, which is applicable for more than PDSCH, especially when indicated TCI is indicated by DCI 1\_1/1\_2 without DLA.  If a TP cannot be acceptable to most companies, we suggest at least having a conclusion to clarify the behavior. |
| Huawei/HiSilicon | For 1-7, “the PL-RS is associated with the PCI” needs to be clarified. Does it mean the PL-RS is configured in AdditionalPCIInfo of the PCI? If it is, we do not support as it is agreed only SSB of additional PCI can be configured.  For 1-14, do not support. QCL assumption for PDCCH/PDSCH/PUCCH/PUSCH before application of the first TCI indication has already been captured in the spec which includes the case of CORESET0.  For 1-20, do not support. Suggest reusing legacy mechanism, i.e., using PL\_RS with pusch-PasslossReferenceRS-ID = 0 for virtual PHR calculation.  For 1-30, do not support. We don’t see why the PC parameters for the two SRS resource sets have to be identical. |
| Spreadtrum | TP 1-7: Agree with MTK’s view, the associated PCI for CSI-RS can be determined based on the TCI state configured for the CSI-RS.  TP 1-14: We support to clarify the default QCL assumption for CORESET#0 after RA procedure.  TP 1-15: We think this is already supported. |
| LG | Issue 1-2: Support Alt 2. In our view, the PC parameters included in the UL/joint TCI state can be commonly applied to multiple CCs sharing a common TCI state for enabling beam-specific power control.  Issue 1-14: To our understanding, default behaviors are already specified for PDCCH/PDSCH/PUSCH.  Issue 1-15: We have a similar understanding with Qualcomm.  Issue 1-30: It is unclear to be configured with two SRS resource sets in Rel-17 unified TCI framework which does not support mTRP operation. |

### Issue 2 (inter-cell beam management)

Table 3 Summary: issue 2

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| **#** | **Issue** | **Companies’ views** |
| 2-2 | **Proposal 2-2A:** On inter-cell beam management, down-select one of the following options:   * Option-1: The PDCCH/PDSCH should be rate matched around the SSBs configured for inter-cell L1-RSRP measurement. * Option-2: Support UE capability for simultaneous reception of PDCCH/PDSCH and SSBs for inter-cell L1-RSRP measurement on the same REs.   **FL note**: It was pointed out that there are some concerns about further introducing others except for rate matching. Hence, let’s firstly handle the above rate matching issue (based on the proposal in P16 in R1-2203505) and then the corresponding TP. If we still have sufficient time after handling above, we can handle the others in the second/third round. | **Option-1:** MTK, QC, OPPO, Apple (change “L1-RSRP measurement” into “L1-RSRP/CBD measurement or associated with active TCI”), ZTE (with change), SS, vivo, Google, Huawei, HiSilicon, Spreadtrum  **Option-2:** |
| **Proposal 2-2B:** On inter-cell beam management, introduce additional CRS-rate matching pattern parameter for each additional PCI  **FL note**: Like *crs-RateMatch-PerCORESETPoolIndex-r16* in Rel-16 mDCI-mTRP. | **Support/fine**: QC, Apple, ZTE  **Not support:** SS, Huawei/HiSilicon |
| 2-3 | **Proposal 2-3 (For discussion purpose):** On inter-cell beam management, the following should be supported.   * non-UE-dedicated PDSCH with scheduling offset < a threshold (TBD: default QCL assumption, e.g., reusing Rel-15/16) * Note: non-UE-dedicated PDSCH refers to PDSCH scheduled from the CORESET associated with CSS   **FL note**: It was pointed out that, before the detailed discussion, we may need to identify whether the above scenario should be supported or not. After that, we may identify the solution in the second round. | **Support/fine**: QC, OPPO, Apple (This is already in spec), ZTE, vivo, Google, Spreadtrum  **Not support:** SS, Huawei/HiSilicon |
| 2-7 | **Proposal 2-7:** On inter-cell beam management, the following QCL Types should be additionally supported:   * For a TCI state configured for periodic TRS,   + Alt-1a: SS/PBCH block associated with additional PCI w.r.t. QCL-TypeC + the same SS/PBCH w.r.t. QCL-TypeD   + Alt-1b: SS/PBCH block associated with additional PCI w.r.t. QCL-TypeC + CSI-RS for BM w.r.t. QCL-TypeD * For a TCI state configured for CSI-RS for CSI,   + Alt-2: TRS w.r.t. QCL-TypeA + SS/PBCH block associated with additional PCI w.r.t. QCL-TypeD   **FL note**: The above alternatives are from P3 in R1-2204682 and Section 2.1 in R1-2204763, respectively. For instance, they provide the corresponding TPs as follows:  **Example-1: 5.1.5 Antenna ports quasi co-location in TS 38.214**  \*\*\* Unchanged text is omitted \*\*\*  For a periodic CSI-RS resource in an *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info*, the UE shall expect that a TCI-State indicates one of the following quasi co-location type(s):  - 'typeC' with an SS/PBCH block and, when applicable, 'typeD' with the same SS/PBCH block, where SS/PBCH block may have a PCI different from the PCI of the serving cell, and the UE can assume center frequency, SCS, SFN offset are the same for SS/PBCH block from the serving cell and SS/PBCH block having a PCI different from the serving cell, or  - 'typeC' with an SS/PBCH block and, when applicable,'typeD' with a CSI-RS resource in an *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *repetition*.  **Example-2: 5.1.5 Antenna ports quasi co-location in TS 38.214**  <Unchanged Parts omitted>  For a periodic CSI-RS resource in an *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info*, the UE shall expect that a TCI-State indicates one of the following quasi co-location type(s):  - 'typeC' with an SS/PBCH block and, when applicable, 'typeD' with the same SS/PBCH block, the reference RS may additionally be an SS/PBCH block having a PCI different from the PCI of the serving cell, or  - 'typeC' with an SS/PBCH block reference RS may additionally be an SS/PBCH block having a PCI different from the PCI of the serving cell and, when applicable,'typeD' with a CSI-RS resource in an *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *repetition*.  <Unchanged Parts omitted>  For a CSI-RS resource in an *NZP-CSI-RS-ResourceSet* configured without higher layer parameter *trs-Info* and without the higher layer parameter *repetition*, the UE shall expect that a TCI-State indicates one of the following quasi co-location type(s):  - 'typeA' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info* and, when applicable, 'typeD' with the same CSI-RS resource, or  - 'typeA' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info* and, when applicable, 'typeD' with an SS/PBCH block, the reference RS may additionally be an SS/PBCH block having a PCI different from the PCI of the serving cell, or  - 'typeA' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info* and, when applicable, 'typeD' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *repetition*, or  - 'typeB' with a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info* when 'typeD' is not applicable. | **Alt-1a**   * Support/fine: MTK, QC, OPPO, Apple, ZTE, SS (proposal is fine, some refinement needed for TP), vivo, Huawei/HiSilicon, Spreadtrum, LG * Not support:   **Alt-1b**:   * Support/fine: Apple, ZTE, SS (proposal is fine, some refinement needed for TP), Huawei/HiSilicon * Not support: MTK   **Alt-2:**   * Support/fine: Apple, ZTE, Huawei/HiSilicon, Spreadtrum * Not support: MTK, SS |

Table 4 Additional inputs: issue 2

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| **Company** | **Input** |
| Mod V0 | 1. **Check and update your view in Table 3** 2. **Share more inputs here if needed** |
| QC | For Proposal 2-2A: Support Option 1. Current RAN4 spec forbids PDCCH/PDSCH reception on same symbol of SSB for L1-RSRP  For Proposal 2-2B: Fine for the proposal  For Proposal 2-3: We are fine. No need to limit such NW flexibility  For Proposal 2-7: Fine for Alt1a. |
| ZTE | 2-2A: To our understanding, the SSB should be associated with an activated TCI state. For measurement SSB, it should be discussed in RAN4. For option1, rate matching should be performed per PCI, instead of cross PCIs as agreed in inter-cell mTRP section. Then we suggest the following changes for option 1:  Option1: The PDCCH/PDSCH should be rate matched around the SSBs associated with an activate TCI state ~~configured for inter-cell L1-RSRP measurement~~which is associated with the same PCI as the PDSCH/PDCCH.  2-3: It should be a common case. |
| Samsung | For **2-3**: Need for default beam in unified TCI framework is not clear. |
| Huawei  /HiSilicon | For 2-3, We don't find the need to discuss such scenario |
| Spreadtrum | Proposal 2-2A: Support Option-1 in principle. One clarification question: Since it has been agreed in AI.8.1.2.2 that the PDCCH/PDSCH should be rate matched around the SSBs from the same cell, does option-1 means a single PDCCH/PDSCH should be rate matched around all the configured SSBs (scheme 3 in R1-2203505)? |
| Xiaomi | For proposal 2-2A: We are Ok to support that PDSCH/PDCCH from non-serving/serving cell is rate matched around non-serving/serving cell SSB, but we are not sure whether it is OK to support that PDSCH/PDCCH from serving cell is rate matched around non-serving SSB. For us, it is unacceptable that non-serving SSB has higher priority than PDSCH/PDCCH from serving cell. |
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### Issue 3 (signaling medium)

