**3GPP TSG-RAN WG4 Meeting # 107 R4-23xxxx**

**Incheon, KR, May 22 – May 26, 2023**

**Agenda item:** 8.23.4

**Source:** Moderator (CATT)

**Title:** Topic summary for [107][220] NR\_pos\_enh2\_part2

**Document for:** Information

# Introduction

This topic summary for [107][220] NR\_pos\_enh2\_part2 contains the discussions in agenda 8.23.3.2, 8.23.3.6 which include the following topics:

* Topic #1: Sidelink Positioning (agenda 8.23.3.2)
* Topic #2: Carrier Phase Positioning (agenda 8.23.3.6)

# Topic #1: Sidelink Positioning (agenda 8.23.3.2)

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2307412 | CATT | **Proposal 1: Besides agreed RAN4 SL-based RSTD, Rx-Tx time difference, RSRP, RSRPP measurements, RAN4 also to define the SL based measurement period requirements for SL-PRS based RTOA and AOA/ZOA.**  **Proposal 2: The following factors should be considered for SL-PRS based measurement requirements:**   * **Available SL-PRS periodicity considering muting** * **Available time duration of SL-PRS resource** * **UE processing capability** * **The number of carriers** * **The number of samples** * **The number of beams** * **Scaling factor due to TEG** * **The definition of measurement window** * **The measurement duration of the last sample**   **Proposal 3: RAN4 to define the SL based measurement period requirements based on single sample. FFS whether to define requirements for multiple samples based on performance evaluation and RAN1 further progress on UE capability.**  **Proposal 4: The scaling factor for Rx TEG defined in existing PRS measurement requirements can be reused for SL positioning.**  **Proposal 5: Wait for further RAN1 progress on SL-PRS resource configuration and UE processing capability.**  **Proposal 6: Reuse the existing Te requirements for SL positioning in Rel-18 and also no new transmit timing adjustment requirements for SL positioning are needed.**  **Proposal 7: The measurement period requirements are not impacted due to synchronization reference source change.** |
| R4-2307432 | LG Electronics Inc. | ***Proposal 1***: RAN4 to specify RRM core requirement for sidelink positioning up to 100MHz CBW in Rel-18. And RRM accuracy requirement follows the limitation of RF spec.  ***Proposal 2***: Support option 1. RAN4 to wait for more RAN1/2 progress and discuss how to define the measurement period requirements after RAN1/2’s decision.  ***Proposal 3***: RAN4 to consider all possible synch. ref sources such as GNSS, gNB and SyncRef UE to overcome the distance difference between synch. source and anchor UEs.  ***Proposal 4***: Support option 1. RAN4 to consider how to make the limitation of timing error for positioning purpose.  ***Proposal 5***: RAN4 to discuss the transmission time adjustment issue after more of RAN1’s progress  ***Proposal 6***: RAN4 to consider how to minimize the latency of the positioning measurement procedure to reduce the impact of UE mobility   * + Anchor UEs should be capable of simultaneous or within [x] slots transmission of SL-PRS.   + Anchor UEs should be capable of simultaneous SL-PRS measurement |
| R4-2307557 | CMCC | ***Proposal 1: for SL PRS measurement requirements, it is proposed to consider both N\_sample = 1 and N\_sample > 1.***  ***Proposal 2: for SL-PRS, it is proposed to define measurement period requirements for following measurements:***   * ***SL-PRS based RTOA measurement*** * ***SL-PRS based Azimuth of arrival (AoA) and SL zenith of arrival (ZoA) measurement*** |
| R4-2307705 | vivo | ***Observation 1: RAN4 could discuss general principle for measurement period requirement in the current stage and waits for more RAN1/2 progress before discussing exact SL PRS measurement period requirements.***  ***Observation 2: the definition of SL-PRS based Rx-Tx is not stable in the current stage, some aspects about report mapping, e.g, reporting range, may be changed in the future.***  ***Proposal 1: RAN4 to define measurement period requirements for SL-PRS RTOA and SL-PRS AOA/ZOA.***  ***Proposal 2: RAN4 could follow the principal that try to define a common measurement period requirement for different measurement types. If technical issue exists, future adaptions will be discussed case by case.***  ***Proposal 3: 4 sample SL-PRS should be considered as the baseline to define measurement period and accuracy requirements.***  ***Proposal 4: For SL-PRS RSTD, SL-PRS RTOA, the report mapping should be configurable, and the requirements including reporting range, max/min value of k, resolution step can be same as Rel-16/Rel-17 report mapping requirements in FR1.***  ***Proposal 5: For SL-PRS RSRP, SL-PRS RSRP, SL-PRS AOA/ZOA, the report mapping should be fixed, and the requirements including reporting range, resolution step can be same as Rel-16/Rel-17 report mapping requirement.***  ***Proposal 6: For SL-PRS Rx-Tx, the report mapping requirement should be discussed after the definition is stable.***  ***Proposal 7: Reuse the existing Te requirements for SL positioning in Rel-18.***  ***Proposal 8: RAN4 to prioritize non-DRX case for the measurement period for SL PRS-based measurements.***  ***Proposal 9: RAN4 to investigate measurement procedure under the condition of selection/reselection of synchronization reference source.***  ***Proposal 10: RAN4 to investigate the UE behaviour when UE is performing SL positioning measurement under the condition of selection/reselection of synchronization source.*** |
