**3GPP TSG-RAN WG4 Meeting # 112 R4-2411806**

**Maastricht, Netherlands, August 19 ‒ August 23, 2024**

**Agenda item:** 6.1.3

**Source:** Moderator (CATT)

**Title:** Topic summary for [112][211] NR\_pos\_enh2\_part2

**Document for:** Information

# Introduction

This topic summary for [111][211] NR\_pos\_enh2\_part2 contains the discussions in agenda 6.1.1.2, 6.1.2.2, 6.1.2.6, which include the following topics:

* Topic #1: Sidelink Positioning Requirements
  + Topic #1-1: SL Positioning Core Requirements Maintenance (agenda 6.1.1.2)
  + Topic #1-2: SL Positioning Performance Requirements (agenda 6.1.2.2)
* Topic #2: Carrier Phase Positioning Requirements
  + Topic #2-1: Carrier Phase Positioning Core Requirements Maintenance (agenda 6.1.1.2)
  + Topic #2-2: Carrier Phase Positioning Performance Requirements (agenda 6.1.2.6)

*Recommendation of prioritized topics:*

* *For SL positioning:*
  + *Sub topic 1-2: Issue 1-2-1/2/5/6/7/8*
  + *Sub topic 1-1: Issue 1-1-1/2/3*
* *For CPP positioning:*
  + *Sub topic 2-2: Issue 2-2-1/2*
  + *Sub topic 2-1: Issue 2-1-1/2/3*

# Topic #1: Sidelink Positioning Requirements

## Companies’ contributions summary

**SL positioning core requirements maintenance:**

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2412643 | Huawei, HiSilicon | **Proposal 1: Update the SL RSTD requirements to reflect that measurement period ends after the UE has measured SL PRS resources from at least two different Tx UEs.**  **Proposal 2: RAN4 not to define any impact of Uu link connection on the measurement period.**  **Proposal 3: Remove dedicated measurement period requirements for SL PRS-RSRP(P).** |
| R4-2413386 | Ericsson | * ***Proposal 1 (SL positioning)****: Update the measurement period definition of SL PRS-RSRP and SL PRS-RSRPP to refer to SL RSTD, SL Rx-Tx, SL AoA, and SL RTOA, depending on which of them the SL PRS-RSRP and SL PRS-RSRPP measurements are configured.* |

