**3GPP TSG-RAN WG4 Meeting # 102-e R4-220XXXX**

**Electronic Meeting, February 21-March 03, 2022**

**Agenda item:** 10.21

**Source:** Moderator (Ericsson)

**Title:** Email discussion summary for [102-e][230] NR\_pos\_enh\_1

**Document for:** Information

# Introduction

The document contains discussion related to the positioning measurement requirements. The document contains the following five main topics:

* Topic #1: Latency reduction of positioning measurement (AI: 10.21.2.2)
* Topic #2: Impact on existing UE positioning and RRM requirements (AI: 10.21.2.4)
* Topic #3: Others (AI: 10.21.2.6)
* Topic # 4: Updated work split and timeline (AI: 10.21.1)
* Topic # 5: Feature list for positioning enhancements (AI: 8)

# Topic #1: Latency reduction of positioning measurement

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2203884**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203884.zip) | CATT | **Proposal 1: Condition 1B can be that difference between the serving cell signal and neighboring cell PRS RX EPRE is within [6] dB.**  **Proposal 2: The following condition can be considered under which the AGC is not needed: enough resource repetitions in one sample. Number of repetitions is FFS.**  **Proposal 3: There is no need for LMF to configure UE to measure with reduced Rx beam sweeping factor.**  **Proposal 4: For the measurement requirements of PRS measurement without gap, the definition of and the calculation of in R16 can be reused.**  **Proposal 5: For the measurement requirements of PRS measurement without gap, the reduced number of samples decided in section 2.1 can be used.**  **Proposal 6: For calculating CSSF outside gap, the assumption of processing unit on PRS measurement needs to be discussed first. If PRS measurement is performed with dedicate engine, CSSF = 1; if PRS measurement is performed with the same engine as RRM measurement, update the CSSF outside MG in 9.1.5.1 by accounting for one positioning frequency layer.**  **Proposal 7: For the calculation of multiple positioning frequency layers, if the PRS processing windows among PFLs are overlapped, the sum approach can be used. But if the processing windows are non-overlapped, the max approach can be used.**  **Proposal 8: If the PRS processing window is reconfigured during measurement period, UE shall restart the PRS measurement.**  **Proposal 9: For the PRS measurement without MG, the condition that the expected Rx timing difference between the PRS from the non-serving cell and that from serving cell is within a threshold is not necessary when multiple FFT processing is assumed.**  **Proposal 10: If single FFT processing is assumed, the condition for PRS measurement without MG is that the expected Rx timing difference between the PRS from the non-serving cell and that from serving cell is within CP.**  **Proposal 11: Define Tlast as T+MGL when all of the PRS resources to be measured are available in the same MG occasion during Tavailable. This can also be applied for R16 positioning measurement.**  **Proposal 12: When defining the measurement requirements, POS MG defined in RAN1 should be regarded as general gap which can be used for both PRS and RRM measurement i.e. no other gaps will be configured when POS MG is configured.** |
| [**R4-2203885**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203885.zip) | CATT | Draft CR on PRS-RSRP measurement period without gaps |
| [**R4-2203886**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203886.zip) | CATT | Draft CR on PRS-RSRPP measurement period without gaps |
| [**R4-2204262**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204262.zip) | CMCC | ***Proposal 1: for latency reduction, it is proposed to reuse all Rel-16 PRS BW (i.e. PRS BW >=24 RB).***  ***Proposal 2: samples for AGC is reduced or not required*** ***when UE is provided with the QCL information of the PRS (dl-PRS-QCL-Info).***  ***Proposal 3: for PRS measurement outside the measurement gap, the scheduling restriction is proposed as following:***   * ***For the UE indicates that PRS is higher priority than DL signal/channels, there is scheduling restriction***   + ***For UE with capability 1, UE is not expected to receive DL signals/channels of lower priority than PRS in the PPW***     - ***For UE with capability 1A, the scheduling restriction apply to all the serving cells,***     - ***For UE with capability 1B, the scheduling restriction only apply to the serving cells in the same band as the PRS***   + ***For UE with capability 2, UE is not expected to receive DL signals/channels of lower priority than PRS in the PRS symbols inside the PPW***     - ***FFS: the scheduling restriction apply to all the serving cells or only apply to the serving cells in the same band as the PRS, pending on the conclusion of RAN1*** * ***For the UE indicates that PRS is lower priority than DL signal/channels, there is no scheduling restriction*** |
| [**R4-2204301**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204301.zip) | OPPO | **Observation 1: Considering PRS configuration parameters in condition 3 is feasible if on-demand PRS and PRS outside MG are jointly considered.**  **Observation 2: UE capability on Rx beam sweeping factor is sufficient for LMF to decide the measurement latency.**  **Proposal 1: For the Rx power definition in condition 1B, prefer option 2: Difference between the serving cell signal and neighboring cell PRS cell-specific Rx EPRE is within [6] dB.**  **Proposal 2: It is not necessary for LMF to configure the UE with a reduced Rx beam sweeping factor.**  **Proposal 3: Consider CP length as the threshold for Rx timing difference between the PRS from the non-serving cell and that from the serving cell.**  **Proposal 4: To optimize PRS measurement within gap, support option 1 as the starting point and further discuss how to achieve option 2 by reasonable PRS and MG configuration.**  **Proposal 5: For multiple PFLs scenarios, the total measurement period could be optimized as formulas (3) and (4).**  **(3)**  **(4)**  **Proposal 6: POS MG should not be considered as concurrent gaps when defining RRM requirements.**  **Proposal 7: Support scenario 1, no MG is configured for RRM measurement.**  **Proposal 8: NCSG will not be configured for PRS measurement when defining RRM requirements.** |
| [**R4-2204302**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204302.zip) | OPPO | Draft CR to measurement period for UE Rx-Tx time difference measurement without gap |
| [**R4-2204303**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204303.zip) | OPPO | Draft CR to scheduling availability of UE during RSTD measurement without gap |
| [**R4-2204409**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204409.zip) | Intel | ***Proposal 1: Conditions under which samples for AGC is reduced or not required for PRS measurements can be:***   * ***Condition #1B:***    + ***the power difference between the serving cell’s SSB and neighboring cell PRS RX EPRE is within [6] dB.*** * ***Condition #2:***    + ***When UE is provided with the QCL information of the PRS (dl-PRS-QCL-Info)***   ***Proposal 2: RAN4 can forward a LS to RAN1 to check whether UE need to be configured by LMF to perform measurement with a reduced RX beam sweeping factor.***  ***Proposal 3:* T*he reduced samples for the gap-less PRS measurement is feasible up to UE capability.***  ***Proposal 4:******The PRS gap-less measurement requirements is appliable for the single PFL only.***  ***Proposal 5: RAN4 needs to define the measurement period requirements*** ***for PRS gapless measurement as:***   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | **No.** | **Parameters/issues** | **Option 1** | **Option 2** | **Option 3** | **Option 4** | **Intel’s view** | | 1 |  | PPWRP |  |  |  | **Option 3** | | 2 |  | R16 | Unmuted and overlapped PRS within PRS processing window |  |  | Option 2 | | 3 |  | R16 | **.** |  |  | **Option 1** | | 4 | **Applicable number of PFLs** |  | > 1 |  |  | Option 1 | | 5 | **Applicable number of samples** | 4 | 4 and < 4 |  |  | Option 2 | | 6 | **Approach on the calculation of multiple positioning frequency layers** | Based on PRS resources overlapping of different PFLs | 1 PFL | Sum approach |  | Option 2 | | 7 | **PRS processing window** | Based on RAN1 discussion | Based on RAN1 discussion |  |  | Option 1 (Option 2 is same) | | 8 | **Requirement applicability** | Rx time difference within CP | Numerology, RX timing difference, RX power offset, | When PRS has higher priority than all other signals/channels inside PRS processing window | PRS overlaps with PPW, PRS not overlap with other signals channels of higher priority, PRS whose RTD is ≤ max RTD supported by UE | Option 2, Option 3 | | 9 | **CSSF outside MG** | Based on processing unit assumption | 1 | Update CSSF outside MG in clause 9.1.5.1 |  | Option 3 | | 10 | **Scheduling restriction** | Scheduling restriction table 1 (R4-2201637) | RLM, BFD and L1/L3 measurement higher priority over PRS |  |  | FFS upon RAN1’s further agreements on the PRS processing priority | | 11 | **PRS/SSB collision** | Extend PRS measurement period or drop SSB | PRS is prioritized. Equal sharing between SSB and PRS in case of full overlapping |  |  | Option 1. | | 12 | **MG/PPW reconfig/activation** | Measurement period is extended |  |  |  |  | | PPW= PRS processing window  PPWRP= PPW Repetition Period | | | | | |  |   **Observation 1: As the pre-configured MG for PRS was introduced in Rel17, the corresponding requirements for this new aspect shall be discussed.**  ***Proposal 6: In Rel17, measurement requirements of PRS and RRM apply at least for scenario 1 below.***   * **Scenario 1: No MG is configured for RRM measurement**   + **POS MG is considered as legacy MG in PRS and RRM measurements when activated**   + **POS MG is not considered in RRM requirements when deactivated**   ***Proposal 7: The threshold, which is used to be compared against with the Rx timing difference to determine whether the PRS from the non-serving cell satisfy the condition of PRS measurement outside MG can be: [-½ CP length, ½ CP length]*** |
| [**R4-2204412**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204412.zip) | Intel | DraftCR to TS 38.133: NR ePos PRS-RSRP with reduced number of samples (9.9.3.5) |
| [**R4-2204464**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204464.zip) | Qualcomm | **Proposal 1: Condition #1:**   * **1A) PRS bandwidth is contained within the active BWP and** * **1B) the difference between the serving cell SS-RSRSP and neighbor cell/TRP PRS-RSRP is within (+6, -18) dB.**   **Proposal 2: Subject to UE capability, the UE may perform PRS measurements based on single sample if the following conditions are met**   * **PRS QCL information is provided with SSB as reference, indicating QCL Type A, Type D and same average gain, and** * **the UE was previously configured to measure the reference SSB and measured the reference SSB within X ms (FFS) of the start of the PRS measurement period.**   **Proposal 3: PRS measurement requirements with M2=0 are not specified based on condition #3.**  **Proposal 4: The LMF should indicate use of a reduced Rx beam sweeping factor explicitly in the location request, otherwise the default Rx beam sweeping factor is assumed by the UE.**  **Proposal 5: For PRS measurement requirements outside measurement gaps, only one PPW can be activated at any one time.**  **Proposal 6: For PRS measurement requirements outside measurement gaps, only one PFL can be processed within each PPW instance.**  **Proposal 7: CSSF\_within\_gap is not applicable to PRS measurements performed within a PPW since the PPW is used exclusively for PRS measurements and there is only one candidate PFL for a given PRS processing window.**  **Proposal 8: The applicable number of samples for PRS gapless measurements includes at least M = 2 (M1=M2=1). Support of M=1 (M1=1, M2=0) is subject to agreements by RAN4 on conditions where it is applicable. Support of PRS measurements with reduced number of samples (< 4) is subject to UE capability.**  **Proposal 8: When calculating , only consider PRS resources that meet the applicability conditions for PRS measurements within the PRS processing window.**  **Proposal 9: is the time duration of available PRS in the positioning frequency layer i to be measured during , and is calculated in the same way as PRS duration K defined in clause 5.1.6.5 of TS 38.214. For calculation of , only unmuted PRS resource instances that meet the applicability conditions for PRS measurements within the PRS processing window are considered.**  **Observation 1: For PRS measurements outside measurement gap, processing of PRS resources measured within each PRS processing window instance must be completed within the PRS processing window instance.**  **Proposal 10: For PRS measurements performed within a PRS processing window, .**  **Proposal 11: For UEs supporting Capability 1A, RAN4 will specify measurement period requirement for the case when PRS has higher priority than all other signals/channels (per UE) present inside the PRS processing window instances comprising the measurement period. If higher-priority signals/channels (per UE) are present inside any of the PRS processing windows comprising the required measurement period, the measurement period can be extended.**  **Proposal 12: For UEs supporting Capability 1B, RAN4 will specify measurement period requirement for the case when PRS has higher priority than all other signals/channels (in a given band) present inside the PRS processing window instances comprising the measurement period. If higher-priority signals/channels (in a given band) are present inside any of the PRS processing windows comprising the required measurement period, the measurement period can be extended.**  **Proposal 13: If the PPW is reconfigured or deactivated during the measurement period, the measurement period can be extended.**  **Proposal 14: If PRS resources in the DL-PRS assistance data consistently overlap with other DL signals/channels that have higher priority, as indicated by the gNB, the measurement requirements do not apply.**  **Proposal 15: SSB is prioritized over PRS in case of collisions between SMTC and PRS within a processing window.**  **Observation 2: The timing of a PRS processing window is specified relative to the cell indicated in its configuration.**  **Observation 3: The timing of the PRS resources relative to a PRS processing window can be determined, within a margin of plus/minus expected RSTD uncertainty, from the timing of reference cell for the PRS processing window and the DL PRS assistance data.**  **Proposal 16a: The applicability condition on Rx timing difference between the serving cell and a neighbor cell/TRP for PRS measurements within a PPW is , where**   * **is the maximum distance between the start of a symbol containing PRS from the neighbor cell/TRP and the start of the closest symbol from the serving cell, taking into account the timing difference between the serving cell and the reference cell/TRP, the expectedRSTD of the neighbor cell/TRP, and the expectedRSTD-uncertainty of the neighbor cell/TRP.** * **is the selected threshold.**   **Proposal 16b: The UE is not required to evaluate the applicability condition on Rx timing difference between serving cell and neighbor cells/TRPs for PRS measurements within a PPW. The applicability condition is ensured by the LMF.**  **Proposal 17: Introduce a UE capability for the value of the threshold of the applicability condition on Rx timing difference between serving cell and neighbor cells/TRPs for PRS measurements within a PPW.**  **Proposal 18: The UE capability for the value of the threshold of the applicability condition on Rx timing difference between serving cell and neighbor cells/TRPs for PRS measurements within a PPW should include the value ¼ of the symbol length.**  **Observation 4: If a single value is specified for the threshold of the applicability condition on Rx timing difference between serving cell and neighbor cells/TRPs for PRS measurements within a PPW, the value should not be ½\*CP length because it would be too restrictive; it may not be met by the network even for collocated cells.**  **Proposal 19: RAN4 should specify requirements for PRS measurements within MG in the following additional scenarios (not supported in Rel-16):**   * **Scenario A: when a per-UE pre-configured MG for positioning is activate and no other MGs are configured and no other pre-configured MGs are activate** * **Scenario B: for a UE that supports the new Rel-17 capability for PRS measurements with per-FR MG, when a per-FR pre-configured MG for positioning is activate and no other per-FR MGs are configured in the same FR and no other per-FR pre-configured MGs are activate in the same FR** * **Scenario C: for a UE that supports Rel-17 concurrent MGs, when a per-UE pre-configured MG for positioning is activate and at most one other MG is configured or at most one other pre-configured MG is activate** * **Scenario D: for a UE that supports Rel-17 concurrent MG and the new Rel-17 capability for PRS measurements with per-FR MG, when a per-FR pre-configured MG for positioning is activate and at most one other per-FR MG is configured in the same FR or at most one other per-FR pre-configured MG is activate.**   **Proposal 20: For a low-latency PFL *i* with , and , set in the measurement period requirement if all the PRS resources in are contained within a single measurement gap instance.** |
