**3GPP TSG-RAN WG4 Meeting # 109 R4-2318176**

**Chicago, US, November 13 – 17, 2023**

**Agenda item:** 8.22.4

**Source:** Moderator (CATT)

**Title:** Topic summary for [109][220] NR\_pos\_enh2\_part2

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# Introduction

This topic summary for [109][220] NR\_pos\_enh2\_part2 contains the discussions in agenda 8.22.2.2, 8.22.2.6 which include the following topics:

* Topic #1: Sidelink Positioning (agenda 8.22.2.2)
* Topic #2: Carrier Phase Positioning (agenda 8.22.2.6)

*Recommendation of prioritized topics:*

* *For SL positioning: sub-topic 1-1 (issue 1-1-1/1a/1b, 1-1-2, 1-1-3/3a) and sub topic 1-2.*
* *For CPP: sub-topic 2-1 and sub-topic 2-2.*

# Topic #1: Sidelink Positioning (agenda 8.22.2.2)

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2318280 | CATT | Simulation results for sidelink positioning |
| R4-2318336 | CATT | **Observation 1: The UE capability for minimum time after the end of a slot carrying a SL-PRS resource for a UE finish the SL-PRS resource processing and preparing the positioning measurement report (component 4) need to be considered in Tlast.**  **Observation 2: The components 1, 2 and 3 of Common SL PRS Processing Capability in RAN1 feature list can be considered as the side condition of the measurement requirements.**  **Observation 3: No additional samples are needed for AGC in SL-PRS based measurement and the measurement requirements can be defined based on one sample.**  **Observation 4: The definition of SL-PRS sample is same as legacy PRS which is one SL-PRS resource defined in RAN1, but there is no need to define it in the specification.**  **Observation 5: There is no discussion in RAN1 on the UE behaviour when there is coverage status change or Uu link connection change.**  **Proposal 1: Choose one of the following alternatives to define the measurement requirement for SL-PRS based RSTD:**   * **Alternative #1: Include the processing capability (component 4) into the formula to determine the scaling factor.**   **Where,**   * **.** * **, where and are the start of the *s*-th and *(s+1)*-th slot where UE needs to measure SL-PRS.** * **, which is the minimum processing time after the end of a slot carrying the active SL-PRS resource(s).** * **= 1 or 4.** * **Alternative #2: Do not include the processing capability (component 4) into the formula, i.e., scaling factor is 1, and to consider the processing capability as requirements applicability.**   **Where,**   * **.** * **, where and are the start of the *s*-th and *(s+1)*-th slot where UE needs to measure SL-PRS, satisfying ≥ .** * **, which is the minimum processing time after the end of a slot carrying the active SL-PRS resource(s).** * **= 1 or 4.**   **Proposal 2: The measurement requirement for SL-PRS based RSTD can also be reused for SL-PRS based AoA/ZoA and SL-PRS based UE Rx-Tx time difference.**  **Proposal 3: The SL-PRS based measurement period requirements apply without DRX as well as for any SL DRX configuration.**  **Proposal 4: The SL-PRS based measurement requirements apply provided no SL-PRS symbols are dropped during the measurement period.**  **Proposal 5: Do not define the SL-PRS based measurement period requirements when there is network coverage change or Uu link connection distortion.**  **Proposal 6: No need to define additional requirements for initiation/cease of SL PRS transmission. The existing requirements for initiation/cease of SLSS transmission still apply for sidelink UE supporting positioning.**  **Proposal 7: When the synchronization reference source changes occurs during the measurement period at Rx side, i.e., at the UE which is performing the measurement,**   * **for SL RSTD and RTOA measurements, UE shall continue the measurement and meet the measurement period requirements.** * **for SL PRS based Rx-Tx measurement, UE shall restart the measurement. And no need to limit the number of restarting in the specification.**   **Proposal 8: The side condition for SL PRS based RSTD is defined as [0, -6]dB for reference cell and neighbor cell.**  **Proposal 9: The side condition for SL PRS based RSRP/RSRPP/UE Rx-Tx is defined as [0]dB and [-6]dB.**  **Proposal 10: Do not define accuracy requirements for SL PRS based RTOA and AOA/ZOA measurement.**  **Proposal 11: Define absolute accuracy requirements for SL PRS-RSSI measurement.** |
| R4-2318337 | CATT | Draft CR #27: on SL Rx-Tx time difference and SL RSRPP measurement requirements |
| R4-2318856 | Xiaomi | Impacts when reference synchronization resources changed  ***Proposal 1: When the synchronization reference source changes during the on-going SL measurement or right before the SL measurement, UE can restart measurement.***   * ***FFS whether to limit the number of restarting***   Measurement period requirements  **Observation 1: Measurement based on single sample is enough to achieve the targeted accuracy if SINR side condition is higher enough.**  ***Proposal 2: Number of samples for positioning measurements can be:***   * = 1   Measurement accuracy requirements  **Observation 2: The accuracy requirements for SL positioning in Rel18 can be defined by the group of SCS, and PRS BW at least.**  ***Proposal 3: RAN4 can take the framework of Rel16 PRS accuracy requirement in FR1 as the start point for the accuracy requirements of SL positioning in Rel18, e.g.***  **Table 1: RSTD accuracy in FR1**   |  |  |  | | --- | --- | --- | | **Accuracy,**  **Tc** | **PRS BW,**  **PRB** | **PRS SCS,**  **kHz** | | [TBD] | ≥[24] | 15 | | [TBD] | ≥[52] | | [TBD] | >[104] | | [TBD] | ≥[48] | 30,60 | |
| R4-2319071 | vivo | ***Observation 1: If the synchronization detection occurs in the procedure of SL positioning measurement and SyncRef UE is synchronous to the current synchronization source, there will be no dropping of SL-PRS.***  ***Observation 2: If the synchronization detection occurs in the procedure of SL positioning measurement and SyncRef UE is asynchronous to the current synchronization source, UE may drop the SL-PRS transmission and reception.***  ***Proposal 1: RAN4 to wait RAN1 progress for SL UE features for further discussing the details, e.g. scaling factors, in measurement period formula.***  ***Proposal 2: RAN4 to define the measurement period requirement for the sample numbers of 1 and 4.***  ***Proposal 3: SL-PRS measurement requirements apply for different resource pool types.***  ***Proposal 4: The measurement period of SL-PRS based RSTD can be reused for SL-PRS based AoA/ZoA.***  ***Proposal 5: For definition #2 for UE Rx-Tx time difference, the measurement period based on SL-RSTD may needs to be extended and the extended duration can be included in Tlast..***  ***Proposal 6: SL PRS measurement requirements apply provided that reception/transmission of the slots containing SL PRS is not dropped due to other SL procedures (e.g., Selection/Reselection of V2X Synchronization Reference Source).***  ***Proposal 7: If the reception/transmission of the slots containing SL PRS is dropped, the measurement period can be extended. RAN4 will specify how exactly the measurement period is extended, e.g.***    ***Where***   * ***L is the number of SL-PRS sample not available at the UE during TSL RSTD for SL-PRS RSTD measurement, where L≤Lmax.***   ***Proposal 8: For SL-AoA measurements, UE shall continue the measurement after the synchronization reference source change.***  ***Proposal 9: For SL RSTD and RTOA measurements, UE shall continue the measurement after the synchronization reference source change.***  ***Proposal 10: For the async case, all the SL-PRS measurement should be dropped after the synchronization reference source change.*** |
| R4-2319072 | vivo | Updated Link-level simulation results for SL-PRS measurement |
| R4-2319073 | vivo | Draft CR #28 TS 38.133 SL-AoA and SL-RTOA measurement requirements |
| R4-2319094 | CMCC | ***Proposal 1: it is proposed that N\_sample is 1, considering AGC for SL positioning is based on the dedicated AGC symbol, not based on SL PRS.*** |
| R4-2319480 | OPPO | **Proposal 1: Define requirements for the sample numbers of 1 and 4.**  **Proposal 2: The scaling factor should be, where:**   * **is the number of SL-PRS resources configured to be measured.** * **is the maximum number of active SL-PRS resources as indicated by component 2 of UE FG 41-1-1.** * **is the maximum number of slots with active SL-PRS resources as indicated by component 3 of UE FG 41-1-1.** * **is the number of slots contained within the processing delay as indicated by component 4 of UE FG 41-1-1.**   **Proposal 3: should include both the duration of last SL-PRS resources and minimum processing time, i.e. .**  **Proposal 4: For UE Rx-Tx time difference with definition #2, the time for SL-PRS transmission should also be considered.**  **Proposal 5: If configured to report multiple UE Rx-Tx time difference measurements with N different SL-PRS receptions or transmissions, the measurement period should be longer, e.g. by further scaling S by N.**  **Proposal 6: The same requirements apply for both non-DRX case and SL DRX case.**  **Proposal 7: SL-PRS measurement requirements apply provided that reception/transmission of the slots containing SL-PRS is not dropped due to other SL procedures.**  **Proposal 8: If the reception/transmission of the slots containing SL-PRS is dropped, the measurement period can be extended but the exact extension is not specified.**  **Proposal 9: SL-PRS measurement requirements apply provided that reception of the slots containing SL-PRS is not interrupted due to Uu operation.**  **Proposal 10: Deprioritize defining requirements for initiation/cease of SL-PRS transmission.** |
| R4-2319991 | Huawei, HiSilicon | **Proposal 1: RAN4 not to define exact formula for SL-PRS measurement period, but to define the measurement period based on the principles for handling active resources and slots defined by RAN1.**  **Proposal 2: RAN4 to discuss how to define the ending point of SL PRS measurement period.**  **Proposal 3: RAN4 to define the SL PRS measurement period based on Nsample = 1.**  **Proposal 4: On reusing the SL RSTD requirements for other measurements.**   * **The measurement period requirement for SL RSTD can be reused for SL AoA/ZoA.** * **For SL Rx-Tx definition #2, additional time uncertainty for waiting for actual transmission needs to be accounted in the measurement period.**   **Proposal 5: RAN4 to discuss the impact of SL DRX after the measurement period requirements for basic scenario (without SL DRX) are stable.**  **Proposal 6: RAN4 to discuss the impact of other channels/signals after the measurement period requirements for basic scenario (without SL PRS dropped) are stable.**  **Proposal 7: RAN4 to discuss the impact of Uu link connection distortion after the measurement period requirements for basic scenario (without Uu link connection distortion) are stable.**  **Proposal 8: In case of synchronization reference source change,**   * **for SL Rx-Tx, RAN4 not to define limit on the number of restarting.** * **for SL RSTD, UE shall continue the measurement after the change.** * **for SL RTOA, UE shall restart the measurement after change and the previous measurement samples are dropped.**   **Proposal 9: RAN4 not to define impact of coverage status change on SL PRS measurement.**  **Proposal 10: SL-PRS measurement requirements apply for different resource pool types.**  **Proposal 11: RAN4 to deprioritize defining requirements for initiation/cease of SL PRS transmissions.** |