**SL positioning performance requirements:**

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2411337 | CATT | **Observation 1: SL PRS-RSRP(P) measurements are always requested with other types of measurements (i.e., SL RSTD/Rx-Tx/AoA).**  **Proposal 1: RAN4 to verify measurement accuracy of the legacy measurements and SL PRS-RSRP(P) in one test case in a separate clause.**  **Proposal 2: Measurement accuracy of the legacy measurements in SL PRS-RSRPP TC is expected to fulfil the measurement accuracy requirements defined for fading channel.**  **Proposal 3: RAN4 to verify measurement delay of the legacy measurements and SL PRS-RSRP(P) in one test case in a separate clause.** |
| R4-2411488 | OPPO | **Proposal 1: The RF calibration margins for SL RSTD and Rx-Tx measurements can be defined as the tables below.**   * + **The RF calibration margin for SL RSTD measurements in FR1:**  |  |  |  |  | | --- | --- | --- | --- | | *PRS BW (RB number)* | | | *Margin (Tc)* | | *SCS=15kHz* | *SCS=30kHz* | *SCS=60kHz* | | *≥ 48* | *≥ 24* | *N/A* | ***Z1=72*** | | *≥ 96* | *≥ 48* | *≥ 24* | ***Z2=36*** |  * + **The RF calibration margin for SL Rx-Tx measurements in FR1:**  |  |  |  |  | | --- | --- | --- | --- | | *[Min(SL PRS Rx BW, SL PRS Tx BW) (RB)]* | | | *Margin (Tc)* | | *SCS = 15 kHz* | *SCS = 30 kHz* | *SCS = 60 kHz* | | *≥ 48* | *≥ 24* | *N/A* | ***δ1=80*** | | *≥ 96* | *≥ 48* | *≥ 24* | ***δ2=56*** |   **Proposal 2: The existing frequency drift margins for RSTD can be reused for SL Rx-Tx measurements.**  **Proposal 3: Verify accuracy requirements for SL PRS-RSRP together with SL Rx-Tx in the same section, but different test cases with and without SL PRS-RSRP.**  **Proposal 4: Define test case to verify accuracy requirements for SL PRS-RSRPP alone in a separate section.** |
| R4-2411793 | Qualcomm | **Tdoc status: Reserved.** |
| R4-2411983 | CMCC | ***Proposal 1: it is proposed that SL PRS-RSRP(P) accuracy is verified with RSTD/RX-TX accuracy together in one test, since SL PRS-RSRP or SL PRS-RSRPP cannot be requested and/or reported without any other SL positioning measurements.*** |
| R4-2412651 | Huawei, HiSilicon | **Proposal 1: The RF calibration margin for SL RSTD (Z) and SL Rx-Tx (δ) can be re-used from corresponding requirements for Uu positioning.**  **Proposal 2: The frequency drift margin for SL Rx-Tx is defined as Y=32 Tc, provided that the time offset between the SL PRS transmission and reception, which are used for a single SL Rx-Tx estimate, is no greater than 160 ms.**  **Proposal 3: For the test configuration,**   * **Shared and dedicated resource pools are randomly used among different TCs** * **Es/Iot: 3dB (to ensure 100% PSCCH decoding)**   **Proposal 4: RAN4 to consider the following SL PRS related parameters for the test.**   * **(symbol num, comb size): (4, 4) and (2, 4)** * **BW: 48 RB for delay TCs, 24 and 48 RB for accuracy TCs** * **MUX of multiple TX UEs: TX UE1: slot n, TX UE2: slot n + 1 and slot n + 100ms**   **Proposal 5: For accuracy TCs for SL PRS-RSRP(P), separate section for testing SL PRS-RSRP/PRS-RSRPP, without verifying the accuracy of the other (SL RSTD/Rx-Tx) measurement, respectively.** |
| R4-2413388 | Ericsson | * ***Proposal 1****: The following specification structure is proposed for SL-PRS configuration section:*   *A.3.21A NR Sidelink Measurements for Positioning*  *A.3.21A.1 Introduction*  *A.3.21A.2 NR SL-PRS configurations*  *A.3.21A.2.1 NR SL-PRS configurations for FR1*   * ***Proposal 2****: SL-PRS bandwidth 24 PRBs with 15 kHz SCS is included in the accuracy requirements for SL RSTD and SL Rx-Tx measurements.* * ***Proposal 3****: The following band groups are included in the accuracy requirements for SL positioning and in the conditions for NR SL-PRS based measurements:*   + *NR\_TDD\_FR1\_B,*   + *NR\_TDD\_FR1\_C,*   + *NR\_FDD\_FR1\_G,*   + *NR\_TDD\_FR1\_J.* * ***Proposal 4****: Accuracy requirements for SL-PRS based measurements are specified in TS 38.133, without any impact of the RAN1 LS [19].* * ***Proposal 5****: SL PRS-RSRP accuracy:*   + *±3.5 dB and ±8 dB for normal and extreme conditions, respectively, for ≥24 PRBs.*   + *FFS, for other BWs* * ***Proposal 6****: SL PRS-RSRPP accuracy:*   + *±4.1 dB and ±8.6 dB for normal and extreme conditions, respectively, for ≥24 PRBs.*   + *FFS, for other BWs* * ***Proposal 7****: SL Rx-Tx accuracy:*   + *AWGN:*     - *≥24 PRBs, AWGN:*       * *± 78+δ, for 15 kHz,*       * *± 57+δ, for 30 kHz,*       * *± 29+δ, for 60 kHz,*     - *FFS, for other BWs*   + *Fading conditions:*     - *≥24 PRBs:*       * *± 137+δ, for 15 kHz,*       * *± 87+δ, for 30 kHz,*       * *± 59+δ, for 60 kHz,*     - *FFS, for other BWs* * ***Proposal 8****: Accuracy test case for SL PRS-RSRP with SL RSTD is defined in a separate section from SL RSTD accuracy test case.* * ***Proposal 9****: Accuracy test case for SL PRS-RSRPP with SL Rx-Tx is defined in a separate section from SL Rx-Tx accuracy test case.* * ***Proposal 10****: In the accuracy test case for SL PRS-RSRP with SL RSTD, the SL PRS-RSRP accuracies for both reference SL-PRS and the other anchor SL-PRS are verified.* * ***Proposal 11****: In the accuracy test case for SL PRS-RSRP with SL RSTD, the SL RSTD accuracy may be practically useful to verify together with the SL PRS-RSRP accuracy.* * ***Proposal 12****: For SL RSTD delay test case, the following SL-PRS signal level configurations are proposed:*  |  |  |  |  | | --- | --- | --- | --- | |  | ***UE1*** | ***UE2*** | ***UE3*** | | ***SL-PRS Es/Noc*** | *5 dB* | *3.2 dB* | *-3 dB* | | ***SL-PRS Es/Iot*** | *0.1 dB* | *-2.99 dB* | *-3 dB* |  * ***Proposal 13****: For SL Rx-Tx delay test case, the following SL-PRS signal level configurations are proposed:*  |  |  |  | | --- | --- | --- | |  | ***UE1*** | ***UE2*** | | ***SL-PRS Es/Noc*** | *5 dB* | *3.2 dB* | | ***SL-PRS Es/Iot*** | *0.1 dB* | *-2.99 dB* |  * ***Proposal 14****: In SL AoA delay test case, the SL-PRS signal level configurations can be the same as in SL Rx-Tx test case.* * ***Proposal 15****: In SL RTOA delay test case, it is proposed to add one interfering UE, so the total number of UEs in the test case is 3, including the target UE. The SL-PRS signal configuration for the three UEs can then be the same as for SL Rx-Tx:*  |  |  |  | | --- | --- | --- | |  | ***Interfering UE*** | ***Target UE*** | | ***SL-PRS Es/Noc*** | *5 dB* | *3.2 dB* | | ***SL-PRS Es/Iot*** | *0.1 dB* | *-2.99 dB* |  * ***Proposal 16****: Update SL-PRS configurations as follows:*  |  |  |  |  |  | | --- | --- | --- | --- | --- | | SL PRS Parameters | Values | | | | | Reference channel | SL PRS.1.1 FR1 | SL PRS.1.2 FR1 | SL PRS.1.3 FR1 | SL PRS.1.4 FR1 | | SCS | 15kHz, 30kHz | | | | | SL-PRS comb size | 2 | | 4 | | | Number of SL-PRS symbols | 4 | | 4 | | | SL-PRS comb offset Note 1 | [1] | | [1] | | | SL-PRS resource slot offset (slot) Note 1 | [0] | [4] | [0] | [4] | | RB numbers containing SL PRS within channel Bandwidth Note 1 | [24~~48~~] | | [48~~96~~] | | | SL-PRS starting PRB | [4] | | [4] | | | Note 1: Unless otherwise specified in the test case | | | | | |