Table 5 Summary: issue 3

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| **#** | **Issue** | **Companies’ views** |
| 3-1 | **Alt-1: 6.1 UE procedure for transmitting the physical uplink shared channel in TS 38.214**  < Unchanged parts are omitted >  When UE is indicated with an SRI corresponding to the UL transmission and UE is configured *DLorJointTCIState* or *UL-TCIState*, if the spatial domain transmission filter associated with the indicated SRI is different from the spatial domain receive filter the UE may use to receive the DL reference signal associated with the indicated TCI state, the UE may use a spatial domain filter that is same as the spatial domain transmission filter associated with the indicated SRI.  < Unchanged parts are omitted >  **Alt-2: 6.1 UE procedure for transmitting the physical uplink shared channel in TS 38.214**  < Unchanged parts are omitted >  For the PUSCH transmission corresponding to a Type 1 configured grant or a Type 2 configured grant activated by DCI format 0\_0 or 0\_1, the parameters applied for the transmission are provided by *configuredGrantConfig* except for *dataScramblingIdentityPUSCH*, *txConfig*, *codebookSubset*, *maxRank*, *scaling* of *UCI-OnPUSCH,* which are provided by *pusch-Config*. For the PUSCH transmission corresponding to a Type 2 configured grant activated by DCI format 0\_2, the parameters applied for the transmission are provided by *configuredGrantConfig* except for *dataScramblingIdentityPUSCH*, *txConfig*, *codebookSubsetDCI-0-2*, *maxRankForDCI-Format0-2*, *scaling* of *UCI-OnPUSCH*, *resourceAllocationType1GranularityDCI-0-2* provided by *pusch-Config*.If the UE is provided with *transformPrecoder* in *configuredGrantConfig*, the UE applies the higher layer parameter *tp-pi2BPSK*, if provided in *pusch-Config*, according to the procedure described in clause 6.1.4 for the PUSCH transmission corresponding to a configured grant. When the UE is configured *[TCI-State](s)* with [*tci-StateId\_r17]* for UL, the UE shall perform PUSCH transmission corresponding to a Type 1 configured grant or a Type 2 configured grant or a dynamic grant according to the spatial relation, if applicable, with a reference to the RS for determining UL Tx spatial filter or the RS configured with *qcl-Type* set to ‘typeD’ of the indicated *[TCI-State]* with *[tci-StateId\_r17]*. The reference RS can be a CSI-RS resource in a *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *repetition*, a CSI-RS resource in an *NZP-CSI-RS-ResourceSet* configured with higher layer parameter *trs-Info* or, in case *[TCI-State]* with [*tci-StateId\_*r17] is for UL only, an SRS resource with the higher layer parameter *usage* set to 'beamManagement', or SS/PBCH block associated with the same or different PCI from the PCI of the serving cell. UE expects that only single-layer PUSCH transmission can be scheduled by DCI format 0\_1 or 0\_2 when the current applicable TCI state is different from the applicable TCI state for the reference SRS associated with the scheduled PUSCH.  <Unchanged part omitted>  **Alt-3: 5.1.5 Antenna ports quasi co-location in TS 38.214**  < Unchanged parts are omitted >  When the UE would transmit the last symbol of a PUCCH with HARQ-ACK information corresponding to the DCI carrying the TCI State indication and without DL assignment, or corresponding to the PDSCH scheduling by the DCI carrying the TCI State indication, and if the indicated TCI State is different from the previously indicated one, except codebook based or non-codebook based PUSCH transmissions, the indicated *DLorJointTCIState* or *UL-TCIstate* should be applied starting from the first slot that is at least symbols after the last symbol of the PUCCH. The first slot and the symbols are both determined on the carrier with the smallest SCS among the carrier(s) applying the beam indication.  For codebook based or non-codebook based PUSCH transmissions, the indicated *DLorJointTCIState* or *UL-TCIstate* should be applied after most recent SRS transmission applying the indicated *DLorJointTCIState* or *UL-TCIstate.*  < Unchanged parts are omitted >  **Alt-4: TS 38.214** 6.1.1.1 Codebook based UL transmission <Unchanged parts are omitted>  The UE shall transmit PUSCH using the same antenna port(s) as the SRS port(s) in the SRS resource indicated by the DCI format 0\_1 or 0\_2 or by *configuredGrantConfig* according to clause 6.1.2.3.  If an SRS resource set with parameter *usage* set to 'codebook' is not configured with *followUnifiedTCIstate,* the UE shall expect that the configured [TCI-State]s with [tci-StateId\_r17] of the SRS resource(s) are always equal to the indicated *[TCI-State]* with *[tci-StateId\_r17].* 6.1.1.2 Non-Codebook based UL transmission <Unchanged parts are omitted>  The UE shall transmit PUSCH using the same antenna ports as the SRS port(s) in the SRS resource(s) indicated by SRI(s) given by DCI format 0\_1 or 0\_2 or by *configuredGrantConfig* according to clause 6.1.2.3, where the SRS port in (*i*+1)-th SRS resource in the SRS resource set is indexed as .  If an SRS resource set with parameter *usage* set to 'nonCodebook' is not configured with *followUnifiedTCIstate,* the UE shall expect that the configured *[TCI-State]s* with *[tci-StateId\_r17]* of the SRS resource(s) are equal to the indicated *[TCI-State]* with *[tci-StateId\_r17].*    **FL note**: The above four alternatives are from R1-2203105, TP5 in R1-2203257, P2 in R1-2203673, P2 in R1-2203948, respectively. | **Alt-1**: ZTE, Huawei/HiSilicon  **Alt-2:** ZTE  **Alt-3:** ZTE, NEC  **Alt-4:** MTK, QC, OPPO, Apple, SS (also fine to have no TP and leave for network implementation), vivo, Spreadtrum, LG |
| 3-3 | **Proposal 3-3A:** On Rel-17 DCI-based beam indication, for both CA and non-CA cases,   * Alt-1: TCI update signaling is applied to all configured BWP(s). * Alt-2: TCI update signaling is applied to active BWP(s)   **FL note**: The corresponding TP can be discussed in the second round. | **Alt-1**: Apple, ZTE, Spreadtrum  **Alt-2: QC, OPPO, SS, vivo, Google, Huawei/HiSilicon, Xiaomi** |
| **Proposal 3-3B:** On Rel-17 DCI-based beam indication, for both CA and non-CA cases,   * Alt-1: BAT should count the BeamAppTime\_r17 in all configured BWP(s). * Alt-2: BAT should count the BeamAppTime\_r17 in active BWP(s) only   **FL note**: The corresponding TP can be discussed in the second round. | **Alt-1**: Apple, ZTE, Spreadtrum  **Alt-2: QC, OPPO, SS, vivo, Google, Huawei/HiSilicon, Xiaomi** |