| [**R4-2204638**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204638.zip) | vivo | Draft CR to 38.133 Introduction of RSTD measurement requirements for latency reduction |
| [**R4-2204639**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204639.zip) | vivo | Draft CR to 38.133 Introduction of scheduling availability of UE during UE Rx-Tx time difference measurement without gaps |
| [**R4-2204640**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204640.zip) | vivo | **Proposal 1: When the PRS bandwidth is within the active BWP and difference between the serving cell signal and neighbouring cell PRS RX EPRE is within [6] dB, the additional samples for AGC for PRS measurement are not required.**  **Proposal 2: UE needs to be configured by LMF to perform measurements with a reduced Rx beam sweeping factor for the low latency positioning case.**  **Proposal 3：**   |  |  | | --- | --- | | **Parameters/issues** | **Proposal** | |  | **the PRS resources unmuted and fully or partially overlapped with PRS processing window** | |  | **R16** | | **Applicable number of PFLs** | **1** | | **Applicable number of samples** | **4 and < 4** | | **Approach on the calculation of multiple positioning frequency layers** | **N/A** | | **Requirement applicability** | **PRS overlapped with PPW.**  **PRS not overlapped with other signals/channels of higher priority.**  **The Rx timing difference between the PRS from the non-serving cell and that from the serving cell is less or equal than the threshold supported by UE.**  **Within a PRS processing window, and UE measurement inside the active DL BWP with PRS having the same numerology as the active DL BWP.** | | **CSSF outside MG** | **Based on outcome of PRS/SSB collision** | | **Scheduling restriction** | **When the PRS is higher priority than other DL signals/channels, the UE is not expected to receive DL signals/channels in the PRS processing window for all DL CCs for capability 1A.**  **When the PRS is higher priority than other DL signals/channels, the UE is not expected to receive DL signals/channels in the PRS processing window for a certain CC for capability 1B.**  **When the PRS is higher priority than other DL signals/channels, the UE is not expected to receive DL signals/channels in the PRS symbols inside the PRS processing window for capability 2.** | | **PRS/SSB collision** | **Extend PRS measurement period.** | | **MG/PPW reconfigure/activation** | **Measurement period is extended.** |   **Observation 1: The maximum expected Rx timing difference between the PRS from serving cell and that from non-serving cell would reach 1064us and 1016us for FR1 and FR2 respectively. As long as the PRS from the non-serving cell is guaranteed within the window, the UE can perform PRS measurement through time-domain sliding correlation.**  **Proposal 4: Introduce the UE capability for the threshold which is used to be compared against with the Rx timing difference to determine whether the PRS from the non-serving cell satisfy the condition of PRS measurement outside MG.**  **Proposal 5: Send LS response to RAN1 that a new UE capability for the threshold which is used to be compared against with the Rx timing difference should be supported.**  **Proposal 6: For scenario 1, i.e., no MG is configured for RRM measurement, the existing RRM and positioning requirements can be reused.**  **Proposal 7: Considering the joint working between concurrent gap and preconfigured gap is not supported in R17, scenario 2 (i.e., one legacy MG is configured for RRM measurement) can be discussed in the later release.** |
| [**R4-2205038**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205038.zip) | Nokia, Nokia Shanghai Bell | **Proposal 1 :** Define low latency requirements the reduced number of sample = 1 with the conditions of measurement under discussion.   * Requirements with other reduced number of samples = 2 or 3 are up to UE capability introduction. * Prefer to apply the conditions for an additional sample regarding AGC training only for = 1   **Proposal 2 :** Regarding the condition-1 of AGC power, we support option-2 : difference between the serving cell signal and neighboring cell PRS RX EPRE is within 6 dB.  **Proposal 3 :** Regarding the condition-2 of QCL, we support 2a : when UE is provided with the QCL information of the PRS (*dl-PRS-QCL-Info*).  **Observation 1 :** Network expects that PRS repetition in consecutive slots helps to improve both the accuracy and the latency by one shot measurement on the consecutive resources, while the UE behavior expects to extend longer period to measure all of the repeated PRS resources due to *{N,T}* UE processing capability.  **Proposal 4 :** Regarding PRS repetition in condition 3, if repeated PRS resources do not help to reduce measurement latency as observation 1, the PRS repetition is not required to be considered.  **Observation 2 :** LMF can know that low latency positioning measurement is required or not for positioning service usecase, but LMF may not know specific channel conditions of a UE to reduce how many samples or how many beam sweeping factor can be reduced due to AGC or QCL conditions.  **Proposal 5 :** Introduce a request from LMF to a UE to initiate low latency measurement by reducing the RX beam sweeping factor.  **Proposal 6 :** There is no change in the way to calculate multi-PFL measurements between MG-based and MG-less positioning measurements. Sum approach is adopted for PPW-based positioning measurement.  **Proposal 7 :** A UE should be able to make the low latency accuracy requirement with the reduced number of samples measurement (i.e. up to =1) within PPW as minimum as well as  **Proposal 8 :** RAN4 considers a partial positioning measurement report. A UE can report positioning measurement per PFL to reduce reporting latency.  - In this case, the measurement period requirement is applied based on one PFL measurement assumption.  **Proposal 9 :** We support the timing difference with candidate thresholds {CP length, half of the symbol, half of the slot, 1ms} with corresponding UE capability.  **Proposal 10 :** Follow RAN1 RX priority agreement per UE capability for RX scheduling restriction over PDCCH/PDSCH/CSI-RS within PPW. No other rule is required impacting data transmission scheduling.  **Proposal 11:** Define positioning measurement requirement when DL MAC-CE for positioning MG activation command is received and when a legacy MG is not configured. (Scenario-1 in issue 1-3-3) |
| [**R4-2205381**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205381.zip) | Huawei, HiSilicon | **Proposal 1: Update condition 1B as**   * **Difference between the serving cell SSB and neighboring cell PRS RX EPRE is within [6] dB**   **Proposal 2: No other conditions are considered for saving AGC samples.**  **Proposal 3: UE shall meet the measurement requirements with reduced Rx beam sweeping factor if it supports the capability, and no PLF indication is needed.**  **Proposal 4: Define Tlast as T+MGL when all of the PRS resources to be measured are available in the same MG occasion during Tavailabe.**  **Proposal 5: RAN4 to define measurement requirements when POS MG(s) are configured with the assumptions that POS MG(s) can only be used for PRS measurement, and only one POS MG can be activated at a time.**  **Proposal 6: RAN4 to define measurement requirements when POS MG(s) are configured for the following scenarios.**  **- Scenario 1: No MG is configured for RRM measurement**   * + **POS MG is considered as legacy MG in PRS and RRM measurements when activated**   + **POS MG is not considered in RRM requirements when deactivated**   **- Scenario 2: One legacy MG is configured for RRM measurement**   * + **POS MG and RRM MG are used for PRS and RRM measurements based on framework of concurrent MGs when POS MG is activated**   + **POS MG is not considered in RRM requirements when deactivated**   + **Requirements only apply when UE supports concurrent MGs.**   **Proposal 7: Provide reply LS to RAN2 based on Proposal 5 and Proposal 6.** |
| [**R4-2205382**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205382.zip) | Huawei, HiSilicon | CR on requirements for UE Rx-Tx measurement with reduced latency |
| [**R4-2205397**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205397.zip) | ZTE | **Proposal 1: AGC settling can be avoided if difference between the serving cell SSB and neighboring cell PRS RX EPRE is within 6 dB.**  **Proposal 2: The UE needs to be configured by LMF to perform measurements with a reduced Rx beam sweeping factor.** |
| [**R4-2205603**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205603.zip) | Ericsson | **Proposal #1.a**: Support option 1 of condition 1B on Rx power definition.  **Proposal #1.b**: In addition to condition 1 also support condition 2 as a complementary condition under which samples for AGC is reduced or not required for PRS measurements.  **Proposal #2:** LMF should not configure UE to perform measurements with Rx beam sweeping factor that is lower than the beam sweeping factor supported by UE as its capability.  **Proposal #3**:   |  |  | | --- | --- | | **Parameter** | **Proposal** | | Applicable number of PFLs | Based on RAN1 agreement. | | Approach on the calculation of multiple PFLs | Sum-based | | Applicable number of samples | 4 and 1. 1 sample when the associated side conditions are met. | | Lavailable\_PRS,i | Option 2. | | Teffect,i | Option 1. | | Requirement applicability | Option 3. | | CSSFPRS,i | Option 3. | | Scheduling restriction | No impact on measurement period requirement. Follow RAN1 agreement on PRS priority within PPW. | | PRS/SSB collision | No impact on measurement period requirement. More relevant to scheduling restriction discussion. | | MG/PPW reconfig/activation | # No MG configured for positioning for a UE capable of performing PRS measurements without gap.  # Measurement period requirement should not change provided a PPW is re-activated.  # Change in PPWRP might have an impact on measurement period requirement as captured in the agreement where Tavailable\_PRS,i = LCM(TPRS,i, PPWRP). |   **Proposal #4:** Network configured threshold shall be supported.  **Proposal #5**: Support option 1 with its applicability to multiple PFLs. |
| [**R4-2205605**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205605.zip) | Ericsson | Draft CR: PRS-RSRPP measurement requirements including latency reduction |
| [**R4-2205385**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205385.zip) | Huawei, HiSilicon | **Proposal 1: Expected RTD is defined as max(X1, X2), where**   * **X1 = X1’, if X1’ < 0.5 slot; X1 = 1-X1’, otherwise** * **X1’= mod(expected RSTD + expected RSTD uncertainty, slot length)** * **X2 = X2’, if X2’ < 0.5 slot; X2 = 1-X2’, otherwise** * **X2’= mod(expected RSTD - expected RSTD uncertainty, slot length)**   **Proposal 2: Introduce UE capability for the maximum Rx timing difference in MG-less PRS measurement, with at least two values {CP length, 0.5 slot}.**  **Proposal 3: It is up to UE implementation whether to calculate the expected Rx time difference and/or compare it against the threshold.**  **Proposal 4: Define scheduling restriction requirements for PRS measurement outside MG based on Table 1.**  **Table 1: scheduling restriction for PRS measurement outside MG**   |  |  |  | | --- | --- | --- | |  | Case 1: PRS measurement is of higher priority | Case 2: PRS measurement is of lower priority | | 1A | UE is not expected to receive DL signals/channels of lower priority in the PPW on all serving cells | UE is not expected to receive scheduled DL signals/channels of higher priority in the PPW on all serving cells, if the corresponding DCI is later than T before the start of the PPW and there is no DL signals/channels configured during PPW or scheduled during PPW with DCI earlier than T before the start of the PPW on any serving cell | | 1B | UE is not expected to receive DL signals/channels of lower priority in the PPW on serving cells in the same band as PRS | UE is not expected to receive scheduled DL signals/channels of higher priority in the PPW on the serving cells in the same band as PRS, if the corresponding DCI is later than T before the start of the PPW and there is no DL signals/channels configured during PPW or scheduled during PPW with DCI earlier than T before the start of the PPW on serving cells in the same band as PRS | | 2 | UE is not expected to receive DL signals/channels of lower priority in the measured PRS symbols on the impacted serving cells | UE is not expected to receive scheduled DL signals/channels of higher priority on the measured PRS symbols on the impacted serving cells, if the corresponding DCI is later than T before the symbol and there is no DL signals/channels configured on the symbol on the impacting serving cell | | Note: For Capability 2, the measured PRS symbols includes serving cell PRS symbols, and serving cell symbols mapped with non-serving cell PRS. Denote L as the serving cell symbol index which is closest to the non-serving cell PRS plus expected RSTD, and N as the number of symbols for the PRS resource.  - If the expected RTD for the non-serving cell PRS is <= CP, serving cell symbols mapped with non-serving cell PRS includes symbol L to symbol L+N-1  - If the expected RTD for the non-serving cell PRS is > CP, serving cell symbols mapped with non-serving cell PRS includes symbol L-1 to symbol L+N | | |   **Proposal 5: Requirements for MG-less PRS measurement apply**   * **when UE has activated PPW and only to PRS resources overlapped with PPW** * **to the PRS resources for which the RTD is <= maximum RTD supported by the UE** * **when PRS resource is not overlapped with DL signals/channels of higher priority**   **Proposal 6: MG-less PRS measurement requirements are defined based on 1 PFL. No need to consider multiple PFLs in the requirements.**  **Proposal 7: If MG reconfiguration/activation or PPW re-activation occurs during the measurement, the measurement period can be longer.**  **Proposal 8: For MG-less PRS measurement,**   * **Lavailable is defined same as in Rel-16 except that only the PRS resources unmuted and fully or partially overlapped with PPW are considered.** * **Teffect is defined same as in Rel-16.**   **Proposal 9: Both 4-sample and reduced sample are applicable for MG-less measurements.**  **Proposal 10a: When SSB and PRS are partially overlapping in time**   * **UE prioritizes PRS measurement when PRS is of high priority, and** * **UE prioritizes RRM measurement when PRS is of lower priority.**   **Proposal 10b: When SSB and PRS are fully overlapping in time, a sharing ratio e.g. 50%:50% is defined.** |
| [**R4-2205386**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205386.zip) | Huawei, HiSilicon | CR on RSTD measurement period requirements without gaps |
| [**R4-2205606**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205606.zip) | Ericsson | CR: General - PRS measurement without gaps |
| [**R4-2205388**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205388.zip) | Huawei, HiSilicon | CR on RSTD measurement period requirements without gaps |
| [**R4-2205607**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205607.zip) | Ericsson | CR: Scheduling availability of UE during PRS-RSRP measurement |
| [**R4-2205400**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205400.zip) | ZTE | **Proposal 1: If single FFT processing is assumed, the condition for PRS measurement without MG is that the expected Rx timing difference between the PRS from the non-serving cell and that from serving cell is within CP. The threshold is not necessary when multiple FFT processing is assumed.** |

