**3GPP TSG-RAN WG4 Meeting # 101-bis-e R4-220xxxx**

**Electronic Meeting, Feb 21st - Mar 3rd, 2022**

**Agenda item:** 10.19.3.2 and 10.19.3.3

**Source:** Moderator (Samsung)

**Title:** Email discussion summary for [102-e][227] NR\_feMIMO\_RRM\_1

**Document for:** Information

# Introduction

This e-mail discussion summary captured the discussions for Rel-17 FeMIMO RRM in RAN4 #101-bis-e meeting.

In RAN4 101-e meeting, 3 WFs were approved.

* **WF on FeMIMO RRM impact for unified TCI** was approved in **R4-2202666**; and
* **WF on FeMIMO RRM requirements for inter-cell beam management** was approved in **R4-2202772**; and
* **WF on other RRM requirements for FeMIMO** was approved in **R4-2202668.**

In addition, a coming LS R4-2112762 from RAN1 would be further discussed.

In this e-mail discussion, the following topics are arranged based on agenda items.

* ~~Unified TCI (6.19.3.1)~~
* Inter-cell beam management (10.19.3.2)
* Other RRM requirements (10.19.3.3)

Based on the e-mail discussions, WF (s) is expected to collect the meeting agreements for future discussions and CRs.

# Topic #1: Inter-Cell Beam Management

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2203774 | Apple Inc. | **Inter-cell L1-RSRP Measurements**Applicability of requirements and known condition**Proposal #1: Define known cell condition for inter-cell L1-RSRP as** **In FR1 the cell is known if it has been meeting the relevant cell identification requirement during the last 5 seconds.****In FR2 the cell is known if, during the last 5 seconds –*** **the UE has sent a valid measurement report for the cell with different PCI and**
* **One of the SSBs measured from the cell with different PCI being configured remains detectable**

**Otherwise, the cell is unknown.****Proposal #2: Defining known condition as above implies that cell with different PCI configured for intercell-L1-RSRP measurement should first have performed L3 measurement.**Measurement period***Observation #1:*** *Inter-cell L1-RSRP measurements should follow the same assumptions as L1-RSRP measurements on the serving cell.* **Proposal #3: RAN4 doesn’t need to specify Rx beam assumption for inter-cell L1-RSRP measurements when SSBs overlap with SMTC either partially or fully.****Proposal #4: Specify sharing factors when SSBs for inter-cell L1-RSRP measurements overlap with serving cell SSB for L1 measurement, SMTC, measurement gap.****Proposal #5: Define SSB based inter-cell L1-RSRP measurement period for known cell with different PCI similar to existing serving cell requirements.** **Proposal #6: Define equal sharing between serving cell and cell with different PCI in FR2 when SSBs overlap.** **Proposal #7: For unknown cell, the L1-RSRP measurement period is extended by the time needed for intra-frequency cell identification and measurement.** Measurement restriction**Proposal #8: Define Measurement restriction on SSB based L1-RSRP measurements for cell with different PCI, if the SSB from cell with different PCI is on the same OFDM symbol as CSI-RS from serving cell for other L1 measurements.**Scheduling Restrictions**Proposal #9: Define scheduling availability for UE performing L1-RSRP measurement on cell with different PCI.** **Reply to RAN1 LS L1-RSRP measurement behavior when SSBs associated with different PCIs overlap**Proposed reply to RAN1:*RAN4 will specify RRM requirements for L1-RSRP measurements for cell with different PCI only when the timing difference among serving cell and cells with different PCIs is less than CP**RAN4 will specify RRM requirements based on UE measurement behavior assumptions for L1-RSRP when SSBs associated with serving cell and cells different PCIs overlap as:**In FR1 –* * *The UE is capable of measuring SSBs from serving cell and cell with different PCI without restriction*

*In FR2 –** *RAN4 has agreed to assume one active UE panel for the RRM requirements*
* *RAN4 defines sharing factor between SSB resources from serving cell and cell with different PCI*
* *The sharing factor assumes equal sharing of resources*
	+ *The UE will measure SSB from cell with different PCI and SSB from serving cell every other occasion*

*For FR2, RAN4 continues discussion on simultaneous reception and measurement on L1-RSRP over the overlapping SSBs based on two active UE panels.* |
| R4-2204267 | CMCC | This contribution provides discussion on inter-cell beam management. The observations and proposals are:***Proposal 1: for the case within SMTC, UE is able to simultaneously measure L1 for serving cell and L1 for non-serving cell (i.e. no need to limit the timing offset within CP)******Proposal 2: for FR1 L1-RSRP measurement delay requirements on cell with different PCI from serving cell, it is proposed as following:**** ***For the L1-RSRP measurement performed within SMTC, existing R15/16 L1-RSRP measurement delay requirements can be reused, assuming UE is able to simultaneously measure L1 for serving cell and non-serving cell***
	+ ***For UE supporting different value of Nmax, same requirements applied (i.e. Nmax has no impact on the delay requirements)***
* ***For the L1-RSRP measurement performed outside SMTC, if timing offset between a serving cell and a cell with different PCI is within CP, existing R15/16 L1-RSRP measurement delay requirements can be reused***
	+ ***For UE supporting different value of Nmax, same requirements applied (i.e. Nmax has no impact on the delay requirements)***

***Proposal 3: For FR2 L1-RSRP measurement delay requirements on cell with different PCI from serving cell, it is proposed that on top of Rel-15/16 requirements, new scaling factor of PNSC is needed. The details are as following:**** ***For the case that SSB for serving cell and SSB for cell with different PCI are partially overlapped, if SSB period for serving cell > SSB period for cell with different PCI:***
	+ ***for NSC L1-RSRP measurement delay, PNSC = 1/(1-TSSB\_NSC/TSSB\_SC) (assuming UE only perform NSC L1-RSRP measurement on the SSB occasions which is not overlapped with SSB of serving cell)***
	+ ***for SC L1-RSRP measurement delay, PNSC = 1 (i.e. no impact on SC L1-RSRP measurement delay)***
* ***For the case that SSB for serving cell and SSB for cell with different PCI are partially overlapped, if SSB period for serving cell < SSB period for cell with different PCI:***
	+ ***for NSC L1-RSRP measurement delay, PNSC = 1***
	+ ***for SC L1-RSRP measurement delay, PNSC = 1/(1-TSSB\_SC/TSSB\_NSC) (assuming UE only perform SC L1-RSRP measurement on the SSB occasions which is not overlapped with SSB of non-serving cell)***
* ***For the case that SSB for serving cell and SSB for cell with different PCI are fully overlapped***
	+ ***for NSC L1-RSRP measurement delay, PNSC = X, the value of X can be further discussed***
	+ ***for SC L1-RSRP measurement delay, PNSC = Y, the value of Y can be further discussed***

***Proposal 4: for the case that L1-RSRP is performed outside SMTC, timing offset between a serving cell and a cell with different PCI is more than CP, if RAN4 agree to specify requirements for this case, the L1-RSRP measurement delay requirements is proposed as following:**** ***TL1-RSRP\_Measurement\_NSC = K \*M\*P \*N\* max(TDRX,TSSB), where N is the number of target NSC(s) which is measured outside SMTC, K, M, P is same as defined in Rel-15/16 L1-RSRP delay requirements.***

***Observation 1: according to the measurement model in TS 38.300, L1-RSRP is the intermediate result of L3-RSRP measurement.******Observation 2: according to existing L3 measurement requirements for intra-frequency, UE simultaneously measure L3 for serving cell and non-serving cell regardless timing offset.*** |
| R4-2204341 | vivo | **Proposal 1 R17 RAN4 RRM requirements for inter-cell BM should be forward compatible to R18 L1/L2-centric mobility.****Proposal 2 RAN4 works for SSB-based inter-cell L1-RSRP measurement requirements in R17 firstly, and further study whether requirements for CSI-RS based inter-cell L1-RSRP measurement is specified in R17 or not.****Proposal 3 The unknown conditions for cell with different PCI at least include*** + **RAN1 agreements for non-serving cell, i.e., same center frequency, SCS, SFN offset**
	+ **Cell detectable condition (FFS: existing intra-frequency measurement can be reused)**
	+ **Timing alignment between serving cell and cell with different PCI are larger than CP**
	+ **FFS other conditions**

**Observation 1 Compared to Case 1, i.e. L1 measurement & report configured by RRC after UE reports L3 MR, less steps in signalling procedure can be observed in Case 2, i.e. L1 measurement & report configured by RRC before UE reports L3 MR, which means the overall latency for L1 measurements can be reduced.****Observation 2 For Case 2, SSBs for L1 measurements can be different from the SSBs for layer 3 measurements, and therefore the SSBs for L1 measurements may be still not detectable, even if the cell configured for L1 measurements can be identified in L3 MO related procedures.****Proposal 4 For both known conditions and unknown conditions, update bullet 2, i.e. ‘Cell detectable condition (FFS: existing intra-frequency measurement can be reused)’, as*** + **after the corresponding cells configured for L1 measurements meet the detectable condition in 9.2.2 for [5] seconds, and**
	+ **the SSBs configured for inter-cell L1 measurements meet the side conditions specified in 9.5.2.**

**Observation 3 For both Case 1 and Case 2, it is possible that L1 measurements for the cell with different PCI are performed under unknown conditions.****Proposal 5 For unknown conditions in FR1 and FR2, single-FFT capable UE is required to perform inter-cell L1-RSRP measurements only inside SMTC, i.e. no RRM requirements are specified for the case SSBs for inter-cell L1-RSRP measurements are only configured outside SMTC under unknown conditions.****Proposal 6 For known conditions in FR1 and FR2, single-FFT capable UE is required to perform inter-cell L1-RSRP measurements for both inside SMTC and outside SMTC.****Proposal 7 For FR1, RAN4 may further discuss whether to also specifiy requirements for multiple-FFTs capable UE in R17, while different UE requirements can be applicable according to different UE capabilities.****Proposal 8 Specify RRM requirements assuming UE only perform L1-RSRP measurements inside SMTC in FR1 and FR2, which are applicable at least*** **for unknown condition, if SSBs for inter-cell L1-RSRP measurements are either fully overlapped or partially overlapped SMTC, or**
* **for known condition, if SSBs for inter-cell L1-RSRP measurements are fully overlapped with SMTC, or**
* **for known condition, if SSBs for inter-cell L1-RSRP measurements are partially overlapped with SMTC, but the SSBs outside STMC are fully overlapped with measurement gaps.**

**Observation 4 R15/R16 SSB-based L1-RSRP measurement requirements in FR1 are specified based on the assumptions that UE may conduct L1 measurements and L3 measurements simultaneously without additional restrictions.****Observation 5 UE is not able to perform one-shot L1-RSRP measurements (i.e. M=1) on the same SSB or CSI-RS occasion simultaneously for both serving cell and a cell with a different PCI in FR1, no matter within SMTC or outside SMTC.****Proposal 9 If UE is configured with *timeRestrictionForChannelMeasurement* for L1 measurements on both serving cell and cells with different PCIs, and the same overlapping SSB occasion or overlapping CSI-RS occasion is considered for the one-shot measurement, consider one of the following options for specifying RRM requirements in R17,** * **Option 1: Introduce additional sharing factor Mcell for L1 measurements requirements, so as to allow UE to perform the one-shot measurement one cell at a time. Mcell equals to the number of cells whose one-shot measurement occasions are overlapped.**
* **Option 2: No RRM requirements are specified for the case UE is configured with *timeRestrictionForChannelMeasurement* for L1 measurements on both serving cell and cells with different PCIs in R17, and the corresponding SSBs for L1-RSRP measurements are overlapped.**

