**3GPP TSG-RAN WG4 Meeting # 109 R4-2318163**

**Chicago, USA, 13 Nov. – 17 Nov. 2023**

**Agenda item:** 8.7.5

**Source:** Moderator (Ericsson)

**Title:** Topic summary for [109][207] FR2\_multiRx\_part2

**Document for:** Information

# Introduction

The AI to be discussed are:

* 5.7.2.2 L1-RSRP Measurements
* 5.7.2.5 TCI State switching
* 5.7.2.6 Receive Time Difference*.*

# Topic #1: L1-RSRP measurements

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2318691 | Apple | **Proposal 1: Fast beam sweeping is assumed to be enabled in the following two cases:**   * **If UE supports the fast beam sweeping UE capability and UE indicates preference of multi-Rx operation** * **If UE supports the fast beam sweeping UE capability and UE has not indicated its preference of no multi-RX operation.**   **Proposal 2: For GBBR, the measurement period should be defined as the time that the UE needs to measure both CMR sets, not a single RS in either set.**  **Proposal 3: For SSB + SSB, it is proposed to adopt Option 2, i.e., set N = 8 + K, where K is the number of SSBs in each CMR set.**  **Proposal 4: For CSI-RS + CSI-RS, it is proposed to set N = ceil(maxNumberRxBeam / K) + 1, where K is the number of CSI-RSs in each CMR set.**  **Observation 1: Option 1 fails to indicate if the UE has completed the measurement of both CMR sets, as it is focused on the measurement of a single RS.**  **Observation 2: For Option 1, it is unclear how the UE can support faster beam sweepting, i.e., indicating N = [reduceNumberRxBeam], following the agreement that UE uses a single Rx panel for measurements at one time instance.**  **Proposal 5: The conditions for enhanced requirements for L1-RSRP not configured with GBBR can reuse the condition to assume fast beam sweeping is enabled, as captured in Proposal 1.** |
| R4-2319042 | vivo | **Proposal 1: Fast beam sweeping is enabled if UE supports the UE capability and when the UE indicates preference of multi-Rx operation.**  **Proposal 2: For measurement period for SSB-based L1-RSRP measurement configured for GBBR, N = [reducedNumberRxBeam] for UE supporting faster beam sweeping under multi-Rx operations; otherwise, N=8.**  **Proposal 3: For measurement period for CSI-RS based L1-RSRP measurement configured for GBBR, the existing L1-RSRP measurement period requirement is reused.**  **Proposal 4: For SSB-based L1-RSRP measurement configured for non-GBBR, the existing L1-RSRP measurement period requirement is reused.**  **Proposal 5: Enhanced features for multi-Rx such as fast beam sweeping, measurement restriction relaxation, scheduling restriction relaxation can also be used for legacy L1-SINR measurement.**  **Proposal 6: When the side conditions are changed with a transition between multi-Rx operation and no multi-Rx operation, the corresponding multi-Rx requirement is not applicable, and no UE behavior needs to be defined.** |
| R4-2319273 | Nokia, Nokia Shanghai Bell | **Proposal 1: Fast beam sweeping is always enabled if UE supports the UE capability.**  **Observation 1: The GBBR measurement delay relaxation by a factor K is not in line with the understanding of the feature in RAN1, so there were no additional repetitions for the UE to fine tune the beam and mitigate cross TRP interference.**  **Proposal 2: RAN4 to define measurement requirements for GBBR-r17 by reusing legacy L1-RSRP delay as a baseline with factor N= [reduceNumberRxBeam] for UE supporting faster beam sweeping under multi-Rx operations; otherwise, N=8.**  **Observation 1: The requirements for L1-RSRP measurement delay and L1-SINR measurement period are similar for multi-Rx operation.**  **Observation 2: GBBR-r17 does not support L1-SINR reporting.**  **Proposal 1: Changes in non-group-based L1-RSRP measurement requirements due to multi-Rx operation are also considered for L1-SINR.** |
| R4-2319464 | OPPO | **Proposal 1: N = [reduceNumberRxBeam] for UE supporting faster beam sweeping under multi-Rx operations; otherwise, N=8.**  **Proposal 2: For CSI-RS based L1-RSRP measurements in FR2, the existing L1-RSRP measurement period is reused when configured for GBBR.**  **Proposal 3: Not to consider enhancement to measurement period of L1-RSRP not configured for GBBR.**  **Proposal 4: No need to specify additional UE behavior at transitions between single-RX and multi-RX operation modes.** |