| R4-2308022 | Ericsson | * ***Proposal 1 (measurement period)****: RAN4 starts defining with defining the measurement period requirements for SL-PRS-RSRP.* * ***Proposal 2 (measurement period)****: RAN4 to further discuss whether the measurement period requirements for other SL PRS-based measurements are different from that for SL-PRS-RSRP.* * ***Proposal 3 (measurement period)****: SL PRS-based measurement period depends on SL DRX cycle length.* * ***Proposal 4 (Uu link distortion [RLF, RRC reestablishment, handover, etc.])****: RN4 to discuss the impact of Uu link distortion on SL positioning measurements, e.g., due to handover, RLF or RR reestablishment in the Uu connection to gNB.* * ***Proposal 5 (dedicated/shared resource pool)****: The same accuracy requirements apply, regardless of the SL PRS resource pool type (dedicated or shared).* * ***Proposal 6 (dedicated/shared resource pool)****: Measurement period may be different for different SL PRS resource pool types (dedicated or shared).* * ***Proposal 7 (synch source change)****: At least SL PRS timing measurements are impacted by the synchronization reference source.* * ***Proposal 8 (synch source change)****: RAN4 to discuss the following scenarios with the synchronization reference source change:*   + *Scenario A: Impact on an SL measurement due to the synch change in the same SL UE performing the measurement:*     - *Receiving UE for unidirectional measurements*     - *Receiving and transmitting UE for bidirectional measurements*   + *Scenario B: Impact on an SL measurement due to the synch change in another SL UE (tx or ) involved in the same measurement:*     - *Transmitting UE for unidirectional or bidirectional measurements*   + *Scenario C: Impact on SL measurements at multiple SL UEs which are sharing the same common synchronization reference source, due to the change of the common synchronization source,*   + *Scenario D: Impact on an SL positioning result due to the change in another SL UE involved in the same positioning session but not necessarily the same SL measurement (multi-RTT scenario).* * ***Proposal 9 (synch source change)****: RAN4 to discuss at least the following options for avoiding/reducing the impact of the changing the synchronization reference source during the on-going SL measurement or right before the SL measurement:*   + *Option 1: delaying/postponing the start of the synch change until the SL measurement is complete,*   + *Option 2: dropping or restarting the impacted SL measurement,* * ***Proposal 10 (coverage status change)****: RAN4 to discuss the impact of a change in coverage status (e.g., going between in-coverage, out-of-coverage, partial coverage, or changing the SL coverage range) on SL positioning measurements, including measurement performance, measurement procedure, UE behaviour, etc.* * ***Proposal 11 (number of samples)****: SL measurement period requirement is defined as a function of the number of samples.* * ***Proposal 12 (number of samples)****: More than 1 sample should be considered for the SL measurement period requirements.* * ***Proposal 13 (number of samples)****: SL measurement accuracy requirement is defined as a function of the number of samples.* * ***Proposal 14 (number of samples)****: More than 1 sample should be considered for the SL measurement accuracy requirements.* * ***Proposal 15 (measurement report range)****: The measurement ranges for SL positioning measurements (except for SL-PRS AOA/ZOA) can be different compared to those specified for Uu positioning measurements. RAN4 to discuss the relevant range for each SL positioning measurement.* * ***Proposal 16 (initiation/cease of SL PRS tx)****: RAN4 to discuss requirements for initiation/cease of SL transmissions for positioning.* |
| R4-2308465 | OPPO | **Observation 1: S-SSB slots are excluded from resource pool, and SL-PRS is transmitted within resource pool.**  **Proposal 1: Define the measurement period requirements for SL-PRS RTOA.**  **Proposal 2: The 4 samples could be reduced since an additional AGC symbol preceding a SL-PRS resource.**  **Proposal 3: The 1 Rx beam could be assumed for SL-PRS measurement in FR1.**  **Proposal 4: For UE transmit timing requirements,**   * **Reuse the existing Te requirement for SL-PRS RSRP, RSRPP, AoA/ZoA and RTOA measurement.** * **A more stringent Te requirement can be considered for Tx anchor UEs for RSTD measurement.** * **FFS whether to reuse the exiting Te requirement for Rx-Tx time difference measurement.**   **Proposal 5: Prioritize non-DRX case to define the measurement period for SL-PRS measurement.**  **Proposal 6: Not consider sharing mechanism between SL-PRS and S-SSB measurement.** |
| R4-2308667 | Huawei, HiSilicon | **Proposal 1: The measurement period requirements are agnostic to the BW of SL PRS. FFS the applicable PRS BW for defining accuracy requirements.**  **Proposal 2: RAN4 to discuss, from spec maintenance point of view, whether common measurement period requirements can be defined for all SL PRS measurements.**  **Proposal 3: RAN4 to use consistent terms with other WGs for SL positioning related requirements.**  **Proposal 4: RAN4 to define measurement period requirements for all measurement types.**  **Proposal 5: Measurement based on single sample is used as baseline for SL PRS measurement period and for accuracy requirements.**  **Proposal 6: RAN4 to discuss possible sharing between SL PRS measurement and other SL measurements based on RAN1 agreements.**  **Proposal 7: RAN4 waits for more RAN1/2 progress before discussing exact SL PRS measurement period requirements.**  **Proposal 8: RAN4 to decide for which measurement types to define accuracy requirements in the Perf part.**  **Proposal 9: RAN4 to consider AWGN and [TDL-A] channel for simulation evaluation.**  **Proposal 10: Define requirements for SL PRS measurement based on Es/Iot side condition of [-6, 0 or 3] dB.**  **Proposal 11: Re-use the existing Te requirements for SL positioning in Rel-18. No new requirements related to transmit timing adjustment for SL positioning are defined.**  **Proposal 12: RAN4 to prioritize non-DRX case for the measurement period for SL PRS-based measurements.**  **Proposal 13: RAN4 to discuss the impact of transition (sync source change or coverage status change) after requirements for non-transition case are stable.**  **Proposal 14: Simultaneous Tx/Rx capability is up to RAN1 discussion.**  **Proposal 15: RAN4 to discuss the requirements for initiation/cease of SL PRS once the UE behavior and procedure is defined in RAN1.** |