**Observation 6 The L1 measurements in option 1 of proposal 9 also include RLM/BFD/CBD measurements.****Proposal 10 Adopt option 1 in Proposal 9 for the case SSBs for cells with different PCIs overlap outside SMTC, and option 2 for the all other cases, including the inside SMTC case, i.e. RRM requirements for FR1 and FR2 in R17 are specified by*** **Introduce additional sharing factor Mcell for L1 measurements requirements for the case SSBs for cells with different PCIs overlap outside SMTC, so as to allow UE to perform the L1 measurement from one cell at a time. Mcell equals to the number of cells whose L1 measurement occasions are overlapped. The L1 measurements also include RLM/BFD/CBD measurements.**
* **No RRM requirements are specified for the case SSBs for serving cell and any cell with a different PCI overlap outside SMTC, and measurement restriction is introduced for this case.**
* **No RRM requirements are specified for the case inside SMTC and UE is configured with *timeRestrictionForChannelMeasurement* for L1 measurements on both serving cell and cells with different PCIs in R17, and the corresponding SSBs for L1-RSRP measurements are overlapped.**

**Proposal 11 For FR1, introduce new measurement restrictions for the cases when*** **L1-RSRP measurement occasions for cell with different PCI are overlapped with serving cell RLM/BFD/CBD measurement occasions outside SMTC, or**
* **L1-RSRP measurement occasions for cell with different PCI are overlapped with serving cell RLM/BFD/CBD measurement occasions inside SMTC, and *timeRestrictionForChannelMeasurement* for L1 measurements is configured for the cell with different PCI.**

**Proposal 12 For FR1, introduce new scheduling restrictions for the cases when L1-RSRP measurements for cell with different PCI are performed outside SMTC.****Proposal 13 Inform RAN1 on RAN4 agreements/conclusions related to *timeRestrictionForChannelMeasurement* for L1 measurements in the reply LS, so that RAN1 may revise the specs accordingly.****Observation 7 For FR1 and FR2, if SSB-based inter-cell L1 measurements are performed within SMTC, scheduling restrictions defined for L3 measurements can be re-used.****Observation 8 For FR1, if SSB-based inter-cell L1 measurements are performed within SMTC, and *timeRestrictionForChannelMeasurement* is not configured for the cell with different PCI, no need to define measurement restrictions for such L1 measurements.****Proposal 14 For known conditions in FR1 and FR2, RRM requirements are specified assuming single-FFT capable UE only performs inter-cell L1-RSRP measurements outside SMTCs for the case SSBs for inter-cell L1-RSRP measurements are not fully overlapped with SMTCs, and the SSB occasions outside SMTCs are not fully overlapped with measurement gaps.****Observation 9 For FR1, if SSB-based inter-cell L1 measurements are performed outside SMTCs, legacy measurement restrictions for serving cell L1-RSRP measurements can be re-used except for the cases described in proposal 11 and proposal 12.****Observation 10 According to RAN1 LS, RRM measurement requirements are not impacted by L1-RSRP measurements on RSs with a PCI different from serving cell.****Proposal 15 For the inside SMTC case, L1-RSRP measurement requirements for the cell with different PCI is specified assuming using same RX beams for L3 measurements, if ‘*timeRestrictionForChannelMeasurement*’ is not configured.****Proposal 16 For FR2, no measurement restriction is specified for the case L1-RSRP measurement on the cell with different PCI is performed only inside SMTC, and ‘*timeRestrictionForChannelMeasurement*’ is not configured. In other word, legacy measurement restrictions for L1 measurements are only re-used for the cases when*** **L1-RSRP measurement occasions for cell with different PCI are overlapped with serving cell RLM/BFD/CBD measurement occasions outside SMTC, or**
* **L1-RSRP measurement occasions for cell with different PCI are overlapped with serving cell RLM/BFD/CBD measurement occasions inside SMTC, and *timeRestrictionForChannelMeasurement* for L1 measurements is configured for the cell with different PCI.**

**Proposal 17 For FR2, legacy scheduling restrictions for L1 measurements are re-used for the cases when L1-RSRP measurements for cell with different PCI are performed outside SMTC.****Proposal 18 Clarify the understanding of beam sweep factor N from RAN4 perspective, for SSB-based L1-RSRP measurements, as following in the reply LS,****‘UE is only required to meet the L1-RSRP measurement accuracy requirement after N samples.’**  |
| R4-2204366 | MediaTek Inc. | Proposal 1: In the L1-RSRP measurement for non-serving cell, to include the time of cell search, SSB index acquisition and L1-RSRP measurement (i.e. TPSS/SSS\_sync\_intra, TSSB\_time\_index\_intra and TL1-RSRP\_Measurement\_Period\_SSB) and NOT to include the L3 measurement (TSSB\_measurement\_period\_intra).Proposal 2: UE is not required to transmit L1-RSRP measurement report if the SSB from the non-serving cell is undetectable.Proposal 3: Non-serving cell is known if UE transmits any L1-RSRP measurement report for the non-serving cell within [X] ms before UE performs the L1-RSRP measurement. FFS: [X] for the valid L1-RSRP report.Proposal 4: For the L1-RSRP measurement of non-serving cell, if the non-serving cell is known and the L1-RSRP report for the SSB to be measured is transmitted within [X] ms before the measurement is performed, the TPSS/SSS\_sync\_intra and TSSB\_time\_index\_intra can be skipped, where the [X] can be the same as the known confition of the non-serving cell.Proposal 5: For the L1-RSRP measurement of non-serving cell, if the non-serving cell is known and the L1-RSRP report for the SSB to be measured is not transmitted within [X] ms before the measurement is performed, the TPSS/SSS\_sync\_intra and TSSB\_time\_index\_intra can be skipped, where the [X] can be the same as the known confition of the non-serving cell.Proposal 6: No UE requirement applies for the case when the non-serving cell is unknown and the L1-RSRP report for the SSB to be measured is transmitted before the measurement is performed.Proposal 7: For the L1-RSRP measurement of non-serving cell, if the non-serving cell is unknown and the L1-RSRP report for the SSB to be measured is not transmitted within [X] ms before the measurement is performed, the TPSS/SSS\_sync\_intra and TSSB\_time\_index\_intra are needed, where the [X] can be the same as the known confition of the non-serving cell.Proposal 8: For inter-cell L1-RSRP measurement performed outside SMTC for FR1 and FR2, not to define the requirement for the case when the timing offset between serving cell and non-serving cell is larger than one CP.Proposal 9: For inter-cell L1-RSRP measurement performed outside SMTC for FR1 and FR2, the same Rx beam assumption as the serving cell measurement will be used for the non-serving cell, i.e., rough beam for L3 measurement and fine beam for L1 measurement for inside SMTC.Observation 1: In the last meeting, for unified TCI state switch for non-serving cell, RAN4 agreed the timing offset between serving cell and non-serving cell is within CP.Proposal 10: For inter-cell L1-RSRP measurement performed inside SMTC for FR1 and FR2, not to define the requirement when the timing offset between serving cell and non-serving cell is larger than one CP. Because less than one CP timing offset assumption is agreed in unified TCI state switch for non-serving cell, i.e., no use case when timing offset is larger than one CP in R17 feMIMO.Proposal 11: For the scheduling availability, two cases should be considered:the data from serving cell and the SSB from non-serving cell for L1-RSRP measurement are transmitted in the same OFDM symbol the data from non-serving cell and the SSB from serving cell for L1-RSRP measurement are transmitted in the same OFDM symbolProposal 12: To introduce a new UE capability for indicating whether the UE supports concurrent intra-frequency measurement on non-serving cell and PDCCH or PDSCH reception from the serving cell and non-serving cell with a different numerology.Proposal 13: RAN4 to discuss whether to define the joint requirement of FR2 inter-band CA with independent beam management and inter-cell beam management.Proposal 14: For the scheduling availability, when the L1-RSRP measurement is performed within SMTC, 1 data symbol before and after SSB symbols are needed if RAN4 agreed that the timing offset between serving cell and non-serving cell is larger than one CP.Proposal 15: Extend the measurement restriction requirement to include the case when two SSBs from serving cell and non-serving cell are collided in the same OFDM symbol.Proposal 16: For the measurement restriction requirement, based on one FFT assumption, there are two cases can be further discussed:If RAN4 agreed the timing offset is less than one CP, no measurement restriction is needed. If RAN4 agreed the timing offset is larger than one CP, UE is required to measure one of but not both SSBs or SSB and CSI-RS. Longer measurement period for SSB based L1-RSRP measurement is expected, and no requirements are defined.Proposal 17: For inter-cell beam management and inter-cell mTRP, RAN4 to study whether the MRTD requirement could be reused for non-serving cell. |
| R4-2204397 | Intel | **Proposal 1: If SSB configuration for L1 measurement are fully overlapped with SMTC, the same RX beam will be used for L3 and L1 measurement inside SMTC. Intermediate results of L3-RSRP measurement can be used for L1 measurement for both FR1 and FR2 and there is no need to specify timing offset assumption for this case.****Proposal 2: If SSB configuration for L1 measurement are partially overlapped with SMTC, UE can perform inter-cell L1-RSRP both inside and within SMTC. Inside SMTC, the same RX beam will be used for L3 and measurement and timing offset assumption inside SMTC will be within one CP.****Proposal 3: L3 measurement will be configured before L1 measurement configuration.****Proposal 4: For SSB outside SMTC, RX beam will be different for serving cell and cell with different PCI.****Proposal 5: Prioritize the requirement for the scenario that SSB configuration for serving cell and cell with different PCI are the same, i.e. SSB configuration are fully overlapped for serving cell and cell with different PCI.****Proposal 6: If SSB configuration for serving cell and cell with different PCI are fully overlapped, a sharing factor X is needed on top of *P* factor for inter-cell L1-RSRP measurement, where X=3.****Proposal 7: RX beam sweeping factor can be further reduced for inter-cell L1-RSRP measurement , e.g. N=4 or 5 to minimize the impact to serving cell L1 measurement.****Proposal 8:** **If SSB configuration for inter-cell beam measurement is fully overlapped with SMTC and the cell is known, the measurement period will be similar to T SSB\_measurement\_period\_intra defined in 9.2.5.2, where one or three sample will take place of 5 samples for FR1 and 8 or 24 samples will be used for FR2.****Proposal 9: If the cell is unknown, extra cell search time and SSB index deriving time may be needed, the total delay time is Tcell search + Tmeasurement + TSSB index.****Proposal 10:** **For unknown case, if SSB configuration for serving cell and cell with different PCI are the same and timing offset is assumed to be less than CP, cell search time and SSB index deriving time can be skipped.** |
| R4-2204517 | Qualcomm Incorporated | **Observation 1: UEs should be able to measure L1-RSRP for non-serving cells irrespective of the timing offset within SMTC****Observation 2: Same Rx beam set should be used for all measurements of the same type.****Observation 3: Whether the cell has been detectable in last X seconds should be the main criteria for determining known/unknown cell.****Observation 4: Measurement requirements should be the same as legacy such that measurement consistency is maintained.****Observation 5: The same sharing factors should be reused for neighbor cell L1-RSRP measurements.** |
| R4-2204697 | Samsung | **Observation 1: UE behaviours for L1-RSRP measurement on NSC may be different for different cases of measurement on FR1/FR2 or inside/outside SMTC.****Proposal 1: For FR1, L3 measurement should be configured for UE prior to inter cell L1-RSRP measurement configured.****Proposal 2: For FR1, RRM requirements are applicable for UE receiving SSBs from cells with different PCI provided receiving timing difference among serving cell and cells with different PCIs is less than CP.****Observation 2: For FR2, UE cannot receive SSBs from cells with different PCI** **simultaneously.****Proposal 3: For FR2 outside SMTC case, if NSC SSBs are fully-overlapped with SC, sharing factor can be introduced between measurements for SC and NSC; if NSC SSBs are partially-overlapped with SC, only those not overlapped SSBs from NSC can be used for NSC L1-RSRP measurement.****Proposal 4: For FR2 inside SMTC case, UE perform L1-RSRP measurement and L3 measurement separately by using different Rx beams; introduce scaling factor for RRM requirement of L1-RSRP measurement on NSC.** |
| R4-2204698 | Samsung | **Observation 1: The feature “L1-RSRP measurement on cell(s) with PCI different from serving cell” is defined for the case of intra-DU and intra-frequency measurement where only SSB-based measurement is supported in NR SA and at most [*NumberOfAdditionalPCI*] cells can be measured.****Observation 2: SNR requirement (side condition) for L1-RSRP measurement is higher than L3-RSRP measurement.** **Proposal 1: RRM requirement should be applicable for L1-RSRP measurement within SMTC provided the L3 measurement for the same NSC is also configured.****Proposal 2: For FR1, UE is able to simultaneous measure L1 for serving cell and non-serving cell within SMTC assuming L1-RSRP is intermediate results of L3-RSRP measurement, i.e., without L3 filter, UE could obtain the L1 results.** **Proposal 3: For FR2 measurement inside STMC, the same beam assumption as outside SMTC is reused that fine beam and rough beam is used for L1 and L3 measurement respectively.****Proposal 4: An intra-frequency NSC shall be considered detectable when for each relevant SSB existing L1-RSRP related side conditions for a corresponding band are fulfilled, which is one of necessary conditions for known NSC.****Observation 3: Based on above assumptions, a scaling factor are needed for L1 and L3 measurement requirement for SSB-based measurement on SC and known NSC.****Observation 4: Scheduling availability is needed for** **L1-RSRP measurement on NSC when the measurement is outside SMTC which may cause transmission performance degradation.****Proposal 5: RRM requirement for L1-RSRP measurement on NSC should apply to the measurement resources configured as SSBs within the active BWP from the cell to be measured.****Proposal 6: Following the assumptions in the above proposals, the measurement requirement of L1-RSRP for serving cell can be used as a baseline requirement for cell with different PCI provided the NSC is known. On this basis, for measurement inside SMTC, scaling factor is introduced for the requirement; for the measurement outside SMTC, scheduling availability and measurement restriction could be defined. For unknown NSC, RAN4 can further study how to define the requirement for different cases.** |
| R4-2205017 | ZTE Corporation | **Proposal 1: For the known condition of non-serving cell configured for L1-RSRP measurements, based on the known condition of intra-frequency handover, some reduction can be further considered.** **Proposal 2: The reduction can be derived from two aspects:**1. **Simplify TPSS/SSS\_sync\_intra to T∆;**
2. **The side condition should be oriented to L1 measurement, no longer L3 measurement.**