| R4-2319992 | Huawei, HiSilicon | **Updated simulation results for SL positioning**  *Not available.* |
| R4-2320458 | Ericsson | * ***Proposal 1 (number of samples and min BW)****: RAN4 will define requirements for SL-PRS based measurements based on:*   + *1 sample for SL-PRS BW>48 PRBs,*   + *4 samples for SL-PRS BW≥24 PRBs.* * ***Proposal 2 (side conditions)****: For SL RSTD, the side conditions assumed in RAN4 requirements are: ≥0 dB for the reference link and ≥-6 dB for the measured link.* * ***Proposal 3 (side conditions)****: For SL Rx-Tx, the requirements are defined down to -6 dB.* * ***Proposal 4 (side conditions)****: Given that SL PRS-RSRP can be configured with other SL-PRS based measurements, the requirements for SL PRS-RSRP can be defined down to -6 dB.* * ***Proposal 5 (side conditions)****: Given that SL PRS-RSRPP can be configured with other SL-PRS based measurements, the requirements for SL PRS-RSRPP can be defined down to -6 dB.* * ***Proposal 6 (side conditions)****:* The Es/Iot combination (0, -3, -3) is not considered as a side condition in SL positioning measurement requirements*.* Note also: This combination is not a valid combination for the agreed setup. * ***Proposal 7 (max SL-PRS BW)****: RAN4 SL positioning requirements are not applicable for CBWs larger than 40 MHz, unless they are supported by TS 38.101-1.* * ***Proposal 8 (initiation/cease of SL-PRS tx)****: RAN4 will define requirements for initiation/cease of SL-PRS transmissions for positioning, based on the agreed RAN1/RAN2 procedures. A new section (e.g., 12A.8) is to be added for SL-PRS initiation and cease, where the procedure is to be described.* * ***Proposal 9 (initiation/cease of SL-PRS tx)****: SL-PRS transmissions for positioning have to be ceased at the synchronization source change and resumed after the completion of the synchronization source change, within up to a certain TBD time.* * ***Proposal 10 (initiation/cease of SL-PRS tx)****: For Mode 1, SL-PRS transmissions for positioning have to be activated shortly upon receiving the network assistance.* * ***Proposal 11 (synch source change at measuring UE)****: For SL Rx-Tx, when the UE has been restarting the measurement upon the synchronization source change at the measuring UE, it has to meet the following physical layer measurement period:*   *, where K is the number of restarts.*   * + *Option 1: No need to define a limit for K (like in LTE).*   + *Option 2: Maximum limit for K is defined, e.g., K≤Kmax, Kmax=TBD.* * ***Proposal 12 (synch source change at measuring UE)****: For SL RSTD, the UE shall continue the measurement upon the synchronization source change at the measuring UE and meet the same measurement period and the accuracy requirements as without the change.* * ***Proposal 13 (synch source change at measuring UE)****: For SL AoA, the UE shall continue the measurement upon the synchronization source change at the measuring UE and meet the same measurement period and the accuracy requirements as without the change.* * ***Proposal 14 (synch source change at measuring UE)****: For SL RTOA, the UE shall continue the measurement upon the synchronization source change at the measuring UE and meet the same measurement period and the accuracy requirements as without the change.* * ***Observation 1 (synch source change at anchor UE)****: In SL positioning, a UE can be aware of the synchronization source of an anchor UE and the synchronization source change at the anchor UE.* * ***Proposal 15 (synch source change at anchor UE)****: Upon the synchronization source change at the anchor UE, the measuring UE shall restart the SL PRS-based timing measurements (SL Rx-Tx, SL RSTD, and SL RTOA).* * ***Proposal 16 (synch source change at anchor UE)****: The measurement period requirements can be defined to cover any of the synchronization source change at the measuring UE and/or any of the anchor UEs, e.g.:*   *, where K is the number of restarts due to the synchronization source change at the measuring UE and/or at any of the anchor UEs.*   * + *Option 1: No need to define a limit for K (like in LTE).*   + *Option 2: Maximum limit for K is defined, e.g., K≤Kmax, Kmax=TBD.* * ***Observation 2 (coverage status change):*** *Upon the coverage change, the reporting possibilities as well as the applicable SL-PRS resource configuration mode may change.* * ***Proposal 17 (coverage status change)****: When an SL UE determines that its coverage status has changed (e.g., changing between any two of: in-coverage, out-of-coverage, partial coverage, unknown coverage, different coverage range, or even transition period), then:*   + *The UE shall restart the on-going SL positioning measurement in new coverage conditions.* * ***Proposal 18 (Uu link distortion [RLF, RRC reestablishment, handover])****: If the SL-PRS resource availability is interrupted due to handover or RRC re-establishment at the measuring or anchor UE, then the UE cannot continue the SL positioning measurement.*    + *FFS: for RLF.* * ***Proposal 19 (SL DRX)****: The same SL-PRS based measurement period requirements apply, regardless of whether the measuring UE is configured or not with SL DRX.* * ***Proposal 20 (SL measurement period)****: The basic measurement period, e.g., for SL RSTD measurement, can be defined as follows:*   *, where*  *S is the number of samples,*  *is the measurement time for sample s, which starts from the beginning of the first slot with SL-PRS for sample s until the beginning of the first slot with SL-PRS for sample s+1,*  *FFS: ≤ , where is the maximum time until the next sample,*  *is FFS (e.g., includes the SL-PRS resources for the last sample + processing time).* |
| R4-2320459 | Ericsson | **Draft CR #25 38133 Introduction to SL positioning measurement requirements** |
| R4-2320460 | Ericsson | **Draft CR #26 38133 SL RSTD and SL PRS-RSRP measurement requirements** |
| R4-2320809 | Nokia, Nokia Shanghai Bell | **Proposal 1: RAN4 to define , where and are defined as the the start of the s-th and (s+1)-th slot where UE can measure the SL PRS.**  **Proposal 2: The agreed measurement period requirement**  **is valid for different resource pool and scenarios when SL PRS slots are dropped due to other SL procedures, considering , where and are defined as the start of the s-th and (s+1)-th slot where UE is able to measure the SL PRS when SL PRS slots are available in a resource pool or not dropped due to other SL procedures.**  **Proposal 3: Consider > N + T and to accommodate for the UE processing capability of {N, T}.**  **Proposal 4: The scaling factor can be defined as: scaling factor = CSSFSL \* , where is UE capability for number of SL PRS resources that it can process in a slot and is UE capability where N is a duration of SL PRS symbols in ms and CSSFSL takes into account any overlapping with higher priority RRM measurements.**  **Proposal 5: RAN4 to define the measurement period requirement for the sample numbers of 1 and 4 both.**  **Proposal 6: The measurement period of SL-PRS based RSTD should only be reused for AoA/ZoA when angle-based measurement is not performed concurrently with other positioning procedures.**  **Proposal 7: RAN4 to reuse the measurement period of SL-PRS based RSTD considering both definition #1 and definition #2 which is aligned with the RAN1 agreements.**  Proposal 8: RAN4 to specify requirements for non-DRX and thereafter for SL-DRX based on RAN1 / RAN2 agreements.  Proposal 9: RAN4 to agree the measurement period can be extended if SL PRS is dropped but it is not specified how the measurement period is extended.  Proposal 10: RAN4 should consider in-coverage and out-of-coverage scenarios to define the SL positioning measurement period requirements.  **Proposal 11: For SL RX-TX based measurement more discussion is needed in RAN4 to decide whether to limit the number of restarting or not.**  **Proposal 12: For SL RSTD and SL RTOA based positioning methods, UE shall continue the measurement after the synchronization reference source change.**  Proposal 13: Option 2 in issue 1-1-5 (impact of Uu link connection distortion) is preferred. Measurement period requirements should consider the Uu impacts like handover or RRC re-establishment.  Proposal 14: RAN4 to discuss (re-)configuration of SL positioning measurement period parameters by considering the impact of key factors such as UE mobility, coverage state, PRS quality, anchor UEs GDoP, etc. to achieve desired SL positioning measurement accuracy.  **Observation 1: Uu PRS measurements requirements are conditioned with lowest side condition of -13dB, i.e., (PRS Ês/Iot)i ≥ -13dB, which needs to be relaxed for SL scenario.**  **Proposal 15: Support higher Es/Iot ratios, such as -6 dB, since the cell size in SL is smaller than that of non-SL.**  **Observation 2: The maximum available bandwidth for SL device is limited to single carrier of 40 MHz for both the transmission and reception path.**  Proposal 16: RAN4 to define RRM requirements for SL positioning up to 40 MHz.  **Proposal 17: RAN4 to define the minimum BW and the associated number of samples based on simulation results.**  Proposal 18: RAN4 should analyze proposal 1, proposal 3 and proposal 4A to define the accuracy requirements for SL-PRS based measurements.  Proposal 19: RAN4 to study the measurement accuracy requirement for SL-PRS assuming anchor UE(s) being in coverage. |
| R4-2320853 | Nokia, Nokia Shanghai Bell | **Simulation Results for Sidelink Positioning** |
| R4-2320911 | Qualcomm Incorporated | **Proposal 1: Prioritize defining requirements for SL PRS measurements assuming one sample (N\_sample = 1).**  **Proposal 2: The scaling factor is equal to 1, i.e. S = N\_sample.**  **Proposal 3: For single sample SL RSTD measurements, the measurement period is given by**   * **The measurement period starts at the end of the slot carrying the active SL-PRS resource(s)** * **is greater than or equal to the time indicated in FG 41-1-1 component 4. needs to include time to prepare the measurement report.** * **If the maximum number of active SL PRS resources or the maximum number of slots with active SL PRS resources is exceeded, the measurement period can be longer.**   **Proposal 4: RAN4 will not consider TEG reporting in the requirements for SL PRS based measurements.**  **Proposal 5: Define measurement accuracy requirements based on single SL PRS instance.**  **Proposal 6: Define a SL PRS measurement sample as a group of SL PRS resource instances comprised of**   * **One SL PRS resource instance triggered by an SCI in the same slot, and** * **up to SL PRS resource instances reserved in future slots by the same SCI.** * **The multiple SL PRS resource instances have the same comb size and number of symbols.**   **Proposal 7: When the UE reports SL PRS-based Rx-Tx time difference based on the actual SL PRS transmission time upon network/LMF request, the measurement period is extended until the UE transmits SL PRS.**   * **FFS whether to define a proximity condition between the reception and transmission of SL PRS for reporting SL PRS-based Rx-Tx time difference based on the actual SL PRS transmission time.**   **Proposal 8: No need to define requirements for sidelink positioning measurements when there is a change in network coverage.**  **Proposal 9: RAN4 to deprioritize defining requirements for initiation/cease of SL PRS transmissions.** |

