**3GPP TSG-RAN WG4 Meeting #102-e R4-22xxxxx**

Electronic Meeting, Feb 21- Mar 4, 2022

**Agenda item:** 10.19.3.1

**Source:** Moderator (Intel)

**Title:** Email discussion summary for [102-e][240] NR\_feMIMO\_RRM\_2

**Document for:** Information

# Introduction

This e-mail discussion summary captured the discussions for Rel-17 FeMIMO Unified TCI state in 10.19.3.1 in RAN4 #102-e meeting.

In RAN4 101bis-e meeting, WF is approved.

* **WF on FeMIMO RRM impact for unified TCI** was approved in R4-2202666

# Topic #1: Unified TCI (10.19.3.1)

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2203773**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203773.zip) | Apple | **PL-RS in UL TCI state switching**  **Proposal #1:**  **Confirm definition of beam alignment as:**   * **If PL-RS is included in UL TCI or joint TCI, PL-RS is identical to the source RS in UL or joint TCI** * **If PL-RS is associated UL TCI or joint TCI, PL-RS and source RS in UL or joint TCI is QCL-Type D.**   **Proposal #2: Confirm that requirements for unified TCI for UL and joint TCI state switching are only defined for beam alignment case**  **MAC-CE based TCI state-pair switching**  **Proposal #3: For TCI State pair switching no new requirements are introduced and the requirements for DL or UL TCI State switching are applicable for TCI states associated with the TCI state pair.**  **TCI switching delay requirement in CA for common TCI**  ***Observation #1:*** *Common TCI for CA could be associated with the same TCI state/RS or a different TCI state/RS.*  ***Observation #2:*** *For common TCI switch associated with same TCI state/ RX existing joint, DL or UL TCI state switching delay applies to all CCs.*  **Proposal #4: For common TCI switch with shared RS, the existing requirements apply to all CCs with same TCI state/RS.**  **Proposal #5: For common TCI switch with shared RS the switching delay will be based on the smallest SCS.**  ***Observation #3:*** *We need to consider command decoding time and beam application/ switching time for CCs with common TCI switch associated with different TCI state/RS.*  ***Observation #4:*** *Command decoding time would be common for CCs with common TCI switch associated with different TCI state/RS.*  **Proposal #6: The command decoding time is common for all CCs with common TCI switch associated with different TCI state/RS.**  ***Observation #5:*** *For CCs with common TCI switch associated with different TCI state/RS the target TCI state condition could be different.*  **Proposal #7: The beam switching time for all CCs with common TCI switch associated with different TCI state/RS should be considered separately.**  **Proposal #8: The command decoding time and switching time for each CC shall be based on the smallest SCS among the CCs.**  **TCI switching delay requirements for NSC**  **Proposal #9: Extend TCI state switching requirements for cell with different PCI to the case when active BWP is not within serving cell active BWP or when SCS are different.**  **Proposal #10: Extend the TCI state switching delay by active BWP switch delay for the case when active BWP is not within serving cell active BWP or when SCS are different.**  **Proposal #11: If TCI state switch to cell with different PCI includes active BWP switch, interruption requirements need to be defined.**  **DCI based TCI state switching delay**  **Proposal #12: DCI based TCI state switching delay requirements are defined when target TCI state is known, is in active TCI state list for DL and joint TCI switch, is maintained for UL and joint TCI state switch.** |
| [**R4-2204266**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204266.zip) | CMCC | ***Proposal 1: the beam alignment definition is proposed as following:***   * ***If PL-RS is included in UL TCI or joint TCI, PL-RS is identical to the source RS in UL or joint TCI*** * ***If PL-RS is associated UL TCI or joint TCI, UL TCI switch and PL-RS switch are activated in the same MAC CE, PL-RS and source RS in UL or joint TCI is QCL-Type D*** * ***If PL-RS is associated UL TCI or joint TCI, UL TCI switch and PL-RS switch are activated in different MAC CE, no need to have the beam alignment assumption for PL-RS and source RS in UL or joint TCI***   ***Proposal 2: for the case that PL-RS is associated with UL TCI state, but UL TCI switch and RL-RS switch are activated in the different MAC CE, the TCI switch delay requirement and PL-RS switch delay requirement need to be specified separately (which means there is no need to include the delay component of measuring PL-RS in the UL switch delay requirement).***  ***Proposal 3: for the case that PL-RS is associated with UL TCI state, but UL TCI switch and RL-RS switch are activated in the different MAC CE, the TCI switch delay requirements and PL-RS switch delay requirements are proposed as following:***   * ***TCI switch delay requirement is*** * ***THARQ + 3ms + 1, if TCI is known*** * ***THARQ + 3ms + TL1-RSRP + 1, if TCI is unknown*** * ***PL-RS switch delay requirement is*** * ***THARQ + 3ms + NM\*(Tfirst\_target-PL-RS + 4\*Ttarget\_PL-RS + 2ms)***   + ***NM = 1, if the target PL-RS is not maintained by the UE, 0 otherwise*** |
| [**R4-2204270**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204270.zip) | Samsung | **Proposal 1: RAN4 will specify the a cell with different cell PCI from serving cell as known cell if the following condtions are met**   * **Active BWP of cell with different PCI shall be within active BWP of serving cell** * **SCS between cell with different PCI and serving cell shall the same** * **Timing offset between SC and NSC are within CP**   **Proposal 2: RAN4 will NOT specify the requirements for unknown cell case (if conditions in proposal 1 cannot be met) for TCI swtiching dealy for a cell with different PCI from serving cell in Rel-17.**  **Proposal 3: RAN4 is to introduce the known condition for cell with different cell ID in introducation section for requirements applicability.**  **Proposal 4: No additional TCI switching delay requirements for CA case if common TCI is configured.**  **Proposal 5: RAN4 can specify the DCI based TCI switching delay requirements by referring to RAN1 agreed delay, i.e., and leave the detailed determination of beam application time for CA case to RAN1 and/or RAN2 specifications.** |
| [**R4-2204339**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204339.zip) | vivo | **Proposal 1 While re-using existing MAC-CE based TCI switching delay requirements for DL TCI switching delay requirements for PDCCH and PDSCH, the TCI state list considered should not be only for PDSCH.**  **Proposal 2 From RAN4 perspective, confirm ‘beam alignment ’ definition** **as applicability scenario for uplink TCI switching requirements, which include**   * **If PL-RS is included in UL TCI or joint TCI, PL-RS is identical to the source RS in UL or joint TCI** * **If PL-RS is associated with UL TCI or joint TCI, PL-RS and source RS in UL or joint TCI is QCL-Type D.**   **Observation 1 In R17 separate TCI, for MAC-CE based TCI state list updates, one MAC CE can update a list with mixed UL TCIs and DL TCIs.**  **Observation 2 MAC-CE based joint UL and DL TCI switching delay, which is different from MAC-CE joint TCI switching delay, comprises the case of**   * **MAC-CE based joint TCI switching delay, and** * **MAC-CE based separate TCI list updates including activation of both UL and DL TCIs**   **Proposal 3 For MAC CE based TCI state list update, specify requirements for the case when not all TCI states are known.**  **Proposal 4 For MAC-CE based joint UL and DL TCI switching delay, introduce reference point in time domain for OTA testing purpose, while the reference point is the later one between endpoints for DL TCI switching delay and UL TCI switching delay, respectively.**  **Proposal 5 If there is at least one unknown DL or UL TCI in the TCI list being activated, the requirement for TCI state list update delay follow the respective unknown case, i.e. extra delay for the respective L1-RSRP measurement is considered.**  **Proposal 6 Specify requirements for common TCI state switching delay in CA scenario, i.e. the switching delay between the TCI states whose QCL-D or UL TX filter is determined by a source RS in one of the CCs, while QCL-A or QCL-C is still determined by the RS in each CC.**  **Proposal 7 If common TCI is known, UE checks TOk for DL on a per-CC basis, and the requirements for DL TCI switching delay follows TOk=1 if at least in one CC, the corresponding source RS is not tracked according to the active TCI state list.**  **Proposal 8 If common TCI is known, UE checks NM for UL on a per-CC basis, and the requirements for UL TCI switching delay follows NM=1 if at least in one CC, the corresponding PL-RS is not maintained according to the active TCI state list.**  **Proposal 9 Update the second bullet under TCIs associated with ‘NSC’ as**  **‘MAC-CE based and DCI based TCI switching delay does not have difference for a serving cell and a cell with PCI different from a serving cell, if the cell with PCI different from a serving cell meets the known condition specified for inter-cell beam measurements’**  **Proposal 10 For MAC-CE based TCI state activation, if the TCI state being activated belongs to a cell with different PCI, UE need to check whether the ‘cell with different PCI’ is known before checking whether the TCI state is known.**  **Observation 3 The L3 measurement periodicity considered for the activation requirements in ‘cell with different PCI’ can be much shorter than that for SCell activation**  **Observation 4 How does network know whether UE has successfully switched the TCI to a ‘cell with different PCI’ not is still unclear based RAN1/RAN2 conclusions.**  **Observation 5 Interruption is considered in intra-frequency DAPS HO due to the baseband and RF adjustments for the activation of another cell, but seems not needed for activation of cell with PCI different from serving cell.**  **Proposal 10 For known conditions, update bullet 2, i.e. ‘Cell detectable condition (FFS: existing intra-frequency measurement can be reused)’, as**   * **after the corresponding cells configured for L1 measurements meet the detectable condition in 9.2.2 for [X=5] seconds**   **and exact value of X can be further discussed.**  **Proposal 11 For MAC-CE based TCI state activation, no RRM requirements is specified for TCI associated to the unknown cells.**  **Proposal 12 For DL TCI state list update requirements, T\_first\_SSB should be scale by the number of cells associated with the target UL TCIs whose SSBs for tracking are overlapped.**  **Proposal 13 For UL TCI state list update requirements, T\_first\_PL-RS and T\_PL-RS should be scale by the number of cells associated with the target UL TCIs whose not-maintained PL-RSs are SSBs, and these SSBs are overlapped** |