| R4-2309130 | Qualcomm Incorporated | **Observation 1: RAN1 has yet to complete the definition of the reference signal for SL positioning.**  **Proposal 1: RAN4 to discuss whether and how to define absolute accuracy requirements for SL-PRS-based RTOA measurements, taking into account timing uncertainty in acquiring the RTOA Reference Time (T0).**  **Observation 2: RAN1 has not yet finalized the definition of SL-PRS-based Rx-Tx measurement.**  **Observation 3: RAN1 has not yet finalized the definition of SL-PRS-based SL RSTD measurement.**  **Observation 4: Reporting of measurements for first path and additional paths is supported for SL-PRS-based RSTD, Rx-Tx difference, RTOA, AoA and RSRPP.**  **Observation 5: RAN1 has completed the definition of SL-PRS-based AoA measurement.**  **Proposal 2: Reuse the UL AoA measurement report mapping in 38.133 for SL AoA measurements.**  **Observation 6: RAN1 has yet to define prioritization rules of SL PRS vs. other sidelink signals.**  **Proposal 3: Develop the measurement period requirement for SL RTT as the baseline and further discuss any potential modifications required to apply the requirement to other SL positioning measurements.**  **Proposal 4: RAN4 waits for more RAN1/2 progress before discussing exact SL PRS measurement period requirements.**  **Proposal 5: RAN4 to define requirements for SL PRS measurements assuming one sample (N\_sample = 1). FFS whether to define requirements for N\_sample > 1.**  **Proposal 6: Define SL positioning requirements for CBW = 100 MHz for SL in Rel-18.**  **Proposal 7: Reuse the existing Te requirements for SL positioning in Rel-18.**  **Proposal 8: No new requirements related to transmit timing adjustment for SL positioning.**  **Proposal 9: Prioritize defining the measurement period requirement for non-DRX (or wait for RAN1 progress).**  **Proposal 10: Prioritize fully staggered SL PRS patterns in RAN4 simulations.**  **Proposal 11: Simulate SL positioning performance in AWGN. FFS other propagation channels.**  **Proposal 12: Assume 1Tx/2Rx antenna configuration for SL positioning simulations.**  **Proposal 13: Simulate PRS BW = 10 MHz, 20 MHz, 40 MHz, and 100 MHz and SCS = 15kHz, 30kHz, 60kHz for SL positioning simulations.**  **Proposal 14: Assume CBW equal to the PRS BW.**  **Proposal 15: Reuse the sampling rate assumptions from NR positioning based on PRS BW.** |
| R4-2309676 | Nokia, Nokia Shanghai Bell | Proposal 1: RAN4 should consider defining the requirements for SL PRS bandwidth of up to 100 MHz.  **Proposal 2: RAN4 can wait for RAN1 agreement on SL PRS comb configurations.**  **Proposal 3: RAN4 should discuss if reduced latency measurement needs to be defined for SL positioning.**  **Observation 1: Sidelink UE performs measurements for all positioning measurement types.**  **Proposal 4: RAN4 to defined measurement period requirement for SL-PRS RTOA, SL-PRS AOA/ZOA.**  **Proposal 5: RAN4 to study measurement period requirement based on the combination of RTOA and SL-PRS-RSRP** **measurements.**  **Proposal 6: RAN4 should define the accuracy requirement for all of the measurement types.**  **Proposal 7: Measurement accuracy needs to be defined for AWGN and fading channel.**  **Proposal 8: RAN4 should study the measurement accuracy requirement for SL-PRS assuming partial coverage with single hop scenario.**  **Proposal 9: RAN4 can investigate further on the side condition, as Es/Iot condition also depends on the channel condition and profile. These are typically performance requirement and can be discussed further in the performance part.**  **Proposal 10: RAN4 to study on how to define the conditions for measurement accuracy requirements for SL PRS based RTOA measurement.**  **Proposal 11: RAN4 should consider R-17 requirement as baseline and can study if further improvement is required s.t. for RTT based method.**  **Proposal 12: The timing compensation due to different propagation delay needs to be agreed at RAN1 discussion.**  **Proposal 13: RAN4 needs to investigate the transmit time accuracy from different anchor UEs.**  **Proposal 14: RAN4 to investigate the impact of synchronization source change on SL positioning measurement.**  **Proposal 15: RAN4 to study the requirement for both SL-DRX and non SL-DRX case.**  **Proposal 16: RAN4 can investigate further if legacy CSSF requirement could be used or not**.  **Proposal 17: RAN4 to support option 2, the transition from one to another scenario.**  **Proposal 18: RAN4 to study the impact of change of network coverage scenario of SL UE(s) on measurement requirement, measurement accuracy, etc.**  **Proposal 19: RAN4 to define the requirements for initiation/cease of SL transmissions for positioning once the UE behavior and procedure is defined in RAN1.** |