| R4-2319722 | Samsung | **Observation 1: No matter from RAN1 or RAN4 perspective, there is no spec-compliant mechanism to indicate the mapping between the UE panel and the Rx beam.**  **Proposal 1: No need to enhance the GBBR measurement delay requirement based on L1-RSRP for GBBR assumption**   * **The existing L1-RSRP measurement period (N=8) is reused for such case.**   **Proposal 2: For measurement period for SSB based L1-RSRP**   * **option 1: N = [reduceNumberRxBeam] for UE supporting faster beam sweeping under multi-Rx operations; otherwise, N=8**   **Observation 2: For Non-GBBR, each TRP may configure separate CSI configuration.**  **Proposal 3: Do not consider enhancement for measurement period of L1-RSRP not configured for GBBR**  **Proposal 4: L1-SINR requirements shall not be defined for the multi-RX UE in Rel-18.**  **Proposal 5: Changes in non-group-based L1-RSRP measurement delay due to multi Rx operation are not also considered for L1-SINR.** |
| R4-2319956 | Huawei, HiSilicon | **Proposal 1: For SSB based GBBR L1-RSRP measurements in FR2, the beam sweeping factor N can be defined as:**   * **Option 1: N = [reduceNumberRxBeam] for UE supporting faster beam sweeping under multi-Rx operations; otherwise, N=8**   **Proposal 2: For CSI-RS based GBBR L1-RSRP measurements in FR2, the legacy beam sweeping factor N can be reused** |
| R4-2320425 | ZTE Corporation | **Observation 1: Alternative 1 of fast beam sweeping is: UE derives the relationship between multiple sub-set of beams and multiple panels through some prior information, so for the receiving of RS or PDSCH/PDCCH, UE can predict which panel is involved in, so only a sub-set of beam sweeping(corresponding the relevant panel) is performed, N can be reduced from 8 to [4].**  **Observation 2: Alternative 2 of fast beam sweeping is: UE detects a pair of beams at each RS instance in parallel by two panels, and each panel covers a sub set of beams. Then the N can be reduced to [4] from 8. The multi-panel operation should be guaranteed during the fast beam sweeping.**  **Proposal 1: Under different implementation assumption of fast beam sweeping, whether need to guarantee the multi-panel operation, which is different. So first to align companies’ view on the implementation assumption of fast beam sweeping.**  **Proposal 2: By applying the alternative 2 of fast beam sweeping, both useful signaling RSRP and interference RSRP can be obtained during fast beam sweeping, Option 1 is preferred for SSB based GBBR measurement period.**  **Proposal 3: For CSI-RS based L1-RSRP measurements in FR2, the existing L1-RSRP measurement period is reused when configured for GBBR.**  **Proposal 4: For SSB based non-GBBR L1-RSRP measurement, the beam sweeping factor N can be reduced for the UE capable of fast beam sweeping. For CSI-RS based non-GBBR L1-RSRP measurement, reuse existing requirements if fine.**  **Proposal 5: Changes in non-group-based L1-RSRP measurement delay due to multi Rx operation are also considered for L1-SINR**  **Proposal 6: The transition between single-RX and multi-RX operation modes would impact the measurement/scheduling restriction.** |
| R4-2320462 | Ericsson | **Proposal 1: Fast beam sweeping is the UE capability, and it is always enabled in a UE supporting this capability as long as the UE is in multi-rx operation.**  **Proposal 2: N = [reducedNumberRxBeam] for UE supporting faster beam sweeping under multi-rx operation; otherwise N=8.**  **Proposal 3: A single value for the reducedNumberRxBeam is preferred, e.g., N=4.**  **Proposal 4: When one or more conditions violated, the UE shall continue the measurement.**  **Proposal 5: Transition period is needed at least for faster beam sweeping, when going between single-rx and multi-rx operations.**  **Proposal 6: During the transition period, the more relaxed requirement (i.e., single-rx) apply.**  **Proposal 7: Transition period length can be defined as one measurement period corresponding to the requirement applicable during the transition period.**  **Proposal 8: No transition period is needed for scheduling restriction and scheduling availability enhancements.** |