| 3-4 | **Alt 1**: **Section 6.1.1.2 Non-Codebook based UL transmission in TS 38.214**  <Unchanged part omitted>  For non-codebook based transmission, the UE can calculate the precoder used for the transmission of SRS based on measurement of an associated NZP CSI-RS resource. A UE can be configured with only one NZP CSI-RS resource for the SRS resource set with higher layer parameter usage in *SRS-ResourceSet* set to 'nonCodebook' if configured. The associated NZP-CSI-RS is the NZP-CSI-RS in the indicated *DLorJoint-TCIState* or *UL-TCIstate,* if applicable.  **Alt 2:** **TS 38.214**  The DM-RS antenna ports  in Clause 6.4.1.1.3 of [4, TS 38.211] are determined according to the ordering of DM-RS port(s) given by Tables 7.3.1.1.2-6 to 7.3.1.1.2-23 in Clause 7.3.1.1.2 of [5, TS 38.212].  For non-codebook based transmission, the UE does not expect to be configured with both *spatialRelationInfo* for SRS resource and *associatedCSI-RS* in *SRS-ResourceSet* for SRS resource set.  For non-codebook based transmission, the UE does not expect to be configured with both *DLorJoint-TCIState* or *UL*-*TCIState* for SRS resource and *associatedCSI-RS* in *SRS-ResourceSet* for SRS resource set.  For non-codebook based transmission, when the SRS resource set is configured with *followUnifiedTCIstate-r17*, the UE does not expect to be configured *associatedCSI-RS* in *SRS-ResourceSet* for SRS resource set.  For non-codebook based transmission, the UE can be scheduled with DCI format 0\_1 or 0\_2 when at least one SRS resource is configured in *SRS-ResourceSet* with *usage* set to 'nonCodebook'.  **FL note**: The above two alternatives are from R1-2203257 and R1-2204169, respectively. | **Alt-1**: ZTE, Huawei/HiSilicon, LG  **Alt-2:** MTK, QC, OPPO, Apple, vivo, Spreadtrum  No change: SS |
| 3-5 | **Alt 1**: **Section 5.1.5 Antenna ports quasi co-location in TS 38.214**  < Unchanged parts are omitted >  When the UE would transmit the last symbol of a PUCCH with HARQ-ACK information corresponding to the DCI carrying the TCI State indication and without DL assignment, or corresponding to the PDSCH scheduling by the DCI carrying the TCI State indication, and if the indicated TCI State is different from the previously indicated one, the indicated *DLorJointTCIState* or *UL-TCIstate* should be applied starting from the first slot that is at least symbols after the last symbol of the PUCCH. The first slot and the symbols are both determined on the carrier with the smallest SCS among the carrier(s) applying the beam indication. The applied indicated TCI state should be based on the activated TCI states in each slot.  < Unchanged parts are omitted >  **Alt 2**: **Section 5.1.5 Antenna ports quasi co-location in TS 38.214**  <Unchanged parts are omitted>  If a PDSCH is scheduled by a DCI format having the TCI field present, the TCI field in DCI in the scheduling component carrier points to the activated TCI states in the scheduled component carrier or DL BWP, the UE shall use the *TCI-State* according to the value of the '*Transmission Configuration Indication*' field in the detected PDCCH with DCI for determining PDSCH antenna port quasi co-location. The UE may assume that the DM-RS ports of PDSCH of a serving cell are quasi co-located with the RS(s) in the TCI state with respect to the QCL type parameter(s) given by the indicated TCI state if the time offset between the reception of the DL DCI and the corresponding PDSCH is equal to or greater than a threshold *timeDurationForQCL*, where the threshold is based on reported UE capability [13, TS 38.306]. When the UE is configured with a single slot PDSCH, the indicated TCI state should be based on the activated TCI states in the slot with the scheduled PDSCH. When the UE is configured with a multi-slot PDSCH, the indicated TCI state should be based on the activated TCI states in the first slot with the scheduled PDSCH, and UE shall expect the activated TCI states are the same across the slots with the scheduled PDSCH. When the UE is configured with DLorJoint-TCIState-r17 and UL-TCIState-r17, the indicated TCI state(s) should be based on the activated TCI states in the slot with the TCI state indication DCI. When the UE is configured with CORESET associated with a search space set for cross-carrier scheduling and the UE is not configured with *enableDefaultBeamForCCS*, the UE expects *tci-PresentInDCI* is set as 'enabled' or *tci-PresentDCI-1-2* is configured for the CORESET, and if one or more of the TCI states configured for the serving cell scheduled by the search space set contains *qcl-Type* set to 'typeD', the UE expects the time offset between the reception of the detected PDCCH in the search space set and the corresponding PDSCH is larger than or equal to the threshold *timeDurationForQCL.*  <Unchanged parts are omitted>  **FL note**: The above are from P7 in R1-2203505 and P6 in R1-2203948, respectively. | **Alt-1**: MTK, ZTE, vivo, Google  **Alt-2: OPPO, Apple,** SS (reword “DLorJoint-TCIState-r17 and UL-TCIState-r17” to “DLorJoint-TCIState-r17 or UL-TCIState-r17”)  **Not supported: QC, Huawei/HiSilicon** |
| 3-7 | **Proposal 3-7:** For DCI format 1\_1 and 1\_2 with PDSCH assignment indicating TCI state, the acknowledgement to the TCI state update is the ACK of the PDSCH  **FL note**: The above has been discussed for several meeting, and either way we need to make a conclusion (or NACK is still possible). After that, we may discuss the following issues: in case of HARQ-ACK multiplexing, the TCI state(s) indicated in a DCI corresponding to last position with ACK value in the HARQ-ACK codebook is applied after application timing (P5 in R1-2203673, P6 in R1-2203771, P2 in R1-2204535). | **Support/fine**: QC, OPPO, Apple, ZTE, NEC, SS (when gNB can’t distinguish NACK and DTX)), Spreadtrum, Xiaomi  **Not support:** MTK, Google |
| 3-10 | **TP 3-10**: To endorse the following text proposal for TS 38.214:  **5.1.5 Antenna ports quasi co-location**  <Unchanged parts are omitted>  When the UE would transmit the last symbol of a PUCCH with HARQ-ACK information or a PUSCH with HARQ-ACK information corresponding to the DCI carrying the TCI State indication and without DL assignment, or corresponding to the PDSCH scheduling by the DCI carrying the TCI State indication, and if the indicated TCI State is different from the previously indicated one, the indicated *DLorJointTCIState* or *UL-TCIstate* should be applied starting from the first slot that is at least symbols after the last symbol of the PUCCH or the PUSCH. The first slot and the symbols are both determined on the carrier with the smallest SCS among the carrier(s) applying the beam indication.  <Unchanged parts are omitted> | **Support/fine**: MTK, QC, OPPO (ok with the TP even through it is not 100% needed.) Apple (clarification for PUSCH repetition case is needed), ZTE, NEC, SS, vivo, Google, Huawei/HiSilicon, Spreadtrum, Xiaomi  **Not support:** |