**Proposal 3: In order to guarantee sufficient flexibility for L1 SSB configuration of NSC as similar as serving cell, which should not be limited by the configuration of SMTC and MG.****Proposal 4: Re-using the existing collision handling in legacy Rel-16 to resolve the possible collision between L1 SSB used for NSC measurement and SMTC/MG.****Proposal 5: For FR1, we should wait for the conclusion of whether UE can simultaneously perform L1 measurement for SC and NSC to identify the measurement requirements of L1-RSRP measurement for NSC.****Proposal 6: For FR2, except for the conclusion of whether UE can simultaneously perform L1 measurement for SC and NSC, whether UE is capable of IBM should further be considered. If the UE is not capable of IBM, the UE can not simultaneously perform L1 measurement for SC and NSC absolutely. So an additional scaling factor referring to the overlapping between L1 SSB of SC and NCS should be considered.****Proposal 7: Forcing the L1 measurement for NSC as one-shot is not reasonable.****Proposal 8: As long as Option 1 can be realized by UE vendor, we prefer Option 1, since Option 2 would lead to longer measurement period which is contradictory with the motivation of introduction of L1-RSRP measurement for NSC.****Proposal 9: No matter for the case outside SMTC or the case within SMTC, the fine beam used to receive L1-SSBs from SC and NSC by UE are possible different.** |
| R4-2205040 | Nokia, Nokia Shanghai Bell | **Observation 1 :** For FR1 UEs, there is no additional UE complexity related to performing simultaneous L3- and L1- RSRP on same SSB occasion.**Proposal 1 :** FR1 UE is able to simultaneously measure L1 for serving cell and non-serving cell when measuring within same SMTC window, assuming L1-RSRP is an intermediate result of L3-RSRP measurement (hence, using 1 or 3 samples out of 5 samples). It is assumed UE can obtain L1-RSRP measurements results based on a subset of the L3 RSRP measurement results before applying a L3 filtering.**Proposal 2 :** We support Option 1 regarding whether FR1 UE is able to simultaneously measure L1-RSRP for serving cell and non-serving cell within SMTC :* Specify option 1 with clarification in Proposal 1
* FR1 UE is also able to measure L1-RSRP for serving cell and non-serving cell outside of SMTC without restriction.

**Proposal 3 :** For FR1 UEs, assuming single FFT implementation, if the received timing offset between the SC and NSC cells is within the CP, the UE is able to perform simultaneous L1 measurements on serving and non-serving cell. **Proposal 4 :** For FR1 UEs, assuming single FFT implementation, if the received timing offset between the SC and NSC cells is larger than CP, a UE is only required to perform L1 measurements sequentially on SC and NSC. RAN4 defines measurement period for this case with separate measurement conditions. **Proposal 5 :** For FR1 UE, we propose to apply measurement period TL1-RSRP\_Measurement\_Period\_SSB for FR1 in TS38.133 Table 9.5.4.1-1.**Proposal 6 :** FR1 UE should be able to measure L1-RSRP on SC and NSC simultaneously and simultaneously with L3 measurements without a measurement time sharing factor. Otherwise, if simultaneous measurements are not possible out of the measurement conditions, a time-sharing factor is defined for requirements.**Proposal 7 :** RAN4 separately specifies non-serving cell measurement (known) conditions for FR1 UE and FR2 UE. Conditions will be different between FR1 UE and FR2 UE.**Proposal 8 :** Given the assumption from the agreement that L3-RSRP measurement delay shall not be impacted by NSC measurements, then L1 measurement on NSC cannot be supported within SMTC window. **Proposal 9 :** RAN4 works on NSC L1-RSRP measurement period requirement that a UE measures NSC L1-RSRP outside of SMTC window for Rel-17 requirement.**Proposal 10 :** RAN4 spec does not restrict L1-measurement behavior on NSC within or outside SMTC. A spec does not prohibit FR2 UE behavior to measure L1-RSRP on NSC within SMTC widow.**Proposal 11 :** In case, if a FR2 UE measures NSC L1-measurement within SMTC window, a beam assumption can be up to UE implementation, however a UE should satisfy current FR2 L1-RSRP accuracy requirement. **Proposal 12 :** For cell detection condition we agree to apply the measurement conditions specified in *TS38.133 chapter 10.1.19.1* and *10.1.20.1* for NSC L1 RSRP measurements under NSC known conditions for FR1 UE and FR2 UE respectively.**Proposal 13 :** For FR2 UE, we propose to reuse measurement period TL1-RSRP\_Measurement\_Period\_SSB in TS38.133 Table 9.5.4.1-2 as baseline.**Proposal 14 :** For FR2 UE, L1-RSRP measurement period requirement on serving cell is not impacted by NSC measurement period, if SSBs from SC and NSC are not overlapped.**Proposal 15 :** When SSBs from SC and NSC are overlapped, a new sharing factor is applied to the L1-RSRP requirement in Table 9.5.4.1-2. (FFS : value of sharing factor)**Proposal 16 :** When a UE measures NSC L1 RSRP measurement, a UE is expected to have RX scheduling restriction from a serving cell. |
| R4-2205336 | Huawei, HiSilicon | ***Proposal 1: For L1-RSRP measurement on cell with different PCI, the known conditions for cell with different PCI can be defined as follows:**** ***The cell with PCI different is an intra-frequency cell.***
* ***The cell with PCI different has been identified and meets the existing intra-frequency cell detectable conditions defined in*** ***clause 9.2.5 during the last 5 seconds.***
* ***Timing alignment between the serving cell and the cell with different PCI are within CP length.***

***Proposal 2: It is suggested that fine beam is always assumed for L1-RSRP measurements on cell with different PCI, regardless of outside SMTC or inside SMTC.******Proposal 3: When the SSB associated with different PCI is within SMTC, UE is required to perform one of but not both L1 measurement and L3 measurement.*** ***Proposal 4: For L1-RSRP measurements on cell with different PCI, whether and how to perform L1 measurement inside SMTC follows the existing definition of sharing factor P used for L1-RSRP measurements on serving cell.******Proposal 5: When SSB of cell with different PCI is non-overlapped with SSB of serving cell, the existing SSB based L1-RSRP measurement requirements for serving cell can be reused for cell with different PCI.******Proposal 6: When SSB of cell with different PCI is partial or fully overlapped with SSB of serving cell, L1-RSRP measurement requirements for cell with different PCI can be defined based the existing SSB based L1-RSRP measurement requirements for serving cell, and new sharing factor will be introduced to SSB based L1-RSRP measurement requirements for both serving cell and the cell with different PCI, which can be defined as follow:***

|  |  |  |  |
| --- | --- | --- | --- |
| **#** | **Scenario** | **PSC** | **PNSC** |
| 1 | TSSB,SC = TSSB,NSC ≤ TSMTC | 2 | 2 |
| 2 | TSSB,SC < TSSB,NSC = TSMTC, orTSSB,NSC < TSSB,SC = TSMTC | 1 | 1 |
| 3 | TSSB,SC < TSSB,NSC < TSMTC | $$\frac{1}{1-\frac{T\_{SSB,SC}}{T\_{SSB,NSC}}}$$ | 1 |
| 4 | TSSB,NSC < TSSB,SC < TSMTC | 1 | $$\frac{1}{1-\frac{T\_{SSB,NSC}}{T\_{SSB,SC}}}$$ |
| Note: PSC is the new sharing factors used for L1-RSRP measurements on serving cell, and PNSC is the new sharing factors used f.or L1-RSRP measurements on cell with different PCI |

***Proposal 7: When SSB of cell with different PCI is partial or fully overlapped with CSI-RS of serving cell, the existing measurement restriction requirements can be reused and there is no need to define additional sharing factor for CSI-RS based L1 measurements.*** |
| R4-2205844 | Ericsson | **Proposal 1: For FR1, within SMTC, L3 measurement framework can be reused. That means timing offset and FFT assumption should follow L3 measurement principles.****Proposal 2: If SSB configured on NSC for L1-RSRP is subset of SSB configured for L3-RSRP, no additional delay is needed for L1-RSRP measurement and L1-RSRP computed in L3-RSRP can be used for L1-RSRP of NSC.****Proposal 3: Known condition for cell with different PCI shall include at least** * **RAN1 agreements for non-serving cell, i.e., same centre frequency, SCS, SFN offset**
* **Cell detectable condition (FFS : existing intra-frequency measurement can be reused)**
* **Timing alignment between serving cell and cell with different PCI are within CP for outside SMTC.**

**Proposal 4: For FR1 and inside SMTC, if SSB configured for L1-RSRP is not subset of SSB configured for L3-RSRP, L1-RSRP measurement delay is TPSS/SSS\_sync\_intra + TSSB\_time\_index\_intra + TL1-RSRP\_Measurement\_Period\_SSB\_NSC ms.****Proposal 5: For FR1 and outside SMTC, if the cell is not known, L1-RSRP measurement delay for outside SMTC is TPSS/SSS\_sync\_intra + TSSB\_time\_index\_intra + TL1-RSRP\_Measurement\_Period\_SSB\_NSC ms.****Proposal 6: For FR1 and outside SMTC, when the timing offset between serving cell and non-serving cell is within CP, UE should measure overlapping neighbour cells at the same time. Number of neighbour cells UE can measure at the same time is a UE capability.****Proposal 7: For FR1 and outside SMTC, when the timing offset between serving cell and non-serving cell is not within the CP, UE should measure the neighbour cells in TDM fashion b adjusting the FFT as per the serving cell or additional serving cell timing.****Proposal 8: For FR2 and inside SMTC, same RX beam should be assumed for L1 and L3 RSRP for NSC L1-RSRP.****Proposal 9: For FR2 and outside SMTC, RAN4 shall initially define requirements for the scenario where SSB of SC and NSC are fully overlapping.** **Proposal 10: For FR2 and outside SMTC, when SSB of SC and NSC(s) are overlapping, UE shall be able to measure the all the SSB at the same time based on UE capability. If the SSB to be measured are more than UE capability, sharing factor to be introduced in FR2.****Proposal 11: RAN4 to support L1-RSRP measurement on NMAX+1 TRPs.**  |

## Open issues summary

Please note that for Topic#1 some proposals (issues) might be omitted by purpose as they are deprioritized in the 1st round discussion or out of scope of [227]. In this document, “a cell with different PCI” may refer to “NSC” for convenience.