## Open issues and comments collection for 1st round

### Sub-topic 1-1: Reduced number of samples for latency reduction

***Agreement at RAN4#101bis-e (WF in R4-2202776):***

|  |  |
| --- | --- |
| ***Parameters*** | ***Value*** |
| ***No of samples w/o AGC (M1)*** | *1* |
| ***PRS Ês/Iot (dB)*** | *≥ -6* |
| ***Propagation conditions*** | *LOS* |
| ***PRS BW (RBs)*** | *≥ [48]* |
| ***Accuracy*** | *R16* |
| ***Repetition*** | *R16* |

**Issue 1-1-1: Applicable PRS BW for reduced number of samples**

* Applicable PRS BW for PRS measurement requirements with reduced number of samples?
* Option 1: CMCC
  + All Rel-16 PRS BW
* Option 2:
  + Uphold RAN4#101bis-e agreement (PRS BW ≥ [48] RBs)
* Recommended WF
  + Need further discussion

|  |  |  |
| --- | --- | --- |
| **Company** | **Comments** | |
| Ericsson | Side conditions were derived based on the simulation results presented by companies. So, we propose to uphold RAN4#101bis-e agreement (PRS BW ≥ [48] RBs) | |
| Nokia | We prefer option-2. Our simulation also found that Rel-16 accuracy are not satisfied with some small RB cases under low latency measurement conditions. | |
| OPPO | Prefer option 2 to keep the previous agreements. | |
| Qualcomm | Option 2. The agreement could be revisited during the performance phase, if needed. | |
| vivo | Support Option 2. Based on our simulation result in R4-2200664, when the RB bandwidth is less than 48RBs, there may exists big difference of positioning accuracy between 1 sample and 4 samples. | |
| Intel | Option 2.  As evaluated in the previous meeting, when PRS BW is less than the specific threshold, with SINR side condition of >-6dB, the accuracy with 1sample can’t be met. | |
| Huawei | Fine with either option. |
| CMCC | Option 1. One consideration is that the target scenarios for Rel-17 positioning are commercial use cases and IIoT use cases, which may require different BW pending on the use cases, it is better to reuse Rel-16 PRS BW to make better coverage. The other consideration is that in last meeting, it was agreed to consider LOS channel and higher side condition(PRS Ês/Iot≥ -6dB). Sine we already agreed to have limitation on propagation condition and higher side condition, we are wondering whether it is necessary to exclude the small BW. |
| CATT | OK with both options. |

**Issue 1-1-2: One or more conditions under which samples for AGC is reduced or not required for PRS measurements**

*Agreement at RAN4#101bis-e (WF in R4-2202776):*

* *Additional samples for AGC for PRS measurements are not required in case at least one of the following conditions is met*
  + *Condition #1:* 
    - *1A) PRS bandwidth is within the active BWP and*
    - *1B) Difference between the serving and neighboring cell [total] RX power is within [6] dB.* 
      * *FFS on the detailed RX power definition.*
* Proposals:
* Condition 1B:
  + Option 1: E///, ZTE, HW
    - Difference between the serving cell SSB and neighboring cell PRS RX EPRE is within [6] dB.
  + Option 2: CATT, OPPO, Intel, Vivo, Nokia,
    - Difference between the serving cell signal and neighboring cell PRS RX EPRE is within [6] dB
  + Option 3: QC
    - Difference between the serving cell SS-RSRSP and neighbor cell/TRP PRS-RSRP is within (+6, -18) dB
* Condition 2 (QCL): E///
  + Condition 2a: CMCC, Nokia, Intel
    - When UE is provided with the QCL information of the PRS (dl-PRS-QCL-Info)
  + Condition 2b:
    - If PRS QCL information is provided with SSB as reference with QCL Type A, Type D and average gain
  + Condition 2c: QC
    - If PRS QCL information is provided with SSB as reference with QCL Type A, Type D and average gain, and
    - the UE was previously configured to measure the reference SSB and measured the reference SSB within X ms (FFS) of the start of the PRS measurement period.
  + Condition 3 (PRS configuration parameters): CATT
    - * PRS resource repetitions (in different slots) within one PRS instance. Number of repetitions is FFS
* Recommended WF
  + Discuss the proposed conditions

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| --- | --- | --- |
| **Company** | **Comments** | |
| Ericsson | On condition 1B:  The main difference between option 1 and option 2 is the clarity in terms of serving cell signal that can be used to calculate the Rx power of the serving cell. For this reason, we support option 1. Given that option 2 clarifies serving cell signal(s) that can be considered for the power measurement, we are open to consider it for condition 1B. We do not support option 3. In our view -18 dB is very low to be considered as one of the side conditions under which UE does not require additional sample for AGC.  On conditions 2:  In our view QCL information does not necessarily help on reducing the number of samples for AGC but helps UE to understand direction to effectively receive PRS and therefore condition 2 shall also be supported in addition to condition 1 under which UE does not require additional sample for AGC.  On condition 3:  We do not support condition 3 as it is not clear how this will help UE reduce sample for AGC. | |
| Nokia | On condition 1B:  We don’t have strong view on condition 1B between option-1 and option-2. We slightly prefer to option-2.  Typically, PRS from multiple cells are multiplexed with PDSCH. In fact, RAN1 agreed that SSB is not multiplexed with PRS of a serving cell. So, we think it is not so useful to refer to SSB AGC gain for PRS RX. If the argument is precise, it is reasonable to refer to the AGC gain of data that can be multiplexed with PRS. However, it won’t be so different even if referring to SSB AGC gain like option-1.  On conditions 2:  We support option-2a.  *DL-PRS-QCL-Info-r16* is assistance information for beam search, and the spec allows RX beam sweeping. the current spec supports *DL-PRS-QCL-Info-r16* with type-C and type-D, but not type-A, so option 2a and 2b impacts on RAN2 spec changes. And we are not sure how QCL information indicates averaging power quasi-colocated channels.  On condition 3:  We expected that PRS repeition would help to improve the accuracy and the latency by measuring at one shot measurement, but it is not the mechanism of Rel-16 and Rel-17 UE behavior. This seems like an issue but won’t be resolved easily.  If repeated PRS resources do not help to reduce measurement latency, the PRS repetition is not required to be considered. | |
| OPPO | For condition 1B, no strong preference between the two options. Option 2 seems more generic. UE could either use PRS signal if transmitted by the serving cells or SSB if PRS is absent. And we would like to point out two things for clarification.   1. Does Rx EPRE represent cell-specific Rx power quality after L3 filtering? In FR2, beam-specific Rx power may be quite different. 2. Which serving cell is considered in case of CA/DC scenario?   For condition 2, we don’t think QCL information is helpful to reduce AGC samples especially when several PRS resources with different QCLed sources are multiplexed in frequency domain.  For condition 3, we are fine to further study. | |
| Qualcomm | Option 3 for condition 1B.  There are two differences to clarify between the options.  First, options 1 and 2 propose comparing RX EPRE while option 3 proposes to compare RSRP. It’s not clear whether RX EPRE is well-defined term in the specifications. In our view, the comparison should be between signal power per RE from the UE receiver perspective. All three options may be trying to say the same thing but it may be more appropriate to use RSRP since it’s a well defined measurement.  The second point is that options 1 and 2 propose a power difference within +-6 dB. For the case where PRS-RSRP is higher than SSB-RSRP, it makes sense to require a small difference because the higher power would impact the Rx AGC set-point. +6 dB is reasonable. When PRS-RSRP is lower, it will not be the dominant factor for Rx AGC and a larger difference w.r.t SSB-RSRP should be supported. The main reason to specify a limit in that case would be to avoid high quantization error. Since both cases are different there is no need to have a symmetric differential power range.  We also support condition 2c. Two key point are: a) no additional SSB measurements should be required (as agreed previously by RAN4), and b) the UE should have a recent measurement of the reference SSB and prior to measuring PRS. | |
| vivo | For Condition 1B, we support Option 2. In our understanding, as long as the difference between the serving cell signal (SSB signal, data signal or PRS signal) and neighboring cell PRS Rx EPRE is within 6dB, the AGC may be not required | |
| Huawei | Follow GTW agreement. | |
| ZTE | On condition 1B:  We decided to use SS-RSRP as an indicator of the received signal power level for serving cell, as according to the GTW session agreement. However this may not be the best solution since RSRP is calculated in baseband, after AGC. Thus, it might not be able to reflect the received power level before AGC. RSSI should be better. |
| CATT | Follow the GTW agreement. |
| Ericsson2 | We also suggest to follow the GTW agreement | |

**Issue 1-1-3: Need for LMF to configure the UE to measure with a reduced Rx beam sweeping factor**

* Whether UE needs to be configured by LMF to perform measurements with a reduced Rx beam sweeping factor?
  + - Option 1: QC, Vivo, Nokia, ZTE
      * Yes
    - Option 2: CATT, OPPO, E///, HW
      * No
    - Option 3: Intel
      * Ask RAN1
* Recommended WF
  + Discuss the proposals

|  |  |  |
| --- | --- | --- |
| **Company** | **Comments** | |
| Ericsson | In 101-bis-e lower RX beam sweeping factor was agreed as a UE capability. It was further agreed that lower RX beam sweeping factor as UE capability should not impact accuracy requirement. In our view configuring Rx beam sweeping factor to UE that is lower than its capability will have an impact on achievable accuracy therefore we support option 2. | |
| Nokia | LMF can know that low latency positioning measurement is required or not for positioning service usecase, but LMF may not know specific channel conditions of a UE such as how many beam sweeping factor can be reduced.  However, LMF needs to indicate a UE to request low latency measurement with a reduced Rx beam sweeping factor. In this sense, we prefer option-1. | |
| OPPO | Support option 2. Whether reduced Rx beam sweeping factor could be used is mainly determined by UE capability. | |
| Qualcomm | Option 1.  In our view, this issue is similar to the question of reduced number of PRS samples. In that case, the LMF provides an explicit request to the UE with a reduced number of samples. The same should apply to reduced Rx beam sweeping factor. Even though the requirements may not reflect any difference in performance, in practice there may be a difference and the LMF should be able to prioritize latency vs. accuracy. | |
| vivo | Support Option 1. Similar to reduced sample number, it may be better to reduce the Rx beam sweeping factor when the UE is indicated from LMF for the low latency positioning case. In addition, we understand it may be no necessary to reduce the Rx beam sweeping factor if there is no urgent positioning request. | |
| Intel | If RAN4 can’t reach consensus, it is better to check this with RAN1 since the capability to support the reduced RX beam is up to RAN1. | |
| Huawei | We support option 2, but we can compromise to option 1 if there is clear justification, e.g. in which case LMF would configure UE to use existing beam sweeping factor. |
| ZTE | Slightly prefer Option 1. There might be more urgent use cases so that the LMF needs to complete positioning faster, and thus can require a reduction in the number of Rx beams. |
| CATT | Support option 2. Ask clarification for option 1: does LMF need to indicate the exact Rx beam sweeping factor if UE support several values? |

**Issue 1-1-4: Additional requirements for reduced number of samples**

* Option 1: Nokia
  + Define low latency requirements the reduced number of sample = 1 with the conditions of measurement under discussion.
    - Requirements with other reduced number of samples = 2 or 3 are up to UE capability introduction.
    - Prefer to apply the conditions for an additional sample regarding AGC training only for = 1
* Recommended WF
  + Discuss the proposals

|  |  |  |
| --- | --- | --- |
| **Company** | **Comments** | |
| Ericsson | Option 1 is fine provided that our understanding on this proposal is to set Nsample = 2 or 3 FFS and apply conditions regarding AGC only for Nsample = 1 is correct. | |
| Nokia | We support option-1. And it is our understanding as well : Nsample = 2 or 3 are still FFS. The agreement so far is Nsample = 1. | |
| Qualcomm | N\_sample = M1 + M2  M1 = number of samples w/o AGC  M2 = number of samples for AGC  RAN4 (and RAN1) already agreed to support M1 = 1 and RAN4 is discussing conditions under which M2 = 0. Otherwise, M2 = 1.  Based on the above, RAN4 should specify low-latency requirements for N\_sample = 1, 2. | |
| vivo | We have the same view with Qualcomm. | |
| Intel | The requirements on the reduced latency can considered the two combinations of “M” under with/wo AGC(1+0, 1+1). | |
| Huawei | Same comment as QC. | |
| CATT | Same understanding as QC. |

### Sub-topic 1-2: PRS measurements without gaps

**Issues 1-2-1A-L: Work needed for PRS measurements without gaps**

**Table 1: List of parameters/aspects identified for gapless measurements in RAN54#101bis-e:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **No.** | **Parameters/issues** | **Option 1** | **Option 2** | **Option 3** | **Option 4** |
| 5 |  | R16 | Unmuted and overlapped PRS within PRS processing window |  |  |
| 6 |  | R16 | **.** |  |  |
| 7 | **Applicable number of PFLs** |  | > 1 |  |  |
| 8 | **Applicable number of samples** | 4 | 4 and < 4 | 1 |  |
| 9 | **Approach on the calculation of multiple positioning frequency layers** | Based on PRS resources overlapping of different PFLs | 1 PFL | Sum approach | N/A |
| 10 | **Requirement applicability** | Rx time difference within CP | Numerology, RX timing difference, RX power offset, | When PRS has higher priority than all other signals/channels inside PRS processing window | PRS overlaps with PPW, PRS not overlap with other signals channels of higher priority, PRS whose RTD is ≤ max RTD supported by UE, same SCS |
| 11 | **CSSF outside MG** | Based on processing unit assumption | 1 | Update CSSF outside MG in clause 9.1.5.1 | N/A |
| 12 | **Scheduling restriction** | Scheduling restriction table 1 (R4-2201637) | RLM, BFD and L1/L3 measurement higher priority over PRS |  |  |
| 13 | **PRS/SSB collision** | Extend PRS measurement period or drop SSB | PRS is prioritized. Equal sharing between SSB and PRS in case of full overlapping |  |  |
| 14 | **MG/PPW reconfig/activation** | Measurement period is extended |  |  |  |
| PPW= PRS processing window  PPWRP= PPW Repetition Period | | | | | |

