**3GPP TSG RAN WG1 #108-e R1-2201994**

**e-Meeting, February 21th – March 3rd, 2022**

**Agenda item:** 8.1.1

**Source:** Moderator (Samsung)

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

**Document for:** Discussion and Decision

## Introduction

In this summary, the term “item 1” refers to the first item in the Rel.17 NR FeMIMO WID, i.e. multi-beam enhancement:

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| 1. Enhancement on multi-beam operation, mainly targeting FR2 while also applicable to FR1:    1. Identify and specify features to facilitate more efficient (lower latency and overhead) DL/UL beam management for intra-cell and inter-cell scenarios to support higher UE speed and/or a larger number of configured TCI states:       1. Common beam for data and control transmission/reception for DL and UL, especially for intra-band CA       2. Unified TCI framework for DL and UL beam indication       3. Enhancement on signaling mechanisms for the above features to improve latency and efficiency with more usage of dynamic control signaling (as opposed to RRC)       4. For inter-cell beam management, a UE can transmit to or receive from only a single cell (i.e. serving cell does not change when beam selection is done). This includes L1-only measurement/reporting (i.e. no L3 impact) and beam indication associated with cell(s) with any Physical Cell ID(s)          1. The beam indication is based on Rel-17 unified TCI framework          2. The same beam measurement/reporting mechanism will be reused for inter-cell mTRP          3. This work shall only consider intra-DU and intra-frequency cases    2. Identify and specify features to facilitate UL beam selection for UEs equipped with multiple panels, considering UL coverage loss mitigation due to MPE, based on UL beam indication with the unified TCI framework for UL fast panel selection |

This summary includes the following:

* Observation and proposal
* Summary of current companies’ positions on each of the aspects within the category

## Summary of companies’ inputs

### Issue 1 (Rel.17 unified TCI framework – note: for intra-cell beam management unless otherwise noted)

Table 1 Summary: issue 1

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| **#** | **Issue** | **Companies’ views** |
| 1.1 | **Proposal 1.A**: Confirm the following working assumption as an agreement with the following refinement (highlighted in **red**):  The UE is not expected to be configured with Rel-15/Rel-16 TCI/SpatialRelationInfo***/PUCCH-SpatialRelationInfo* (except *spatialRelationInfoPos*)** if the UE is configured with Rel-17 TCI in any CC in a band   * The CC list for Rel-16 multi-CC beam indication should not contain any CC in a band configured with Rel-17 TCI assuming different CC lists are used for Rel-16 and Rel-17   **FL Note**: Discussed offline [1] | **Support/fine**: MTK, Qualcomm, Ericsson, OPPO, Samsung, Apple, Nokia/NSB, ZTE, Intel, Lenovo/MotM, NTT Docomo, CATT, Xiaomi, Spreadtrum, CMCC, Huawei/HiSi, LG, Fraunhofer IIS/HHI, vivo, NEC, Futurewei, Ericsson, TCL  **Not support:** |
| 1.2 | **Proposal 1.B.1**: On Rel-17 unified TCI framework, for any SRS resource or resource set that does not share the same indicated Rel-17 TCI state(s) as dynamic-grant/configured-grant based PUSCH and all of dedicated PUCCH resources, but can be configured as a target signal of a Rel-17 UL or, if applicable, joint TCI (hence the Rel-17 UL or, if applicable, joint TCI state pool), Rel-17 mechanism(s) which reuse mechanisms similar to the Rel-15/16 spatial relation info update signaling/configuration design(s) are used to update/configure such SRS (s) with Rel-17 UL or, if applicable, joint TCI state(s).   * Including inter-cell case, where SSB with PCI different from the serving cell can be used as a source RS in Rel-17 UL, or if applicable joint, TCI state for these SRS resources * The UL PC parameter setting (including PL-RS) for the SRS resource set should be derived based on the setting associated with TCI indicated for the SRS resource with the lowest SRS-ResourceId in that SRS resource set * The MAC-CE signaling for the Rel-17 mechanism(s) to update the spatial relation of the AP/SP-SRS not sharing the indicated Rel-17 TCI state shall provide an ID of Rel-17 UL or, if applicable, joint TCI state instead of an RS resource ID for each AP/SP-SRS resource, and strive to reuse other aspects of the MAC-CE for the Rel-15/16 spatial relation info update (including 'SP SRS Activation/Deactivation MAC CE', 'Enhanced SP/AP SRS Spatial Relation Indication MAC CE', and 'Serving Cell Set based SRS Spatial Relation Indication MAC CE')   + Note:  The exact details are up to RAN2. * Note: A Rel-17 UE is not required to support both this feature and optional Rel-16 features of SRS spatial relation info within the same band.   **FL Note**: Discussed offline [1]. Note that supporting companies comment that the preference from ZTE seems to go against previous agreement (association between Rel-17 TCI state and UL PC setting) | **Support/fine**: MTK, Qualcomm, Ericsson, OPPO, Samsung, Apple, Nokia/NSB, Intel, Lenovo/MotM, NTT Docomo, CATT, Xiaomi, Spreadtrum, CMCC, Huawei/HiSi, LG, Fraunhofer IIS/HHI, vivo, NEC, Futurewei, CMCC, ZTE  **Not support:** |
| 1.3 | **Proposal 1.C**: For Rel-17 unified TCI framework, on applying the indicated Rel-17 TCI state to PDCCH reception and the respective PDSCH reception for a CORESET other than CORESET#0 that is associated with both UE-dedicated and non-UE-dedicated reception on PDCCH in a CC and its respective PDSCH reception, at least for intra-cell, UE always applies the indicated Rel-17 TCI state   * TBD (RAN1#108-e): For inter-cell   **FL Note**: Discussed offline [1]. It has been commented that not supporting CORESET C is not an option since it is inherited from Rel-15/16. Also note that most supporters of the proposal are fine with “like CORESET B” alternative | **Support/fine**: MTK (intra), Samsung (intra), Nokia/NSB (intra), Xiaomi (intra), Lenovo/MotM (intra), Spreadtrum, NTT Docomo, Fraunhofer IIS/HHI (intra), NEC, Futurewei, Intel (intra), Ericsson, CMCC  **Not support:** vivo (like CORESET B), OPPO (like CORESET B), CATT (like CORESET B), LG (like CORESET B), Qualcomm (depends on search space), Apple |
| 1.4 | **Proposal 1.D**: For Rel-17 unified TCI framework, in RAN1#107-e, for the Rel-17 TCI state indication of CORESET 0, at least for intra-cell:   * Follow the same rule as ‘CORESET B’, i.e. whether to apply the indicated Rel-17 TCI state associated with the serving cell is configured per CORESET by RRC – if not applied, use the legacy MAC-CE/RACH signalling mechanism * Note: The CSI-RS associated with the Rel-17 TCI state applied to CORESET 0 should be QCLed with an SSB associated with serving cell PCI (same as Rel-15)   TBD (RAN1#108-e): For inter-cell  **FL Note**: Discussed offline [1] | **Support/fine**: Lenovo/MotM, Nokia/NSB, MTK, ZTE, CMCC, Samsung, Xiaomi, Apple, NTT Docomo, Huawei/HiSi, Fraunhofer IIS/HHI, OPPO, NEC, CATT, Futurewei, vivo (reuse Rel-15/16 if not indicated TCI state), CMCC, Apple, Ericsson, LG  **Not support:** Spreadtrum (like CORESET A), Qualcomm (depends on SS) |
| 1.5 | **Proposal 1.E**: Agree in principle on the following text proposal for TS 38.214:  **TS38.214 section 5.1.5:**  The UE with activated [*TCI-State]* configured with [*tci-StateId\_r17]* receives DCI format 1\_1/1\_2 providing indicated *TCI-State* with[*tci-StateId\_r17]* for a CC or all CCs in the same CC list configured by *[simultaneousTCI-UpdateList1* or *simultaneousTCI-UpdateList2]*. 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:  - …  After a UE receives an initial higher layer configuration of more than one [*DLorJoint-TCIState-Id-r17]* and before ~~reception~~ application of an indicated TCI state from the configured TCI states:   * The UE assumes that DM-RS of PDSCH and DM-RS of PDCCH ~~in a CC~~, and the CSI-RS applying the indicated TCI state are quasi co-located with the SS/PBCH block the UE identified during the initial access procedure   After a UE receives an initial higher layer configuration of more than one [*DLorJoint-TCIState-Id-r17]* or [*UL-TCIState-r17]* and before application of an indicated TCI state from the configured TCI states:   * The UE assumes that the UL TX spatial filter, if applicable, for dynamic-grant and configured-grant based PUSCH and PUCCH ~~resource in a CC~~, and SRS applying the indicated TCI state is the same as that for a PUSCH transmission scheduled by a RAR UL grant during the initial access procedure   After a UE receives a higher layer configuration of more than one [*DLorJoint-TCIState-Id-r17]* as part of a Reconfiguration with sync procedure as described in [12, TS 38.331]and before ~~reception~~ application of an indicated TCI state from the configured TCI states:   * The UE assumes that DM-RS of PDSCH and DM-RS of PDCCH ~~in a CC~~, and the CSI-RS applying the indicated TCI state are quasi co-located with the SS/PBCH block or the CSI-RS resource the UE identified during the random access procedure initiated by the Reconfiguration with sync procedure as described in [12, TS 38.331]   After a UE receives a higher layer configuration of more than one [*DLorJoint-TCIState-Id-r17]* or [*UL-TCIState-r17]* as part of a Reconfiguration with sync procedure as described in [12, TS 38.331] and before application of an indicated TCI state from the configured TCI states:   * The UE assumes that the UL TX spatial filter, if applicable, for dynamic-grant and configured-grant based PUSCH and PUCCH ~~resource in a CC~~, and SRS applying the indicated TCI state is the same as that for a PUSCH transmission scheduled by a RAR UL grant during random access procedure initiated by the Reconfiguration with sync procedure as described in [12, TS 38.331]   If a UE receives a higher layer configuration of one single DLorJoint-TCIState-Id-r17 ~~TCI state~~, that can be used as an indicated TCI state, the UE ~~assumes that~~ obtains the QCL assumptions from the configured one single TCI state for DM-RS of PDSCH and DM-RS of PDCCH, and the CSI -RS applying the indicated TCI state. ~~the TCI state is the indicated TCI state with [DLorJoint-TCIState-r17].~~    If a UE receives a higher layer configuration of one single DLorJoint-TCIState-Id-r17 or UL-TCIState-r17, that can be used as an indicated TCI state, the UE determines an UL TX spatial filter, if applicable, from the configured one single TCI state for dynamic-grant and configured-grant based PUSCH and PUCCH, and SRS applying the indicated TCI state.  **FL Note**: Discussed offline [1] | **Support/fine**: MTK, Ericsson, OPPO, Samsung, Apple, Nokia/NSB, ZTE, Intel, Lenovo/MotM, NTT Docomo, CATT, Xiaomi, Spreadtrum, CMCC, LG, Fraunhofer IIS/HHI, vivo, NEC, Futurewei,  **Not support:**Qualcomm |
| 1.6 | **Not support:** | |
| 1.7 | **Proposal 1.C.2**: For Rel-17 unified TCI framework, on applying the indicated Rel-17 TCI state to PDCCH reception and the respective PDSCH reception for a CORESET other than CORESET#0 that is associated with both UE-dedicated and non-UE-dedicated reception on PDCCH in a CC and its respective PDSCH reception, for inter-cell,   * UE always applies the indicated Rel-17 TCI state * UE is not expected to receive a common signal with a TCI state associated with a PCI different from that of the serving cell   **FL Note**: Possible compromise (based on companies’ views) to finalize details of proposal 1.C.1[1]. Rather than not allowing CORESET C for inter-cell at all, it makes more sense to allow it except for receiving common signals from NSC | **Support/fine**: Ericsson, Samsung, NTT Docomo, Fraunhofer IIS/HHI, Nokia/NSB, NEC, CMCC  **Not support:** Apple, Qualcomm, LG |
| 1.8 | **Proposal 1.D.2**: For Rel-17 unified TCI framework, in RAN1#107-e, for the Rel-17 TCI state indication of CORESET 0, for inter-cell:   * Follow the same rule as ‘CORESET B’, i.e. whether to apply the indicated Rel-17 TCI state associated with the serving cell is configured per CORESET by RRC – if not applied, use the legacy MAC-CE/RACH signalling mechanism * UE is not expected to receive a common signal with a TCI state associated with a PCI different from that of the serving cell * Note: The CSI-RS associated with the Rel-17 TCI state applied to CORESET 0 should be QCLed with an SSB (same as Rel-15)   **FL Note**: Possible compromise (based on companies’ views) to finalize details of proposal 1.D.1[1]. Rather than not allowing CORESET 0 for inter-cell at all, it makes more sense to allow it except for receiving common signals from NSC | **Support/fine**: Apple, Ericsson, Samsung, NTT Docomo, Fraunhofer IIS/HHI, LG, Nokia/NSB, NEC, CMCC  **Not support:** Qualcomm (depends on SS, or only use legacy rule) |
| 1.9 | On Rel-17 unified TCI framework, for P/SP-CSI-RS, the UE assumes that:   * Alt1. The indicated Rel-17 TCI state is always applied * Alt2. Whether to apply the indicated Rel-17 TCI state is configured per CSI-RS resource by RRC – if not applied, use the legacy MAC-CE signalling mechanism * Alt3. The indicated Rel-17 TCI state is never applied, i.e. the legacy RRC/MAC-CE signalling mechanism is always used * Alt4. The indicated Rel-17 TCI state is applied when the UE is not configured with any TCI state for the P/SP CSI-RS   **FL Note**: Open issue that needs to be resolved | **Alt1:**  **Alt2:** Fraunhofer IIS/HHI (2nd pref.), LG, Nokia/NSB, Samsung  **Alt3:** MTK (add RRC), Qualcomm, OPPO, Xiaomi  **Alt4:** Apple, Ericsson, NTT Docomo, Fraunhofer IIS/HHI, TCL, CMCC |
| 1.10 | On Rel-17 unified TCI framework, when CSI-RS follows the indicated Rel-17 TCI state, “followUnifiedTCI-State-r17” should be configured per CSI-RS resource and applied to AP CSI reporting only  **FL Note**: To be discussed as a part of reply to incoming LS R1-2200887 (R2-2202002). May not be needed. | **Support/fine:** Huawei/HiSi  **Not support:** Apple, Ericsson, Samsung (issue 1.9 is sufficient), Qualcomm, NTT Docomo, TCL |
| 1.11 | For Rel-17 unified TCI framework, in RAN1#107-e, for the Rel-17 TCI state indication of CORESET 0, the UE assumes TCI state based on latest RA procedure, if no TCI state is indicated after RA procedure.  **FL Note**: May not be needed if 1.5 and 1.8 are agreed | **Support/fine:** Samsung, Ericsson (could be left to UE implementation), NTT Docomo, Nokia/NSB, CMCC  **Not support:** Apple, Qualcomm (use legacy rule), TCL |
| 1.12 | On Rel.17 unified TCI framework, for Rel-17 unified TCI, for DL channels/signals that share the same indicated Rel-17 TCI state as UE-dedicated reception on PDSCH/PDCCH (via Rel-17 MAC-CE/DCI TCI state update), the following option on source RSs and QCL-Types is also supported:   * Option 3: CSI-RS for CSI is configured for QCL-TypeA and QCL-TypeD source RS   **FL Note**: It was explained that the so-called “circular” issue is avoided in practice via NW implementation, i.e. NW will not configure the same CSI-RS for CSI both as source and target RSs. **Need conclusion**. | **Support/fine**: Sony, CMCC, Ericsson, Qualcomm, NTT Docomo, Fraunhofer IIS/HHI, Nokia/NSB, TCL, CMCC  **Not support:** Apple |
| 1.13 | For cross-carrier scheduling, support cross-carrier DCI-based TCI state indication  **FL Note**: Spec impact of this proposal is unclear. Before this is fully clarified by the proponents, the discussion is suspended. | **Support/fine:** Qualcomm,Samsung, MTK (support by default), NTT Docomo (supported by default), Fraunhofer IIS/HHI (supported by default), Nokia/NSB, Xiaomi, CMCC  **Not support:** Ericsson (no spec impact) |
| 1.14 | On path-loss measurement for Rel.17 unified TCI framework, at least for discussion purposes, when both PL-RS and spatial relation RS in the UL or (if applicable) joint TCI state are not the same, “beam alignment” also pertains to the following events:   * The PL-RS is identical to the QCL Type-D source RS or UL spatial relation RS of the spatial relation RS in the UL or (if applicable) joint TCI state * The QCL Type-D source RS of PL-RS is identical to the spatial relation RS in the UL or (if applicable) joint TCI state * The QCL Type-D source RS of PL-RS is identical to the QCL Type-D source RS or UL spatial relation RS of the spatial relation RS in the UL or (if applicable) joint TCI state   **FL Note:** Any additional event (bullet) doesn’t seem acceptable for a number of companies. Even the above, some still have concern. **Need conclusion or leave to RAN4**. | **Support/fine:** MTK, Samsung, Qualcomm, NTT Docomo, Nokia/NSB, TCL, CMCC  **Not support:** Ericsson (leave to RAN4) |
| 1.15 | Support to report virtual PHR based on the power control parameters associated with indicated TCI state for PUSCH/PUCCH transmission. | **Support/fine:** Apple  **Not support:** |