### Sub-topic 1-1: UE L1-RSRP measurement on NSC

**Issue 1-1-1 L1-RSRP measurement on NSC configured for UE**

* Proposals (Apple, Intel, Samsung): Cell with different PCI configured for intercell-L1-RSRP measurement should first have performed L3 measurement.
	+ Option 1: Support
	+ Option 2: Do not support
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round. If the proposal is supported (option 1), it suggests that L1-RSRP measurement on NSC that has been identified.

**Issue 1-1-2 Known NSC condition for L1-RSRP measurement**

* Proposals
	+ Proposal 1 (Apple): Define known cell condition for NSC

|  |
| --- |
| **In FR1 the cell is known if it has been meeting the relevant cell identification requirement during the last 5 seconds.****In FR2 the cell is known if, during the last 5 seconds** * **the UE has sent a valid measurement report for the cell with different PCI and**
* **One of the SSBs measured from the cell with different PCI being configured remains detectable**
 |

* + Proposal 2 (vivo): Update bullet 2, i.e. ‘Cell detectable condition (FFS: existing intra-frequency measurement can be reused)’, as
		- After the corresponding cells configured for L1 measurements meet the detectable condition in 9.2.2 for [5] seconds, and
		- The SSBs configured for inter-cell L1 measurements meet the side conditions specified in 9.5.2.
	+ Proposal 3 (MTK): Non-serving cell is known if UE transmits any L1-RSRP measurement report for the non-serving cell within [X] ms before UE performs the L1-RSRP measurement. FFS: [X] for the valid L1-RSRP report.
	+ Proposal 4 (QC): Whether the cell has been detectable in last X seconds should be the main criteria for determining known/unknown cell.
	+ Proposal 5 (Samsung): An intra-frequency NSC shall be considered detectable when for each relevant SSB existing L1-RSRP related side conditions (*TS38.133 chapter 10.1.19.1* and *10.1.20.1*) for a corresponding band are fulfilled, which is one of necessary conditions for known NSC.
	+ Proposal 6 (ZTE): For the known condition of non-serving cell configured for L1-RSRP measurements, based on the known condition of intra-frequency handover, and some reductions:
		- Simplify TPSS/SSS\_sync\_intra to T∆;
		- The side condition should be oriented to L1 measurement, no longer L3 measurement.
	+ Proposal 7 (Nokia): RAN4 separately specifies non-serving cell measurement (known) conditions for FR1 UE and FR2 UE.
	+ Proposal 8 (Huawei):

|  |
| --- |
| * ***The cell with PCI different is an intra-frequency cell.***
* ***The cell with PCI different has been identified and meets the existing intra-frequency cell detectable conditions defined in*** ***clause 9.2.5 during the last 5 seconds.***
* ***Timing alignment between the serving cell and the cell with different PCI are within CP length.***
 |

* + Proposal 9 (Ericsson): Known condition for cell with different PCI shall include at least
		- RAN1 agreements for non-serving cell, i.e., same centre frequency, SCS, SFN offset
		- Cell detectable condition (FFS : existing intra-frequency measurement can be reused)
		- Timing alignment between serving cell and cell with different PCI are within CP for outside SMTC
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round.
	+ Considering too many proposals for this issue, Moderator suggest companies to simply select known condition from
		- Option 1: NSC is known if NSC meets the existing intra-frequency requirement defined in clause 9.2.5 during the last [x]s.
		- Option 2: NSC is known if NSC is detectable, i.e. L1-RSRP side conditions given in clause 10.1.19.1 and 10.1.20.1.

**Issue 1-1-3 Unknown NSC condition for L1-RSRP measurement**

* Proposals
	+ Option 1 (vivo):
		- The unknown conditions for cell with different PCI at least include
			* RAN1 agreements for non-serving cell, i.e., same center frequency, SCS, SFN offset
			* After the corresponding cells configured for L1 measurements meet the detectable condition in 9.2.2 for [5] seconds
			* Timing alignment between serving cell and cell with different PCI are larger than CP
	+ Option 1a (vivo):
		- For unknown conditions in FR1 and FR2, single-FFT capable UE is required to perform inter-cell L1-RSRP measurements only inside SMTC
	+ Option 2:
		- NSC is unknown provided the known condition is not meet.
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round.

**Issue 1-1-4 Assumptions for defining inter-cell L1-RSRP measurement requirement**

* Proposals
	+ Proposal 1 (Apple): RAN4 doesn’t need to specify Rx beam assumption for inter-cell L1-RSRP measurements when SSBs overlap with SMTC either partially or fully.
	+ Proposal 2 (CMCC): For the case within SMTC, UE is able to simultaneously measure L1 for serving cell and L1 for non-serving cell and no need to limit the timing offset within CP.
	+ Proposal 3 (vivo): For known conditions in FR1 and FR2, single-FFT capable UE is required to perform inter-cell L1-RSRP measurements for both inside SMTC and outside SMTC.
	+ Proposal 4 (vivo): For known conditions in FR1 and FR2, RRM requirements are specified assuming single-FFT capable UE only performs inter-cell L1-RSRP measurements outside SMTCs for the case SSBs for inter-cell L1-RSRP measurements are not fully overlapped with SMTCs, and the SSB occasions outside SMTCs are not fully overlapped with measurement gaps.
	+ Proposal 5 (vivo): For the inside SMTC case, L1-RSRP measurement requirements for the cell with different PCI is specified assuming using same RX beams for L3 measurements, if ‘*timeRestrictionForChannelMeasurement*’ is not configured.
	+ Proposal 6 (MTK): rough beam for L3 measurement and fine beam for L1 measurement for inside SMTC
	+ Proposal 7 (Intel):
		- If SSB configuration for L1 measurement are fully overlapped with SMTC, the same RX beam will be used for L3 and L1 measurement inside SMTC. No need to specify timing offset assumption for this case. No need to specify timing offset assumption for this case.
		- If SSB configuration for L1 measurement are partially overlapped with SMTC, UE can perform inter-cell L1-RSRP both inside and within SMTC. Inside SMTC, the same RX beam will be used for L3 and measurement and timing offset assumption inside SMTC will be within one CP.
		- For SSB outside SMTC, RX beam will be different for serving cell and cell with different PCI.
	+ Proposal 7 (Qualcomm): UEs should be able to measure L1-RSRP for non-serving cells irrespective of the timing offset within SMTC
	+ Proposal 8 (Huawei): Fine beam is always assumed for L1-RSRP measurements on cell with different PCI, regardless of outside SMTC or inside SMTC.
	+ Proposal 9 (Ericsson): For FR1, within SMTC, L3 measurement framework can be reused. That means timing offset and FFT assumption should follow L3 measurement principles.
	+ Proposal 10 (Ericsson):
		- For FR1 and outside SMTC, when the timing offset between serving cell and non-serving cell is within CP, UE should measure overlapping neighbour cells at the same time. Number of neighbour cells UE can measure at the same time is a UE capability.
		- For FR1 and outside SMTC, when the timing offset between serving cell and non-serving cell is not within the CP, UE should measure the neighbour cells in TDM fashion by adjusting the FFT as per the serving cell or additional serving cell timing.
		- For FR2 and inside SMTC, same RX beam should be assumed for L1 and L3 RSRP for NSC L1-RSRP.
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round.
	+ Considering too many proposals for this issue, Moderator suggest companies to at least share their views on issues that
		- I1: Measurement within SMTC, for FR1, whether measurement on SC and NSC can be performed simultaneously.
		- I2: Measurement on NSC within SMTC, for FR2, whether the same Rx beam for L1 and L3 can be assumed.
		- I3: Measurement on NSC within SMTC, whether timing offset within CP is needed.

**Issue 1-1-5 Introduce sharing factor for inter-cell L1-RSRP measurement requirement**

* Proposals
	+ Proposal 1 (Apple): Specify sharing factors when SSBs for inter-cell L1-RSRP measurements overlap with serving cell SSB for L1 measurement, SMTC, measurement gap.
	+ Proposal 2 (Apple): Define equal sharing between serving cell and cell with different PCI in FR2 when SSBs overlap.
	+ Proposal 3 (Huawei): When SSB of cell with different PCI is partial or fully overlapped with SSB of serving cell, L1-RSRP measurement requirements for cell with different PCI can be defined based the existing SSB based L1-RSRP measurement requirements for serving cell, and new sharing factor will be introduced to SSB based L1-RSRP measurement requirements for both serving cell and the cell with different PCI, which can be defined as follow:

|  |  |  |  |
| --- | --- | --- | --- |
| **#** | **Scenario** | **PSC** | **PNSC** |
| 1 | TSSB,SC = TSSB,NSC ≤ TSMTC | 2 | 2 |
| 2 | TSSB,SC < TSSB,NSC = TSMTC, orTSSB,NSC < TSSB,SC = TSMTC | 1 | 1 |
| 3 | TSSB,SC < TSSB,NSC < TSMTC | $$\frac{1}{1-\frac{T\_{SSB,SC}}{T\_{SSB,NSC}}}$$ | 1 |
| 4 | TSSB,NSC < TSSB,SC < TSMTC | 1 | $$\frac{1}{1-\frac{T\_{SSB,NSC}}{T\_{SSB,SC}}}$$ |

* + Proposal 4 (CMCC): On top of Rel-15/16 requirements, new scaling factor of PNSC is needed for FR2.
		- If SSB period for SC and SSB period for NSC are partial overlapped, UE only perform SC/NSC L1-RSRP measurement on the SSBs not overlapped, by sharing factor.
		- If SSB period for SC and SSB period for NSC are partial overlapped, sharing factor FFS.
	+ Proposal 5 (Ericsson):
		- For FR2 and outside SMTC, RAN4 shall initially define requirements for the scenario where SSB of SC and NSC are fully overlapping.
		- For FR2 and outside SMTC, when SSB of SC and NSC(s) are overlapping, UE shall be able to measure the all the SSB at the same time based on UE capability. If the SSB to be measured are more than UE capability, sharing factor to be introduced in FR2.
	+ Proposal 6 (Intel): If SSB configuration for serving cell and cell with different PCI are fully overlapped, a sharing factor X is needed on top of *P* factor for inter-cell L1-RSRP measurement, where X=3.
	+ Proposal 7 (vivo): RRM requirements for FR1 and FR2 in R17 are specified by
		- Introduce additional sharing factor Mcell for L1 measurements requirements for the case SSBs for cells with different PCIs overlap outside SMTC, so as to allow UE to perform the L1 measurement from one cell at a time. Mcell equals to the number of cells whose L1 measurement occasions are overlapped. The L1 measurements also include RLM/BFD/CBD measurements.
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round.
	+ For information, according to RAN1 agreement, UE capability of the maximal number [X1] for measuring fully-overlapped SSBs is under RAN1 discussing. Proposal 3 and 4 are following the same logic.
	+ Moderator Proposed that:
		- For the case SSBs for different purposes are overlapped (time and frequency), if they can be measured by the same beam, and the number of these SSBs are less or equal than [Y], then no sharing factor; otherwise sharing factor to be introduced.
		- The introduced sharing factor following the logic of proposal 3 and **Issue 2-2-1** UE behaviours.