## Open issues summary

### Sub-topic 1-1 SL Positioning Core Requirements Maintenance

#### Issue 1-1-1: End point of SL-PRS based RSTD measurement period requirements

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| --- |
| *Agreements in RAN4#110bis:*   * The SL RSTD measurement period ends after the UE has measured SL PRS resources from at least two different Tx UEs including target and reference UEs. * FFS whether any updates to the TS 38.133 are needed. |

* Proposals
  + Option 1: (Huawei)
    - Update the SL RSTD requirements to reflect that measurement period ends after the UE has measured SL PRS resources from at least two different Tx UEs.
* Recommended WF
  + Discuss Option 1.

#### Issue 1-1-2: Impact of Uu link connect

* Proposals
  + Option 1: (Huawei)
    - RAN4 not to define any impact of Uu link connection on the measurement period.
* Recommended WF
  + Discuss option 1.

#### Issue 1-1-3: Measurement period requirements for SL PRS-RSRP(P)

* Proposals
  + Option 1: (Huawei)
    - Remove dedicated measurement period requirements for SL PRS-RSRP(P).
  + Option 2: (Ericsson)
    - Update the measurement period definition of SL PRS-RSRP and SL PRS-RSRPP to refer to SL RSTD, SL Rx-Tx, SL AoA, and SL RTOA, depending on which of them the SL PRS-RSRP and SL PRS-RSRPP measurements are configured.
* Recommended WF
  + Discuss the option(s).

### Sub-topic 1-2 SL Positioning Performance Requirements

#### Issue 1-2-1: RF calibration margin for SL RSTD/Rx-Tx

* Proposals
  + Option 1a: (OPPO)
    - The RF calibration margins for SL RSTD and Rx-Tx measurements can be defined as the tables below.
      * The RF calibration margin for SL RSTD measurements in FR1:

|  |  |  |  |
| --- | --- | --- | --- |
| *PRS BW (RB number)* | | | *Margin (Tc)* |
| *SCS=15kHz* | *SCS=30kHz* | *SCS=60kHz* |
| *≥ 48* | *≥ 24* | *N/A* | ***Z1=72*** |
| *≥ 96* | *≥ 48* | *≥ 24* | ***Z2=36*** |

* + - * The RF calibration margin for SL Rx-Tx measurements in FR1:

|  |  |  |  |
| --- | --- | --- | --- |
| *[Min(SL PRS Rx BW, SL PRS Tx BW) (RB)]* | | | *Margin (Tc)* |
| *SCS = 15 kHz* | *SCS = 30 kHz* | *SCS = 60 kHz* |
| *≥ 48* | *≥ 24* | *N/A* | ***δ1=80*** |
| *≥ 96* | *≥ 48* | *≥ 24* | ***δ2=56*** |

* + Option 1b: (Huawei)
    - The RF calibration margin for SL RSTD (Z) and SL Rx-Tx (δ) can be re-used from corresponding requirements for Uu positioning.
* Recommended WF
  + Reuse the RF calibration margins defined for Uu positioning for SL RSTD and SL Rx-Tx:
    - * The RF calibration margin for SL RSTD measurements in FR1:

|  |  |  |  |
| --- | --- | --- | --- |
| *PRS BW (RB number)* | | | *Margin (Tc)* |
| *SCS=15kHz* | *SCS=30kHz* | *SCS=60kHz* |
| *≥ 48* | *≥ 24* | *N/A* | ***Z1=72*** |
| *≥ 96* | *≥ 48* | *≥ 24* | ***Z2=36*** |

* + - * The RF calibration margin for SL Rx-Tx measurements in FR1:

|  |  |  |  |
| --- | --- | --- | --- |
| *[Min(SL PRS Rx BW, SL PRS Tx BW) (RB)]* | | | *Margin (Tc)* |
| *SCS = 15 kHz* | *SCS = 30 kHz* | *SCS = 60 kHz* |
| *≥ 48* | *≥ 24* | *N/A* | ***δ1=80*** |
| *≥ 96* | *≥ 48* | *≥ 24* | ***δ2=56*** |

#### Issue 1-2-2: Frequency drift margin for SL Rx-Tx measurement

* Proposals
  + Option 1a: (OPPO)
    - The existing frequency drift margins for RSTD can be reused for SL Rx-Tx measurements.
  + Option 1b: (Huawei)
    - The frequency drift margin for SL Rx-Tx is defined as Y=32 Tc, provided that the time offset between the SL PRS transmission and reception, which are used for a single SL Rx-Tx estimate, is no greater than 160 ms.
* Recommended WF
  + Reuse the frequency drift defined for RSTD for SL Rx-Tx measurements:
    - The frequency drift margin for SL Rx-Tx is defined as Y=32 Tc, provided that the time offset between the SL PRS transmission and reception, which are used for a single SL Rx-Tx estimate, is no greater than 160 ms.

