**3GPP TSG-RAN WG4 Meeting #104-e R4-22xxxxx**

Electronic Meeting, 15th-26th, Aug., 2022

**Agenda item:** 9.17.2

**Source:** Moderator (Intel)

**Title:** Email discussion summary for [104-e][221] NR\_feMIMO\_RRM\_1

**Document for:** Information

# Introduction

This e-mail discussion summary captured the discussions for Rel-17 FeMIMO RRM Core requirement maintenance in 9.17.2 in RAN4 #104-e meeting.

In RAN4 103-e meeting, WF is approved.

* **WF on FeMIMO RRM impact for unified TCI** was approved in R4-2211203
* **WF on FeMIMO RRM requirements for inter-cell beam management** was approved inR4-2211148

# Topic #1: Unified TCI state (9.17.2.1)

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2211858**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2211858.zip) | Apple | **Proposal #1: Honour the previous agreements that for joint TCI state switch UE is not expected to receive on the DL or transmit on the UL until it completes both UL and DL TCI state switch.** **Proposal #2: When PL-RS in UL TCI state switch is SSB in FR2, longer delay is expected.*****Observation #1:*** *UE needs to maintain up to 4 RS but might measure and report L1-RSRP on more resources. UE report of L1-RSRP report cannot guarantee that PL-RS is maintained.***Proposal #3: If necessary, introduce definition of maintained PL-RS based on number of activated PL-RS.****Proposal #4: UE need not track UL time/frequency for DL-RS associated with active UL TCI state for UL transmission.** **Proposal #5: Do consider unknown TCI state in TCI state list update delay requirements.****Proposal #6: We can capture that longer delay applies if any TCI state is unknown in TCI state list update.**  |
| [**R4-2212120**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212120.zip) | Intel Corporation | **Proposal 1: UE don’t need to perform timing/frequency tracking for UL TCI state activation.****Proposal 2: Keep the current clarification for Joint TCI state switch in the specification.****Proposal 3: When SSB is indicated as PL-RS in UL TCI state for FR2, longer delay is expected.****Proposal 4: The known condition will depend on the associated RS with QCL-type A/D in common TCI state.****Proposal 5:** **The delay requirement is defined for multiple CCs for the common TCI indicated by simultaneousU-TCI-UpdateList1/2/3/4-r17.****Proposal 6: Prefer to define MAC CE based TCI state list update requirement for known TCI state case. If there is unknown TCI state in the TCI state list, longer delay is expected.** |
| [**R4-2212515**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212515.zip) | MediaTek Inc. | **Proposal 1: The source RS in active UL TCI state should be subset of source RS in DL TCI state to guarantee the timing of UL TCI state is under tracking.****Observation 1: For UL TCI state, RAN4 has agreed the requirement is defined when the TCI state is associated with DL-RS, i.e. no need to consider SRS.****Observation 2: For PL-RS, network should configure up to 4 PL-RS for 8 active TCI states, i.e. some active TCI states may share the same PL-RS configuration.****Observation 3: For joint TCI state switch, UE is required to make DL reception or UL transmission before UE completes the DL or UL TCI state switching, respectively.****Proposal 2: For the case when SSB is indicated as PL-RS, reuse the existing delay requirement of MAC CE based UL TCI state switch.****Observation 4: The source RS in target TCI state for a CC which is in the simultaneousTCI-UpdateList may be configured on the other CC, and the limitation of the QCL Type should follow the description of “cell” field.****Observation 5: The source RS in target TCI state which is provided by unifiedTCI-StateRef manner may be configured on the other CC and the limitation of QCL Type should also follow the description in “cell” field.****Proposal 3: For common TCI state switch delay requirement, suggest to define the requirement without differentiating the triggering signaling, e.g. unifiedTCI-StateRef or simultaneousTCI-UpdateList.****Proposal 4: For common TCI state switch, if TCI states involving QCL-Type C, the requirement can be defined per CC or across CCs.****Proposal 5: For MAC CE based TCI state list update, requirement is not applicable if unknown TCI state is included in the TCI state list.** |
| [**R4-2212664**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212664.zip) | vivo | **Observation 1 In R17 unified TCI, especially for the inter-cell BM scenario, the UL TCI only provides UL TX spatial filter information, and UL timing of the UE can be determined by the applied DL QCL information and the TAC. In some cases, UE might not be able to obtain DL timing of the target TRP when UE is able to transmit UL based on the corresponding UL TCI from the target TRP.** **Observation 2 Network may have full control on the what is sent in TAC, and on when to send the UL TCI config/indication. Therefore, there is no issue on the feasibility of this feature if network may ensure that, UE’s UL timing is already stable when UL TCI is configured/indicated.****Proposal 1 RAN4 further discuss whether/how to optimize the case ‘UE might not be able to obtain DL timing of the target TRP when UE is able to transmit UL based on the corresponding UL TCI from the target TRP’ in R17, i.e. whether to further require UE to track time and/or frequency on DL-RS associated with active UL TCI in R17.****Observation 3 The understanding of agreements in RAN4 101-bis-e was confirmed in RAN4 102-e as*** + **If when both DL TCI(s) and UL TCI(s) are activated by one MAC CE, or when at least one joint TCI(s) are activated by one MAC CE**
		- **For DL TCI switching delay requirements, UE is not able to make DL reception when either DL TCI switching is not finished or UL TCI switching is not finished.**
		- **For UL TCI switching delay requirements, UE is not able to make UL transmission, when either DL TCI switching is not finished or UL TCI switching is not finished**

**Proposal 2 RAN4 to confirm again the understanding of agreements in RAN4 101-bis-e as** * + **If when both DL TCI(s) and UL TCI(s) are activated by one MAC CE, or when at least one joint TCI(s) are activated by one MAC CE**
		- **For DL TCI switching delay requirements, UE is not expected to be able to make DL reception when either DL TCI switching is not finished or UL TCI switching is not finished.**
		- **For UL TCI switching delay requirements, UE is not expected to be able to make UL transmission, when either DL TCI switching is not finished or UL TCI switching is not finished**

**Observation 4 In legacy requirements, Rx beam sweeping is not specified for SSB-based measurements for time-frequency tracking and PL-RS update, no matter the SSB is configured for L1-RSRP/L1-SINR measurement or not, since the Rx beam for this SSB reception is already considered as known. For L1-RSRP measurements requirements, the Rx beam sweeping is considered for the worst case, and is not applicable to the case when a tighter requirement is applied.****Proposal 3 MAC-CE based UL TCI state switching delay requirements agreed in RAN4 101-bis-e can be applicable to the case when the PL-RS is the SSB which is configured for L1-RSRP measurements.****Observation 5 L1-RSRP measurements and PL-RS measurements require different number of samples and can deal with different range of Es/Iot, therefore it is not feasible to consider PL-RS as maintained if UE has performed L1-RSRP measurements on the corresponding RS.****Proposal 4 Do NOT specify addition condition in RRM spec that if a UE has measured and reported L1-RSRP within [Y] msec on the SSB indicated as PL-RS in UL TCI state, the PL-RS can be regarded as maintained.****Observation 6 According to latest RAN1/2 specs, the case that ‘only one CC in the CC list is configured with unified TCI, and or each of all other CCs in the CC list, only ref CC configuration is provided’ is feasible.****Proposal 5 For the common TCI, RRM requirements are only specified for the case when one CC in the CC list is configured with TCI and is the reference CC for all other CCs.****Proposal 6 For R17, if RAN4 only specifies RRM requirements for DL TCI switching of PDSCH and PDCCH, i.e. RRM requirements for TCI switching of DL-RS are not specified, then, there is no need to consider QCL-B/C.****Observation 7 From RAN1/2 design, network may make decision on the set of TCIs to be activated without L1 measurement reporting.****Proposal 7 In R17 TCI state list update requirements, specify requirements for the case when not all activated TCIs are known.****Proposal 8 For clarification on the applicable unified TCI after DCI BWP switching, RAN4 adopt the above text proposal.** |
| [**R4-2212665**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212665.zip) | vivo | CR on unified TCI in R17 feMIMO |
| [**R4-2212689**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212689.zip) | Nokia, Nokia Shanghai Bell | 1. If UE has an active UL (or joint) TCI state , should a UE track UL TCI state timing or frequency derived from DL-RS associated with TCI state in the same way as the UE does for activated DL TCI?

i-1. Which DL-RS can be used to track timing or frequency for activated UL TCI for non-serving cell (i.e. additional PCI(s) associated with a serving cell)? Specifically, how can a UE track timing or frequency for an active UL TCI state if SRS is indicated as source RS for the UL TCI?1. If UE maintains the PL-RS of the active UL TCI state (or joint) TCI state as per the RAN1 agreement, does the UE maintain all of PL-RSs in the activated UL (or joint) TCI states to support inter-cell or mTRP scenarios?

ii-1. What are the UE capabilities for measuring pathloss to support the active UL TCI list in inter-cell and mTRP? RAN4 notes that there is no UE capability related to pathloss measurement in TS38.306. RAN4 respectfully asks RAN1/2 to take RAN4 questions in consideration for UL TCI signaling and UE behaviors and define ‘active’ TCI state for ‘UL’. |
| [**R4-2212920**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212920.zip) | Nokia, Nokia Shanghai Bell | **Observation 1 :** Fundamental conditions for active TCI for UL are missing. There is no definition of active TCI for UL in RAN1/2 specs. Also, a UE should keep time and frequency sync tracking on the source RS in UL TCI to be capable of UL transmission.**Observation 2 :** *maxNumberActiveTCI-PerBWP* under *tci-StatePDSCH* should be about activated TCI-states with UE synchronization for both DL and UL. The current spec addresses about DL only.**Proposal 1 :** Rel-17 active UL TCI state should be under time and frequency tracking. This means that active UL TCI list belongs to active DL TCI state list.* Add the time and frequency tracking condition to the active TCI state for UL.

**Observation 3 :** We found main issues regarding ‘active UL TCI list’ in inter-cell or mTRP scenarios(i) Network does not know which PL-RS is maintained by UE, so it does not know which path loss measurement is available for UL transmission in inter-cell scenarios. PL-RS maintenance is executed by UE selection.(ii) A UE does not know which TCI(s) in the 8 active TCI states will be used for UL transmission by network scheduling. A UE also does not know which PL-RS should be maintained. (iii) If PL-RS is not maintained among the 8 active TCI states by a UE, network experiences UL switching latency due to PL-RS 5 sample measurement delay.**Proposal 2 :** Based on Observation-2,3 regarding ‘active TCI list’ for UL, we propose a LS draft in appendix.* Send LS to RAN1/2 to share the issue statements on active TCI list for UL. Possible solution is up to RAN1/2 in Rel-17 or Rel-18 enhancement.
* Improve PL-RS measurement period for TCI switching using active UL TCI list by reducing strict 5 PL-RS sample measurement period.

**Proposal 3 :** when SSB is indicated as PL-RS in UL TCI state for FR2, - The number of sample M will not always be fixed as 5 samples. - If a UE performs both L1-RSRP measurements and PL-RS measurements on the same SSB, the number of samples used for L1-RSRP is counted for pathloss measurement.- If a UE has reported L1-RSRP measurement on a PL-RS within a time window, the PL-RS is regarded as maintained. **Proposed 4 :** Regarding Issue 1-1-3a Joint TCI state switching requirement, it is clear that option-2 is the obvious UE behaviors based on the agreements in RAN4#101-bis. No more technical discussion is required. A CR should capture the option-2 statement as the agreement.**Proposal 5 :** Clarify what new UE behaviors are additionally defined with QCL type-C.* QCL-type C information is required to be ‘active TCI’ state, but wonder if QCL-type C information is needed to be ‘known conditions’ for ‘known’ TCI state in CA scenario.