**Issue 1-1-6 Applicability of RRM requirements for UE L1-RSRP measurements on NSC**

* Proposals
	+ Proposal 1 (vivo): for inside SMTC in FR1 and FR2, requirements are applicable
		- for unknown condition, if SSBs for inter-cell L1-RSRP measurements are either fully overlapped or partially overlapped SMTC, or
		- for known condition, if SSBs for inter-cell L1-RSRP measurements are fully overlapped with SMTC, or
		- for known condition, if SSBs for inter-cell L1-RSRP measurements are partially overlapped with SMTC, but the SSBs outside STMC are fully overlapped with measurement gaps.
	+ Proposal 2 (MTK): UE is not required to transmit L1-RSRP measurement report if the SSB from the non-serving cell is undetectable.
	+ Proposal 3 (MTK): To introduce a new UE capability for indicating whether the UE supports concurrent intra-frequency measurement on non-serving cell and PDCCH or PDSCH reception from the serving cell and non-serving cell with a different numerology.
	+ Proposal 4 (MTK): Inside SMTC for FR1 and FR2, not to define the requirement when the timing offset between serving cell and non-serving cell is larger than one CP, because no use cases.
	+ Proposal 5 (Samsung): For FR1, RRM requirements are applicable for UE receiving SSBs from cells with different PCI provided receiving timing difference among serving cell and cells with different PCIs is less than CP.
	+ Proposal 6 (Samsung): RRM requirement for L1-RSRP measurement on NSC should apply to the measurement resources configured as the SSB within the active BWP or the active downlink BWP is initial BWP.
	+ Proposal 7 (Nokia): Given the assumption from the agreement that L3-RSRP measurement delay shall not be impacted by NSC measurements, then L1 measurement on NSC cannot be supported within SMTC window. RAN4 works on NSC L1-RSRP measurement period requirement that a UE measures NSC L1-RSRP outside of SMTC window for Rel-17 requirement.
	+ Proposal 8 (MTK) For inter-cell L1-RSRP measurement performed outside SMTC for FR1 and FR2, not to define the requirement for the case when the timing offset between serving cell and non-serving cell is larger than one CP.
	+ Proposal 9(vivo): RRM requirements for FR1 and FR2 in R17 are specified as
		- No RRM requirements are specified for the case SSBs for serving cell and any cell with a different PCI overlap outside SMTC, and measurement restriction is introduced for this case.
		- No RRM requirements are specified for the case inside SMTC and UE is configured with *timeRestrictionForChannelMeasurement* for L1 measurements on both serving cell and cells with different PCIs in R17, and the corresponding SSBs for L1-RSRP measurements are overlapped.
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round.
	+ Moderator proposed that the requirement is applicable to (defined for)
		- known NSC (known condition is up to **Issue 2-1-2** based on the last meeting WF); and
		- unknown NSC on a certain condition (e.g. when SSBs from NSC for L1-RSRP measurements are measured within SMTC).

### Sub-topic 1-2: Behaviours for L1-RSRP measurement on NSC

**Issue 1-2-1 How to define L1-RSRP measurement on NSC**

* Proposals
	+ Proposal 1 (CMCC): For the case within SMTC, UE is able to simultaneously measure L1 for serving cell and L1 for non-serving cell and no need to limit the timing offset within CP.
	+ Proposal 2 (Samsung, Nokia, Ericsson): For FR1, UE is able to simultaneous measure L1 for serving cell and non-serving cell within SMTC assuming L1-RSRP is intermediate results of L3-RSRP measurement, i.e., without L3 filter, UE could obtain the L1 results.
	+ Proposal 3 (Nokia): For FR1 UEs, assuming single FFT implementation, if the received timing offset between the SC and NSC cells is within the CP, the UE is able to perform simultaneous L1-RSRP measurements on serving and non-serving cell. If larger than CP, a UE is only required to perform L1-RSRP measurements sequentially on SC and NSC. RAN4 defines measurement period for this case with separate measurement conditions.
	+ Proposal 4 (Huawei): When the SSB associated with different PCI is within SMTC, UE is required to perform one of but not both L1 measurement and L3 measurement. For L1-RSRP measurements on cell with different PCI, whether and how to perform L1 measurement inside SMTC follows the existing definition of sharing factor P used for L1-RSRP measurements on serving cell.
	+ Proposal 5 (ZTE):An additional scaling factor referring to the overlapping between L1 SSB of SC and NCS should be considered.
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round
	+ Moderator proposed the basic logic of defining the requirement that
		- For outside SMTC, UE scheduling availability for serving cell may be introduced.
		- For FR1 inside SMTC, measurement on SC and NSC can be performed by the same beam; and L1 and L3 measurement on NSC can be performed simultaneously.
		- For FR2 inside SMTC, measurement on SC and NSC CANNOT be performed by the same beam; and whether L1 and L3 measurement on NSC can be performed simultaneously depends on the FR2 Rx beam assumption in **Issue 2-1-3. And Issue 2-1-4**

**Issue 1-2-2 UE behaviour when SSBs associated with different PCIs overlap**

* Proposals
	+ Proposal 1 (Apple):
		- For FR1, the UE is capable of measuring SSBs from serving cell and cell with different PCI without restriction.
		- For FR2, RAN4 defines sharing factor between SSB resources from serving cell and cell with different PCI, between which are equally shared.
	+ Proposal 2 (Intel): Prioritize the requirement for the scenario that SSB configuration are fully overlapped for serving cell and cell with different PCI.
	+ Proposal 3 (Samsung):
		- For FR2 outside SMTC case, if NSC SSBs are partially-overlapped with SC, only those not overlapped SSBs from NSC can be used for NSC L1-RSRP measurement.
		- For FR2 inside SMTC case, if NSC SSBs are fully-overlapped with SC, UE perform L1-RSRP measurement and L3 measurement separately by using different Rx beams; introduce scaling factor for RRM requirement of L1-RSRP measurement on NSC.
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round. The conclusion will be based on **Issue 2-1-4** and **Issue 2-2-1**.

**Issue 1-2-3 Measurement restrictions on inter-cell L1-RSRP measurement**

* Proposals
	+ Proposal 1 (Apple): Define Measurement restriction on SSB based L1-RSRP measurements for cell with different PCI, if the SSB from cell with different PCI is on the same OFDM symbol as CSI-RS from serving cell for other L1 measurements.
	+ Proposal 2(vivo): For FR1, introduce new measurement restrictions for the cases when
		- L1-RSRP measurement occasions for cell with different PCI are overlapped with serving cell RLM/BFD/CBD measurement occasions outside SMTC, or
		- L1-RSRP measurement occasions for cell with different PCI are overlapped with serving cell RLM/BFD/CBD measurement occasions inside SMTC, and *timeRestrictionForChannelMeasurement* for L1 measurements is configured for the cell with different PCI.
	+ Proposal 3 (vivo): For FR2, legacy measurement restrictions for L1 measurements are only re-used for
		- L1-RSRP measurement occasions for cell with different PCI are overlapped with serving cell RLM/BFD/CBD measurement occasions outside SMTC, or
		- L1-RSRP measurement occasions for cell with different PCI are overlapped with serving cell RLM/BFD/CBD measurement occasions inside SMTC, and *timeRestrictionForChannelMeasurement* for L1 measurements is configured for the cell with different PCI.
	+ Proposal 4 (MTK): Extend the measurement restriction requirement to include the case when two SSBs from serving cell and non-serving cell are collided in the same OFDM symbol
	+ Proposal 5 (Huawei): When SSB of cell with different PCI is partial or fully overlapped with CSI-RS of serving cell, the existing measurement restriction requirements can be reused and there is no need to define additional sharing factor for CSI-RS based L1 measurements.
	+ Proposal 6 (ZTE): For FR1, if UE can not perform L1 measurements for SC and NSC simultaneously, it would lead to longer measurement period which is contradictory with the motivation of introduction of L1-RSRP measurement for NSC. For FR2, the UE can not simultaneously perform L1 measurement for SC and NSC absolutely.
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round.
	+ Companies could directly give their text proposal by revising the corresponding draft CR.

**Issue 1-2-4 Scheduling availability for UE performing L1-RSRP measurement**

* Proposals
	+ Proposal 1 (Apple): Define scheduling availability for UE performing L1-RSRP measurement on cell with different PCI.
	+ Proposal 2 (vivo): For FR1, introduce new scheduling restrictions for the cases when L1-RSRP measurements for cell with different PCI are performed outside SMTC.
	+ Proposal 3 (vivo): For FR2, legacy scheduling restrictions for L1 measurements are re-used for the cases when L1-RSRP measurements for cell with different PCI are performed outside SMTC.
	+ Proposal 4 (MTK): For the scheduling availability, two cases should be considered:
		- the data from serving cell and the SSB from non-serving cell for L1-RSRP measurement are transmitted in the same OFDM symbol
		- the data from non-serving cell and the SSB from serving cell for L1-RSRP measurement are transmitted in the same OFDM symbol
* Proposal 5 (MTK): For the scheduling availability, when the L1-RSRP measurement is performed within SMTC, 1 data symbol before and after SSB symbols are needed if RAN4 agreed that the timing offset between serving cell and non-serving cell is larger than one CP
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round.
	+ The proposals are basically aligned. Companies could directly give their text proposal by revising the corresponding draft CR.

**Issue 1-2-5 Whether to jointly consider the requirement of IBM and inter cell beam management**

* Proposal 1 (MTK): RAN4 to discuss whether the scheduling restriction requirement of inter-cell beam management should be extend to FR2 inter-band CA with independent beam management.
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round.
	+ From Moderator’s view, No IBM issue exists in intra-frequency measurement.