## Open issues summary

*Several issues related to L1-RSRP measurements are still open. The following open issues should be discussed in order to progress the work and proceed with the definition of the actual requirements.*

* Group based beam reporting requirements, i.e., requirements for measurements configured for GBBR
* L1-RSRP measurement period requirements
* L1-SINR measurement period requirements
* Other issues

### Sub-topic 1-1: General aspects.

**Issue 1-1-1: If UE supports the fast beam sweeping UE capability, when is fast beam sweeping is assumed to be enabled:**

* Proposals
  + Option 1: UE indicates it prefers multi-Rx operation or UE has not indicated it prefers single-RX operation.
  + Option 2: Fast beam sweeping is always enabled if UE supports the fast beam sweeping capability
* Recommended WF:
  + Need further discussion

### Sub-topic 1-2: Measurement period requirements

**Issue 1-2-1: Measurement period for L1-RSRP configured for GBBR**

**Background:**

For SSB based L1-RSRP measurements in FR2 the measurement period for GBBR defined as:

|  |  |
| --- | --- |
| Configuration | TL1-RSRP\_Measurement\_Period\_SSB (ms) |
| non-DRX | max(TReport, ceil(M\*P\*N)\*TSSB) |
| DRX cycle ≤ 320ms | max(TReport, ceil(1.5\*M\*P\*N)\*max(TDRX,TSSB)) |
| DRX cycle > 320ms | ceil(1.5\*M\*P\*N)\*TDRX |
| Note 1: TSSB = ssb-periodicityServingCell is the periodicity of the SSB-Index configured for L1-RSRP measurement. TDRX is the DRX cycle length. TReport is configured periodicity for reporting.  Note 2: N is FFS | |

* N is FFS
* Option 1: N = [reduceNumberRxBeam] for UE supporting faster beam sweeping under multi-Rx operations; otherwise N=8. (vivo, OPPO, QC, HW, ZTE, MTK, Samsung)
* Option 2: N = 8 + K, where K is the number of SSBs in each CMR set (Apple)
* FFS: For CSI-RS based L1-RSRP measurements in FR2, the existing L1-RSRP measurement period is reused when configured for GBBR.

**Issue 1-2-2 a: measurement period for SSB based L1-RSRP**

* Proposals
  + option 1: N = [reduceNumberRxBeam] for UE supporting faster beam sweeping under multi-Rx operations; otherwise, N=8
  + option 2: N = 8 + K, where K is the number of SSBs in each CMR set
* Recommended WF
  + Further discussion is needed

**Issue 1-2-2 b: measurement period for CSI-RS based L1-RSRP**

* Proposals
  + Option 1: For CSI-RS based L1-RSRP measurements in FR2, the existing L1-RSRP measurement period is reused when configured for GBBR.
  + Option 2: For CSI-RS + CSI-RS, it is proposed to set N = ceil(maxNumberRxBeam / K) + 1, where K is the number of CSI-RSs in each CMR set
* Recommended WF
  + Further discussion is needed

**Issue 1-2-3: Measurement period for non-GBBR (i.e., measurement period of L1-RSRP not configured for GBBR)**

* Proposals
  + Option 1: Consider faster beam sweeping factor related enhancement
  + Option 2: Do not consider enhancement to measurement period of L1-RSRP not configured for GBBR
* Recommended WF
  + Need further discussion

### Sub-topic 1-3: Others

**Issue 1-3-1: Shall L1-SINR requirements be defined for the multi-RX UE**

* Proposals
  + Option 1: Yes
    - Changes in non-group-based L1-RSRP measurement delay due to multi Rx operation are also considered for L1-SINR
  + Option 2: NO
* Recommended WF
  + Need further discussion

**Issue 1-3-2a: Measurement period for L1-SINR (based on conclusion of issue 1-3-1)**

* Proposals
  + Option 1: Consider faster beam sweeping factor related enhancement
  + Option 2: Enhanced features for multi-Rx such as fast beam sweeping, measurement restriction relaxation, scheduling restriction relaxation can also be used for legacy L1-SINR measurement
* Recommended WF
  + Need further discussion