**Proposals on parameters under issues 1-2-1A-L:**

**Issue 1-2-1A:**

* + - Option 1: CATT
      * R16
    - Option 2: Intel, Vivo, E///, HW
      * PRS resources unmuted and fully or partially overlapped with PRS processing window
    - Option 3: QC
      * is the time duration of available PRS in the positioning frequency layer i to be measured during , and is calculated in the same way as PRS duration K defined in clause 5.1.6.5 of TS 38.214. For calculation of , only unmuted PRS resource instances that meet the applicability conditions for PRS measurements within the PRS processing window are considered.
* Recommended WF
  + Discuss the proposals

|  |  |  |
| --- | --- | --- |
| **Company** | **Comments** | |
| Ericsson | In our view both option 2 and option 3 shall be supported and combined formulation can be captured as:   * + ” is the time duration of available PRS in the positioning frequency layer i to be measured during , and is calculated in the same way as PRS duration K defined in clause 5.1.6.5 of TS 38.214. For calculation of , only PRS resources unmuted and fully or partially overlapped with PRS processing window are considered.” | |
| Nokia | We are ok with option-2 and option-3. In addition, effective PRS resources are considered based on PRS priority in Issue 1-2-1H. The conclusion of the issue also impacts on . A tentative wording will be :  “…..only PRS resources unmuted and fully or partially overlapped with PRS processing window based *on the PRS reception priority rule* in [TS38.214 X] are considered.” | |
| OPPO | Support option 2. The calculation way in option 3 can also be supported as baseline, or we can wait for more conclusions on PRS processing capability (including how to calculating PRS duration) in RAN1. | |
| Qualcomm | Option 3. Only PRS resources that can be measured within PPW should be counted. The applicability conditions include those mentioned in option 2 but there are more conditions. E.g. same SCS and within active BWP. The one exception regarding applicability conditions would be the Rx timing difference between serving cell and neighbor cells/TRPs. In that case the UE should not be required to evaluate whether the applicability condition is met; it simply assumes that the condition is met by all PRS resources in the assistance data. | |
| vivo | Support Option 2. There seems to be no difference between Option 2 and Option 3. | |
| Intel | Option 2 and 3 are fine for us. | |
| Huawei | Support combining option 2 and 3, and further addressing Nokia and QC comments, so wording suggestion based on Ericsson version:   * + ” is the time duration of available PRS in the positioning frequency layer i to be measured during , and is calculated in the same way as PRS duration K defined in clause 5.1.6.5 of TS 38.214. For calculation of , only unmuted PRS resource instances that meet the applicability conditions and fully or partially overlapped with PRS processing window are considered.”   The applicability condition should also includes “PRS resource not dropped due to collision with other DL signals/channels of higher priority”. |
| CATT | Fine with option 3. It is the combination of option 1 and option 2, the calculation of is the same as R16 but the applicability condition need to be updated based on PRS processing window. |

**Issue 1-2-1B:**

* + - Option 1: CATT, Intel, Vivo, E///, HW
      * R16
    - Option 2: QC
      * For PRS measurements performed within a PRS processing window, .
* Recommended WF
  + Discuss the proposals

|  |  |  |
| --- | --- | --- |
| **Company** | **Comments** | |
| Ericsson | In our view Rel. 16 definition is sufficient. | |
| Nokia | Option-1 | |
| OPPO | Option 1. | |
| Qualcomm | Option 2. The Rel-16 expression simplifies to option 2 because PRS processing is completed within the PPW. | |
| vivo | Support Option 1. We understand there is no difference between gap measurement and without gap measurement for . | |
| Intel | Option 1.  Even the eventual calculation is same for these two options, it is better to algin the formulation among Rel16 and 16. | |
| Huawei | Option 1.  In our view, option 1 is more generic and can accommodate all kinds of UE processing capabilities. |
| CATT | Option 1. |

**Issue 1-2-1C: Applicable number of PFLs**

* + - Option 1: Intel, Vivo, QC, HW
      * 1 PFL
    - Option 2: E///
      * Based on RAN1 agreements
* Recommended WF
  + Discuss the proposals

|  |  |  |
| --- | --- | --- |
| **Company** | **Comments** | |
| Ericsson | In our understanding there can be multiple PLFs within active BWP as defined in TS38.214 “*dl-PRS-ResourceBandwidth* defines the number of resource blocks configured for DL PRS transmission. The parameter has a granularity of 4 PRBs with a minimum of 24 PRBs and a maximum of 272 PRBs. All DL PRS resources sets within a positioning frequency layer have the same value of *dl-PRS-ResourceBandwidth*. To conclude the WI, we are open to define up to L applicable number of PFLs. L can be FFS and will be defined after seeking input from RAN1. | |
| Nokia | We agree option-2 with Ericsson comments.  If Applicable number of PFLs =1, a UE only measures PRS with the same value of *dl-PRS-ResourceBandwidth on* a single PFL. This may restrict the number of measurement cells.  Alternatively, we propose a partial measurement report per PFL, while a UE can measure multiple PFLs. Then the requirement can be applicable per PFL. This is an optional discussion related to Issue 3-3-1. | |
| OPPO | Option 2, views from RAN1 are needed. | |
| Qualcomm | Option 1 | |
| vivo | Option 1. We are OK with seeking more input from RAN1. | |
| Intel | Option 1. | |
| Huawei | Option 1.  For defining the requirements, we prefer to only consider the scenario with one PFL in each active BWP. In this case we do not need to consider requirements for multiple PFLs. To us this is more RAN4 discussion (scenarios for which to define requirements). |
| CATT | We suggest to follow the requirements of R16, i.e.the requirements are applied for multiple PFLs. And we also think this should be RAN4 discussion whether to define requirements for multiple layers. From RAN1 specification, it is clear that multiple PFLs can be configured, whether to define requirements is within RAN4 scope. |

**Issue 1-2-1D: Applicable number of samples (N)**

* + - Option 1:
      * Proposal 1: Intel, Vivo, Nokia, E///, HW, CATT
        + N=4 and N < 4
      * Proposal 2 (for N<4): Nokia, E///
        + N=1
    - Option 2: QC
      * The applicable number of samples for PRS gapless measurements includes at least M = 2 (M1=M2=1).
      * Support of M=1 (M1=1, M2=0) is subject to agreements by RAN4 on conditions where it is applicable. Support of PRS measurements with reduced number of samples (< 4) is subject to UE capability.
* Recommended WF
  + Discuss the proposals

|  |  |  |
| --- | --- | --- |
| **Company** | **Comments** | |
| Ericsson | We support N = 1 and N = 4. | |
| Nokia | We support N = 1 and N = 4. Others are FFS. | |
| Qualcomm | Option 2. See also answer to issue 1-1-4. | |
| vivo | Support Proposal 1. Option 2 are also fine. For Proposal 2 from Option 1, we understand only when the conditions for not requiring AGC are met, the number of sample can be 1. | |
| Intel | In our views, both N=4 and N<4 shall be supported. | |
| Huawei | Support option 2, which has same technical meaning but is more accurate than option 1. | |
| CATT | Support proposal 1. Both N=4 and N<4 should be included. For the number of sample when N<4, both N=1 and N=2 need to be considered which is same as issue 1-1-4. |

**Issue 1-2-1E: Approach on the calculation of multiple positioning frequency layers**

* + - Option 1: CATT
      * If the PRS processing windows among PFLs are overlapped, the sum approach can be used. But if the processing windows are non-overlapped, the max approach can be used.
    - Option 2: Intel, Nokia, QC
      * 1 PFL
    - Option 3: Vivo
      * N/A
    - Option 4: Nokia, E///
      * Sum approach is adopted for PPW-based positioning measurement.
* Recommended WF
  + Discuss the proposals

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| **Company** | **Comments** | |
| Ericsson | This is related to Issue **1-2-1C**.We can conclude discussion on this issue after issue 1-2-1C is settled down. In our view sum approach shall be adopted because of the reason provided in our comments to issue 1-2-1C. | |
| Nokia | We comment on our intention of option-2 and option-4 in **1-2-1C**. | |
| OPPO | Depends on the conclusion for issue 1-2-1C. If multiple PFLs are considered, option 4 should be supported. | |
| Qualcomm | Option 2. | |
| vivo | This issue is related to Issue 1-2-1C. If only a positioning frequency layer is measured, it may be no necessary to define the approach on the calculation of multiple positioning frequency layers. | |
| Intel | Option2. This is also rely on **Issue 1-2-1C** | |
| Huawei | Support option 2 and 3.  The issue is pending on Issue 1-2-1C. |
| CATT | Support Option 1 but can compromise to option 4. |

**Issue 1-2-1F: Requirement applicability conditions**

* + - Option 1: CATT
      * Expected Rx timing difference between PRS from non-serving cell and that from serving cell is within CP (single FFT)
    - Option 2:
      * Proposal 1: Intel
        + Numerology, RX timing difference, RX power offset.
      * Proposal 2: Intel, E///
        + When PRS has higher priority than all other signals/channels inside PRS processing window
    - Option 3: Vivo
      * PRS overlapped with PPW.
      * PRS not overlapped with other signals/channels of higher priority.
      * The Rx timing difference between the PRS from the non-serving cell and that from the serving cell is less or equal than the threshold supported by UE.
      * Within a PRS processing window, and UE measurement inside the active DL BWP with PRS having the same numerology as the active DL BWP.
    - Option 4: QC
      * For PRS measurement requirements outside measurement gaps, only one PPW can be activated at any one time.
      * For UEs supporting Capability 1A, RAN4 will specify measurement period requirement for the case when PRS has higher priority than all other signals/channels (per UE) present inside the PRS processing window instances comprising the measurement period. If higher-priority signals/channels (per UE) are present inside any of the PRS processing windows comprising the required measurement period, the measurement period can be extended.
      * For UEs supporting Capability 1B, RAN4 will specify measurement period requirement for the case when PRS has higher priority than all other signals/channels (in a given band) present inside the PRS processing window instances comprising the measurement period. If higher-priority signals/channels (in a given band) are present inside any of the PRS processing windows comprising the required measurement period, the measurement period can be extended.
      * If PRS resources in the DL-PRS assistance data consistently overlap with other DL signals/channels that have higher priority, as indicated by the gNB, the measurement requirements do not apply
    - Option 5: HW
      * when UE has activated PPW and only to PRS resources overlapped with PPW
      * to the PRS resources for which the RTD is <= maximum RTD supported by the UE
      * when PRS resource is not overlapped with DL signals/channels of higher priority
* Recommended WF
  + Discuss the proposals

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| **Company** | **Comments** | |
| Ericsson | We support proposal 2 in option 2 that defines one of the conditions when gapless PRS measurement requirements apply. In our view option 3 and option 5 can be combined and supported. We would also like to acknowledge that the condition on RTD might be revised based on the outcome of discussion on issue 1-2-2. | |
| Nokia | We support option-2. We see details of conditions in other issues such that BW/SCS in Issue 1-2-1C, PRS resource counting is addressed in Issue 1-2-1A and also timing difference issue. | |
| OPPO | Option 3 and option 5 are generally aligned with agreements reached in RAN1. | |
| Qualcomm | RAN1 has already defined applicability conditions for measuring PRS within PPW and in our view RAN4 does not need to discuss those conditions further. i.e. PRS resources within the PPW, with the same SCS as the active DL BWP, contained within the bandwidth of the DL BWP, satisfying the Rx timing difference condition, taking into account priority with respect to other DL signals/channels.  We support Option 4, which discusses additional conditions for measurement requirements in RAN4.  Bullets 2 and 3 of option 4 propose to specify measurement period requirements only when PRS has higher priority than all other signals/channels (per UE or in a given band, depending of capability 1A/1B) present inside the PPW instances comprising the measurement period. | |
| vivo | Support Option 3. For Proposal 1 of Option 2, we are not clear that there is a limit on Rx power offset. | |
| Intel | The options here seem not exclusive each other.  We can decouple these applicability into several sub-topics,e.g.   1. PRS overlapping with other signals 2. Timing misalignments 3. Power offset | |
| Huawei | There are quite some commonalities between options, and we see at least following aspects can be agreed:   * PRS within activated PPW * Same SCS * Rx time difference < threshold * No collision with other DL signals/channels of higher priority |
| CATT | The options are not exclusive to each other and can be combined. Option 3 or option 5 can be the baseline. |

**Issue 1-2-1G: CSSF outside MG**

* + - Option 1: CATT
      * If PRS measurement is performed with dedicate engine, CSSF = 1; if PRS measurement is performed with same engine as RRM measurement, update CSSF outside MG in 9.1.5.1 by accounting for one positioning frequency layer
    - Option 2: Intel, E///
      * CSSF outside MG as in clause 9.1.5.1
    - Option 3: Vivo
      * Based on outcome of PRS/SSB collision
    - Option 4: QC
      * CSSF\_within\_gap is not applicable to PRS measurements performed within a PPW since the PPW is used exclusively for PRS measurements and there is only one candidate PFL for a given PRS processing window.
* Recommended WF
  + Discuss the proposals