### Sub-topic 1-3: Delay requirement for L1-RSRP measurement on NSC

**Issue 1-3-1 L1-RSRP measurement delay requirements on cell with different PCI**

* Proposals
	+ Proposal 1(CMCC): For FR1
		- Within SMTC, existing L1-RSRP measurement delay requirements can be reused, assuming UE is able to simultaneously measure L1 for SC and NSC;
		- Outside SMTC, existing L1-RSRP measurement delay requirements can be reused, provided timing offset within CP;
		- Nmax has no impact on the delay requirements.
	+ Proposal 2 (MTK): For FR1 and FR2
		- In the L1-RSRP measurement for non-serving cell, to include the time of cell search, SSB index acquisition and L1-RSRP measurement (i.e. TPSS/SSS\_sync\_intra, TSSB\_time\_index\_intra and TL1-RSRP\_Measurement\_Period\_SSB) and NOT to include the L3 measurement (TSSB\_measurement\_period\_intra).
		- For the L1-RSRP measurement of non-serving cell, if the non-serving cell is known and the L1-RSRP report for the SSB to be measured is transmitted within [X] ms before the measurement is performed, the TPSS/SSS\_sync\_intra and TSSB\_time\_index\_intra can be skipped
		- For the L1-RSRP measurement of non-serving cell, if the non-serving cell is known and the L1-RSRP report for the SSB to be measured is not transmitted within [X] ms before the measurement is performed, the TPSS/SSS\_sync\_intra and TSSB\_time\_index\_intra can be skipped.
		- For the L1-RSRP measurement of non-serving cell, if the non-serving cell is unknown and the L1-RSRP report for the SSB to be measured is not transmitted within [X] ms before the measurement is performed, the TPSS/SSS\_sync\_intra and TSSB\_time\_index\_intra are needed, where the [X] can be the same as the known confition of the non-serving cell.
	+ Proposal 3 (Intel):
		- If SSB configuration for serving cell and cell with different PCI are fully overlapped, a sharing factor X is needed on top of *P* factor for inter-cell L1-RSRP measurement, where X=3. RX beam sweeping factor can be further reduced for inter-cell L1-RSRP measurement , e.g. N=4 or 5 to minimize the impact to serving cell L1 measurement.
		- If SSB configuration for inter-cell beam measurement is fully overlapped with SMTC and the cell is known, the measurement period will be similar to T SSB\_measurement\_period\_intra defined in 9.2.5.2, where one or three sample will take place of 5 samples for FR1 and 8 or 24 samples will be used for FR2.
	+ Proposal 4 (Samsung): The measurement requirement of L1-RSRP for serving cell can be used as a baseline requirement for cell with different PCI provided the NSC is known. On this basis, for measurement inside SMTC, scaling factor is introduced for the requirement; for the measurement outside SMTC, scheduling availability and measurement restriction could be defined.
	+ Proposal 5 (Nokia): For FR1 UE, apply measurement period TL1-RSRP\_Measurement\_Period\_SSB for FR1 in TS38.133 Table 9.5.4.1-1. For FR2 UE, we propose to reuse measurement period TL1-RSRP\_Measurement\_Period\_SSB in TS38.133 Table 9.5.4.1-2 as baseline.
	+ Proposal 6 (Huawei): When SSB of cell with different PCI is non-overlapped with SSB of serving cell, the existing SSB based L1-RSRP measurement requirements for serving cell can be reused for cell with different PCI.
	+ Proposal 7 (Ericsson): RAN4 to support L1-RSRP measurement on NMAX+1 TRPs.
		- If SSB configured on NSC for L1-RSRP is subset of SSB configured for L3-RSRP, no additional delay is needed for L1-RSRP measurement and L1-RSRP computed in L3-RSRP can be used for L1-RSRP of NSC.
		- For FR1 and inside SMTC, if SSB configured for L1-RSRP is not subset of SSB configured for L3-RSRP, L1-RSRP measurement delay is TPSS/SSS\_sync\_intra + TSSB\_time\_index\_intra + TL1-RSRP\_Measurement\_Period\_SSB\_NSC ms.
		- For FR1 and outside SMTC, if the cell is not known, L1-RSRP measurement delay for outside SMTC is TPSS/SSS\_sync\_intra + TSSB\_time\_index\_intra + TL1-RSRP\_Measurement\_Period\_SSB\_NSC ms.
	+ Proposal 8 (Apple): Define SSB based inter-cell L1-RSRP measurement period for known cell with different PCI similar to existing serving cell requirements.
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round.
	+ Considering too many proposals for this issue, Moderator suggest companies to first decide that for requirement of L1-RSRP measurement on NSC
		- Option 1: take the intra-frequency requirement defined in clause 9.2.5 as the baseline.
		- Option 2: take the L1-RSRP requirement defined in clause 9.5.4 as the baseline.

**Issue 1-3-2 Define delay requirement for L1-RSRP measurement on unknown NSC**

* Proposals
	+ Proposal 1 (Apple): For unknown cell, the L1-RSRP measurement period is extended by the time needed for intra-frequency cell identification and measurement.
	+ Proposal 2 (vivo): RRM requirements are specified for the case SSBs for inter-cell L1-RSRP measurements are only performed inside SMTC under unknown conditions for single-FFT capable UE.
	+ Proposal 3 (MTK): No UE requirement applies for the case when the non-serving cell is unknown and the L1-RSRP report for the SSB to be measured is transmitted before the measurement is performed.
	+ Proposal 4 (Intel):
		- If the cell is unknown, extra cell search time and SSB index deriving time may be needed, the total delay time is Tcell search + Tmeasurement + TSSB index.
		- For unknown case, if SSB configuration for serving cell and cell with different PCI are the same and timing offset is assumed to be less than CP, cell search time and SSB index deriving time can be skipped.
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round.
	+ Please discuss the additional part in the requirement of unknown compared to known NSC in this issue.
	+ Known condition could be discussed first in **Issue 2-1-2**. It is moderator suggestion that defining requirement for NSC for only certain scenario (as **Issue 2-1-5**)

**Issue 1-3-3 Whether to define requirements for CSI-RS based L1-RSRP measurement on NSC in R17**

* Proposals
	+ Proposal 1 (vivo): RAN4 works for SSB-based inter-cell L1-RSRP measurement requirements in R17 firstly, and further study whether requirements for CSI-RS based inter-cell L1-RSRP measurement is specified in R17 or not.
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round.
	+ The issue is invalid unless RAN1 agree on CSI-RS based L1-RSRP measurement on NSC. Currently only SSB based and NO CSI-RS based measurement is supported by RAN1 design. In dCR R4-2204696 it specifies that L1-RSRP on NSC can be measured by SSB only.

### Sub-topic 1-4: Reply RAN1 LS on multi SSBs overlapped

**Issue 1-4-1 How to reply RAN1 LS on L1-RSRP measurement when SSBs overlapped**

* Proposals (Moderator): Companies please share their views on the reply LS, w.r.t. skeleton of the reply LS and corresponding content of each items.
* Recommended WF
	+ Collect companies’ view in the1st round.
	+ Text proposal of LS can be discussed in 2nd round based on the 1st round views.

## Companies views’ collection for 1st round

### Open issues

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| **Company** | **Comments** |
| **Moderator** | Considering too many proposals for this Topic#1, Moderator’s suggestion is given in the “Recommended WF” for each issue and please check the “Recommended WF” before making your comments. Thanks. |
| vivo | **Issue 1-1-1 L1-RSRP measurement on NSC configured for UE**Support option 1. Our understanding is the same as option 1.**Issue 1-1-2 Known NSC condition for L1-RSRP measurement**We support revised version of Option 1:Update bullet 2, i.e. ‘Cell detectable condition (FFS: existing intra-frequency measurement can be reused)’, asNSC is known if NSC meets the existing the detectable condition ~~intra-frequency requirement~~ defined in clause 9.2.2 ~~9.2.5~~ during the last [x]s.The reasons are:1. We think bullet 1 and bullet 3 in last meeting agreements should be kept in principle. The restrictions on RRC configuration (i.e. bullet 1) and timing alignment (i.e. bullet 3) are important applicability condition for the L1 measurement.2. We think the wording ‘intra-frequency requirement’ is not clear, we prefer to define known condition based on cell detectable condition in 9.2.2.**Issue 1-1-3 Unknown NSC condition for L1-RSRP measurement**Support option 1.For option 2, we think the scope would be too open and some aspect are beyond the scope of current WI. Therefore, if RAN4 goes with option 2, it is highly possible that RAN4 will only specify requirements for the known condition in R17.We prefer to specify another set of requirements, in which timing difference between cells is not restricted. The case of timing difference larger than CP is also considered for measurement, which would enable UE measurement on more than 1 serving cell, and reduce restrictions in NW deployment. In this case, no matter the configuration of SSB for NSC is either fully overlapped with SMTC or partially overlapped with SMTC, UE is only required to measure L1-RSRP inside SMTC.**Issue 1-1-4 Assumptions for defining inter-cell L1-RSRP measurement requirement***I1: Measurement within SMTC, for FR1, whether measurement on SC and NSC can be performed simultaneously.*[vivo] Yes, on the conditions that either power difference between SC and NSC is limited, or UE does not perform one-shot L1 measurement on SC and NSC simultaneously, i.e. on the overlapped OFDM symbol.*I2: Measurement on NSC within SMTC, for FR2, whether the same Rx beam for L1 and L3 can be assumed.*[vivo] **Yes, the same Rx beam can be used for L1 and L3, and rough beam is re-used.**Note that it is not forced to perform L1 measurement on SC or NSC based on the rough beam assumption in all cases. In other word, measurement on NSC within SMTC, for FR2, the same Rx beam for L1 and L3 can be assumed, but not always assumed.The motivation for the proposal is to reduce impact to legacy requirements. In legacy L1 and L3 measurement requirements for the case within SMTC, sharing factor between L1 and L3 measurement is defined. If the same Rx beam can not be assumed for L1 and L3 measurement, then the Rx beam for NSC L1 measurement need to be different from both L1 serving cell and L3 measurement, and either the serving cell L1 measurement or L3 measurement will be impacted. This is not preferred in our understanding.*I3: Measurement on NSC within SMTC, whether timing offset within CP is needed.*[vivo] No. This is not needed. Based on legacy requirements, timing offset within CP is not assumed for L3 measurements.**Issue 1-1-5 Introduce sharing factor for inter-cell L1-RSRP measurement requirement**We have concern on the moderator’s proposal.Firstly, we think RAN4 should think more when introducing the sharing factors. What will be the impact to legacy L1 requirements if the sharing factor is introduced? Will the sharing factor also impact to other L1 measurements such as RLM/BFD/CBD, especially if serving cell measurement is scaled by the factor? If so, is RAN4 going to provide CR in this meeting, capturing the scaling factor for all L1 measurements in legacy requirements, such as 8.5.X, 8.1.X? For example, regarding proposal 3, is RAN4 going to capture the PSC factor for scenario #1 and scenario #3 also in 8.1.X and 8.5.X? An alternative solution in our understanding is to introduce measurement restrictions for the overlapping between SC and NSC, and the sharing factor only applies when SSBs for NSCs are overlapped.Secondly, we think the wording ‘the number of these SSBs are less or equal than [Y]’ is not clear. If UE is assumed to perform L1 measurements based on the finer beam from one cell at a time, what is the reason for Y here? Even the number of overlapping SSB will be restricted, it is not related to the applicability of sharing factor.Thirdly, we think it is quite awkward if the periodicity of NSC SSB is less than periodicity of SC SSB. Therefore, we do not think requirements for scenario #4 is needed. Fourthly, whether the case when L3 rough beams are used can be based on conclusion of 1-1-4.Therefore, we propose:1. Remove ‘the number of these SSBs are less or equal than [Y]’.2. For scenario #1 and #3, measurement restriction is introduced instead of the sharing factors. Otherwise, the sharing factor PSC should be captured in 8.1.X, 8.5.X and 9.5.X.3. Do not specify RRM requirements for scenario #4.4. Further update the sharing factor based on conclusion of 1-1-4.**Issue 1-1-6 Applicability of RRM requirements for UE L1-RSRP measurements on NSC**We support the recommended WF.**Issue 1-2-1 How to define L1-RSRP measurement on NSC**Regarding the recommended WF, 1. We are OK to the first bullet, but we think the same scheduling availability as legacy can be re-used under certain conditions. The details can be discussed in issue 1-2-4.2. We are OK to the second bullet, if either power difference between SC and NSC is limited, or UE does not perform one-shot L1 measurement on SC and NSC simultaneously, i.e. on the overlapped OFDM symbol.3. For the 3rd bullet, we are OK.**Issue 1-2-2 UE behaviour when SSBs associated with different PCIs overlap**We think the discussion of this issue is the same as issue 1-1-4 and 1-1-5. We suggest to focus on those issues.Our view is provided clear in the draft LS in the appendix of R4-2204341.For proposal 1, power difference issue needs to be addressed for FR1, and sharing factor would also impact other L1 measurements in FR2.For proposal 2, we think the discussion can be prioritized, but how to define requirements can be FFS. We prefer measurement restriction for this case, if it is done outside SMTC. Otherwise all other L1 requirements will be impacted.For proposal 3 first bullet, we are wondering why gNB would like to configure periodicity of NSC SSB that is shorter than SC SSB, if they are outside SMTC. The gNB may simply configure SSB periodicity the same as SC SSB, while setting different slot offset so as to make it fully non-overlapped. We prefer no requirements for this case. For proposal 3 the second bullet, we prefer measurement restrictions rather than sharing factor for this case, if they are both configured with one-shot measurement. If either one is not, we prefer to re-use L3 measurement requirements for this case. **Issue 1-2-3 Measurement restrictions on inter-cell L1-RSRP measurement** We think proposal 2, 3 and 4 are quite similar. We may further revise the CR if RAN4 can reach consensus on other issues.Note that proposal 2 is related to the power difference issue in FR1. We are also fine to discuss other alternatives.**Issue 1-2-4 Scheduling availability for UE performing L1-RSRP measurement**We think proposals are similar, we can work on the CR directly.Note that proposal 2 is related to the power difference issue in FR1. We are also fine to discuss other alternatives.**Issue 1-2-5 Whether to jointly consider the requirement of IBM and inter cell beam management**We would like to know the issue better. Does the issue want to discuss the inter-cell beam measurement in the inter-band CA case? It is true that legacy scheduling restrictions for L1-RSRP measurement requirements are also applicable on SCells for intra-band CA. However, for inter-band CA, we do not see the issue if we re-use the legacy scheduling restrictions, which is capture in 9.5.6.3. ‘When inter-band carrier aggregation in FR2 is performed, there are no scheduling restrictions on FR2 serving cells in the bands due to L1-RSRP measurement performed on FR2 serving cell(s) in different band(s), provided that UE is capable of independent beam management on this FR2 band pair. Additionally, there is no scheduling restriction if the UE is configured with different numerology between SSB on one FR2 band and data on the other FR2 band provided the UE is configured for IBM operation for the band pair.’**Issue 1-3-1 L1-RSRP measurement delay requirements on cell with different PCI**Regarding the recommended WF, we support option 2, and the details of the requirements are already provided in our draft CR R4-2204342.We think all the proposals listed here are related to previous issues.**Issue 1-3-2 Define delay requirement for L1-RSRP measurement on unknown NSC**We support proposal 2 and agree with recommended WF. The principle is aligned with draft CR R4-2204342.For proposal 1 and 4, we think they are related to issue 1-1-1.**Issue 1-3-3 Whether to define requirements for CSI-RS based L1-RSRP measurement on NSC in R17**We have a different understanding from the moderator on the RAN1 agreements. Our understanding is that RAN1 has only listed CSI-RS based inter-cell L1-RSRP measurement as FFS, but no conclusions like ‘no consensus to support it in R17’. We think it would be difficult to exclude CSI-RS based inter-cell beam measurement in R17.However, we are OK to moderator’s proposal to exclude this in RAN4. If no consensus in RAN4, we may also ask RAN1 back.**Issue 1-4-1 How to reply RAN1 LS on L1-RSRP measurement when SSBs overlapped**We have provided one draft version in the annex of R4-2204341. We propose to 1. separate the discussion for the case overlapped inside SMTC and the case overlapped outside SMTC, and 2. focus on the providing the information that may have RAN1 spec impact. |
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### CRs/TPs comments collection