**Proposal 6:** Regarding common TCI state switching delay requirement for shared RS,* + - The delay requirement is defined based on the common TCI indicated by simultaneousU-TCI-UpdateList1/2/3/4-r17, and the requirements are applied to all CCs referring to the common TCI.
		- The delay requirement is defined based on the common TCI indicated by RefUnifiedTCIStateList-r17, and the requirements are applied to all CCs referring to the common TCI.
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| [**R4-2213172**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213172.zip) | Samsung | CR to TS38.133 Corrections on R17 unified TCI state switching requirement |
| R4-2213290 | ZTE Corporation |  |
| [**R4-2213481**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213481.zip) | Huawei, HiSilicon | ***Proposal 1: For UL TCI state switching, when source RS and PL-RS for target UL TCI state is the same SSB, beam sweeping shall be assumed for PL-RS measurement time in FR2.******Observation 1: When CSI-RS and SSB are in the same TCI chain, SSB is assumed to be used as beam reference for CSI-RS, instead of using CSI-RS as beam reference for SSB, and beam sweeping shall be assumed for this SSB.******Proposal 2: For UL TCI state switching, when source RS is CSI-RS and associated PL-RS is SSB, beam sweeping shall be assumed for PL-RS measurement time in FR2.******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.***

***Observation 1: The QCL configuration for downlink channels will not be indicated by UL-TCIState.******Observation 2: The wording “DLorJoint-TCIState or UL-TCIState configured for a cell with different PCI” used in TS38.133 is incorrect.******Proposal 4: The wording of introduction for active DL/UL TCI state switch delay requirements for unified TCI needs to be updated to align with RAN1/RAN2 specifications.*** |
| [**R4-2213482**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213482.zip) | Huawei, HiSilicon | CR on maintaining TCI state switching requirements for R17 unified TCI |
| [**R4-2213873**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213873.zip) | ZTE Corporation | **Proposal 1: Option 1 is common understanding in general. However referring to the multi-TRP scenario, Option 2 is reasonable since different TRPs for DL and UL is possible. For the case that not any DL timing can be referenced, UE needs to perform time/frequency tracking for target UL TCI state.****Proposal 2: Considering the upper bounds of active TCI state and maintained PL-RS is different, it is possible that UE can only maintain part of PL-RS of the active TCI states in the list. In such case, 5 samples measurement for the PL-RS is necessary and can not be reduced.** **Proposal 3: The active DL TCI state list and active UL TCI state list are independent. Active UL TCI state list should not be impacted by active DL TCI state list.****Proposal 4: For the joint TCI state switching delay, not any dependency exists between DL and UL. UE applies the requirements of DL TCI state switch and UL TCI state switch respectively.** **Proposal 5: For the case when SSB is indicated as PL-RS in UL TCI state for FR2, which means the source RS is the SSB or QCL-Ded with the SSB. It should be emphasized once more that beam alignment is the precondition based on previous agreements. So not additional Rx beam sweeping is necessary. We prefer Option 2.****Proposal 6: Reuse the existing known condition. If the associated RS in common TCI state provides QCL-TypeD or QCL-TypeC, the known condition can only consider whether the associated RS in the reference CC is known or not.****Proposal 7: Both Option 1 and Option 1a are fine to us. To be more clear compared with share RS mode, Option 1a is preferred.****Proposal 8: We are fine with the motivation of above two sub-bullets. The 1st sub-bullet refers to different RS scheme, and the 2nd sub-bullet refers to shared RS scheme. But referring to the exact signaling, as we known, RAN2 has revised sometimes during Rel-17, so we can use the final determined signalling here.****Proposal 9: Option 2 is aligned with legacy. But considering it is possible that some of TCI states in the list do not fulfill known condition, so Option 1 is suggested by us.****Proposal 10: Since the case is possible, of course the delay requirement is needed. Option 1 is preferred by us.** |
| [**R4-2213939**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213939.zip) | Ericsson | **Proposal 1: RAN4 to revise the agreement as “No extra requirement needed for Joint TCI mode, DL and UL requirements can be applicable independently” by removing note.****Proposal 2: During joint TCI state switch, if DL TCI state switch is completed before UL TCI state switch is completed, HARQ for new DL TCI state transmissions to be transmitted using old TCI state.****Proposal 3: UL TCI state do not need separate time and frequency tracking than the existing UL timing mechanism.****Proposal 4: if SMTC periodicity is less than 160ms, MAC-CE based UL TCI state switching delay when SSB is indicated as PL-RS in UL TCI state for FR2, UL TCI state switching delay can be reused without any additional delay.** **Proposal 5: if SMTC periodicity is more than 160ms, MAC-CE based UL TCI state switching delay when SSB is indicated as PL-RS in UL TCI state for FR2 is defined as THARQ + 3ms + TL1-RSRP\_SSB +5\*Ttarget\_SSB+ 2ms. Where, TL1-RSRP\_SSB is same as TL1-RSPR\_Measurement\_Period\_SSB for SSB as specified in clause 9.5.4.1, with the assumption of M=1 and TReport = 0.****Proposal 6: RAN4 to not add any additional applicability condition related to UL time tracking for DCI based UL TCI state switch delay.****Proposal 7: If the associated RS in common TCI state provides QCL-TypeC or QCL-TypeD, the known condition can only consider whether the associated RS in the reference CC is known or not.****Proposal 8: For QCL-Type A/B/C/D, reuse the existing known condition. If the source RS is configured per CC, then the known condition is per CC.****Proposal 9: RAN4 to specify requirements for the case when not all TCI states are known in atcive TCI state update list.****Proposal 10: If all the TCIs in the active TCI state list are not known, upon receiving PDSCH carrying MAC-CE active TCI state list update at slot n, UE shall be able to receive PDCCH to schedule PDSCH with the new target TCI states at the first slot that is after n + + (THARQ + TL1-RSRP + Tfirst-SSB\_List + TSSB-proc) / *NR slot length.*****Proposal 11: RAN4 to add following part to CR “When the UE does not have the required activated TCI-state(s) information to receive PDCCH/ PDSCH and to transmit PUSCH/PUCCH/SRS in the new BWP, the UE shall use old TCI-state(s) before the BWP switch until a new MAC CE updating the required activated TCI-state(s) information is received after the BWP switch”.** |
| [**R4-2213940**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213940.zip) | Ericsson | CR on unified TCI state switching requirements  |

## Open issues summary

### Sub-topic 1-1 Active UL TCI state

**Issue1-1-1 Whether UE need to track UL time/frequency for DL-RS associated with active UL TCI state**

* Proposals:
	+ Proposal 1(Apple, Intel, Ericsson):
		- UE don’t need to track UL time/frequency for DL-RS associated with active UL TCI state for UL transmission.
	+ Proposal 2(MTK):
		- The source RS in active UL TCI state should be subset of source RS in DL TCI state to guarantee the timing of UL TCI state is under tracking.
	+ Proposal 3(vivo):
		- RAN4 further discuss whether/how to optimize the case ‘UE might not be able to obtain DL timing of the target TRP when UE is able to transmit UL based on the corresponding UL TCI from the target TRP’ in R17, i.e. whether to further require UE to track time and/or frequency on DL-RS associated with active UL TCI in R17.
	+ Proposal 4(Nokia):
		- Rel-17 active UL TCI state should be under time and frequency tracking. This means that active UL TCI list belongs to active DL TCI state list.
		- Add the time and frequency tracking condition to the active TCI state for UL.
	+ Proposal 5(ZTE):
		- Option 1: UL timing is derived from current DL timing
		- Option 2: UL TCI state timing is derived from the RS of the UL TCI state.
		- Option 1 is common understanding in general. However referring to the multi-TRP scenario, Option 2 is reasonable since different TRPs for DL and UL is possible. For the case that not any DL timing can be referenced, UE needs to perform time/frequency tracking for target UL TCI state.
* Update from GTW session:
	+ No conclusion. Further discuss.
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round

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| **Company** | **Comments** |
| Intel | For UL TCI state activation of serving cell, we think that no timing/frequency tracking is needed since the timing will be dependent on the serving cell DL timing.For UL TCI state activation for non-serving cell, the UL timing will be dependent on the DL timing of non-serving cell. whether extra timing/frequency tracking is needed require further discussion. In general case, if the DL RS in the activated UL TCI state belong to the active DL TCI list, then no further timing tracking is needed since UE will maintain the timing for the active DL TCI state. if DL RS is not in the active DL TCI list, UE may not maintain the timing. However, for unified TCI state switch, the requirement is defined that timing offset between serving cell and non-serving cell is smaller than CP. It seems that serving cell DL timing may still be applied for UL timing of non-serving cell. but it’s better that the exact timing of non-serving cell is used. Therefore, we prefer proposal 2 with some update:* + - Source RS in active UL TCI state should be subset of source RS in DL active TCI list, no timing/frequency tracking for UL TCI state is needed.

For UL TCI state activation for serving cell, the assumption also applies. |
| vivo | We are open to further discuss this issue. However, it seems quite unlikely to solve this issue in R17.In our understanding, the issue can be solved by network implementation. No additional work is needed in R17. We are open to further discuss this issue in R18 TA enhancements in MIMO evo WI. |
| MediaTek | We are ok with intel’s version: * + - Source RS in active UL TCI state should be subset of source RS in DL active TCI list, no timing/frequency tracking for UL TCI state is needed.
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| Apple | We support option1. For UL TCI is only a beam indication – QCL Type D. For DL TCI we have QCL Type A/B/C and D. The source RS for QCL-Type D could be different from QCL Type A/B/C. In that case UE is tracking DL timing based on RS of QCL Type A/C, but not RS of QCL Type D. Ul transmission doesn’t need any timing adjustment based on TCI state switch. If UE is receiving from 2 TRP (inter-cell or intra-cell), the UL timing is still only 1, based on the DL serving cell timing and TA. We seem to be revisiting the discussions from R16 UL Spatial relation switch, where we concluded that time tracking is not needed for UL SpRel switch. We don’t think UL TCI state list should be a subset of DL TCI state list. We are not aware of such restriction from RAN1.  |
| Ericsson | Option 1 |
| Huawei | We agree with Proposal 1 and option 1 in Proposal 5.UL TCI state includes only one source RS for determining UL beam and does not include the RS for timing tracking. UL timing is derived from DL timing.Simultaneous DL/UL with different beam directions for multi-TRP scenario is R18 scope and not supported in R17. Hence, the activated DL TCI and UL TCI at the same time shall belong to the same TRP. The case of different TRPs for DL TCI and UL TCI is not possible in R17. |

**Issue1-1-2 PL-RS maintenance for active TCI**

* Proposals:
	+ Proposal 1(Nokia):
		- Send LS to RAN1/2 to share the issue statements on active TCI list for UL. Possible solution is up to RAN1/2 in Rel-17 or Rel-18 enhancement.
		- Improve PL-RS measurement period for TCI switching using active UL TCI list by reducing strict 5 PL-RS sample measurement period.
	+ Proposal 2(ZTE):
		- Considering the upper bounds of active TCI state and maintained PL-RS is different, it is possible that UE can only maintain part of PL-RS of the active TCI states in the list. In such case, 5 samples measurement for the PL-RS is necessary and can not be reduced.
	+ Proposal 3 (Apple):
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round

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| **Company** | **Comments** |
| Intel | Since the max number of maintained PL-RS is 4, and the number of active TCI state can be 8. There is some mismatch. It’s possible that one PL-RS is associated with more than one active TCI states. we are also fine to send LS to further clarify the issue. |
| vivo | In our understanding, based on RAN1 spec, the restriction on the max # of maintained PL-RS should be applicable to both the explicitly configured case, i.e. PL-RS IE is not absent in UL TCI config, and the implicitly configured case, i.e. PL-RS IE is absent in UL TCI config. If the max # of PL-RS exceed UE capability in either case, there is no UE requirement.We are OK to send the LS to RAN1 for the clarification. It seems the default UE behavior when PL-RS IE is absent, has not been clarified by RAN1/2. It is OK to check with RAN1.  |
| MediaTek | Share the same view as Intel. To our understanding, one PL-RS may be associated with more than one active TCI states. Thus, we do not see the problem here. |
| Apple | Our understanding is that UE should maintain the PL-RS in the active UL TCI state. Number of active TCI states is up to UE capability. If UE can support > 4 active UL TCI states, then how does it maintain > 4 PL-RS. We are fine to send LS to RAN1 on how to handle if UE can support > 4active TCI state.  |
| Huawei | In RAN1, it agreed that the total number of maintained PL-RSs per CC is no more than 4, same as R16. So, the UE is assumed to maintain the PL-RS of the activated UL TCI state or joint TCI state when the number of active PL-RS on this CC is no more than 4. |

**Issue1-1-3 The relation of active UL TCI state list with active DL TCI state list**

* Proposals:
	+ Proposal 1(ZTE):
		- The active DL TCI state list and active UL TCI state list are independent. Active UL TCI state list should not be impacted by active DL TCI state list.
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round

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| **Company** | **Comments** |
| Intel | As commented in issue 1-1-1, we prefer that source RS in active UL TCI state list is a subset of active DL TCI state list, then no extra time/frequency tracking is needed. |
| vivo | In our understanding, proposal 1 means NW would not assume any additional dependency between UL TCI list and DL TCI list other than those defined in RAN1. In our understanding, for the joint TCI mode, DL TCI list and UL TCI list are not independent.May ZTE clarify the motivation? |
| MediaTek | Share the same view as Intel. |
| Apple | In our view they are independent for separate UL/DL TCI state list indicated by *dl-orJoint-TCI-ToAddModList* for DL TCI state and *ul-TCI-ToAddModList* for UL TCI state . But for joint TCI state the same TCI is used for UL and DL indicated by *dl-orJoint-TCI-ToAddModList* Could ZTE please clarify the motivation for this? |
| Ericsson | Do not understand the impact of agreement to this issue. We think list can be fully NW configurable. |

### Sub-topic 1-2 MAC CE based TCI state Switching delay requirements

**Issue 1-2-1 Joint TCI switching delay requirement**

* Proposals:
	+ Proposal 1(Apple, Intel):
		- Keep the previous clarification for Joint TCI state switch in the specification, i.e.joint TCI state switch UE is not expected to receive on the DL or transmit on the UL until it completes both UL and DL TCI state switch.
	+ Proposal 2(vivo):
		- RAN4 to confirm again the understanding of agreements in RAN4 101-bis-e as
		- If when both DL TCI(s) and UL TCI(s) are activated by one MAC CE, or when at least one joint TCI(s) are activated by one MAC CE
		- For DL TCI switching delay requirements, UE is not expected to be able to make DL reception when either DL TCI switching is not finished or UL TCI switching is not finished.
		- For UL TCI switching delay requirements, UE is not expected to be able to make UL transmission, when either DL TCI switching is not finished or UL TCI switching is not finished
	+ Proposal 3(Nokia, ZTE):
		- Joint TCI switching delay is regarded as same as a pair of separate DL/UL TCI switching.
		- In case of joint TCI state switch, UE is expected to receive on DL, when UE completes the DL state switch.
		- In case of joint TCI state switch, UE is expected to transmit on UL, when UE completes the UL state switch.
	+ Proposal 3a(Ericsson):
		- RAN4 to revise the agreement as “No extra requirement needed for Joint TCI mode, DL and UL requirements can be applicable independently” by removing note.
		- During joint TCI state switch, if DL TCI state switch is completed before UL TCI state switch is completed, HARQ for new DL TCI state transmissions to be transmitted using old TCI state.
* Update based on GTW discussion:
	+ keep the previous agreement and further work on the CR to further clarify the following wordings in the CR:
* ***In 38.133, for DL TCI state switching,***
	+ *[In case of joint TCI state switch, UE is not expected to receive on DL before UE completes the DL and UL TCI state switch.]*
* ***In 38.133, for UL TCI state switching,***
	+ *[In case of joint TCI state switch, UE is not expected to transmit on UL before UE completes the DL and UL TCI state switch.]*
* Recommended WF
	+ Further work on the CR to further clarify the following wordings in the CR