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| **Company** | **Comments** | |
| Ericsson | CSSF\_within\_gap as defined in Rel. 16 is not valid for gapless PRS measurement. For this reason we propose to incorporate CFFS outside MG as defined in clause 9.1.5.1 of TS38.133. | |
| Nokia | We support option-1 and option-2 as below :  If PRS is high-prioritized within PPW, we support option-1, CSSF = 1.  If PRS is not prioritized as the first measurement object within PPW, option-2 is fine. | |
| OPPO | Support option 2. | |
| Qualcomm | Our understanding here is that CSSF would be to account for sharing of the PPW to perform different measurements, similar to the way CSSF is used for measurements gaps. However, PPW only for PRS measurements and only one PFL is assumed. That’s the reasoning behind option 4.  Our view is that RAN4 should specify measurement period requirements for PRS measured within PPW when there are not collisions between PPW and other DL signals/channel that have higher priority (see issue 1-2-1F). CSSF is not needed to account for such collisions. | |
| Vivo | This issue may be related to 1-2-1I. According to the different priority rules, CSSF may be different. | |
| Intel | Option 2. For Option 4, when we calculate CCSF, only the number of PFL needed instead of PPW. | |
| Huawei | Support option 3.  We suggest to discuss this issue together with Issue 1-2-1I. If the conclusion there is to prioritize one of the SSB, which we understand includes both serving cell SSB and SMTC for all MOs which are measured outside MG, then we may not need to apply CSSF for PRS measurement, otherwise we can work on CSSF outside MG. |
| CATT | Firstly we think the capability of parallel PRS measurement defined in RRC\_INACTIVE state can also be considered. For the UE not supporting the capability, If the requirements are only applied when PRS is prioritized, then CSSF = 1, if PRS is not prioritized, the CSSF outside gap defined in 9.1.5.1 can be the baseline. |

**Issue 1-2-1H: Scheduling restriction**

* + - Option 1: Intel
      * FFS upon RAN1’s further agreements on the PRS processing priority
    - Option 2: Vivo
      * When the PRS is higher priority than other DL signals/channels, the UE is not expected to receive DL signals/channels in the PRS processing window for all DL CCs for capability 1A.
      * When the PRS is higher priority than other DL signals/channels, the UE is not expected to receive DL signals/channels in the PRS processing window for a certain CC for capability 1B.
      * When the PRS is higher priority than other DL signals/channels, the UE is not expected to receive DL signals/channels in the PRS symbols inside the PRS processing window for capability 2.
    - Option 3: CMCC
      * For the UE indicates that PRS is higher priority than DL signal/channels, there is scheduling restriction
        + For UE with capability 1, UE is not expected to receive DL signals/channels of lower priority than PRS in the PPW

For UE with capability 1A, the scheduling restriction apply to all the serving cells,

For UE with capability 1B, the scheduling restriction only apply to the serving cells in the same band as the PRS

* + - * + For UE with capability 2, UE is not expected to receive DL signals/channels of lower priority than PRS in the PRS symbols inside the PPW

FFS: the scheduling restriction apply to all the serving cells or only apply to the serving cells in the same band as the PRS, pending on the conclusion of RAN1

* + - * For the UE indicates that PRS is lower priority than DL signal/channels, there is no scheduling restriction
    - Option 4: Nokia, E///
      * Follow RAN1 RX priority agreement per UE capability for RX scheduling restriction over PDCCH/PDSCH/CSI-RS within PPW. No other rule is required impacting data transmission scheduling.
    - Option 5: HW
      * Define scheduling restriction requirements for PRS measurement outside MG based on Table below.

**Table: scheduling restriction for PRS measurement outside MG**

|  |  |  |
| --- | --- | --- |
|  | Case 1: PRS measurement is of higher priority | Case 2: PRS measurement is of lower priority |
| 1A | UE is not expected to receive DL signals/channels of lower priority in the PPW on all serving cells | UE is not expected to receive scheduled DL signals/channels of higher priority in the PPW on all serving cells, if the corresponding DCI is later than T before the start of the PPW and there is no DL signals/channels configured during PPW or scheduled during PPW with DCI earlier than T before the start of the PPW on any serving cell |
| 1B | UE is not expected to receive DL signals/channels of lower priority in the PPW on serving cells in the same band as PRS | UE is not expected to receive scheduled DL signals/channels of higher priority in the PPW on the serving cells in the same band as PRS, if the corresponding DCI is later than T before the start of the PPW and there is no DL signals/channels configured during PPW or scheduled during PPW with DCI earlier than T before the start of the PPW on serving cells in the same band as PRS |
| 2 | UE is not expected to receive DL signals/channels of lower priority in the measured PRS symbols on the impacted serving cells | UE is not expected to receive scheduled DL signals/channels of higher priority on the measured PRS symbols on the impacted serving cells, if the corresponding DCI is later than T before the symbol and there is no DL signals/channels configured on the symbol on the impacting serving cell |
| Note: For Capability 2, the measured PRS symbols includes serving cell PRS symbols, and serving cell symbols mapped with non-serving cell PRS. Denote L as the serving cell symbol index which is closest to the non-serving cell PRS plus expected RSTD, and N as the number of symbols for the PRS resource.  - If the expected RTD for the non-serving cell PRS is <= CP, serving cell symbols mapped with non-serving cell PRS includes symbol L to symbol L+N-1  - If the expected RTD for the non-serving cell PRS is > CP, serving cell symbols mapped with non-serving cell PRS includes symbol L-1 to symbol L+N | | |

* Recommended WF
  + Discuss the proposals

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| --- | --- | --- |
| **Company** | **Comments** | |
| Ericsson | In our view option 4 captures proposals in option 2 and option 3. Therefore, in our view options 2,3, and 4 can be supported. On FFS part of option 3, our understanding is that scheduling restriction applies to the serving cells in the same band as the PRS. | |
| Nokia | We support Option-4. We prefer to refer to RAN1 spec regarding the UE capability. | |
| OPPO | Option 2, 3, 4. | |
| Qualcomm | Option 1. Our understanding is that this is being addressed in RAN1. | |
| vivo | Support Option 2. We are fine with Option 3. | |
| Intel | In principle, we support Option 1,3, 4. | |
| Huawei | We support option 5.  The difference between option 5 and option 2/3/4 is for the case when PRS has lower priority. We agree that in principle there should be no scheduling restriction, but we need to consider the issue that for dynamically scheduled PDSCH, UE may have already scheduled PRS measurement if the DCI is too close to the symbol where PRS and PDSCH overlap. |
| CMCC | We are fine with option 2,3,4. For option 5, for the case that PRS has lower priority, in our view, since PRS will be dropped, UE is expected to receive scheduled DL signals/channels of higher priority, there is no scheduling restriction. As for the issue on dynamically scheduled PDSCH, we are open to discussion. |
| CATT | Fine with option 4. But we would like to be clarified whether there these restriction will be captured in RAN4 specification? Because in our understanding, we just need to follow the priority rules defined in RAN1 and no other scheduling restriction is needed in RAN4 specification. |

**Issue 1-2-1I: PRS/SSB collision within PPW**

* + - Option 1: Intel
      * Extend PRS measurement period or drop SSB
    - Option 2: Vivo, QC
      * Extend PRS measurement period and prioritize SSB
    - Option 3: E///
      * No impact on measurement period requirement. More relevant to scheduling restriction discussion.
    - Option 4: HW
      * When SSB and PRS are partially overlapping in time
        + UE prioritizes PRS measurement when PRS is of high priority, and
        + UE prioritizes RRM measurement when PRS is of lower priority.
      * When SSB and PRS are fully overlapping in time, a sharing ratio e.g. 50%:50% is defined.
* Recommended WF
  + Discuss the proposals

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| **Company** | **Comments** | |
| Ericsson | This issue is still open in RAN1. For RAN4 work we can consider no impact on measurement period requirement and can be handled via scheduling restriction. | |
| Nokia | PRS priority over SSB has not been well concluded in RAN1 scheduling restriction discussion. If it is not concluded in RAN1, RAN4 assumes that Option-2 is the baseline, and at least prioritize SSB of serving cell. | |
| Qualcomm | Option 2 | |
| vivo | Support Option 2. In our understanding, RRM measurement is very critical for UE. When the PRS and SSB is collision, SSB shall be higher priority than PRS. | |
| Intel | Whether PRS measurement period shall be extended is also up to PRS priority. So Option 1,2 and 4 are same from the technical point view. | |
| Huawei | We support option 4. To clarify, we understand the SSB here includes both serving cell SSB and SMTC for all MOs which are measured outside MG.  We are open to consider option 2 as well, but it is a bit conflicting with the target of low latency measurement, especially when PRS is configured with high priority. | |
| CMCC | Whether PRS measurement or RRM measurement is prioritized is up to the PRS priority. |
| CATT | The issue is related to the PRS priority and suggest to wait for RAN1 conclusion first. |

**Issue 1-2-1J: MG/PPW reconfiguration/activation**

* + - Option 1: CATT
      * PRS measurement is restarted
    - Option 2: Intel, Vivo, QC, HW
      * Measurement period is extended
    - Option 3: E///
      * # No MG configured for positioning for a UE capable of performing PRS measurements without gap.
      * # Measurement period requirement should not change provided a PPW is re-activated.
      * # Change in PPWRP might have an impact on measurement period requirement as captured in the agreement where Tavailable\_PRS,i = LCM(TPRS,i, PPWRP).
* Recommended WF
  + Discuss the proposals

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| **Company** | **Comments** | |
| Ericsson | A UE capable of performing gapless measurement will be configured to do the PRS measurement during PPW and no MG for positioning measurement will be configured to that UE. Therefore, in our view discussion on MG reconfig/activation is not relevant to measurement period requirement discussion for gapless PRS measurement. If PPW is reconfigured then in our view a change in PPWRP will have an impact on measurement period requirement as captured in 101-bis-e agreement where Tavailable\_PRS,i = LCM(TPRS,i, PPWRP). | |
| Nokia | We support the second and third bullets in option-3. Although it impacts on the measurement period, but the requirement is applicable as the second bullet. | |
| OPPO | Support option 2. | |
| Qualcomm | Option 2. Similar to the case of MG reconfiguration. | |
| vivo | Support Option 2. | |
| Intel | Option 2 | |
| Huawei | Option 2. |
| CATT | Fine with option 2 to follow the same principle for MG reconfiguration in R16. |

**Issue 1-2-1K: calculation**

* + - Option 1: QC
      * When calculating , only consider PRS resources that meet the applicability conditions for PRS measurements within the PRS processing window.
* Recommended WF
  + Discuss the proposals

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| **Company** | **Comments** |
| Ericsson | Option 1 looks fine. |
| Nokia | agreeable in principle. Applicability conditions are under discussions. |
| Qualcomm | Option 1. |
| vivo | In general, we agree with Option 1. |
| Huawei | OK with option 1. |
| CATT | Fine with option 1. Suggest to align the wording in LPRS\_available. |

**Issue 1-2-1L: Positioning measurement reporting**

* + - Option 1: Nokia
      * RAN4 considers a partial positioning measurement report. A UE can report positioning measurement per PFL to reduce reporting latency.  
         - In this case, the measurement period requirement is applied based on one PFL measurement assumption.
* Recommended WF
  + Discuss the proposals

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| **Company** | **Comments** | |
| Ericsson | In our view, this issue is related to issues 1-2-1C and 1-2-1E. We can come back to this issue after 1-2-1C and 1-2-1E are settled down. | |
| Nokia | We support it, and also comment in 1-2-1C. | |
| OPPO | We are fine to come back this issue after 1-2-1C. | |
| Qualcomm | We understand this is not supported in Rel-16 and Rel-17. It would be problematic for RSTD, which requires one reference TRP to be selected across all PFLs. | |
| Intel | Don’t’ support this. One of question on this is how the UE or LMF combine the report from the different PFLs which were reported with different time stamp? | |
| Huawei | We are open to consider option 1, but question is why it is only applicable for measurement outside MG, and whether such reporting needs to be configured by LMF. | |
| CATT | Open to discuss but whether this can also be used for MG based measurement in R16 and if how this can be benefit for LMF if NW anyway need the final results of multiple layers. |

**Issue 1-2-2: Related to RAN1 LS on condition of PRS measurement outside the MG**

*Response to RAN1 LS in R1-2112883 on condition of PRS measurement outside the MG. Response on if UE needs to calculate the expected Rx time difference and/or compare it against the threshold.*

* Option 1: HW
  + - Expected RTD is defined as max(X1, X2), where
      * X1 = X1’, if X1’ < 0.5 slot; X1 = 1-X1’, otherwise
      * X1’= mod(expected RSTD + expected RSTD uncertainty, slot length)
      * X2 = X2’, if X2’ < 0.5 slot; X2 = 1-X2’, otherwise
      * X2’= mod(expected RSTD - expected RSTD uncertainty, slot length)
    - Introduce UE capability for the maximum Rx timing difference in MG-less PRS measurement, with at least two values {CP length, 0.5 slot}.
    - It is up to UE implementation whether to calculate the expected Rx time difference and/or compare it against the threshold
* Option 2:
  + Proposal 2a: Vivo, Nokia, E///
    - Introduce the UE capability for the threshold which is used to be compared against with the Rx timing difference to determine whether the PRS from the non-serving cell satisfy the condition of PRS measurement outside MG.
  + Proposal 2b: Nokia
    - Timing difference with candidate thresholds {CP length, half of the symbol, half of the slot, 1ms} with corresponding UE capability.
* Option 3: Intel, OPPO, CATT, ZTE
  + The threshold, which is used to be compared against with the Rx timing difference to determine whether the PRS from the non-serving cell satisfy the condition of PRS measurement outside MG can be: [-½ CP length, ½ CP length]
* Option 4: Nokia
  + If single FFT processing is assumed, the condition for PRS measurement without MG is that the expected Rx timing difference between the PRS from the non-serving cell and that from serving cell is within CP.
* Option 5: QC
  + The applicability condition on Rx timing difference between the serving cell and a neighbor cell/TRP for PRS measurements within a PPW is , where
    - is the maximum distance between the start of a symbol containing PRS from the neighbor cell/TRP and the start of the closest symbol from the serving cell, taking into account the timing difference between the serving cell and the reference cell/TRP, the expectedRSTD of the neighbor cell/TRP, and the expectedRSTD-uncertainty of the neighbor cell/TRP.
    - is the selected threshold.
  + The UE is not required to evaluate the applicability condition on Rx timing difference between serving cell and neighbor cells/TRPs for PRS measurements within a PPW. The applicability condition is ensured by the LMF.
  + Introduce a UE capability for the value of the threshold of the applicability condition on Rx timing difference between serving cell and neighbor cells/TRPs for PRS measurements within a PPW.
  + The UE capability for the value of the threshold of the applicability condition on Rx timing difference between serving cell and neighbor cells/TRPs for PRS measurements within a PPW should include the value ¼ of the symbol length.
* Recommended WF
  + Discuss the proposals