| [**R4-2204365**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204365.zip) | MediaTek Inc. | **Proposal 1: The definition of beam alignment is as following:**   * + **If PL-RS is included in UL TCI or joint TCI, PL-RS is identical to the source RS in UL or joint TCI**   + **If PL-RS is associated UL TCI or joint TCI, PL-RS and source RS in UL or joint TCI is QCL-Type D.**   **Proposal 2: For the MAC CE based and DCI based TCI state-pair indication, the TCI state switching delay requirement can be defined for UL TCI and DL TCI switching independently.**  **Observation 1: In the last meeting, RAN4 agreed "Active BWP of cell with different PCI shall be within active BWP of serving cell". It is unclear whether the BWPs of serving cell and non-serving cell are the same or not.**  **Proposal 3: To clarify in RAN4 that the BWPs of serving cell and non-serving cell are the same.**  **Proposal 4: Non-serving cell is known if UE transmits any L1-RSRP measurement report for the non-serving cell within [X] ms before the TCI state is switched. FFS: [X] for the valid L1-RSRP report and the value can follow the conclusion in inter-cell beam management.**  **Proposal 5: For the case when the non-serving cell is known and the target TCI state is known, the same TCI state switch delay requirement as serving cell can be reused.**  **Proposal 6: For the case when the non-serving cell is known and the target TCI state is unknown, the same TCI state switch delay requirement as serving cell can be reused.**  **Proposal 7: No UE requirement applies for the case when the non-serving cell is unknown and the target TCI state is known.**  **Proposal 8: For the case when the non-serving cell is unknown and the target TCI state is unknown, two options are suggested:**   * **Option 1: To extend the TCI state switch delay requirement, i.e., add TPSS/SSS\_sync\_intra (at least 600 ms) and TSSB\_time\_index\_intra (at least 120 ms).** * **Option 2: No UE requirement applies.**   **Proposal 9: For common TCI switching delay for CA case, reuse the delay requirement as the TCI state switching for single CC, with the clarification that the first slot to apply the new TCI state is determined on the CC with the smallest SCS among the CCs which applying the beam indication.** |
| [**R4-2204396**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204396.zip) | Intel Corporation | **Proposal 1: Define UL TCI state switching delay requirement for 4 scenarios.**  **Proposal 2: For MAC-CE based TCI state-pair indication, the TCI state switching delay requirement can be defined for UL TCI and DL TCI switching respectively.**  **Proposal 3: For the case that Pathloss RS is unknown:**   * **If Pathloss RS is included in target TCI state and pathloss RS are identical to associated DL RS in target TCI state, or Pathloss RS is activated with target TCI state in the same MAC CE command and Pathloss RS is QCL-typeD with associated DL RS in target TCI state** * **The PL-RS switching delay requirement is THARQ + 3ms + TL1-RSRP+ Tfirst\_target-PL-RS + 4\*Ttarget\_PL-RS + 2ms.**   **Proposal 4: For MAC-CE based DL/UL TCI switching delay for cell with different PCI, only define SSB based RX beam refinement.**  **Proposal 5: If the timing offset is larger than CP, extra delay may be expected for** **MAC-CE based UL TCI switching delay for cell with different PCI**.  **Proposal 6: If the associated RS in common TCI state provides QCL-TypeD, the known condition can only consider whether the associated RS in the reference CC is known or not.**  **Proposal 7: For intra-band CA, if the RS in the TCI state provides QCL-TypeD, re-use MAC-CE based TCI switching delay defined for single CC. The slot where new TCI state applies is determined based on the carrier with the smallest SCS in the CC set.**  **Proposal 8: For intra-band CA, if the RS in the TCI state provides QCL-TypeA or QCL-TypeB, the slot where new TCI state applies is determined based on the SCS of CC where TCI state switching is configured.** |
| [**R4-2205016**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205016.zip) | ZTE Corporation | **Proposal 1: The MAC CE based TCI state-pair switching is similar as the MAC CE based joint TCI state switching, so Option 1 is preferred by us, i.e. DL and UL MAC CE based TCI state switching requirements can be used independently for the case of TCI state-pair switching.**  **Proposal 2: Proposal 2: The beam alignment definition as applicability scenario for uplink TCI switching requirements can be:**   * **If PL-RS is included in UL TCI or joint TCI, PL-RS is identical to the source RS in UL or joint TCI** * **If PL-RS is associated UL TCI or joint TCI, PL-RS and source RS in UL or joint TCI is QCL-Type D.**   **Proposal 3: Considering for applying the unified TCI state in intra-band CA case, still reuse the existing known condition is enough, not need to update the known condition. Once the source RS of target TCI state is known for each CC in the intra-band CC group, which means the known condition is satisfied.**  **Proposal 4: We are fine with the Option 1 and Option 2.** |
| [**R4-2205039**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205039.zip) | Nokia, Nokia Shanghai Bell | **Observation 1 :** RAN1 has considered beam alignment definition that PL-RS and source RS in UL or joint TCI is QCL-Type D, but it is under FFS.  **Proposal 1 :** Beam alignment definition should include the case that PL-RS and source RS in UL or joint TCI are QCLed by QCL-Type D.  **Proposal 2 :** We propose to apply the known state UL-TCI switching requirement for PL-RS switching delay when PL-RS is identical to the source RS in UL/Joint-TCI **AND** when the target PL-RS is known.  **Proposal 3 :** We propose not to define PL-RS switching delay requirement when PL-RS is identical to the source RS in UL/Joint-TCI **AND** when the target PL-RS is unknown.  - Both the source RS in the UL-TCI and the target PL-RS are assumed unknown as consequence  **Proposal 4 :** Reuse MAC-CE based UL-TCI switching delay requirement of known UL target TCI state when PL-RS and source RS in UL or joint TCI is QCLed by Type-D **AND** when both the UL-TCI state and the target PL-RS are known .  **Proposal 5 :** Reuse MAC-CE based UL TCI switching delay requirement of known UL target TCI state, when PL-RS and source RS in UL or joint TCI is QCLed by QCL-Type-D **AND**   * when the UL target TCI state is unknown but when the target pathloss reference signal is known. * when the UL target TCI state is known but when the target pathloss reference signal is unknown.   **Proposal 6 :** Apply DCI-based UL-TCI switching delay requirement for DCI-based PL-RS switching delay requirements, when the target pathloss reference signal is known AND when the target UL TCI state is known.  **Observation 2 :** RAN1 defines beam application time (BAT) for Rel-17 DL and UL TCI switching delay. The delay refers to for both DL and UL.  **Observation 3 :** Rel-16 TCI switching delay referring to *timeDurationForQCL* cannot be reused for Rel-17 unified TCI framework.  **Proposal 7 :** Adopt DCI-based DL and UL switching requirements in Appendix 6  **Observation 4 :** Common cross-CC TCI update is about a reference CC for TCI switching across multiple CCs, it does not impact TCI switching delay requirements that RAN4 is currently discussing.  **Proposal 8 :** No need to define additional requirement on TCI switching delay requirement in CA case.  **Proposal 9 :** RAN4 may take a note in the spec for TCI switching delay requirement in CA case :   * *The requirements of Rel-17 unified TCI switching delay are applicable to CA cases based on the rule of reference BWP/CC selection in TS38.214.*   **Proposal 10 :** RAN4 studies further how to handle TCI switching delay on NSC out of the conditions for same TCI switching delay assumption between SC and NSC.  **Proposal 11 :** Rel-17 unified TCI switching delay requirement are defined by UL-TCI and DL-TCI switching requirements. We don’t see reason to define TCI state-pair indication requirement separately. |
| [**R4-2205334**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205334.zip) | Huawei, HiSilicon | ***Proposal 1: When a SSB is indicated as PL-RS in a UL TCI state, the scaling factor for beam sweeping needs to be introduced for PL-RS measurement time in FR2.***  ***Proposal 2: In FR2, the MAC-CE based UL TCI state switching delay need to be separately defined for SSB based PL-RS.***  ***Proposal 3: In FR2, when a SSB is indicated as PL-RS in a UL TCI state, the MAC-CE based UL TCI state switching delay for both known case and unknown case can be defined as:***   * ***THARQ + 3ms + NM\*(5\*TL1-RSRP\_SSB + 2ms) with the assumption of M=1.*** * ***Where NM = 1, if the target PL-RS is not maintained by the UE, 0 otherwise.***   ***Proposal 4: For MAC-CE based TCI state switching, the following is suggested to be clarified in the known condition requirements.***   * ***The associated DL-RS for target TCL state can be a SSB with a PCI different from serving cell PCI.***   ***Proposal 5: DCI based DL TCI state switching delay can be defined as:***   * ***When a UE receives the DCI triggering DL TCI state activation at slot n, UE shall be able to receive PDCCH/PDSCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n + THARQ + [Y] symbols, where, Y is configured via higher layer parameter [TBD], and THARQ is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3].***   ***Proposal 6: DCI based UL TCI state switching delay can be defined as:***   * ***When a UE receives the DCI triggering UL TCI state activation at slot n, UE shall be able to transmit PUCCH/PUSCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n + THARQ + [Y] symbols, where, Y is configured via higher layer parameter [TBD], and THARQ is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3].*** |
| [**R4-2205843**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205843.zip) | Ericsson | **Proposal 1: RAN4 to agree that NM=1 is allowed in Rel-17 and shall define requirements for non-maintained case.**  **Proposal 2: For CA cross-carrier scheduling, RAN4 to agree that, when a DCI based TCI state switch command is received at slot n, and sends ACK at slot n+TACK, it should be able to receive on the new beam at n+TACK+ TBAT. Where TBAT is signalled by the gNB based on the UE capability and the slot and beam application time are based on the carrier with smallest SCS.**  **Proposal 3: Single TCI state switching requirements shall be reused for common TCI state switching requirements.**  **Proposal 4: DCI based common TCI switch delay shall follow the RAN1 agreement. That means, when a UE receive DCI based TCI state switch command at slot n, and sends ACK at slot n+TACK, UE should be able to receive on the new beam at n+TACK+ TBAT.**  **Proposal 5: RAN4 to agree on following beam alignment definition as applicability scenario for uplink TCI switching requirements.**   * + - **If PL-RS is included in UL TCI or joint TCI, PL-RS is identical to the source RS in UL or joint TCI**     - **If PL-RS is associated with UL TCI or joint TCI, PL-RS and source RS of the UL TCI or joint TCI are QCL-Type D.** |

