**3GPP TSG-RAN WG4 Meeting # 111 R4-24XXXXX**

**Fukuoka, Japan, May 20 ‒ May 24, 2024**

**Agenda item:** 7.12.3

**Source:** Moderator (CATT)

**Title:** Topic summary for [111][213] NR\_pos\_enh2\_part2

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# Introduction

This topic summary for [111][213] NR\_pos\_enh2\_part2 contains the discussions in agenda 7.12.1.2, 7.12.2.2, 7.12.2.6, which include the following topics:

* Topic #1: Sidelink Positioning Requirements
	+ Topic #1-1: SL Positioning Core Requirements Maintenance (agenda 7.12.1.2)
	+ Topic #1-2: SL Positioning Performance Requirements (agenda 7.12.2.2)
* Topic #2: Carrier Phase Positioning Requirements
	+ Topic #2-1: Carrier Phase Positioning Core Requirements Maintenance (agenda 7.12.1.2)
	+ Topic #2-2: Carrier Phase Positioning Performance Requirements (agenda 7.12.2.6)

*Recommendation of prioritized topics:*

* *For SL positioning:*
	+ *Sub topic 1-2: Issue 1-2-1/2/3/4/5*
	+ *Sub topic 1-1: Issue 1-1-1/2/4*
* *For CPP positioning:*
	+ *Sub topic 2-2: Issue 2-2-1/2/3*
	+ *Sub topic 2-1: Issue 2-1-1/2/3/4*

# Topic #1: Sidelink Positioning Requirements

## Companies’ contributions summary

**SL positioning core requirements maintenance:**

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2407490 | CATT | **SL positioning:** **Proposal 1: When UE is indicated of the synchronization source change at anchor UE via *SL-RTD-Info* during the positioning measurements, the UE shall restart the measurements after the synchronization source change.**  |
| R4-2407877 | OPPO | **Proposal 1: The condition regarding time separation between the target and reference SL PRS resource should be considered in accuracy requirements.****Proposal 2: When the synchronization reference source change occurs during the measurement period at Tx side, e.g., UE receives an updated sl-RTD-Info, the measuring UE shall restart the SL PRS-based timing measurements of the related Tx UE.**  |
| R4-2407968 | Qualcomm Incorporated | **Proposal 1: RAN4 not to define any special UE behavior for a UE performing SL Rx-Tx measurements in the event of a synchronization reference source change at a Tx UE during the SL Rx-Tx measurement period.****Proposal 2: SL Rx-Tx measurement accuracy requirements do not apply in the event of a synchronization reference source change at a Tx UE during the SL Rx-Tx measurement period.****Proposal 3: If a UE receives *sl-RTD-Info* while performing SL RSTD or SL RTOA measurements, the UE is allowed to restart the measurements and the measurement period can be longer.**  |
| R4-2408299 | vivo | ***Proposal 1: The FG 41-1-1a should not be included as applicability conditions for measurement period requirements for SL positioning measurements.******Proposal 2: Performance requirements for SL RSTD apply provided the time separation between the SL PRS resources from the target and reference is no larger than 160 ms.******Proposal 3: For SL RSTD and SL RTOA measurements, UE shall restart the measurement after the synchronization reference source change at Tx side.******Proposal 4: For SL-PRS Rx-Tx measurements:**** ***If the UE reports the transmission timestamp of a SL PRS, it shall continue the measurement after the synchronization reference source change at Tx/Rx side.***
* ***Else, UE shall restart the SL Rx-Tx time difference measurement***
 |
| R4-2409262 | 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: Include FG 41-1-1a for the applicability condition of SL PRS measurement requirements when UE supports SL PRS measurement on multiple CCs or RPs.****Proposal 3: Measurement requirements for SL RSTD apply provided the time separation between the [last] SL-PRS from the reference UE and [last] SL-PRS from the target UE is no larger than [160 ms].****Proposal 4: For synchronization reference source change occurs at Tx side, measurement accuracy requirements do not apply and no specific UE behaviour is defined.****Proposal 5: RAN4 not to define any impact of Uu link connection on the measurement period.****Proposal 6: Use Nsample = 1 for SL-PRS BW = 48 PRB.**  |
| R4-2409580 | Ericsson | **Proposal 3**: For SL RTOA, UE behaviour upon the synchronization source change at the transmitting UE is the same as when upon the synchronization change at the measuring UE.**Proposal 4**: For SL RTOA, the same UE behaviour shall apply as for SL RSTD (as defined in TS 38.133) in case of the synchronization source change at the transmitting UE, e.g., indicated by SL-RTD-Info [TS 38.355].**Observation 1 (Uu link distortion [RLF, RRC reestablishment, handover])**: Handover, RRC re-establishment, RLF can cause long SL-PRS resource interruptions or even unavailability. **Proposal 4 (Uu link distortion [RLF, RRC reestablishment, handover])**: It is clarified in TS 38.133 for the SL-PRS based measurements in the introduction section 12A.1: * *NOTE 3: When a UE in RRC\_CONNECTED state is performing transmissions and/or reception for SL positioning operation, the UE shall meet all the requirements specified in Clause 6, assuming that UE has a dedicated RX/TX chain for the sidelink operation. Otherwise, the UE may interrupt the SL positioning measurements or SL-PRS transmissions in order to meet the measurement requirements specified in Clause 6.*
 |