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

## Open issues summary

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

#### Issue 1-1-1: Measurement types to be defined for SL positioning measurement requirements:

* Proposals:
  + Option 1: (CATT, CMCC, vivo, Huawei, Nokia)
    - Besides agreed RAN4 SL-based RSTD, Rx-Tx time difference, RSRP, RSRPP measurements, RAN4 also to define the SL based measurement period requirements for SL-PRS based RTOA and AOA/ZOA.
  + Option 2: (OPPO)
    - Define the measurement period requirements for SL-PRS RTOA
    - Not necessary to define delay requirements for AoA/ZoA if no performance requirement defined.
* Recommended WF
  + Agree on:
    - Define the measurement period requirements for SL-PRS based RTOA and AOA/ZOA.

#### Issue 1-1-2: The principle for defining the measurement period requirements:

* Proposals:
  + Proposal 1: (CATT)
    - The following factors should be considered for SL-PRS based measurement requirements:
      * Available SL-PRS periodicity considering muting
      * Available time duration of SL-PRS resource
      * UE processing capability
      * The number of carriers
      * The number of samples
      * The number of beams
      * Scaling factor due to TEG
      * The definition of measurement window
      * The measurement duration of the last sample
  + Proposal 2: (vivo, Ericsson, Huawei, Qualcomm)
    - RAN4 could follow the principal that try to define a common measurement period requirement for different measurement types. If technical issue exists, future adaptions will be discussed case by case.
    - FFS which measurement can be used as baseline (SL PRS-based Rx-Tx or SL PRS based RSRP)
  + Proposal 3: (Ericsson)
    - Measurement period may be different for different SL PRS resource pool types (dedicated or shared).
* Recommended WF
  + Need discussion.

#### Issue 1-1-3: Parameters in the measurement period requirements:

* Proposals:
  + Number of sample general:
    - Proposal 1: SL measurement period requirement is defined as a function of the number of samples.
  + Number of samples:
    - Option 1: Nsample = 1
    - Option 2: Nsample = 4
    - Option 3: 1 < Nsample < 4
    - Option 4: 1< Nsample
  + Scaling factor due to TEG:
    - Option 1: Reuse the existing requirements in Rel-17.
  + The number of Rx beam:
    - Option 1: NRxBeam = 1 in FR1.
* Recommended WF
  + Agree on:
    - The number of Rx beam:
      * NRxBeam = 1 in FR1.
  + Discuss the number of samples and scaling factor due to TEG.

#### Issue 1-1-4: Impact of SL-DRX

* Proposals:
  + Option 1: (CATT, vivo, OPPO, Huawei, Qualcomm)
    - RAN4 to prioritize non-DRX case for the measurement period for SL PRS-based measurements.
  + Option 2: (Ericsson)
    - SL PRS-based measurement period depends on SL DRX cycle length.
  + Option 3: (Nokia)
    - RAN4 to study the requirement for both SL-DRX and non-SL-DRX case.
* Recommended WF
  + Need discussion.

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

* Proposals:
  + Option 1: (OPPO)
    - Not consider sharing mechanism between SL-PRS and S-SSB measurement.
  + Option 2: (Huawei)
    - RAN4 to discuss possible sharing between SL PRS measurement and other SL measurements based on RAN1 agreements.
* Recommended WF
  + Need discussion.

#### Issue 1-1-6: Impact of network coverage change

* Proposals:
  + Option 1: (CATT)
    - The measurement period requirements still apply when there is change of network coverage scenario.
  + Option 2: (Huawei)
    - RAN4 to discuss the impact of transition (coverage status change) after requirements for non-transition case are stable.
  + Option 3 (Ericsson):
    - RAN4 to discuss the impact of a change in coverage status (e.g., going between in-coverage, out-of-coverage, partial coverage, or changing the SL coverage range) on SL positioning measurements, including measurement performance, measurement procedure, UE behaviour, etc.
* Recommended WF
  + Need discussion.

#### Issue 1-1-7: Impact of Uu link connection

* Proposals:
  + Option 1: (Ericsson)
    - RAN4 to discuss the impact of Uu link distortion on SL positioning measurements, e.g., due to handover, RLF or RR reestablishment in the Uu connection to gNB.
* Recommended WF
  + Need discussion.

#### Issue 1-1-8: initiation/cease of SL PRS tx

* Proposals:
  + Option 1 (Ericsson, Huawei):
    - RAN4 to discuss requirements for initiation/cease of SL transmissions for positioning.
* Recommended WF
  + Need discussion.

### Sub-topic 1-2 Timing related requirements

#### Issue 1-2-1: Timing error limit requirements of SL UE for positioning (both anchor UE and target UE)

* Proposals:
  + Option 1: (CATT, vivo, Huawei, Qualcomm)
    - Reuse the existing Te requirements for SL positioning in Rel-18 and also no new transmit timing adjustment requirements for SL positioning are needed
  + Option 2: (LGE)
    - More stringent timing error limit requirement is needed for SL positioning.
  + Option 3: (OPPO)
    - Reuse the existing Te requirement for SL-PRS RSRP, RSRPP, AoA/ZoA and RTOA measurement.
    - A more stringent Te requirement can be considered for Tx anchor UEs for RSTD measurement.
    - FFS whether to reuse the exiting Te requirement for Rx-Tx time difference measurement.
* Recommended WF
  + Need discussion.