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 | Proposal 1.B.1: Regarding the 3rd sub-bullet, we prefer to clarify the MAC-CE is used for semi-persistent SRS as in Rel-15/16. Thus, we suggest:   * The MAC-CE signaling for the Rel-17 mechanism(s) to update the spatial relation of the semi-persistent SRS not sharing the indicated Rel-17 TCI state shall strive to reuse the MAC-CE for the Rel-15/16 spatial relation info update   Proposal 1.D: We suggest to clarify CORESET 0 should be QCLed with an SSB associated with serving cell PCID.  Note: The CSI-RS associated with the Rel-17 TCI state applied to CORESET 0 should be QCLed with an SSB associated with serving cell PCI (same as Rel-15)  Proposal 1.B.2: We feel this proposal may not be necessary. It is clearly indicated in Proposal 1.B that the MAC-CE shall strive to reuse the MAC-CE for the Rel-15/16 spatial relation info update, and details are up to RAN2 design. On the other hand, the 4th sub-bullet (the power control parameters for the SRS resource set …) should be captured in RAN1 spec, which doesn't impact the MAC-CE design.  Proposal 1.C.2 and Proposal 1.D.2: We are fine with these proposals in principle. However, we prefer to further clarify what does “UE is not expected to receive common signals from a cell associated with a different PCI from that of the serving cell” mean. Does it mean UE doesn't perform PDCCH monitoring on CSS set if the indicated TCI state is associated with a different PCI from that of the serving cell? Or it means UE doesn't expect the indicated TCI state is associated with a different PCI from that of the serving cell.  Issue 1.9: We prefer Alt3 since P/SP-CSI-RS is usually used as source RS, especially TRS. BTW, RRC should be added in Alt3 for P-CSI-RS.   * Alt3. The indicated Rel-17 TCI state is never applied, i.e. the legacy RRC/MAC-CE signalling mechanism is always used   Issue 1.10: In the incoming LS R1-2200887 (R2-2202002), RAN2 raised some questions related to this issue. We can discuss this when reply the LS to RAN2.  Issue 1.11: It seems the proposal overlaps with Proposal 1.E.  Issue 1.13: We see cross-carrier DCI-based TCI state indication is not precluded from Rel-17 TCI, additional agreement may not be needed.  We’d like to point out one another issue on BFR. There are some remaining issues (but not critical) need to be addressed according the agreements from the last meeting.  **Agreement from RAN1#107**  On Rel-17 unified TCI framework, for intra-cell beam management, after X symbols from the UE receives the BFRR from NW, the UE assumes the same QCL parameter as the ones associated with the index q new for all PDSCH /PDCCH receptions in a CC, as well as other signals/channels configured to sharing the same indicated Rel-17 TCI state as PDSCH /PDCCH reception.   * The above applies to Rel-15 SpCell BFR, Rel-16 CBRA based SpCell BFR , and Rel-16 SCell BFR * Note: q new is a candidate beam identified by the UE in set q1. q1 is the set of candidate beams   **Agreement from RAN1#107**  On Rel-17 unified TCI framework, after X symbols from the UE receives the BFRR from NW, the UE uses the same UL spatial filter as the one associated with the index q new or the last PRACH transmission for all PUSCH transmissions and all of PUCCH resources in a CC, as well as other signals/channels configured to sharing the same indicated Rel-17 TCI state as PUSCH and all of PUCCH resources.   * The above applies to Rel-15/16 SpCell BFR, Rel-16 CBRA based SpCell BFR, and Rel-16 SCell BFR * Note: q new is a candidate beam identified by the UE in set q1. q1 is the set of candidate beams   FFS: UL PC control including q u , q d , and closed loop index |
| Apple | 1.2: We think RAN1 should make the content for the MAC CE clear instead of leaving everything to RAN2, and the MAC CE format can be up to RAN2, as discussed in issue 1.6.  1.3: We think the application of the indicated TCI should be determined based on the type of SS, based on the agreement before that UE-dedicated signal always share the indicated TCI and whether non-UE dedicated signal shares the indicated TCI is configured by gNB  1.6: Since legacy MAC CE cannot support to indicate non-serving cell SSB for the beam indication and pathloss RS indication, enhancement of MAC CE is needed.  1.7: Similar to 1.3, we think the application of the indicated TCI should be determined based on the type of SS, based on the agreement before that UE-dedicated signal always share the indicated TCI and whether non-UE dedicated signal shares the indicated TCI is configured by gNB  1.9: Alt4 is added  1.10: We are not sure why “applied to AP CSI reporting only” is needed  1.11: It seems this is covered by 1.8  1.12: In our view, this does not seem to be a valid issue in maintenance phase  1.13: We think some more details needs be provided. Does it mean the CC ID indicated in DCI can indicate the target applicable CC for the indicated TCI?  1.14: We are open, but it seems this is not quite necessary.  Additional issue: we think the following proposals can be discussed to make the virtual PHR meaningful. Currently virtual PHR is always based on a default power control parameters set, which could be different from what is configured for current transmission.  ***Support to report virtual PHR based on the power control parameters associated with indicated TCI state for PUSCH/PUCCH transmission.*** |
| Nokia | 1.1: Support Proposal 1.A  1.2: Support Proposal 1.B.1  1.3: Support Proposal 1.C  1.4: Support Proposal 1.D  1.5: Support Proposal 1.E  1.6: In principle we are fine with the proposal but it seems a bit weird if the PL RS needs to be assumed to be the same for the SRS resources that can be provided with different TCI state and thus different QCL-Type RS. Thus, we would consider the following update for the second last bullet:   * The power control parameters, except PL RS, for the SRS resource set should be derived based on the power control parameters associated with TCI indicated for the first SRS resource   1.7: Support Proposal 1.C.2  1.8: Same as CORESET B. If the TCI state indicates RS associated with PCI different from that of a serving cell, the follow unified TCI does not apply (until TCI indicates RS of a serving cell)  1.9: We think that the following alternative should be added:   * Alt4. Whether to apply the indicated Rel-17 TCI state is configured per CSI-RS resource by RRC – if not applied, use the legacy MAC-CE signalling mechanism   1.10: We don’t see need to restrict to aperiodic reporting.  1.11: Support  1.12: Support  1.13: Support  1.14: Ok |
| Ericsson | P1.B.1: We would be OK with the proposal, if we remove “The same UL PC parameter setting (including PL-RS) is guaranteed for SRS resources in the same SRS resource set”. This is up to NW configuration.  P.1.E: The expression “TCI states with [DLorJoint-TCIState-Id-r17]” is somewhat difficult to understand, and unnecessarily complicated. There is an IE called DLorJoint-TCIState-r17:  DLorJoint-TCIState-r17 ::= SEQUENCE {  tci-StateUnifiedId-r17 DLorJoint-TCIState-Id-r17,  tci-StateType-r17 ENUMERATED {DLOnly, JointULDL},  qcl-Type1-r17 QCL-Info,  qcl-Type2-r17 QCL-Info OPTIONAL -- Need R  }  and using that name to refer to the type of TCI state is both shorter and easier to understand. We propose the following modification:  **TS38.214 section 5.1.5:**  The UE with activated [*TCI-State]* configured with [*tci-StateId\_r17]* receives DCI format 1\_1/1\_2 providing indicated *TCI-State* with[*tci-StateId\_r17]* for a CC or all CCs in the same CC list configured by *[simultaneousTCI-UpdateList1* or *simultaneousTCI-UpdateList2]*. 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:  - …  After a UE receives an initial higher layer configuration of more than one [*DLorJoint-TCIState-r17]* and before ~~reception~~ application of an indicated TCI state from the configured TCI states:   * The UE assumes that DM-RS of PDSCH and DM-RS of PDCCH ~~in a CC~~, and the CSI-RS applying the indicated TCI state are quasi co-located with the SS/PBCH block the UE identified during the initial access procedure   After a UE receives an initial higher layer configuration of more than one [*DLorJoint-TCIState-r17]* or [*UL-TCIState-r17]* and before application of an indicated TCI state from the configured TCI states:   * The UE assumes that the UL TX spatial filter, if applicable, for dynamic-grant and configured-grant based PUSCH and PUCCH ~~resource in a CC~~, and SRS applying the indicated TCI state is the same as that for a PUSCH transmission scheduled by a RAR UL grant during the initial access procedure   After a UE receives a higher layer configuration of more than one [*DLorJoint-TCIState-r17]* as part of a Reconfiguration with sync procedure as described in [12, TS 38.331]and before ~~reception~~ application of an indicated TCI state from the configured TCI states:   * The UE assumes that DM-RS of PDSCH and DM-RS of PDCCH ~~in a CC~~, and the CSI-RS applying the indicated TCI state are quasi co-located with the SS/PBCH block or the CSI-RS resource the UE identified during the random access procedure initiated by the Reconfiguration with sync procedure as described in [12, TS 38.331]   After a UE receives a higher layer configuration of more than one [*DLorJoint-TCIState-r17]* or [*UL-TCIState-r17]* as part of a Reconfiguration with sync procedure as described in [12, TS 38.331] and before application of an indicated TCI state from the configured TCI states:   * The UE assumes that the UL TX spatial filter, if applicable, for dynamic-grant and configured-grant based PUSCH and PUCCH ~~resource in a CC~~, and SRS applying the indicated TCI state is the same as that for a PUSCH transmission scheduled by a RAR UL grant during random access procedure initiated by the Reconfiguration with sync procedure as described in [12, TS 38.331]   1.10: Here we should note that the running CR is lacking the configuration of Rel-17 TCI states, and perhaps that the use of the field “followUnifiedTCI-State-r17” is unfortunate: the interpretation would be that if the field “followUnifiedTCI-State-r17” is missing, the UE would require configuration of Rel-17 TCI states. However, the main mode of operation is that when Rel17 TCI states are provided, all signals should follow the unified TCI. Having said that, it would seem sufficient to configure “followUnifiedTCI-State-r17” in the CSI-AssociatedReportConfig IE, since when R17 TCI states would be configured explicitly, full flexibility exists.  1.11: We could also consider leaving this to UE implementation. If the UE finds a better SSB for CORESET#0 reception, the UE would be free to use that.  1.13: This is supported by default, and there is no spec impact.  1.14: RAN4 is discussing a full definition of beam alignment. Leave to RAN4. |
| Samsung | **Issue 1.1, proposal 1.A:** Support, with an update to the sub-bullet  The configuration of a CC to follow Rel-17 or Rel-16 TCI states is done per band rather than per CC according to the main bullet of the proposal, therefore, we suggest the following update to the sub-bullet:   * The CC list for Rel-16 multi-CC beam indication should not contain any CC in a band configured with Rel-17 TCI assuming different CC lists are used for Rel-16 and Rel-17   **Issue 1.2, proposal 1.B.1:** OK  **Issue 1.3, proposal 1.C**: Support  Regarding the TBD. Our first preference is not to support CORESET C for inter-cell case. For the inter-cell case, the CSS is received on the serving cell, while the USS can be received on a cell with a PCI different from the PCI of a serving cell. Therefore, different beams are needed and hence different CORESETs. We can consider an alternative where if a CORESET C is used for the inter-cell case,   * When the indicated beam is on a cell other than the serving cell, the CSS is not monitored. * When the indicated beam is on the serving cell, the CSS is monitored.   **Issue 1.4, proposal 1.D:** Support  **Issue 1.5, proposal 1.F:** Support  Should also consider the case of configuring one TCI state that can be used for the indicated TCI state.  If a UE receives a higher layer configuration of one single TCI state, that can be used as an indicated TCI state, with[*DLorJoint-TCIState-Id-r17],* the UE ~~assumes that~~ obtains the QCL assumptions from the configured one single TCI state for DM-RS of PDSCH and DM-RS of PDCCH, and the CSI-RS applying the indicated TCI state. ~~the TCI state is the indicated~~~~TCI state~~~~with~~~~[~~*~~DLorJoint-TCIState-r17]~~*~~.~~  If a UE receives a higher layer configuration of one single TCI state, that can be used as an indicated TCI state, with[*DLorJoint-TCIState-Id-r17]* or [*UL-TCIState-Id],* the UE determines an UL TX spatial filter, if applicable, from the configured one single TCI state for dynamic-grant and configured-grant based PUSCH and PUCCH, and SRS applying the indicated TCI state.  **Issue 1.6, proposal 1.B.2:** Not needed. In proposal 1.B.1, it is already proposed to use mechanisms similar to Rel-15/16. No further agreements are needed on top of that.  **Issue 1.7, proposal 1.C.2:** OK  Our first preference is not to support CORESET C for inter-cell case. For the inter-cell case, the CSS is received on the serving cell, while the USS can be received on a cell with a PCI different from the PCI of a serving cell. Therefore, different beams are needed and hence different CORESETs. However, as a compromise we can accept this proposal.  **Issue 1.8, proposal 1.D.2:** OK  Seems to be overlapping issue 1.4, we suggest to combine.  **Issue 1.9:**  Whether to apply the indicated Rel-17 TCI state is configured ~~per CORESET~~ by RRC – if not applied, use the legacy MAC-CE signalling mechanism  **Issue 1.10:** Not needed. Agreeing to an alternative in issue 1.9 is sufficient.  **Issue 1.11**: Support  This follows a similar behavior in Rel-15/16 where after RA, CORESET 0 follows the QCL assumptions/spatial filters used in RA until a new TCI state is activated for CORESET 0. This is on top of proposal 1.4. When CORESET 0 is configured to follow the unified TCI state, between the most recent random access procedure and the indication of a new TCI state, CORESET 0 follows the QCL assumptions based on the most recent random access procedure. After the UE is indicated a unified TCI state, CORESET 0 follows that TCI state.  **Issue 1.12:** Not needed, given that we are already in the maintenance phase. But OK to support if there is majority support.  **Issue 1.13:** Support  **Issue 1.14:** Support |