*The moderator can suggest a limited number of papers which could be presented.*

## Open issues summary

*Moderator: RAN1 feature list in R4-2315006 (R1-2308523) with attachment R1-2308521.*

### Sub-topic 1-1 SL-PRS measurement period requirements

*In RAN1 feature list R4-2318013 (R1-**2310637), the common SL PRS processing capability is defined as below:*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Note | Mandatory/Optional |
| 41. NR\_pos\_enh2 | 41-1-1 | Common SL PRS Processing Capability in a SL BWP | 1. Maximum SL PRS bandwidth in MHz in a resource pool for positioning, which is supported and reported by UE for SL-PRS measurement  2. Maximum number of active SL PRS resources across all configured RPsassuming maximum SL PRS bandwidth in MHz, which is supported and reported by UE3. Maximum number of slots with active SL PRS resources across all configured RPsassuming maximum SL PRS bandwidth in MHz, which is supported and reported by UE  4. Minimum time after the end of a slot carrying the active SL-PRS resource(s) assuming maximum number of symbols and maximum bandwidth for a UE finish the SL-PRS resource processing [and preparing the positioning measurement report] [assuming the active SL-PRS resources during this time haven’t exceeded the reported capabilities] which is supported and reported by UE]  [5. SL PRS buffering capability] | Component 1 candidate values:  FR1 bands: {5, 10, 20, 40, 50, 80, 100}  FR2 bands: {50, 100, 200, 400}  Component 2 candidate values:  FR1 bands: {1, 2, 4, 6, 8, 12, 16[, 24, 32, 48, 64, 128]} for each SCS: 15kHz, 30kHz, 60kHz  FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64, 128} for each SCS: 60kHz, 120kHz  Component 3 candidate values:  FFS  Component 4 candidate values: {[30ms, 40ms, 50ms, 100ms]}  [Component 5 candidate values: {Type 1 – sub-slot/symbol level buffering, Type 2 – slot level buffering}]  Note: a SL PRS resource is considered as active starting at the end of the last symbol of the PSCCH carrying the SCI trigger and the occupancy is released at the end of timeline indicated in component 4  Need for location server/server UE to know if the feature is supported | Optional with capability signaling |

#### Issue 1-1-1: Measurement period requirements for SL-PRS based RSTD:

|  |
| --- |
| *Agreements in RAN4#108bis:*   * The measurement period requirements for SL-PRS based RSTD is defined as:   where   * S = scaling factor \* Nsample. Scaling factor is FFS. * , where and are the start of the *s*-th and *(s+1)*-th slot where UE needs to measure SL-PRS, satisfying is > FFS. * is FFS. * For Nsample, further discuss the two options:   + Option 1: Define requirement for the sample number of 1 and FFS for 4.   + Option 2: Define requirement for the sample numbers of 1 and 4. |

Proposals:

* Option 1: (CATT)
  + Include the processing capability (component 4) into the formula to determine the scaling factor.

Where,

* .
* , where and are the start of the *s*-th and *(s+1)*-th slot where UE needs to measure SL-PRS.
* , which is the minimum processing time after the end of a slot carrying the active SL-PRS resource(s).
* Option 2: (CATT)
  + Do not include the processing capability (component 4) into the formula, i.e., scaling factor is 1, and to consider the processing capability as requirements applicability.

Where,

* .
* , where and are the start of the *s*-th and *(s+1)*-th slot where UE needs to measure SL-PRS, satisfying ≥ .
* , which is the minimum processing time after the end of a slot carrying the active SL-PRS resource(s).
* Option 2a: (Qualcomm)
  + For single sample SL RSTD measurements, the measurement period is given by
    - The measurement period starts at the end of the slot carrying the active SL-PRS resource(s)
    - is greater than or equal to the time indicated in FG 41-1-1 component 4. needs to include time to prepare the measurement report.
    - If the maximum number of active SL PRS resources or the maximum number of slots with active SL PRS resources is exceeded, the measurement period can be longer.
* Option 3: (OPPO)
  + The scaling factor should be, where:
    - is the number of SL-PRS resources configured to be measured.
    - is the maximum number of active SL-PRS resources as indicated by component 2 of UE FG 41-1-1.
    - is the maximum number of slots with actives SL-PRS resources as indicated by component 3 of UE FG 41-1-1.
    - is the number of slots contained within the processing delay as indicated by component 4 of UE FG 41-1-1.
  + should include both the duration of last SL-PRS resources and minimum processing time, i.e. .
* Option 4: (Nokia)
  + The basic measurement period, e.g., for SL RSTD measurement, can be defined as follows:

Where,

* scaling factor = CSSFSL \* , where is UE capability for number of SL PRS resources that it can process in a slot and is UE capability where N is a duration of SL PRS symbols in ms and CSSFSL takes into account any overlapping with higher priority RRM measurements.
* , where and are the start of the *s*-th and *(s+1)*-th slot where UE needs to measure SL-PRS, satisfying > N + T.

* Option 5: (Ericsson)
  + The basic measurement period (without restart), e.g., for SL RSTD measurement, can be defined as follows:

*,*

Where,

* *S* is the number of samples,
* is the measurement time for sample s, which starts from the beginning of the first slot with SL-PRS for sample s until the beginning of the first slot with SL-PRS for sample s+1,
* FFS: ≤ , where is the maximum time until the next sample,
* is FFS (e.g., includes the SL-PRS resources for the last sample + processing time).
* Option 6: (Huawei)
  + RAN4 not to define exact formula for SL-PRS measurement period, but to define the measurement period based on the principles for handling active resources and slots defined by RAN1.
  + RAN4 to discuss how to define the ending point of SL PRS measurement period.
* Option 7: (vivo)
  + RAN4 to wait RAN1 progress for SL UE features for further discussing the details, e.g. scaling factors, in measurement period formula.