#### Issue 1-2-3: General aspects for measurement accuracy requirements for SL positioning

* Proposals
  + Option 1: (Ericsson)
    - Accuracy requirements for SL-PRS based measurements are specified in TS 38.133, without any impact of the RAN1 LS.
    - SL-PRS bandwidth 24 PRBs with 15 kHz SCS is included in the accuracy requirements for SL RSTD and SL Rx-Tx measurements.
    - The following band groups are included in the accuracy requirements for SL positioning and in the conditions for NR SL-PRS based measurements:
      * NR\_TDD\_FR1\_B,
      * NR\_TDD\_FR1\_C,
      * NR\_FDD\_FR1\_G,
      * NR\_TDD\_FR1\_J.
* Recommended WF
  + Discuss the option(s).

#### Issue 1-2-4: Measurement accuracy for SL PRS-RSRP(P)/Rx-Tx

* Proposals
  + Option 1: (Ericsson)
    - SL PRS-RSRP accuracy:
      * ±3.5 dB and ±8 dB for normal and extreme conditions, respectively, for ≥24 PRBs.
      * FFS, for other BWs
    - SL PRS-RSRPP accuracy:
      * ±4.1 dB and ±8.6 dB for normal and extreme conditions, respectively, for ≥24 PRBs.
      * FFS, for other BWs
    - SL Rx-Tx accuracy:
      * AWGN:
        + ≥24 PRBs, AWGN:

± 78+δ, for 15 kHz,

± 57+δ, for 30 kHz,

± 29+δ, for 60 kHz,

* + - * + FFS, for other BWs
      * Fading conditions:
        + ≥24 PRBs:

± 137+δ, for 15 kHz,

± 87+δ, for 30 kHz,

± 59+δ, for 60 kHz,

* + - * + FFS, for other BWs
* Recommended WF
  + Discuss the option(s).

#### Issue 1-2-5: Delay and accuracy TCs for SL PRS-RSRP(P)

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| Issue 1-2-7: Whether to verify accuracy of legacy measurements in SL PRS-RSRP(P) TCs Proposals in RAN4#111 meeting:   * + Option 1:     - Consider the following rules:       * If RAN1/2 confirms that the SL PRS-RSRP(P) is possible to be requested and/or reported standalone, the SL PRS-RSRP(P) accuracy is verified alone in separate section.       * If RAN1/2 confirms that the SL PRS-RSRP(P) cannot be requested and/or reported standalone, the SL PRS-RSRP(P) accuracy should be verified with RSTD/RX-TX accuracy together in one section.   + Option 2:     - Verify accuracy requirements for SL PRS-RSRP together with SL Rx-Tx in the same section, but different test cases with and without SL PRS-RSRP.     - Define test case to verify accuracy requirements for SL PRS-RSRPP in a separate section.   + Option 3:     - Support option 1a to define separate sections for testing SL PRS-RSRP/PRS-RSRPP, without verifying the accuracy of the other (SL RSTD/Rx-Tx) measurement, respectively. |

* Proposals
  + Option 1: (CATT)
    - RAN4 to verify measurement accuracy of the legacy measurements and SL PRS-RSRP(P) in one test case in a separate clause.
    - Measurement accuracy of the legacy measurements in SL PRS-RSRPP TC is expected to fulfil the measurement accuracy requirements defined for fading channel.
    - RAN4 to verify measurement delay of the legacy measurements and SL PRS-RSRP(P) in one test case in a separate clause.
  + Option 2: (OPPO)
    - Verify accuracy requirements for SL PRS-RSRP together with SL Rx-Tx in the same section, but different test cases with and without SL PRS-RSRP.
    - Define test case to verify accuracy requirements for SL PRS-RSRPP alone in a separate section.
  + Option 3: (CMCC)
    - it is proposed that SL PRS-RSRP(P) accuracy is verified with RSTD/RX-TX accuracy together in one test, since SL PRS-RSRP or SL PRS-RSRPP cannot be requested and/or reported without any other SL positioning measurements.
  + Option 4: (Huawei)
    - For accuracy TCs for SL PRS-RSRP(P), separate section for testing SL PRS-RSRP/PRS-RSRPP, without verifying the accuracy of the other (SL RSTD/Rx-Tx) measurement, respectively.
  + Option 5: (Ericsson)
    - Accuracy test case for SL PRS-RSRP with SL RSTD is defined in a separate section from SL RSTD accuracy test case.
    - Accuracy test case for SL PRS-RSRPP with SL Rx-Tx is defined in a separate section from SL Rx-Tx accuracy test case.
    - In the accuracy test case for SL PRS-RSRP with SL RSTD, the SL PRS-RSRP accuracies for both reference SL-PRS and the other anchor SL-PRS are verified.
    - In the accuracy test case for SL PRS-RSRP with SL RSTD, the SL RSTD accuracy may be practically useful to verify together with the SL PRS-RSRP accuracy.
* Recommended WF
  + For SL RSRP(P) delay TCs,
    - No test cases are defined to specifically verify measurement delay requirements for SL PRS-RSRP/RSRPP, regardless of whether the measurement delay requirements are specified for SL PRS-RSRP/RSRPP. (Agreement in RAN4#110bis)
    - SL RSTD and SL Rx-Tx delay TCs are updated to include SL RSRP(P) measurements.
  + For SL RSRP(P) accuracy TCs, discuss the following aspects:
    - Whether to define separate sections for SL RSRP(P) accuracy TCs
    - Whether to verify the accuracy of legacy measurements in SL RSRP(P) TCs