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| **CR/TP number** | **Comments collection** |
| **R4-2204696**Samsung | Draft CR for the introduction of L1-RSRP measurement on NSC requirements in R17 |
|  | vivo: 1. ‘number of resources does not exceed the higher layer parameter [*NumberOfAdditionalPCI*].’ We are not sure this is the correct understanding of RAN1 agreements.2. According to WID, it is worth to clarify whether inter-cell L1 measurements is only applicable to one intra-frequency cell with a PCI different from serving PCell, i.e. the intra-frequency neighbor cell on the frequency layer of SCell is not considered in this release. This is different from legacy L1-RSRP measurements. |
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| **R4-2203775**Apple | Draft CR for Requirements Applicability and Measurement Reporting Requirements |
|  | vivo: Up to conclusions of issue 1-1-2 and 1-1-3. |
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| **R4-2204342**vivo | Draft CR for L1-RSRP measurement requirements for inter-cell BM in R17 |
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| **R4-2204492**MediaTek | Draft CR for measurement restriction and scheduling availability |
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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**  |
| **Sub-topic #1-1** |  |
| **Sub-topic #1-2** |  |
| **Sub-topic #1-3** |  |
| **Sub-topic #1-4** |  |

## Discussion on 2nd round (if applicable)

[Moderator] The open issues are list here for your reference. In case of double efforts, companies may choose to make their comments directly on the corresponding WF.

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| **Company** | **Comments** |
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| **CR/TP number** | **Comments collection** |
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# Topic #2: Other RRM requirements

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| [R4-2203776](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2117440.zip) | Apple Inc. | **Requirement for TRP specific Beam Failure Recovery** **Proposal #1: Do not introduce sharing factor PTRP in FR1.****Proposal #2: Introduce PTRP = 2 in FR2 for overlapping resources for equal sharing between BFD/ CBD resources between the 2 TRPs.****Proposal #3: The baseline assumption in Rel-17 for RAN4 minimum requirements is that UE doesn’t support simultaneous reception with different QCL Type D.****Proposal #4: Condition for PTRP = 2 is overlapping BFD/CBD resources in FR2 .****QCL definition** **Proposal #5: Do not include SRS in QCL chain definition in RAN4.** |
| R4-2204343 | vivo | **Observation 1 In R17, UL TCIs are only applicable to UL signals/channels, and UL RSs can not be used as source RSs of DL TCIs or joint TCIs.****Proposal 1 How to define tci-StateType for UL TCI should be further clarified by RAN1/RAN2. The update of TCI chain can be further discussed once progress in RAN1/RAN2 can be achieved.****Observation 2 Compared to R15/16 BFD-RSs, different use case is assumed for the BFD-RSs when one CORESET is configured with two TCI states in HST-SFN scenario.****Proposal 2 Adopt Text proposal 1 and Text proposal 2 for clarifications on BFD and RLM requirements in R17 HST-SFN scenario.**Text Proposal 1: TS 38.133 Clause 8.5.1If a CORESET that the UE uses for monitoring PDCCH includes two TCI states and the UE is provided *sfnSchemePdcch* set to 'sfnSchemeA' or 'sfnSchemeB', on the [BFD-RS pair] , the UE shall estimate the radio link quality and compare it to the threshold Qout\_LR for the purpose of assessing downlink radio link quality of the serving cell beams. Otherwise, on each RS resource configuration in the set , the UE shall estimate the radio link quality and compare it to the threshold Qout\_LR for the purpose of ~~accessing~~ assessing downlink radio link quality of the serving cell beams. Text Proposal 2: TS 38.133 Clause 8.1.1If a CORESET that the UE uses for monitoring PDCCH includes two TCI states and the UE is provided *sfnSchemePdcch* set to 'sfnSchemeA' or 'sfnSchemeB', on the [RLM-RS pair], the UE shall estimate the downlink radio link quality and compare it to the thresholds Qout and Qin for the purpose of monitoring downlink radio link quality of the cell. Otherwise, on each RLM-RS resource, the UE shall estimate the downlink radio link quality and compare it to the thresholds Qout and Qin for the purpose of monitoring downlink radio link quality of the cell.**Proposal 3 In R17 feMIMO WI, simultaneous transmission or reception based on 2 active UE panels is not considered for RRM requirements, and the enhancements of related RRM requirements can be considered in R18 FR2 related RAN4-led WI.****Proposal 4 RRM requirements for TRP-specific BFR should be specified for FR1 in R17.****Proposal 5 For the CC configured with TRP-specific BFR, introduce scaling factor PTRP = 2 to the following period requirements*** **SSB-based BFD**
* **CSI-RS-based BFD**
* **SSB-based CBD**
* **CSI-RS-based CBD**
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| R4-2204367 | MediaTek Inc. | **Proposal 1: For TRP specific BFR, for FR1, not to introduce the scaling factor PTRP to extend the evaluation period of BFD and CBD.****Proposal 2: For the TRP specific BFR in FR2, PTRP is 2.** |
| [R4-2205041](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118260.zip) | Nokia, Nokia Shanghai Bell | **Proposal 1:** The existing BFD and CBD measurement requirements in R16 can be a baseline to mTRP-specific BFR in Rel-17. TS 38.133 clause 8.5.2.1 is modified with further conditions and scaling factor. **Proposal 2 :** Apply BFR requirements with the two conditions below :(i) Evaluate sequentially one BFD-RS set out of multiple BFD-RS sets (ii) Evaluate only one BFD-RS set with priority out of multiple BFD-RS sets configured to a UE**Proposal 3 :** If a UE receives sequentially a BFD-RS set from multiple TRPs and if the number of BFD-RS included in the two BFD-RS sets (k=0,1) is more than 2 or higher, consider to apply scaling\_factor\_BFD to TEvaluate\_BFD\_SSB evaluation period. **Proposal 4:** If a UE receives sequentially a BFD-RS set from multiple TRPs and if the number of BFD-RS included in the two BFD-RS sets (k=0,1) is more than 2 or higher, consider applying scaling\_factor\_CBD to TEvaluate\_CBD evaluation period. **Proposal 5:** When a UE is configured with BFD evaluation priority over a BFD-RS set (corresponding to serving cell or primary TRP), apply the scaling factor=1 (not to extend evaluation period requirement.) * In this case, the UE is allowed to set RX scheduling restrictions for the receptions of the PDCCH/PDSCH or the transmission of PUCCH/PUSCH scheduled/ associated with the CORESETs of non-failed BFD-RS set

**Proposal 6 :** If a FR2 UE does not support simultaneous reception, the following scheduling restriction applies due to beam detection on mTRP ( in *8.5.8.3 Scheduling availability of UE performing L1-RSRP measurement on FR2)** *The UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH, CSI-RS for tracking or CSI-RS for CQI on reference symbols to be measured for candidate beam detection.*

**Proposal 7 :** Adopt baseline from the BFRQ requirements in TS38.133 8.5.9.2, and studies further details depending on a recovery target cell and the evaluation period above.  |
| [R4-2205337](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118758.zip) | Huawei, HiSilicon | ***Proposal 1: In Rel-17, DL TCI chain and UL TCI chain need to be defined for deriving the QCL information of PDCCH/PDSCH and PUCCH/PUSCH respectively.******Proposal 2: In Rel-17, SRS can be part of a TCI chain when the TCI chain is used for deriving the QCL information of PUCCH/PUSCH.******Proposal 3: The QCL definition in R17 can be updated as follows.***

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| *For the requirements specified in this version of the specification for TCI state switching, downlink TCI state switching for unified TCI or uplink TCI state switching for unified TCI, a reference signal is considered to be QCLed to another reference signal if it is in the same TCI chain as the other reference signal, provided that the number of reference signals in the chain is no more than 4. It is assumed there is single QCL type per TCI chain.**A DL TCI chain consists of an SSB, and one or more CSI-RS resources, and the TCI state of each reference signal includes another reference signal in the same TCI chain, where the SSB can be associated with serving cell PCID or associated with a PCID different from serving cell PCID.* *DMRS of PDCCH or PDSCH is QCLed with the reference signal in its active TCI state and any other reference signal that is QCLed, based on the criteria for DL TCI chain, with the reference signal in the active TCI state.**A UL TCI chain consists of an SSB, and one or more CSI-RS resources and/or one or more SRS resources, and the TCI state of each reference signal includes another reference signal in the same TCI chain, where the SSB can be associated with serving cell PCID or associated with a PCID different from serving cell PCID.* *DMRS of PUCCH or PUSCH is QCLed with the reference signal in its active TCI state and any other reference signal that is QCLed, based on the criteria for UL TCI chain, with the reference signal in the active TCI state.* |

***Proposal 4: For FR1, there is no need to introduce the sharing factor PTRP for BFD and CBD measurements in R17, and the existing BFD and CBD measurement requirements in R16 can be applied in R17.******Proposal 5: The sharing factor PTRP can be defined as 2 when BFD/CBD RS resources from different resource sets are overlapped on the same symbol.*** |
| [R4-2205845](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118840.zip) | Ericsson | **Proposal 1: RAN4 not to introduce sharing factor for FR1 and not to introduce additional delay for processing of BFD-RS/CBD-RS from two TRP.****Proposal 2: In FR2, sharing factor shall only be applicable if the BFD-RS and CBD-RS are received different QCL type D at different time instance.****Proposal 3: RAN4 to agree that sharing factor in FR2, PTRP,is 2 when BFD-RS and CBD-RS are received using different QCL type-D in TDM fashion.** **Proposal 4: RAN4 to agree table 1 and table 2 as the evaluation period for SSB based BFD for each TRP in m-TRP operation for FR1 and FR2 respectively.**Table 1: Evaluation period TEvaluate\_BFD\_SSB for FR1