## Open issues summary

### Sub-topic 1-1: Definition of beam alignment

**Issue 1-1-1 Beam alignment assumption if PL-RS is included in UL TCI or joint TCI**

* Proposals
  + Option 1(Apple, vivo, MTK, ZTE, Ericsson, ZTE, CMCC, Intel, Nokia):
    - PL-RS is identical to the source RS in UL or joint TCI
* Recommended WF
  + Agree with option 1

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| **Company** | **Comments** |
| CMCC | Support recommended WF |
| Nokia | We are ok with the proposal. |
| Apple | Support the recommended WF. |
| Huawei | Agree with option 1. |
| vivo | Support the recommended WF. |
| ZTE | Fine with the recommended WF. |
| Intel | Support the recommended WF. |
| Ericsson | Agree with option 1 |
| Samsung | Agree with Moderator recommended WF |

**Issue 1-1-2 Beam alignment assumption if PL-RS is associated with UL TCI or joint TCI**

* Proposals
  + Option 1(Apple, vivo, MTK, ZTE, Ericsson, Nokia):
    - PL-RS and source RS in UL or joint TCI are QCL-Type D
  + Option 2 (CMCC):
    - When UL TCI switch and PL-RS switch are activated in the same MAC CE, PL-RS and source RS in UL or joint TCI is QCL-Type D
    - When UL TCI switch and PL-RS switch are activated in different MAC CE, no need to have the beam alignment assumption for PL-RS and source RS in UL or joint TCI
* Recommended WF
  + Collect companies’ view for these proposals in 1st round

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| **Company** | **Comments** |
| CMCC | Option 2. For the associated scenario, it can be considered case by case.  If UL TCI switch and PL-RS switch are activated in the same MAC CE, we agree that PL-RS and source RS in UL or joint TCI need to be QCL-Type D.  But for the case that UL TCI switch and PL-RS switch are activated in different MAC CE, both switch procedures can be performed separately, and no need to have the beam alignment assumption. For example, if UE receive the MAC CE on UL TCI switch before the MAC CE on PL-RS switch, UE will perform UL TCI switch firstly, and the uplink transmission power after TCI switch can be based on the old PL-RS, which may be not QCL-type D with the source RS in UL TCI. |
| Nokia | We support option-1.  Option-2 seems like a bit specific issue. We want to understand the issue further.  As reading the CMCC Tdoc, we found :  *When UL TCI switch and PL-RS switch are activated in different MAC CE, both switch procedures can be performed separately,*  *If UE receive the MAC CE on UL TCI switch before the MAC CE on PL-RS switch, UE will perform UL TCI switch firstly, and the uplink transmission power after TCI switch can be based on the old PL-RS, which may be not QCL-type D with the source RS in UL TCI.*  We are not sure if a UE uses UL TX power based on the old PL-RS or based on a new PL-RS measurement. |
| Apple | Option 1.  We don’t think UL-TCI and PL-RS can be activated by different MAC-CE. PL-RS is part of UL TCI. We checked with RAN2 colleagues and they confirmed that PL-RS is included in UL TCI and Joint TCI IE.  This is from RAN2’s running CR for introduction of FeMIMO:  Graphical user interface, text, application  Description automatically generated  The Editors note is whether to include the PC configuration in UL TCI or in UL-BWP-Dedicated IE.  We would like to understand how PL-RS can be activated with different MAC-CE. Can companies please clarify?  Based on feedback from our RAN1/2 colleagues there is no separate PL-RS activation discussed in R17 for unified TCI.  We request you to further check, or we can send LS to RAN1/2 if there is still ambiguity. |
| Huawei | Support option 1. |
| vivo | Option 1. Same view as Apple.  In RAN1 105, the following is agreed.  ‘The UE maintains the PL-RS of the activated UL TCI state or (if applicable) joint TCI state’  Therefore, update of PL-RS list is done by updating UL TCI in the R17 unified TCI framework. |
| ZTE | Support Option 1.  After checking the progress in RAN1/RAN2, for Option 2, we have similar view as Apple. |
| Intel | Support option 2.  In current section 7 in 38.213, uplink power control:   |  | | --- | | in clauses 7.1.1, 7.2.1, and 7.3.1, the RS index for obtaining the downlink pathloss estimate for PUSCH, PUCCH, and SRS transmission is provided by *PL-RS* associated with or included in the indicated *TCI-StateID\_r17* |   It specifies that PL-RS may be associated or included in the *TCI-StateID\_r17.*  *In previous RAN1 discussion,* there are two possible configuration for PL-RS, however no conclusion is reached.  (1) RL-RS is included in the UL TCI. In this case, the PL-RS can only be used for this UL TCI state.  (2) PL-RS is associated with the UL TCI state. which means that the PL-RS can be used for multiple UL TCI states.  It’s more efficient for the use of PL-RS.  Then from my understanding, if PL-RS is included in the UL TCI state, both PL-RS and UL TCI will be updated simultaneously. Therefore, we need to consider them together. However, if PL-RS is not included in the UL TCI state, and it’s associated with the TCI state, we don’t need to consider the update the PL-RS for the UL TCI state switching. The associated PL-RS may have already been measured before. Otherwise, if the PL-RS is associated with multiple TCI state, it seems that we need to calculate the Pathloss for multiple times for each TCI state switching. |
| Ericsson | Option 1. Same view as Apple. |
| Samsung | We also think option 1 is correct assumption.  Even though, we think companies can further align the interpretation of current RAN1 and RAN2 specification on whether the PL-RS and UL TCI can be active in different MAC CE or not, from TCI switching delay requirements, UL TCI switching delay can be defined without considering the PL-RS switching delay even if configured in different MAC-CE (as interpreted by some companies) especially without considering the case UE has to measure the newly updated PL-RS before switching to target TCI state. As WF, maybe RAN4 can consider the following agreements for specifying the requirements, i.e.,   * RAN4 will further confirm if PL-RS and UL TCI can be activated in the different MAC-CE   UL TCI switching delay can be defined without considering the PL-RS switching even if PL-RS is configured in different MAC-CE |