Recommended WF:

* Categorize the proposals as the following, and further discuss in the meeting:
* Proposal 1: (CATT, Qualcomm, Ericsson, OPPO, Nokia)
  + The basic measurement period for SL RSTD measurement can be defined as follows:
    - The definition of *S*:
      * Option 1A: (CATT, Qualcomm, Ericsson)
        + .
      * Option 1B: (CATT)
      * Option 1C: (OPPO)
      * Option 1D: (Nokia)
    - The definition of : , where and are the start of the *s*-th and *(s+1)*-th slot where UE needs to measure SL-PRS. (CATT, Ericsson, Nokia)
      * Option 2A: (CATT)
        + , satisfying ≥ .
      * Option 2B: (Nokia)
        + , satisfying > N + T.
      * Option 2C: (Ericsson)
        + is the measurement time for sample s, which starts from the beginning of the first slot with SL-PRS for sample s until the beginning of the first slot with SL-PRS for sample s+1,
        + FFS: ≤ , where is the maximum time until the next sample.
    - The definition of :
      * Option 3A: (CATT)
        + , which is the minimum processing time after the end of a slot carrying the active SL-PRS resource(s).
      * Option 3B: (OPPO)
        + , which includes both the duration of last SL-PRS resources and minimum processing time.
      * Option 3C: (Nokia)
      * Option 3D (Ericsson)
        + is FFS (e.g., includes the SL-PRS resources for the last sample + processing time)
* Proposal 2: (Huawei)
  + RAN4 not to define exact formula for SL-PRS measurement period, but to define the measurement period based on the principles for handling active resources and slots defined by RAN1.
  + RAN4 to discuss how to define the ending point of SL PRS measurement period.

#### 1.2.1.1a Issue 1-1-1a: Nsample in measurement period requirements for SL-PRS based RSTD:

Proposals:

* Option 1: (Xiaomi, CMCC, Huawei, Qualcomm)
  + = 1.
* Option 2: (CATT, vivo, OPPO, Ericsson, Nokia)
  + = 1 and 4.
* Option 2a: (Ericsson)
  + = 1 for SL-PRS BW>48 PRBs,
  + = 4 for SL-PRS BW≥24 PRBs

Recommended WF:

* Discuss in the meeting.

#### 1.2.1.1b Issue 1-1-1b: The definition one sample

Proposals:

* Option 1: (Qualcomm)
  + Define a SL PRS measurement sample as a group of SL PRS resource instances comprised of
    - One SL PRS resource instance triggered by an SCI in the same slot, and
    - up to SL PRS resource instances reserved in future slots by the same SCI.
    - The multiple SL PRS resource instances have the same comb size and number of symbols.
* Option 2: (CATT)
* Option 2: (CATT)
  + The definition of SL-PRS sample is same as legacy PRS which is one SL-PRS resource defined in RAN1, but there is no need to define it in the specification.

Recommended WF:

* Discuss in the meeting.

#### Issue 1-1-2: Measurement period requirements for other SL-PRS based measurements:

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| *Agreements in RAN4#108bis:*   * The measurement period requirement for SL-PRS based RSTD can be reused for other SL-PRS based measurement (i.e., SL-PRS based RTOA, RSRP and RSRPP). * For SL-PRS based AoA/ZoA, check and confirm whether the measurement period of SL-PRS based RSTD can be reused in the next meeting. * For definition #1 and [definition #2] for UE Rx-Tx time difference, reuse the measurement period of SL-PRS based RSTD.   + Definition #1: use the Rel-16/17 definition for gNB Rx-Tx time difference/UE Rx-Tx time difference in Uu.   + Definition #2: the actual SL-PRS transmission time is used for the definition of SL-PRS based Rx-Tx time difference measurement. |

Proposals:

* Option 1: (CATT, Nokia)
  + The measurement requirement for SL-PRS based RSTD can also be reused for SL-PRS based AoA/ZoA and SL-PRS based UE Rx-Tx time difference.
* Option 1a: (Nokia)
  + The measurement period of SL-PRS based RSTD should only be reused for AoA/ZoA when angle-based measurement is not performed concurrently with other positioning procedures.
* Option 2: (vivo, Huawei)
  + The measurement requirement for SL-PRS based RSTD can also be reused for SL-PRS based AoA/ZoA.
  + For SL Rx-Tx definition #2, additional time uncertainty for waiting for actual transmission needs to be accounted in the measurement period.
* Option 3: (OPPO)
  + For UE Rx-Tx time difference with definition #2, the time for SL-PRS transmission should also be considered.
  + If configured to report multiple UE Rx-Tx time difference measurements with N different SL-PRS receptions or transmissions, the measurement period should be longer, e.g. by further scaling S by N.
* Option 4: (Qualcomm)
  + For SL Rx-Tx definition #2, the measurement period is extended until the UE transmits SL PRS.
    - FFS whether to define a proximity condition between the reception and transmission of SL PRS for reporting SL PRS-based Rx-Tx time difference based on the actual SL PRS transmission time.

Recommended WF:

* Discuss in the meeting based on the following:
  + For SL-PRS based AoA/ZoA,
    - The measurement requirement for SL-PRS based RSTD can also be reused. (CATT, Nokia, vivo, Huawei)
    - FFS: applicable only when angle-based measurement is not performed concurrently with other positioning procedures. (Nokia)
  + For SL Rx-Tx definition #2,
    - Option 1A: (CATT, Nokia)
      * The measurement requirement for SL-PRS based RSTD can also be reused.
    - Option 1B: (vivo, OPPO, Huawei, Qualcomm)
      * Additional time uncertainty for waiting for actual transmission needs to be accounted in the measurement period.
      * FFS whether to define a proximity condition between the reception and transmission of SL PRS for reporting SL PRS-based Rx-Tx time difference based on the actual SL PRS transmission time. (Qualcomm)
  + For SL Rx-Tx (including both definitions),
    - FFS: If configured to report multiple UE Rx-Tx time difference measurements with N different SL-PRS receptions or transmissions, the measurement period should be longer, e.g. by further scaling S by N. (OPPO)

#### Issue 1-1-3: UE behavior and the impact on SL-PRS measurement requirements when synchronization reference source change occurs at Rx side

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| *Agreements in RAN4#108bis:*   * UE behavior and the impact on SL-PRS measurement requirements when synchronization reference source change occurs at Rx side   + For SL Rx-Tx measurement, UE shall restart the measurement after change and the previous measurement smaples are dropped. The SL Rx-Tx measurement period requirement due to the change:     - Apply the existing measurement period requirement, and starting point of the measurement period is after the change.       * Option A: Limit the number of restarting, FFS the exact number.       * Option B: FFS whether to limit the number of restarting.   + For SL RSRP and RSRPP measurements, UE shall continue the measurement after the change.   + For SL RSTD and RTOA measurements, FFS UE shall continue the measurement after the change. |

Proposals:

* Option 1: (CATT)
  + When the synchronization reference source changes occurs during the measurement period at Rx side, i.e., at the UE which is performing the measurement,
    - for SL RSTD and RTOA measurements, UE shall continue the measurement and meet the measurement period requirements.
    - for SL PRS based Rx-Tx measurement, UE shall restart the measurement. And no need to limit the number of restarting in the specification.
* Option 2: (vivo)
  + For SL-AoA measurements, UE shall continue the measurement after the synchronization reference source change.
  + For SL RSTD and RTOA measurements, UE shall continue the measurement after the synchronization reference source change.
  + For the async case, all the SL-PRS measurement should be dropped after the synchronization reference source change.
* Option 3: (Huawei)
  + for SL Rx-Tx, RAN4 not to define limit on the number of restarting.
  + for SL RSTD, UE shall continue the measurement after the change.
  + for SL RTOA, UE shall restart the measurement after change and the previous measurement samples are dropped.
* Option 4: (Ericsson)
  + For SL RSTD, the UE shall continue the measurement upon the synchronization source change at the measuring UE and meet the same measurement period and the accuracy requirements as without the change.
  + For SL AoA, the UE shall continue the measurement upon the synchronization source change at the measuring UE and meet the same measurement period and the accuracy requirements as without the change.
  + For SL RTOA, the UE shall continue the measurement upon the synchronization source change at the measuring UE and meet the same measurement period and the accuracy requirements as without the change.
  + For SL Rx-Tx, when the UE has been restarting the measurement upon the synchronization source change at the measuring UE, it has to meet the following measurement delay requirement:

, where K is the number of restarts.

* + - Option 1: No need to define a limit for K (like in LTE).
    - Option 2: Maximum limit for K is defined, e.g., K≤Kmax, Kmax=TBD.
* Option 5: (Nokia)
  + For SL RSTD and SL RTOA based positioning methods, UE shall continue the measurement after the synchronization reference source change.

Recommended WF:

* When the synchronization reference source changes occurs during the measurement period at Rx side, i.e., at the UE which is performing the measurement,
  + for SL RSTD measurements,
    - UE shall continue the measurement and meet the existing measurement period requirements.
  + for SL RTOA measurements,
    - Option 1A: UE shall continue the measurement and meet the existing measurement period requirements.
    - Option 1B: UE shall restart the measurement after change and the previous measurement samples are dropped.
  + for SL PRS based Rx-Tx measurement, UE shall restart the measurement after change and the previous measurement samples are dropped. The SL Rx-Tx measurement period requirement due to the change applies the existing measurement period requirement, and starting point of the measurement period is after the change. (agreement in last meeting)
  + FFS: The Tmeasurement delay after restarting:
    - , where K is the number of restarts.
      * Option 2A: No need to define a limit for K (like in LTE).
      * Option 2B: Maximum limit for K is defined, e.g., K≤Kmax, Kmax=TBD.