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| **Company** | **Comments** |
| Intel | Suggest to remove the bracket. |
| vivo | In our view, the wording in the CR is already clear. We propose to directly remove the square bracket. |
| MediaTek | Suggest to remove the bracket. In the test, the ACK/NACK transmission may not be stable when UL is not complete even though DL TCI state switch is complete. So, it is hard to verify whether the DL switch is complete or not.* ***In 38.133, for DL TCI state switching,***
	+ *~~[~~In case of joint TCI state switch, UE is not expected to receive on DL before UE completes the DL and UL TCI state switch.~~]~~*
* ***In 38.133, for UL TCI state switching,***
	+ *~~[~~In case of joint TCI state switch, UE is not expected to transmit on UL before UE completes the DL and UL TCI state switch.~~]~~*
 |
| Apple | Support to remove the brackets.  |
| Ericsson | We can look at the CR in the second round. |
| Huawei | Based on GTW discussion, the following wordings are suggested* ***In 38.133, for DL TCI state switching,***
	+ *In case of joint TCI state switch, UE is not expected to receive UE-dedicated PDCCH/PDSCH with target TCI state before UE completes the DL and UL TCI state switch.*
* ***In 38.133, for UL TCI state switching,***
	+ *In case of joint TCI state switch, UE is not expected to transmit uplink signal with target TCI state before UE completes the DL and UL TCI state switch.*
 |

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

* Proposals
	+ Proposal 1(Intel, Apple, Huawei):
		- longer delay is expected.
	+ Proposal 1a(Huawei):
		- For UL TCI state switching, when source RS and PL-RS for target UL TCI state is the same SSB, beam sweeping shall be assumed for PL-RS measurement time in FR2.
		- For UL TCI state switching, when source RS is CSI-RS and associated PL-RS is SSB, beam sweeping shall be assumed for PL-RS measurement time in FR2.
		- 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 2(MTK, vivo):
		- Reuse the existing delay requirement of MAC CE based UL TCI state switch.
	+ Proposal 3(Nokia):
		- The number of sample M will not always be fixed as 5 samples.
		- If a UE performs both L1-RSRP measurements and PL-RS measurements on the same SSB, the number of samples used for L1-RSRP is counted for pathloss measurement.
		- If a UE has reported L1-RSRP measurement on a PL-RS within a time window, the PL-RS is regarded as maintained.
	+ Proposal 4(ZTE):
		- No additional Rx beam sweeping is necessary. We prefer Option 2.
		- If a UE has measured and reported L1-RSRP within [Y] msec on the SSB indicated as PL-RS in UL TCI state, the PL-RS is regarded to be maintained. (i.e. a filtered L1-RSRP measurement process is equivalent to PL measurement process based on *= referenceSignalPower – higher layer filtered RSRP* in TS38.213)
	+ Proposal 5(Ericsson):
		- if SMTC periodicity is less than 160ms, MAC-CE based UL TCI state switching delay when SSB is indicated as PL-RS in UL TCI state for FR2, UL TCI state switching delay can be reused without any additional delay.
		- if SMTC periodicity is more than 160ms, MAC-CE based UL TCI state switching delay when SSB is indicated as PL-RS in UL TCI state for FR2 is defined as THARQ + 3ms + TL1-RSRP\_SSB +5\*Ttarget\_SSB+ 2ms. Where, TL1-RSRP\_SSB is same as TL1-RSPR\_Measurement\_Period\_SSB for SSB as specified in clause 9.5.4.1, with the assumption of M=1 and TReport = 0.
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round

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| **Company** | **Comments** |
| Intel | The issue is also related to the definition of PL-RS maintenance. We prefer Proposal 1 as a compromise solution. |
| vivo | We support P2, main bullet of P4. We think they are aligned.For P1, we are not yet convinced why longer delay is expected. For 2nd bullet of P3, we prefer to keep the requirement in a simple form.For 3rd bullet of P3 and sub bullet of P4, our understanding is that PL-RS measurement and L1-RSRP measurement are different. L1 measurement can not be used as a maintained condition for PL-RS.For P5, we are not sure why SMTC periodicity is considered here. Proponent may clarify. |
| MediaTek | Prefer option 2 since we do not see why UE can not measure the SSB based on the beam which is specified after L1-RSRP measurement. |
| Apple | We support Proposal 1, 1a.For any SSB based measurement in FR2 (RLM, BFD, CBD, L1-RSRP, L1-SINR) we consider beam sweeping time. If SSB based PL-RS is not maintained the measurement time should account for a factor of 8 for Rx beam refinement.  |
| Ericsson | We support Proposal 2.If P2 is not agreeable, as a compromise we propose P5. Here we assume that RX beam will not change for 1280ms, that results in SMTC of 160ms. We understand that if RX beam, do not change, for PL-RS measurement additional beam sweeping is not needed.  |
| Huawei | Support Proposal 1, longer delay is expected due to beam sweeping on SSB measurements in FR2.For a TCI chain, due to no TCI state configuration for SSB, the SSB is considered as final source RS for the CSI-RS resources in the same TCI chain. So, UE needs to perform beam sweeping on SSB for obtaining best Rx beam information for both SSB and the CSI-RS which is QCL-TypeD to this SSB. Due to channel variation, beam sweeping shall always be assumed for each PL-RS measurement sample, which is based the same assumption as other SSB-based L1 measurements. However, the existing delay does not allow beam sweeping for SSB based PL-RS measurements. So, we suggest to extend the switching delay. If the exact value of switching delay needs to be defined, then Proposal 1a is suggested. |

**Issue 1-2-3 Wording Update of introduction for active DL/UL TCI state switch delay requirements**

* Proposals
	+ Proposal 1(Huawei):
		- Observation 1: The QCL configuration for downlink channels will not be indicated by UL-TCIState.
		- Observation 2: The wording “DLorJoint-TCIState or UL-TCIState configured for a cell with different PCI” used in TS38.133 is incorrect.
		- The wording of introduction for active DL/UL TCI state switch delay requirements for unified TCI needs to be updated to align with RAN1/RAN2 specifications.
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round

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| **Company** | **Comments** |
| Intel | Fine with proposal 1. |
| vivo | We are generally fine with the wording change. Details can be discussed in the CR. |
| MediaTek | Support proposal 1. |
| Apple | We are fine with proposal 1.  |
| Ericsson | We had similar change in our CR too. We can discuss details in the CR. |

### Sub-topic 1-3 Common TCI state switching in CA case

**Issue 1-3-1 Known condition on shared RS in CA scenario**

* Proposals
	+ Proposal 1(Intel):
		- The known condition will depend on the associated RS with QCL-type A/D in common TCI state.
	+ Proposal 2(vivo):
		- For R17, if RAN4 only specifies RRM requirements for DL TCI switching of PDSCH and PDCCH, i.e. RRM requirements for TCI switching of DL-RS are not specified, then, there is no need to consider QCL-B/C.
	+ Proposal 3(ZTE, Ericsson, MTK):
		- If the associated RS in common TCI state provides QCL-TypeD or QCL-TypeC, the known condition can only consider whether the associated RS in the reference CC is known or not.
	+ Proposal 4(Nokia):
		- Clarify what new UE behaviors are additionally defined with QCL type-C.
		- QCL-type C information is required to be ‘active TCI’ state, but wonder if QCL-type C information is needed to be ‘known conditions’ for ‘known’ TCI state in CA scenario.
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round

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| **Company** | **Comments** |
| Intel | In legacy TCI state known condition, no detailed QCL type is mentioned. Here, it’s better that we also don’t need to mention the QCL type.* + - The known condition will depend on the associated RS in common TCI state.
 |
| Vivo | We support P2. P1 is also OK.The following is captured in TS 38.214 since R15.*For the DM-RS of PDCCH, the UE shall expect that a TCI-State or DLorJointTCIState except an indicated DLorJointTCIState indicates one of the following quasi co-location type(s):**- 'typeA' with a CSI-RS resource in a NZP-CSI-RS-ResourceSet configured with higher layer parameter trs-Info and, when applicable, 'typeD' with the same CSI-RS resource, or**- 'typeA' with a CSI-RS resource in a NZP-CSI-RS-ResourceSet configured with higher layer parameter trs-Info and, when applicable, 'typeD' with a CSI-RS resource in an NZP-CSI-RS-ResourceSet configured with higher layer parameter repetition, or**- 'typeA' with a CSI-RS resource in a NZP-CSI-RS-ResourceSet configured without higher layer parameter trs-Info and without higher layer parameter repetition and, when applicable, 'typeD' with the same CSI-RS resource*.Only typeA and typeD are specified as possible QCL for PDSCH and PDCCH.TCI state can also be configured to CSI-RS. The possible QCL for CSI-RS can be QCL-C.Therefore, in our observation, RAN1 and RAN4 may have different understanding on the possible QLC for PDSCH and PDCCH. In R15 test case, RAN4 has specify TCI state for PDSCH and PDCCH, whose source RS is SSB, as in Table A.5.5.8.1.1.1-3 and Table A.3.16.2-1 of TS 38.133. This contradicts with RAN1 spec. As in TS 38.214, SSB can only be used as QCL-C source RS, but not QCL-A source RS. Therefore, we would like to further clarify the understanding to RAN1 spec in RAN4. If no consensus, LS can be sent to RAN1 for clarification.Moreover, RAN4 may also further discuss whether TCI switching for DL RS is within the scope of R17 RRM requirements or not. |
| MediaTek | We are open to discuss whether to send LS to RAN1 or not. However, to our understanding, according to 331, the QCL Type-C and D can be used for across CC. |
| Apple | Same view as Intel. If RAN1 already has restrictions on the QCL Type for associated RS, we don’t see the necessity to capture it in RAN4 spec, we don’t seem to be providing any additional information. If we have some incorrect config in our test cases, we are open to discuss and update those.@Vivo-could you please clarify – “TCI switching for DL RS is within the scope of R17 RRM requirements or not”  |
| Ericsson | One RS of one CC can be QCLed with other RS of other CC only using QCL type C and D. Other QCL types are not possible for shared RS case. |
| Huawei | According to RAN1’s agreements, common TCI state only provides common QCL information and/or common UL TX spatial filter(s) across a set of configured CCs. The RS in the TCI state that provides QCL-TypeA shall be in the same CC as the target channel or RS.Hence, the known TCI condition will depend on the associated RS with QCL-type D in common TCI state. |

**Issue 1-3-2 Known condition on different RS in CA scenario**

* Proposals
	+ Proposal 1(ZTE, Ericsson):
		- For QCL-Type A/B/C/D, reuse the existing known condition. If the source RS is configured per CC, then the known condition is per CC.
* Recommended WF
	+ Agree with Proposal 1.

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| **Company** | **Comments** |
| Intel | Agree with Proposal 1. |
| vivo | We do not think we need to agree on proposal 1 here. Common TCI is for intra-band CA. RAN4 may skip the case that QCL-type is configured per CC for common TCI. |
| MediaTek | Support proposal 1. |
| Apple | Support the recommended WF. But we don’t need to specify the QCL Type.  |
| Ericsson | We agree with proposal 1. Apple suggestion is also fine. |

**Issue 1-3-3 Common TCI state switching delay requirement**

* Proposals
	+ Proposal 1(MTK):
		- For common TCI state switch delay requirement, suggest to define the requirement without differentiating the triggering signaling, e.g. unifiedTCI-StateRef or simultaneousTCI-UpdateList.
	+ Proposal 1a(Nokia):
		- The delay requirement is defined based on the common TCI indicated by simultaneousU-TCI-UpdateList1/2/3/4-r17, and the requirements are applied to all CCs referring to the common TCI.
		- The delay requirement is defined based on the common TCI indicated by RefUnifiedTCIStateList-r17, and the requirements are applied to all CCs referring to the common TCI.
	+ Proposal 2(ZTE):
		- The 1st sub-bullet refers to different RS scheme, and the 2nd sub-bullet refers to shared RS scheme. But referring to the exact signaling, as we known, RAN2 has revised sometimes during Rel-17, so we can use the final determined signalling here.
	+ Proposal 3(vivo):
		- For the common TCI, RRM requirements are only specified for the case when one CC in the CC list is configured with TCI and is the reference CC for all other CCs.
		- For R17, if RAN4 only specifies RRM requirements for DL TCI switching of PDSCH and PDCCH, i.e. RRM requirements for TCI switching of DL-RS are not specified, then, there is no need to consider QCL-B/C.
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round

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| **Company** | **Comments** |
| Intel | Fine with proposal 1,1a. Don’t need to distinguish unifiedTCI-StateRef or simultaneousU-TCI-UpdateList1/2/3/4-r17. |
| vivo | Support proposal 3.The case when common TCI is configured on more than one CC is slightly ambiguous in our understanding. If known condition is specified per CC, then the cross CC codepoint configuration based on MAC CE is not clear to us. For example, we have not find out anywhere in RAN1/2 spec, waht should be the UE behavior if the number of codepoints is different for different CCs in the same list.Therefore, we prefer to simplify RRM requirements. Only specify requirements for the case when one CC in the CC list is configured with TCI and is the reference CC for all other CCs. |
| MediaTek | Support proposal 1. We can only define the delay requirement based on the source RS periodicity. How does the source RS is configured (i.e. configured on reference CC or not.) seems RAN1’s issue. |
| Apple | There are diverse views on how common TCI is indicated. simultaneousTCI-UpdateList is introduced in Rel-16 in our understanding. We should only introduce requirements for common TCI for Rel-17 and that is indicated by IE simultaneousU-TCI-UpdateList1/2/3/4-r17. |
| Ericsson | As mentioned in our paper we do not think both of these IE can correctly specify whether the CC in IE uses shared or different RS. In that sense our view is close to option 1. |

### Sub-topic 1-4 TCI state list update delay

**Issue 1-4-1 Whether to consider unknown TCI state in the TCI state list**

* Proposals
	+ Proposal 1(vivo, Nokia, Ericsson, ZTE):
		- Yes
	+ Proposal 2(MTK):
		- No
	+ Proposal 3(Apple, Intel):
		- Don’t consider unknown TCI state. Longer delay applies if any TCI state is unknown in TCI state list update.
* Update based on GTW discussion:

 **Agreement:**

* [Longer delay applies if any TCI state is unknown in TCI state list update]. Active TCI state list can contains known and unkown TCI states.
* Recommended WF
	+ further discuss whether bracket can be removed.