**Issue 1-3-2b: Other enhancements for L1-SINR (based on conclusion of issue 1-3-1)**

* Proposals
  + Proposal 1: Enhanced features for multi-Rx such as fast beam sweeping, measurement restriction relaxation, scheduling restriction relaxation can also be used for legacy L1-SINR measurement
* Recommended WF
  + Need further discussion

**Issue 1-3-3: UE behaviour at transitions between single-RX and multi-RX operation modes**

* Proposals:
  + Option 1: Consider transition period between single-RX and multi-RX operation and define UE behaviour during transition period
  + Option 2: Consider transition period between single-RX and multi-RX operation but do not define UE behaviour during transition period
  + Option 3: Do not consider transition period between single-RX and multi-RX operation but define UE behaviour during transition period
  + Option 4: Do not consider transition period between single-RX and multi-RX operation and do not define UE behaviour during transition period
* Recommended WF
  + Further discussion is needed.

# Topic #2: TCI state switch

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| **R4-2318694** | **Apple** | **Observation 1: It is acknowledged that in mDCI, where each TRP has its own active TCI state list, it may not be always guaranteed that the two target TCI states are QCL-ed with typeD to the latest reported beam pair (i.e., RS resources pair) within one group.**  **Proposal 1: Since RAN4 has agreed not to specify UE behavior when the UE cannot receive two target TCI states simultaneously, it is reasonable to assume that the network will ensure the two target TCI states are QCL-ed with typeD to the latest reported beam pair within one group. No change is needed to the big CR.**  **Proposal 2: Based on RAN1 LS, it is proposed to change the existing requirement text “The requirements apply provided that the offset betweeen the reception of the DCI received in slot n1 and PDSCH scheduled by DCI received in slot n2 is equal to or greater than timeDurationForQCL, and the offset betweeen the reception of the DCI received in slot n2 and PDSCH scheduled by DCI received in slot n1 is equal to or greater than timeDurationForQCL.” to “UE shall be able to receive PDSCHs with target TCI states after slot max(n1, n2) + timeDurationForQCL.”**  **Proposal 3: It is up to network to avoid scheduling the UE to receive PDCCH and PDSCH from different directions with different QCL TypeD RSs in case the UE cannot receive them simultaneously.** |
| **R4-2318852** | **xiaomi** | **Observation 1: Current known condition for Multi-RX reception is defined based on two TCI states together, which can apply for sDCI.**  **Observation 2: For mDCI, if we have assumption that each MAC CE are independent, the TCI state known condition will only be decided by the single TCI state in this MAC CE. It can’t guarantee whether the another TCI state in another MAC CE is in GBBR or not.**  **Proposal 1: Known condition in mDCI case will be defined based on single TCI state, i.e. whether the target TCI state is reported in GBBR before.**  **Proposal 2: Add clarification for DCI based dual TCI activation for simultaneous reception in mDCI:**   * **Dual target TCI states can be used in the same slot for PDSCH only after both TCI states are activated.**   **Proposal 3: Added clarification for MAC CE based TCI activation for simultaneous reception in mDCI:**   * **Depending on UE capability, dual target TCI states can be used in the same slot for PDCCH only after both TCI states are activated.** |
| **R4-2319045** | **vivo** | **Proposal 1: For MAC-CE based PDCCH TCI state switch in m-DCI scenario, no dual TCI state switch requirements are defined for simultaneous PDCCH reception with different QCL typd D associated with different CoresetPoolIndex in Rel-18.**  **Proposal 2: No requirements are defined for DCI based dual TCI states switch when time offset between DCI and PDSCH from any TRPs are less than timeDurationForQCL.**  **Proposal 3: RRC based TCI state switch delay requirements are defined for dual TCI states and legacy delay requirements are reused for each TRP (CorsetPoolIndex).**  **Proposal 4: For m-DCI, legacy known condition is reused** |