#### 1.2.1.3a Issue 1-1-3a: UE behavior and the impact on SL-PRS measurement requirements when synchronization reference source change occurs at Tx side

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| *Agreements in RAN4#107:*   * SL timing related positioning measurement requirements are defined under the RAN4 assumption that there is no timing misalignment among multiple anchor UEs due to different synchronization reference sources.   *Agreements in RAN1#114:*  Agreement  To mitigate the impact of synchronization errors between anchor UEs for SL-PRS based measurement, the exchanged synchronization information of anchor UEs between a UE and LMF or another UE includes the following:   * [The synchronization source type (GNSS, gNB/eNB, and UE) of anchor UEs,   + If the synchronization source of an anchor UE is SyncRef UE, the anchor UE can optionally indicate the coverage status and synchronization connection status (whether the SyncRef UE is directly or indirectly synchronized to GNSS/gNB, or other SyncRef UE) of the SyncRef UE   + If the synchronization source of an anchor UE is gNB, the anchor UE can further provide cell identity information] * [Synchronization quality/accuracy information] * The RTD between anchor UEs.   Agreement  Support to include the following in the exchanged synchronization information of anchor UEs between a UE and LMF or another UE:   * The synchronization source type (GNSS, gNB/eNB, and UE) of anchor UEs. |

Proposals:

* Option 1: (Ericsson)
  + Upon the synchronization source change at the anchor UE, the measuring UE shall restart the SL PRS-based timing measurements (SL Rx-Tx, SL RSTD, and SL RTOA).
    - The measurement reporting delay requirements can be defined to cover any of the synchronization source change at the measuring UE and/or any of the anchor UEs, e.g.:

, where K is the number of restarts due to the synchronization source change at the measuring UE and/or at any of the anchor UEs.

* + - * Option 1: No need to define a limit for K (like in LTE).
      * Option 2: Maximum limit for K is defined, e.g., K≤Kmax, Kmax=TBD.

Recommended WF:

* Discuss in the meeting.

#### Issue 1-1-4: Requirements applicability regarding SL-DRX

Proposals:

* Option 1: (CATT, OPPO, Ericsson)
  + The SL-PRS based measurement period requirements apply without DRX as well as for any SL DRX configuration.
* Option 2: (Huawei, Nokia)
  + RAN4 to discuss the impact of SL DRX after the measurement period requirements for basic scenario (without SL DRX) are stable.

Recommended WF:

* Discuss in the meeting.

#### Issue 1-1-5: Impact of other channels/signals/SL procedures

Proposals:

* Option 1: (CATT, OPPO, Nokia)
  + The SL-PRS based measurement requirements apply provided no SL-PRS symbols are dropped during the measurement period.
  + If the reception/transmission of the slots containing SL-PRS is dropped, the measurement period can be extended but the exact extension is not specified.
* Option 2: (vivo)
  + SL PRS measurement requirements apply provided that reception/transmission of the slots containing SL PRS is not dropped due to other SL procedures (e.g., Selection/Reselection of V2X Synchronization Reference Source).
  + If the reception/transmission of the slots containing SL PRS is dropped, the measurement period can be extended. RAN4 will specify how exactly the measurement period is extended, e.g.



Where

* L is the number of SL-PRS sample not available at the UE during TSL RSTD for SL-PRS RSTD measurement, where L≤Lmax.
* Option 3: (Huawei)
  + RAN4 to discuss the impact of other channels/signals after the measurement period requirements for basic scenario (without SL PRS dropped) are stable.

Recommended WF:

* The SL-PRS based measurement requirements apply provided that reception/transmission of the slots containing SL PRS is not dropped.
* If the reception/transmission of the slots containing SL-PRS is dropped,
  + Option 1A: the measurement period can be extended but the exact extension is not specified.
  + Option 1B: the measurement period can be extended. RAN4 will specify how exactly the measurement period is extended, e.g.



Where

* L is the number of SL-PRS sample not available at the UE during TSL RSTD for SL-PRS RSTD measurement, where L≤Lmax.

#### Issue 1-1-6: Impact of Uu link connection

Proposals:

* Option 1: (CATT)
  + Do not define the SL-PRS based measurement period requirements when there is Uu link connection distortion.
* Option 2: (OPPO)
  + SL-PRS measurement requirements apply provided that reception of the slots containing SL-PRS is not interrupted due to Uu operation.
* Option 3: (Huawei)
  + RAN4 to discuss the impact of Uu link connection distortion after the measurement period requirements for basic scenario (without Uu link connection distortion) are stable.
* Option 4: (Ericsson, Nokia)
  + If the SL-PRS resource availability is interrupted due to handover or RRC re-establishment at the measuring or anchor UE, then the UE cannot continue the SL positioning measurement.
    - FFS: for RLF.

Recommended WF:

* Discuss in the meeting.
  + There is no requirement on the impact of Uu link connection in sidelink communication. And RAN1/2 didn’t define UE behaviour for such impact in sidelink positioning.
  + Please companies check if option 1 can be acceptable.

#### Issue 1-1-7: Impact of network coverage change

Proposals:

* Option 1: (CATT, Huawei, Qualcomm)
  + Do not define the SL-PRS based measurement period requirements when there is network coverage change.
* Option 2: (Ericsson)
  + When an SL UE determines that its coverage status has changed (e.g., changing between any two of: in-coverage, out-of-coverage, partial coverage, unknown coverage, different coverage range, or even transition period), then:
    - The UE shall restart the on-going SL positioning measurement in new coverage conditions.
* Option 3: (Nokia)
  + RAN4 should consider in-coverage and out-of-coverage scenarios to define the SL positioning measurement period requirements.

Recommended WF:

* Discuss in the meeting.
  + RAN1/2 didn’t define UE behaviour for network coverage change in sidelink positioning.
  + Please companies check if option 1 can be acceptable.

#### Issue 1-1-8: Impact of the type of resource pool

* Proposals:
  + Option 1: (vivo, Huawei)
    - SL-PRS measurement requirements apply for different resource pool types.

Recommended WF:

* Please companies check if option 1 can be agreeable.

### Sub-topic 1-2 Other RRM requirements

#### Issue 1-2-1: Requirements for initiation/cease of SL PRS Tx

Proposals:

* Option 1 (CATT):
  + No need to define additional requirements for initiation/cease of SL PRS transmission. The existing requirements for initiation/cease of SLSS transmission still apply for sidelink UE supporting positioning.
* Option 2: (OPPO, Huawei, Qualcomm)
  + Deprioritize defining requirements for initiation/cease of SL-PRS transmission.
* Option 3: (Ericsson)
  + RAN4 will define requirements for initiation/cease of SL-PRS transmissions for positioning, based on the agreed RAN1/RAN2 procedures. A new section (e.g., 12A.8) is to be added for SL-PRS initiation and cease, where the procedure is to be described.
  + SL-PRS transmissions for positioning have to be ceased at the synchronization source change and resumed after the completion of the synchronization source change, within up to a certain TBD time.
  + For Mode 1, SL-PRS transmissions for positioning have to be activated shortly upon receiving the network assistance.

Recommended WF:

* Discuss in the meeting.
  + RAN1/2 didn’t define any procedures for initiation/cease of SL PRS Tx.
  + Please companies check if option 2 can be acceptable.

### Sub-topic 1-3 Accuracy requirements

#### Issue 1-3-1: SINR side condition

Proposals:

* For SL RSTD,
  + Option 1: (CATT, Ericsson)
    - (0 dB, -6 dB) for reference cell and neighbour cell.
* For SL Rx-Tx,
  + Option 1: (CATT)
    - Two sets of side condition: [0]dB and [-6]dB.
  + Option 2: (Ericsson, Nokia)
    - [-6]dB. ,
* For SL PRS RSRP/RSRRPP,
  + Option 1: (CATT)
    - Two sets of side condition: [0]dB and [-6]dB.
  + Option 2: (Ericsson, Nokia)
    - [-6]dB.

Recommended WF:

* Discuss in the meeting.

#### Issue 1-3-2: Applicable PRS bandwidth for SL positioning requirements

Proposals:

* Proposal 1: (Ericsson, Nokia)
  + RAN4 SL positioning requirements are not applicable for CBWs larger than 40 MHz, unless they are supported by TS 38.101-1.
* Recommended WF

Recommended WF:

* Discuss in the meeting.
  + Please companies check if option 1 can be acceptable.

#### Issue 1-3-3: The accuracy requirements for SL-PRS based measurement

Proposals:

* Proposal 1: measurement type
  + Option 1A: (CATT):
    - Do not define accuracy requirements for SL PRS based RTOA and AOA/ZOA measurement.
    - Define absolute accuracy requirements for SL PRS-RSSI measurement.
* Proposal 2: framework of the accuracy requirements
  + Option 2A: (Xiaomi):
    - RAN4 can take the framework of Rel16 PRS accuracy requirement in FR1 as the start point for the accuracy requirements of SL positioning in Rel18, e.g.
* **Table 1: RSTD accuracy in FR1**

|  |  |  |
| --- | --- | --- |
| **Accuracy,**  **Tc** | **PRS BW,**  **PRB** | **PRS SCS,**  **kHz** |
| [TBD] | ≥[24] | 15 |
| [TBD] | ≥[52] |
| [TBD] | >[104] |
| [TBD] | ≥[48] | 30,60 |

* Proposal 3: scenarios
  + Option 3A: (Nokia):
    - RAN4 to study the measurement accuracy requirement for SL-PRS assuming anchor UE(s) being in coverage.
* Proposal 4: samples
  + Option 4A: (Qualcomm):
    - Define measurement accuracy requirements based on single SL PRS instance.