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| **Company** | **Comments** |
| Intel | Suggest to remove the bracket. |
| MediaTek | Suggest to remove the bracket. |
| Apple | Support to remove the bracket. |
| Ericsson | In the GTW, it is agreed that unknown TCI states can be in the list. We do not see a reason to specify the delay. We use longer delay is required when there is uncertainty about the delay. Since the delay can be explicitly specified here, it is useful for NW to know the actual delay. |
| Huawei | Support to remove the bracket. |

**Issue 1-4-2 MAC CE based TCI state list update delay for unknown TCI state**

* Proposals
	+ Proposal 1(ZTE, Ericsson):
		- If all the TCIs in the active TCI state list are not known, upon receiving PDSCH carrying MAC-CE active TCI state list update at slot n, UE shall be able to receive PDCCH to schedule PDSCH with the new target TCI states at the first slot that is after n + + (THARQ + TL1-RSRP + Tfirst-SSB\_List + TSSB-proc) / *NR slot length*.
* Recommended WF
	+ Depends on the conclusion of 1-4-1. Collect companies’ view for these proposals in 1st round

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| **Company** | **Comments** |
| Intel | Depends on the conclusion of 1-4-1. |
| MediaTek | Wait for conclusion in Issue 1-4-1 |
| Apple | No requirement based on agreement in GTW. |
| Ericsson | Support proposal 1 based on the above reasoning. |
| Huawei | Follow GTW agreements |

### Sub-topic 1-5 Clarification on the applicable TCI after DCI BWP switching

**Issue 1-5-1 Clarification on the applicable unified TCI after DCI BWP switching**

* Proposals
	+ Proposal 1(vivo):
		- Provided the UE does not have the required activated TCI-state(s) information to receive PDCCH/ PDSCH and to transmit PUSCH/PUCCH/SRS in the new BWP, the UE shall use old TCI-state(s) before the BWP switch until a new MAC CE updating the required activated TCI-state(s) information is received after the BWP switch. If more than one codepoints of TCI states are activated by MAC CE in the old BWP, the UE shall use old TCI-state before the BWP switch until a new DCI updating the required TCI-state information is received after the BWP switch, while the new DCI is
		- based on the old list of TCI state codepoints before the delay for the MAC CE based activation of TCI-state(s) in the new BWP, and
		- based on the new list of TCI state codepoints after the delay for the MAC CE based activation of TCI-states in the new BWP.
		- If UE has the information on the required TCI-state information to receive PDCCH/PDSCH and to transmit PUSCH/PUCCH/SRS in the new BWP,
		- UE shall be able to receive PDCCH/PDSCH and to transmit PUSCH/PUCCH/SRS with old TCI-state before the delay as specified in Clause 8.15 and 8.16 in the new BWP.
		- UE shall be able to receive PDCCH/PDSCH and to transmit PUSCH/PUCCH/SRS with new TCI-state after the delay as specified in Clause 8.15 and 8.16 in the new BWP.
	+ Proposal 2(Ericsson):
		- RAN4 to add following part to CR “When the UE does not have the required activated TCI-state(s) information to receive PDCCH/ PDSCH and to transmit PUSCH/PUCCH/SRS in the new BWP, the UE shall use old TCI-state(s) before the BWP switch until a new MAC CE updating the required activated TCI-state(s) information is received after the BWP switch”.
* Recommended WF
	+ Collect companies’ view in 1st round

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| **Company** | **Comments** |
| vivo | We prefer Proposal 1. Proposal 2 is also acceptable to us. |
| Ericsson | We prefer proposal 2. |
| Huawei | There is no need for further clarification. DCI BWP switching does not imply TCI state change. TCI state switching follow the beam indication mechanism for unified TCI. |

## Companies views’ collection for 1st round

### CRs/TPs comments collection

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| **CR/TP number** | **Comments collection** |
| [**R4-2212665**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212665.zip)vivo | CR on unified TCI in R17 feMIMO |
| depend on ongoing discussion. |
| Apple: Some changes depend on conclusion of open issues. |
| Huawei: There is no need to add TCI assumptions in BWP switching requirements. The wording related to joint TCI switching needs to be updated based on discussion. |
| [**R4-2213172**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213172.zip)Samsung | CR to TS38.133 Corrections on R17 unified TCI state switching requirement  |
| Ericsson: OK |
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| [**R4-2213482**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213482.zip)Huawei, HiSilicon  | CR on maintaining TCI state switching requirements for R17 unified TCI  |
| Some modification in 8.16.3 depends on ongoing discussion. |
| Apple: We use term cell with different PCI in RAN4, aligned with what we use in inter-cell BM, we don’t prefer to use different terminology in different sections.  |
| Ericsson: Some changes overlap with our CR. Some changes pending on the ongoing disucssion |
| [**R4-2213940**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213940.zip)Ericsson | CR on unified TCI state switching requirements  |
| depend on ongoing discussion. Some modifications in 8.15.1 are conflicting with CR [R4-2213482](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213482.zip). |
| Apple: The CR should be revised based on agreements. some issues are still under discussion. The CR overlaps with secions in R4-2213482 – please aim to merge so it greatly reduces workload and review process in 2nd round. |
| Huawei: The wording related to joint TCI switching needs to be updated based on discussion. For TCI state list delay, only clarify longer delay for unknown TCI case. For MAC-CE based UL TCI switch, longer delay is needed for SSB based PL-RS in FR2. |

## 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)

# Topic #2: Inter-cell beam measurement (9.17.2.2)

## Companies’ contributions summary

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| [**R4-2211859**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2211859.zip) | Apple | **Sharing factors*****Observation #1:*** *The sharing factors agreed when periodicity of serving cell SSB and SSB from cell with different PCI are different and less than SMTC are incorrect.* ***Observation #2:*** *The current sharing factors don’t account for MG correctly.* **Proposal #1: RAN4 further discuss and agree on the sharing factors considering SSB occasions form serving cell and cell with different PCI, measurement gap and SMTC occasions.****Applicability of Sharing factors*****Observation #3:*** *Overlapping SSB between serving cell and cell with different PCI could have 2 possibilities – Case 1 – SSBs are overlapping if they overlap based on SSB periodicity and offset alone with overlapping SSB window; Case 2 – SSBs are overlapping if they overlap in SSB window and have same SSB index.* **Proposal #2: RAN4 further discuss and confirm definition of overlapping SSB between serving cell and cell with different PCI and capture it in spec.*****Observation #4:*** *If Case 1 is agreed as the definition of overlapping SSBs, sharing factors are applicable when SSBs windows overlap based on periodicity and offset of SSBs without considering SSB index.****Observation #5:*** *If case 2 is agreed as definition of overlapping SSB, then we need to consider SSB index in the definition of overlapping.***Proposal #3: In case overlapping is defined based on SSB occasion and SSB index, we further discuss overlapping definition and applicability of sharing factors in FR2.** ***Observation #6:*** *The RX beams need to switch for measuring adjacent SSBs from different cells****Observation #7:*** *Measuring serving cell SSB and SSB from cell with different PCI that are adjacent without sharaing factor might be challenging for UE* **Proposal #4: If we define overlapping considering SSB index - Define overlapping SSBs when SSBs from different cells have the same SSB index or are adjacent without symbol gap between them. Sharing factor applies on overlapping SSBs from different cells.** **Scheduling Restriction*****Observation #8:*** *Scheduling restriction or measurement restriction is missing in FR1 for SSB symbols from cell with different PCI overlapping with UL slots in dynamic TDD.* **Proposal #5: Introduce scheduling restriction for dynamic TDD when L1-RSRP measurement on cell with different PCI overlaps with serving cell UL slots.****Reply LS to RAN1*****Observation #9:*** *RAN4 has scheduling restriction in FR1 for SSB symbols from cell with different PCI configured for L1-RSRP measurements if UE doesn’t support simultaneousRxDataSSB-DiffNumerology* *and SCS of data and SSB are different. No other measurement restrictions or scheduling restrictions are introduced.***Proposal #6: Send reply LS to RAN1 capturing the current status of requirements in RAN4 and consider our TP in the reply LS.** TP for Reply LS

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| RAN4 would like to thank RAN1 for the LS on SSB measurement for L1-RSRP on inter-cell beam management. For L1-RSRP measurement on SSB on cell with different PCI, in FR1 RAN4 defines scheduling restriction on PDCCH/PDSCH on symbols overlapping with SSB from cell with different PCI if SSB and PDSCH/PDCCH have different SCS and UE doesn’t support *simultaneousRxDataSSB-DiffNumerology*. Otherwise, UE is expected to receive PDSCH on symbols overlapping with SSB from cell with different PCI. It is common understanding that some degradation is expected due to overlapping signals on the same REs.  |

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| [**R4-2211860**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2211860.zip) | Apple | CR for inter-cell beam management |
| [**R4-2211977**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2211977.zip) | Xiaomi | **Observation 1: The scenario of RAN1 LS is limited to UE measure SSB based L1-RSRP in cell with different PCI and receive PDSCH/PDCCH on the same cell.****Observation 2: The description in RAN1 LS for the same RE of SSB and PDSCH/PDCCH indicate the scenario as the mTRP scenario with UE receive PDCCH/PDSCH on TRP 1 and measure SSB on TRP 2 on the same RE.** **Observation 3: The scheduling restriction requirement defined in current spec applies per cell.****Observation 4: RAN4 has not defined corresponding requirement for UE measurements of L1-RSRP and reception of PDSCH/PDCCH on the same RE in FR1 in current spec.****Proposal: There should be no restrictions for UE receiving PDCCH/PDSCH from TRP 1 and measure SSB based L1-RSRP from TRP 2 within FR1.** |
| [**R4-2212121**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212121.zip) | Intel Corporation | **Proposal 1: Don’t need additional known cell condition with L1 measurement.****Proposal 2: Inter-cell L1-RSRP measurements are applicable for both inter-cell BM and inter-cell mTRP with sequential measurements.****Proposal 3: The UE shall send L1-RSRP reports only for report configurations configured for the active BWP.** * **If the timing difference of arrival at UE between the SSBs of serving cell and cell with different PCI is larger than CP length, UE is not required to report L1-RSRP.**
* **If UE reports L1-RSRP measurement, then the UE may not meet L1-RSRP measurement reporting requirements based on the accuracy requirements for the case when the timing offset is below the threshold.**

**Observation 1: In the sharing factor table, and are originally configured SSB periodicity for SC and NSC respectively. however, the actual used SSB periodicity will be used by considering the impact of SMTC and MG.****Proposal 4: TSSB\_SC and TSSB\_CDP needs to be updated by P1\*TSSB\_SC and P2\*TSSB\_CDP, where P1 and P2 are original scaling factors defined for L1-RSRP measurement in section 9.5.4. 1 and 9.13.4.1.** **Observation 2:** **After updating by and , only need to consider SSB collision between serving cell and cell with different PCI.****Proposal 5: After updating by and , the below sharing factor can be re-used:**

|  |  |  |  |
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| **#** | **Scenario** | **PSC** | **PCDP** |
| **1** | **T’SSB,SC = T’SSB,CDP**  | **2** | **2** |
| **2** | **T’SSB,SC < T’SSB,CDP**  |  | **1** |
| **3** | **T’SSB,CDP < T’SSB,SC**  | **1** |  |

**Observation 3: In RAN1, UE will not monitor PDCCH when one RE of PDCCH is overlapped with one RE of SSB of the same cell.****Observation 4: In RAN1, UE assume that the PRBs containing SSB are not available for PDSCH .****Observation 5:In RAN1, UE can’t process PDCCH/PDSCH and SSB with the same PCI simultaneously when REs are overlapped.****Observation 6: In RAN4, only when SCS is different and UE didn’t support simultaneousRxDataSSB-DiffNumerology, there is scheduling restriction to avoid overlap of SSB and data in the same symbol. For other cases, there are not scheduling restrictions.****Proposal 6: Prefer to define scheduling restriction to avoid overlap between SSB and data on the same RE.RAN4 needs to further discuss whether it’s up to RAN1 or RAN4 to define the restriction.** |
| [**R4-2212128**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212128.zip) | Intel Corporation | CR for Update of sharing factor for SSB based L1-RSRP for serving cell and cell with different PCI |
| [**R4-2212516**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212516.zip) | MediaTek Inc. | **Proposal 1: For known cell condition of non-serving cell, not to add an additional known cell condition with L1 measurement only.****Proposal 2: The existing inter cell L1-RSRP measurement defined in TS 38.133 is applicable for both inter-cell beam management and inter-cell mTRP scenarios.****Proposal 3: For R17 inter-cell BM, introduce a new design, so-called“two stages puncture sharing factor calculation” to determine the sharing factor between serving cell and non-serving cell.****Proposal 4: The number of non-serving cell to be measured in FR1 is one.****Proposal 5: Introduce scheduling restriction for dynamic TDD when L1-RSRP measurement on non-serving cell overlaps with serving cell UL slots. In addition, one OFDM symbol before and after SSB should also be considered because of TA.****Observation 1: In TS 38.214 and TS 38.133, the wording “non-serving cell” and “additional serving cell”, respectively, are used to describe a cell with different PCI from serving cell.**Proposal 6: Update the capability signaling simultaneousRxDataSSB-DiffNumerology as below:

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| ***simultaneousRxDataSSB-DiffNumerology*****Indicates whether the UE supports concurrent intra-frequency measurement on serving cell or neighbouring cell and PDCCH or PDSCH reception from the serving cell or an additional serving cell with a different numerology as defined in clause 8 and 9 of TS 38.133 [5].** |

**Proposal 7: Introduce scheduling restriction on non-serving cell when UE performs L1-SINR measurement, BFD, CBD, RLM on serving cell.** |
| [**R4-2212521**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212521.zip) | MediaTek Inc. | CR on scheduling availability for inter cell beam management |
| [**R4-2212528**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212528.zip) | MediaTek Inc. | **Proposal 1: No UE requirement is applied when UE measures SSB for L1-RSRP measurement and receives PDSCH /PDCCH on the same RE in FR1*.*** |
| [**R4-2212666**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212666.zip) | vivo | **Observation 1 The WID clearly states that in R17 only intra-frequency ICBM is considered.****Proposal 1 RAN4 deprioritize the case when servingcellMO is not configured on the serving cell that configured with inter-cell L1 measurements in R17. Therefore, no additional known condition is specified in R17, but it can be discussed in future release.****Observation 2 R16 SSB-based L1-RSRP measurement requirements are only specified for the case when SSBs are either partially overlapped with SMTC (i.e. TSSB < TSMTCperiod) or fully overlapped with SMTC (i.e. TSSB = TSMTCperiod). The case when SSBs are not overlapped with SMTC are not considered.****Observation 3 R16 SSB-based L1-RSRP measurement requirements are only specified for the case when SSBs are either partially overlapped with gaps (i.e. TSSB < MGRP) or non-overlapped with gaps. The case when SSBs are fully overlapped with GAPs are not considered.****Proposal 2 In R17, for L1-RSRP measurements on SSBs of the CDP, RAN4 do not specify RRM requirements for the following cases:*** **SSBs of CDP are not overlapped with SMTC.**
* **SSBs of CDP are fully overlapped with GAP.**

**Proposal 3 The sharing factor between SSB of SC and SSB of CDP is specified in a case by case manner as in [3].****Proposal 4 For the case when the remaining occasions are fully overlapped between serving cell and the cell with different PCI, introduce sharing factor PSC = PCDP = 2.****Proposal 5 Sharing factors are applicable when SSB from serving cell and cell with different PCI are overlapping with same SSB index, or are adjacent SSB index with no symbol gap****Proposal 6 The ICBM feature shall be applicable to SCell.****Proposal 7 For intra-band ICBM using common TCI configurations, different reference CCs in the same CC list between the serving cell and a cell with different PCI is not supported in R17.****Proposal 8 For intra-band ICBM using common TCI configurations, requirements are defined for the case when SSB measurements for a cell with different PCI are only performed in the cell that has the same SSB frequency as the reference CC.****Proposal 9 R17 ICBM feature is applicable to FR1 HST and FR2 HST. If RAN4 identifies any issue in applying HST related enhancements to ICBM related RRM requirements, RAN4 solve them in the R17 maintenance phase.** **Proposal 10 R17 ICBM feature is applicable to the scenarios when UE is configured with R17 enhanced gaps. If RAN4 identifies any issue in applying R17 enhanced gaps to ICBM related RRM requirements, RAN4 solve them in the R17 maintenance phase.****Proposal 11 No clarification is needed on whether inter-cell L1-RSRP requirements are applicable for inter cell mTRP.****Proposal 12 No clarification is needed on whether UE shall send L1 measurement report if the known condition is not met.****Proposal 13 Do not introduce scheduling restriction for dynamic TDD when L1-RSRP measurement on cell with different PCI overlaps with serving cell UL slots** |
| [**R4-2212667**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212667.zip) | vivo | **In R15 and R16, for SSB based L1-RSRP measurements performed in FR1, the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on the symbols corresponding to the SSB indexes configured for L1-RSRP measurement, ONLY if*** **UE do not support *simultaneousRxDataSSB-DiffNumerology*, and,**
* **UE performing L1-RSRP measurement with a different subcarrier spacing than PDSCH/PDCCH**

**RAN4 has never specified RRM requirements assuming SSB based L1-RSRP measurement and reception of PDSCH/PDCCH are performed on the same RE in FR1.****In R15 and R16, for SSB based L1-RSRP measurements performed in FR2, since UE is assumed to use different RX beams for L1-RSRP measurements and reception of PDSCH/PDCCH, the UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/CSI-RS for tracking/CSI-RS for CQI on the symbols corresponding to the SSB indexes configured for L1-RSRP measurement.****In R17 inter-cell L1-RSRP measurements, the same rules for introducing scheduling restriction as R15/R16 are re-used, which is applicable to** * **PDSCH/PDCCH of the serving cell, when UE is performing L1-RSRP measurement on additional serving cell and/or cell(s) with PCI different from serving cell, or**
* **PDSCH/PDCCH of the additional serving cell, when UE is performing L1-RSRP measurement on serving cell and/or cell(s) with PCI different from serving cell**
	+ **the additional serving cell is a cell which UE is receiving the PDCCH/PDSCH from cell(s) with PCI different from serving cell.**
 |
| [**R4-2212668**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212668.zip) | vivo | CR on inter-cell beam managements in R17 feMIMO |
| [**R4-2213171**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213171.zip) | Samsung | From a RAN4 RRM specification point of view, for FR1, * If L1-RSRP measurement performed on SSB which has the same SCS as PDSCH/PDCCH, there is no scheduling restriction on the PDSCH/PDCCH due to the L1-RSRP measurement for inter-cell beam management;
* If L1-RSRP measurement performed on SSB which has different SCS as PDSCH/PDCCH and UE support the capability *simultaneousRxDataSSB-DiffNumerology*, there is no scheduling restriction on the PDSCH/PDCCH due to the L1-RSRP measurement for inter-cell beam management;
* Otherwise, the UE is not expected to receive PDCCH/PDSCH on symbols overlapped with SSB configured as L1-RSRP measurement RS for inter-cell beam management.

For RAN4 RRM specification, there is no requirement or restriction that is related to UE measurements of L1-RSRP and reception of PDSCH/PDCCH on the same RE in FR1 for inter-cell beam management, provided the SSB has the same SCS as PDSCH/PDCCH or UE support the capability *simultaneousRxDataSSB-DiffNumerology.*From RAN4 perspective, if the SSB has the same SCS as PDSCH/PDCCH or UE support the capability *simultaneousRxDataSSB-DiffNumerology*, when UE is configured to measure on SSBs while still receiving PDSCH/PDCCH on overlapped REs simultaneously in FR1, decoding performance degradations and/or additional UE receiver complexities are expected. |
| R4-2213284 | ZTE Corporation |  |
| R4-2213305 | ZTE Corporation |  |
| [**R4-2213483**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213483.zip) | Huawei, HiSilicon | ***Proposal 1: For inter-cell beam managements, it is suggested to define the values of PSC and PCDP as Table 3.*****Table 3: Updated definition of sharing factors PSC and PCDP**

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| **#** | **Scenario** | **PSC** | **PCDP** |
| A | SC SSB occasions outside MG are fully overlapping with CDP SSB occasions outside MG | 2 | 2 |
| B | SC SSB occasions outside MG are partially overlapping with CDP SSB occasions outside MG | 2 | 1 |
| C | Scenario C: CDP SSB occasions outside MG are partially overlapping with SC SSB occasions outside MG. | 1 | 2 |

***Proposal 2: The sharing factors are applied for L1-RSRP measurement when SSBs from serving cell and cell with different PCI are overlapping in time domain.*** |
| [**R4-2213484**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213484.zip) | Huawei, HiSilicon | CR on maintaining L1-RSRP measurement requirements for R17 inter-cell BM |
| [**R4-2213867**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213867.zip) | ZTE Corporation | **Observation 1: About the additional known condition of a cell with different PCI, the split between L1 measurement and L3 measurement is somehow contradictory with some previous agreements achieved in 102 meeting.****Proposal 1: About whether need to identify additional known condition of a cell with different PCI, we need to identify whether such use case exists. If not any use case can be identified, it is recommended by us to remove the FFS so as to keep alignment with previous agreements.****Proposal 2: Option 1 is aligned with FR2 case, however Option 2 is aligned with FR1 case.****Proposal 3: UE of course would not report L1-RSRP if it hasn’t measured, which is common understanding. So we do not have strong view between Option 1 and Option 2.****Proposal 4: After further check all the sharing factors including existing P and newly added** PSC, PCDP **overall, we agree with Option 1.****Proposal 5: No matter whether SSB indexes are same between SSB of the serving cell SSB and SSB of the cell with different PCI, UE can not perform L1 measurement for serving cell and the cell with different PCI at the same time. So We are not sure about the necessity of such applicability rule.****Proposal 6: To align with RAN 1 progress, it seems RAN4 should support the number of cell with different PCI larger than 1. The direct impact is that RAN 4 needs to identify the scaling factor for Nmax>1 case.****Proposal 7: For the scheduling restriction due to L1-RSRP measurement on cell with different PCI, RAN 4 has agreed that the timing offset between serving cell and cell with different PCI should be less than CP, thus no need to introduce additional 1 slot scheduling restriction even considering dynamic TDD.****Proposal 8: To sum up, for all sub-bullets in FFS, we have the following suggestions:*** **The ICBM feature can be applicable to SCell**
* **For intra-band ICBM using common TCI configurations, different reference CCs in the same CC list between the serving cell and a cell with different PCI is not supported in R17.** Same reference CC is applicable for serving cell and a cell with different PCI in a CC list. The serving cell and cell with different PCI in the reference CC are referenced by other serving cells and cells with different PCI respectively in the CC list.
* **FFS: For intra-band ICBM using common TCI configurations, requirements are defined for the case when SSB measurements for a cell with different PCI are only performed in the cell that has the same SSB frequency as the reference CC.**
* **~~Further discuss the UE capability and corresponding FR2 UE behaviour for simultaneous detection of time and frequency full-overlapped SSBs in R18 FR2 multi-Rx chain WI.~~**
* **R17 ICBM feature is applicable to FR1 HST and FR2 HST. If RAN4 identifies any issue in applying HST related enhancements to ICBM related RRM requirements, RAN4 solve them in the R17 maintenance phase.**
* **FFS: R17 ICBM feature is applicable to the scenarios when UE is configured with R17 enhanced gaps. If RAN4 identifies any issue in applying R17 enhanced gaps to ICBM related RRM requirements, RAN4 solve them in the R17 maintenance phase.**
 |
| [**R4-2213888**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213888.zip) | ZTE Corporation | Reply LS on SSB measurement for L1-RSRP on inter-cell beam management |
| [**R4-2213941**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213941.zip) | Ericsson | **Proposal 1: Inter-cell L1-RSRP measurements for cell with different PCI are applicable for both inter-cell BM and inter-cell mTRP.****Proposal 2: Number of other PCI UE can measure for L1-RSRP on FR1 is same as RAN1 capability and i.e., it can be more than 1 and up to 7.****Proposal 3: RAN4 to specify sharing factor in simpler and generic form, which can work for most of the configurations.****Proposal 4: Similar to the approach followed in concurrent gaps can be reused for designing the sharing factor.** |
| [**R4-2213942**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213942.zip) | Ericsson | Maintenance CR on inter-cell beam management |
| [**R4-2213943**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213943.zip) | Ericsson | LS to RAN4 on SSB measurement for L1-RSRP on inter-cell beam management |
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## Open issues summary

### Sub-topic 2-1: Requirements Applicability

**Issue 2-1-1: Whether to consider additional known cell condition**

* Proposals:
	+ Proposal 1(MTK, Intel)：
		- Don’t need to add an additional known cell condition with L1 measurement only.
	+ Proposal 1a(vivo)：
		- No additional known condition is specified in R17, but it can be discussed in future release.
	+ Proposal 2(ZTE)：
		- Need to identify whether such use case exists. If not any use case can be identified, it is recommended by us to remove the FFS so as to keep alignment with previous agreements.
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round

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| **Company** | **Comments** |
| Intel | Support Proposal 1. |
| vivo | Support P1a but also OK to P1 for R17.For intra-frequency scenario, we do not think additional known condition is necessary. |
| MediaTek | Support proposal 1. To our understanding, typically, UE uses fine beam to do L1 measurement within a specific rough beam coverage which is determined by L3 measurement before. So, if UE skips L3 measurement , UE has to use fine beam to find the best SSB within the whole sphere. In that case, the UE may not find the acceptable beam within limited time (N=8) because the beam width of fine beam is too small. |
| Apple | We don’t think any additional update is needed in R17 spec. |
| Ericsson | Support proposal 1. |
| Huawei | Support proposal 1.The existing definition of known cell conditions is sufficient. |