Table 6 Additional inputs: issue 3

|  |  |
| --- | --- |
| **Company** | **Input** |
| Mod V0 | 1. **Check and update your view in Table 5** 2. **Share more inputs here if needed** |
| MediaTek | Issue 3-1: Current spec already states clearly UE should apply the UL spatial filter determined from the indicated joint or UL TCI state, regardless what UL spatial filter applies to the corresponding SRS transmission. Thus, we prefer Alt4, which doesn't change current behavior. Otherwise, we don't see any change is needed since NW can make sure the alignment by its implementation. |
| QC | For 3-1, support Alt4, which seems the simplest clarification to support most use cases and also simplifies UE implementation to handle different configurations  For 3-3A and 3-3B, prefer active BWP. Otherwise, the BAT may be unnecessarily extended  For 3-4, support Alt2, which seems more general  For 3-5, we think both Alt1 and Alt2 are not needed. To our understanding, Alt1 is the legacy rule and does not need to mention just for R17  For 3-7, support. NACK does not work for all cases. At least ACK works.  For 3-10, fine, or remove PUCCH. |
| OPPO | Regarding Issue 3-1: to satisfy the specification that PUSCH and SRS use the same port since Rel-15, Alt4 seems to be the only choice. |
| ZTE | 3-1: Alt2 is our first choice. Single layer is not so sensitive to spatial relation misalignment between SRS and indicated TCI state (PUSCH).  Alt1 and Alt3 are similar, which are actually equal to the scheme that PUSCH with SRI directly follows spatial relation of most recent SRS instead of indicated TCI state. After the most recent SRS follows indicated TCI state, spatial relation based on SRS and the spatial relation based on indicated TCI are the same. In other words, unified TCI takes effect on PUSCH scheduled with SRI via SRS indirectly. This could also be acceptable.  Regarding Alt 4, it is hard to align configured *[TCI-State]s* with *[tci-StateId\_r17]* of the SRS resource(s) with the indicated *[TCI-State],* RRC can not be sent as frequently as MAC CE or DCI. It is more reasonable to expect SRS resource with CB/NCB to be configured with *followUnifiedTCIstate.*  Alternatively, this can also be up to implementation.  3-4: The indicated TCI state is applied to UL transmission (SRS and PUSCH) by determining spatial relation of UL transmission, and power control parameters related to the TCI state. In FR1, there is no need to determine spatial relation for UL transmission.  For non-codebook based transmission, the UE calculates the precoder used for the transmission of SRS based on measurement of an associated NZP CSI-RS resource.  If the associated NZP CSI-RS resource follows the indicated TCI state, at least follows the spatial relation of the indicated TCI state, precoder of SRS can be aligned with the indicated TCI state, consequently affect subsequent PUSCH transmissions. Otherwise, precoder of SRS can only be determined based on the asssociated NZP CSI-RS resource which may not be aligned (or QCLed) with the indicated TCI state, the indicated TCI state cannot be applied to SRS and PUSCH timely.  Alt 2 is similar to Alt1. If not configured with *associatedCSI-RS*, (and the SRS resource set is configured *followUnifiedTCIstate-r17*), how the UE determines precoder for SRS resources should be specified further, especially for FR1.  3-5: Unified TCI state can be updated by same codepoint index in a new MAC CE activating a set of TCI states. |
| NEC | For 3-1. We support Alt 3. Compared to Alt 4, Alt 3 further guarantees that both PUSCH and SRS are transmitted with the same UL beam.  For 3-7. Support, we also think NACK doesn’t work. If NACK can be applied for confirmation of TCI update, we are wondering the need of HARQ-ACK feedback for TCI application.  For 3-10. Support. |
| vivo | For 3-1, Alt-4 is enough and simple to ensure the TCI state alignment between PUSCH and SRS.  For 3-3, support that the TCI update signaling is applied to active BWP, and the BAT should count the *BeamAppTime\_r17* in active BWP only.  When the TCI state update signaling is applied to all configured BWPs and the BAT counts *BeamAppTime\_r17* in all configured BWPs, there is a possibility that the SCS configured for an inactive BWP is smaller than that for the active BWPs in the configured CC list, and is used to determine the beam application time for all configured CCs/BWPs, which leads to unnecessary large latency.  For 3-4, Alt-2 is similar to the Rel-15/16 spec, where for non-codebook based transmission, the UE does not expect to be configured with both *spatialRelationInfo* for SRS resource and *associatedCSI-RS* in *SRS-ResourceSet* for SRS resource set.  For 3-5, support Alt-1.  There is ambiguity in current spec regarding which TCI state is used for DCI based beam indication when there is MAC CE update of active TCI state list.  For Rel-17 unified TCI framework, the similar principle with Rel-15/16 single slot PDSCH can be reused for application of the indicated TCI state.  In addition, for multi-slot transmission and reception, there is ambiguity whether all the transmission occasions should use the same TCI state across multiple slots or updated per occasion basis based on indicated beams. This issue will affect the UE behavior in 52.6GHz, so it is necessary to be discussed and clarified as follows.  **TS 38.214**  **5.1.5 Antenna ports quasi co-location**  < Unchanged parts are omitted >  When the UE would transmit the last symbol of a PUCCH with HARQ-ACK information corresponding to the DCI carrying the TCI State indication and without DL assignment, or corresponding to the PDSCH scheduling by the DCI carrying the TCI State indication, and if the indicated TCI State is different from the previously indicated one, the indicated *DLorJointTCIState* or *UL-TCIstate* should be applied starting from the first slot that is at least symbols after the last symbol of the PUCCH. The first slot and the symbols are both determined on the carrier with the smallest SCS among the carrier(s) applying the beam indication. For the DL/UL channel over multiple slots, including multi-slot PDSCH, PUCCH repetition, PUSCH repetition, multi-slot PUSCH, multiple PDSCHs/PUSCHs scheduled by DCI, the indicated *DLorJointTCIState* or *UL-TCIstate* is applied for the transmission/reception occasions after BAT.  < Unchanged parts are omitted > |
| Google | **Issue 3-3**: We share similar views with QC.  **Issue 3-5**: We support Alt-1, which is clearer to address the ambiguity.  **Issue 3-10**: Support the TP, which is a good clarification. |
| Huawei, HiSilicon | For 3-3A: support Alt-2. The TCI update signaling is applied only to the active BWP, but the updated TCI-state is applied for all the configured BWPs. |
| Spreadtrum | Issue 3-4: Alt 2 is aligned with the restriction of concurrent configuration of UL beam and associated CSI-RS for SRS.  Issue 3-5: For Alt-1, we suggest to delete’ applied’. The red sentence is only about which TCI state is indicated. Regarding the TCI state application, it has been specified that for multi-slot PDSCH, the indicated TCI state is not always applied: ‘When the UE is configured with a multi-slot PDSCH, the indicated TCI state should be based on the activated TCI states in the first slot with the scheduled PDSCH, and UE shall expect the activated TCI states are the same across the slots with the scheduled PDSCH.’ |
| Xiaomi | Proposal 3-3A: prefer Alt-2  Proposal 3-3B: prefer Alt-2  Proposal 3-7: support it and prefer to specific the case of HARQ-ACK multiplexing.  TP 3-10: support |
| Huawei, HiSilicon | For 3-5, we have concern with both TPs. Alt1 is unclear. Alt2 cannot work when UE processing time to receive the DCI and read its content is larger than the slot time. This can happen especially in FR2-2. |
| LG | Issue 3-1: We have a similar understanding with MediaTek and Qualcomm to handle the mismatch between TCI state and SRI indication. To make it more clear, we suggest the following.  When UE is indicated with an SRI corresponding to the UL transmission and UE is configured *DLorJointTCIState* or *UL-TCIState*, if the spatial domain transmission filter associated with the indicated SRI is different from the spatial domain transmission filter by the TCI state, the UE applies the UL spatial filter determined from the indicated *DLorJointTCIState* or *UL-TCIState*  Issue 3-4: When the associated NZP CSI-RS resource follows the indicated TCI state, the precoder of SRS can be aligned with the indicated TCI state for non-codebook based transmission where the UE calculates the precoder based on measurement of an associated NZP CSI-RS resource. |

### Issue 4 (MP-UE)

Table 7 Summary: issue 4

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| --- | --- | --- |
| **#** | **Issue** | **Companies’ views** |
| 4-2 | **Proposal 4-2**: On Rel.17 enhancements to facilitate UE-initiated panel activation and selection, down-select one of the following   * Alt-1: Introduce an RRC parameter to provide the indication of enabled UE capability index(es)   + The bitwidth and interpretation of the capability index reported in beam report should be based on the configured UE capability index(es) instead of UE capability report * Alt-2: The bitwidth of the capability index reported in beam report is fixed to 2-bit.   **FL Note:** Besides for Alt1 from Apple, Alt-2 is based on E///, SS and OPPO’s suggestion in the preparation phase. | **Alt-1**: MTK, QC, Apple, ZTE, NTT DOCOMO, Huawei/HiSilicon  **Alt-2:** OPPO |

Table 8 Additional inputs: issue 4

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| --- | --- |
| **Company** | **Input** |
| Mod V0 | 1. **Check and update your view in Table 7** 2. **Share more inputs here if needed** |
| QC | For Proposal 4-2, fine for Alt1. Although optimization, but it is simple |
| OPPO | Regarding 4-2: Alt-1 is optimization. |
| ZTE | 4-2: We prefer a flexible bitsize which is more extendable. |
| NTT DOCOMO | Our first preference is Alt.1, while we can also accept Alt.2. |
| Spreadtrum | No strong preference. We are OK with majority view. |
| LG | We are OK with either Alts |

### Issue 5 (MPE)

None.