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| **Company** | **Comments** | |
| Ericsson | Our preference is a network-based approach. It is still not clear why this needs to be a UE capability. Under what conditions a UE will not be able to meet a network configured threshold value shall be made clear if this needs to be defined as a UE capability. | |
| Nokia | We prefer option-2a, and we can compromise the threshold types regarding the number of thresholds. | |
| OPPO | Option 3 | |
| Qualcomm | We support option 5.  For this issue, RAN4 first needs to agree how to define the Rx timing condition. Then, having agreed on how to define the condition, RAN4 should discuss the value(s) of the threshold.  In our view, the condition should be based on the timing difference at the symbol level. If the condition is defined at the symbol level then any thresholds larger than ½ symbol need not be considered. Our proposal is ¼ symbol.  If a UE capability is introduced for the threshold value, the candidate values should include values larger than ½ \*CP or 1\*CP. | |
| vivo | Support Option 2. In our understanding, same as PRS measurement within gap, as long as the PRS from the non-serving cell is guaranteed within the window, the UE can perform PRS measurement through time-domain sliding correlation. If the threshold is restricted, when the expected RSTD is larger, the positioning measurement for non-serving cell may not be performed. We can compromise to introduce the UE capability for the threshold.  In addition, we revisit the candidate margin value to {CP length, half of the symbol, half of the slot, 0.5ms}. We noticed in the existing requirements, the absolue RSTD report value can arrive at about 500us. Therefore, it is feasible to introduce 0.5ms as UE capability to determine whether the PRS from the non-serving cell satisfy the condition of PRS measurement outside MG. | |
| Huawei | Support option 1.  First we understand there can be two kinds of UE implementations, one requires tight NW sync, and the other does not require any NW sync, and this is the reason we suggest to define UE capability on the threshold.   * For the first UE implementation, we suggest the threshold to be +/- CP/2 * For the second UE implementation, we suggest the threshold to be +/- half slot   The proposal for the second UE implementation is based on the definition of RTD in option 1. We think this is also something RAN4 needs to discuss because it is not clear what is being compared to the threshold. | |
| ZTE | Prefer to have the threshold as CP length.  Don’t think UE capabilities can help, at this stage it seems companies have different understandings and are not on the same page, so even if we discuss UE capabilities we will receive different suggestions, and when we figure it out eventually we may converge to a single value. |
| CATT | Option 3 with the threshold [-CP, +CP]. And we have concern to define the UE capability. If this capability is defined, it means some UE will request tight NW synchronization. But even in R16, we have no such restriction, why we need to define a lower UE capability in R17? |

### Sub-topic 1-3: Measurement gaps enhancement for PRS measurements

**Issue 1-3-1: Optimization of PRS measurements with gaps**

* + Option 1: HW, CATT, Nokia, OPPO, E///
    - Define Tlast as T+MGL when all of the PRS resources to be measured are available in the same MG occasion during Tavailabe.
  + Option 2: QC
    - For a low-latency PFL *i* with , and , set in the measurement period requirement if all the PRS resources in are contained within a single measurement gap instance.
  + Option 3: Optimization for multiple PFLs
    - Proposal 1: OPPO, E///
      * Support optimization for multiple PLFs
    - Proposal 2: OPPO
      * For multiple PFLs scenarios, total measurement period could be optimized as below:

* Recommended WF
  + Discuss the proposals

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| **Company** | **Comments** | |
| Ericsson | We support option 1. Notation “i" indicating applicability to multiple PFL shall however be added. | |
| Nokia | We support option-1 | |
| OPPO | Support option 1 and option 3. Option 2 could also be considered for on-demand PRS and/or PRS measurement outside MG. | |
| Qualcomm | We support option 3, which clearly targets scenarios where low-latency reporting is possible.  Regarding option 1, note that “when all of the PRS resources to be measured are available in the same MG occasion” does not mean that the UE can measure all the resources in one MG occasion (it depends on UE capability N) or in the next MG occasion (if CSSF > 1), even if N\_sample=1. Would there be much value in optimizing T\_last if low-latency reporting is not possible? | |
| Intel | We suggest to optimize the more general scenario e.g. Option 1. For Option 2, such optimization is limited to some specific scenarios. From RAN4 requirement perspective, the scenario specific requirements shall be avoided. | |
| Huawei | We support option 1, but we are open to consider the issues raised by QC. | |
| CMCC | Support option 1, which is more general. |
| CATT | Option 1. |

**Issue 1-3-2: Requirements for pre-configured MG for positioning**

Scenarios under which PRS measurement requirements can be defined based on preconfigured measurement gap procedure (defined in clause 5.1.6.5, TS 38.214 v17.0.0 and TS 38.321):

* Option 1 (No MG is configured for RRM measurement):
  + Proposal 1: CATT, Nokia, Intel, Vivo, OPPO
    - Define positioning measurement requirement when DL MAC-CE for positioning MG activation command is received and when a legacy MG is not configured
  + Proposal 2: Vivo
    - Existing RRM and positioning requirements can be reused
  + Proposal 3: OPPO
    - POS MG should not be considered as concurrent gaps when defining RRM requirements.
    - NCSG will not be configured for PRS measurement when defining RRM requirements.
* Option 2: HW
  + RAN4 to define measurement requirements when POS MG(s) are configured with the assumptions that POS MG(s) can only be used for PRS measurement, and only one POS MG can be activated at a time.
  + RAN4 to define measurement requirements when POS MG(s) are configured for the following scenarios.
    - Scenario 1: No MG is configured for RRM measurement
      * POS MG is considered as legacy MG in PRS and RRM measurements when activated
      * POS MG is not considered in RRM requirements when deactivated
    - Scenario 2: One legacy MG is configured for RRM measurement
      * FFS to define requirements for RRM and PRS measurements based on framework of concurrent MGs when POS MG is activated
      * POS MG is not considered in RRM requirements when deactivated
  + Provide reply LS to RAN2 based on above proposals
* Option 3: QC
  + RAN4 should specify requirements for PRS measurements within MG in the following additional scenarios (not supported in Rel-16):
    - Scenario A: when a per-UE pre-configured MG for positioning is activate and no other MGs are configured and no other pre-configured MGs are activate
    - Scenario B: for a UE that supports the new Rel-17 capability for PRS measurements with per-FR MG, when a per-FR pre-configured MG for positioning is activate and no other per-FR MGs are configured in the same FR and no other per-FR pre-configured MGs are activate in the same FR
    - Scenario C: for a UE that supports Rel-17 concurrent MGs, when a per-UE pre-configured MG for positioning is activate and at most one other MG is configured or at most one other pre-configured MG is activate
    - Scenario D: for a UE that supports Rel-17 concurrent MG and the new Rel-17 capability for PRS measurements with per-FR MG, when a per-FR pre-configured MG for positioning is activate and at most one other per-FR MG is configured in the same FR or at most one other per-FR pre-configured MG is activate.
* Option 4: E///
  + Scenario 1: No MG is configured for RRM measurement
    - POS MG is considered as legacy MG in PRS and RRM measurements when activated
    - POS MG is not considered in RRM requirements when deactivated
  + Scenario 3:
    - POS MG(s) are configured with the assumptions that POS MG(s) can only be used for PRS measurement, and only one POS MG can be activated at a time.
* Recommended WF
  + Discuss the proposals

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| **Company** | **Comments** | |
| Ericsson | Given the limited amount of time, we are ok to compromise to Option 1 which covers only scenario 1. | |
| Nokia | Although RAN1/2 have agreed to support pre-MG for positioning, it won’t be full UE support with the pre-MG. We agree to Proposal-1 with limited requirement applicability and conditions. | |
| OPPO | Support proposal 1 in option 1 with a little modification. Based on RAN1 agreements, both DL and UL MAC-CE could be used to activate/deactivate pre-configured MG for positioning.  Proposal 3 in option 1 is response to RAN2’s questions in LS R2-2202052. The principle in MG\_enh WID is that joint operation between pre-configured MG, NCSG and concurrent gaps should not be considered in Rel-17 for RRM requirements. In our understanding, the POS MG introduced by RAN1 should be considered as pre-configured MG. Then, it can be inferred from the first bullet that NO additional gap is configured for RRM and POS MG should be used for both RRM and PRS measurement. The second bullet is already agreed in NCSG discussion, this information should be sent to RAN2. | |
| Qualcomm | Option 3.  First, it should be clear that the pre-configured MG discussed here are only for positioning measurements.  Scenario A is equivalent to scenario 1 in options 2 and 4.  Scenario 2 in option 2 is included in Scenarios B, C, D. | |
| vivo | Support Option 1. We are fine with Option 4. | |
| Intel | As the joint discussion on the concurrent gap and pre-configured gap will be deferred to the future release, we suggest to focus on the scenario 1 for ePos in Rel17 also. | |
| Huawei | Support option 2.  We suggest to first agree on the general assumption as follows   * Whether the pre-configured MG can be used only for PRS measurement, or it can also be used for RRM measurement * Whether more than one pre-configured MG can be activated at the same time.   It is noted that the pre-configured MG discussed here is different from the pre-MG discussed in MG Enh WI.  Next RAN4 can discuss for which scenarios to define requirements. |
| CATT | Support option 1. |
| Ericsson2 | Following was agreed in GTW. The details of preconfigured gaps for positioning measurements are not clear since some work is ongoing in RAN2. Therefore, different to have progress on scenario 2.   * + Scenario 1: No MG is configured for RRM measurement     - Define positioning measurement requirement when DL MAC-CE for positioning MG activation command is received and when other MGs are not configured   + Scenario 2: One legacy MG is configured for RRM measurement   FFS whether to define requirements for RRM and PRS measurements based on framework of concurrent MGs when POS MG is activated |

### Sub-topic 1-4: Draft CRs

* All draft CRs under this thread are provided in section 1.2.5.
* Comments are invited for draft CRs in section 1.2.5