**Issue 2-1-2 Whether Inter-cell L1-RSRP requirements are applicable for inter cell mTRP**

* Proposals:
	+ Proposal 1(MTK, Ericsson, Intel):
		- The existing inter cell L1-RSRP measurement defined in TS 38.133 is applicable for both inter-cell beam management and inter-cell mTRP scenarios.
	+ Proposal 1a(vivo):
		- No clarification is needed on whether inter-cell L1-RSRP requirements are applicable for inter cell mTRP.
	+ Proposal 2(ZTE):
		- Inter-cell L1-RSRP requirements are not applicable for inter cell mTRP case, which UE is required to be able simultaneously receive from both serving cell and non-serving cell at a time, i.e. inter cell joint transmission (JT) -- is aligned with FR2 case
		- Inter-cell L1-RSRP measurements – measurements on cell with different PCI are applicable for both inter-cell BM and inter-cell mTRP -- is aligned with FR1 case.
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round

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| **Company** | **Comments** |
| Intel | Support Proposal 1 and 1a. |
| vivo | Support P 1a but also OK to P1.We think this issue can be further discussed in R18 FR2 multi-RX WI. No clarification is needed for R17. |
| MediaTek | Support proposal 1 to avoid the mis-understanding on the requirement. |
| Apple | The existing requirements are applicable to both L1- based beam indication and inter-cell mTRP scenarios, in both cases L1-RSRP for cell with diff PCI are configured. No clarification is needed in spec. |
| Ericsson | Support proposal 1. 1a is also fine. |
| Huawei | For FR1, we agree with Proposal 1.For FR2, simultaneous DL/UL with different beam directions for multi-TRP scenario is R18 scope and not supported in R17. TDM based inter-cell mTRP transmission shall be assumed in R17. For TDM based inter-cell mTRP, inter-cell BM can be configured and the existing inter-cell L1-RSRP measurement requirements can be applied. |

### Sub-topic 2-2: Measurement report requirement

**Issue 2-2-1: UE reporting behaviour**

* Proposals:
	+ Proposal 1(vivo):
		- No clarification is needed on whether UE shall send L1 measurement report if the known condition is not met.
	+ Proposal 2(Intel):
		- The UE shall send L1-RSRP reports only for report configurations configured for the active BWP.
		- If the timing difference of arrival at UE between the SSBs of serving cell and cell with different PCI is larger than CP length, UE is not required to report L1-RSRP.
		- If UE reports L1-RSRP measurement, then the UE may not meet L1-RSRP measurement reporting requirements based on the accuracy requirements for the case when the timing offset is below the threshold.
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round

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| **Company** | **Comments** |
| Intel | Support Proposal 2. Similar requirement as CSI-RS L3 measurement can be clarified. timing offset may vary with time and it will cost extra effort for UE to calculate the timing offset and compare it with the CP length.  |
| Vivo | Support P1.Similar issue was discussed in CSI-RS L3.However, for L1 reporting, when L1 report config is provided to UE, e.g. in PUCCH, the UE behavior on not reporting L1 has not been specified by RAN1. This is different from L3 report which can be done by MAC padding.Therefore, we prefer not to specify this UE behavior in R17. |
| MediaTek | Support proposal 1. Current spec is clear enough. For timing difference is larger than one CP, there is no requirement, i.e. whether to transmit report is up to UE implementation. Similar discussion has already happened in R16 CSI-RS L3 measurement WI. The conclusion is up to UE implementation. |
| Apple | Not sure where this clarification shall be added in spec. We define the requirements for known condition, the general assumption is that of any conditions are not met, the requirements are not applicable.  |
| Ericsson | Support proposal 1. |
| Huawei | Proposal 1.The requirements are only applied for known case, which implies no requirements for unknown case. So, there is no need to further clarify UE reporting behavior for unknown case |

### Sub-topic 2-3: L1-RSRP measurement requirement

**Issue 2-3-1 General assumption for sharing factor**

* Proposals:
	+ - RAN4 do not specify RRM requirements for the following cases: (vivo)
		- SSBs of CDP are not overlapped with SMTC.
		- SSBs of CDP are fully overlapped with GAP.
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round

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| **Company** | **Comments** |
| Intel | Agree with the proposal. In current specification 9.14.3, it also didn’t consider the list cases. |
| vivo | Support the proposal. This is the same as R15. |
| MediaTek | Support the proposal. |
| Apple | For serving cell we don’t change the conditions we specify the sharing factor in our understanding. Support the proposal. |
| Huawei | We can agree with the proposals. Serving cell SSBs have the same assumptions since R15. |

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**Issue 2-3-2 Overlapping SSB definition**

Background:

Definition of overlapping SSB between serving cell and cell with different PCI needs to be clarified to understand when sharing factors are applied.

Case 1: SSB are overlapping when the periodicity and offset of SSB from serving cell and cell with different PCI result in overlapping SSB window, SSB index are not considered

 Example: TSSB,SC = 20, with offset 1 and TSSB,CDP = 40, with offset 1; SSB index not considered- SSB index of serving cell and cell with different PCI are same or different

Case 2: SSB are overlapping when they have the same SSB index in addition to overlapping SSB window.

 Example: TSSB,SC = 40, with offset 1 and TSSB,CDP = 20, with offset 1; SSB index = 3 for both SSBs.

* Proposal: Further discuss the definition of overlapped SSB
	+ Option 1:
		- SSBs are overlapping if they overlap based on SSB periodicity and offset alone with overlapping SSB window
	+ Option 2:
		- SSB are overlapping when they have the same SSB index in addition to overlapping SSB window*.*
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round

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| **Company** | **Comments** |
| Intel | SSB are overlapping when SSB from serving cell and cell with different PCI are overlapping with same SSB index, or are adjacent SSB index with no symbol gap. Not sure whether the scenario is option 1? |
| vivo | We think option 2 would be better. If SSB index can be different between SC and NSC, they are not overlapped.  |
| MediaTek | The issue is unclear to us. Could proponent clarify it more? thanks |
| Apple | TO Intel: with SSB index is considered in overlapping definition, then that would be case 2 or option 2 above.To MTK: We would like to confirm and define what overlapping SSB between serving cell and cell with diff PCI mean in RAN4. Until now we have SSB from serving cell overlapping with MG or SMTC occasion, but now we have SSB overlapping with SSB. Is it defined as overlapping if they overlap at a SSB occasion level (Case1) or at a symbol level (Case 2)For overlapping SSB definition, we are fine with either option, but we need to clarify it in spec. If Option 2 is agreed, we need further discussion for next issue.  |
| Ericsson | As long as UE cannot measure overlapping SSB’s irrespective of same SSB index or different SSB index, we think Option 1 makes more sense. The advantage of including SSB index in overlapping definition is not clear to us. |
| Huawei | The definition of overlapped SSB can depend on SSB index.There is no offset configuration for SSB resource. SC SSB occasions will be fully or partially within SMTC windows, and CDP SSB occasions will also be partially within SMTC windows. The position information of a SSB resource can be confirmed by SSB periodicity and the detected SSB position within SMTC window.SC SSB and CDP SSB with the same SSB index will always be overlapped. Due to timing misalignment within CP, SC SSB and CDP SSB with adjacent SSB index and no symbol gap may be overlapped. |

**Issue 2-3-3 Applicability of Sharing factors**

For the case when Option 2 is agreed in Issue 2-3-2, the applicability of sharing factor needs to be discussed.

* Proposals:
	+ Proposal 1(Apple,vivo):
		- Sharing factors are applicable when SSB from serving cell and cell with different PCI are overlapping with same SSB index, or are adjacent SSB index with no symbol gap.
	+ Proposal 2(ZTE):
		- No matter whether SSB indexes are same between SSB of the serving cell SSB and SSB of the cell with different PCI, UE can not perform L1 measurement for serving cell and the cell with different PCI at the same time. So We are not sure about the necessity of such applicability rule.
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round

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| **Company** | **Comments** |
| Intel | Fine with proposal 1. |
| vivo | We are OK to proposal 1.  |
| MediaTek | Proposal 1 make sense to us.  |
| Apple | We support proposal 1.  |
| Ericsson | Proposal 2 make more sense to us, especially when UE measurement capability do not change based on same or different SSB index. |
| Huawei | Proposal 1 is fine for us. |

**Issue 2-3-4 Sharing factors design**

* Proposals:
	+ Proposal 1(Apple):
		- RAN4 further discuss and agree on the sharing factors considering SSB occasions form serving cell and cell with different PCI, measurement gap and SMTC occasions.
	+ Proposal 2(Intel):
		- TSSB\_SC and TSSB\_CDP needs to be updated by P1\*TSSB\_SC and P2\*TSSB\_CDP, where P1 and P2 are original scaling factors defined for L1-RSRP measurement in section 9.5.4. 1 and 9.13.4.1.
		- After updating by and , the below sharing factor can be re-used:

|  |  |  |  |
| --- | --- | --- | --- |
| # | Scenario | PSC | PCDP |
| 1 | T’SSB,SC = T’SSB,CDP  | 2 | 2 |
| 2 | T’SSB,SC < T’SSB,CDP  |  | 1 |
| 3 | T’SSB,CDP < T’SSB,SC  | 1 |  |

* + Proposal 3(MTK):
		- For R17 inter-cell BM, introduce a new design, so-called“two stages puncture sharing factor calculation” to determine the sharing factor between serving cell and non-serving cell.
	+ Proposal 4(vivo):
		- The sharing factor between SSB of SC and SSB of CDP is specified in a case by case manner as in [R4-2212668](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212668.zip).
		- For the case when the remaining occasions are fully overlapped between serving cell and the cell with different PCI, introduce sharing factor PSC = PCDP = 2.
	+ Proposal 5(Huawei):
		- For inter-cell beam managements, it is suggested to define the values of PSC and PCDP as Table 3.

Table 3: Updated definition of sharing factors PSC and PCDP

|  |  |  |  |
| --- | --- | --- | --- |
| **#** | **Scenario** | **PSC** | **PCDP** |
| A | SC SSB occasions outside MG are fully overlapping with CDP SSB occasions outside MG | 2 | 2 |
| B | SC SSB occasions outside MG are partially overlapping with CDP SSB occasions outside MG | 2 | 1 |
| C | Scenario C: CDP SSB occasions outside MG are partially overlapping with SC SSB occasions outside MG. | 1 | 2 |

* + - The sharing factors are applied for L1-RSRP measurement when SSBs from serving cell and cell with different PCI are overlapping in time domain.
	+ Proposal 6(ZTE):
		- Update the sharing factors PSC and PCDP for scenarios 3 and 4 to also consider SMTC periodicity.
	+ Proposal 7(Ericsson):
		- RAN4 to specify sharing factor in simpler and generic form, which can work for most of the configurations.
		- Similar to the approach followed in concurrent gaps can be reused for designing the sharing factor.
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | Support proposal 2, which is a general rule. periodicity for each cell will be updated by considering the confliction with SMTC and MG first. then the sharing between two cells can be calculated based on the updated periodicity. |
| vivo | We prefer proposal 2,3 which can be merged with proposal 4. Proposal 5 is also OK to us. However, one comment to proposal 5 is that the SMTC should also be considered. For example, if all SSB from SC fall in SMTC, Psharing\_factor should be considered and there is no need to scale PCDP = 2An updated draft of the CR can be found in the inbox, which is based on proposal 2 but the wording is refined.https://www.3gpp.org/ftp/tsg\_ran/WG4\_Radio/TSGR4\_104-e/Inbox/Drafts/%5B104-e%5D%5B221%5D%20NR\_feMIMO\_RRM\_1/Draft\_CR |
| MediaTek | Support proposal 3. It would be more simple than legacy requirement. Following the similar logic as R17 Gap enhancement, to calculate the sharing factor which is considering MG and SMTC only first. And then calculate the sharing factor between serving cell and non-serving cell.In R18 MUSIM, there are more MG introduced, impacting L1 measurement requirement. Using concurrent MG framework has a better forward compatibility. |
| Apple | In general we need to update the sharing factors considering all scenarios. We think there are 2 ways to do this, one is to introduce PSC and PCDP as the sharing factors between SC and NSC and incorporate them in the numerator of P sharing factor. The P sharing factor also needs to be updated in some cases for SC in our opinion.Option 1:Intermediate sharing factors:

|  |  |  |  |
| --- | --- | --- | --- |
| **#** | **Scenario** | **PSC** | **PCDP** |
| 1 | TSSB,SC = TSSB,NSC < TSMTC  | 2 | 2 |
| 2 | TSSB,NSC < TSSB,SC = TSMTC | 1 | 1 |
| 3 | TSSB,SC < TSSB,NSC < (TSMTC and MGRP) if MG and SMTC are partially overlapping with SSB ; MG and SMTC are partially or fully overlapping |  | 1 |
| 3a | TSSB,SC < TSSB,NSC < TSMTC if SSB partially overlapping with SMTC no overlap with MG |  | 1 |
| 3b | TSSB,SC < TSSB,NSC < MGRPif SSB partially overlapping with MG and no overlap with SMTC |  | 1 |
| 4 | TSSB,NSC < TSSB,SC < (TSMTC and MGRP) if MG and SMTC are partially overlapping with SSB ; MG and SMTC are partially or fully overlapping | 1 |  |
| 4a | TSSB,NSC < TSSB,SC < TSMTC if partially overlapping with SMTC no overlap with MG | 1 |  |
| 4b | TSSB,NSC < TSSB,SC < MGRPif partially overlapping with MG and no overlap with SMTC | 1 |  |
| 5 | If SSB occasions of SC and CDP fully overlap outside MG and SMTC occasions | 2 | 2 |
| 6 | If SSB occasions of SC and CDP partially overlap outside MG and SMTC occasionsT\_SSB,SC< T\_SSB-CDP |  | 1 |
| 7 | TSSB,NSC >= TSMTC, | No L1-RSRP requirement applied. |