## Summary of Editorial (E) issues

### Issue 1 (Rel.17 unified TCI framework)

Table 9 Summary: issue 1

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| --- | --- | --- |
| **#** | **Issue** | **Companies’ views** |
| 1-5 | **TP 1-5**: To endorse the following text proposal for TS 38.213:  **7 Uplink Power control**  < Unchanged parts are omitted >  - in clause 7.3.1, if *p0-Alpha-CLID-SRS-Set* is provided  - if *useIndicatedTCIState* is provided for a SRS resource set, the values of , , and SRS power control adjustment state are provided by *p0-Alpha-CLID-SRS-Set* associated with the indicated *DLorJoint-TCIState* or *UL-TCIState*  - else, if *useIndicatedTCIState* is not provided for a SRS resource set and for a ~~first~~ SRS resource from the SRS resource set, the values of , , and SRS power control adjustment state are provided by *p0-Alpha-CLID-SRS-Set* associated with *DLorJoint-TCIState* or *UL-TCIState* of an SRS resource with lowest *SRS-ResourceId* in the SRS resource set and a RS index for obtaining a pathloss estimate for the SRS transmission is provided by PL-RS associated with or included in the ~~indicated~~ *DLorJoint-TCIState* or *UL-TCIState* of an SRS resource with lowest *SRS-ResourceId* in the SRS resource set  < Unchanged parts are omitted >  **FL Note:** Above is based on Xiaomi’s version. | **Support/fine**: MTK, QC, OPPO, Apple, ZTE, SS, Google, Spreadtrum, Xiaomi, Huawei/HiSilicon, LG  **Not support:** |
| 1-6 | **TP 1-6**: To endorse the following text proposal for TS 38.213:  **7         Uplink Power control**  < Unchanged parts are omitted >  In the remaining of this clause, if a UE is provided *DLorJoint-TCIState* or *UL-TCIstate* and for an indicated *DLorJoint-TCIState* or *UL-TCIstate* as described in [6, TS 38.214]  - in clauses 7.1.1, 7.2.1, and 7.3.1, the RS index for obtaining the downlink pathloss estimate for PUSCH, PUCCH, and SRS transmission is provided by *PL-RS* ~~associated with or~~ included in the indicated *DLorJoint-TCIState* or *UL-TCIstate* except for SRS transmission that is not provided *useIndicatedTCIState*  - in clause 7.1.1, if *p0-Alpha-CLID-PUSCH-Set* is provided, the values of , , and the PUSCH power control adjustment state are provided by *p0-Alpha-CLID-PUSCH-Set* ~~associated with~~ included in the indicated *DLorJoint-TCIState* or *UL-TCIstate*  - in clause 7.2.1, if *p0-Alpha-CLID-PUCCHSet* is provided, the values of and the PUCCH power control adjustment state are provided by *p0-Alpha-CLID-PUCCH-Set* ~~associated with~~ included in the indicated *DLorJoint-TCIState* or *UL-TCIstate*  - in clause 7.3.1, if *p0-Alpha-CLID-SRS-Set* is provided,  - if *useIndicatedTCIState* is provided for a SRS resource set, the values of , , and SRS power control adjustment state are provided by *p0-Alpha-CLID-SRS-Set* ~~associated with~~ included in the indicated *DLorJoint-TCIState* or *UL-TCIState*  - else, if *useIndicatedTCIState* is not provided for a SRS resource set and for a first SRS resource from the SRS resource set, the values of , , and SRS power control adjustment state are provided by *p0-Alpha-CLID-SRS-Set* ~~associated with~~ included in the *DLorJoint-TCIState* or *UL-TCIState* of an SRS resource with lowest *SRS-ResourceId* in the SRS resource set and a RS index for obtaining a pathloss estimate for the SRS transmission is provided by PL-RS ~~associated with or~~ included in the indicated *DLorJoint-TCIState* or *UL-TCIState* of an SRS resource with lowest *SRS-ResourceId* in the SRS resource set  < Unchanged parts are omitted > | **Support/fine**: QC, OPPO, ZTE, SS, Google, LG  **Not support:** MTK, Apple, vivo, Spreadtrum, Huawei/HiSilicon |
| 1-11 | **TP 1-11**: To endorse the following text proposal for TS 38.214:  **5.1.5 Antenna ports quasi co-location**  The UE receives an activation command, as described in clause 6.1.3.14 of [10, TS 38.321] or 6.1.3.x of [10, TS 38.321], used to map up to 8 TCI states and/or pairs of TCI states, with one TCI state for DL channels/signals and one TCI state for UL channels/signals to the codepoints of the DCI field *'Transmission Configuration Indication'* for one or for a set of CCs/DL BWPs, and if applicable, for one or for a set of CCs/UL BWPs. When a set of TCI state IDs are activated for a set of CCs/DL BWPs and if applicable, for a set of CCs/UL BWPs, where the applicable list of CCs is determined by the indicated CC in the activation command, the same set of TCI state IDs are applied for all DL and/or UL BWPs in the indicated CCs. If the activation command only includes *DLorJointTCIState* and/or *UL-TCIState* mapped to one TCI codepoint, UE shall apply the indicated *DLorJointTCIState* and/or *UL-TCIState.*  **FL Note:** Above is provided based on DOCOMO’s version, after reviewing several candidate TP. Then we can refine the wording, if needed. | **Support/fine**: Apple, ZTE, NEC (should update with MAC confirmation timing), SS, Google, Huawei/HiSilicon (support with modification)  **Not support:** MTK, OPPO, vivo, LG |
| 1-13 | **TP 1-13**: To endorse the following text proposal for TS 38.213:  **6 Link recovery procedures**  < Unchanged parts are omitted >  If a UE is provided *TCI-State\_r17* indicating a unified TCI state for the PCell or the PSCell [6, TS 38.214], after X symbols from a last symbol of a first PDCCH reception in a search space set provided by *recoverySearchSpaceId* where the UE detects a DCI format with CRC scrambled by C-RNTI or MCS-C-RNTI, the UE  - if *AdditionalPCIInfo* is not provided, monitors PDCCH in all CORESETs, and receives PDSCH and aperiodic CSI-RS ~~in a~~ resource ~~from~~ in a CSI-RS resource set with same indicated TCI state as for the PDCCH and PDSCH, using the same antenna port quasi co-location parameters as the ones associated with the corresponding index , if any  - transmits PUCCH, PUSCH and SRS that uses a same spatial domain filter with same indicated TCI state as for the PUCCH and the PUSCH, using a same spatial domain filter as for the last PRACH transmission  < Unchanged parts are omitted >  If a UE is provided *TCI-State\_r17* indicating a unified TCI state for the PCell or the PSCell and the UE provides BFR MAC CE in Msg3 or MsgA of contention based random access procedure, after X symbols from the last symbol of the PDCCH reception that determines the completion of the contention based random access procedure as described in [11, TS 38.321], the UE  - if *AdditionalPCIInfo* is not provided, monitors PDCCH in all CORESETs, and receives PDSCH and aperiodic CSI-RS resource in a CSI-RS resource set with same indicated TCI state as for the PDCCH and PDSCH using the same antenna port quasi co-location parameters as the ones associated with the corresponding index , if any  - transmits PUCCH, PUSCH and SRS that uses a same spatial domain filter with same indicated TCI state as for the PUCCH and PUSCH, using a same spatial domain filter as for the last PRACH transmission  < Unchanged parts are omitted >  If a UE is provided *TCI-State\_r17* indicating a unified TCI state, after X symbols from a last symbol of a PDCCH reception with a DCI format scheduling a PUSCH transmission with a same HARQ process number as for the transmission of the first PUSCH and having a toggled NDI field value, the UE  - monitors PDCCH in all CORESETs, and receives PDSCH and aperiodic CSI-RS ~~in a~~ resource ~~from~~ in a CSI-RS resource set using the same antenna port quasi co-location parameters as the ones associated with the corresponding index , if any  - transmits PUCCH, PUSCH and SRS that uses a same spatial domain filter with same indicated TCI state as for the PUCCH and PUSCH, using a same spatial domain filter as the one corresponding to , if any  < Unchanged parts are omitted > | **Support/fine**: MTK, OPPO, Langbo, ZTE, SS, vivo, Google, Spreadtrum, Huawei/ HiSilicon, LG  **Not support:** Apple |
| 1-19 | **TP 1-19**: To endorse the following text proposal for TS 38.213:  **6 Link recovery procedures**  < Unchanged parts are omitted >  If the UE is not provided by *failureDetectionResourcesToAddModList* for a BWP of the serving cell, the UE determines the set to include periodic CSI-RS resource configuration indexes with same values as the RS indexes in the RS sets indicated by *TCI-State* or *DLorJointTCIState* for respective CORESETs that the UE uses for monitoring PDCCH. If the UE is not provided or for a BWP of the serving cell, the UE determines the set or to include periodic CSI-RS resource configuration indexes with same values as the RS indexes in the RS sets indicated by *TCI-State* for first and second CORESETs that the UE uses for monitoring PDCCH, where the UE is provided two coresetPoolIndex values 0 and 1 for the first and second CORESETs, or is not provided coresetPoolIndex value for the first CORESETs and is provided coresetPoolIndex value of 1 for the second CORESETs, respectively. If there are two RS indexes in a TCI state, the set or , or includes RS indexes configured with *qcl-Type* set to 'typeD' for the corresponding TCI states. If a CORESET that the UE uses for monitoring PDCCH includes two TCI states and the UE is provided *sfnSchemePdcch* set to 'sfnSchemeA' or 'sfnSchemeB', the set includes RS indexes in the RS sets associated with the two TCI states. The UE expects the set to include up to two RS indexes. If the UE is provided or , the UE expects the set or the set to include up to a number of RS indexes indicated by *capabilityparametername*. If the UE is not provided or , and if a number of active TCI states for PDCCH receptions in the first or second CORESETs is larger than , the UE determines the set or to include periodic CSI-RS resource configuration indexes with same values as the RS indexes in the RS sets associated with the active TCI states for PDCCH receptions in the first or second CORESETs corresponding to search space sets according to an ascending order for monitoring periodicity. If more than one first or second CORESETs correspond to search space sets with same monitoring periodicity, the UE determines the order of the first or second CORESETs according to a descending order of a CORESET index.  **FL Note:** Above is provided based on P4 in R1-2204031. | **Support/fine**: MTK, OPPO, Langbo, Apple, ZTE, SS, vivo, Google, Spreadtrum, Xiaomi, Huawei/ HiSilicon, LG  **Not support:** |
| 1-31 | **TP 1-31**: To endorse the following text proposal for TS 38.214:  **5.1.5 Antenna ports quasi co-location**  Independent of the configuration of *tci-PresentInDCI* and *tci-PresentDCI-1-2* in RRC connected mode, if the offset between the reception of the DL DCI and the corresponding PDSCH is less than the threshold *timeDurationForQCL* and at least one configured TCI state for the serving cell of scheduled PDSCH contains *qcl-Type* set to 'typeD',  - if the UE is not provided *DLorJoint-TCIState-r17* indicating a unified TCI state, the UE may assume that the DM-RS ports of PDSCH(s) of a serving cell are quasi co-located with the RS(s) with respect to the QCL parameter(s) used for PDCCH quasi co-location indication of the CORESET associated with a monitored search space with the lowest *controlResourceSetId* in the latest slot in which one or more CORESETs within the active BWP of the serving cell are monitored by the UE. Otherwise, the UE may assume that the QCL parameters of PDSCH(s) of a serving cell are determined by the indicated unified TCI state. In those cases ~~this case~~, if the *qcl-Type* is set to 'typeD' of the PDSCH DM-RS is different from that of the PDCCH DM-RS with which they overlap in at least one symbol, the UE is expected to prioritize the reception of PDCCH associated with that CORESET. This also applies to the intra-band CA case (when PDSCH and the CORESET are in different component carriers). | **Support/fine**: QC, Apple, ZTE, Huawei/ HiSilicon  **Not support:** MTK (need modification), OPPO (the current TP has some problem), SS (see modification), vivo (needs clarification if there are channels not applying the indicated beam), Google (discuss after decision of Issue 2-3) |