### CRs/TPs comments collection

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| **CR/TP number** | **Comments collection** |
| R4-2203885, Draft CR on PRS-RSRP measurement period without gaps, CATT | Ericsson:  Nsample = 2 is yet to be agreed. So text related to Nsample = 2 shall be removed.  “FFS the requirements when UE indicate that PRS is lower priority than other signals within PRS processing window” clause shall be removed.  Definition of CSSF,i shall be updated to “ is the carrier specific scaling factor for PRS-RSRP measurements, and is determined according to CSSFoutside\_gap,i in clause 9.1.5.1 for measurement conducted outside measurement gaps, i.e. when PRS resources to be measured are unmuted and fully or partially overlapped with PPW.” |
| Nokia  Nsample = 2 is FFS in RAN1 discussion, so it needs to be removed or in bracket.  We propose that the resource counting on refers to scheduling availability section, since PRS in PPW has different reception behaviors up to UE capability.  “…..only PRS resources unmuted and fully or partially overlapped with PRS processing window based on the PRS reception priority rule in [TS38.214 X] are considered.”  Also, we see that CSSF,i also refers to PRS RX rules for scaling :   * If PRS is high-prioritized within PPW, we support option-1, CSSF = 1. * If PRS is not prioritized as the first measurement object within PPW, option-2 is fine. |
| CATT: Nsample = 2 is for the case where M1=M2=1 based on issue 1-2-1D. CSSF is pending on the ongoing discussion, we will put it in [] and further update based on the agreement. |
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| R4-2203886, Draft CR on PRS-RSRPP measurement period without gaps, CATT | Ericsson:  Nsample = 2 is yet to be agreed. So text related to Nsample = 2 shall be removed.  “FFS the requirements when UE indicate that PRS is lower priority than other signals within PRS processing window” clause shall be removed.  Definition of CSSF,i shall be updated to “ is the carrier specific scaling factor for PRS-RSRP measurements, and is determined according to CSSFoutside\_gap,i in clause 9.1.5.1 for measurement conducted outside measurement gaps, i.e. when PRS resources to be measured are unmuted and fully or partially overlapped with PPW.” |
| Same as above |
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| R4-2204302, Draft CR to measurement period for UE Rx-Tx time difference measurement without gap, OPPO | Ericsson:  ”If the UE supports [*PRSMeas-NoGap*] and PRS processing window is configured, UE shall be able to measure PRS when   * the PRS resource is contained within the active DL BWP with the same numerology as the active DL BWP, and * the expected Rx timing difference between neighbouring cell and the serving cell is smaller than [TBD].   + The expected Rx timing difference is determined by expected RSTD and expected RSTD uncertainty in the assistance data. ”   shall be moved to requirements applicability section. This addition is not relevant to measurement period requirement. |
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| R4-2204303, Draft CR to scheduling availability of UE during RSTD measurement without gap, OPPO | Ericsson:  “The UE shall be capable of measuring PRS from a neighbouring cell within a PRS processing window but without measurement gap when   * the PRS resource is contained within the active DL BWP with the same numerology as the active DL BWP, and * the expected Rx timing difference between neighbouring cell and the serving cell is smaller than [TBD].   + The expected Rx timing difference is determined by expected RSTD and expected RSTD uncertainty in the assistance data. ”   shall be moved to requirements applicability section. This addition is not relevant to measurement period requirement.  Priority state is missing in the added text on scheduling availability. Following alternate text is proposed:   * “If Cap. 1A UE capable of supporting priority options 1,2, and 3 is configured with priority state 1 for PRS-RSRP measurement, then UE is not expected to receive PDCCH/PDSCH/CSI-RS inside PPW. * If Cap.1A UE capable of supporting priority option 2 is configured with priority state 2 for PRS-RSRP measurement, then UE is not expected to receive PDSCH/CSI-RS inside PPW but is expected to receive PDCCH and URLLC PDSCH inside PPW. * If Cap. 1B UE capable of supporting priority options 1,2, and 3 is configured with priority state 1 for PRS-RSRP measurement, then UE is not expected to receive PDCCH/PDSCH/CSI-RS in the same band as DL PRS inside PPW. * If Cap. 1B UE capable of supporting priority option 2 is configured with priority state 2 for PRS-RSRP measurement, then UE is not expected to receive PDSCH/CSI-RS in the same band as DL PRS inside PPW but is expected to receive PDCCH and URLLC PDSCH in the same band as DL PRS inside PPW. * If Cap. 2 UE capable of supporting priority options 1,2, and 3 is configured with priority state 1 for PRS-RSRP measurement, then the UE is not expected to receive PDCCH/PDSCH/CSI-RS on overlapped symbols with DL PRS inside PPW. * If Cap. 2 UE capable of supporting priority option 2 is configured with priority state 2 for PRS-RSRP measurement, then UE is not expected to receive PDSCH/CSI-RS on overlapped symbols with DL PRS inside PPW but is expected to receive PDCCH and URLLC PDSCH on overlapped symbols with DL PRS inside PPW.” |
| If checking RAN1 LS R1-2108639, the captured texts are RAN1 working assumption for RAN1 discussions. It seems not proper to specify it in RAN4 spec. From the Issues 1-2-1A-L, some statements are not fully agreed yet or FFS.  We agree to Ericsson. This section is to address RX scheduling restriction. |
| OPPO: we are fine with Ericsson’s proposal. |
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| R4-2204412, DraftCR to TS 38.133: NR ePos PRS-RSRP with reduced number of samples (9.9.3.5), Intel | Ericsson:  Proposed changes are fine. |
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| R4-2204638, Draft CR to 38.133 Introduction of RSTD measurement requirements for latency reduction, vivo | Ericsson:  Nsample = 2 shall be removed. Preclude this from ongoing WI. |
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| R4-2204639, Draft CR to 38.133 Introduction of scheduling availability of UE during UE Rx-Tx time difference measurement without gaps, vivo | Ericsson:  Priority state is missing in the added text on scheduling availability. Following alternate text is proposed:   * “If Cap. 1A UE capable of supporting priority options 1,2, and 3 is configured with priority state 1 for PRS-RSRP measurement, then UE is not expected to receive PDCCH/PDSCH/CSI-RS inside PPW. * If Cap.1A UE capable of supporting priority option 2 is configured with priority state 2 for PRS-RSRP measurement, then UE is not expected to receive PDSCH/CSI-RS inside PPW but is expected to receive PDCCH and URLLC PDSCH inside PPW. * If Cap. 1B UE capable of supporting priority options 1,2, and 3 is configured with priority state 1 for PRS-RSRP measurement, then UE is not expected to receive PDCCH/PDSCH/CSI-RS in the same band as DL PRS inside PPW. * If Cap. 1B UE capable of supporting priority option 2 is configured with priority state 2 for PRS-RSRP measurement, then UE is not expected to receive PDSCH/CSI-RS in the same band as DL PRS inside PPW but is expected to receive PDCCH and URLLC PDSCH in the same band as DL PRS inside PPW. * If Cap. 2 UE capable of supporting priority options 1,2, and 3 is configured with priority state 1 for PRS-RSRP measurement, then the UE is not expected to receive PDCCH/PDSCH/CSI-RS on overlapped symbols with DL PRS inside PPW.   If Cap. 2 UE capable of supporting priority option 2 is configured with priority state 2 for PRS-RSRP measurement, then UE is not expected to receive PDSCH/CSI-RS on overlapped symbols with DL PRS inside PPW but is expected to receive PDCCH and URLLC PDSCH on overlapped symbols with DL PRS inside PPW.” |
| Same as above |
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| R4-2205382, CR on requirements for UE Rx-Tx measurement with reduced latency, Huawei, HiSilicon | Ericsson: Nsample = 2 shall be removed. Preclude this from ongoing WI. |
| Huawei: To Ericsson, Nsample = 2 is for the case where M1=M2=1. |
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| R4-2205605, PRS-RSRPP measurement requirements including latency reduction, Ericsson | Huawei: The CR looks fine, one comment is to remove the last sentence in 9.9.6.5. The clause is for measurement with MG, so there is no need to mention requirements for measurement outside MG. |
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| R4-2205386, CR on RSTD measurement period requirements without gaps, Huawei, HiSilicon | Ericsson: CSSF,i is missing in measurement period requirement formula. |
| Huawei: To Ericsson, this is pending on Issue 1-2-1G and 1-2-1I. We can revise the CR by adding CSSF and put it in [] with an editor note that it may be updated based on agreement. |
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| R4-2205606, General - PRS measurement without gaps, Ericsson | Huawei: some of the statements are same for MG based and MG-less measurement, e.g. “The UE is not required to perform additional SSB measurement for the SSB configured as QCL source of PRS resources”, and we suggest to remove them to avoid duplication.  Also the CR may be updated to capture agreement on the applicability, i.e. issue 1-2-1F. |
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| R4-2205388, CR on scheduling restriction for PRS-RSRPP measurement, Huawei, HiSilicon | Ericsson: RAN1 agreement on priority states are missing. |
| Huawei: To Ericsson, we can revise the CR and try to use same wording as suggested. |
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| R4-2205607, Scheduling availability of UE during PRS-RSRP measurement, Ericsson | Huawei: suggest to add the following for defining “symbols with DL PRS”.  *For UE supporting PRS processing type 2, the symbols for PRS measurement includes serving cell PRS symbols, and serving cell symbols mapped with non-serving cell PRS.* |
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## Summary for 1st round

### Open issues

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|  | **Status summary** |
| **Sub-topic 1-1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |
| **Sub-topic 1-2** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |
| **Sub-topic 1-3** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |
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### CRs/TPs

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

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| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

# Topic #2: Impact on existing UE positioning and RRM requirements

## Companies’ contributions summary

|  |  |  |
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| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2205399**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205399.zip) | ZTE | **Proposal 1: R15 SRS as well as R16 positioning-dedicated SRS can both be used as the SRS for UE Rx-Tx and gNB Rx-Tx measurements.**  **Proposal 2: If SRS antenna port switching happens during UE/gNB Rx-Tx, there can be impact on positioning measurement and its accuracy.**  **Proposal 3: There is no need to specify whether this can be avoided by the network or not in specifications.** |
| [**R4-2205604**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205604.zip) | Ericsson | **Observation 1**: SRS antenna port switching may lead to timing error of 130 ns due to transmit time misalignment between the SRS antenna ports under the assumption that Rel-15 SRS is supported for UE Rx-Tx time difference and SRS antenna port switching is enabled.  **Observation 2**: Each SRS antenna port switching during the UE Rx-Tx timing measurement period will cause significant additional timing error (up to 260 Tc corresponding to 40 m) in the UE Rx-Tx timing measurement results.  **Observation 3**: SRS antenna port switching is enabled/configured by gNB while the UE is configured with UE Rx-Tx time difference measurement by LMF via LPP without gNB awareness.  **Observation 4**: UE Rx-Tx timing measurement is configured occasionally, is one time reporting upon receiving multi-RTT assistance data and is also more critical feature than SRS antenna port switching.  **Proposal #3**: If the UE is configured with SRS both antenna port switching and UE Rx-Tx timing measurement then to any impact due to SRS switching on UE Rx-Tx timing measurement accuracy is avoided.  **Proposal #4**: Following options are considered to avoid impact on due to SRS switching on UE Rx-Tx timing measurement accuracy:   * **Option 1**: The UE does not perform SRS antenna port switching during the UE Rx-Tx timing measurement period. * **Option 2**: The UE performs SRS antenna port switching but discards the UE Rx-Tx timing measurement if the SRS antenna port switching occurs during the UE Rx-Tx timing measurement period. * **Option 1 is preferred**.   Following are relevant if Rel-15 SRS is supported for gNB Rx-Tx time difference:  **Observation 5**: Each SRS antenna port switching may lead to timing error of 130 ns in Rx-Tx time difference measurement results due to transmit time misalignment between the SRS antenna ports.  **Observation 6**: The gNB can deconfigure the UE with SRS antenna port switching when the gNB is configured to perform the gNB Rx-Tx time difference measurement by the LMF via NRPPa.  **Proposal #5**: Impact of the SRS antenna port switching on gNB Rx-Tx time difference measurement can be prevented by gNB implementation. |
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## Open issues and comments collection for 1st round

### Sub-topic 2-1: SRS antenna port switching on UE Rx-Tx time difference

**Issue 2-1-1: Is Rel-15 SRS (*SRS-Resource*) supported for UE Rx-Tx time difference in Rel-17?**

*At RAN4#101bis-e LS in R4-2202680 was sent to RAN1 for confirmation.*

* Option 1: ZTE
  + Yes
* Recommended WF
  + Discuss the proposals

|  |  |  |
| --- | --- | --- |
| **Company** | **Comments** | |
| Ericsson | Option 1. | |
| Nokia | We prefer to wait for RAN1 conclusion, since LS has been sent. | |
| OPPO | Wait for RAN1 feedback. | |
| Qualcomm | RAN4 should wait for a response from RAN1. That was the point of sending the LS. | |
| Huawei | Option 1, but also fine to wait for RAN1 feedback. | |
| ZTE | Technically, our understanding is yes. But can wait for RAN1. However we should also notice that R17 completion is close and at some point we need to make decisions. | |
| CATT | Wait for RAN1 reply. |

**Issue 2-1-2: Impact of SRS antenna switching on UE Rx-Tx time difference accuracy, if Rel-15 SRS (*SRS-Resource* is supported for UE Rx-Tx time difference in Rel-17.**

* Option 1: E///, ZTE
  + UE Rx-Tx time difference measurement and accuracy requirements are impacted due to SRS antenna port switching, if SRS antenna port switches during the measurement period.
* Recommended WF
  + Discuss the proposals

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| **Company** | **Comments** |
| Ericsson | Option 1. |
| Qualcomm | RAN4 should wait for a response from RAN1. That was the point of sending the LS. |
| Huawei | Suggest to wait for RAN1 feedback. |
| ZTE | Technically, our understanding is yes. But can wait for RAN1. However we should also notice that R17 completion is close and at some point we need to make decisions. |
| CATT | Wait for RAN1 reply. |
|  |  |

### Sub-topic 2-2: SRS antenna port switching on gNB Rx-Tx time difference

**Issue 2-2-1: Can Rel-15 SRS (*SRS-Resource*) be used for gNB Rx-Tx time difference in Rel-17?**

*At RAN4#101bis-e LS in R4-2202680 was sent to RAN1 for confirmation.*

* Option 1: ZTE
  + Yes
* Recommended WF
  + Discuss the proposals

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| --- | --- |
| **Company** | **Comments** |
| Ericsson | Option 1 |
| Qualcomm | RAN4 should wait for a response from RAN1. That was the point of sending the LS. |
| Huawei | Option 1, but also fine to wait for RAN1 feedback. |
| ZTE | Technically, our understanding is yes. But can wait for RAN1. However we should also notice that R17 completion is close and at some point we need to make decisions. |
| CATT | Wait for RAN1 reply. |
|  |  |

**Issue 2-2-2: Impact of SRS antenna switching on gNB Rx-Tx time difference, if Rel-15 SRS (*SRS-Resource*) can be used for gNB Rx-Tx time difference.**

* Option 1: E///, ZTE
  + gNB Rx-Tx time difference accuracy is impacted due to SRS antenna port switching, if SRS antenna port switches during the measurement
* Recommended WF
  + Discuss the proposals

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Option 1. |
| Qualcomm | RAN4 should wait for a response from RAN1. That was the point of sending the LS. |
| Huawei | Suggest to wait for RAN1 feedback. |
| ZTE | Technically, our understanding is yes. But can wait for RAN1. However we should also notice that R17 completion is close and at some point we need to make decisions. |
| CATT | Wait for RAN1 reply. |
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## Summary for 1st round

### Open issues

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|  | **Status summary** |
| **Sub-topic 2-1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |
| **Sub-topic 2-2** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

### CRs/TPs

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| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

# Topic #3: Others

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2205387**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205387.zip) | Huawei, HiSilicon | **Proposal 1: RAN4 to discuss what propagation model to use for defining PRS-RSRPP accuracy requirements.**  **Proposal 2: Ask RAN1/2 to update the RSTD reporting signaling in Rel-17 to allow UE reporting an RSTD reference resource for each PFL.**  **Proposal 3: Update the requirements on the start of the measurement period by taking into account scheduled location.** |
| [**R4-2205604**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205604.zip) | Ericsson | **Proposal #1**: Define requirements for scenarios 1 and 3. Preclude scenario 2 discussion in Rel. 17 WI.  **Proposal #2**: No RSTD reporting enhancement in Rel. 17 |
| [**R4-2204305**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204305.zip) | OPPO | **Proposal 1: Do not update RSTD reporting signalling in Rel-17 to allow UE reporting an RSTD reference resource for each PFL.**  **Proposal 2: Ask RAN2 whether to support partial measurement report for PRS measurement.**  **Proposal 3: Define separate measurement period requirements for PRS measurement within MG and without MG respectively.**  **Observation 1: Since measurement sequence among multiple PFLs is up to UE implementation, it is hard to specify per-PFL measurement period for partial measurement reporting depending on PFL.** |
| [**R4-2204643**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204643.zip) | Vivo | **Proposal 1: PRS-RSRPP shall not be normalized for reporting if it is reported without PRS-RSRP.**  **Proposal 2: Wait for the conclusion from RAN1/2 before defining the differential PRS-RSRP measurement requirement.**  **Proposal 3: No need to update the RSTD reporting signalling in Rel-17 to allow UE reporting an RSTD reference resource for each PFL.** |

## Open issues and comments collection for 1st round

### Sub-topic 3-1: PRS-RSRPP

**Issue 3-1-1: PRS-RSRPP accuracy**

* Proposal 1: HW
  + RAN4 to discuss what propagation model to use for defining PRS-RSRPP accuracy requirements
* Recommended WF
  + Discuss the proposal

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| --- | --- | --- |
| **Company** | **Comments** | |
| Ericsson | In principle proposal 1 is fine. We propose to consider propagation models considered for RSTD accuracy requirements. However, this is related to performance part. This issue should be discussed during the performance part. At least this meeting should focus on core part. | |
| Nokia | We are fine to consider the requirement introduction for PRS-RSRPP accuracy. And agree to Ericsson comment and consider together with the other Rel-17 items whether this accuracy study is important over other core/performance studies. | |
| Qualcomm | This should be discussed during the performance part. | |
| vivo | In the last meeting, we also put forward the related proposal in R4-2200662: **Proposal 4：The LOS channel model (e.g., AWGN and TDL-D) should be considered for first path PRS-RSRP measurement accuracy requirements.**  We agree with the HW that the LOS channel model should be considered for defining PRS-RSRPP accuracy requirements. However, the detail should be decided in the performance part. | |
| Intel | Can be discussed in performance part | |
| Huawei | Agree with companies that this issue belongs to perf part, and the intention is to raise up this issue as it may require some quite detailed discussion. We may not need to reach any agreement for this issue. | |
| CATT | Open to discuss in perf part. |

**Issue 3-1-2: PRS-RSRPP report mapping**

***Agreements at RAN4#101bis-e:***

*Should PRS-RSRPP be normalized for reporting if it is reported without PRS-RSRP? NO*

* Option 1: Vivo
  + PRS-RSRPP shall not be normalized for reporting if it is reported without PRS-RSRP
* Recommended WF
  + No further discussion as already agreed.