| Qualcomm | For Proposal 1.A, support  For Proposal 1.B.1, support  For Proposal 1.C, the proposal may not be aligned with the previous agreement. To our understanding, all non-UE-dedicated PDCCH/PDSCH can be indicated whether to share the indicated unified TCI. However, the Proposal 1.C implies the CSS of CORESET associated with both USS and CSS must ALWAYs follow the indicated unified TCI.  So our preference is to vary CORESET beam across CSS and USS. This is fully aligned with agreement and should not conflict with any existing rule. For CSS, UE will use either the indicated unified TCI or the R15/16 configured TCI for that CORESET based on gNB instruction, while for USS, the CORESET beam is reset to the indicated unified TCI. The CORESET beam reset is already considered in current spec, e.g. BFR CORESET beam reset. In addition, we are also fine for not supporting Type-C CORESET.  **Agreement**  On Rel.17 unified TCI framework, for intra-cell beam indication, the following DL RSs can share the same indicated Rel-17 TCI state as UE-dedicated reception on PDSCH and for UE-dedicated reception on all or subset of CORESETs in a CC:   * DMRS(s) associated with non-UE-dedicated reception on CORESET(s) and the associated PDSCH * […]   For Proposal 1.D, the proposal may not be aligned with the previous agreement. To our understanding, UE-dedicated PDCCH/PDSCH must ALWAYs follow the indicated unified TCI. This is described in numerous agreements, e.g. xxx can share the same indicated TCI for UE dedicated PDCCH/PDSCH. However, the Proposal 1.D implies the USS of CORESET 0 can still not follow the indicated unified TCI based on gNB instruction. So our preference is to vary the beam of CORESET #0 across CSS and USS, i.e. using the indicated unified TCI for USS, while using the indicated TCI or R15/16 configured TCI for CSS. We can also live with purely using R15/16 QCL rule to determine CORESET 0’s TCI.  For Proposal 1.E, we prefer not to support this TP because (1) The case of single configured TCI is missing; (2) This may not be critical issue to our understanding, since legacy rule works well, e.g. PDCCH beam follows the SSB beam, PDSCH beam follows the PDCCH beam, and PUCCH beam follows the Msg3 in current spec. To our understanding, the major benefit is the RS now also follows the SSB beam. But this may not be critical, since the duration from RRC configuration completion to MAC-CE activation time can be as short as 3 ms. It should be sufficient if the traffic can flow in this duration as in legacy. (3) A more critical issue is the applied beam after MAC-CE activating multiple TCIs but before DCI selecting one of them. There is even no legacy rule for this to our understanding.  So for Proposal 1.E, we suggest to (1) consider the single configured TCI case, which is also mentioned in legacy spec; (2) Clarify optimization topics can still be discussed in R17 maintenance phase as common understanding; (3) consider to discuss the applied beam after activating multiple TCIs but before DCI selecting one of them as FFS.  For Proposal 1.B.2, support  For Proposal 1.C.2, prefer not to support with same comment as for Proposal 1.C  For Proposal 1.D.2, prefer not to support with same comment as for Proposal 1.D. Fine with purely using legacy QCL rule for CORESET 0.  For 1.9, support Alt3, which is already agreed to our understanding, i.e. only AP CSI-RS can share the indicated TCI  For 1.10, prefer not to support. Prefer per set instead of per resource  For 1.11, prefer not to support. The legacy RACH based beam resetting rule works well for CORESET 0  For 1.12, fine  For 1.13, support  For 1.14, support |
| OPPO | **1.B.1:**  regarding the 2nd bullet of PC parameter setting. In our view either the method of gNB implementation to ensure same setting or the method of reusing the rel15/16 mechanism can work.  **1.C**: can be ok with supporting ‘CORESET C’ with applying the rule defined for CORESET B.  1.D: ok  1.B.2: It is enough to conclude that a joint TCI state ID or UL TCI state ID is indicated in the MAC CE. The other bullets in the proposal are not needed.  1.C.2: We need to clarify that if the indicated TCI state is associated with NSC SSB, the UE is not expected to receive non-UE-dedicated reception on PDCCH and its respective PDSCH.  1.D.2: For CORESET#0, the UE needs the associated SSB to derive the configuration of SS#0. If the indicated TCI state is associated with a NSC SSB, the UE is not able to do that. Thus, we need add one note that:   * **Note: the UE does not expect to receive PDCCH in CSS associated with CORESET#0 and its respective PDSCH if the indicated TCI state is associated with NSC SSB**.   1.9: we prefer Alt3. Actually, 1.9 might not be a open issue since if we do not make any conclusion, Alt3 is the natural result.  1.10: The “followUnifiedTCI-State-r17”is configured per CSI-RS resource set, right?  1.11: it is not needed. The rel15/16 rule applies automatically.  1.14: One case (which is more general actually) is missed: PL-RS and spatial relation RS are QCLed w.r.t TypeD, suggest to add it:  On path-loss measurement for Rel.17 unified TCI framework, at least for discussion purposes, when both PL-RS and spatial relation RS in the UL or (if applicable) joint TCI state are not the same, “beam alignment” also pertains to the following events:   * The PL-RS is identical to the QCL Type-D source RS or UL spatial relation RS of the spatial relation RS in the UL or (if applicable) joint TCI state * The QCL Type-D source RS of PL-RS is identical to the spatial relation RS in the UL or (if applicable) joint TCI state * The QCL Type-D source RS of PL-RS is identical to the QCL Type-D source RS or UL spatial relation RS of the spatial relation RS in the UL or (if applicable) joint TCI state * The PL-RS and the UL spatial relation RS are QCLed w.r.t TypeD. |
| NTT DOCOMO | Proposal 1.A  Proposal 1.B.1:  Proposal 1.C:  Proposal 1.D:  Proposal 1.E: Support.  **Re Qualcomm’s comment**: Regarding to the following comment, Rel.15/16 gNB usually don’t configure TCI state field. However, in Rel.17 unified TCI state, gNB would configure TCI state field (because, if gNB does not use DCI based beam indication, Rel.16 spec. already works well). Also, in Rel.17, default QCL for PDSCH (< timeDurationForQCL) of Rel.15/16 would be not (always) applied. Hence, we cannot say “*PDSCH beam follows the PDCCH beam*” in Rel.17.  > *(2) This may not be critical issue to our understanding, since legacy rule works well, e.g. PDCCH beam follows the SSB beam, PDSCH beam follows the PDCCH beam, and PUCCH beam follows the Msg3 in current spec.*  From our perspective, we are supportive to discuss more detail of the following cases proposed by Qualcomm.  (1) The case of single configured TCI  (3) the applied beam after MAC-CE activating multiple TCIs but before DCI selecting one of them  Proposal 1.B.2:  Proposal 1.C.2:  Proposal 1.D.2:  1.9: Prefer Alt.4. There is no legacy behavior for P/SP CSI-RS, when no TCI state is configured. Hence, proposal does not harm the legacy behavior.  1.10 Not support. We think proposal of 1.9 is sufficient.  1.11 Support.  1.12: Support to cover all QCL rules supported in Rel.15/16.  1.13: We think the current spec. already supports this.  1.14 Support |
| Fraunhofer IIS/HHI | Proposals 1.A, 1.B.1, 1.C, 1.D, 1.E: Support  Proposal 1.B.2: This proposal doesn’t seem to be necessary as 1.B.1 states to reuse Rel. 15/16 mechanisms and that the further details of the MAC-CE are finalized by RAN2.  Proposal 1.C.2 and 1.D.2: Support the extension from intra-cell to the intra-cell case with the proposed compromise.  Proposal 1.9: OK with applying the unified TCI-state in case of no explicit TCI configuration or enabled via RRC (Alt-4 or Alt-2/modified Alt-2 by Samsung).  Proposal 1.12: Support  Proposal 1.13: OK (although it seems to be automatically supported in the spec. already)  Proposal 1.14: Support |
| NEC | **Proposal 1.A:** Support  **Proposal 1.B.1:** Support  **Proposal 1.C:** Support, and we also support CORESET C for inter-cell case.  **Proposal 1.D:** Support, and we also support CORESET 0 for inter-cell case.  **Proposal 1.E:** Support the update from Ericsson and Samsung.  In addition, similar as the case “TCI state application in case of only one TCI state configured in RRC”, we think there is a missing agreement capture in TS38.214, which is the case “MAC CE activates one TCI state”, in this case, the activated TCI state can be applied after MAC CE confirmation, no need of further DCI based indication and application.   |  | | --- | | TS 38.214 section 5.1.5  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. 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 single activated TCI state with [*DLorJoint-TCIState-Id-r17]* and/or only one single activated TCI state with [*UL-TCIState-Id]*, the activated TCI state with [*DLorJoint-TCIState-Id-r17]* and/or the activated TCI state with [*UL-TCIState-Id]* should be applied starting from the first slot that is after slot where *m* is the SCS configuration for the PUCCH. |   **Proposal 1.C.2:** We are fine in general.  And regarding “UE is not expected to receive common signals from a cell with a different PCI from that of the serving cell”, we also think it can be further clarified. For example, if UE only support one active TCI state, the UE doesn’t monitor PDCCH in CSS of the CORESET. And if UE can support more than one activated TCI state, it seems monitoring PDCCH in CSS based on previous TCI state from serving cell still possible, at least when CSS and USS are not overlapped.  **Proposal 1.D.2:** Support. |
| Xiaomi | Proposal 1.C.2 and Proposal 1.D.2: We would like to clarify the meaning of “UE is not expected to receive common signals from a cell with a different PCI from that of the serving cell”. We prefer to revise it to “UE is not expected to monitor PDCCH on CSS set or receive PDSCH scheduled by PDCCH on CSS set with indicated TCI state associated with a different PCI from that of the serving cell”  Proposal 1.9: Slightly prefer Alt 3  Proposal 1.11: We would like to clarify the difference with legacy rule first.  Proposal 1.13: Support |
| LG | Our views are update in the table.  1.A: Support  1.B.1: Support  1.C, 1.C.2, 1.D, and 1.D.2: After some more thoughts, our view is updated from when we do offline discussion, and updated in the table It is preferred that CORESET C and CORESET 0 apply the same principle as CORESET B to configure whether to use the UE specific beam RS for those PDCCH by RRC. In addition, we think that it may be better to allow such configurability regardless of CORESET types and rely on NW implementation which CORESETs to apply unified TCI in order to simplify specification and implementation. Otherwise, we may have to define CORESET A/B/C with intra-/inter-cell BM in specification, which only complicates specification and may not be so beneficial from implementation perspective.  1.B.2: Agreeing on this does not seem necessary if this has no difference from Rel-15/16 since applying same design as legacy was agreed before.  1.9: Similar view as Samsung. Support Alt2 which is the most flexible via RRC. We wonder how Alt4 can support BM CSI-RS beam sweeping, i.e. different beam is applied in different CSI-RS resource where some of them may not have QCL reference RS.  1.14: we can leave this issue for RAN4 as Ericsson mentioned. |
| TCL | For proposal 1.A, support.  For proposal 1.B.1 and 2, it is not necessary to include the power control parameters in MAC-CE. Maybe how to include the PC parameters in RRC signaling should be considered.  For issue 1.9, prefer Alt.4.  For issue 1.10, agree with Qualcomm.  For issue 1.11, not support because of redundancy.  For issue 1.12, support.  For issue 1.14, support. |
| CMCC | Proposal 1.C: For compromise, we can accept the proposal.  For inter-cell case, we prefer to allow CORESET C, otherwise, RRC reconfiguration may be needed before applying inter-cell BM.  Proposal 1.B.2: We think it is not needed, but can accept it.  Proposal 1.C.2&Proposal 1.D.2: Support in principle. We prefer to clarify it as UE doesn't expect the indicated TCI state is associated with a different PCI from that of the serving cell.  1.9: We prefer Alt 4. In Rel-15/16, the TCI state for CSI-RS must be configured. Alt 4 can save the signaling overhead.  1.0: No need to mention AP CSI reporting. Suggest the following changes:  On Rel-17 unified TCI framework, when CSI-RS follows the indicated Rel-17 TCI state, “followUnifiedTCI-State-r17” should be configured per CSI-RS resource ~~and applied to AP CSI reporting only~~.  1.11/1.12/1.13/1.14: Support |
| Mod V19 | **Revised proposals per comments.**  **On 1.B.2, the content is now merged with 1.B.1.** |
| Vivo | **Proposal 1.A**: Support  **Proposal 1.B.1**: Resource Serving Cell ID and Resource BWP ID for spatial relationship derivation for SRS resource in the MAC CE can be absent. The strive to reuse wording is bizarre.  **Proposal 1.C**:  For a CORESET C associated with USS and CSS other than Type3, i.e. with both UE-dedicated and non-UE-dedicated reception on PDCCH, the same solution with CORESET B can be reused.  We don’t see much difference between CORESET B and CORESET C for the CSS reception part. For the USS part, with RRC signaling it provides the most flexibility.  For inter-cell beam indication, due to the CORESET C comprising the non-UE-dedicated reception on a PDCCH, the TCI state associated with a PCI different from the serving cell is not applied to CORESET C.  **Proposal 1.D**: Support  **Proposal 1.C.2**: Don’t support. For a CORESET C associated with USS and CSS, i.e. with both UE-dedicated and non-UE-dedicated reception on PDCCH, the same solution with CORESET B can be reused for CORESET C. But it needs to be clarified that for inter-cell case the CORESET B associated with CSS and the CORESET C associated with USS and CSS always do not apply the indicated TCI state associated with a PCI different from the serving cell.  **Proposal 1.D.2**: The conclusion of for intra-cell case can be reused to inter-cell case, e.g. follow the same rule as CORESET B. There is no need to discuss this proposal.  **Issue 1.9**: There is no agreement about the application of the indicated TCI state for P/SP-CSI-RS. For Alt4, the indicated TCI state is applied when gNB does not configure any TCI state for the P/SP CSI-RS. But the legacy behavior needs to be clarified when gNB does not configure any TCI state for the P/SP CSI-RS, which may conflict with Alt4.  **Issue 1.10**: Agree with Qualcomm. The parameter “followUnifiedTCI-State-r17” can be configured per CSI-RS resource set.  **Issue 1.11**: This proposal needs to be decided based on the discussion of the issue 1.4 and 1.8.  **Issue 1.12**: Support.  **Issue 1.13**: This proposal is already supported in Rel-17, e.g. Carrier indicator field in DCI.  **Issue 1.14**: Don’t support. There is no RAN1 spec impact for the other cases of beam alignment definition which should be discussed in RAN4. |