| **R4-2319278** | **Nokia, Nokia Shanghai Bell** | [**Observation 1: According to the RAN1 specification, the delay timeDurationForQCL applies independent of whether the DCIs from two TRPs are received simultaneously or non-simultaneously in the multi-DCI scenario.**](#_Toc149906459)  [**Proposal 1: For multi-DCI scenario, DCI based TCI state switch is per TRP. Hence legacy requirement can be reused and applied per TRP. When the TCI state switching periods/delays are overlapping in time, the UE shall be able to receive the two target TCI states simultaneously after both TCI state switches are completed.**](#_Toc149906460)  [**Proposal 2: Rel-18 UEs which support simultaneous PDCCH reception can receive the PDCCHs from the two TRPs simultaneously when the later of the two TCIs states is switched.**](#_Toc149906461)  [**Proposal 3: For UEs (including Rel-18) not supporting simultaneous PDCCH reception capability, the requirements per TRP would apply independently. Legacy requirements for MAC-CE based TCI state switch for PDCCH apply per TRP.**](#_Toc149906462)  [**Proposal 4: RRC based TCI state switch delay requirements will apply when the UE is configured via RRC with TCI states per CORESET associated with a different CORESETPoolIndex. The legacy RRC requirements can be reused and shall apply per TRP.**](#_Toc149906463)  [**Proposal 5: If the reference signals of the TCI states received in the MAC-CE for TCI state activation has QCL relation with the reference signal of the TCI state which is already a part of the active TCI state list, the UE can skip synchronization with the first SSB for that TCI state.**](#_Toc149906464)  [**Proposal 6: Update the known dual TCI state conditions with: In m-DCI, when the UE receives a TCI state switch command for only one CORESETPoolIndex while the TCI state for the other CORESETPoolIndex is not switched, the target TCI state shall be QCL-ed with type D to a RS of a resource pair within one group of which the other RS has a QCL type D relation to the TCI state not being switched.**](#_Toc149906465) |
| **R4-2319359** | **Huawei, HiSilicon** | **Observation 1: The relation between timeDurationForQcl and the time span between PDCCH and PDSCH cross TRPs has not been discussed in RAN1 and RAN1 will not introduce the restriction in RAN1 spec.**  **Proposal 1: No requirements for dual TCI state switching for mDCI when the time span between PDCCHs and scheduled PDSCHs cross TRPs are smaller than timeDurationForQCL.**  **Proposal 2: UE is not expected to be scheduled simultaneous PDSCH reception with different QCL type-D when the time span between PDCCHs and scheduled PDSCHs cross TRPs are smaller than timeDurationForQCL** |
| **R4-2319467** | **OPPO** | **Proposal 1: RAN4 to discuss whether to introduce UE capability for reception of first prepared PDSCH during the overlapping duration with timeDurationForQcl of later prepared PDSCH**  **Proposal 2: For the overlapping case of DCI based dual TCI state switching in mDCI**   * **Option 1: RAN4 does not define any restriction on receiving PDSCH after each TCI switching, left to UE implementation.** * **Option 2: RAN4 to introduce restrictions for all UEs of receiving one PDCSH during the overlapping duration of timeDurationForQCL used for preparing for the other PDSCH, e.g., the duration between point B and C** * **Option 3: Introduce UE capability for PDSCH reception during overlapping duration due to mDCI based dual TCI state switching. If UE supports “early-reception of PDSCH” from the first complete TCI, the reception of first coming PDSCH can be started within timeDurationForQcl for later coming PDSCH, not impacted by processing of the other PDSCH TCI swtich. Otherwise, the reception of any PDSCH should be started after the complete of dual TCI state switching for both PDSCHs.**   **Proposal 3: RAN4 to complete requirements in R18 maintenance stage for MAC CE based PDCCH TCI state switch for m-DCI.**  **Proposal 4: Reuse legacy delay requirements for each TCI state switch for MAC CE based PDCCH TCI state switch for m-DCI.**  **Proposal5: RAN4 to discuss whether dual target TCI states can be used in the same slot for PDCCH or PDSCH only after both TCI states on TCI state list(s) are activated.** |
| **R4-2320761** | **Ericsson** | 1. **For mDCI based dual DCI state switch, TCI state switch on each coreset is independent without any restriction on the DCI reception.** 2. **Between point C and D, UE to receive on TCI state 0 alone, if new TCI state 0 and old TCI state 1 are not in a beam pair.** 3. **For RRC based dual TCI state switch, each TCI state switch should follow legacy TCI state switch delay.** |