### Sub-topic 1-2 Switching delay requirements for serving cell

**Issue 1-2-1 Requirement applicability of DCI based DL and UL TCI state switching delay**

* Proposals
  + Option 1(Apple):
    - When target TCI state is known, is in active TCI state list for DL and joint TCI switch, is maintained for UL and joint TCI state switch.
* Recommended WF
  + Collect companies’ view for these proposals in 1st round

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| **Company** | **Comments** |
| Nokia | This proposal lists conditions as we understand :   1. When target TCI state is known 2. When target TCI state is in active TCI state list for DL and joint TCI switch 3. When target TCI state is maintained for UL and joint TCI state switch.   (i) and (ii) are fine, as it is same as the existing requirement.  (iii) is unclear. What does it mean “target TCI state is maintained for UL and joint TCI state switch”? This seems more related to PL-RS switching as we considered in PL-RS switching, perhaps not directly related to UL? |
| Apple | We support the proposal.  @Nokia, The TCI state switch might also change PL-RS for UL/joint TCI switch and we only consider the case when PL-RS is maintained for DCI based UL/Joint TCI state switch |
| vivo | We share the same understanding as Apple.  We are not sure whether this needs to be clarified in RAN4 spec. We think the codepoint definition in RAN1/2 design is already enough to ensure all of them. Only after UE finishes TCI switching, i.e., after the endpoint specified in RAN4 spec, the TCI is considered as active, and DCI-based switching is applicable. |
| ZTE | We can understand and agree with the motivation in Option 1. But we also concern (iii) listed by Nokia. When we discussing PL-RS switching delay, we considered the maintained case. However we are not sure whether we can say “maintained UL TCI state”. |
| Intel | Fine with option 1. |
| Ericsson | OK with option 1 |
| Samsung | We think the DCI based TCI switching delay can simply refer to RAN1/2 beam application time but leave the detailed condition, i.e., whether target TCI is included in TCI list or maintained in RAN1/2 specifications. |

**Issue 1-2-2 Define DCI based DL and UL TCI state switching delay as**

* Proposals
  + Option 1(Nokia):
    - If the target TCI state is known, the DL TCI switching to the indicated TCI-State in the DCI format shall be completed starting from the first slot that is at least *BeamAppTime\_r17* symbols after the last symbol of the PUCCH. The first slot and the *BeamAppTime\_r17* symbols are both determined on the carrier with the smallest SCS among the carrier(s) applying the beam indication. The value of *BeamAppTime\_r17* is defined in TS 38.331 [2]. The known condition for TCI state defined in clause [8.15.2] is applied.
    - If the target TCI state is known, the UL TCI switching to the indicated TCI-State in the DCI format shall be completed starting from the first slot that is at least *BeamAppTime\_r17* symbols after the last symbol of the PUCCH. The first slot and the *BeamAppTime\_r17* symbols are both determined on the carrier with the smallest SCS among the carrier(s) applying the beam indication. The value of *BeamAppTime\_r17* is defined in TS 38.331 [2]. The known condition for TCI state defined in clause [8.16.2] is applied.
  + Option 2(Huawei):
    - When a UE receives the DCI triggering DL TCI state activation at slot n, UE shall be able to receive PDCCH/PDSCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n + THARQ + [Y] symbols, where, Y is configured via higher layer parameter [TBD], and THARQ is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3].
    - When a UE receives the DCI triggering UL TCI state activation at slot n, UE shall be able to transmit PUCCH/PUSCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n + THARQ + [Y] symbols, where, Y is configured via higher layer parameter [TBD], and THARQ is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3].
* Recommended WF
  + Collect companies’ view for these proposals in 1st round

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| **Company** | **Comments** |
| Nokia | In RAN1/2 unified TCI framework, it has been agreed that as option-1, but option-2 seems to have different understanding.  A few points are different between option-1 and option-2 :   * [Y] symbol is not just a fixed delay after THARQ. It has some conditions as below. * The start point is from the last symbol of the PUCCH. The unified TCI switching does not consider ’slot n + THARQ’ based on RAN1 agreement. * For Rel-17 unified TCI framework, a new starting point of the delay counting is from PUCCH TX in RAN1 spec, but we are open to discuss RAN4 view.     We prefer to align with RAN1 to remove potential confusions in future. We support option-1. |
| Apple | We support option 2. It is in line with existing DCI based switching delay requirements. |
| Huawei | The difference between option 1 and option 2 is the definition of starting point.  For option 1, the wording “the last symbol of the PUCCH” is not clear for us. We can accept option 1 if “the last symbol of the PUCCH” is revised as “the last symbol of the PUCCH with acknowledgement in response to the DCI triggering TCI state activation”. |
| vivo | We support to go with option 1 with slightly modification:  ‘PUCCH’ should be replaced by ‘UL transmission carrying ACK’.  The corresponding RAN1 agreement is cited below.  ‘On Rel-17 DCI-based beam indication, regarding application time of the beam indication, the first slot to apply the indicated TCI is at least Y symbols after the last symbol of the acknowledgment of the joint or separate DL/UL beam indication.’  Therefore we also think ‘THARQ is the timing between DL data transmission and acknowledgement as specified in TS 38.213’ in option 2 is not accurate enough. |
| ZTE | Support Option 1. It is aligned with the following RAN1 agreements. If within the modification proposed by Huawei and vivo, which would be better. |
| Intel | Agree with Huawei and vivo, It’s better to change PUCCH to PUCCH with acknowledgement of beam indication. |
| Ericsson | I think we agreed on this in last meeting, starting point is ACK transmission and delay is BAT. |
| Samsung | In general, we think option 1 is acceptable and also ok with vivo’s changes. |

**Issue 1-2-3 MAC CE based UL TCI state switch when UL TCI switch and RL-RS switch are activated in different MAC CE**

* Proposals
  + Option 1(CMCC):
    - The TCI switch delay requirements and PL-RS switch delay requirements are defined separately, proposed as following:
    - TCI switch delay requirement is
    - THARQ + 3ms + 1, if TCI is known
    - THARQ + 3ms + TL1-RSRP + 1, if TCI is unknown
    - PL-RS switch delay requirement is
    - THARQ + 3ms + NM\*(Tfirst\_target-PL-RS + 4\*Ttarget\_PL-RS + 2ms), where NM = 1, if the target PL-RS is not maintained by the UE, 0 otherwise
* Recommended WF
  + Collect companies’ view for these proposals in 1st round

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| **Company** | **Comments** |
| CMCC | In general, the intention of option 1 is to clarify that for the case that PL-RS is associated with UL TCI state, UL TCI switch and RL-RS switch are activated in different MAC CE, there is no need to include PL-RS delay in the UL switch delay requirements. TCI switch delay requirement and PL-RS switch delay requirement can be specified separately.  As we commented in Issue 1-1-2, for the case that PL-RS is associated with UL TCI state, UL TCI switch and RL-RS switch are activated in different MAC CE, no need to have the beam alignment assumption, so the requirements can be specified separately. And the legacy requirements in Rel-16 can be reused. |
| Nokia | It is related with Issue 1-1-2 and Issue 1-5-1. If option-1 is adopted, the UL TCI requirements are not reused for PL-RS switching requirement. But we think that MAC-CE based known PL-RS requirement is not different from CMCC proposal, so there is a possible way to reuse it.  If UL TCI requirement is reused for PL-RS, we share the view that there is unclarity on which delay component is considered in which delay requirement (see our comment in Issue 1-5-1 option-1), since there are cases like ‘unknown and known’ state or ‘same and different’ messages of UL TCI and PL-RS switching.  In the 2nd round, we are open to discuss this option versus the RAN4#101bis agreement. |
| Apple | We don’t think this case is possible – please see our comments for Issue 1-1-2. |
| Huawei | For the case that PL-RS is associated with UL TCI state, it shall be studied whether the UE still needs to perform PL-RS switching when the associated UL TCI state is activated by MAC-CE. If PL-RS switching is only activated by waiting another MAC-CE command, then we can agree with option 1, to reuse legacy requirements in R16. |
| vivo | Same view as Apple. |
| ZTE | Similar view as Apple. |
| Intel | We support option 1.  Similar as legacy, we may not need to consider the PL-RS calculation delay if they are not activated with UL TCI switch simultaneously. Here, simultaneously activation has two cases:   1. PL-RS is included in TCI-StateID\_r17 2. PL-RS is associated with UL TCI state and activated with UL TCI state in the same MAC CE   We would like to further check whether the following assumption for UL TCI state switch delay is correct:   1. Impact of PL-RS is considered.    * + Pathloss RS is included in TCI-StateID\_r17 ,      + or Pathloss RS is associated with UL TCI state and activated with target TCI state in the same MAC CE command 2. Impact of PL-RS is not considered.    * + Pathloss RS is not included in TCI-StateID\_r17,      + and Pathloss RS is associated with UL TCI state and Pathloss RS is not activated with target TCI state in the same MAC CE command. |
| Ericsson | Our understanding is there is no separate PL-RS switching supported in Rel-17. |
| Samsung | As we commented in issue 1-1-2, RAN4 may need further consider whether such case exists or not but from requirements perspective, we agree with Intel/CMCC, the impact of PL-RS will not considered for UL TCI switching even though PL-RS is activated in different MAC-CE |

**Issue 1-2-4 TCI state-pair indication requirement**

* Proposals
  + Option 1(Apple, MTK, Intel, ZTE, Nokia):
    - The TCI state switching delay requirement can be defined for UL TCI and DL TCI switching independently.
* Recommended WF
  + Agree with option 1.