#### Issue 1-2-6: SL-PRS signal level configurations

* Proposals
  + Option 1: (Huawei)
    - Es/Iot: 3dB (to ensure 100% PSCCH decoding)
  + Option 2: (Ericsson)
    - For SL RSTD delay test case:

|  |  |  |  |
| --- | --- | --- | --- |
|  | ***UE1*** | ***UE2*** | ***UE3*** |
| ***SL-PRS Es/Noc*** | *5 dB* | *3.2 dB* | *-3 dB* |
| ***SL-PRS Es/Iot*** | *0.1 dB* | *-2.99 dB* | *-3 dB* |

* + - For SL Rx-Tx and SL AoA delay test case:

|  |  |  |
| --- | --- | --- |
|  | ***UE1*** | ***UE2*** |
| ***SL-PRS Es/Noc*** | *5 dB* | *3.2 dB* |
| ***SL-PRS Es/Iot*** | *0.1 dB* | *-2.99 dB* |

* + - In SL AoA delay test case, the SL-PRS signal level configurations can be the same as in SL Rx-Tx test case.
    - In SL RTOA delay test case, it is proposed to add one interfering UE, so the total number of UEs in the test case is 3, including the target UE. The SL-PRS signal configuration for the three UEs can then be the same as for SL Rx-Tx:

|  |  |  |
| --- | --- | --- |
|  | ***Interfering UE*** | ***Target UE*** |
| ***SL-PRS Es/Noc*** | *5 dB* | *3.2 dB* |
| ***SL-PRS Es/Iot*** | *0.1 dB* | *-2.99 dB* |

* Recommended WF
  + Discuss the option(s).

#### Issue 1-2-7: SL-PRS bandwidth configurations

* Proposals
  + Option 1: (Huawei)
    - BW: 48 RB for delay TCs, 24 and 48 RB for accuracy TCs
  + Option 2: (Ericsson)
    - Update the bandwidth of SL-PRS configurations as follows:

|  |  |  |
| --- | --- | --- |
| RB numbers containing SL PRS within channel Bandwidth Note 1 | [24~~48~~] | [48~~96~~] |

* Recommended WF
  + Discuss the option(s). Two options are not mutually exclusive.

#### Issue 1-2-8: Other test case configurations

* Proposals
  + Option 1: (Huawei)
    - Shared and dedicated resource pools are randomly used among different TCs
    - (symbol num, comb size): (4, 4) and (2, 4)
    - MUX of multiple TX UEs: TX UE1: slot n, TX UE2: slot n + 1 and slot n + 100ms
* Recommended WF
  + Discuss the option(s).

#### Issue 1-2-9: Spec structure for SL-PRS test configuration

* Proposals
  + Option 1: (Ericsson)
    - The following specification structure is proposed for SL-PRS configuration section:
      * A.3.21A NR Sidelink Measurements for Positioning
      * A.3.21A.1 Introduction
      * A.3.21A.2 NR SL-PRS configurations
      * A.3.21A.2.1 NR SL-PRS configurations for FR1
* Recommended WF
  + Option 1 agreeable?

## CRs

**CRs for SL positioning core requirements maintenance**

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| **T-doc number** | **Company** | **Title** |
| R4-2412644 | Huawei, HiSilicon | draftCR on RRM requirements for SL positioning |
| R4-2413387 | Ericsson | Draft CR 38133 on remaining core issues for SL positioning |

**CRs for SL positioning performance requirements**

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| --- | --- | --- |
| **T-doc number** | **Company** | **Title** |
| R4-2411334 | CATT | Draft CR on SL PRS-RSRP(P) measurement delay and accuracy test cases in FR1 |
| R4-2411489 | OPPO | [TC 11-1 and 11-2] CR on TC for SL measurement accuracy in FR1 |
| R4-2412652 | Huawei, HiSilicon | draftCR on performance requirements for SL positioning |
| R4-2413389 | Ericsson | Draft CR 38133 on remaining performance issues for SL positioning |