## Open issues summary

*Several issues related to TCI State Switching are still opened. The following open issues should be discussed in order to clearly identify the scope of the discussion and proceed with the definition of the actual requirements.*

* General principles for defining requirements
* DCI based TCI state switch
* MAC CE based TCI state switch
* RRC based TCI state switch
* Known conditions
* Active TCI state list update

### Sub-topic 2-1: General principle for defining requirements

None

### Sub-topic 2-2: DCI based TCI state switch

*A diagram of a computer program

Description automatically generated with medium confidence*

**Issue 2-2-1: DCI based dual TCI state switch delay for mDCI:**

* Proposals:
  + Proposal 1: Based on RAN1 LS, it is proposed to change the existing requirement text “The requirements apply provided that the offset betweeen the reception of the DCI received in slot n1 and PDSCH scheduled by DCI received in slot n2 is equal to or greater than timeDurationForQCL, and the offset betweeen the reception of the DCI received in slot n2 and PDSCH scheduled by DCI received in slot n1 is equal to or greater than timeDurationForQCL.” to “UE shall be able to receive PDSCHs with target TCI states after slot max(n1, n2) + timeDurationForQCL.”
  + Proposal 2: Add clarification for DCI based dual TCI activation for simultaneous reception in mDCI:
    - Dual target TCI states can be used in the same slot for PDSCH only after both TCI states are activated.
  + Proposal 3: No requirements are defined for DCI based dual TCI states switch when time offset between DCI and PDSCH from any TRPs are less than timeDurationForQCL.
  + Proposal 4: For multi-DCI scenario, DCI based TCI state switch is per TRP. Hence legacy requirement can be reused and applied per TRP. When the TCI state switching periods/delays are overlapping in time, the UE shall be able to receive the two target TCI states simultaneously after both TCI state switches are completed
  + Proposal 5: No requirements for dual TCI state switching for mDCI when the time span between PDCCHs and scheduled PDSCHs cross TRPs are smaller than timeDurationForQCL.
    - UE is not expected to be scheduled simultaneous PDSCH reception with different QCL type-D when the time span between PDCCHs and scheduled PDSCHs cross TRPs are smaller than timeDurationForQCL
  + Proposal 6: RAN4 to discuss whether to introduce UE capability for reception of first prepared PDSCH during the overlapping duration with timeDurationForQcl of later prepared PDSCH.
    - For the overlapping case of DCI based dual TCI state switching in mDCI,
      * Option 1: RAN4 does not define any restriction on receiving PDSCH after each TCI switching, left to UE implementation.
      * Option 2: RAN4 to introduce restrictions for all UEs of receiving one PDCSH during the overlapping duration of timeDurationForQCL used for preparing for the other PDSCH, e.g., the duration between point B and C
      * Option 3: Introduce UE capability for PDSCH reception during overlapping duration due to mDCI based dual TCI state switching. If UE supports “early-reception of PDSCH” from the first complete TCI, the reception of first coming PDSCH can be started within timeDurationForQcl for later coming PDSCH, not impacted by processing of the other PDSCH TCI swtich. Otherwise, the reception of any PDSCH should be started after the complete of dual TCI state switching for both PDSCHs.
  + Proposal 7:
    - For mDCI based dual DCI state switch, TCI state switch on each coreset is independent without any restriction on the DCI reception.
    - Between point C and D, UE to receive on TCI state 0 alone, if new TCI state 0 and old TCI state 1 are not in a beam pair.
* Recommended WF:
* Proposals are bit diverse. Suggest discussing following cases for aligning views.
  + For DCI based TCI state switch, switching happens within CP and UE can receive entire timeDurationForQCL. Based on this assumption, please discuss following.
  + If TCI 1 and TCI 2 are a beam pair.
    - Option 1:
      * UE to receive on TCI 1 and TCI 2 between C and D. After D, to receive on TCI 2 and TCI 4
    - Option 2:
      * No requirements till point D. i.e., UE is not expected to receive on TCI 2 till point D.
    - Option 3: No requirements between point C and D. i.e., UE is not expected to receive on TCI 2 and TCI 1 between C and point D
  + If TCI 1 and TCI 2 are not a beam pair.
    - Option 1:
      * No requirements till point D. i.e., UE is not expected to receive on TCI 2 till point D.
    - Option 2: No requirements between point C and D. i.e., UE is not expected to receive on TCI 2 and TCI 1 between C and point D.
    - Option 2:
      * UE to receive on TCI 2 alone till Point D and after D, to receive on TCI 2 and TCI 4
    - Option 3: introduce a UE capability to receive on TCI 2 when switching to TCI 4