#### Issue 1-2-2: Impact due to the Tx/Rx timing difference of multiple anchor Ues

*Moderator: From moderator understanding, the issue is to discuss the impact when target UE performs measurements from multiple anchor UEs, the transmission timing of different anchor UEs are different due to e.g. different synchronization reference sources, or the target UE receiving timings from multiple anchor UEs are different due to e.g. different propagation delay. And the same issue for the other side i.e. anchor UE measurements. Please indicate if the understanding is incorrect.*

* Proposals:
  + Option 1: (LGE)
    - Consider all possible synchronization reference sources such as GNSS, gNB and SyncRef UE to overcome the distance difference between synchronization source and anchor UEs.
  + Option 2: (Huawei)
    - Simultaneous Tx/Rx capability is up to RAN1 discussion.
  + Option 3: (Nokia)
    - The timing compensation due to different propagation delay needs to be agreed at RAN1 discussion.
    - RAN4 needs to investigate the transmit time accuracy from different anchor UEs.
* Recommended WF
  + Need discussion.

#### Issue 1-2-3: The scenarios on synchronization reference resource change

* Proposals:
  + Option 1: (Ericsson)
    - RAN4 to discuss the following scenarios with the synchronization reference source change:
      * Scenario A: Impact on an SL measurement due to the synch change in the same SL UE performing the measurement:
        + Receiving UE for unidirectional measurements
        + Receiving and transmitting UE for bidirectional measurements
      * Scenario B: Impact on an SL measurement due to the synch change in another SL UE (tx or ) involved in the same measurement:
        + Transmitting UE for unidirectional or bidirectional measurements
      * Scenario C: Impact on SL measurements at multiple SL UEs which are sharing the same common synchronization reference source, due to the change of the common synchronization source,
      * Scenario D: Impact on an SL positioning result due to the change in another SL UE involved in the same positioning session but not necessarily the same SL measurement (multi-RTT scenario).
* Recommended WF
  + Need discussion.

#### Issue 1-2-4: UE behavior and measurement period requirements when synchronization reference source change occurs

* Proposals:
  + Proposal 1: (CATT)
    - The measurement period requirements are not impacted due to synchronization reference source change.
  + Proposal 2: (Ericsson)
    - When the synchronization reference source changes during the on-going SL measurement or right before the SL measurement:
      * Alt 1: Delaying/postponing the start of the synch change until the SL measurement is complete
      * Alt 2: Dropping or restarting the impacted SL measurement
  + Proposal 3: (Huawei)
    - RAN4 to discuss the impact of transition (sync source change) after requirements for non-transition case are stable.
  + Proposal 4 (Ericsson):
    - At least SL PRS timing measurements are impacted by the synchronization reference source.
* Recommended WF
  + Need discussion.

### Sub-topic 1-3 Others

#### Issue 1-3-1: Applicable CBW for SL positioning:

* Proposals:
  + Option 1: (Qualcomm, Nokia)
    - RAN4 to specify RRM requirement for sidelink positioning up to 100MHz CBW in Rel-18.
  + Option 2: (LGE)
    - RAN4 to specify RRM core requirement for sidelink positioning up to 100MHz CBW in Rel-18. And RRM accuracy requirement follows the limitation of RF spec.
  + Option 3: (Huawei)
    - The measurement period requirements are agnostic to the BW of SL PRS. FFS the applicable PRS BW for defining accuracy requirements.
* Recommended WF
  + Agree on:
    - RAN4 to specify RRM requirement for sidelink positioning up to 100MHz CBW in Rel-18.

#### Issue 1-3-2: Report mapping

* Proposals:
  + Option 1: (vivo)
    - For SL-PRS RSRP, SL-PRS RSRPP, SL-PRS AOA/ZOA, SL-PRS RSTD, SL-PRS RTOA, the report mapping requirements including reporting range, resolution step can be same as Rel-16/Rel-17 report mapping requirement.
  + Option 2: (Ericsson)
    - The measurement ranges for SL positioning measurements (except for SL-PRS AOA/ZOA) can be different compared to those specified for Uu positioning measurements. RAN4 to discuss the relevant range for each SL positioning measurement.
  + Option 3: (Qualcomm)
    - Reuse the UL AoA measurement report mapping in 38.133 for SL AoA measurements.
* Recommended WF
  + Need discussion.

#### Issue 1-3-3: Simulation assumption

* Proposals:
  + SL PRS pattern:
    - Fully staggered SL PRS patterns.
  + Channel model:
    - AWGN
    - TDL-A
  + Antenna:
    - 1T/2R
  + SL PRS BW:
    - 10 MHz, 20 MHz, 40 MHz, and 100 MHz
  + SCS:
    - 15kHz, 30kHz, 60kHz
  + CBW:
    - equal to the SL PRS BW
  + Sampling rate:
    - Reuse the assumption for NR PRS based measurement
  + Side condition:
    - [-6, 0] dB
    - [-6, 3] dB
* Recommended WF
  + Discuss each assumption in the proposal.