# Topic #2: Carrier Phase Positioning Requirements

## Companies’ contributions summary

**Carrier phase positioning core requirements maintenance:**

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2411335 | CATT | **Proposal 1: When an aperiodic time window is configured, the measurement period requirements of CPP is upper-bounded by the duration of this time window.** |
| R4-2412643 | Huawei, HiSilicon | **Proposal 4: When aperiodic time window is configured and UE support FG 41-2-3,**   * **the measurement period for CPP is** **,** * **the measurement period for RSTD/Rx-Tx is** **,**  * **is the time from the start of the measurement to the start of the time window,** * **is the processing time for PFL i,** * **is the legacy requirements for RSTD and Rx-Tx.**   **Proposal 5: RAN4 to clarify that the application of the periodic time window is limited to the PFL indicated for CPP measurement.**  **Proposal 6: RAN4 not to introduce enhancements related to carrier frequency offset. Instead, RAN4 to account for the impact of carrier frequency offset in the CPP accuracy requirements.** |
| R4-2413386 | Ericsson | * ***Observation 1****: CPP measurements cannot be requested without configuring time window for CPP measurements. PFL for CPP measurement is therefore* ***always*** *indicated to UE by LMF.* * ***Observation 2****: For an indicated PFL, time window for PRS measurement can either be a periodic window or one-shot window.* * ***Observation 3****: Up to 2-time windows, indicating 2 PFLs, can be configured to UE for CPP measurements.* * ***Proposal 2 (CPP)****: Aperiodic time window for CPP measurement is not supported and therefore no corresponding requirement for CPP measurement is defined.* * ***Proposal 3 (CPP)****: When UE supports DL PRS-RSCPD measurement inside measurement time window, as indicated in supportOfMeasurementsInTimeWindow, and LMF configures measurement time window(s) for RSCPD measurement:* * *The existing requirements for DL RSTD measurement without time window apply to the DL RSTD measurement.* * *The requirements for RSCPD measurement apply to DL RSCPD measurement for the PRS resource(s) that have occasions only within the measurement time window.* * ***Proposal 4 (CPP)****: When UE supports DL PRS-RSCPD and DL RSTD measurements inside measurement time window, as indicated in supportOfMeasurementsInTimeWindow, and LMF configures measurement time window(s) for RSCPD and RSTD measurements:* * *The requirements for DL RSCPD apply to DL RSTD measurement and DL RSCPD measurement performed on the PRS resources in indicated PFL.* * *The existing requirements for DL RSTD measurement without time window apply to DL RSTD measurement performed on the PRS resources of PFLs occurring outside of the PRS measurement time window.* * ***Proposal 5 (CPP)****: When UE supports DL PRS-RSCP measurement inside measurement time window, as indicated in supportOfMeasurementsInTimeWindow, and LMF configures measurement time window(s) for RSCP measurement:* * *The existing requirements for UE RX-Tx measurement without time window apply to UE RX-Tx measurement.* * *The requirements for RSCP measurement apply to DL RSCP measurement for the PRS resource(s) that have occasions only within the measurement time window.* * ***Proposal 6 (CPP)****: When UE supports DL PRS-RSCP and UE RX-Tx measurements inside measurement time window, as indicated in supportOfMeasurementsInTimeWindow, and LMF configures measurement time window(s) for RSCP and UE Rx-Tx measurements:* * *The requirements for DL RSCP apply to UE RX-Tx measurement and DL RSCPD measurement performed on the PRS resources in indicated PFL.* * *The existing requirements for UE RX-Tx measurement without time window apply to UE RX-Tx measurement performed on the PRS resources of PFLs occurring outside of the PRS measurement time window.* |
| R4-2413461 | Lenovo | **Observation 1:** For a subcarrier spacing of 15 kHz, the maximum phase change from the first symbol of the slot to the last is 66 degrees for 1 GHz, 133 degees for 2 GHz, and 199 degrees for 3 GHz.  **Observation 2:** With DL-PRS repetition, the variation of the reference symbol carrier phase is scaled by the number of consecutive slots.  **Observation 3:** If the UE and the PRU take measurements in different slots, it is not clear that the LMF can meaningfully combine these measurements to get a carrier phase-based positioning estimate.  **Proposal 1:** The carrier phase definition should be clarified to indicate the carrier phase is defined at a specific location within the slot.  **Proposal 2**: 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 for the carrier phase measurement.  **Proposal 3**: Define the referred carrier phase difference as the difference between the referred carrier phase measurements.  **Proposal 4**: Define the same common reference time for the UE and the PRU.  **Proposal 5**: 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. |
| R4-2313462 | Nokia | 1. RAN4 to base the measurement period definition for multiple configured PFLs on option 1 of issue 2-1-2 in R4-2410193 and define the measurement time per PFL based on the UE capability to support time window for CP / legacy measurements. 2. RAN4 to specify measurement requirements for aperiodic time window, defined in the LPP spec, and to set the measurement period equal to the duration of the time window. 3. RAN4 to further investigate, based on common simulation assumptions, how to reduce the impact of CFO to absolute DL RSCPD / relative DL RSCP measurement accuracy. |