Table 10 Additional inputs: issue 1

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| --- | --- |
| **Company** | **Input** |
| Mod V0 | 1. **Check and update your view in Table 9** 2. **Share more inputs here if needed** |
| MediaTek | Issue 1-6: According to current RRC design, these UL PC parameters are not directly configured in the TCI state, and corresponding setting ID is used instead. Thus, we prefer to use “associated with” rather than “included in”.  Issue 1-11: Even in Rel-15/16, the behavior if only one codepoint is activated is not explicitly specified since it is straightforward. We fail to see why this must be captured for Rel-17 unified TCI.  Issue 1-31: We are fine the preclude the default PDSCH behavior if UE configured with Rel-17 TCI since this is not needed. According to current spec, UE always applies the indicated TCI state for PDSCH reception regardless before or after *timeDurationForQCL.*  **5.1.5 Antenna ports quasi co-location**  Independent of the configuration of *tci-PresentInDCI* and *tci-PresentDCI-1-2* in RRC connected mode, if the offset between the reception of the DL DCI and the corresponding PDSCH is less than the threshold *timeDurationForQCL* and at least one configured TCI state for the serving cell of scheduled PDSCH contains *qcl-Type* set to 'typeD',  - if the UE is not provided *DLorJoint-TCIState-r17*, the UE may assume that the DM-RS ports of PDSCH(s) of a serving cell are quasi co-located with the RS(s) with respect to the QCL parameter(s) used for PDCCH quasi co-location indication of the CORESET associated with a monitored search space with the lowest *controlResourceSetId* in the latest slot in which one or more CORESETs within the active BWP of the serving cell are monitored by the UE.. In this case, if the *qcl-Type* is set to 'typeD' of the PDSCH DM-RS is different from that of the PDCCH DM-RS with which they overlap in at least one symbol, the UE is expected to prioritize the reception of PDCCH associated with that CORESET. This also applies to the intra-band CA case (when PDSCH and the CORESET are in different component carriers). |
| QC | For TP 1-31, we still prefer original TP structure to clearly state that the indicated TCI is applied to the default beam. Because other parts of the spec are still not clear for the default beam behavior. For example, like the paragraph below, UE still does not know which TCI to apply as default beam if the UE is provided *DLorJoint-TCIState-r17*  The UE can be configured with a list of up to *128* *DLorJointTCIState* configurations, within the higher layer parameter *PDSCH-Config* for providing a reference signal for the quasi co-location for DM-RS of PDSCH and DM-RS of PDCCH in a CC, for CSI-RS, and to provide a reference, if applicable, for determining UL TX spatial filter for dynamic-grant and configured-grant based PUSCH and PUCCH resource in a CC, and SRS. |
| OPPO | Issue #1: we do not have the term “unified TCI state” defined in the spec.  Issue #2: Apply indicated TCI as default beam is not editorial change, instead it is a new function. In both intra-cell and inter-cell beam management, we are not sure if setting the default beam to be the DCI-indicated TCI state is the correct choice. For example, in inter-cell BM case, the CSS and associated PDSCH do not follow the inter-cell TCI state, if the design of “applying indicated TCI as default beam”, then the system would have to apply some inter-cell TCI state on PDSCH associated with the CSS, which contradict with the original design. |
| NEC | Issue 1-11, we are fine in general.  We think this issue is similar as the case of only one *DLorJointTCIState* and/or *UL-TCIState* configured in RRC, which we discussed in last meeting, and the only TCI state is applied. Similarly, if only one joint or DL+ UL TCI state activated in MAC, we think the TCI state should be applied after MAC confirmation. If without this, do we need further delay of (DCI indication + HARQ-ACK feedback + beam application time) to apply the TCI state?  We have the agreement of MAC-based TCI update and MAC+DCI based TCI update, but no capturing of MAC-based TCI update in the specification.   |  | | --- | | **Agreement**  On beam indication signaling medium to support joint or separate DL/UL beam indication in Rel.17 unified TCI framework:   * Support L1-based beam indication using at least UE-specific (unicast) DCI to indicate joint or separate DL/UL beam indication from the active TCI states   + The existing DCI formats 1\_1 and 1\_2 are reused for beam indication   + Support a mechanism for UE to acknowledge successful decoding of beam indication     - The ACK/NAK of the PDSCH scheduled by the DCI carrying the beam indication can be used as an ACK also for the DCI     - FFS: Whether any additional specification support is needed * Support activation of one or more TCI states via MAC CE analogous to Rel.15/16:   + At least for the single activated TCI state, the activated TCI state is applied   + The content for the MAC CE is determined based on the outcome of issue 1   + FFS: If supported, default TCI state when more than one TCI states are activated by MAC CE   + Note: There is no implications on the support of single TRP or multi-TRP * FFS: Additional enhancement such as L1-based beam indication with group-common DCI * FFS: Whether the Rel.17 beam indication can also apply to beam indication for single channel (e.g. PDSCH only, single CORESET) or a subset of channels * FFS: Additional details on extending the support of L1-based beam indication when separate UL (from DL) common beam indication is configured   **Agreement**  On Rel-17 DCI-based beam indication, regarding application time of the beam indication for CA, the first slot and the Y symbols are both determined on the carrier with the smallest SCS among the carrier(s) applying the beam indication.   * For Rel-17 MAC-CE based beam indication (when only a single TCI codepoint is activated) and activation, it follows the Rel-16 application timeline of MAC-CE activation   How to capture this in the specifications is up to the editors |   Considering the MAC CE confirmation timing, we propose to update the TP to be:   |  | | --- | | < Unchanged parts are omitted >  When the UE would transmit a PUCCH with HARQ-ACK information in slot *n* corresponding to the PDSCH carrying the activation command, the indicated mapping between TCI states and codepoints of the DCI field *'Transmission Configuration Indication'* should be applied starting from the first slot that is after slot where ** is the SCS configuration for the PUCCH and is the subcarrier spacing configuration for with a value of 0 for frequency range 1, and is provided by *K-Mac* or if *K-Mac* is not provided. If *tci-PresentInDCI* is set to 'enabled' or *tci-PresentDCI-1-2* is configured for the CORESET scheduling the PDSCH, and the time offset between the reception of the DL DCI and the corresponding PDSCH is equal to or greater than *timeDurationForQCL* if applicable, after a UE receives an initial higher layer configuration of TCI states and before reception of the activation command, the UE may assume that the DM-RS ports of PDSCH of a serving cell are quasi co-located with the SS/PBCH block determined in the initial access procedure with respect to *qcl-Type* set to 'typeA', and when applicable, also with respect to *qcl-Type* set to 'typeD'.  If there is only one DLorJoint-TCIState that can be used as an indicated TCI state in the activation command, the UE obtains the QCL assumptions from the activated TCI state for DM-RS of PDSCH and DM-RS of PDCCH, and the CSI-RS applying the indicated TCI state starting from the first slot that is after slot where ** is the SCS configuration for the PUCCH and is the subcarrier spacing configuration for with a value of 0 for frequency range 1, and is provided by *K-Mac* or if *K-Mac* is not provided.  If there is only one DLorJoint-TCIState or UL-TCIState that can be used as an indicated TCI state in the activation command, the UE determines an UL TX spatial filter, if applicable, from the activated TCI state for dynamic-grant and configured-grant based PUSCH and PUCCH, and SRS applying the indicated TCI state starting from the first slot that is after slot where ** is the SCS configuration for the PUCCH and is the subcarrier spacing configuration for with a value of 0 for frequency range 1, and is provided by *K-Mac* or if *K-Mac* is not provided. | |
| Samsung | For **1-31:** Suggest to move “if the UE is not provided *DLorJoint-TCIState-r17*” to the main paragraph. None of the cases in the sub-bullets apply to the unified TCI state.  Independent of the configuration of *tci-PresentInDCI* and *tci-PresentDCI-1-2* in RRC connected mode, if the UE is not provided *DLorJoint-TCIState-r17* and if the offset between the reception of the DL DCI and the corresponding PDSCH is less than the threshold *timeDurationForQCL* and at least one configured TCI state for the serving cell of scheduled PDSCH contains *qcl-Type* set to 'typeD', |
| vivo | For TP 1-6, it can be clarified what the wording ‘associated with’ and ‘included in’ means.  For TP 1-31, this issue is not editorial and needs to be discussed. For CORESETs not configured to follow the Rel-17 unified TCI state and the respective PDSCH, they should not follow the indicated TCI state.  . |
| Google | **Issue 1-6**: To us, current RRC structure means UL PC parameters or PL-RS is “included in” joint/DL TCI or UL TCI.  **Issue 1-11**: We suggest capturing the existing agreement. This intended behavior is very similar to configuration of a single *DLorJoint-TCIState* or *UL-TCIState*. We don’t understand why one is captured and the other is not.  **Issue 1-31**: This issue seems related to the outcome of Issue 2-3. Suggest deferring the discussion until the decision of Issue 2-3. |
| Spreadtrum | **TP 1-6:** Based on 38.331, PC setting and PL-RS are individually configured in a list. Based on our understanding, the RRC parameters Uplink-powerControlId and PUSCH-pathlossReferenceRS-Id are considered included in a TCI state, but PC setting and PL-RS should be considered as being associated with a TCI state. This is similar with the associated CSI-RS configuration for SRS.  **TP 1-31:** It is related with proposal 2-3. |
| Xiaomi | **TP 1-19:** support  **TP 1-31:** support the modification by SS |
| Huawei/HiSilicon | For 1-6, it should be “associated with” according to RAN1 agreement.  For 1-11, we suggest the following modification:  The UE receives an activation command, as described in clause 6.1.3.14 of [10, TS 38.321] or 6.1.3.x of [10, TS 38.321], used to map up to 8 TCI states and/or pairs of TCI states, with one TCI state for DL channels/signals and one TCI state for UL channels/signals to the codepoints of the DCI field *'Transmission Configuration Indication'* for one or for a set of CCs/DL BWPs, and if applicable, for one or for a set of CCs/UL BWPs. When a set of TCI state IDs are activated for a set of CCs/DL BWPs and if applicable, for a set of CCs/UL BWPs, where the applicable list of CCs is determined by the indicated CC in the activation command, the same set of TCI state IDs are applied for all DL and/or UL BWPs in the indicated CCs. If the activation command only includes *DLorJointTCIState* and/or *UL-TCIState* mapped to one TCI codepoint, UE shall apply the indicated *DLorJointTCIState* and/or *UL-TCIState* in the activation command. |
| LG | Issue 1-6: As CATT pointed out, the PC settings for PUSCH, PUCCH, and SRS transmission has been decided by RAN2 to be included in joint/UL TCI state and the description can be aligned correspondingly.  Issue 1-11: We have a similar view with MediaTek that there is no need to specify the straightforward behavior. |