Final sharing factors:For case when SSB partially overlap with SMTC, SSB partially overlap with MG and MG and SMTC are partially or fully overlappedFor case when SSB partially overlap with SMTC, SSB partially overlap with MG and MG and SMTC are not overlappedFor case when SSB partially overlaps with MG, doesn’t overlap with SMTCFor case when SSB partially overlaps with SMTC, doesn’t overlap with MG**With this option, we understand that we need to consider many additional scenarios, and many cases would need if conditions and would make the spec rather difficult to read and follow.**Option 2:A 2nd option is to determine the number of available occasions and come up with sharing factors. No intermediate sharing factor for PSC and PCDP. If the SSB from serving cell and cell with diff PCI don’t collide, we use the simpler formula like we had for legacy L1-RSRP for serving cell. This approach is simpler to capture in spec in our opinion and easy to comprehend.

|  |  |  |  |
| --- | --- | --- | --- |
| **#** | **Scenario** | **P for Serving cell** | **P for cell with different PCI** |
| 1 | TSSB,SC = TSSB,CDP < TSMTC or MGRP |  |   |
| Example

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Timeline(ms)signal/occassion | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 130 | 140 | 150 |
| SC’s SSB | O |  | O |  | O |  | O |  | O |  | O |  | O |  | O |  |
| NSC’s SSB | O |  | O |  | O |  | O |  | O |  | O |  | O |  | O |  |
| SMTC | V |  |  |  | V |  |  |  | V |  |  |  | V |  |  |  |
| MG |  |  | X |  |  |  |  |  |  |  | X |  |  |  |  |  |

P of serving cell = 2\*8/2/1 = 8P for cell with diff PCI = 2\*8/2/1 = 8 |
| 2 | TSSB,SC < TSSB,CDP < TSMTC or MGRPAll occasions of SSB of SC collide with CDP, MG and/or SMTC |  |   |
|  | Example

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Timeline(ms)signal/occassion | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 |
| SC’s SSB | O | O | O | O | O | O | O | O |
| NSC’s SSB |  | O |  | O |  | O |  | O |
| Smtc | V |  |  |  | V |  |  |  |
| mg | X |  | X |  | X |  | X |  |

P of serving cell = 2\*4/1/2 = 4P for cell with diff PCI = 2\*4/2/2 = 2 |
| 3 | TSSB,CDP < TSSB,SC ≤ TSMTC or MGRPAll occasions of SSB of SC collide with CDP, MG and/or SMTC |  |   |
| 4 | TSSB,SC < TSSB,CDP < TSMTC or MGRPNot all occasions of SSB of SC collide with CDP, MG and/or SMTC |  |  |
|  | Example

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Timeline(ms)signal/occassion | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 |
| SC’s SSB | O | O | O | O | O | O | O | O |
| NSC’s SSB | O |  | O |  | O |  | O |  |
| SMTC | V |  |  |  | V |  |  |  |
| MG |  | X |  |  |  |  |  |  |

P of serving cell = 8/1/3 = 8/3P for cell with diff PCI = 8/2/2 = 2 |
| 5 | TSSB,CDP < TSSB,SC ≤ TSMTC or MGRPNot all occasions of SSB of CDP collide with SC, MG and/or SMTC |  |  |
|  | Example 5 (Scenario 5)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Timeline(ms)signal/occassion | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 |
| SC’s SSB | O |  | O |  | O |  | O |  |
| NSC’s SSB | O | O | O | O | O | O | O | O |
| SMTC | V |  |  |  | V |  |  |  |
| MG |  |  |  | X |  |  |  |  |

P of serving cell = 8/2/2 = 2P for cell with diff PCI = 8/1/3 = 8/3 |
| SSBSC1 is the number of SSB occasions of serving cell which are colliding with CDP but not colliding with MG or SMTC within time max(MGRP, SMTC)SSBCDP1 is number of SSB occasions of CDP which are colliding with SC but not colliding with MG or SMTC within max(MGRP,SMTC)SSBSC2 is the number of SSB occasions of serving cell which are not colliding with CDP, MG or SMTC within time max(MGRP, SMTC)SSBCDP2 is number of SSB occasions of CDP which are not colliding with SC, MG or SMTC within max(MGRP,SMTC) |

 |
| Ericsson | In principle we prefer Proposal 7. We understand that proposal 3 also is based on the same principle, we can consider proposal 3 as staring point to derive sharing factor.  |
| Huawei | Either Proposal 2 or Proposal 5 is OK for us. We slightly prefer Proposal 5.For Proposal 2, the value of scaling factors for scenario 2 and 3 will be no larger than 2. Proposal 5 can be considered as a simplified version of Proposal 2.  |

**Issue 2-3-5 Number of non-serving TRPs to be measured**

* Proposals:
	+ Proposal 1(MTK):
		- The number of non-serving cell to be measured in FR1 is one.
	+ Proposal 2(Ericsson):
		- Number of other PCI UE can measure for L1-RSRP on FR1 is same as RAN1 capability and i.e., it can be more than 1 and up to 7.
	+ Proposal 2a(ZTE):
		- RAN 4 needs to identify the scaling factor for Nmax>1 case.
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round

|  |  |
| --- | --- |
| **Company** | **Comments** |
| CMCC | We support option 2. In our understanding, the reason to assume Nmax =1 for FR2 is that we need to consider the sharing factor for SC and NSC, and the situation is complex for the case with Nmax >1. However, for FR1, we do not have this issue. In previous meeting, it was agreed that for FR1, L1-RSRP for SC and cell with different PCI can be performed simultaneously. Same requirements applied for both Nmax =1 and Nmax >1. We do not see the nececssity th limit Nmax =1 for FR1. |
| Intel | Fine with proposal 2 and 2a. |
| vivo | No strong view. For P 2a, we think scaling factor is not needed for FR1.  |
| MediaTek | Slightly prefer proposal 1. To our understanding, the same assumption should be aligned between FR1 and FR2. |
| Apple | In RAN4 our agreement was to capture requirements for Nmax=1. Okay to introduce that requirements in FR1 are applicable to number of non-serving cells indicated by UE capability since additional sharing factors need not be introduced. For FR2 we are not in favor for starting this discussion or changing the existing conditions. |
| Ericsson | For FR1, proposal 2. Proposal 2a: We think scaling factor is not needed.To Apple: Our proposal is for FR1 only as we agreed already for FR2 that Nmax=1; |

### Sub-topic 2-4: Scheduling Restriction

**Issue 2-4-1 Scheduling restriction for dynamic TDD**

* Proposals:
	+ Proposal 1(Apple):
		- Introduce scheduling restriction for dynamic TDD when L1-RSRP measurement on cell with different PCI overlaps with serving cell UL slots.
	+ Proposal 1a(MTK):
		- Introduce scheduling restriction for dynamic TDD when L1-RSRP measurement on non-serving cell overlaps with serving cell UL slots. In addition, one OFDM symbol before and after SSB should also be considered because of TA.
	+ Proposal 2(vivo):
		- Do not introduce scheduling restriction for dynamic TDD when L1-RSRP measurement on cell with different PCI overlaps with serving cell UL slots.
	+ Proposal 3(ZTE):
		- For the scheduling restriction due to L1-RSRP measurement on cell with different PCI, RAN 4 has agreed that the timing offset between serving cell and cell with different PCI should be less than CP, thus no need to introduce additional 1 slot scheduling restriction even considering dynamic TDD.
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round

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| --- | --- |
| **Company** | **Comments** |
| vivo | We do not think it is necessary to introduce scheduling restriction. The following is captured in TS 38.213.‘For unpaired spectrum operation for a UE on a cell in a frequency band of FR1, and when the scheduling restrictions due to RRM measurements [10, TS 38.133] are not applicable, if the UE detects a DCI format indicating to the UE to transmit in a set of symbols, the UE is not required to perform RRM measurements [10, TS 38.133] based on a SS/PBCH block or CSI-RS reception on a different cell in the frequency band if the SS/PBCH block or CSI-RS reception includes at least one symbol from the set of symbols.’Based on above, if there is no scheduling restriction defined in TS 38.133, it is already clear in RAN1 spec that there is no RRM requirements. However, conversely if scheduling restriction is defined, it is supposed that NW may not send SFI since L1 measurement is prioritized. This is different from current RAN1 design.  |
| MediaTek | Support proposal 1a. the flexible symbol may be overwritten as UL and it may collide with SSB symbol. Besides, considering TA, the additional symbol should be considered. |
| Apple | Thanks Vivo for the reference. We already have such scheduling restriction in L3 measurements that SSB measurement is prioritized in dynamic TDD. We need to change the legacy UE behavior in that case. Our proposal is to extend the same to L1 measurements on cell with different PCI. If we agreed to introduce this for L3 measurements, we don’t see why we would use different approach for inter-cell L1-RSRP measurements. We are fine to extend to 1 symbol before and after SSB.  |
| Ericsson | Proposal 2. |

**Issue 2-4-2 Update capability *simultaneousRxDataSSB-DiffNumerology***

* Proposals:
	+ Proposal 1(MTK):
		- Introduce scheduling restriction for dynamic TDD when L1-RSRP measurement on cell with different PCI overlaps with serving cell UL slots.
		- Update the capability signaling simultaneousRxDataSSB-DiffNumerology as below:

|  |
| --- |
| ***simultaneousRxDataSSB-DiffNumerology***Indicates whether the UE supports concurrent intra-frequency measurement on serving cell or neighbouring cell and PDCCH or PDSCH reception from the serving cell or an additional serving cell with a different numerology as defined in clause 8 and 9 of TS 38.133 [5]. |

* Recommended WF
	+ Collect companies’ view for these proposals in 1st round

|  |  |
| --- | --- |
| **Company** | **Comments** |
| vivo | Not sure whether we can directly modify the interpretation of a R15 IE. Perhaps a new IE is needed which is dependent on R17 ICBM feature.We prefer not to add such revision. Understanding of additional serving cell is already clarified in RAN4. What is captured in RAN1/2 can be directly discussed in RAN1/2. |
| MediaTek | Support proposal 1. Because, to our understanding, current wording serving cell is not clear for R17 inter cell BM. |
| Apple | We also have the same view as Vivo. We dont think such change can be made by RAN4. Our understanding is that if UE supports this capability, its also applicable for PDCCH/PDSCH from cell with diff PCI.  |
| Huawei | No need for proposal 1.A serving cell can be associated with an additional PCI, where the cell with additional PCI can be considered as a TRP of serving cell. Data transmission only can be from the serving cell other than non-serving cell. The date transmission of the serving cell can be QCL-typeD to a TCI state associated to an additional PCI. |

**Issue 2-4-3 Whether to define scheduling restriction for non-serving cell**

* Proposals:
	+ Option 1(MTK):
		- Introduce scheduling restriction on non-serving cell when UE performs L1-SINR measurement, BFD, CBD, RLM on serving cell.
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | No strong view. It seems that current scheduling restriction can apply for non-serving cell. |
| vivo | We do not think option 1 is needed. Based on current spec the understanding of additional serving cell is already clear. If the understanding is clear, there is no need to consider additional serving cell. |
| MediaTek | Support option 1, to our understanding, we define the requirement when RS from SC for L1-RSRP measurement is collided with data channel from NSC. We tend to believe the similar logic can extend to L1-SINR measurement, BFD, CBD, RLM on serving cell when UE performs data reception on non-serving cell. |
| Apple | We don’t think this is needed. In our current scheduling restrictions we say UE cannot receive PDSCH/PDCCH or transmit PUCCH/PUSCH/SRS without saying serving cell and need not add additional cell.  |
| Ericsson | We think current scheduling restriction applies to non-serving cell as well |
| Huawei | Not agree with proposal 1.Data transmission for this UE only can be from the serving cell other than non-serving cell. A serving cell can be associated with an additional PCI, where the cell with additional PCI can be considered as a TRP of serving cell. The date transmission of the serving cell can be QCL-typeD to a TCI state associated to an additional PCI. There is no need to define scheduling restrictions on non-serving cell. |

### Sub-topic 2-5: Applicability of ICBM feature

**Issue 2-5-1: Applicability of ICBM feature**

* Proposals:
	+ Option 1(vivo):
		- The ICBM feature shall be applicable to SCell. (ZTE)
		- For intra-band ICBM using common TCI configurations, different reference CCs in the same CC list between the serving cell and a cell with different PCI is not supported in R17.(ZTE)
		- For intra-band ICBM using common TCI configurations, requirements are defined for the case when SSB measurements for a cell with different PCI are only performed in the cell that has the same SSB frequency as the reference CC.
		- R17 ICBM feature is applicable to FR1 HST and FR2 HST. If RAN4 identifies any issue in applying HST related enhancements to ICBM related RRM requirements, RAN4 solve them in the R17 maintenance phase. (ZTE)
		- R17 ICBM feature is applicable to the scenarios when UE is configured with R17 enhanced gaps. If RAN4 identifies any issue in applying R17 enhanced gaps to ICBM related RRM requirements, RAN4 solve them in the R17 maintenance phase.
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round

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| --- | --- |
| **Company** | **Comments** |
| CMCC | We support the bullet “R17 ICBM feature is applicable to FR1 HST and FR2 HST. If RAN4 identifies any issue in applying HST related enhancements to ICBM related RRM requirements, RAN4 solve them in the R17 maintenance phase.” |
| Intel | Fine with the first, second bullet. |
| vivo | Support all the bullets.  |
| MediaTek | Support first bullet. |
| Apple | We are not in favor of extending ICBM requirements for concurrent R17 WIs, and that has been the approach taken in the past. This needs more discussion and consensus within RAN4.  |
| Ericsson | We are not sure about this discussion is entirely up to RAN4.  |