### Sub-topic 2-3: MAC CE based TCI state switch

**Issue 2-3-1: MAC CE based PDCCH TCI state switch for m-DCI scenario**

* Proposals
  + Proposal 1: Added clarification for MAC CE based TCI activation for simultaneous reception in mDCI
    - Depending on UE capability, dual target TCI states can be used in the same slot for PDCCH only after both TCI states are activated
  + Proposal 2: For MAC-CE based PDCCH TCI state switch in m-DCI scenario, no dual TCI state switch requirements are defined for simultaneous PDCCH reception with different QCL typd D associated with different CoresetPoolIndex in Rel-18
  + Proposal 3: Rel-18 UEs which support simultaneous PDCCH reception can receive the PDCCHs from the two TRPs simultaneously when the later of the two TCIs states is switched.
    - For UEs (including Rel-18) not supporting simultaneous PDCCH reception capability, the requirements per TRP would apply independently. Legacy requirements for MAC-CE based TCI state switch for PDCCH apply per TRP.
  + Proposal 4: RAN4 to complete requirements in R18 maintenance stage for MAC CE based PDCCH TCI state switch for m-DCI.
    - Reuse legacy delay requirements for each TCI state switch for MAC CE based PDCCH TCI state switch for m-DCI.
    - RAN4 to discuss whether dual target TCI states can be used in the same slot for PDCCH or PDSCH only after both TCI states on TCI state list(s) are activated
* Recommended WF
  + If UE capabilities till Rel-17 are considered in this WI, then NO requirements for this case. Discuss whether to consider Rel-18 UE capability or not.

### Sub-topic 2-4: RRC based TCI state switch

**Issue 2-4-1: RRC based TCI state switch**

* Proposals
  + Proposal 1: RRC based TCI state switch delay requirements are defined for dual TCI states and legacy delay requirements are reused for each TRP (CorsetPoolIndex).
  + Proposal 2: RRC based TCI state switch delay requirements will apply when the UE is configured via RRC with TCI states per CORESET associated with a different CORESETPoolIndex. The legacy RRC requirements can be reused and shall apply per TRP
  + Proposal 3: For RRC based dual TCI state switch, each TCI state switch should follow legacy TCI state switch delay
* Recommended WF
  + - All three proposals are similar. Discuss wording in CR.

### Sub-topic 2-5: Known conditions

**Issue 2-5-2: Definition of known condition**

There is proposal to change the definition of know condition.

* Proposals
  + Proposal 1: Known condition in mDCI case will be defined based on single TCI state, i.e. whether the target TCI state is reported in GBBR before.
  + Proposal 2: For m-DCI, legacy known condition is reused.
  + Proposal 3: when the UE receives a TCI state switch command for only one CORESETPoolIndex while the TCI state for the other CORESETPoolIndex is not switched, the target TCI state shall be QCL-ed with type D to a RS of a resource pair within one group of which the other RS has a QCL type D relation to the TCI state not being switched
  + Proposal 4: Since RAN4 has agreed not to specify UE behavior when the UE cannot receive two target TCI states simultaneously, it is reasonable to assume that the network will ensure the two target TCI states are QCL-ed with typeD to the latest reported beam pair within one group. No change is needed to the big CR.
* Recommended WF
  + Need further discussion. First discuss whether update is needed. If update is needed, consider below moderator proposal as baseline for further wording update.
    - For sDCI, the dual TCI state are known if the following conditions are met:

- Dual TCI states are QCL-ed with typeD to reported beam pair (i.e., RS resources pair) within one group

- The dual TCI states and all the RSs in the two QCL chains remain detectable during the TCI state switching period

- SNR of the TCI state ≥ -3dB

- RS resource pair configured for dual TCI states is reported in last [1280]ms

* + - For mDCI, each target TCI state is known if the following conditions are met:

- target TCI state is reported in a beam pair (i.e., RS resources pair) in last [1280]ms

- the TCI state and all the RSs in the QCL chains remain detectable during the TCI state switching period

- SNR of the TCI state ≥ -3dB

### Sub-topic 2-6: Active TCI state list update

**Issue 2-6-1: Other proposals of active TCI state list update:**

* Proposals
  + Proposal 1: It is up to network to avoid scheduling the UE to receive PDCCH and PDSCH from different directions with different QCL TypeD RSs in case the UE cannot receive them simultaneously.
* Recommended WF
  + Discuss in CR whether any update is needed.