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| **Company** | **Comments** |
| Nokia | Option-1 says no other requirements for TCI state-pair indication. If so, we agree. |
| Apple | We support the recommended WF. |
| Huawei | Agree with option 1. |
| vivo | We think the issue is related to requirements for TCI state list update. We can remove the issue here without conclusions since the intention is not clear. |
| ZTE | Agree with Option 1. |
| Intel | Agree with option 1. |
| Ericsson | Do not understand the issue clearly. Can proponents please clarify. |
| Samsung | Option 1 is not really related to TCI state-pair indication but we agreed no requirements for TCI state-pair indication. |

**Issue 1-2-5 MAC-CE based UL TCI state switching delay when SSB is indicated as PL-RS in UL TCI state for FR2**

* Proposals
  + Option 1(Huawei):
    - When a SSB is indicated as PL-RS in a UL TCI state, the scaling factor for beam sweeping needs to be introduced for PL-RS measurement time in FR2.
    - In FR2, the MAC-CE based UL TCI state switching delay need to be separately defined for SSB based PL-RS.
    - In FR2, when a SSB is indicated as PL-RS in a UL TCI state, the MAC-CE based UL TCI state switching delay for both known case and unknown case can be defined as:
    - THARQ + 3ms + NM\*(5\*TL1-RSRP\_SSB + 2ms) with the assumption of M=1.
    - Where NM = 1, if the target PL-RS is not maintained by the UE, 0 otherwise.
* Recommended WF
  + Collect companies’ view for these proposals in 1st round

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| **Company** | **Comments** |
| Nokia | We understand the motivation, but this proposal combines both L1-RSRP measurements and PL-RS measurements only on the SSB resource in one procedure. Later, they can be other RSs than SSB. We think it will be good to make a generic requirement with *Ttarget\_PL-RS* . (M=1 means NM=1?) |
| Apple | We support the proposal. All SSB based measurements consider RX beam sweeping/ scaling factor. We should do the same for PL-RS as well. We are wondering if the measurement time should be 5\* TFirstSSB + 39\*TSSB instead of TL1-RSRP\_SSB. |
| Huawei | To Nokia: M is used for defining L1-RSRP measurement period, not identical to NM. M=1 means one sample is assumed for L1-RSRP measurement period.  To Apple: The UE needs to perform both L1-RSRP measurements and PL-RS measurements on the same SSB. For L1-RSRP measurements, the sharing factor P is considered for SSB overlapping with SMTC or measurement gap. For PL-RS measurements, the sharing factor P also need to be considered. So, we prefer to use TL1-RSRP\_SSB. |
| vivo | We are not sure what is the impact to previous agreements.  We think beam sweeping factor is already captured in T\_L1-RSRP if the UL TCI is unknown. Note that the QCL-D source of UL TCI has to be at least QCL-D with the PL-RS. Therefore, the known/unknown status should be the same for UL TCI and PL-RS. |
| ZTE | We agree with the first sub-bullet. For the later two, we believe further discussion is needed. |
| Intel | Here, we want to first clarify our understanding about known condition for UL TCI state.  The known condition is whether associated RS in TCI target state is known. If it’s unknown, RX beam sweeping will be based on the associated RS in the TCI state. If SSB is also included in the UL TCI state as PL-RS, we may calculate pathloss by the same beam based on the beam alignment assumption, i.e. SSB for PL-RS and associated RS in TCI state is QCL-D. We will not use SSB of PL-RS for Rx beam sweeping. we think it’s better to decouple L1-RSRP measurement and PL-RS procedure. |
| Ericsson | May be a clarification question.  If I understand correctly, UE needs to only measure L1-RSRP for obtaining pathloss and no need to report it to NW. However, TL1-RSRP\_SSB (TL1-RSRP\_SSB) contains TReport (configured periodicity for reporting) component which is not required to be considered for pathloss measurement. May be we could define TL1-RSRP\_SSB as (M\*P)\*TSSB. |
| Samsung | We agree with Nokia that requirements can be specified in generic manner without explicitly refer to SSB as RS. On the other hand, Rel-17 requirements can be specified based on SSB |

**Issue 1-2-6 TCI state list for PDCCH and PDSCH**

* Proposals
  + Option 1(vivo):
    - While re-using existing MAC-CE based TCI switching delay requirements for DL TCI switching delay requirements for PDCCH and PDSCH, the TCI state list considered should not be only for PDSCH.
* Recommended WF
  + Collect companies’ view for these proposals in 1st round

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| **Company** | **Comments** |
| Nokia | Agreeable. It is applicable to both PDCCH and PDSCH.  One note : not only for PDCCH and PDSCH, but also for all DL assignments in our understanding. |
| Apple | We agree that the TCI state list update can also be for PDCCH. |
| Huawei | Agree with option 1. |
| vivo | We support the proposal. |
| ZTE | Agree with Option 1. |
| Intel | Fine with option 1. |
| Ericsson | Since same TCI state is used for PDCCH and PDSCH in Rel=17, do we need to specify this? Isn’t it implicit? |
| Samsung | Agree with option 1 |

**Issue 1-2-7 Whether NM is allowed to be equal to 1 in Rel-17 specification**

* Proposals
  + Option 1(Ericsson):
    - RAN4 to agree that NM=1 is allowed in Rel-17 and shall define requirements for non-maintained case.
* Recommended WF
  + Agree with option 1.

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| **Company** | **Comments** |
| Nokia | What is the target requirement of this proposal? At least PL-RS switching, it is fine. |
| Apple | We agree with the recommended WF. |
| vivo | We agree with the recommended WF. |
| ZTE | Same view as Nokia. |
| Intel | To Nokia, from my understanding, the requirement applies to both UL TCI state switch and PL-RS switching. |
| Ericsson | To Nokia: It is for PL-RS/UL TCI state switching requirements using UL TCI or joint TCI state switching. |
| Samsung | We agree with Moderator’s recommendation |

### Sub-topic 1-3 Switching delay requirements when SSB is associated with cell with different PCI

**Issue 1-3-1 Known cell condition for TCI state switch associated with different PCI**

* Proposals
  + Option 1(Samsung):
    - Active BWP of cell with different PCI shall be within active BWP of serving cell
    - SCS between cell with different PCI and serving cell shall the same
    - Timing offset between SC and NSC are within CP
  + Option 2(vivo):
    - If the cell with PCI different from a serving cell meets the known condition specified for inter-cell beam measurements
    - UE need to check whether the ‘cell with different PCI’ is known before checking whether the TCI state is known.
    - update bullet 2 of known condition for inter-cell beam measurement as
    - after the corresponding cells configured for L1 measurements meet the detectable condition in 9.2.2 for [X=5] seconds, and exact value of X can be further discussed.
  + Option 3(MTK):
    - The BWPs of serving cell and non-serving cell are the same
    - If UE transmits any L1-RSRP measurement report for the non-serving cell within [X] ms before the TCI state is switched. FFS: [X] for the valid L1-RSRP report and the value can follow the conclusion in inter-cell beam management.
* Recommended WF
  + Collect companies’ view for these proposals in 1st round