### Sub-topic 2-6: LS from RAN1

**Issue 2-6-1: Whether there is scheduling restriction in RAN4 when SSB and PDCCH/PDSCH are overlapped on the same RE**

* Proposals:
	+ Proposal 1: No restrictions are introduced in FR1 except for the case when SSB and PDCCH/PDSCH SCS are different, and UE doesn’t support *simultaneousRxDataSSB-DiffNumerology*.
* Update from GTW discussion:
	+ Need alignment of the views on the scenario to be discussed.
* Recommended WF
	+ Further align with the scenario, whether the SSB and PDCCH/PDSCH are from the same PCI or different PCI

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | For inter-cell BM, RAN1 agreed that the PDCCH /PDSCH should be rate matched around the SSBs indicated by ssb-PositionsInBurst-r17 for the same PCI as that associated with TCI state of the PDSCH /PDCCH.In TS38.213 section 10 and TS38.214 section 5.1.4, the rate match pattern for PDCCH/PDSCH for inter-cell BM is clarified.

|  |
| --- |
| For monitoring of a PDCCH candidate by a UE, if the UE- has received *ssb-PositionsInBurst* in *AdditionalPCIInfo* for a serving cell, and- at least one RE for a PDCCH candidate overlaps with at least one RE of a candidate SS/PBCH block corresponding to a SS/PBCH block index provided by *ssb-PositionsInBurst* in *AdditionalPCIInfo* with same physical cell identity as the one associated with a RS having same quasi-collocation properties as a CORESET for the PDCCH candidate, the UE is not required to monitor the PDCCH candidate. |

it specified that UE is not expected to handle SSB and PDCCH from non-serving cell with the same PCI simultaneously. from our understanding, RAN1 is currently further discussing whether PDCCH/PDSCH needs to be rate matched with SSB configured for L1-RSRP from cell with different PCI to avoid overlapping. Some companies prefer to define rate match to avoid such overlap since it will cause performance degradation. However, Some other companies think that if PDCCH is rate matched with SSB with different PCI, it’s resource inefficient or it’s left to NW scheduling. RAN1 would like to check whether RAN4 has some requirement for the overlapped issue.We are also fine to further clarify the issue. |
| vivo | Our understanding on the scenario is that:1. The LS has already provided the information that RAN1 is clear on the same PCI case. RAN1 has already introduced rate matching when PDSCH and SSB are overlapped in either serving cell or the cell with different PCI. However, RAN1 is not clear on the case when PDSCH from SC and SSB from NSC are overlapped in the same RE. RAN1 would like to ask RAN4 whether there is any conclusion on this.2. Proposal 1 is based on R15 SC. In R17, the same has been introduced for NSC. However, RAN4’s assumption is that RAN1 would take care of the case when NSC SSB overlap with SC PDSCH/PDCCH. RAN4 never assume such overlapping would happen, since the conclusion in RAN4 is made based on the SC case. |
| MediaTek | Disagree with proposal 1. Suggest to only clarify there is no requirement in RAN4 when SSB and PDCCH/PDSCH are transmitted in the same RE. no need to consider the signals are same PCI or different PCI. |
| Apple | On the scenario, we have the same understanding as Intel and Vivo.In RAN4 in Rel-15 we specified scheduling restriction if UE can receive SSB and PDCCH/PDSCH on the same symbols. We never discussed same RE as it was already defined in RAN1 that PDSCH is rate matched around SSB.  |
| Ericsson | After internal checking, our understanding was RAN1 was talking about different PCI overlap.For different PCI overlap, we are fine with Proposal 1. |
| Huawei | After checking with RAN1, PDCCH/PDSCH which is QCLeD to serving PCI SSB will be rate matching with serving PCI SSB, but may be overlapped with additional PCI SSB on the same RE. Similarly, PDCCH/PDSCH which is QCLeD to additional PCI SSB will be rate matching with additional PCI SSB, but may be overlapped with serving PCI SSB on the same RE.We agree with proposal 1, only to inform RAN1 that RAN4 does not define scheduling restriction requirements due to PDCCH/PDSCH and SSB overlapped on the same RE. |

**Issue 2-6-2: Whether any clarification or update is needed in RAN4 spec when SSB and PDCCH/PDSCH are overlapped on the same RE**

* Proposals:
	+ Proposal 1: No. Just inform RAN1 about the current status in RAN4.
	+ Proposal 2: Clarify that performance degradation is expected when overlapping happen in RAN4.
	+ Proposal 3: Clarify that there is no UE requirement when overlapping happen in RAN4.
	+ Proposal 4: Define scheduling restriction to avoid overlap between SSB and data on the same RE in RAN4.
* Recommended WF
	+ First align the scenario in issue 2-6-1. If align, then collect companies’ view for these proposals.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | Prefer proposal 2 or 4. performance degradation is expected if UE perform SSB measurement and data reception simultaneously. Therefore, we prefer to define some scheduling restriction in RAN4 to avoid the overlap. Or clarify that performance degradation is expected for the scenario. |
| vivo | We support P2, P3.  |
| MediaTek | Support proposal 3. Currently, RAN4 does not have any requirement for SSB and PDCCH/PDSCH are collided in the same RE scenario. And we tend to believe such requirement should be defined in RAN1. So, we suggest to reply RAN1 there is no requirement and it may lead to performance degradation. |
| Ericsson | Currently UE can receive data and measure SSB if the SCS is same. It should not be any different for this case and we do not think performance degradation is expected.  |
| Huawei | Agree with Proposal 1, just inform RAN1 that RAN4 does not define scheduling restriction requirements for the case that SSB and PDCCH/PDSCH are overlapped on the same RE. |

## Companies views’ collection for 1st round

### CRs/TPs comments collection

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| [**R4-2211860**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2211860.zip)Apple | CR for inter-cell beam management |
| depends on ongoing discussion. |
| Huawei: it depends on the conclusion on issues 2-3-2 and 2-4-1 |
| [**R4-2212128**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212128.zip)Intel  | CR for Update of sharing factor for SSB based L1-RSRP for serving cell and cell with different PCI |
| depends on ongoing discussion. |
| Huawei: it depends on the conclusion on issues 2-3-4 |
| [**R4-2212521**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212521.zip)MediaTek Inc. | CR on scheduling availability for inter cell beam management  |
| Agree with CR. |
| Ericsson: Looks fine. Wording can be further checked in 2nd round. |
| [**R4-2212668**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212668.zip)vivo | CR on inter-cell beam managements in R17 feMIMO |
| Huawei: it depends on the conclusion on issues 2-3-4 |
| some contents depend on ongoing discussion. |
| [**R4-2213484**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213484.zip)Huawei, HiSilicon | CR on maintaining L1-RSRP measurement requirements for R17 inter-cell BM  |
| depends on ongoing discussion. |
|  |
| [**R4-2213942**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213942.zip)Ericsson | Maintenance CR on inter-cell beam management  |
| depends on ongoing discussion. |
| Huawei: it depends on the conclusion on issues 2-1-2 and 2-3-5 |

## 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)

# Topic #3: Other RRM requirements (9.17.2.3)

## Companies’ contributions summary

## Open issues summary

|  |  |  |
| --- | --- | --- |
| [**R4-2211767**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2211767.zip) | NTT DOCOMO, INC. | CR to TS38.133 Correction on Rel17 TRP specific CBD requirements |
| R4-2213295 | ZTE Corporation | CR on SFN based RLM and LRP |
| [**R4-2213485**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213485.zip) | Huawei, HiSilicon | Discussion on remaining issues for R17 TRP specific BFR**Observation 1: For TRP specific link recovery, both two BFD resource sets are configured for radio link quality measurements on a serving cell, even though SSB resources in either one resource set can be associated with a PCI different from the serving cell.****Proposal 1: For TRP specific link recovery, it is suggested to use the wording “a serving cell” instead of “a serving cell and cell with different PCI”, where the serving cell can be either configured with additionalPCIList or not.****Proposal 2: For TRP specific link recovery, it is suggested to clarify that the SSBs in set and can be indicated to be associated with an additional PCI.****Proposal 3: For TRP specific BFD/CBD measurements in FR2, it is suggested that there is no measurement restrictions between BFD/CBD RS resources from different sets.** |
| [**R4-2213486**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213486.zip) | Huawei, HiSilicon | CR on maintaining R17 TRP specific BFR requirements |
| [**R4-2213878**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213878.zip) | ZTE Corporation | CR on SFN based RLM and LRP |
| [**R4-2213931**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213931.zip) | Apple | CR on TRP Specific BFR requirements |
| [**R4-2213944**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213944.zip) | Ericsson | Discussion on TRP specific link recovery procedures**Proposal 1: RAN4 not to introduce prioritization for beam failure recovery procedure when serving cell and non-serving cell beam failure recovery happens simultaneously.** |
| [**R4-2213945**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213945.zip) | Ericsson | CR on corrections for TRP specific BFR |

### Sub-topic 3-1: TRP-specific link recovery

**Issue 3-1-1 Wording update and clarification for TRP specific link recovery**

* Proposals:
	+ Option 1(Huawei):
		- For TRP specific link recovery, it is suggested to use the wording “a serving cell” instead of “a serving cell and cell with different PCI”, where the serving cell can be either configured with additionalPCIList or not.
		- For TRP specific link recovery, it is suggested to clarify that the SSBs in set and can be indicated to be associated with an additional PCI.
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round

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| **Company** | **Comments** |
| Intel | Fine with option 1. |
| MediaTek |  Ok with option 1. |
| Apple | We also had a CR to address this issue, we are fine with Huawei’s revision.On SSB based measurement for BFD, I don’t think this is possible. We should delete the sections for SSB based TRp specific BFD.  |
| Ericsson | Ok with option 1 |
| Huawei | Support option 1 |

**Issue 3-1-2 Measurement restrictions**

* Proposals:
	+ Option 1(Huawei):
		- For TRP specific BFD/CBD measurements in FR2, it is suggested that there is no measurement restrictions between BFD/CBD RS resources from different sets.
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round

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| **Company** | **Comments** |
| Intel | Fine with option 1. |
| MediaTek | Ok with option 1. |
| Apple | Our understanding is that if they are overlapped we have PTRP=2 in FR2. Not sure which case we try to cover here.  |
| Ericsson  | Same view as Apple |
| Huawei | Support option 1, since the requirements for two sets overlapping case have been defined. |

**Issue 3-1-3 Prioritization for beam failure recovery procedure**

* Proposals:
	+ Option 1(Ericsson):
		- RAN4 not to introduce prioritization for beam failure recovery procedure when serving cell and non-serving cell beam failure recovery happens simultaneously.
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round

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| **Company** | **Comments** |
| Intel | Fine with option 1. |
| Apple | We don’t have any distinction if the sets are from same cell or different cells, we assume the sharing factor, measurement period apply to both TRPs from serving cell or intercell TRPs.  |
| Ericsson | Option 1 |
| Huawei | We can agree not to introduce prioritization for beam failure recovery procedure when beam failure occurs simultaneously on both BFD-RS sets. |

## Companies views’ collection for 1st round

### CRs/TPs comments collection

|  |  |
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| **CR/TP number** | **Comments collection** |
| [**R4-2211767**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2211767.zip)NTT DOCOMO, INC. | CR to TS38.133 Correction on Rel17 TRP specific CBD requirements  |
| Apple: Okay with change, could we merge this change to one of the existing CRs with changes in same section? Eg - R4-2213931 (Apple) or R4-2213486 (Huawei, HiSilicon) whichever is pursued. |
| Ericsson: OK |
| DCM: We are OK to merge into another CR. |
| [**R4-2213486**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213486.zip)Huawei, HiSilicon | CR on maintaining R17 TRP specific BFR requirements |
| Apple: Okay with some changes. We think SSB based BFD for TRP specific BFR should be removed from spec as this is not supported in RAN1. We have kept the Rel-15 SSB based BFD due to legacy reasons. We are fine to merge changes in our CR. |
| Ericsson: wording needs to be verified. |
| [**R4-2213878**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213878.zip)ZTE Corporation | CR on SFN based RLM and LRP  |
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| [**R4-2213931**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213931.zip)Apple | CR on TRP Specific BFR requirements |
| Ericsson: I think we need more discussion here. Somehow from Rel-15 RAN1 and RAN2 specs differ on this aspect. Even in Rel-15 RAN1 do not support SSB based BFD but RAN2 supports it. Based on my internal check, some companies supported defining the SSB based BFD as it is supported from RAN2 point of view. |
| Huawei: TRPs shall belong to the same serving cell, even though a TRP can be associated with an additional PCI. In TS38.331, both SSB and CSI-RS can be defined as TRP specific BFD-RS. |
| [**R4-2213945**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213945.zip)Ericsson | CR on corrections for TRP specific BFR |
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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**

|  |  |  |  |
| --- | --- | --- | --- |
| **New Tdoc number** | **Title** | **Source** | **Comments** |
|  | WF on … | YYY |  |
|  | LS on … | ZZZ | To: RAN\_X; Cc: RAN\_Y |
|  |  |  |  |

**Existing tdocs**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Tdoc number** | **Revised to** | **Title** | **Source** | **Recommendation**  | **Comments** |
| R4-22xxxxx |  | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
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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** | **Revised to** | **Title** | **Source** | **Recommendation**  | **Comments** |
| R4-22xxxxx |  | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-22xxxxx |  | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-22xxxxx |  | LS on … | ZZZ | Agreeable, Revised, Noted |  |
|  |  |  |  |  |  |

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

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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)