Recommended WF:

* Discuss in the meeting.

## CRs

*Moderator: companies please provide comments on the following CRs. This part is just the list of the CRs, comments can be provided directly on the CR document with change marks.*

|  |  |
| --- | --- |
| **CR** | **Comments** |
| R4-2318337 Draft CR #27: on SL Rx-Tx time difference and SL RSRPP | Company A: |
| Company B: |
| R4-2319073 Draft CR #28 TS 38.133 SL-AoA and SL-RTOA |  |
|  |
| R4-2320459 Draft CR #25 38133 Introduction to SL positioning |  |
|  |
| R4-2320460 Draft CR #26 38133 SL RSTD and SL PRS-RSRP |  |
|  |

# Topic #2: Carrier Phase Positioning (agenda 8.22.2.6)

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2318339 | CATT | **Proposal 1: For RSCP/RSCPD reported together with other positioning measurement, the legacy measurement requirements (i.e., RSTD and UE Rx-Tx time different) apply.**   * **When LMF requests the UE to perform measurements on indicated DL PRS resource set(s) occurring within indicated time window(s) for a PFL, the calculation of TPRS and LPRS only consider the PRS resources in the indicated resources sets and overlapped with both the MG and the indicated time window(s).**   **Proposal 2: Define accuracy requirements for DL RSCPD measurement at least for AWGN channel.**  **Proposal 3: Define accuracy requirements for DL RSCPD measurement for Two-Tap channel based on the simulation results. For RSTD measurement which is reported together, the existing accuracy requirements for fading channel are reused.**  **Proposal 4: Do not define absolute accuracy requirements for DL RSCP measurement.**  **Proposal 5: Define relative accuracy requirements for DL RSCP measurement by reusing the simulation results of DL RSCPD measurement.**  **Proposal 6: Define DL RSCPD measurement accuracy requirements for side condition [-6, -13]dB and [-3, -6]dB respectively, i.e., the side condition of RSTD measurement for 4 samples and 1 samples respectively.**  **Proposal 7: Define relative DL RSCP measurement accuracy requirements for side condition [-3, -13]dB and [0, -6]dB respectively, i.e., the side condition of UE Rx-Tx time difference measurement for 4 samples and 1 samples respectively.**  **Proposal 8: Update the simulation assumption of DL RSCPD measurement to accommodate the simulation for relative accuracy of DL RSCP measurement.** |
| R4-2318899 | Lenovo | **Proposal 1**: Define a common reference time and refer the DL-PRS carrier phase measurements to this reference time by subtracting the phase rotation due to the carrier frequency offset in the time interval between the DL-PRS and the reference time from the carrier phase measurement.  **Proposal 2**: Define the referred carrier phase difference as the difference between the referred carrier phase measurements.  **Proposal 3**: Define the same common reference time for the UE and the PRU.  **Proposal 4**: The UE and the PRU report either the referred carrier phase measurements or the carrier phase difference measurements computed using the referred carrier phase measurements. |
| R4-2319262 | CATT | *Updated simulation assumption for CPP measurements* |
| R4-2319485 | OPPO | **Proposal 1: Support option B, reuse the existing requirements under the condition that the configuration of MGRP and Twindow** **is aligned.**  **Proposal 2: Deprioritize CPP measurement in RRC\_IDLE state.**  **Proposal 3: Define the DL RSCPD accuracy measurement requirements with single sample.**  **Proposal 4: Define the gNB accuracy measurement requirements of UL RSCP NG-RAN node assisted positioning.** |
| R4-2320001 | Huawei, HiSilicon | **Proposal 1: When LMF requests the UE to perform measurements on indicated DL PRS resource set(s) occurring within indicated time window(s) for a PFL, and UE supports FG 41-2-3, adopt option A to update the existing measurement period requirements for the PFL:**   * **Tavailable is defined as LCM(Tprs, MGRP, Twindow), where Twindow is the maximum periodicity of the indicated time window(s)** * **When calculating Lprs and Tprs, only the PRS resources in the indicated resources sets and overlapped with both the MG and the indicated time window(s) are considered**   **Otherwise, existing RSTD/UE Rx-Tx measurement period requirements apply.**  **Proposal 2: RAN4 to define the CPP measurements requirements in RRC\_IDLE state if time allows.**  **Proposal 3: RAN4 not to specify UE behavior or requirements related to measurement of carrier frequency offset. FFS whether and how to account for carrier frequency offset in the accuracy requirements of CP measurements.** |
| R4-2320361 | Ericsson | **Draft CR # 23 Requirements for DL RSCPD reported with RSTD in RRC CONNECTED state** |
| R4-2320374 | Ericsson | **Observation 1**: Periodic time window is optionally configured to UE for carrier phase measurement.  **Observation 2**: When UE is optionally configured with periodic time window then the periodicity of the time window is defined similar to IE *NR-DL-PRS-Periodicity-and-ResourceSetSlotOffset* in TS 37.355.  **Proposal 1**: Do not consider Twindow in measurement period requirement for carrier phase measurements when UE is optionally configured with time window for RSCPD measurement with RSTD and RSCP measurement with UE Rx-Tx time difference measurement. i.e., *Tavailable is defined as LCM(Tprs, MGRP).*  **Proposal 2**: Legacy measurement period requirements do not apply when UE is configured with time window for RSCPD measurement with RSTD and RSCP measurement with UE Rx-Tx time difference measurement.  **Proposal 3**: When calculating Lavailable\_PRS and Tprs, only the PRS resources in the indicated resources sets and overlapped with both the MG and the indicated time window(s) are considered.  **Proposal 4**: If during the measurement period, the MG pattern is reconfigured or time window for carrier phase measurement is reconfigured, the measurement period for RSCPD with RSTD and RSCP with UE Rx-Tx can be longer.  **Proposal 5**: Do not define requirements for RRC\_IDLE mode for carrier phase measurement. |
| R4-2320812 | Nokia, Nokia Shanghai Bell | 1. The impact of carrier frequency offset is significant and measures to mitigate the carrier frequency offset in the TRP transmissions and UE/PRU receptions are important to be taken, in order to improve the quality of the CP estimate. 2. For each duration of the time window, RAN4 to define appropriate measurement gap patterns for per-UE MG and per-FR MG according to Table 1 and Table 2. 3. The sequence of time windows for DL CPP needs to have at least partial overlapping with measurement gap occasions in RRC\_CONNECTED state. 4. Regarding the measurement period definition, RAN4 to distinguish two cases:  * If reduced number of measurement samples is configured for other ToA measurements (UE Rx-Tx time difference or RSTD, respectively), measurement periods between CPP and other measurements can be aligned and are based on measurement requirements for reduced number of measurement samples as specified for UE Rx-Tx time difference or RSTD, respectively in Rel-17. * Else, if not configured, then the measurement periods cannot be aligned as RSCP/RSCPD are based on single sample, whilst UE Rx-Tx time difference/RSTD are based on 4 samples as defined for Rel-16. As an alternative, the UE may report 4 measurements for RCSPD/DL RSCP together with the paired single ToA measurement (RSTD/UE Rx-Tx time difference), as agreed by RAN1.  1. RAN4 to use the Rel-16 measurement behaviour for RSTD in case of handover as baseline for measurement behaviour for RSCPD. 2. RAN4 to modify the RRM requirement for serving cell change for DL CPP with configured DL RSCP and UE Rx-Tx time difference such, that both measurements need to be restarted upon serving cell change. 3. RAN4 to investigate RRM impacts due to SRS configuration change and UL transmission timing change due to TA adjustment or UE autonomous timing adjustment. 4. RAN4 to investigate whether UE can keep using fixed Tx timing although the DL reception reference timing is changed in order to guarantee the measurement accuracy for UL RSCP.   Measurement period requirements in RRC\_INACTIVE   1. RAN4 to consider the case of collision of PRS resources in configured time window(s) with DL signals/channels, such as SSB, SIB1, CORESET0, MSG2/MSGB, paging and DL SDT for defining the measurement behaviour for DL CPP in RRC\_INACTIVE state.   Measurement period requirements in RRC\_IDLE   1. If time allows, RAN4 can specify support for NR CPP DL measurements in RRC\_IDLE state in Rel-18, based on the NR CPP DL measurement behaviour in RRC\_INACTIVE state and the signalling framework for NR positioning in RRC\_IDLE state for LPHAP currently designed by RAN2.   Measurement reporting requirements   1. Regarding the measurement reporting for DL PRS, RAN4 to distinguish two cases:  * If reduced number of measurement samples is configured for ToA measurements (UE Rx-Tx time difference or RSRD, respectively), measurement reporting of CPP and other measurements can be done together after each measurement sample. Reporting delay requirements for reduced number of samples in Rel-17 apply. * Else, if not configured, then the measurement reporting is based on normal measurement samples for ToA measurements (UE Rx-Tx time difference or RSTD, respectively) and UE can report measurement results from multiple time windows covered by the normal measurement period. Reporting delay requirements for normal number of samples in Rel-16 apply.  1. Whether network supports joint measurement reporting of NR CPP UL measurements (i.e. UL RSCP) and legacy UL positioning measurements, is left implementation specific, however NRPPa needs to support it.   Impact due to carrier frequency offset   1. RAN4 to specify measures for mitigating the impact due to carrier frequency offsets of TRP, UE and PRU. 2. RAN4 to specify a common reference time for RSCP and RSCPD measurement, respectively, between UE and PRU and for different TRPs in TS 38.133. The reference time can be FFS, e.g. start of slot where the PRS is transmitted, or start of the measurement gap occasion or start of the configured time window for the CP measurement.   UE measurement accuracy requirements   1. **RAN4 to align the targeted PRS BW range for NR DL CPP in RRC\_CONNECTED to that for positioning techniques specified in Rel-16 and in RRC\_INACTIVE to that for positioning techniques specified in Rel-17 in regard to BW related RRM performance requirements.** 2. **RAN4 to specify relative accuracy requirements for DL RSCP.** 3. **RAN4 to agree the number of RSCPD measurement samples for accuracy requirements is 1. FFS whether to also specify RSCPD accuracy for Nsample > 1 depending on performance evaluations including the impact of carrier frequency offsets.**   TRP measurement accuracy requirements   1. RAN4 to postpone the decision on whether to define UL RSCP measurement accuracy requirements to performance part. 2. RAN4 to consider whether the Rel-16 approach for gNB Rx-Tx time difference accuracy performance with specified BB performance and manufacturer declared impairments margin can be reused for defining UL RSCP accuracy performance in Rel-18. |
| R4-2320813 | Nokia, Nokia Shanghai Bell | Simulation results for DL RSCPD |
| R4-2320814 | Nokia, Nokia Shanghai Bell | Draft CR 38.133 #11: Measurement requirements for RSCPD reported with RSTD in RRC\_INACTIVE |
| R4-2320815 | Nokia, Nokia Shanghai Bell | Draft CR 38.133 #12: Measurement requirements for DL RSCP reported with UE Rx-Tx time difference in RRC\_INACTIVE |
| R4-2320816 | Nokia, Nokia Shanghai Bell | Draft CR 38.133 #24: Measurement requirements for DL RSCP reported with UE Rx-Tx time difference in RRC\_CONNECTED |
| R4-2320915 | Qualcomm Incorporated | **Proposal 1: For the measurement period requirement for CPP (i.e. legacy measurements plus carrier phase measurements) with periodic time windows:**   * **, where is the maximum window periodicity for PFL *i*** * **only counts PRS resource instances within the indicated time window(s).**   **Proposal 2: For the measurement period requirement for CPP (i.e. legacy measurements plus carrier phase measurements) with non-periodic time windows:**   * **only counts PRS resource instances within the indicated time window(s).** * **the start of the measurement period is delayed until the start of the time window.**   **Proposal 3: Prioritize defining CPP measurement accuracy requirements for single sample measurements.**  **Proposal 4: Do not define absolute measurement accuracy requirements for DL RSCP.** |