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| **Company** | **Comments** |
| Nokia | We are fine with adding the condition below to opion-1.  *If UE transmits any L1-RSRP measurement report for the non-serving cell within [X] ms before the TCI state is switched.* |
| Apple | We can re-use the known cell condition from inter-cell L1-RSRP measurements. They should be the same as both are for the same purpose. |
| Huawei | We can agree with option 3.  TCI state switching only indicates the QCL information change but not BWP change.  A TCI state switching can be associated with different PCI by indicating that the source RS of the target TCI is QCL-TypeD to a SSB with different PCI. The SSB with different PCI is configured for L1-RSRP measurements. For inter-cell BM, we suggest that UE performs L1-RSRP measurement on known NSC. |
| vivo | Same view as apple. We support option 2. |
| ZTE | Support Option 1+Option 2. UE should first identify the non-serving cell is known, then can handle the TCI state switching for this cell. |
| Intel | we also think it’s better to align the known cell condition with inter-cell beam measurement. |
| Ericsson | To make TCI state switch based on known condition, UE should have already transmitted L1-RSRP report. We think similar to legacy known condition can be defined as other conditions are already defined for NSC known condition and need not be repeated as TCI only indicates QCL relation. TCI known means QCL relation is known.  That means, we could define as following.   * + - TCI state is known if UE transmits valid L1-RSRP measurement report for the non-serving cell within [X] ms before the TCI state is switched. X is FFS. |
| Samsung | We can accept to add the L1-RSRP measurement report with [x]ms as known condition. The intension of specifying the cell known condition is NOT specify the requirements for cell unknown (if proposed conditions cannot met) in RAN4 specification. |

**Issue 1-3-2 TCI state switch delay requirement for known cell case**

* Proposals
  + Option 1 (MTK):
    - For the case when the non-serving cell is known and the target TCI state is known, the same TCI state switch delay requirement as serving cell can be reused.
    - For the case when the non-serving cell is known and the target TCI state is unknown, the same TCI state switch delay requirement as serving cell can be reused.
* Recommended WF
  + Agree with option 1.

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| **Company** | **Comments** |
| Nokia | RAN4 has agreed that the same TCI state switch delay requirement as serving cell can be reused for non-serving cell under conditions. We wonder what is a new condition from option-1. |
| Apple | We agree with the proposal for both UL and DL TCI state switch. |
| Huawei | We can agree with option 1. |
| vivo | OK to the proposal if the case activating more than 1 TCIs is not considered. |
| ZTE | Fine with the recommended WF. |
| Intel | Agree with option 1. |
| Ericsson | In principle agree with proposal but not sure if it is really needed. We also agree with Nokia comments. |
| Samsung | Agree with option 1. |

**Issue 1-3-3 Whether to define TCI state switch delay requirement for unknown cell case**

* Proposals
  + Option 1(Samsung, vivo, MTK): No
    - RAN4 will NOT specify the requirements for unknown cell case for TCI swtiching dealy for a cell with different PCI from serving cell in Rel-17 (Samsung).
    - For MAC-CE based TCI state activation, no RRM requirements is specified for TCI associated to the unknown cells (vivo).
  + Option 2(Apple): Yes
    - Extend TCI state switching requirements for cell with different PCI to the case when active BWP is not within serving cell active BWP or when SCS are different.
    - Extend the TCI state switching delay by active BWP switch delay for the case when active BWP is not within serving cell active BWP or when SCS are different.
  + Option 3 (MTK): depends on condition
    - No UE requirement applies for the case when the non-serving cell is unknown and the target TCI state is known.
    - For the case when the non-serving cell is unknown (the timing offset between serving cell and non-serving cell is less than one CP) and the target TCI state is unknown, two options are suggested:
    - Option 1: To extend the TCI state switch delay requirement, i.e., add TPSS/SSS\_sync\_intra (at least 600 ms) and TSSB\_time\_index\_intra (at least 120 ms).
    - Option 2: No UE requirement applies.
  + Option 4 (Nokia):
    - RAN4 studies further how to handle TCI switching delay on NSC out of the conditions for same TCI switching delay assumption between SC and NSC
* Recommended WF
  + Collect companies’ view for these proposals in 1st round

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| **Company** | **Comments** |
| Nokia | We prefer option-1 the first bullet.  The second bullet in option-1 includes L1-RSRP for cells under unknown condition. We can discuss it in ICBM.  Regarding Option-2/3, we agree they are valid points that RAN4 surely continues studying, but may not be in Rel-17. |
| Apple | We support option 2 and option 3. Cell is unknown if (1) active BWP/SCS is different or (2) cell is not identified – for 1st case we can extend switching delay by BWP switching delay for 2nd case we can extend by cell identification time for intra-freq. |
| Huawei | We support option 1.  When a TCI state associated with different PCI is activated, UE could not obtain any beam information of the target TCI state if the corresponding cell with different PCI had not been identified and measured. |
| vivo | We support option 1. We do not see the difference between the 2 bullets under option 1.  For option 2, we think the second bullet is not required, since the same physical layer for SC and NSC is assumed according to RAN1 agreements. For the 1st bullet, we are open to discuss. But RAN4 may not be able to define the corresponding UE behavior if the cell can not be detected. Perhaps RLF can be triggered? If so, we prefer no requirements for this case. |
| ZTE | Support Option 1 |
| Intel | We prefer option 1. |
| Ericsson | OK with option 1 |
| Qualcomm | We support option 1, this seems to be a real corner case and difficult to support. |
| Samsung | We support option 1. For unknown cell case, even though RAN4 can further discuss considering different conditions (some or all of cell known conditions are not met) to specify the requirements, it is not clear about the intension of specify the requirements in such cases. On the other hand, without specifying the requirements for such case, even such cases are allowed from spec perspective but certainly is not “recommended” as typical deployment cases since UE performance is not expected in such cases. |

**Issue 1-3-4 Whether introduce the interruption requirement due to TCI state switch associated with different PCI**

* Proposals
  + Option 1 (Apple):
    - If TCI state switch to cell with different PCI includes active BWP switch, interruption requirements need to be defined.
* Recommended WF
  + Collect companies’ view for these proposals in 1st round

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| **Company** | **Comments** |
| Nokia | This is a valid point that RAN4 continues studying, but we prefer to deprioritize in Rel-17. |
| Apple | This depends on Issue 1-3-3. If we agree to extend delay by active BWP switch for unknown cell then interruption requirements need to be considered. |
| Huawei | We suggest not to consider this case. As we comment on issue 1-3-1, the active BWP has not been changed due to TCI state switching. |
| vivo | We think if the same physical layer configuration is assumed according to RAN1 agreements, including the BW related configuration, interruption is not needed. |
| ZTE | Same view as Nokia. |
| Intel | We think that the same BW will be configured. Therefore, we don’t need to consider this case. |
| Ericsson | Same view as Intel. We don’t need to consider this case. |
| Samsung | As commented in issue 1-3-3, we do not think we need to specify the requirements for such cases. |

**Issue 1-3-5 Whether to only consider SSB based L1-RSRP measurement for cell with different PCI**

* Proposals
  + Option 1(Intel):
    - only consider SSB based L1-RSRP measurement for RX beam refinement.
* Recommended WF
  + Collect companies’ view for these proposals in 1st round

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| **Company** | **Comments** |
| CMCC | This is pending on RAN1 discussion. At least in our understanding, CSI-RS based L1-RSRP measurement for cell with different PCI is considered (according to our RAN1 delegates, it is supported that CSI-RS configured for a serving cell can be QCLed with a SSB from cell with different PCI). If companies have different understanding, it is suggested to send LS to RAN1. |
| Nokia | We think this is an ICBM related issue. RAN1 agreement is required first. |
| Apple | We agree with the proposal. CSI-RS based measurement is not supported for inter-cell L1-RSRP. |
| Huawei | We agree with option 1 for R17. |
| vivo | Same issue is discussed in [227] thread. Agree with CMCC’s view. But provided that it is already the last meeting for the core requirements, we are OK to deprioritize it to R18 or fix it in the maintenance phase. |
| ZTE | Agree with Option 1. Since RAN 1 only agrees SSB based inter-cell Beam Management. |
| Intel | RAN1 has not explicit agree that CSI-RS can be used for L1-RSRP measurement for NSC.  Besides, similar as CSI-RS L3 measurement, there are many issues to be considered, e.g. whether there are some time domain limitations about CSI-RS configuration since CSI-RS is more flexible, whether there is associatedSSB, how to detect the timing of another cell, etc.  Due to the limited time, we suggest only to consider SSB based L1-RSRP measurement for NSC. |
| Ericsson | We think only SSB based is supported in Rel-17. |
| Samsung | We agree with option 1 at least for Rel-17. For further release, whether to specify the requirements for CSI-RS based measurement can be discussed. |

**Issue 1-3-6 Update of known conditions for associated DL-RS**

* Proposals
  + Option 1(Huawei):
    - For MAC-CE based TCI state switching, it is suggested to clarify the followings in the known condition requirements.
    - The associated DL-RS for target TCL state can be a SSB with a PCI different from serving cell PCI.
* Recommended WF
  + Collect companies’ view for these proposals in 1st round