### Issue 2 (inter-cell beam management)

Table 11 Summary: issue 2

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| **#** | **Issue** | **Companies’ views** |
| 2-4 | **TP 2-4**: To endorse the following text proposal for TS 38.214:  **5.1.5 Antenna ports quasi co-location**  < Unchanged parts are omitted >   * If the UE is configured with ~~[~~*~~NumberOfAdditionalPCI~~*~~]~~ *additionalPCI-r17* and with *PDCCH-Config* that contains two different values of *coresetPoolIndex* in *ControlResourceSet*, the UE receives an activation command for CORESET associated with each *coresetPoolIndex*, as described in clause 6.1.3.14 of [10, TS 38.321], used to map up to 8 TCI states to the codepoints of the DCI field *'Transmission Configuration Indication'* in one CC/DL BWP. When a set of TCI state IDs are activated for a *coresetPoolIndex*, the activated TCI states corresponding to one *coresetPoolIndex* can be associated with one physical cell ID and activated TCI states corresponding to another *coresetPoolIndex* can be associated with another physical cell ID.   < Unchanged parts are omitted > | **Support/fine**: MTK, Apple, ZTE, SS, Google (suggest *SSB-MTC-AddtionalPCI*), Spreadtrum, Huawei/HiSilicon, LG  **Not support:** |
| 2-5 | **TP 2-5**: To endorse the following text proposal for TS 38.214:  **5.2.1.4.3 L1-RSRP Reporting**  < Unchanged parts are omitted >  When the UE is configured with *SSB-MTC-AddtionalPCI-r17*~~[~~*~~NumberOfAdditionalPCI~~*~~]~~, a CSI-SSB-ResourceSet configured for L1-RSRP reporting includes one ~~or more~~ set~~s~~ of SSB indices and one set of PCI indices, where each SSB index is associated with a PCI index. ~~PCI indices are associated with the sets of SSB indices, respectively.~~  < Unchanged parts are omitted > | **Support/fine**: MTK, Apple, ZTE (PCI index should be *AdditionalPCIIndex-r17*), SS, vivo, Google, Spreadtrum, Huawei/HiSilicon, LG  **Not support:** |
| 2-8 | **TP 2-8**: To endorse the following text proposal for TS 38.214:  **5.2.1.4.3 L1-RSRP Reporting**  \*\*\* Unchanged text is omitted \*\*\*  When the UE is configured with [*NumberOfAdditionalPCI*], the higher layer parameter groupBasedBeamReporting set to 'disabled', and nrofReportedGroups-r17 is not configured, a CSI-SSB-ResourceSet configured for L1-RSRP reporting includes one or more sets of SSB indices where PCI indices are associated with the sets of SSB indices, respectively.  \*\*\* Unchanged text is omitted \*\*\* | **Support/fine**: MTK, OPPO, Spreadtrum, LG  **Not support: QC, Apple, ZTE,** Huawei/HiSilicon |