*The moderator can suggest a limited number of papers which could be presented.*

## Open issues summary

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

#### Issue 2-1-1: PRS measurement period requirements for DL RSCP/DL RSCPD:

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| RAN4#108 agreements: Issue 2-1-1: PRS measurement period requirements for DL RSCP/DL RSCPD: *Agreements:*   * RSCP/RSCPD is reported together with other positioning measurement(s) and the same measurement period requirement (i.e., Rx-Tx time difference/RSTD measurements) should apply.   + FFS: whether the existing Rx-Tx time difference/RSTD measurement periods apply   *Agreements in RAN4#108bis:*   * When LMF requests the UE to perform measurements on indicated DL PRS resource set(s) occurring within indicated time window(s) for a PFL, and UE supports FG 41-2-3, the Twindow needs to be considered in the measurement period:   + For periodic time window,     - Option A: adopt the following updates to the existing measurement period requirements for the PFL:       * Tavailable is defined as LCM(Tprs, MGRP, Twindow), where Twindow is the maximum periodicity of the indicated time window(s)       * When calculating Lprs and Tprs, only the PRS resources in the indicated resources sets and overlapped with both the MG and the indicated time window(s) are considered.     - Option B: reuse the existing requirement under the condition that the configuration of MGRP and Twindow is aligned.   + For one-shot time window case, the measurement is within the indicated time window. * Otherwise, further check whether the legacy measurement period requirements apply. |

Proposals

* Option 1: (CATT)
  + For RSCP/RSCPD reported together with other positioning measurement, the legacy measurement requirements (i.e., RSTD and UE Rx-Tx time different) apply.
    - When LMF requests the UE to perform measurements on indicated DL PRS resource set(s) occurring within indicated time window(s) for a PFL, the calculation of TPRS and LPRS , only consider the PRS resources in the indicated resources sets and overlapped with both the MG and the indicated time window(s).
* Option 2: (OPPO)
  + When LMF requests the UE to perform measurements on indicated DL PRS resource set(s) occurring within indicated time window(s) for a PFL, and UE supports FG 41-2-3,
    - For periodic time window, reuse the existing requirement under the condition that the configuration of MGRP and Twindow is aligned.
* Option 3: (Huawei, Qualcomm)
  + When LMF requests the UE to perform measurements on indicated DL PRS resource set(s) occurring within indicated time window(s) for a PFL, and UE supports FG 41-2-3,
    - Tavailable is defined as LCM(Tprs, MGRP, Twindow), where Twindow is the maximum periodicity of the indicated time window(s)
    - When calculating Lprs and Tprs, only the PRS resources in the indicated resources sets and overlapped with both the MG and the indicated time window(s) are considered.
  + Otherwise, existing RSTD/UE Rx-Tx measurement period requirements apply.
* Option 3a: (Qualcomm)
  + For the measurement period requirement for CPP (i.e. legacy measurements plus carrier phase measurements) with non-periodic time windows:
    - only counts PRS resource instances within the indicated time window(s).
    - the start of the measurement period is delayed until the start of the time window.
* Option 4: (Ericsson)
  + Do not consider Twindow in measurement period requirement for carrier phase measurements when UE is optionally configured with time window for RSCPD measurement with RSTD and RSCP measurement with UE Rx-Tx time difference measurement. i.e., *Tavailable is defined as LCM(Tprs, MGRP).*
    - When calculating Lavailable\_PRS and Tprs, only the PRS resources in the indicated resources sets and overlapped with both the MG and the indicated time window(s) are considered.
  + Legacy measurement period requirements do not apply when UE is configured with time window for RSCPD measurement with RSTD and RSCP measurement with UE Rx-Tx time difference measurement.
* Option 5: (Nokia)
  + If reduced number of measurement samples is configured for other ToA measurements (UE Rx-Tx time difference or RSTD, respectively), measurement periods between CPP and other measurements can be aligned and are based on measurement requirements for reduced number of measurement samples as specified for UE Rx-Tx time difference or RSTD, respectively in Rel-17.
  + Else, if not configured, then the measurement periods cannot be aligned as RSCP/RSCPD are based on single sample, whilst UE Rx-Tx time difference/RSTD are based on 4 samples as defined for Rel-16. As an alternative, the UE may report 4 measurements for RCSPD/DL RSCP together with the paired single ToA measurement (RSTD/UE Rx-Tx time difference), as agreed by RAN1.

Recommended WF:

* Discuss the following proposals in the meeting:
  + Proposal 1: (CATT, OPPO, Huawei, Qualcomm, Ericsson)
    - When LMF requests the UE to perform measurements on indicated DL PRS resource set(s) occurring within indicated time window(s) for a PFL, and UE supports FG 41-2-3,
      * For periodic time window,
        + Option 1A: adopt the following updates to the existing measurement period requirements for the PFL: (Huawei, Qualcomm)

Tavailable is defined as LCM(Tprs, MGRP, Twindow), where Twindow is the maximum periodicity of the indicated time window(s)

When calculating Lprs and Tprs, only the PRS resources in the indicated resources sets and overlapped with both the MG and the indicated time window(s) are considered.

* + - * + Option 1B: reuse the existing requirement under the condition that the configuration of MGRP and Twindow is aligned. (OPPO)
        + Option 1C: reuse the existing requirement. (CATT, Ericsson)

When calculating Lavailable\_PRS and Tprs, only the PRS resources in the indicated resources sets and overlapped with both the MG and the indicated time window(s) are considered.

* + - * For one-shot time window case, (Qualcomm)
        + only counts PRS resource instances within the indicated time window(s).
        + the start of the measurement period is delayed until the start of the time window.
    - Otherwise, the legacy measurement period requirements apply.
  + Proposal 2: (Nokia)
    - If reduced number of samples is configured for other ToA measurements (UE Rx-Tx time difference or RSTD, respectively), legacy measurement period requirements with reduced number of samples apply for RSCP/RSCPD.
    - Else, if not configured, the measurement period requirements of RSCP/RSCPD are based on single sample, whilst UE Rx-Tx time difference/RSTD measurement period requirements are based on 4 samples.
      * The UE may report 4 measurements for RCSPD/DL RSCP together with the paired single ToA measurement (RSTD/UE Rx-Tx time difference), as agreed by RAN1.