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| **Company** | **Comments** |
| Nokia | We are ok with clarification. HW seems to suggest not to capture the wording “a cell with PCI different from a serving cell” into specification. Any alternative suggestion? |
| Apple | Okay with clarification. We assume both serving and cell with different PCI are in the same section anyway. |
| Huawei | Support option 1  A TCI state switching only can be connected to a different PCI by indicating that the source RS of the target TCI is QCL-TypeD to a SSB with different PCI. |
| vivo | We are ok with the clarification. |
| ZTE | Agree with Option 1. We think the clarification would happen in the case of TCI state indication within inter-cell Beam Management. |
| Intel | Generally fine with option 1.  But not quite clear how to reflect this in spec. did it mean that we don’t extra define MAC CE based TCI state switch requirement for NSC? In the CR structure, we split the case for SC and NSC. For NSC, there are several differences, i.e. the known cell condition needs to be specified, only consider SSB based RX beam sweeping for NSC. We think it’s better to split the two cases. Furthermore, if it’s decided that extra requirement for unknown cell case needs to be defined, it’s more convenient to extend the spec. |
| Ericsson | Ok with proposal |
| Samsung | Option 1 is certainly correct statement, i.e., PL-RS RS can be SSB for TCI switching to cell with different cell ID from serving cell. The intension of including such statements as clarifications in TCI known condition is not clear. What if PL-RS RS is not SSB, are we going to consider the different delay requirements as unknown TCI case? |

### Sub-topic 1-4 Delay requirements for common TCI state switching in CA case

**Issue 1-4-1 Known condition in CA scenario**

* Proposals
  + Option 1(ZTE):
    - Reuse the existing known condition. Once the source RS of target TCI state is known for each CC in the intra-band CC group, which means the known condition is satisfied.
  + Option 2 (Intel):
    - If the associated RS in common TCI state provides QCL-TypeD, the known condition can only consider whether the associated RS in the reference CC is known or not.
* Recommended WF
  + Collect companies’ view for these proposals in 1st round

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| **Company** | **Comments** |
| Nokia | Support option-2. only consider whether the associated RS in the reference CC is known. |
| Apple | For common TCI switch the target TCI for different CCs can be same RS or different RS. The known condition should be dependent on shared RS or different RS. If different RS, then known condition based on each RS separately. Option 2 captures this better. |
| vivo | Support option 2. |
| ZTE | For Option 1, at least for TCI state providing QCL-TypeD, the source RS of target TCI state for each CC within intra-band CA can be a shared RS of different RS. For the case of different RS, source RS would be transmitted in the CC applying target TCI state, i.e. each CC in the intra-band CA. For the case of shared RS, Option 2 is more precise. |
| Intel | Support option 2. |
| Ericsson | We support option 2. |
| Samsung | Support option 2 but how to specify the known condition for CA case as well as requirements can be further discussed |

**Issue 1-4-2 Whether** **common TCI state switching delay requirement is defined for all CC or per CC**

* Proposals
  + Option 1: Defined per CC.
    - Option 1a (Apple): The beam switching time for all CCs with common TCI switch associated with different TCI state/RS should be considered separately.
    - Option 1b (vivo): If TCI states involve QCL-A or QCL-C, TCI state switch is still determined by the RS in each CC.
    - Option 1c (Intel): If the RS in the TCI state provides QCL-TypeA or QCL-TypeB, the slot where new TCI state applies is determined based on the SCS of CC where TCI state switching is configured.
  + Option 2: Defined for all CC
    - Option 2a (Apple): For common TCI switch with shared RS, the existing requirements apply to all CCs with same TCI state/RS. For common TCI switch with shared RS the switching delay will be based on the smallest SCS.
    - Option 2b (MTK, ZTE): Reuse the delay requirement as the TCI state switching for single CC, with the clarification that the first slot to apply the new TCI state is determined on the CC with the smallest SCS among the CCs which applying the beam indication.
    - Option 2c (Nokia):No need to define additional requirement on TCI switching delay requirement in CA case. RAN4 may take a note in the spec for TCI switching delay requirement in CA case:
    - The requirements of Rel-17 unified TCI switching delay are applicable to CA cases based on the rule of reference BWP/CC selection in TS38.214.
    - Option 2d (Ericsson):
    - Single TCI state switching requirements shall be reused for common TCI state switching requirements.
    - DCI based common TCI switch delay shall follow the RAN1 agreement. That means, when a UE receive DCI based TCI state switch command at slot n, and sends ACK at slot n+TACK, UE should be able to receive on the new beam at n+TACK+ TBAT.
    - Option 2e(Samsung):
    - No additional TCI switching delay requirements for CA case if common TCI is configured.
    - RAN4 can specify the DCI based TCI switching delay requirements by referring to RAN1 agreed delay, i.e., and leave the detailed determination of beam application time for CA case to RAN1 and/or RAN2 specifications.
    - Option 2f (vivo):
    - Specify requirements for common TCI state switching delay in CA scenario, i.e. the switching delay between the TCI states whose QCL-D or UL TX filter is determined by a source RS in one of the CCs.
    - If common TCI is known, UE checks TOk for DL on a per-CC basis, and the requirements for DL TCI switching delay follows TOk=1 if at least in one CC, the corresponding source RS is not tracked according to the active TCI state list.
    - If common TCI is known, UE checks NM for UL on a per-CC basis, and the requirements for UL TCI switching delay follows NM=1 if at least in one CC, the corresponding PL-RS is not maintained according to the active TCI state list.
* Recommended WF
  + Collect companies’ view for these proposals in 1st round

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| **Company** | **Comments** |
| Nokia | In principle for common TCI, we can simplify discussion into two parts (i) making requirement (ii) applying requirement.   * For (i), only a single reference CC is referred to set up a requirement. * For (ii), the requirement is applied to all CCs.   Then, we can apply the current requirements under on-going discussion to CA cases. Rules of how to select a reference CC are defined by RAN1 TS38214. RAN4 spec can refer to it, make a note in RAN4 spec :  *The requirements of Rel-17 unified TCI switching delay are applicable to all CCs in CA cases based on the rule of reference BWP/CC selection in TS38.214.* |
| Apple | Option 1a and option 2a depending on same RS or different RS. |
| Huawei | We can agree with option 2c and 2e, no need to define additional TCI state switching delay requirements, but to add a note or clarification on the reference SCS according to RAN1/RAN2 spec. |
| vivo | We agree with SCS issue proposed in option 2a, 2b, 2e.  Regarding how to check TOk and NM, we think clarification is needed for the common TCI. UE will anyway check TOk and NM in each of the CCs. |
| ZTE | We believe Option 2a, 2b, 2c are same and we agree with all of them. Three key points were captured by them:   1. Not need any additional requirement for common TCI state switching, re-using the requirement for single-CC case; 2. The requirement applies for all CCs; 3. When applying the requirement, the SCS should be the smallest SCS within all CCs; |
| Intel | Sorry, we add option 2g by missing it previously.  We agree with option 1c, 2c and 2e, 2g. the single CC based TCI state switch delay can be re-used basically.  We prefer to add a note that: for QCL-TypeD, the requirement can apply for all CCs. While for QCL-Type A and B, the requirement only apply for the target CC. |
| Ericsson | Single CC requirement is reused basically. |
| Samsung | We think different options in option 2 are not far away from each other. The question is how to describe the requirements applicability for CA case if common TCI is configured. Our proposal of leaving the detailed reference SCS description to RAN1 spec instead of re-writing in RAN4 spec. |

### Sub-topic 1-5 Requirements for PL-RS switching delay indicated by unified TCI

**Issue 1-5-1 Whether to define MAC CE based PL-RS switching requirement when PL-RS is unknown**

* Proposals
  + Option 1(Intel): Yes
    - If Pathloss RS is included in target TCI state and pathloss RS are identical to associated DL RS in target TCI state, or Pathloss RS is activated with target TCI state in the same MAC CE command and Pathloss RS is QCL-typeD with associated DL RS in target TCI state
    - The PL-RS switching delay requirement is THARQ + 3ms + TL1-RSRP+ Tfirst\_target-PL-RS + 4\*Ttarget\_PL-RS + 2ms.
  + Option 2(Nokia): No
    - Not to define PL-RS switching delay requirement when PL-RS is identical to the source RS in UL/Joint-TCI **AND** when the target PL-RS is unknown.
    - Apply MAC-CE based UL TCI switching delay requirement of **known** UL target TCI state, when target PL-RS and source RS in UL/joint TCI are QCL-Type-D **AND**
* when the UL target TCI state is known but when the target pathloss reference signal is unknown **OR**
* when the UL target TCI state is unknown but when the target pathloss reference signal is known.
* Recommended WF
  + Collect companies’ view for these proposals in 1st round