# Topic #2: Carrier Phase Positioning (agenda 8.23.3.6)

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2307417 | CATT | **Proposal 1: RAN4 to define measurement period requirements, accuracy requirements and report mapping for DL RSCP and DL RSCPD measurements.**  **Proposal 2: When DL RSCP is reported together with UE Rx–Tx time difference measurement, the existing Rel-17 UE Rx-Tx time difference measurement requirements for single carrier can be reused including the requirements for measurement with gap in RRC\_CONNECTED and the measurement in RRC\_INACTIVE.**  **Proposal 3: When DL RSCPD is reported together with RSTD measurement, the existing Rel-17 RSTD measurement requirements for single carrier can be reused including the requirements for measurement with gap in RRC\_CONNECTED and the measurement in RRC\_INACTIVE.**  **Proposal 4: The mobility impact in RRC\_CONNECTED and the collision handling in RRC\_INACTIVE state in Rel-17 can also be reused.**  **Proposal 5: The measurement period requirements defined in RAN4 apply to both UE and PRU(s). Further discuss in performance part whether to define higher accuracy requirements for PRU.**  **Proposal 6: The Rel-17 side condition and PRS configurations for UE Rx-Tx time difference can be reused for DL RSCP measurement.**  **Proposal 7: The Rel-17 side condition and PRS configurations for RSTD can be reused for DL RSCPD measurement.**  **Proposal 8: The reporting range for DL RSCP and RSCPD is [0, 360) degree. And the resolution can be further decided after performance evaluation.** |
| R4-2307431 | LG Electronics Inc. | ***Proposal 1***: RSCP and RSCPD should have different report mapping tables and the candidates of the units 15, 30, 45, 60, and 120 degrees for the carrier phase report can be possible.  ***Proposal 2***: Support both options. For carrier phase positioning, RAN4 should consider the higher positioning resolution compared to the one for the time-based measurement metric. And RAN4 can consider configurable reporting granularity according to UE capability. |
| R4-2308044 | ZTE Corporation | **Observation 1: RAN1 only supports the combination of CPP and other positioning methods for positioning research, whether the CPP method can be the standalone method for positioning enhancement or not haven’t been discussed.**  **Observation 2: The latest RAN meeting the revised WID only support “with” measurement gap for CPP.**  **Proposals:**  **Proposal 1: The legacy measurement period can be used as baseline or a starting point when defining the CPP related measurement period:**  **Where** |
| R4-2308469 | OPPO | **Proposal 1: When RSCP/RSCPD is reported together with legacy positioning measurement, the existing requirements for the associated legacy measurement should apply.**  **Proposal 2: Not consider multiple RF frequencies for RSCP/RSCPD measurement if a single RF frequency is defined for a PFL.**  **Proposal 3: Support DL carrier phase measurement within MG.**  **Proposal 4: For absolute and differential carrier phase measurement, discuss the following issues to define report mapping tables:**   * **The unit for carrier phase report** * **The range for carrier phase report** * **The resolution for carrier phase report**   **Proposal 5: Whether to introduce configuration or UE capability for the reporting granularity for DL RSCP/RSCPD can be FFS based on further conclusions in RAN1.** |
| R4-2308672 | Huawei, HiSilicon | **Proposal 1: RAN4 to define measurement period requirements for both RSCP and RSCPD. RAN4 to discuss for which measurements to define accuracy in Perf part.**  **Proposal 2: RAN4 not to define specific requirements for PRU.**  **Proposal 3: When RSCP or RSCPD is reported together with other measurements, measurement period for the other measurements apply for RSCP or RSCPD.**  **Proposal 4: RAN4 to discuss the number of samples for accuracy requirements for RSCP and RSCPD, as well as the applicable PRS configuration.**  **Proposal 5: RAN4 waits for RAN1 conclusion on support of multiple CP measurements for multiple RF frequencies before discussing the impact on RAN4 requirements.**  **Proposal 6: RF frequencies for target TRP and reference TRP in RSCPD measurement is up to RAN1.**  **Proposal 7: When RSCP or RSCPD is reported together with other measurements, measurement reporting requirements for other measurements apply for CP measurements.**  **Proposal 8: RAN4 to consider using same channel model for PRS-RSRPP for defining accuracy for CP measurements.**  **Proposal 9: RAN4 to discuss the BW ranges for defining accuracy requirements for CP measurements in the Perf part.**  **Proposal 10: RAN4 to discuss the Es/Iot side condition for defining accuracy requirements for CP measurements in the Perf part.**  **Proposal 11: Define same report mapping for all CP measurements (DL RSCP/RSCPD, UL RSCP). Use the following mapping as baseline, FFS adaptation.**   * **Unit: degree** * **Range: [-pi, +pi)** * **Resolution: 1 degree** |