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| Configuration | TEvaluate\_BFD\_SSB (ms)  |
| no DRX | Max(50, Ceil(5 × P) × TSSB) |
| DRX cycle ≤ 320ms | Max(50, Ceil(7.5 × P) × Max(TDRX,TSSB)) |
| DRX cycle > 320ms | Ceil(5 × P) × TDRX |
| Note: TSSB is the periodicity of SSB in the set . TDRX is the DRX cycle length. |

Table 2: Evaluation period of one SSB based BFD-RS set in m-TRP operation in FR2

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| Configuration | TEvaluate\_BFD\_SSB (ms)  |
| no DRX | Max(50, Ceil(5\*P \* N\*TTRP)\*TSSB) |
| DRX cycle ≤ 320ms | Max(50, Ceil(7.5\*P\*N)Max(TDRX,TSSB)) |
| DRX cycle > 320ms | Ceil(5\*P\*N)\*TDRX |
| Note: TSSB is the SSB periodicity of the SSB in the set . TDRX is the DRX cycle length. |

**Proposal 5: RAN4 to agree table 3 and table 4 as the evaluation period for CSI-RS based BFD for each TRP in m-TRP operation.** Table 3: Evalution period of one CSI-RS based BFD-RS set in m-TRP operation in FR1

|  |  |
| --- | --- |
| Configuration | TEvaluate\_BFD\_CSI-RS (ms)  |
| no DRX | Max(50, [MBFD × P × PBFD] × TCSI-RS) |
| DRX cycle ≤ 320ms | Max(50, [1.5 × MBFD × P × PBFD] × Max(TDRX, TCSI-RS)) |
| DRX cycle > 320ms | [MBFD × P × PBFD] × TDRX |
| Note: TCSI-RS is the periodicity of the CSI-RS resource in the set . TDRX is the DRX cycle length. |

Table 4: Evalution period of one CSI-RS based BFD-RS set in m-TRP operation in FR2

|  |  |
| --- | --- |
| Configuration | TEvaluate\_BFD\_CSI-RS (ms)  |
| no DRX | Max(50, [MBFD × P × N × PBFD\*TTRP] × TCSI-RS) |
| DRX cycle ≤ 320ms | Max(50, [1.5 × MBFD × P × N × PBFD\*TTRP] × Max(TDRX, TCSI-RS)) |
| DRX cycle > 320ms | [MBFD × P × N × PBFD\*TTRP] × TDRX |
| Note: TCSI-RS is the periodicity of the CSI-RS resource in the set . TDRX is the DRX cycle length. |

**Proposal 6: RAN4 to agree table 5 and table 6 as the evaluation period for SSB based CBD for each TRP in m-TRP operation.** Table 5: Evaluation period of one SSB based CBD-RS set in m-TRP operation of FR1

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_CBD\_SSB (ms)**  |
| non-DRX, DRX cycle ≤ 320ms | Max(25, Ceil(3 \* P \*PCBD) \*TSSB) |
| DRX cycle > 320ms | Ceil(3 \*P \*PCBD) \*TDRX |
| Note: TSSB is the SSB periodicity of the SSB in the set . TDRX is the DRX cycle length. |

Table 6: Evaluation period of one SSB based CBD-RS set in m-TRP operation of FR2

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_CBD\_SSB (ms)**  |
| non-DRX, DRX cycle ≤ 320ms | Max(25, Ceil(3 \*P \*N \*PCBD\*TTRP) \*TSSB) |
| DRX cycle > 320ms | Ceil(3 \*P \*N \*PCBD\*TTRP) \*TDRX |
| Note: TSSB is the SSB periodicity of the SSB in the set . TDRX is the DRX cycle length. |

**Proposal 7: RAN4 to agree table 7 and table 8 as the evaluation period for CSI-RS based CBD for each TRP in m-TRP operation.** Table 7: Evaluation period for one CSI-RS based CBD-RS set in m-TRP operation of FR1

|  |  |
| --- | --- |
| **Configuration** | **TEvaluateC\_CBD\_CSI-RS (ms)**  |
| non-DRX, DRX cycle ≤ 320ms | Max(25, Ceil(MCBD × P × PCBD) × TCSI-RS) |
| DRX cycle > 320ms | Ceil(MCBD × P × PCBD) × TDRX |
| Note: TCSI-RS is the periodicity of CSI-RS resource in the set . TDRX is the DRX cycle length. |

Table 8: Evaluation period for one CSI-RS based CBD-RS set in m-TRP operation of FR2

|  |  |
| --- | --- |
| **Configuration** | **TEvaluate\_CBD\_CSI-RS (ms)**  |
| non-DRX, DRX cycle ≤ 320ms | Max(25, Ceil(MCBD × P × N × PCBD\*TTRP) × TCSI-RS) |
| DRX cycle > 320ms | Ceil(MCBD × P × N × PCBD\*TTRP) × TDRX |
| Note: TCSI-RS is the periodicity of CSI-RS resource in the set . TDRX is the DRX cycle length. |

**Proposal 8: RAN4 to agree that delay required from BFD on TRP to SR transmission on TRP for BFR procedure is given by T = T1 x Ceil((T2+D) /T1); Where:*** **T1 is equal to the periodicity of PUCCH configured with *schedulingRequestIDForBFR*.**
* **T2 = TEvaluate\_CBD is the evaluation period.**

**D is the UE Processing time and value of D is [2ms].** |

## Open issues summary

### Sub-topic 2-1: TRP specific BFR

**Issue 2-1-1 Requirement for TRP specific Beam Failure Recovery**

* Proposals:
	+ Proposal 1: Do not introduce sharing factor PTRP in FR1.
	+ Proposal 2: RRM requirements for TRP-specific BFR should be specified for FR1 in R17.
	+ Proposal 3: Introduce PTRP = 2 in FR2 for overlapping resources for equal sharing between BFD/ CBD resources (SSB and CSI-RS) between the 2 TRPs.
	+ Proposal 4: When a UE is configured with BFD evaluation priority over a BFD-RS set (corresponding to serving cell or primary TRP), apply the scaling factor=1 (not to extend evaluation period requirement.)
		- In this case, the UE is allowed to set RX scheduling restrictions for the receptions of the PDCCH/PDSCH or the transmission of PUCCH/PUSCH scheduled/ associated with the CORESETs of non-failed BFD-RS set
	+ Proposal 5: If a FR2 UE does not support simultaneous reception, the following scheduling restriction applies due to beam detection on mTRP (in *8.5.8.3 Scheduling availability of UE performing L1-RSRP measurement on FR2)*
		- *The UE is not expected to transmit PUCCH, PUSCH or SRS or receive PDCCH, PDSCH, CSI-RS for tracking or CSI-RS for CQI on reference symbols to be measured for candidate beam detection.*
	+ Proposal 6: RAN4 to agree that delay required from BFD on TRP to SR transmission on TRP for BFR procedure is given by T = T1 x Ceil((T2+D) /T1); Where:
		- T1 is equal to the periodicity of PUCCH configured with *schedulingRequestIDForBFR*.
		- T2 = TEvaluate\_CBD is the evaluation period. D is the UE Processing time and value of D is [2ms].
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round.

### Sub-topic 2-2: QCL definition

**Issue 2-2-1 QCL definition for UL TCI state**

* Proposals
	+ Proposal 1: In R17, UL TCIs are only applicable to UL signals/channels, and UL RSs cannot be used as source RSs of DL TCIs or joint TCIs. The update of TCI chain can be further discussed once progress in RAN1/RAN2 can be achieved.
	+ Proposal 2: In Rel-17, DL TCI chain and UL TCI chain need to be defined for deriving the QCL information of PDCCH/PDSCH and PUCCH/PUSCH respectively.
	+ Proposal 3: In Rel-17, SRS can be part of a TCI chain when the TCI chain is used for deriving the QCL information of PUCCH/PUSCH.
* Recommended WF
	+ Collect companies’ view for these proposals in 1st round.

### Sub-topic 2-3: Text proposal for BFD and RLM requirements in HST-SFN

**Issue 2-3-1 Text Proposal for clarifications on BFD and RLM requirements in R17 HST-SFN scenario**

* Proposals
	+ Proposal 1 (vivo): Text Proposal for clarifications on BFD and RLM requirements in R17 HST-SFN scenario

Text Proposal 1: TS 38.133 Clause 8.5.1

If a CORESET that the UE uses for monitoring PDCCH includes two TCI states and the UE is provided *sfnSchemePdcch* set to 'sfnSchemeA' or 'sfnSchemeB', on the [BFD-RS pair] , the UE shall estimate the radio link quality and compare it to the threshold Qout\_LR for the purpose of assessing downlink radio link quality of the serving cell beams. Otherwise, on each RS resource configuration in the set , the UE shall estimate the radio link quality and compare it to the threshold Qout\_LR for the purpose of ~~accessing~~ assessing downlink radio link quality of the serving cell beams.

Text Proposal 2: TS 38.133 Clause 8.1.1

If a CORESET that the UE uses for monitoring PDCCH includes two TCI states and the UE is provided *sfnSchemePdcch* set to 'sfnSchemeA' or 'sfnSchemeB', on the [RLM-RS pair], the UE shall estimate the downlink radio link quality and compare it to the thresholds Qout and Qin for the purpose of monitoring downlink radio link quality of the cell. Otherwise, on each RLM-RS resource, the UE shall estimate the downlink radio link quality and compare it to the thresholds Qout and Qin for the purpose of monitoring downlink radio link quality of the cell.

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

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Moderator  |  |
| vivo | **Issue 2-1-1 Requirement for TRP specific Beam Failure Recovery** Fine to P1, P2, P3.For P4, no sure whether it is a RAN2 issue.For P5, we think it is for all the cases except when CSI-RS is configured for BFD is explicitly configured and is type-D QCLed with active TCI state for PDCCH or PDSCH, and the CSI-RS is not in a CSI-RS resource set with repetition ON.For P6, if it means the legacy requirements are reused, we are OK.**Issue 2-2-1 QCL definition for UL TCI state** Support proposal 1. For P2 and P3, we are not sure what is the QCL type between SRS and PUSCH.Note that in our understanding, the most important information for QCL applicability is the following sentences in TS 38.133:‘For the requirements specified in this version of the specification, a reference signal is considered to be QCLed to another reference signal if it is in the same TCI chain as the other reference signal, provided that the number of Reference Signals in the chain is no more than 4. It is assumed there is single QCL type per TCI chain.’**Issue 2-3-1 Text Proposal for clarifications on BFD and RLM requirements in R17 HST-SFN scenario** Support the text proposal. Can be further discussed in CR. |
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### CRs/TPs comments collection

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| --- | --- |
| **CR/TP number** | **Comments collection** |
| **R4-2205338**Huawei | Draft CR for QCL definition for R17 unified TCI, further revised on last meeting dCR |
| vivo: Up to issue 2-2-1. |
|  |
| **R4-2205846**Ericsson | Draft CR for TRP specific BFR and BFR with two CORESET |
| vivo: TRP specific BFR part is up to issue 2-1-1. Moreover, not sure whether 8.5B should be used. For BFR with two CORESET, the wording‘When a CORESET with two active TCI states are configured for HST-SFN’ is not clear enough. Note that in R16 HST-SFN is also discussed in RAN4 demod session and here the issue is completely different from that. We propose to change it into‘When a CORESET that the UE uses for monitoring PDCCH includes two TCI states and the UE is provided *sfnSchemePdcch* set to 'sfnSchemeA' or 'sfnSchemeB',’ |
|  |

## 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.*

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Sub-topic #2-1** |  |
| **Sub-topic #2-2** |  |
| **Sub-topic #2-3** |  |

## Discussion on 2nd round (if applicable)

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| **Company** | **Comments** |
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| **CR/TP number** | **Comments Collection** |
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# Recommendations for Tdocs

## 1st round

**New tdocs**

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

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

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

## 2nd round

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

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

# Annex

Contact information

|  |  |  |
| --- | --- | --- |
| **Company** | **Name** | **Email address** |
| Moderator (Samsung) | Yiyan Zhang | Yiyan.zhang@samsung.com |
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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)