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| **Company** | **Comments** |
| Nokia | On option-1, we don’t agree. It needs further clarification why adding TL1-RSRP .again.  TL1-RSRP is considered in MAC-CE UL-TCI switching delay in TCI unknow case. If PL-RS switching additionally has TL1-RSRP again, it seems doubly consider two of TL1-RSRP.  On option-2, we propose to introduce PL-RS switching delay requirement only in known state case. Firstly, Rel-16 PL-RS switching requirement has only been defined in known state case.  Secondly, if L1-measurement has been measured on either PL-RS or source-RS in UL-TCI, then it can be assumed to be known state, so we propose the second bullets of option-2. This proposal intends to avoid a situation to consider additional TL1-RSRP. for PL-RS switching.  Alternatively, Issue 1-2-3 discussion can be a solution to remove ambiguity. |
| Apple | We can specify requirements if PL-RS is unknown. But this is also related to Issue 1-2-5. Also as we commented in Issue 1-1-2, PL-RS is always in UL TCI. |
| Huawei | When PL-RS is identical to the source RS in UL/Joint-TCI, then both PL-RS and source RS are either known or unknown. If PL-RS measurement time is considered into UL TCI state switching delay, the switching delay for known case needs to be defined. |
| vivo | Same view as Apple. This is related to 1-2-5. No need to duplicate discussion. |
| ZTE | When PL-RS is identical to the source RS in UL/Joint-TCI, then both PL-RS and source RS are either known or unknown. Which is related to Issue 1-2-5. |
| Intel | Fine to solve the issue 1-1-2 and 1-2-5 first. |
| Samsung | Agree with Intel comments on focus on the issues 1-1-2 and 1-2-5 first. |

**Issue 1-5-3 DCI-based PL-RS switching delay requirements**

* Proposals
  + Option 1(Nokia):
    - Apply DCI-based UL TCI switching delay requirement for DCI-based PL-RS switching delay requirements, when the target pathloss reference signal is known AND when the target UL TCI state is known.
* Recommended WF
  + Collect companies’ view for these proposals in 1st round

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| **Company** | **Comments** |
| Nokia | Support |
| Apple | Since we only consider beam alignment case, both PL-RS and RS for UL TCI are either known or unknown together, cannot have a mis-match. |
| Huawei | We can agree with option 1.  For DCI based UL TCI switching, the PL-RS included in or associated with the target TCI is considered to be maintained. |
| vivo | Same view as Apple. |
| ZTE | Same view as Apple. |
| Intel | Generally fine to define requirement for known case. |
| Ericsson | Support the proposal with clarification from Apple |
| Samsung | Agree with option 1 |

### Sub-topic 1-6 TCI state list update delay

**Issue 1-6-1 MAC CE based TCI state list update delay for serving cell**

* Proposals
  + Option 1(vivo):
    - For MAC CE based TCI state list update, specify requirements for the case when not all TCI states are known.
    - For MAC-CE based joint UL and DL TCI switching delay, introduce reference point in time domain for OTA testing purpose, while the reference point is the later one between endpoints for DL TCI switching delay and UL TCI switching delay, respectively.
    - If there is at least one unknown DL or UL TCI in the TCI list being activated, the requirement for TCI state list update delay follow the respective unknown case, i.e. extra delay for the respective L1-RSRP measurement is considered.
* Recommended WF
  + Collect companies’ view for these proposals in 1st round

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| **Company** | **Comments** |
| Nokia | To manage TCI state list update, a UE is mandated to measure L1-RSRP measurement?  A UE is already allowed with L1-RSRP time when MAC-CE based TCI switching is triggered under unknown TCI state. |
| Apple | Is the 2nd point also for TCI state list update? It is very complicated to define active TCI list update requirements when all are not known and little use for such requirements. We should first define requirements for the case when all are known. The active TCI list update facilitates DCI based switch, so known condition is sufficient. |
| vivo | Support the proposal.  To Nokia, this is not related to L1-RSRP measurement requirements. If all TCIs are known, clearly there is no need to measure L1-RSRP. Please check our CR R4-2204340.  To Apple, we think the situation is different from R15. If you check R4-2204340, it is not that complicated if the case not all are known is considered. Since NW may most likely to activate more than 1 TCIs in one MAC CE, it is important to specify the corresponding requirements in RAN4. |
| Intel | Prefer to only define TCI state list update requirement for known TCI state case, similar as legacy. |
| Ericsson | Typically, NW sends active TCI state list based on latest L1-RSRP report from UE. However, we also see vivo’s point.  We agree with first point and last point in the proposal. 2nd point not sure if it needed to be discussed now. |
| Samsung | We can only specify the requirements for all TCI is known in such list update case. |

**Issue 1-6-2 MAC CE based TCI state list update delay for cell with different PCI**

* Proposals
  + Option 1(vivo):
    - For DL TCI state list update requirements, T\_first\_SSB should be scale by the number of cells associated with the target UL TCIs whose SSBs for tracking are overlapped.
    - For UL TCI state list update requirements, T\_first\_PL-RS and T\_PL-RS should be scale by the number of cells associated with the target UL TCIs whose not-maintained PL-RSs are SSBs, and these SSBs are overlapped
* Recommended WF
  + Collect companies’ view for these proposals in 1st round

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| **Company** | **Comments** |
| Nokia | As we know, the current working assumption is the number of NSC =1. We are open to discuss up to needs. |
| Apple | We are not very sure how this applies to different PCI. Are SSB with different PCI also in the active TCI list or different active TCI list? Could proponents please clarify? |
| vivo | Support the proposal.  To Nokia, this is to solve the issue that SSBs for NSC and SC are overlapped. In case number of NSC > 1, it is also applicable.  To Apple, this is to solve the issue that SSBs for NSC and SC are overlapped, and the TCIs to be activated (i.e not in the already-active list) are associated to the overlapping SSB. In our understanding, TCI associated to SC and TCI associated to NSC can be activated in the same list. |
| Intel | We are open to further discuss. |
| Ericsson | Ok with proposal in principle. |
| Samsung | For SSB overlapped case between serving cell and “NSC”, how to scale the measurement period can be discussed separately. TCI switching requirements can refer to L1-RSRP measurement period if scaling factor is introduced. Except L1-RSRP measurement, it is not clear whether to scale the overall switching delay by the number of cell even though the SSB are overlapped. |

## Companies views’ collection for 1st round

### CRs/TPs comments collection

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| **CR/TP number** | **Comments collection** |
| **R4-2204340**  vivo | draft CR on active DL and UL TCI state list update delay requirements in R17 |
| Apple: We prefer to discuss and agree on the requirements before reviewing CR. |
|  |
| [**R4-2204403**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204403.zip)  Intel | DraftCR to TS 38.133: MAC-CE based downlink/uplink TCI state switch delay for unified TCI state |
| Apple:  is not expected that UE will be required to make DL reception before UE completes the DL ~~or~~ and UL TCI state switch.  We will review when we have agreements on the open issues related to UL TCI and PL-RS. |
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| [**R4-2204491**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204491.zip)  ZTE | Draft CR for Introduction of DL TCI state switching delay for unified TCI |
| Apple: DL TCI switch should also be applicable to joint TCI state in our understanding. |
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| [**R4-2204492**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204491.zip)  ZTE | Draft CR for Introduction of UL TCI state switching delay for unified TCI |
| Apple: UL TCI switch should also be applicable to joint TCI state in our understanding. |
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| [**R4-2205042**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205042.zip)  Nokia | DraftCR on DCI based DL and UL TCI switching delay requirements |
|  | Apple: We need to wait for conclusion of issue 1-2-1 and 1-2-2 to have the appropriate text. Also need to include different PCI |
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| [**R4-2205335**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205335.zip)  Huawei | DraftCR on known condition requirements for R17 unified TCI |
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## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

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|  | **Status summary** |
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## Discussion on 2nd round (if applicable)

# Recommendations for Tdocs

## 1st round

**New tdocs**

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| **Title** | **Source** | **Comments** |
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**Existing tdocs**

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| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
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Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics incl. existing and new tdocs.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. For new LS documents, please include information on To/Cc WGs in the comments column
4. Do not include hyper-links in the documents

## 2nd round

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| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
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Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. Do not include hyper-links in the documents

# Annex

Contact information

|  |  |  |
| --- | --- | --- |
| **Company** | **Name** | **Email address** |
| Moderator (Intel) | Li Hua | hua.li@intel.com |
| CMCC | Jingjing Chen | chenjingjing@chinamobile.com |
| Apple | Manasa Raghavan | Manasa.raghavan@apple.com |

Note:

1. Please add your contact information in above table once you make comments on this email thread.
2. If multiple delegates from the same company make comments on single email thread, please add you name as suffix after company name when make comments i.e. Company A (XX, XX)