| R4-2308795 | Ericsson | **Proposal 1**: RAN4 to define measurement delay and accuracy requirements for DL RSCPD and DL RSCP measurements. Accuracy requirement is further discussed during the performance part of the WI.  **Proposal 2**: RAN4 to not define measurement delay requirements for the case when CPP measurement is performed by UE outside of the MG or within PPW in RRC\_CONNECTED state.  **Proposal 3**: Measurement delay requirements for RSTD and UE Rx-Tx measurements apply when UE is configured to perform and report DL RSCPD and DL RSCP measurements together with legacy RSTD and UE Rx-Tx measurements.  **Proposal 4**: RAN4 to define requirements for the case, where centre frequency of the DL PFL is the specific RF frequency associated with a DL carrier phase measurement.  **Proposal 5**: RAN4 to not define measurement requirements for DL carrier phase measurement for multiple RF frequencies.  **Proposal 6**: For RSCPD measurement RF frequencies for target TRP and reference TRP should belong to same PFL.  **Proposal 7:** When RSCPD measurement is reported together with RSTD measurement, then RSTD measurement is performed on the same target TRP and reference TRP on which RSCPD measurement is performed.  **Proposal 8**: DL RSCPD and DL RSCP accuracy requirements are defined by considering PRS bandwidths used to define legacy RSTD and UE Rx-Tx accuracy requirements, respectively.  **Proposal 9**: Deprioritize accuracy requirement discussion for UL CPP measurement.  **Proposal 10**: SINR side condition for the NR carrier phase measurement can be same as these for Rel.16/17 positioning measurement with PRS.  **Proposal 11**: RAN4 to specify measurement reporting requirements for DL RSCPD and DL RSCP measurements.  **Proposal 12**: Reporting resolution for carrier phase measurement is 0.002 radians.  **Proposal 13**: Reporting range for DL RSCP measurement is [0, 2𝜋].  **Proposal 14**: Reporting range for DL RSCPD measurement is [-𝜋, 𝜋]. |
| R4-2309135 | Qualcomm Incorporated | **Proposal 1: Do not define requirements for DL RSCP reported with RSTD.**  **Proposal 2: Do not define requirements for DL RSCPD reported with UE Rx-Tx.**  **Proposal 3: RAN4 will not discuss requirements for stand-alone CPP measurements unless RAN1 agrees first to support such measurements.**  **Proposal 4: Do not define absolute measurement accuracy requirements for DL RSCP.**  **Proposal 5: RAN4 to define requirements for CPP measurements performed over the whole PFL/carrier bandwidth and associated with the center frequency of the PFL/carrier by default, consistent with RAN1 agreements.**  **Proposal 6: RAN4 will not discuss requirements for CPP measurements performed for multiple frequencies within a PFL/carrier unless RAN1 agrees first to support such measurements.**  **Observation 1: RAN1 is discussing whether/how the LMF will indicate to the UE the PRS resources used to measure carrier phase. RAN4 to wait for RAN1 conclusions on this issue.**  **Proposal 7: Measurement period requirements for CPP shall take into account the time window indication by the LMF.**  **Proposal 8: RAN4 to wait for further progress in RAN1 before defining the measurement period requirements for CPP measurements.**  **Proposal 9: Prioritize defining CPP measurement accuracy requirements for single sample measurements. Note: This agreement does not preclude specifying measurement period requirements for number of samples greater than one.** |
| R4-2309678 | Nokia, Nokia Shanghai Bell | 1. RAN4 to define measurement period and measurement reporting requirements for DL RSCP, which can be reported together with UE Rx-Tx time difference. 2. RAN4 to define measurement period and measurement reporting requirements for DL RSCPD, which can be reported together with RSTD. 3. RAN4 to define measurement reporting requirements for UL RSCP, which can be reported together with RTOA, gNB Rx-Tx time difference or standalone. 4. RAN4 to focus on defining measurement requirements for MG assisted DL CPP measurements in RRC\_CONNECTED state, for DL CPP measurements in RRC\_INACTIVE state and for UL CPP measurements for UE in RRC\_CONNECTED and RRC\_INACTIVE states. 5. RAN4 to investigate and specify measurement period, reporting, and accuracy requirements for DL RSCP and DL RSCPD measurements, for the cases of single and multiple measurement instances aligned to requirements for UE Rx-Tx and RSTD measurements, respectively, specified in Rel-16 and in Rel-17 for reduced latency. 6. RAN4 to investigate, if Tx timing accuracy requirements and DL RSCP/ DL-RSCPD measurement accuracy requirements can be tighter for PRU than for target UE, this being subject to PRU capability. 7. RAN4 should investigate how measurement periods (MP) for DL CP measurements can be aligned to those for Rel-16 / Rel-17 measurement types (i.e. MP for DL RSCP aligned to that for UE Rx-Tx time difference and MP for DL RSCPD aligned to that for RSTD). 8. In case the network operates multiple PFL’s to support RSTD or UE Rx-Tx time difference measurements, the same PFL per each cell should be configurable for the paired DL CP measurement, i.e. DL RSCPD or DL RSCP, respectively. 9. The RF frequencies for target TRP and serving TRP for the RSCP measurement can be different. 10. The RF frequencies for target TRP and reference TRP in RSCPD measurement can be different. 11. RAN4 to study typical fading channel profiles for NR CPP where LOS component is more expressed, in addition to AWGN channel. 12. RAN4 to define the reporting range [0; 2pi] for DL RSCP and UL RSCP and [-pi; pi] for DL RSCPD. 13. RAN4 to consider lower reporting granularity for CP measurements than Tc used for TOA measurements. 14. RAN4 to postpone the decision on whether to define UL RSCP measurement accuracy requirements to performance part. 15. 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. |