**Carrier phase positioning performance requirements:**

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2411339 | CATT | **Proposal 1: Verify both the accuracies of legacy measurements and CPP measurements in one TC with a 90% success rate to reflect UE’s real positioning performance in the deployment.** |
| R4-2411492 | OPPO | **Proposal 1: Not verify the accuracy requirements for legacy RSTD/Rx-Tx measurement in the RSCPD/RSCP TC.**  **Proposal 2: Define extra margins for frequency drift and RF calibration, and no extra simulation is needed.** |
| R4-2411982 | CMCC | ***Proposal 1: for CPP, it is proposed to verify the accuracies of legacy measurements and CPP measurements in one TC to guarantee the positioning performance in the deployment.*** |
| R4-2412659 | Huawei, HiSilicon | **Proposal 1: The accuracy requirements for CP measurement apply provided that the two PRS resources for calculating RSCPD or relative RSCP are located in the same set of symbols** **after accounting for expected RSTD.**  **Proposal 2: For defining CP measurement accuracy requirements, add additional margin on top of simulation results to account for the impact of carrier frequency offset and RSTD uncertainty.**  **Proposal 3: For accuracy TCs for RSCPD/RSCP, the accuracy of the other measurement configured and reported together with RSCPD/RSCP is not verified.** |
| R4-2412693 | Ericsson | 1. RAN4 to clarify that the RSCPD accuracy requirement and the relative RSCP accuracy requirement apply given that the carrier phase measurements are performed on PRS resources within a slot. 2. RAN4 to not define extra margin for RSCPD and relative RSCP measurements. 3. Accuracy requirements of both measurements, carrier phase and legacy measurement, are verified in the test cases for CPP. |
| R4-2413313 | Nokia | 1. For the AWGN channel, the DL RSCPD accuracy dependency on carrier frequency is not so significant. 2. For the AWGN channel, the DL RSCPD accuracy mainly depends on the cells with lower Es/Iot. 3. Preliminary results show that CFO does have a non-negligible impact on DL RSCPD measurement accuracy. 4. Current frequency stability requirements appear to be not sufficient for a solid CP estimation. 5. RAN4 to further investigate how to reduce the impact of CFO to DL RSCPD measurement accuracy. |

## Open issues summary

### Sub-topic 2-1 Carrier Phase Positioning Core Requirements Maintenance

#### Issue 2-1-1: Measurement period requirements for DL RSCP/DL RSCPD with aperiodic time window

* Proposals
  + Option 1a: (CATT)
    - When an aperiodic time window is configured, the measurement period requirements of CPP is upper-bounded by the duration of this time window.
  + Option 1b: (Nokia)
    - RAN4 to specify measurement requirements for aperiodic time window, defined in the LPP spec, and to set the measurement period equal to the duration of the time window.
  + Option 2: (Huawei)
    - When aperiodic time window is configured and UE support FG 41-2-3,
      * the measurement period for CPP is ,
      * the measurement period for RSTD/Rx-Tx is ,
      * is the time from the start of the measurement to the start of the time window,
      * is the processing time for PFL i,
      * is the legacy requirements for RSTD and Rx-Tx.
  + Option 3: (Ericsson)
    - Aperiodic time window for CPP measurement is not supported and therefore no corresponding requirement for CPP measurement is defined.
* Recommended WF
  + Discuss the option(s).

#### Issue 2-1-2: Measurement period requirements for DL RSCP/DL RSCPD with periodic time window with multiple PFLs configured

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| Proposals from RAN4#111 meeting:   * + Option 1: (Qualcomm)     - When multiple PFLs are configured in the assistance data and DL RSCPD is requested with RSTD, the measurement period is given by       * where j is the index of the indicated PFL, if provided by the LFM, otherwise the PFL j is selected by UE implementation.       * If an aperiodic time window is configured, the start of the measurement period coincides with the start of the time window.     - When multiple PFLs are configured in the assistance data and DL RSCP is requested with UE Rx-Tx, the measurement period is given by       * where j is the index of the indicated PFL, if provided by the LFM, otherwise the PFL j is selected by UE implementation.       * If an aperiodic time window is configured, the start of the measurement period coincides with the start of the time window.   + Option 2: (OPPO)     - When multiple PFLs are configured where RSCPD is supposed to be measured in PFL j, support option 1 with the following updates (taking RSCPD measurement as the example)       * For UE supporting both FG 41-2-3 and FG 42-2-8， is the measurement period for both RSCPD and RSTD in PFL j by taking time window into account.       * For UE supporting FG 41-2-3 only, , where is the measurement period for RSCPD in PFL j by taking time window into account, and is the legacy measurement period for RSTD in PFL j without time window.       * For UE not supporting FG 41-2-2 or FG 41-2-8, . |