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

Table 3 Summary: issue 2

|  |  |  |
| --- | --- | --- |
| **#** | **Issue** | **Companies’ views** |
| 2.1 | For the already agreed NW-controlled inter-cell beam reporting, support reporting L1-RSRP for the subset of configured SSBs detected during the L3 measurement | **Support/fine:** Ericsson, MTK  **Not support:** Qualcomm, Nokia/NSB (RAN4 issue), Samsung, OPPO, Xiaomi, CMCC |
| 2.2 | Resource configuration for supporting mixed SC and NSC beam reports in a single reporting instance  **FL note**: It was pointed out that there is an existing agreement (which I agree). Hence this proposal does not seem needed | **PCIs associated with multiple SSB sets:** Xiaomi  **PCIs associated with SSBs in a set (already agreed, hence proposal is not needed)**: Huawei/HiSi, MTK, NTT Docomo, Samsung, OPPO, Ericsson, Qualcomm, CMCC |
| 2.3 | **Proposal 2.C**: For inter-cell beam measurement, support measuring overlapped SSBs from different PCIs as a UE capability  **FL note**: This issue may need RAN4 input first | Measuring overlapped SSBs from different PCIs  **Not supported:** OPPO  **UE capability (max. number)**: Qualcomm, MTK, Apple, Samsung, NTT Docomo, OPPO (ok), Xiaomi, Ericsson, CMCC  **Wait for RAN4**: Nokia/NSB, Ericsson |
| 2.4 | MAC CE activates non-serving cell SSBs for measurement  **FL note**: This was discussed several times before and needs **conclusion** | **Support/fine:** ZTE, Apple, Qualcomm, NTT Docomo, Xiaomi (for AP), CMCC  **Not support:** MTK, Ericsson (already supported implicitly), Samsung (already supported implicitly), OPPO, LG |