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

## Open issues summary

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

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

* Proposals
  + Option 1: (CATT)
    - When DL RSCP/RSCPD is reported together with legacy positioning measurement, the existing Rel-17 measurement requirements for single carrier can be reused.
  + Option 2: (OPPO, Huawei, Ericsson, ZTE, Nokia)
    - When DL RSCP/RSCPD is reported together with legacy positioning measurement, the existing requirements for the associated legacy measurement should apply.
  + Option 3: (Qualcomm)
    - Do not define requirements for DL RSCP reported with RSTD.
    - Do not define requirements for DL RSCPD reported with UE Rx-Tx.
  + Option 4: (Qualcomm)
    - Measurement period requirements for CPP shall take into account the time window indication by the LMF.
* Recommended WF
  + Need discussion.

#### Issue 2-1-2: Gap conditions for DL carrier phase measurement requirements:

* Proposals
  + Option 1: (OPPO, Nokia)
    - For DL carrier phase measurement in RRC\_CONNECTED state, MG-based measurement is supported.
  + Option 2: (Ericsson)
    - RAN4 to not define measurement delay requirements for the case when CPP measurement is performed by UE outside of the MG or within PPW in RRC\_CONNECTED state.
* Recommended WF
  + Agree on:
    - For DL carrier phase measurement in RRC\_CONNECTED state, MG-based measurement requirements are defined.
  + Further discuss
    - RAN4 to not define measurement delay requirements for the case when CPP measurement is performed by UE outside of the MG or within PPW in RRC\_CONNECTED state.

#### Issue 2-1-3: Applicable RF frequencies for DL carrier phase measurement requirements:

* Proposals
  + Option 1: (OPPO)
    - Not consider multiple RF frequencies for RSCP/RSCPD measurement if a single RF frequency is defined for a PFL.
  + Option 2: (Huawei, Qualcomm)
    - RAN4 waits for RAN1 conclusion on support of multiple CP measurements for multiple RF frequencies per PFL before discussing the impact on RAN4 requirements.
    - RF frequencies for target TRP and reference TRP in RSCPD measurement is up to RAN1.
  + Option 3: (Ericsson)
    - RAN4 to not define measurement requirements for DL carrier phase measurement for multiple RF frequencies.
    - For RSCPD measurement RF frequencies for target TRP and reference TRP should belong to same PFL.
    - When RSCPD measurement is reported together with RSTD measurement, then RSTD measurement is performed on the same target TRP and reference TRP on which RSCPD measurement is performed.
  + Option 4: (Nokia)
    - In case the network operates multiple PFL’s to support RSTD or UE Rx-Tx time difference measurements, the same PFL per each cell should be configurable for the paired DL CP measurement, i.e. DL RSCPD or DL RSCP, respectively.
    - The RF frequencies for target TRP and reference TRP in RSCPD measurement can be different.
* Recommended WF
  + Need discussion.

#### Issue 2-1-4: Impact of UE mobility in RRC\_CONNECTED:

* Proposals
  + Option 1: (CATT)
    - The mobility impact in RRC\_CONNECTED in Rel-17 can also be reused.
* Recommended WF
  + Need discussion.

#### Issue 2-1-5: Impact of collisions with other signals/channels in RRC\_INACTIVE:

* Proposals
  + Option 1: (CATT)
    - The collision handling in RRC\_INACTIVE state in Rel-17 can also be reused.
* Recommended WF
  + Need discussion.

#### Issue 2-1-6: Applicable requirements for PRU:

* Proposals
  + Option 1: (CATT)
    - The measurement period requirements defined in RAN4 apply to both UE and PRU(s).
  + Option 2: (Huawei)
    - RAN4 not to define specific requirements for PRU
* Recommended WF
  + Need discussion.

### Sub-topic 2-2 Measurement reporting requirements

*Moderator: this part means the measurement reporting delay requirements (e.g. 9.9.2.4 for RSTD)*

#### Issue 2-2-1: Measurement reporting requirements for DL carrier phase measurement:

* Proposals
  + Option 1: (Huawei)
    - When RSCP or RSCPD is reported together with other measurements, measurement reporting requirements for other measurements apply for CP measurements.
* Recommended WF
  + Need discussion.

### Sub-topic 2-3 Others

#### Issue 2-3-1: Report mapping for DL RSCP/RSCPD:

* Proposals
  + Reporting range:
    - Option 1: [0, 360) degree for DL RSCP and RSCPD
    - Option 2: [-180, +180) degree for DL RSCP and RSCPD
    - Option 3: [-𝜋, + 𝜋) radian for DL RSCP and RSCPD
    - Option 3: [0, 2𝜋] radian for DL RSCP, and [-𝜋, 𝜋] radian for DL RSCPD
  + Granularity:
    - Option 1: 1 degree
    - Option 2: 0.002 radians
    - Option 3: Configurable according to UE capability
    - Option 4: one of 15, 30, 45, 60 degrees
* Recommended WF
  + Need discussion.

#### Issue 2-3-2: Report mapping for UL RSCP:

* Proposals
  + Option 1: (Huawei)
    - Same as DL RSCP/RSCPD.
  + Option 2: (Nokia)
    - Define the reporting range [0, 2 𝜋] for UL RSCP.
* Recommended WF
  + Need discussion.

#### Issue 2-3-3: Simulation assumption for RSCP/RSCPD:

* Proposals
  + PRS configuration
    - Reuse Rel-17 configuration of UE Rx-Tx time difference for RSCP
    - Reuse Rel-17 configuration of RSTD for RSCPD
  + Side condition
    - Reuse Rel-17 UE Rx-Tx side condition for RSCP
    - Reuse Rel-17 RSTD side condition for RSCPD
  + Channel model:
    - Same channel model as PRS-RSRPP
  + Number of samples:
    - Nsample = 1
    - Nsample > 1
* Recommended WF
  + Discuss each assumption in the proposal.