#### Issue 2-1-2: CPP measurement in RRC\_IDLE state:

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| RAN1#113 Agreement  From RAN1’s perspective, carrier phase positioning for UE in RRC\_IDLE state is supported for UE-based and UE-assisted positioning in Rel-18.   * Note: No additional specification work is expected specifically related to carrier phase positioning for UE in RRC\_IDLE state in RAN1. |

Proposals

* Option 1: (Huawei)
  + RAN4 to define the CPP measurements requirements in RRC\_IDLE state if time allows.
* Option 1a: (Nokia)
  + If time allows, RAN4 can specify support for NR CPP DL measurements in RRC\_IDLE state in Rel-18, based on the NR CPP DL measurement behaviour in RRC\_INACTIVE state and the signalling framework for NR positioning in RRC\_IDLE state for LPHAP currently designed by RAN2.
* Option 2: (OPPO, Ericsson)
  + Deprioritize CPP measurement in RRC\_IDLE state.

Recommended WF:

* Discuss in the meeting.

#### Issue 2-1-3: The impact of carrier frequency offset:

Proposals

* Option 1: (Lenovo)
  + Define a common reference time and refer the DL-PRS carrier phase measurements to this reference time by subtracting the phase rotation due to the carrier frequency offset in the time interval between the DL-PRS and the reference time from the carrier phase measurement.
  + Define the referred carrier phase difference as the difference between the referred carrier phase measurements.
  + Define the same common reference time for the UE and the PRU.
  + The UE and the PRU report either the referred carrier phase measurements or the carrier phase difference measurements computed using the referred carrier phase measurements.
* Option 2: (Huawei)
  + RAN4 not to specify UE behavior or requirements related to measurement of carrier frequency offset. FFS whether and how to account for carrier frequency offset in the accuracy requirements of CP measurements.
* Option 3: (Nokia)
  + RAN4 to specify measures for mitigating the impact due to carrier frequency offsets of TRP, UE and PRU.
  + RAN4 to specify a common reference time for RSCP and RSCPD measurement, respectively, between UE and PRU and for different TRPs in TS 38.133. The reference time can be FFS, e.g. start of slot where the PRS is transmitted, or start of the measurement gap occasion or start of the configured time window for the CP measurement.

Recommended WF:

* Discuss in the meeting.

#### Issue 2-1-4: Requirements applicability regarding MG reconfiguration

Proposals

* Option 1: (Ericsson)
  + If during the measurement period, the MG pattern is reconfigured or time window for carrier phase measurement is reconfigured, the measurement period for RSCPD with RSTD and RSCP with UE Rx-Tx can be longer.

Recommended WF:

* It seems straightforward which is same as the legacy measurements.
* Please companies check if option 1 can be agreeable.

#### Issue 2-1-5: Impact of UE mobility

Proposals

* Option 1: (Nokia)
  + RAN4 to use the Rel-16 measurement behaviour for RSTD in case of handover as baseline for measurement behaviour for RSCPD.
  + RAN4 to modify the RRM requirement for serving cell change for DL CPP with configured DL RSCP and UE Rx-Tx time difference such, that both measurements need to be restarted upon serving cell change.

Recommended WF:

* Already agreed in RAN4#108 meeting, suggest not to further discuss and can directly work on the CR.

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| **Issue 2-1-2: Impact of UE mobility in RRC\_CONNECTED:**  *Agreements*  Reuse Rel. 17 requirements for mobility impact on RSTD/UE Rx-Tx measurement in RRC\_CONNECTED / RRC\_INACTIVE state for RSCPD/RSCP measurements |

### Sub-topic 2-2 CPP measurement reporting requirements

#### Issue 2-2-1: Reporting requirements for DL CPP measurement

Proposals:

* Option 1: (Nokia)
  + If reduced number of measurement samples is configured for ToA measurements (UE Rx-Tx time difference or RSRD, respectively), measurement reporting of CPP and other measurements can be done together after each measurement sample. Reporting delay requirements for reduced number of samples in Rel-17 apply.
  + Else, if not configured, then the measurement reporting is based on normal measurement samples for ToA measurements (UE Rx-Tx time difference or RSTD, respectively) and UE can report measurement results from multiple time windows covered by the normal measurement period. Reporting delay requirements for normal number of samples in Rel-16 apply.

Recommended WF

* Already agreed in RAN4#108 meeting, suggest to stick to the agreements.

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| *Agreements:*   * RSCP/RSCPD is reported together with other positioning measurement(s) and the same measurement reporting delay requirement (i.e., Rx-Tx time difference/RSTD measurements) should apply. |

### Sub-topic 2-3 Accuracy requirements for DL RSCPD

#### Issue 2-3-1: Channel model

Proposals

* Option 1: (CATT)
  + Define accuracy requirements for DL RSCPD measurement at least for AWGN channel.
  + Define accuracy requirements for DL RSCPD measurement for Two-Tap channel based on the simulation results. For RSTD measurement which is reported together, the existing accuracy requirements for fading channel are reused.

Recommended WF:

* Discuss in the meeting.

#### Issue 2-3-2: Side condition

Proposals

* Option 1: (CATT)
  + Define DL RSCPD measurement accuracy requirements for side condition [-6, -13]dB and [-3, -6]dB respectively, i.e., the side condition of RSTD measurement for 4 samples and 1 samples respectively.

Recommended WF:

* Discuss in the meeting.

#### Issue 2-3-3: Number of Samples

Proposals

* Option 1: (OPPO, Nokia, Qualcomm)
  + Define the DL RSCPD accuracy measurement requirements with single sample.

Recommended WF:

* Discuss in the meeting.
  + Please companies check if option 1 can be agreeable.

#### Issue 2-3-4: PRS configuration

Proposals

* Option 1: (Nokia)
  + RAN4 to align the targeted PRS BW range for NR DL CPP in RRC\_CONNECTED to that for positioning techniques specified in Rel-16 and in RRC\_INACTIVE to that for positioning techniques specified in Rel-17 in regard to BW related RRM performance requirements.

Recommended WF:

* Discuss in the meeting.

### Sub-topic 2-4 Accuracy requirements for DL RSCP

#### Issue 2-4-1: whether to define accuracy requirements for DL RSCP

Proposals

* Option 1: (CATT, Qualcomm)
  + Do not define absolute accuracy requirements for DL RSCP measurement.
* Option 2: (CATT, Nokia)
  + Define relative accuracy requirements for DL RSCP measurement.
* Option 2a: (CATT)
  + Define relative accuracy requirements for DL RSCP measurement by reusing the simulation results of DL RSCPD measurement.

Recommended WF:

* Discuss in the meeting.

#### Issue 2-4-2: Side condition

Proposals

* Option 1: (CATT)
  + Define relative DL RSCP measurement accuracy requirements for side condition [-3, -13]dB and [0, -6]dB respectively, i.e., the side condition of UE Rx-Tx time difference measurement for 4 samples and 1 samples respectively.
  + Update the simulation assumption of DL RSCPD measurement to accommodate the simulation for relative accuracy of DL RSCP measurement.
    - In R4-2319262, to add SINR side condition (-3, -13, -13)dB for NSample = 4 and (0, -6, -6)dB for NSample = 1.

Recommended WF:

* Discuss in the meeting.

### Sub-topic 2-5 Accuracy requirements for UL RSCP

#### Issue 2-5-1: Accuracy requirements for UL carrier phase measurement:

* Proposals
  + Option 1: (OPPO)
    - Define the gNB accuracy measurement requirements of UL RSCP NG-RAN node assisted positioning.
  + Option 2: (Nokia)
    - RAN4 to postpone the decision on whether to define UL RSCP measurement accuracy requirements to performance part.
    - RAN4 to consider whether the Rel-16 approach for gNB Rx-Tx time difference accuracy performance with specified BB performance and manufacturer declared impairments margin can be reused for defining UL RSCP accuracy performance in Rel-18.
  + Option 3: (Nokia)
    - RAN4 to investigate RRM impacts due to SRS configuration change and UL transmission timing change due to TA adjustment or UE autonomous timing adjustment.
    - RAN4 to investigate whether UE can keep using fixed Tx timing although the DL reception reference timing is changed in order to guarantee the measurement accuracy for UL RSCP.

Recommended WF:

* Discuss in the meeting.

## CRs

*Moderator: companies please provide comments on the following CRs. This part is just the list of the CRs, comments can be provided directly on the CR document with change marks.*

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| **CR** | **Comments** |
| R4-2320361 Draft CR # 23 Requirements for DL RSCPD reported with RSTD in RRC CONNECTED state | Company A: |
| Company B: |
| R4-2320814 Draft CR #11: Measurement requirements for RSCPD reported with RSTD in RRC\_INACTIVE |  |
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| R4-2320815 Draft CR #12: Measurement requirements for DL RSCP reported with UE Rx-Tx time difference in RRC\_INACTIVE |  |
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| R4-2320816 Draft CR #24: Measurement requirements for DL RSCP reported with UE Rx-Tx time difference in RRC\_CONNECTED |  |
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