* Proposals
  + Option 1: (Huawei, Ericsson)
    - RAN4 to clarify that the application of the periodic time window is limited to the PFL indicated for CPP measurement.
  + Option 1a: Ericsson
    - When UE supports DL PRS-RSCPD measurement inside measurement time window, as indicated in supportOfMeasurementsInTimeWindow, and LMF configures measurement time window(s) for RSCPD measurement:
      * The existing requirements for DL RSTD measurement without time window apply to the DL RSTD measurement.
      * The requirements for RSCPD measurement apply to DL RSCPD measurement for the PRS resource(s) that have occasions only within the measurement time window.
    - When UE supports DL PRS-RSCPD and DL RSTD measurements inside measurement time window, as indicated in supportOfMeasurementsInTimeWindow, and LMF configures measurement time window(s) for RSCPD and RSTD measurements:
      * The requirements for DL RSCPD apply to DL RSTD measurement and DL RSCPD measurement performed on the PRS resources in indicated PFL.
      * The existing requirements for DL RSTD measurement without time window apply to DL RSTD measurement performed on the PRS resources of PFLs occurring outside of the PRS measurement time window.
    - When UE supports DL PRS-RSCP measurement inside measurement time window, as indicated in supportOfMeasurementsInTimeWindow, and LMF configures measurement time window(s) for RSCP measurement:
      * The existing requirements for UE RX-Tx measurement without time window apply to UE RX-Tx measurement.
      * The requirements for RSCP measurement apply to DL RSCP measurement for the PRS resource(s) that have occasions only within the measurement time window.
    - When UE supports DL PRS-RSCP and UE RX-Tx measurements inside measurement time window, as indicated in supportOfMeasurementsInTimeWindow, and LMF configures measurement time window(s) for RSCP and UE Rx-Tx measurements:
      * The requirements for DL RSCP apply to UE RX-Tx measurement and DL RSCPD measurement performed on the PRS resources in indicated PFL.
      * The existing requirements for UE RX-Tx measurement without time window apply to UE RX-Tx measurement performed on the PRS resources of PFLs occurring outside of the PRS measurement time window.
  + Option 2: (Nokia)
    - RAN4 to base the measurement period definition for multiple configured PFLs on option 1 of issue 2-1-2 in R4-2410193 and define the measurement time per PFL based on the UE capability to support time window for CP / legacy measurements.
* Recommended WF
  + Discuss the option(s).

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

* Proposals
  + Option 1: (Huawei)
    - RAN4 not to introduce enhancements related to carrier frequency offset. Instead, RAN4 to account for the impact of carrier frequency offset in the CPP accuracy requirements.
  + Option 2: (Lenovo)
    - The carrier phase definition should be clarified to indicate the carrier phase is defined at a specific location within the slot.
    - 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 for 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 3: (Nokia)
    - RAN4 to further investigate, based on common simulation assumptions, how to reduce the impact of CFO to absolute DL RSCPD / relative DL RSCP measurement accuracy.
* Recommended WF
  + Discuss the option(s).

### Sub-topic 2-2 Carrier Phase Positioning Performance Requirements

#### Issue 2-2-1: Whether to verify the accuracy of legacy measurements in RSCPD/RSCP TCs

* Proposals
  + Option 1: (CATT, CMCC, Ericsson)
    - Verify both the accuracies of legacy measurements and CPP measurements in one TC with a 90% success rate to reflect UE’s real positioning performance in the deployment.
  + Option 2: (OPPO, Huawei)
    - Not verify the accuracy requirements for legacy RSTD/Rx-Tx measurement in the RSCPD/RSCP TC.
* Recommended WF
  + Discuss the option(s).

#### Issue 2-2-2: Additional margins due to frequency drift and RF calibration

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| Proposals from RAN4#111 meeting:   * + Option 1: Define extra margin in requirements     - FFS: need for extra simulations.   + Option 2: Do not define extra margin in requirements     - Do not update simulation assumptions for carrier phase measurement.   Further discuss in the next meeting, proponents are requested to bring results justifying the additional margin for Option 1. |

* Proposals
  + Option 1: (OPPO)
    - Define extra margins for frequency drift and RF calibration, and no extra simulation is needed.
  + Option 2: (Huawei)
    - The accuracy requirements for CP measurement apply provided that the two PRS resources for calculating RSCPD or relative RSCP are located in the same set of symbols after accounting for expected RSTD.
    - For defining CP measurement accuracy requirements, add additional margin on top of simulation results to account for the impact of carrier frequency offset and RSTD uncertainty.
  + Option 3: (Ericsson)
    - RAN4 to clarify that the RSCPD accuracy requirement and the relative RSCP accuracy requirement apply given that the carrier phase measurements are performed on PRS resources within a slot.
    - RAN4 to not define extra margin for RSCPD and relative RSCP measurements.
  + Option 4: (Nokia)
    - RAN4 to further investigate how to reduce the impact of CFO to DL RSCPD measurement accuracy.
* Recommended WF
  + Discuss the option(s).

## CRs

**CRs for carrier phase positioning core requirements maintenance**

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| **T-doc number** | **Company** | **Title** |
| R4-2411333 | CATT | Draft CR on core requirements for CPP |
| R4-2412645 | Huawei, HiSilicon | draftCR on RRM requirements for CPP |
| R4-2412679 | Ericsson | draftCR 38.133 Core requirement for CPP |

**CRs for carrier phase positioning performance requirements**

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| **T-doc number** | **Company** | **Title** |
| R4-2411624 | Xiaomi | (8-1,8-2,8-3,8-4, 8-7,8-8) Draft CR RSCPD test case |
| R4-2412694 | Ericsson | draftCR 38.133 Phase II test cases for CPP |
| R4-2413312 | Nokia | Sets (7-7) and (7-8) Measurement delay TCs for RSCP with UE Rx-Tx in RRC\_INACTIVE for FR1 and FR2 |