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| --- | --- |
| **Company** | **Comments** |
| Ericsson | Already agreed in 101-bis-e. |
| Nokia | RAN4 concluded it is up to RAN1/2. |
| Qualcomm | Support the recommended WF. |
| vivo | We are fine with the Recommended WF. |
| Intel | Support the recommended WF. |
| Huawei | Support the recommended WF. |

### Sub-topic 3-2: Measurement requirements

**Issue 3-2-1: Differential PRS-RSRP measurement requirements**

* Option 1: Vivo

Wait for the conclusion from RAN1/2 before defining the differential PRS-RSRP measurement requirement.

* Recommended WF
  + Discuss the proposals

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| --- | --- |
| **Company** | **Comments** |
| Ericsson | Proposal is not clear. What is the difference between what is proposed and what is supported in Rel. 16? Can Vivo also clarify what is meant by differential PRS-RSRP measurement requirements as part of CORE requirements, which Vivo intends to define. |
| Nokia | This proposal seems to share the status that RAN4 concluded it is up to RAN1/2, which is fine. |
| Qualcomm | We assume there’s a typo in the issue title and this issue is about PRS-RPRPP.  We’re not sure we understand the motivation behind this proposal. RAN1 and RAN2 have been asked to decide what should be the reference measurement for reporting purposes. Anyway, we’re OK to wait for their conclusions. |
| vivo | Option 1. From the LS agreed in the last meeting, the reference measurement is up to RAN1/2 to decide when the PRS-RSRPP differential reporting is used. Therefore we can wait for the conclusion from RAN1/2 before defining the differential PRS-RSRPP measurement requirement.  Reply Ericsson: There is a typo error. It should be ‘differential PRS-RSRPP measurement requirement’. |
| Huawei | Could vivo please clarify if “differential PRS-RSRPP measurement requirement” means relative accuracy requirement? |
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**Issue 3-2-2: Measurement period starting point**

* Option 1: HW
  + Update the requirements on the start of the measurement period by taking into account scheduled location.
* Recommended WF
  + Discuss the proposals

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| **Company** | **Comments** |
| Ericsson | This will then mean to update the description of measurement period requirement and clarify when the measurement period shall start. |
| Nokia | We think Rel-16 principle can be reused with PPW, however a minor update is required. |
| Qualcomm | We support option 1. The requirement should be modified for scheduled location request. The starting point needs to be discussed. |
| Huawei | Support option 1.  To Ericsson: yes, this is the expected spec impact. |
| CATT | Need further check. |
|  |  |

### Sub-topic 3-3: PRS measurement reporting enhancement

**Issue 3-3-1: RSTD reporting enhancement**

* Ask RAN1/2 to update the RSTD reporting signaling in Rel-17 to allow UE reporting an RSTD reference resource for each PFL?
  + - Option 1: HW
      * Yes
    - Option 2: OPPO, E///, Vivo
      * No
* Recommended WF
  + Discuss the proposals

|  |  |  |
| --- | --- | --- |
| **Company** | **Comments** | |
| Ericsson | Option 2. | |
| Nokia | We are ok with Option-1. | |
| Qualcomm | We would support sending the LS. It may be too late for Rel-17. | |
| vivo | Option 2. | |
| Intel | Option 2.  Not clear the benefits of induvial PFL measurement reporting and how did NW combine them? | |
| Huawei | Option 1.  The motivation of option 1 is to enable more accurate RSTD reporting for the case of multiple PFLs.  As a compromise, we suggest to send the LS and let RAN2 to decide whether to update the signaling in Rel-17. | |
| CATT | Option 2. |

**Issue 3-3-2: Partial measurement reporting**

* Ask RAN2 whether to support partial measurement report for PRS measurement?
  + - Option 1: OPPO
      * Yes
    - Option 2:
      * No
* Recommended WF
  + Discuss the proposals

|  |  |  |
| --- | --- | --- |
| **Company** | **Comments** | |
| Ericsson | We do not see any need to define any additional PRS measurement reporting beyond what has been agreed. So, we support option 2. | |
| Nokia | We are ok with option-1. It would be one LS with Issue 3-3-1. | |
| OPPO | This issue could be merged with issue 1-2-1L. | |
| Qualcomm | Option 2 | |
| Intel | Option 2. | |
| Huawei | Same issue as 1-2-1L, and we are fine to combine this issue as Issue 3-3-1 if there is consensus. | |
| CATT | Option 2. |

## Summary for 1st round

### Open issues

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic 3-1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |
| **Sub-topic 3-2** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |
| **Sub-topic 3-3** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

### CRs/TPs

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

# Topic #4: Updated work split and timeline

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2206025**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2206025.zip) | Ericsson | Updated work split on RRM core requirements for positioning |
| R4-2206026 | Ericsson | Big DraftCR on Positioning Enhancement (For post meeting agreement/endorsement) |

## Open issues and comments collection for 1st round

### Sub-topic 4-1: Draft CR work split

**Issue 4-1-1: Updated work split and CR allocation**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **No.** | **Requirements for** | **Detail** | **New or impacted section in TS 38.133Note1** | **Volunteer Company** |
| 1 | All | Big DraftCR on Positioning Enhancement | All relevant sections in TS 38.133 | Ericsson (Rapporteur) |
| 2 | Latency reduction | RSTD measurement period with reduced number of samples | 9.9.2.5 | vivo |
| RSTD measurement period related to measurement gaps enhancement |
| 3 | PRS-RSRP measurement period with reduced number of samples | 9.9.3.5 | Intel |
| PRS-RSRP measurement period related to measurement gaps enhancement |
| 4 | UE Rx-Tx time difference measurement period with reduced number of samples | 9.9.4.5 | Huawei |
| UE Rx-Tx time difference measurement period related to measurement gaps enhancement |
| 5 | PRS-RSRPP | PRS-RSRPP measurement requirements **including latency reduction** | 9.9.6 (new) | Ericsson |
| 6 | PRS measurement in RRC\_INACTIVE state | General section | 5.5, 5.5.1 (new) | Huawei |
| 7 | RSTD measurement requirements | 5.5.2 (new) | Qualcomm |
| 8 | PRS-RSRP measurement requirements | 5.5.3 (new) | vivo |
| 9 | UE Rx-Tx time difference measurement requirements | 5.5.4 (new) | Ericsson |
| 10 | PRS-RSRPP measurement requirements | 5.5.5 (new) | CATT |
| 11 | PRS measurement without gaps | General section | 9.9.1 | Ericsson |
| 12 | RSTD measurement period without gaps | 9.9.2.7 (new) | Huawei |
| 13 | Scheduling availability of UE during RSTD measurement | 9.9.2.8 (new) | OPPO |
| 14 | PRS-RSRP measurement period without gaps | 9.9.3.6 (new) | CATT |
| 15 | Scheduling availability of UE during PRS-RSRP measurement | 9.9.3.7 (new) | Ericsson |
| 16 | UE Rx-Tx time difference measurement period without gaps | 9.9.4.6 (new) | OPPO |
| 17 | Scheduling availability of UE during UE Rx-Tx time difference measurement | 9.9.4.7 (new) | vivo |
| 18 | PRS-RSRPP measurement period without gaps | 9.9.6.x (new) | CATT |
| 19 |  | Scheduling availability of UE during PRS-RSRPP measurement | 9.9.6.y (new) | Huawei |
| 20 | Timing error group (TEG) | General | TBD |  |
| 21 | UE Rx TEG related requirements | TBD |  |
| 22 | UE Tx TEG related requirements | TBD |  |
| 23 | RRM impact on PRS measurements | Impact of RRM on PRS measurement requirements and UE behavior | TBD |  |
| 24 | PRS measurement impact on RRM | Impact of PRS measurement on RRM measurement requirements and UE behavior | TBD |  |
| 25 | A-GNSS positioning | Enhancement requirements for A-GNSS positioning | TBDNote 2 |  |
| Note 1: All items 1-20 are for TS 38.133  Note 2: Impacts only TS 38.171 | | | |  |

* Recommended WF
  + Comments invited on remaining draft CR # 21-25
* Note: Any of draft CRs # 21-25, if needed, will be assigned to volunteer companies in 2nd round

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson |  |
| Huawei | Agree with Ericsson’s view on 20-25. |
| CATT | Agree with Ericsson that TEG may have impact on the core requirements. We would like to be clarified whether separate CRs are needed or to be combined with the assigned CRs. |
| Ericsson2 | CATT: combine with the assigned CRs. |
|  |  |
|  |  |

**Issue 4-1-2: Time plan**

* **RAN4#102-e:**
  + Companies provide draft CRs
  + Endorsement of draft CR
  + Agreement of Big CR
* Recommended WF
  + Comments invited on proposed time plan, which can be updated based on agreements

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| --- | --- |
| **Company** | **Comments** |
| Huawei | OK |
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## Summary for 1st round

### Open issues

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic 4-1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |
| **Sub-topic 4-2** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

### CRs/TPs

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

# Topic #5: Feature list for positioning enhancements

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2204651**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204651.zip) | Vivo | Update on Rel-17 RAN4 UE feature list for NR |

## Open issues and comments collection for 1st round

### Sub-topic 5-1: Features for positioning enhancements

*The agreed features will be included in the overall feature list under [102-e][143] R17\_feature\_list.*

* **Proposal: Vivo**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Features** | **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Need for the gNB to know if the feature is supported** | **Applicable to the capability signalling exchange between UEs (V2X WI only)”.** | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | **Need of FDD/TDD differentiation** | **Need of FR1/FR2 differentiation** | **Capability interpretation for mixture of FDD/TDD and/or FR1/FR2** | **Note** | **Mandatory/Optional** |
| 14. NR\_pos\_enh | 14-1 | per-FR MG for PRS measurement | Capability of supporting per-FR MG for PRS measurement | Rel-15 per-FR gap (independentGapConfig) | yes | no |  | Per UE | No | No | N/A |  | Optional with capability signalling |
| 14  NR\_pos\_enh | 14-2 | PRS measurement for reduced sample in RRC\_inactive state | Capability of supporting reduced number of samples (M=1) for PRS measurement in RRC\_inactive state | [27-17] | no |  | The reduced number of samples (M=1) for PRS measurement in RRC\_inactive state cannot be supported. The UE is assumed to support M=4 only. | Per UE | No | No | N/A |  | Optional with capability signaling |
| 14. NR\_pos\_enh | 14-3 | PRS measurement without MG | Capability for the threshold used to be compared against with the Rx timing difference to determine whether the PRS from the non-serving cell satisfy the condition of PRS measurement outside MG. | [27-3-2] | yes |  |  | Per UE | No | No | N/A | The candidate threshold values: [CP length, half of the symbol, half of slot, 1ms] | Optional with capability signaling |

* Recommended WF
  + Discuss the proposals

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | We are fine with features listed in the table. |
| vivo | The UE feature for 14-1 has be agreed in the last meeting.  For 14-2, it may need to wait the outcome of Issue 2-4-1 in the thread 231.  For 14-3, it is related to Issue 1-2-2. |
| Intel | For 14-2, shall be FFS.  For 14-3, the capability from RAN1below seems enough to indicate UE can support the measurement outside gap.  ”27-3-2a: Support of priority handing of PRS when PRS measurement is outside MG [R1-2200767] |
| Huawei | 14-1 was agreed in last meeting as vivo mentioned.  14-2 in our view is being discussed in RAN1, so we do not think RAN4 needs to duplicate the same discussion.  14-3 can be supported. |
| CATT | 14-1 was agreed in last meeting.  14-2 is related to ongoing discussion. We prefer not to define(i.e. use the same capability as RRC\_CONNECTED state) or follow RAN1 agreement.  14-3 is related to ongoing discussion, and we prefer not. |
|  |  |

### Sub-topic 5-2: Features for PRS measurement in RRC\_INACTIVE state

*Proposal:*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Features** | **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Need for the gNB to know if the feature is supported** | **Applicable to the capability signalling exchange between UEs (V2X WI only)”.** | **Consequence if the feature is not supported by the UE** | **Type**  **(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | **Need of FDD/TDD differentiation** | **Need of FR1/FR2 differentiation** | **Capability interpretation for mixture of FDD/TDD and/or FR1/FR2** | **Note** | **Mandatory/Optional** |
| 14. NR\_pos\_enh | 14-4 | Parallel PRS measurements in RRC\_INACTIVE state | Capability for the support of performing RRM measurement and PRS measurement in parallel |  | yes | no | RRM measurement and PRS measurement cannot be performed in parallel | Per UE | No | No | N/A |  | Optional with capability signalling |

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | We agree with feature 14-4. |
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## Summary for 1st round

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic 5-1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

## Discussion on 2nd round (if applicable)

# Recommendations for Tdocs

## 1st round

**New tdocs**

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

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **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** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-210xxxx | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-210xxxx | LS on … | ZZZ | Agreeable, Revised, Noted |  |
|  |  |  |  |  |

Notes:

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

# Annex

Contact information

|  |  |  |  |
| --- | --- | --- | --- |
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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)