Table 4 Additional inputs: issue 2

|  |  |
| --- | --- |
| **Company** | **Input** |
| Mod V0 | 1. **Check and update your view in Table 3** 2. **Share more inputs here if needed** |
| MediaTek | ~~Issue 2.1: This proposal is unclear to us. Is it event-driven reporting based on the event of L3 measurement? We thought this is already precluded from Rel-17.~~  Issue 2.2: Singe set of SSBs associated with multiple PCI indices has been agreed in RAN1#107 to our understanding.  **Agreement**  On Rel-17 enhancements for inter-cell beam management and inter-cell mTRP, a CSI-SSB-ResourceSet configured for L1-RSRP measurement/reporting includes at least a set of SSB indices where PCI indices are associated with the set of SSB indices, respectively. The PCI indices refer to PCIs within the set of PCIs configured for inter-cell beam management or inter-cell multi-TRP.   * The additionalInfo associated with SSB(s) with PCI(s) different from the serving cell agreed in RAN1 Agenda Item 8.1.2.2 is also applicable to inter-cell BM * Detailed signaling design is up to RAN2 * FFS (to be concluded in RAN1#107-e): Whether the above L1-RSRP measurement/reporting also includes group-based beam report for inter-cell mTRP   Issue 2.4: Prefer not to introduce any new functionality at this stage. |
| Apple | 2.1: We think some clarification may be needed. In our understanding, L3 measurement could be the first step for UE to perform L1 measurement, since L3 measurement can provide some rough timing/beam assumption. But is this proposal to ask UE to perform L1 and L3 measurement at the same time, or to ask UE to perform L1 measurement after it measured L3 results?  2.2: Based on our understanding, mixed SC/NSC for one beam report instance has already been agreed.  2.3: We think this should be a UE capability.  2.4: We support this operation. It is not necessary for UE to measure SSBs from all neighbor cells. Based on current UE capability, it is also hard for gNB to provide such configuration. Then gNB can only use RRC reconfiguration to change the SSBs to be measured. |
| Nokia/NSB | 2.1. The issue should capture that this is for inter-cell SSBs. Anyway, this sounds more of a RAN4 issue.  2.2. RAN1 should indicate to RAN2 e.g. in the LS reply that resource configuration needs to support mixed reporting in a single reporting instance.Already in R2-2202000 the PCI is associated with SSBs in a CSI-SSB-ResourceSet. To support mixed mode reporting e.g. with additional PCI, the number of these sets could be increased to 2 (also discussed in the CR). However, this is RAN2 issue.  2.3. wait for RAN4.  2.4. To aid NW activation of SSBs, UE should be able to indicate network that it has detected or determined that reporting configuration should be activated. |
| MediaTek | Issue 2.1: After further check the intention of 2.1, we understood this proposal requires UE only needs to perform L1-RSRS measurement/reporting on the SSBs that are detected during L3 measurements. We are supportive to this proposal. |
| Ericsson | 2.1: The idea is not to perform event-driven reporting: we still use NW-controlled reporting. However, the UE may choose to report only some of the configured RSs – the RSs the UE anyway detected as part of the L3 mobility.  2.2: There is no need to include different PCIs in the resource configuration, since measurements from multiple resource sets can be included in the same report.  2.3: RAN4 input could be valuable. But overlapping SSBs is the only relevant deployment. A UE that does not support measurements in overlapping SSBs does not support mobility.  2.4: Already supported. |
| Samsung | **Issue 2.1:** Not needed.  The UE should report a subset of SSBs detected during measurement. The subset includes measurements that are within the reporting range. When to perform the measurement can be left for UE’s implementation.  **Issue 2.2:**  We already have this agreement. Multiple CSI-SSB ResourceSet seems to be not aligned with the agreement.  **Agreement**  On Rel-17 enhancements for inter-cell beam management and inter-cell mTRP, a CSI-SSB-ResourceSet configured for L1-RSRP measurement/reporting includes at least a set of SSB indices where PCI indices are associated with the set of SSB indices, respectively. The PCI indices refer to PCIs within the set of PCIs configured for inter-cell beam management or inter-cell multi-TRP.   * The additionalInfo associated with SSB(s) with PCI(s) different from the serving cell agreed in RAN1 Agenda Item 8.1.2.2 is also applicable to inter-cell BM * Detailed signaling design is up to RAN2 * FFS (to be concluded in RAN1#107-e): Whether the above L1-RSRP measurement/reporting also includes group-based beam report for inter-cell mTRP   **Issue 2.3:** Can be supported based on a UE capability  **Issue 2.4**: Not needed. SSBs for measurements can be configured by RRC. |
| Qualcomm | For 2.1, do not support. UE may not measure L3-RSRP for the desired occasions for reporting L1-RSRP. L3 and L1 are handled by different processes  For 2.2, no need. UE will report SSBs among SSBs in the same set as agreed  For 2.3, either only allowing TDMed SSB measurement or leaving SDMed SSB measurement as UE capability is fine  For 2.4, support for power saving aspect |
| OPPO | 2.1: It is not needed. The UE is configured with a list of SSB for L1-RSRP. It shall be up to UE implementation to select the SSBs for reporting.  2.2: The proposal is not needed, since that is already supported.  2.3: our preference is not supporting it. But can live with UE capability.  2.4: The proposal seems not needed. Measuring L1-RSRP of NSC SSB shall follow the configuration/indication method that are supported in CSI framework and SSBs are configured in RRC. If it is SP measurement, it can be activated by MAC CE, as in current CSI framework. |
| NTT Docomo | 2.1: Does the proposal intend to support both modes, which is selected/configured by RRC (based on separate UE capability)?  - Mode1: Report L1-RSRP for the subset of configured SSBs  - Mode2: Report L1-RSRP for the subset of configured SSBs detected during the L3 measurement  2.2: Agree with MediaTek: *Singe set of SSBs associated with multiple PCI indices has been agreed in RAN1#107*  2.3: Support UE capability. “Not support” is too restrictive.  2.4: We are fine with the proposal. |
| Xiaomi | 2.1: Do not support. We do not think it is reasonable to constrain UE to only perform L1-RSRP measurement/reporting on the SSBs that are detected during L3 measurements.  2.2: We have to clarify that what we proposed in our Tdoc is that CSI-SSB-ResourceSet associated with serving cell PCI and CSI-SSB-ResourceSet associated with non-serving cell PCI can be configured in one CSI-ResourceConfig to inform UE that beam(s) associated with a non-serving cell should be mixed with that associated with serving-cell in one reporting instance. It is not conflict with the agreement mentioned by MediaTek and Samsung. Because we already agreed that in one reporting instance, depending on NW configuration, beam(s) associated with a non-serving cell can be mixed with that associated with serving-cell. But there is no discussion on how to inform UE.  2.3: The measurement of no-serving cell SSB in RRM is good reference. Namely, there is no need to support measuring overlapped SSBs from different PCIs from our understanding. And we are fine with supporting it based on UE capability.  2.4: Support, at least for the aperiodic reporting. |
| LG | 2.2: As Samsung mentioned, it was already agreed based on a CSI-SSB-ResourceSet on one beam report instance  2.4: We have a similar understanding with OPPO that the proposal seems not needed. |
| CMCC | 2.1: Not needed.  2.2: Not needed. It has already been agreed.  2.3: Support as a UE capability.  2.4: Support. |
| Mod V19 | **Added proposal 2.C** |
| vivo | **Issue 2.1:** Support. And we share similar view with MediaTek.  **Issue 2.3:** We support L1 measurement on overlapped SSBs from different PCIs is a UE capability. For the UE without the UE capability, to guarantee measurement accuracy and requirement in inter-cell case, the higher layer parameter *timeRestrictionForChannelMeasurements* should be always set to “*notConfigure*d”.  **Issue 2.4:** We support the proposal.  Besides, several essential issues should also be discussed and resolved.  **The following issues should also be discussed in addition to above issues and we would like to :**  **Issue 2.5**: default beam mechanism in inter-cell case  DL channels/RSs are divided into two categories in Rel-17, non-UE-dedicated and UE-dedicated, where in inter-cell cases, non-UE-dedicated DL channels/RSs are defined as the DL channels/RSs associated with non-UE-dedicated CORESET and follow R15/16 TCI state deactivation/activation and indication mechanism, while the QCL assumption of DL UE-dedicated channels/RSs follows the indicated TCI-state-r17. Therefore, the default QCL assumption of DL channels/RSs should also be determined separately.   * For UE-dedicated DL channels/RSs, they follow the previous indicated TCI-state-r17; * For non-UE-dedicated channels/RSs, reuse legacy default beam mechanism defined in Rel-15/16 to obtain their QCL assumption respectively.   Proposal: For inter-cell cases, default beam mechanism should be determined separately.   * + For non-UE-dedicated DL channels/RSs, reuse legacy default beam mechanism defined in Rel-15/16 to obtain their QCL assumption respectively;   + For UE-dedicated DL channels/RSs, follow the previous indicated TCI-state-r17;   **Issue 2.6:** beam indication across CCs  For inter-cell case with one TCI pool configured within a set of CCs, when different PCIs are associated with the TCI states in different CCs, it should be allowed that the same TCI state ID can refer to different PCI on different CCs.  Proposal: For inter-cell case with one TCI pool configured within a set of CCs, when different PCIs are associated with the TCI states in different CCs, it should be allowed that the same TCI state ID can refer to different PCI on different CCs.  **Issue 2.7:** rate match for PDSCH and PDCCH  PDSCH/PDCCH from non-serving cell (PCI) associated with TCI state and/or QCL-info is rate matched around non-serving cell SSB with the same PCI, which means per PCI rate match, has been agreed in AI.8.1.2.2.  From UE measurement perspective, when UE is configured to measure on SSBs while still receiving PDSCH on overlapped resources, there would be performance degradations and additional UE complexities to guarantee the corresponding performance. In legacy UE implementation, there is no such simultaneous L1-RSRP measurement and PDSCH reception on the same RE case. We think the same rule also apply to inter-cell measurement in Rel-17. Therefore, PDCCH/PDSCH should also be rate matched around the SSBs configured for L1-RSRP measurement, besides SSBs associated with the same PCI as that of the activated/indicated TCI state of the PDCCH/PDSCH. |

### Issue 3 (signaling medium)

Table 5 Summary: issue 3

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| **#** | **Issue** | **Companies’ views** |
| 3.1 | **Proposed conclusion 3.A**: On Rel-17 DCI-based beam indication, regarding application time of the beam indication, there is no consensus on supporting a second configured BAT for, e.g. MPUE or inter-cell BM, for a given SCS and all the CCs configured with the common TCI state ID update.  **FL Note**: Discussed offline [1]. This has been discussed since RAN1#107-e. While more companies prefer to support a second BAT (for MPUE or inter-cell), there are significant number of companies against this.    Single BAT: vivo, Oppo, NTT Docomo, CMCC, Qualcomm, Nokia/NSB  Two BATs: Huawei/HiSi, CATT, LG, Ericsson, NEC | |
| 3.2 | **Proposal 3.B**: On Rel-17 DCI-based beam indication, regarding application time of the beam indication for CA, in RAN1#108-e, further discuss and select one from the following alternatives for BAT configuration across CCs when common TCI state ID update is not configured/supported:   * Alt1. The BAT is configured per-CC * Alt2. Use the same scheme as that with common TCI state ID update, i.e. a common BAT is determined by the CC(s) with the smallest SCS in a band * Alt3. A BAT list is configured under the cell group config and applied for each CC in the CG. For CCs not configured with a common TCI state ID update, the BAT is determined by the SCS of the active BWP of the CC.   **FL Note**: Discussed offline [1]. | **Alt1**: Huawei/HiSi, NTT Docomo, Xiaomi, Ericsson (no additional restriction), Samsung, CMCC, Intel (when common TCI state ID update is not configured/supported), MTK (also for non-CA case), NEC, CATT, OPPO, LG, CMCC, Nokia/NSB, TCL  **Alt2:** Qualcomm, ZTE, Apple, Lenovo/MotM, Spreadtrum,  **Alt3**: vivo |
| 3.3 | **Proposal 3.C**: On Rel-17 DCI-based beam indication, regarding the CC list for common TCI state ID update and activation, introduce new RRC parameter(s) to configure the CC list(s)   * FFS: The maximum number of CC lists can be configured   **FL Note**: Discussed offline [1]. | **Support/fine**: NTT Docomo, Qualcomm, OPPO, Fraunhofer IIS/HHI, LG, vivo, CMCC, Intel, MTK, Lenovo/MotM, Samsung, CATT, Apple, Ericsson, TCL  **Not support:** |
| 3.4 | When the gap between the last symbol of beam indication DCI and the determined first slot does not meet the UE capability, the UE starts to apply the indicated TCI state in the first slot that can satisfy the UE capability | **Support/fine:** OPPO  **Not support (error case):** MTK, Ericsson, NTT Docomo, Apple, Nokia/NSB, Samsung, Qualcomm. LG, CMCC |
| 3.5 | **Proposal 3.D:** 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 | **Support/fine:** OPPO, Qualcomm, NTT Docomo, NEC, Xiaomi, TCL, CMCC  **Not support:** |
| 3.6 | The value range of RRC configured BAT (beamAppTime-r17)   * {0, ..., 14} from NTT Docomo | **Support/fine**: NTT Docomo  **Other proposals**:   * {7, 14, 28, 42, 56, 70, 84, 98}): MTK, Ericsson, Samsung, Qualcomm, NTT Docomo * In addition, add smaller values {1, 2, 4}: Samsung, NTT Docomo * {24, 28, 42}: Apple |
| 3.7 | If the UE is configured with Rel-17 TCI, TCI field is always present in DCI format 1\_1/1\_2 | **Support/fine:** MTK, Samsung, Qualcomm, Nokia/NSB  **Not support:** Apple, Ericsson (for single activated TCI state), NTT Docomo, OPPO, LG, TCL, CMCC |
| 3.8 | For DCI format 1\_2 for TCI update and without DL assignment, the RV field should always present  **FL Note**: Since RV=1 is the condition of using the DCI format for beam indication, RV field is always present. Hence this proposal doesn’t seem needed | **Support/fine:** Qualcomm, Samsung,  **Not support (**already agreed since RV=1**):** Ericsson, NTT Docomo, Apple, OPPO, LG, TCL, CMCC |
| 3.9 | Regarding TCI indication by DCI without DL assignment, for type-1 HARQ-ACK codebook determination, virtual PDSCH is assumed in the same slot of the DCI by UE. | **Support/fine**: ZTE, Nokia/NSB  **Not support:** Qualcomm, Apple, OPPO, TCL |
| 3.10 | For DCI formats 1\_1 and 1\_2 without DL assignment, the UCI carrying the HARQ feedback should be mapped to high priority HARQ codebook and PUCCH resources associated with priority index 1 when the UE is configured with two priority indexes. If UE is configured with single priority index, the UCI carrying the HARQ feedback for beam indication should be prioritized over other UCI. | **Support/fine**: Intel  **Not support:** Ericsson (not essential), Qualcomm (no need), OPPO |
| 3.11 | **Proposal 3.B.1**: On Rel-17 DCI-based beam indication, regarding application time of the beam indication for non-CA, the BAT is configured per-CC | **Support/fine**: MTK, Samsung  **Not support:** |
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Table 6 Additional inputs: issue 3