**SL positioning performance requirements:**

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2407492 | CATT | **Proposal 1: For SL RSTD, the SINR side condition is (-3, -6).** **Proposal 2: For SL UE Rx-Tx and SL RSRP(P), the SINR side condition is -6 dB.** **Proposal 3: The following rules are considered for the SL PRS-RSRP(P) accuracy tests:**  **- 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.**  |
| R4-2407879 | OPPO | **Proposal 1: The side condition is [0, -6]dB for SL RSTD and [-6]dB for the other SL PRS measurements.****Proposal 2: The existing margins due to frequency drift and RF calibration for DL PRS can be reused for SL PRS.****Proposal 3: Consider time margins due to frequency drift to Rx-Tx time difference accuracy requirement if the UE reports the transmission timestamp of a SL PRS, and the time margins for RSTD could be reused.** **Proposal 4: 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 5: Define test case to verify accuracy requirements for SL PRS-RSRPP in a separate section.**  |
| R4-2407969 | Qualcomm Incorporated | **Proposal 1: Define SL position measurement accuracy using the following structure, aligned with the simulation assumptions.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Accuracy (Tc)** | **SL PRS Ês/Iot (dB)** | **SL PRS SCS (kHz)** | **SL PRS bandwidth (num RB)** | **Nsample** |
|
| [TBD] | (Ês/Iot)ref ≥TBD (Ês/Iot)i ≥TBD | 15 | ≥ 48 | [1] |
| ≥ 96 | 1 |
| [TBD] | 30 | ≥ 24 | 4 |
| ≥ 48 | [1] |
| ≥ 96 | 1 |
| [TBD] | 60 | ≥ 24 | 4 |

**Proposal 2: At least for AWGN, define one set of measurement accuracy requirements applicable to fully staggered and partially staggered (half comb) SL PRS.****Proposal 3: For measurement accuracy requirements with multiple samples (Nsample = 4), do not assume coherent combining between samples.****Proposal 4: RAN4 to define accuracy requirement for SL RSTD and SL Rx-Tx by considering the framework of ±(X+Y+Z) Tc and ±(X+δ) Tc, respectively.** * **X is the simulated measurement accuracy for a given propagation condition and number of measurement samples,**
* **Y is the frequency/clock drift margin,**
* **Z and δ are the RF calibration margins.**

**Proposal 5: Measurement requirements for SL RSTD apply provided the time separation between the target and reference SL PRS resources is no larger than [160 ms].****Proposal 6: Define the RF calibration margin for SL RSTD measurements in FR1 using the following structure:**

|  |  |
| --- | --- |
| PRS BW (RB number) | Margin (Tc) |
| SCS=15kHz | SCS=30kHz | SCS=60kHz |
| ≥ 48 | ≥ 24 | N/A | Z1 |
| ≥ 96 | ≥ 48 | ≥ 24 | Z2 |
| N/A | ≥ 96 | N/A | Z3 |

**Proposal 7: Define the RF calibration margin for SL Rx-Tx measurements in FR1 using the following structure:**

|  |  |
| --- | --- |
| Min(SL PRS Rx BW, SL SRS Tx BW) (RB) | Margin (Tc) |
| SCS = 15 kHz | SCS = 30 kHz | SCS = 60 kHz |
| ≥ 48 | ≥ 24 | N/A | δ1 |
| ≥ 96 | ≥ 48 | ≥ 24 | δ2 |
| N/A | ≥ 96 | N/A | δ3 |

**Proposal 8: Define the side conditions for SL RSTD as 0 dB for reference cell and -3 dB for target cell.****Proposal 9: Define two side conditions for SL Rx-Tx, SL PRS-RSRP and SL PRS-RSRPP: 0 dB and -3 dB.** **Proposal 10: Define SL positioning test cases for a single carrier and single resource pool.****Proposal 11: Do not define SL positioning test cases with additional path reporting.****Proposal 12: Do not define SL positioning test cases with LoS/NLoS reporting.****Proposal 13: Do not define SL positioning test cases with Tx/Rx ARP-ID reporting.****Proposal 14: Define SL PRS configurations for SL positioning test cases that apply to both shared and dedicated resource pools*** **No TDM of SL PRS from different UEs in the same slot**
* **No comb-based multiplexing of SL PRS from different UEs in the same slot**
* **No FDM of SL PRS from different UEs in the same slot**
 |
| R4-2408300 | vivo | ***Proposal 1: The SINR side condition is defined as [-3, -6] dB for SL-RSTD and [-6] dB for SL Rx-Tx/SL RSRP/SL RSRPP.******Proposal 2: RAN4 to define accuracy requirement for SL RSTD and SL Rx-Tx by considering the framework of ±(X+Y+Z) Tc and ±(X+δ) Tc, respectively.**** + ***X is the simulated measurement accuracy for a given propagation condition and number of measurement samples,***
	+ ***Y is the frequency/clock drift margin,***
	+ ***Z and δ are the RF calibration margins.***