**Issue 2-6-2: Other proposals of active TCI state list update:**

* Proposals
  + Proposal 1: If the reference signals of the TCI states received in the MAC-CE for TCI state activation has QCL relation with the reference signal of the TCI state which is already a part of the active TCI state list, the UE can skip synchronization with the first SSB for that TCI state
* Recommended WF
  + Only SSB or only CSI-RS are considered in this WI. No CSI-RS+SSB is considered for GBBR. Discuss the possibility of scenario.

# Topic #3: Receive time difference

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| **R4-2318696** | **Apple** | **Proposal 1: RTD < CP should be captured in 38.133 as a condition for the relevant multi-RX RRM requirements to apply.**  **Proposal 2: It is proposed to state in clause 3.6 “Applicability of requirements in this specification version.” that RTD < CP is the condition for the relevant multi-RX RRM requirements to apply.**  **Proposal 3: L1-RSRP GBBR requirements should not be extended to RTD >CP because of UE implementation impact. UE support of RTD>CP can be discussed in R19** |
| **R4-2319046** | **vivo** | **Proposal 1: L1-RSRP measurement requirements are defined under the assumption of RTD <CP.**  **Proposal 2: A dedicated clause 3.6.X is used to capture applicability of requirements for multi-Rx.** |
| **R4-2320427** | **ZTE Corporation** | **Proposal 1: The restriction of RTD < CP is not set as the applicability condition of GBBR measurement requirements. Besides, the applicability of measurement/scheduling restriction should be constraint to the case of RTD < CP** |
| **R4-2320724** | **Nokia, Nokia Shanghai Bell** | **Proposal 1: Capture MRTD requirements as a new clause in 38.133, 7.6** |
| **R4-2320763** | **Ericsson** | **Proposal 1: RAN4 to agree that L1-RSRP GBBR requirements are applicable for RTD >CP** |

## Open issues summary

### Sub-topic 3-1

*Sub-topic description:*

*Open issues and candidate options before meeting:*

**Issue 3-1-1: How to capture RTD applicability conditions in multi-RX WI**

* Proposals
  + Proposal 1: RTD < CP should be captured in 38.133 as a condition for the relevant multi-RX RRM requirements to apply.
    - Proposal 1a: It is proposed to state in clause 3.6 “Applicability of requirements in this specification version.” that RTD < CP is the condition for the relevant multi-RX RRM requirements to apply.
  + Proposal 2: A dedicated clause 3.6.X is used to capture applicability of requirements for multi-Rx.
  + Proposal 3: The applicability of measurement/scheduling restriction should be constraint to the case of RTD < CP
  + Proposal 4: Capture MRTD requirements as a new clause in 38.133, 7.6
* Recommended WF
  + Should the RTD condition be added to scheduling/measurement restriction/l1-RSRP requirements clause as a side condition?
  + If RTD side condition is added to relevant sections which are impacted, discuss the need adding additional general applicability rule in separate clause.
  + Please note that If UE support MRTD = CP alone, we didn’t have as separate clause in spec so far.

**Issue 3-1-2: Whether L1-RSRP GBBR requirements should be extended to RTD >CP if the UE supports RTD>CP capability**

* Proposals
  + Proposal 1: Yes
    - Proposal 1a: The restriction of RTD < CP is not set as the applicability condition of GBBR measurement requirements.
    - Proposal 1b: as the L1-RSRP of GBBR assumes single panel and does not depend on RTD condition.
  + Proposal 2: NO
    - L1-RSRP GBBR requirements should not be extended to RTD >CP because of UE implementation impact. UE support of RTD>CP can be discussed in R19.
* Recommended WF
  + Needs further discussion.