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| **Company** | **Input** |
| Mod V0 | 1. **Check and update your view in Table 5** 2. **Share more inputs here if needed** |
| MediaTek | Proposal 3.B: There are two possible cases including CA and non-CA when common TCI state ID update is not configured/supported. For CA case, how to provide BAT is clarified in this proposal. However, it is still unclear how to provide BAT for non-CA case. Thus, we suggest to have another proposal for non-CA case, and it seems there is only one solution as follows:  **Proposal 3.B.1**: On Rel-17 DCI-based beam indication, regarding application time of the beam indication for non-CA, the BAT is configured per-CC.  Proposal 3.C: Suggest to add “activation” in the main bullet. Meanwhile, since common TCI state ID update and activation is only agreed for intra-band CA, we also expect multiple CC lists may be needed, where each band requires at least one. Thus, we suggest:   * **Proposal 3.C**: On Rel-17 DCI-based beam indication, regarding the CC list(s) for common TCI state ID update and activation, introduce new RRC parameter(s) to configure the CC list(s)FFS: The maximum number of CC lists can be configured   Issue 3.4: This doesn't seem necessary. A UE capability is already defined for the BAT.  Issue 3.6: We suggest {7, 14, 28, 42, 56, 70, 84, 98}. This may need to be concluded in order to provide answer to the incoming LS R1-2200887 (R2-2202002) from RAN2.  Issue 3.7: In Rel-15/16, whether the TCI field is present in DCI is configured by an RRC parameter in a CORESET. Since the TCI field in Rel-15/16 is used only for the scheduled PDSCH reception, it can be absent and UE will follow the PDCCH beam indicated for the corresponding CORESET for the scheduled PDSCH reception. However, in Rel-17 unified TCI framework, the TCI field is used for almost all DL and UL channels. Thus, it should be present if Rel-17 TCI is configured rather than per-CORESET configured. Even the DCI-based TCI update may not be used when there is only one active TCI states, the TCI field sill can be present since the DCI payload size should not be changed dynamically according to TCI activation. For UE that cannot support TCI update via DCI, UE ignores this bit field, which is similar to the BWP indicator field. |
| Apple | 3.4: We failed to see the necessity, but we think the default PDSCH/aperiodic CSI-RS beam can be discussed for scheduling offset below threshold  3.6: We think candidate value can be {14, 28, 42}  3.7: What is the benefit?  3.8: It seems this has already been agreed? Current validation rule requires the value of RV=all 1  3.9: We do not know why this is needed, and some clarification could be helpful.  3.10: We would like to understand what the consequence would be without this proposal. |
| Nokia | 3.1: We consider single BAT is needed as TCI state indication is from the activate TCI states and thus expect there is no panel switch on needed. Thus, we support proposed conclusion 3.A.  3.2: We support Alt1.  3.3: Support Proposal 3.C.  3.4: Not sure we understand the proposal – our understanding is that it cannot happen per agreements.  3.5: Ok  3.6: Ok  3.7: Ok  3.9: Ok |
| Ericssson | P 3.B: Alt1 states how the BAT is configured, whereas Alt2 states how the BATs are interpreted. (RAN2 plans to configure the BAT in the PDSCH-Config, i.e., per BWP.) On top of this configuration, we can add a configuration restriction in 38.331. This is how we see that the common TCI state update will be handled. So the remaining issue is if we should add additional restrictions in the specification on CCs that are not configured for common TCI update. Here we do not see why this is needed: a reasonable NW implementation will include all the CCs in a band in the CC list.  P3.C: We propose to use the same principle as in R16: configure 2 CCs lists (to handle inter-band CA)  Issue 3.4: If the configured BATs do not meet the UE capability, the UE should reject the RRC configuration.  Issue 3.6: Large values are needed, so that the NW can react on a missing ACK. Note that the NW cannot distinguish between a missed beam indication (the UE missed the PDCCH) and a missed ACK (the NW missed the PUCCH).  Issue 3.7: Operation with a single activated TCI state would not require a TCI field.  Issue 3.8: The spec is clear: if the RV field is not there, it’s not a beam indication. |
| Samsung | **Issue 3.1, proposed conclusion 3.A:** OK  While we prefer to have 2 BATs, we see that there is no consensus.  **Issue 3.2, proposed conclusion 3.B:** Alt 1  We suggest the following update:  On Rel-17 DCI-based beam indication, regarding application time of the beam indication for CA, in RAN1#108-e, further discuss and select one from the following alternatives for BAT configuration across CCs ~~when common TCI state ID update is not configured/supported~~:   * Alt1. The BAT is configured per-CC * Alt2. Use the same scheme as that with common TCI state ID update, i.e. a common BAT is determined by the CC(s) with the smallest SCS in a band * Alt3. A BAT list is configured under the cell group config and applied for each CC in the CG. For CCs not configured with a common TCI state ID update, the BAT is determined by the SCS of the active BWP of the CC.   This should also apply to the case that the CCs have a common TCI state update ID. In this case, the BAT follows the CC/BWP with the largest SCS.  **Issue 3.3, proposed conclusion 3.C:** Support  Also fine to have multiple CC lists.  **Issue 3.4:** We prefer to consider is an error case to avoid misalignment between UE and gNB.  **Issue 3.5:** The need for this proposal is unclear.  A NACK can also be considered as an acknowledgment when there is no confusion between NACK and DTX. Or when the UE sends the same TCI state in all DCIs that are mapped to the same codebook.  Perhaps the proponents can explain why this is insufficient (if we miss something). It looks like an optimization.  **Issue 3.6:** Agree to discuss this issue.  In Re1-15, the value timeDurationForQCL depends on the SCS and is given as shown below, maybe this can be considered when deciding the BAT values for Rel-17  timeDurationForQCL SEQUENCE {  scs-60kHz ENUMERATED {s7, s14, s28} OPTIONAL,  scs-120kHz ENUMERATED {s14, s28} OPTIONAL  We can consider values smaller than 7 in Rel-17, we don’t see a strong need to consider all consecutive value between 1 and 7 (an increment of 1). For example, we can consider 1, 2, 4, 7, 14, 28, and a few values higher than 28.  Some values might not be applicable to all SCS.  **Issue 3.7:** Support  **Issue 3.8:** Support  **Issue 3.9:** We have some concerns.  It has been agreed that the virtual PDSCH is determined based on the TDRA. It seems that the proposal isn’t according to the agreement:  **Agreement RAN1#104bis-e**  For beam indication with Rel-17 unified TCI, support DCI format 1\_1/1\_2 without DL assignment:   * Use ACK/NACK mechanism analogous to that for SPS PDSCH release with both type-1 and type-2 HARQ-ACK codebook:   + Upon a successful reception of the beam indication DCI, the UE reports an ACK     - Note that upon a failed reception of the beam indication DCI, a NACK can be reported.     - For type-1 HARQ-ACK codebook, a location for the ACK information in the HARQ-ACK codebook is determined based on a virtual PDSCH indicated by the TDRA field in the beam indication DCI, based on the time domain allocation list configured for PDSCH     - For type-2 HARQ-ACK codebook, a location for the ACK information in the HARQ-ACK codebook is determined according to the same rule for SPS release   **Issue 3.10:**  For the case when there one priority index, the HARQ-ACK associated with the DCI carrying beam indication can be multiplexed with other UCI information. What is the rationale for prioritization in this case? |
| Qualcomm | For conclusion 3.A, support  For Proposal 3.B, support Alt2  For Proposal 3.C, fine  For 3.4, no need. gNB should avoid such BAT configuration  For 3.5, support  For 3.6, fine with {7, 14, 28, 42, 56, 70, 84, 98}  For 3.7, support  For 3.8, support  For 3.9, unclear the benefit for such constraint  For 3.10, seems no need, since the DCI can indicate the priority for the PUCCH |
| OPPO | Conclusion 3.A: ok  3.B: we support Alt1, which is simple implementation in spec.  3.C: ok  3.4: Suggest to make a conclusion that it is a error case and the UE does not expect it.  3.5: Support. If the UE does not decode PDCCH correctly, the UE can still feedback NACK, which would cause problem.  3.6: fine with > 7 values.  3.7: sympathize Ericsson’s Not support: if single TCI state is activated, why TCI field must be present?    3.8: one condition for DCI 1\_2 w/o PDSCH assignment to indicate TCI state is RV value = 1s. So, this proposal seems not needed.  3.9: the motivation is not clear. Why this limitation is needed? The current spec is clear and works  3.10: the motivation for prioritizing the beam indication HARQ feedback is not clear. Actually, the HARQ feedback for PDSCH shall have higher priority than that of the beam indication. Dropping the HARQ of PDSCH would cause more resource waste due to the retransmission of whole PDSCH. But beam indication is in DCI and the PDCCH will be transmitted any way. |
| NTT Docomo | Proposed conclusion 3.A: Support.  Proposal 3.B: support Alt.1  Proposal 3.C: support  3.4: No need to make agreement. It is just error case of gNB configuration.  3.5: Support. As pointed out in previous meeting, for semi-static HARQ codebook, UE sends NACK even if UE miss detects DCI. Only “ACK” can be reliable for semi-static HARQ codebook.  3.6: We can include larger value than 14, but we suggest to include smaller value than 7. *timeDurationForQCL* in Rel.15 is counted from DCI, on the other hand, BAT is counted from ACK, which is later than DCI. Hence, it should be possible to assume smaller value than *timeDurationForQCL* in Rel.15. We suggest as {1, 2, 4, 7, 14, 28, 42, 56, 70, 84, 98}.  3.7: We think not needed. gNB can decide whether to configure tciPresentInDCI for all CORESET jointly. It is up to gNB configuration.  3.8. Agree with Ericsson. When gNB uses beam indication DCI without DL assignment, gNB can configure RV field. It is up to gNB configuration.  3.9: We would like to understand what the consequence would be without this proposal.  3.10: We would like to understand what the consequence would be without this proposal. |
| NEC | **Proposed conclusion 3.A**: we also support two BATs.  **Issue 3.5**: Support.  In addition, we haven’t ever discussed DCI based beam update in case of HARQ-ACK multiplexing, which we think is a quite typical use case and which indicated TCI state to be applied should be discussed. As mentioned in out tdoc, we proposed that **clarifying that only ACK of the PDSCH scheduled by the DCI carrying the beam indication can be used as an ACK also for the DCI. And 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.** |
| Xiaomi | 3.1: support  3.3: support and also fine with multiple CC lists  3.5: support and share same reason as NTT Docomo. In addition, as proposed by NEC, we also propose to discuss that if there are ACK/NACKs of multiple DCIs indicating different TCI states in one HARQ-ACK codebook, which one TCI state will be applied? |
| LG | 3.2: Fine with the proposal and support Alt1.  3.3: Support the proposal.  3.4: This is an error case that we don’t need to take care in specification  3.7: We have a similar view with Ericsson where a single activated TCI state is operated (via MAC-CE). Also, it is unreasonable to mandate the TCI field for DL grant scheduling only while the beam is unchanged.  3.8: Not needed as similar to Ericsson and Docomo. |
| TCL | For proposal 3.B, prefer Alt. 1.  For proposal 3.C, support.  For issue 3.5, support.  For issue 3.7, not necessary. Whether TCI filed is present in DCI format 1\_1/1\_2 can be configured by RRC or up to the number of TCI states.  For issue 3.8, no need.  For issue 3.9, no need. One of the agreement of RAN1#104-e meeting states that “The ACK is reported in a PUCCH k slots after the end of the PDCCH reception where k is indicated by the PDSCH-to-HARQ\_feedback timing indicator filed in the DCI format”. This implies that virtual PDSCH is in the same slot as the DCI scheduling this virtual PDSCH. |
| CMCC | 3.4: We think gNB should avoid such configuration.  3.5: Support.  3.7: Not needed. Whether the TCI field is present in DCI can be configured by gNB.  3.8: We think it has already been agreed. RV=all ‘1’s. |
| Mod V19 | **Revised proposals** |
| Vivo | **Issue 3.1:** Support.  **Issue 3.2:** We can wait until further RAN2 design. No need to make decision right now.  The following was agreed in RAN2   * IT shall be possible to configure the parameter BeamAppTime differnet for different SCS * FFS if parameter BeamAppTime is under the cell group config.   Our understanding is that the values if further agreed to be a cell group level can be used for the CC(s) not configured with a common TCI state ID update, i.e., the beam application time of the active BWP on this CC is the BAT corresponding to the SCS of this active BWP in the BAT list under the cell group config.  **Issue 3.3:** Support.  **Issue 3.4:** The gap between beam indication DCI and the determined first slot should be further discussed in UE feature.  **Issue 3.5:** Support.  **Issue 3.6:** Fine with value 0, but not all values between 0 and 7 are required.  **Issue 3.7:** If a UE does not support DCI-based TCI state indication, the TCI field is not required in DCI. This issue can be modified as follows:  **Issue 3.8:** This proposal is not needed. Implementation issue.  **Issue 3.9:** Agree with Samsung. The current spec is clear.  **Issue 3.10:** It is a corner case and does not require additional discussion. |