Table 12 Additional inputs: issue 2

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| --- | --- |
| **Company** | **Input** |
| Mod V0 | 1. **Check and update your view in Table 10** 2. **Share more inputs here if needed** |
| MediaTek | Issue 2-4: We prefer to use “SSB-MTC-AddtionalPCI-r17” instead of “additionalPCI-r17” to make spec more consistent.  Issue 2-8: We prefer to use “SSB-MTC-AddtionalPCI-r17” instead of “[*NumberOfAdditionalPCI*]” to make spec more consistent. |
| QC | For TP 2-8, we have different understanding on the conclusion. To our understanding, it simply says the L1-RSRP scheme agreed in MB does not include group-based report. This is natural, since group-based report should be discussed in mTRP BM session. The conclusion does not say group-based report cannot have non-serving SSB for measurement. It just says MB will not make such decision. Based on RAN2 spec, it is allowed to our understanding. Otherwise, we are not clear why we need to unnecessarily forbid gNB using group report to select the beam group for inter-cell mTRP? Any better way to do that?  **Conclusion**  On Rel-17 enhancements for inter-cell beam management and inter-cell mTRP, in Rel-17, there is no consensus that the agreed L1-RSRP measurement/reporting also includes group-based beam report for inter-cell mTRP |
| ZTE | 2-8: We don’t need this restriction. The current spec is better for forward compatibility. |
| vivo | For TP 2-4: Share the same view with MTK.  For TP 2-5: Support |
| Google | **Issue 2-4, 2-5 and 2-8**: For these issues, we suggest using *SSB-MTC-AddtionalPCI*. |
| Spreadtrum |  |

### Issue 3 (signaling medium)

Table 13 Summary: issue 3

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| **#** | **Issue** | **Companies’ views** |
| 3-8 | **TP 3-8**: To endorse the following text proposal for TS 38.214:  **5.1.5 Antenna ports quasi co-location**  < Unchanged parts are omitted >  When the UE would transmit the last symbol of a PUCCH with HARQ-ACK information corresponding to the DCI carrying the *TCI-State* indication and without DL assignment, or corresponding to the PDSCH scheduling by the DCI carrying the TCI -State indication, and if the *indicated TCI-State* is different from the ~~previously indicated one~~one being applied, the indicated *[TCI-State]* with[*tci-StateId\_r17]* should be applied starting from the first slot that is at least symbols after the last symbol of the PUCCH.  < Unchanged parts are omitted > | **Support/fine**: MTK, Apple, ZTE, vivo, Google, Spreadtrum, Xiaomi, Huawei/HiSilicon, LG  **Not support:** |

Table 12 Additional inputs: issue 3

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| --- | --- |
| **Company** | **Input** |
| Mod V0 | 1. **Check and update your view in Table 11** 2. **Share more inputs here if needed** |
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### Issue 4 (MP-UE)

Table 13 Summary: issue 3

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| **#** | **Issue** | **Companies’ views** |
| 4-1 | **TP 4-1**: To endorse the following text proposal for TS 38.214:  **5.2.1.4 Reporting configurations**  A CSI Reporting Setting is said to have a wideband frequency-granularity if  - *reportQuantity* is set to 'cri-RI-PMI-CQI', or 'cri-RI-LI-PMI-CQI', *cqi-FormatIndicator* is set to 'widebandCQI' and *pmi-FormatIndicator* is set to 'widebandPMI', or  - *reportQuantity* is set to 'cri-RI-PMI-CQI', or 'cri-RI-LI-PMI-CQI', *codebookType* is set to 'typeII-PortSelection-r17' with M=1 and *cqi-FormatIndicator* is set to 'widebandCQI', or  - *reportQuantity* is set to 'cri-RI-i1' or  - *reportQuantity* is set to 'cri-RI-CQI' or 'cri-RI-i1-CQI' and *cqi-FormatIndicator* is set to 'widebandCQI', or  - *reportQuantity* is set to 'cri-RSRP' or 'ssb-Index-RSRP' or 'cri-SINR', or 'ssb-Index-SINR', or  - *reportQuantity-r17* is set to ~~or~~ 'cri-RSRP-Capability~~[Set]~~Index' or 'ssb-Index-RSRP-Capability~~[Set]~~Index' or 'cri-SINR-Capability~~[Set]~~Index', or 'ssb-Index-SINR-Capability~~[Set]~~Index'  **FL Note:** If anything else, please share them. Thank you. | **Support/fine**: MTK, OPPO, Apple, vivo, NTT DOCOMO, Spreadtrum, Huawei/HiSilicon  **Not support:** SS |

Table 14 Additional inputs: issue 4

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| --- | --- |
| **Company** | **Input** |
| Mod V0 | 1. **Check and update your view in Table 13** 2. **Share more inputs here if needed** |
| Samsung | Not essential. We don’t see the need to introduce a new RRC parameter at this point. Similar to R16, where two new beam reports (CRI, L1-SINR) and (SSBRI, L1-SINR) were added as candidate values for the existing (R15) *reportQuantity*, we can just add 4 new beam reports to the existing *reportQuantity*. This has been done for other RRC parameters as well, e.g. *codebookType* |
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### Issue 5 (MPE)

Table 15 Summary: issue 5

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| **#** | **Issue** | **Companies’ views** |
| 3-11 | **Proposal**: On Rel.17 enhancements to facilitate MPE mitigation, send LS to RAN2 to clarify MPE-Resource-r17 is either an SSB resource or a **periodic** CSI-RS  **FL Note1:** After briefly reviewing the already agreement, it seems that we have not discussed the time-behavior for CSI-RS in MPE. Therefore, the above clarification seems to be necessary.  **FL Note2:** The issue # as approved in R1-2205130 is still used for consistency. | **Support/fine**: MTK, ZTE, SS, NTT DOCOMO, Spreadtrum, Huawei/HiSilicon, LG  **Not support:** Apple |

Table 16 Additional inputs: issue 4

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| --- | --- |
| **Company** | **Input** |
| Mod V0 | 1. **Check and update your view in Table 15** 2. **Share more inputs here if needed** |
| MediaTek | Agree with FL’s view |
| Samsung | OK |
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# References

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| --- | --- | --- | --- |
| 1 | [R1-2203064](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2203064.zip) | Enhancement on multi-beam operation | FUTUREWEI |
| 2 | [R1-2203105](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2203105.zip) | Remaining issues on multi-beam operation in Rel-17 | Huawei, HiSilicon |
| 3 | [R1-2203257](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2203257.zip) | Remaining issues on multi-beam enhancements | ZTE |
| 4 | [R1-2203301](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2203301.zip) | Remaining issues on multi-beam enhancements | Spreadtrum Communications |
| 5 | [R1-2203421](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2203421.zip) | Maintenance issues on Rel-17 multi-beam operation | CATT |
| 6 | [R1-2203505](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2203505.zip) | Maintenance on multi-beam enhancement | vivo |
| 7 | [R1-2203673](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2203673.zip) | Discussion on remaining issues on multi-beam operation | NEC |
| 8 | [R1-2203764](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2203764.zip) | Maintenance of Enhancements on Multi-beam Operation | Langbo |
| 9 | [R1-2203771](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2203771.zip) | Remaining issues on multi-beam operation enhancement | xiaomi |
| 10 | [R1-2203855](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2203855.zip) | Maintenance on Rel-17 multi-beam | Samsung |
| 11 | [R1-2203948](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2203948.zip) | Remaining Issues of Enhancements on Multi-Beam Operation | OPPO |
| 12 | [R1-2204031](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2204031.zip) | Maintenance of multi-beam enhancements | Ericsson |
| 13 | [R1-2204137](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2204137.zip) | Text proposal on multi-beam operation | LG Electronics |
| 14 | [R1-2204169](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2204169.zip) | Remaining issues on muiti-beam operation | Lenovo |
| 15 | [R1-2204192](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2204192.zip) | Maintenance issue of unified TCI power control | ASUSTeK |
| 16 | [R1-2204199](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2204199.zip) | Remaining Issues on Beam Management Enhancement | Apple |
| 17 | [R1-2204274](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2204274.zip) | Remaining issues of enhancements on multi-beam operation | CMCC |
| 18 | [R1-2204335](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2204335.zip) | Remaining issues on multi-beam operation | NTT DOCOMO, INC. |
| 19 | R1-2204447 | Remaining issues on multi-beam enhancements | Spreadtrum Communications |
| 20 | [R1-2204535](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2204535.zip) | Maintenance of enhancements on Multi-beam Operation | Nokia, Nokia Shanghai Bell |
| 21 | [R1-2204680](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2204680.zip) | Maintenance of enhancements on multi-beam operation | Google Inc. |
| 22 | [R1-2204682](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2204682.zip) | Maintenance of Rel-17 multi-beam operation | MediaTek Inc. |
| 23 | [R1-2204763](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2204763.zip) | Enhancements on Multi-Beam Operations | Intel Corporation |
| 24 | [R1-2204976](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_109-e/Docs/R1-2204976.zip) | Enhancements on Multi-beam Operation | Qualcomm Incorporated |
|  |  |  |  |