### Issue 4 (MP-UE)

Table 7 Summary: issue 4

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| **#** | **Issue** | **Companies’ views** |
| 4.1 | **Proposal 4.A**: Confirm the following working assumption as an agreement with the following refinement (highlighted in **red**):  Support the UE reporting a list of UE capability value sets   * Each UE capability value set comprises the max supported number of SRS ports * For any two different value sets, at least one capability value needs to be different   + ~~FFS:~~ In addition also identical value sets are allowed. * Whether the UE capability value set can be common across all BWPs/CCs in same band or BC can be discussed in UE feature session   **FL Note:** Discussed offline [1] | **Support/fine**: MTK, Apple, Nokia/NSB, Fraunhofer IIS/HHI, NTT Docomo, NEC, LG, Qualcomm, OPPO, Xiaomi, LG, CMCC  **Not support:** Ericsson, Samsung (not support FFS) |
| 4.2 | **Proposal 4.B**: On Rel.17 enhancements to facilitate UE-initiated panel activation and selection,   * From the perspective of UE capability, maximum number of supported UL Tx layers = min{maximum number of SRS ports for a reported set, maximum number of UL Tx layers reported by UE ~~capability~~}   **FL Note:** Discussed offline [1] | **Support/fine**: MTK, Apple, Nokia/NSB, NTT Docomo, NEC, LG (in principle), Qualcomm, OPPO, Xiaomi, LG, CMCC  **Not support:** Ericsson (no need to discuss), Samsung |
| 4.3 | **Proposal 4.C**: On Rel.17 enhancements to facilitate UE-initiated panel activation and selection, UE can report one index of UE capability value set for each reported CRI/SSBRI in one beam reporting.  **FL Note:** Discussed offline [1] | **Support/fine**: MTK, Apple, Nokia/NSB, Ericsson, Qualcomm, Fraunhofer IIS/HHI, NTT Docomo, NEC, LG, Samsung, Xiaomi, CMCC  **Not support:** |
| 4.4 | **Proposal 4.D**: On Rel.17 enhancements to facilitate UE-initiated panel activation and selection, one value of the max supported number of SRS ports (e.g., 0) is reserved to indicate the DL-only panel  **FL Note:** Discussed offline [1] | **Support/fine**: MTK, Ericsson, Qualcomm, NTT Docomo, LG, Xiaomi, CMCC  **Not support:** Apple, Nokia/NSB, Fraunhofer IIS/HHI, NEC, Samsung, OPPO |
| 4.5 | **Proposal 4.E**: On Rel.17 enhancements to facilitate UE-initiated panel activation and selection, all types of time-domain behavior, i.e., periodic, semi-persistent, and aperiodic reporting, are supported for the enhanced beam report with index(es) of UE capability value set.   * [FFS: Semi-persistent and/or aperiodic reporting is triggered only when periodic reporting is configured] * [In such case, the candidate periodicities for periodic report are subjective to UE capability]   **FL Note:** Discussed offline [1] | **Support/fine**: MTK, Nokia/NSB, Ericsson, Qualcomm, Fraunhofer IIS/HHI, NTT Docomo, NEC, LG, Samsung (without sub-bullets), OPPO (without sub-bullets), CMCC  **Not support:** Apple (On SP/AP report) |
| 4.6 | **Proposal 4.F**: Regarding acknowledgement mechanism of the reported correspondence from NW to UE, down-select the following alternatives:   * Alt-1: Being based on TCI state activation/update mechanism where the activated TCI state includes reported RS (SSBRI or CSI-RS) [and is additionally associated with the index of UE capability value set]; * Alt-2: A dedicated SS can be configured to send the ACK, which is like PCell-BFR. * Alt-3: A scheme based on the BFR response in SCell BFR * Alt-4: acknowledgement mechanism is not supported. * Alt-5: use the indicated SRS resource set matching the reported SRS port #   **FL Note:** Discussed offline [1] | **Support/fine**: MTK (Alt1), Qualcomm (Alt5, use SRS resource set indicator), NTT Docomo, Nokia/NSB (Alt1), Samsung (Alt1), OPPO (Alt2/3), CMCC (Alt2/3)  **Not support (Alt4):** Apple (Alt1 is unclear on whether the text in bracket should be included or not), Ericsson |
| 4.7 | **Proposal 4.G**: Regarding how to update the number of SRS ports according to UE reporting, down-select the following alternatives:   * [Alt1: via UL BWP switching where each UL BWP has different number of SRS ports   + FFS: BWP fallback mechanism which would let NW to control UE panel, i.e. switch to a specific UE panel or panel type when timer expires.] * Alt2: via SRS resource set selection by DCI where each set has different number of ports   + Note1: ‘SRS resource set indicator’ is already specified in DCI format 0\_1/0\_2 and it provides functionality to select one SRS resource set by the DCI between two SRS resource sets configured by RRC   + Note2: TPMI/TRI mapping for varying number of SRS ports is already specified for fullpowerMode2. * Alt3: via TCI state update/activation mechanism with two options   + Opt1: MAC-CE based TCI state update is targeted to a certain SRS resource set that the SRS resource set if the target set is different from the previous used set.   + Opt2: UE can assume that the SRS resource set which can be triggered (aperiodic) or which is to be used (periodic or semi-persistent) is the one that is associated with the same capability set index as the UE provided in the report together with the reported RS and included in the activated TCI state. * FFS: Any other RRC parameters, e.g., the maximum number of UL layers, codebook subset, uplink full power mode, configuration of SRS for antenna switching and so on, may need to be updated simultaneously with the number of configured SRS ports.   **FL Note:** Discussed offline [1] | **Support/fine**: MTK (Alt1, no spec impact), Nokia/NSB (Alt-1), Qualcomm (Alt2), NTT Docomo (Alt2), NEC (Alt2), LG (Alt2), Samsung (Alt2), OPPO (Alt2), Xiaomi, CMCC (Alt2)  **Not support:** Apple, Ericsson |
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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** |
| Apple | 4.4: We think current discussion is for uplink panel selection. We do not know why this is needed.  4.5: We have concern on SP/AP report, as UE is not free to change panel if gNB does not trigger beam report any more.  4.6: We suggest we clearly state each alternative without bracket, which can be helpful for further down-selection.  4.7: We think the first issue is to discuss what parameters need to be updated. The solution should be general for all parameters. |
| Nokia | 4.1: Support Proposal 4.A as it would be future-proof for potential multi-panel UL transmission in Rel18.  4.2: Support Proposal 4.B  4.3: Support Proposal 4.C  4.4: In such case the UE should also provide SSBRI/CRI with valid capability value set index for the UL transmission purpose, i.e. that UE cannot report only reserved value.  4.5: Support without any additional rule.  4.6: TCI state activation/update mechanism is a logical mechanism to update the correspondence assumption.  4.7: We think that this can be done jointly with 4.6, i.e. with TCI state activation/update mechanism. Thus, we propose to add yet another alternative:   * Alt3: via TCI state update/activation mechanism with two options   + Opt1: MAC-CE based TCI state update is targeted to a certain SRS resource set that the SRS resource set if the target set is different from the previous used set.   + Opt2: UE can assume that the SRS resource set which can be triggered (aperiodic) or which is to be used (periodic or semi-persistent) is the one that is associated with the same capability set index as the UE provided in the report together with the reported RS and included in the activated TCI state. |
| Ericsson | P 4.A: we made a working assumption so that we can work out the remaining details. So far, there are many remaining details. We should not confirm the WA before those details have been worked out. We would in any case have strong concerns of removing the FFS, as it is not useful for the considered functionality.  P4.B: This would seem to be a natural consequence.  P4.F: There is no need for an acknowledgment.  P4.G: The proposal is a bit unclear with Alt1 in brackets. It would seem that the only thing that is actually proposed is Alt2, which could be formulated in a more compact way. |
| Samsung | **4.1.** we don’t see the benefit of supporting identical values. Hence, can support Proposal 4.A without the sub-bullet on identical values. We can be open to further discussion on the FFS part, if needed.  **4.2.** we don’t agree with this way of determining max #UL layers (as in Proposal 4.B). Technically, the UE needs to report this since the UE is reporting potential panel activation/selection, which may impact max #UL layers. One simple to report both max #SRS ports and max #UL layers together is via TPMI where #rows= max #SRS ports and #columns=max #UL layers. Hence, we propose to use TPMI to indicate both max #supported layers and max #UL layers jointly.  **4.3.** support Proposal 4.C  **4.4.** do not support Proposal 4.D. We fail to see the need for DL-only panel reporting. Could proponents clarify?  **4.5.** can support Proposal 4.E if both sub-bullets are removed  **4.6.** can support TCI state activation/update based ACK mechanism. We prefer a dedicated value of the TCI state activation/update signaling for this.  **4.7.** We are open to Alt2 based solution |
| Qualcomm | For Proposal 4.A, fine, but can someone clarify the use case of identical sets?  For Proposal 4.B, support but should be common sense, which is the purpose of the feature  For Proposal 4.C, support  For Proposal 4.D, support  For Proposal 4.E, support  For Proposal 4.F, support a new Alt5 to use the indicated SRS resource set matching the reported SRS port #  For Proposal 4.G, support |
| OPPO | Proposal 4.A: Ok  Proposal 4.B: Ok  Proposal 4.D: do not support. In such beam reporting, the UE reports the CRI/SSBRI for UL transmission. Why does the UE need to report a CRI/SSBRI for DL only?  4.E: support the main bullet and the sub-bullets in [] are not needed.  4.F: can live with Alt-2 or Alt 3. In Alt-2: the SS-BFR can be reused here. The UE monitors SS-BFR after sending the beam reporting.  4.G: Indeed, we need to discuss the issue mentioned here and we are open to scheme based on Alt2. |
| Fraunhofer IIS/HHI | Proposal 4.A: Support  Proposal 4.B: Such a rule can be assumed by default, but OK if companies require explicit specification.  Proposal 4.C: Support  Proposal 4.D: Have similar view as Apple. In our perspective, the reporting is required for UL panel activation or selection. The DL panel information is not necessary.  Proposal 4.E: OK  Proposal 4.F: Ok with Alt-1 (prefer without the bracketed text) or Alt-4. |
| NTT Docomo | Our views are added in the table  For proposal 4A, we are also fine with removing the whole FFS bullet “~~FFS: In addition also identical value sets are allowed~~.” |
| NEC | Our views are added in the table  **4.A**: Support. We also support identical values for different value sets, and we think it can be represented by a ‘repeated number of capability value sets’ instead of reporting multiple capability value sets.  **4.B**: As mentioned offline, for the maximum number of UL layers, we would like to also point out that before the first beam report containing this value set info, NW does not know which value (e.g., max. number of SRS ports) can be assumed. Therefore we suggest to add that the **smaller max. number of SRS ports in multiple UE capability value sets is to be assumed initially or by default**.  **4.C**: We are fine with it. Actually we think it is much more common to report beams associated with one panel in one beam report, thus we are also fine with a configured number of indexes.  **4.D**: Other than ‘DL-only’ in UE capability reporting which suggests UE is equipped with a DL-only panel, the need we see is to reserve a special status of UE capability value set index in a beam report to represent that **this beam (SSBRI/CRI) is not suitable for UL transmission**.  **4.E**: Support. Also support to remove the bracket to restrict that semi-persistent and/or aperiodic reporting is triggered only when periodic reporting is configured  **4.F**: From the perspective of protecting the report, since periodic report is assumed (and AP/SP reporting is associated with it, as in offline proposal), there is actually no need to have ACK mechanism. In addition, NW can trigger AP/SP reporting as NACK message when periodic reporting is not received successfully as expected.  **4.G**: We are open to Alt-2, but need more information is needed. In our understanding, different SRS resources (with different number of ports) can be configured if multiple value sets are reported. If it is the case, it is up to NW to determine the configuration/activation/trigger of different SRS resources. |
| Xiaomi | Proposal 4.A: we are fine with it  Proposal 4.B: support  Proposal 4.C: support  Proposal 4.D: support  Proposal 4.F: generally fine with Alt 1 or Alt 4. As for the text in bracket, if the SSBRI or CRI is different, we slightly prefer to not indicate the index of UE capability value set. |
| LG | Our views are added in the table  4.A: Support  4.B: Support in principle. Just wonder whether there is any possibility of maximum number of SRS ports for a reported set is greater than the maximum number of UL Tx layers reported by UE. If there is no such possibility, it can be revised “maximum number of supported UL Tx layers = ~~min{~~maximum number of SRS ports for a reported set~~, maximum number of UL Tx layers reported by UE}~~” Sorry if we missed something.  4.C: Support  4.D: Support. Quite a huge signaling overhead can be saved with this simple fix for both gNB and UE since Rel-17 beam reporting can be used for both DL beam determination as well as UL beam determination. Otherwise, UE always need to report CRI/SSBRI for DL with Rel-15/16 reporting and CRI/SSBRI for DL with Rel-17 reporting, separately, since NW does not know whether the UE has DL only panel or not.  4.E: Support  4.F: We think that TCI update signaling and/or SRS resource set indication signaling can be understood as ACK for the UE, which has dependency on the outcome of 4.G  4.G: Support. Considering large RRC overhead and forward compatibility to Rel-18 STxMP, we support Alt2. We are open to discuss FFS points further. |
| CMCC | 4.A: Support.  4.B: Support.  4.C: Support.  4.D: Support. In Rel-15/16, the purpose of beam reporting is to find proper DL beams. In Rel-17, the beam reporting framework is enhanced to report the index of corresponding UE capability value sets, but the basic purpose to find proper DL beams should be kept. One possibility is that a CSI-RS/SSB with highest L1-RSRP/SINR is measured by a UE with a DL-only panel. In order not to degrade the DL performance, the UE should report the CRI/SSBRI with the highest L1-RSRP/SINR. Thus, we think it is necessary to indicate the DL-only panel.  4.E: Support.  4.F: Alt-2 and Alt-3 should be considered in different cases. If the beam reporting is carried on PUCCH, Alt-2 can be used. If the beam reporting is carried on PUSCH, Alt-3 can be used.  4.G: Support Alt2. |
| Mod V19 | **Revised proposals** |
| vivo | **Proposal 4.A**: Support to confirm the WA. No strong view on the FFS.  **Proposal 4.B**: The spec impact of this proposal needs to be clarified.  **Proposal 4.C**: Support. This proposal is flexible enough to support different implementation of panel activation at UE.  **Proposal 4.D**: Don’t support a mixed report format for DL-only panel selection and UL-only panel selection. For Rel-17 unified TCI framework, joint TCI and separate TCI are configured by RRC. When joint TCI is configured, the optimal UE panel for DL and for UL are the same and there is no necessity to support DL-only panel in this case. When separate TCI is configured, it is also not necessary to further optimize for different DL-only panel and UL-only panels in this case since different beam report types can be configured by gNB, e.g., RRC parameter *reportQuantity* set to legacy value in Rel-15/16 or new RRC parameter in Rel-17 can be used to indicate DL-only or UL-only panel selection.  **Proposal 4.E**: Support to reuse legacy time-domain behavior of beam report, e.g. periodic, semi-persistent and aperiodic reporting.  **Proposal 4.E**: On Rel.17 enhancements to facilitate UE-initiated panel activation and selection, all types of time-domain behavior, i.e., periodic, semi-persistent, and aperiodic reporting, are supported for the enhanced beam report with index(es) of UE capability value set.   * ~~[FFS: Semi-persistent and/or aperiodic reporting is triggered only when periodic reporting is configured]~~ * ~~[In such case, the candidate periodicities for periodic report are subjective to UE capability]~~   **Proposal 4.F**: It is not necessary to define new acknowledgement mechanism for beam report in Rel-17.  The UL panel selection with different supported number of ports can be realized through BWP switching, regardless of whether the beam report including the correspondence is lost. If the gNB is ready to schedule UL transmission with a specific port #, target BWP needs to be switched firstly for a target panel selection. If the new beam report is lost, the indicated TCI state is based on the old beam report. The subsequent triggered SRS and scheduled PUSCH with the specific port # on the target panel are based on the old optimal SSBRI/CRI. Similar to legacy gNB implementation, for example, when the gNB detects the deterioration of uplink performance, the gNB can re-trigger the beam report to update the correspondence between index and SSBRI/CRI.  Thus, we prefer to add Alt5.  **Proposal 4.F**: Regarding acknowledgement mechanism of the reported correspondence from NW to UE, down-select the following alternatives:   * Alt-1: Being based on TCI state activation/update mechanism where the activated TCI state includes reported RS (SSBRI or CSI-RS) [and is additionally associated with the index of UE capability value set]; * Alt-2: A dedicated SS can be configured to send the ACK, which is like PCell-BFR. * Alt-3: A scheme based on the BFR response in SCell BFR * Alt-4: acknowledgement mechanism is not supported. * Alt-5: use the indicated SRS resource set matching the reported SRS port # * Alt-6: No spec impact   **Proposal 4.G**: Support Alt1. The UL BWP switching can be reused, where each BWP is configured with different SRS port #. Alt1 does not require spec impact and the gNB can realize the reasonable UL panel selection and update of SRS port # through UL BWP switching. For FFS of BWP fallback, the legacy behavior when timer expires for BWP switching can be reused and new fallback mechanism does not need to be introduced, where there is no impact on the current spec. |
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### Issue 5 (MPE)

Table 9 Summary: issue 5

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| **#** | **Issue** | **Companies’ views** |
| 5.1 | On Rel-17 enhancements to facilitate MPE mitigation, the SSB/CSI-RS resource set associated with P-MPR reporting should be also associated with L1-RSRP/SINR reporting | **Support/fine**: MTK  **Not support**: |
| 5.2 | The beam-specific P-MPR should be triggered when the P-MPR for indicated UL/joint TCI met legacy condition defined in 38.321, i.e. P-MPR for the indicated TCI is above mpe-Threshold or P-MPR change for this TCI is above phr-Tx-PowerFactorChange | **Support/fine**: Apple  **Not support**: |
| 5.3 | For PHR report to facilitate MPE mitigation, reported PCMAX, PH and P-MPR parameters can be associated with the cell which the reported SSBRI/CRI is associated with | **Support/fine**: NEC  **Not support**: |
| 5.2 | Limit the maximum number of P-MPR value larger than mpe-Threshold and without any available SSBRI/CRI to 1. | **Support/fine**: Xiaomi  **Not support**: |

Table 10 Additional inputs: issue 5

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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 | In our view, NW may not be able to perform UL beam selection from the reported SSBs/CSI-RSs only based on corresponding P-MPR values, and at least we see corresponding L1-RSRP/SINR values are essential. In normal case, NW performs beam UL beam selection based on L1-RSRP/SINR reporting from UE. When P-MPR reporting is triggered and reported from UE, in additional to L1-RSRP/SINR reporting, NW can use the P-MPR reporting as a reference for UL beam selection. In order to make sure that UE can perform measurement on the same set of RS resources and report the SSBRIs/CRIs for L1-RSRP/SINR and P-MPR reporting, the SSB/CSI-RS resource set associated with P-MPR reporting should be also associated with L1-RSRP/SINR reporting. Thus, we’d like to propose the following:  **Proposal: On Rel-17 enhancements to facilitate MPE mitigation, the SSB/CSI-RS resource set associated with P-MPR reporting should be also associated with L1-RSRP/SINR reporting** |
| Apple | In our view, the triggering condition for P-MPR report needs to be clarified. Currently the trigger condition is per UE basis, which is not aligned with the beam-specific P-MPR supported in Rel-17. We suggest discussing the following proposal.  ***The beam-specific P-MPR should be triggered when the P-MPR for indicated UL/joint TCI met legacy condition defined in 38.321, i.e. P-MPR for the indicated TCI is above mpe-Threshold or P-MPR change for this TCI is above phr-Tx-PowerFactorChange.*** |
| NTT Docomo | In our view, similar as in beam reporting in issue4, for MP-UE, index of corresponding UE capability value set should be reported along with SSBRI/CRI in PHR MAC CE. |
| NEC | As mentioned in out tdoc, we proposed that **for PHR report to facilitate MPE mitigation, reported PCMAX, PH and P-MPR parameters can be associated with the cell which the reported SSBRI/CRI is associated with**. And we believe RAN1 can send an LS to RAN2 for their information. |
| Xiaomi | As mentioned in our contribution, according to the agreement, for each P-MPR value, up to 1 SSBRI(s)/CRI(s) will be reported together. It is possible that there are more than one beam/panel whose P-MPR is larger than mpe-Threshold and without any available SSBRI/CRI. But only one P-MPR value larger than mpe-Threshold and without any available SSBRI/CRI is necessary to be included in the report to indicate the MPE event. Thus we propose to limit the maximum number of P-MPR value larger than mpe-Threshold and without any available SSBRI/CRI to 1. |
| Mod V19 | **Added proposals** |
| vivo | For issue 5.1, the restriction seems not needed.  For issue 5.2 , the following revision is preferred:  The ~~beam~~ panel-specific P-MPR should be triggered when the P-MPR for indicated UL/joint TCI met legacy condition defined in 38.321, i.e. P-MPR for the indicated TCI is above mpe-Threshold or P-MPR change for this TCI is above phr-Tx-PowerFactorChange  For issue 5.3, do not support.  For issue 5.4, we do not understand.  We would also like to additionally discuss the following proposal:  Issue 5.5, support to report capability value set index in MPE report. |

# References

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | R1-2201995 | Moderator Summary of Offline Discussion on Rel-17 Multi-Beam | Moderator (Samsung) |
| 2 | [R1-2200929](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2200929.zip) | Remaining issues on multi-beam operation in Rel-17 | Huawei, HiSilicon |
| 3 | [R1-2200996](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2200996.zip) | Enhancement on multi-beam operation | FUTUREWEI |
| 4 | [R1-2201078](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201078.zip) | Maintenance on multi beam enhancement | vivo |
| 5 | [R1-2201185](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201185.zip) | Remaining issues on multi-beam enhancements | ZTE |
| 6 | [R1-2201223](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201223.zip) | Enhancements on Multi-beam Operation | OPPO |
| 7 | [R1-2201328](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201328.zip) | Discussion on remaining issues on Rel-17 multi-beam operation | CATT |
| 8 | [R1-2201425](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201425.zip) | Remaining issues in enhancements on multi-beam operation | Fraunhofer IIS, Fraunhofer HHI |
| 9 | [R1-2201426](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201426.zip) | Enhancements on Multi-beam Operation | Lenovo, Motorola Mobility |
| 10 | [R1-2201463](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201463.zip) | Remaining issues on multi-beam operation | NTT DOCOMO, INC. |
| 11 | [R1-2201534](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201534.zip) | Remaining issues on multi-beam enhancements | Spreadtrum Communications |
| 12 | [R1-2201567](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201567.zip) | Enhancements on Multi-beam Operation | LG Electronics |
| 13 | [R1-2201575](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201575.zip) | Remaining issues on Multi-beam Operation | Sony |
| 14 | [R1-2201644](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201644.zip) | Remaining issues on multi-beam enhancements | Ericsson |
| 15 | [R1-2201682](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201682.zip) | Enhancements to Multi-Beam Operations | Intel Corporation |
| 16 | [R1-2201758](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201758.zip) | Views on Rel-17 Beam Management enhancement | Apple |
| 17 | [R1-2201844](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201844.zip) | Remaining issues of enhancements on multi-beam operation | CMCC |
| 18 | [R1-2201896](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201896.zip) | Discussion on remaining issues on multi-beam operation | NEC |
| 19 | [R1-2201943](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201943.zip) | Remaining issues on multi-beam operation enhancement | Xiaomi |
| 20 | [R1-2201996](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201996.zip) | Maintenance on Rel-17 Multi-Beam | Samsung |
| 21 | [R1-2202057](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2202057.zip) | Remaining issues on Rel-17 multi-beam operation | MediaTek Inc. |
| 22 | [R1-2202122](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2202122.zip) | Enhancements on Multi-beam Operation | Qualcomm Incorporated |
| 23 | [R1-2202316](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2202316.zip) | Maintenance of enhancements for Multi-beam Operation | Nokia, Nokia Shanghai Bell |
| 24 | [R1-2202003](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2202003.zip) | Other Potential Enhancements for Rel-17 Multi-beam | Samsung |
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