***Proposal 3: Define measurement accuracy requirements based on the following RB number configuration**** ***15kHz SCS: 48, 96***
* ***30kHz SCS: 24, 48,***
* ***60kHz SCS: 24***

***Proposal 4:******Define the RF calibration margin for SL RSTD measurements in FR1 using the following structure:***

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

***Define the RF calibration margin for SL Rx-Tx measurements in FR1 using the following structure:***

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

***Proposal 5: 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.******Proposal 6:******Consider the following configurations for test:***

|  |  |
| --- | --- |
| **SCS and BW** | **Config 1: 15 kHz SCS 48 RBs 10MHz** |
| **Config 2: 15 kHz SCS 96 RBs 20MHz** |
| **Config 3: 30 kHz SCS 48 RBs 20MHz** |
| **Coverage** | **In coverage** |
| **Synchronization source** | **gNB** |
| **SINR for test** | **For UE 1, 3dB, for other UEs, -6dB** |

 |
| R4-2409271 | Huawei, HiSilicon | **Proposal 1: Accuracy requirements for SL PRS measurements are defined based on Es/Iot of** * **SL RSTD: (0, -3)dB for reference and target UE**
* **SL Rx-Tx/SL PRS RSRP/RSRPP: -3dB for the target UE**

**Proposal 2: Accuracy requirements for SL PRS measurements are defined based on BW of** * **15kHz SCS: 48 RB≤BW< 96 RBs, 96 RB≤BW**
* **30kHz SCS: 24 RB≤BW< 48 RBs, 48 RB≤BW<96 RBs**
* **60kHz SCS: 24 RB≤BW**

**Proposal 3: Define group delay calibration margin** **Z and δ as in Table 1.****Table 1: Group delay calibration margin Z and δ for SL RSTD and SL Rx-Tx**

|  |  |
| --- | --- |
| Min(PRS BW, SRS BW) (RB) | Margin (Tc) |
| SCS = 15 kHz | SCS = 30 kHz | SCS = 60 kHz |
| ≥ [48] | ≥ [24] | N/A | TBD |
| ≥ [96] | ≥ [48] | ≥ [24] | TBD |

**Proposal 4: For accuracy TCs for SL PRS-RSRP(P), adopt option 1a:****separate section for testing SL PRS-RSRP/PRS-RSRPP, without verifying the accuracy of the other (SL RSTD/Rx-Tx) measurement, respectively** **Proposal 5: For the test configuration,** * **Shared and dedicated resource pools are randomly used among different TCs**
* **All TX and RX UEs are in coverage and using gNB as sync reference**
* **Es/Iot: 3dB (to ensure 100% PSCCH decoding)**

**Proposal 6: 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**
 |
| R4-2409371 | Ericsson | * ***Proposal 1 (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 2 (side conditions):*** *For SL Rx-Tx, the requirements are defined down to -6 dB.*
* ***Proposal 3 (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 4 (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 5 (measurement accuracy requirements)****: Two sets of accuracy requirements are to be defined for SL positioning measurements, i.e., for:*
	+ *1 sample (>48 PRBs), and*
	+ *4 samples (≤48 PRBs).*
* ***Proposal 6 (measurement accuracy requirements)****: The measurement accuracy requirements can be specified in the following format:*

*Note: The table is captured in Issue 1-2-4.* * ***Proposal 7 (test cases)****:SL positioning test cases are defined for 3 general NR Uu configurations:*

|  |  |
| --- | --- |
| NR Uu configuration | Description |
| 1 | NR Uu: 15 kHz SSB SCS, 20 MHz bandwidth, FDD duplex mode |
| 2 | NR Uu: 15 kHz SSB SCS, 20 MHz bandwidth, TDD duplex mode |
| 3 | NR Uu: 30 kHz SSB SCS, 40 MHz bandwidth, TDD duplex mode |

* ***Proposal 8 (test cases)****:SL positioning test cases are defined for 3 general NR SL configurations:*

|  |  |
| --- | --- |
| NR SL configuration | Description |
| 1 | SL: 15 kHz, 10 MHz bandwidth, TDD duplex mode |
| 2 | SL: 30 kHz, 10 MHz bandwidth, TDD duplex mode |
| 3 | SL: 30 kHz, 20 MHz bandwidth, TDD duplex mode |

* ***Proposal 9 (test cases)****: The number of SL UEs in the measurement delay test cases for SL positioning is 4:*
	+ *1 target UE,*
	+ *3 anchor UEs (1 reference anchor UE and 2 other anchor UEs).*
* ***Proposal 10 (test cases)****: The number of SL UEs in the measurement accuracy test cases for SL positioning is 3:*
	+ *1 target UE,*
	+ *2 anchor UEs (1 reference anchor UE and 1 other anchor UE).*
* ***Proposal 11 (test cases)****: For each SL positioning measurement type, measurement delay test cases are defined for both numbers of samples (can be in the same section):*
	+ *1 sample, and*
	+ *4 samples.*
* ***Proposal 12 (test cases)****: For each SL positioning measurement type (for which accuracy requirements are defined), measurement accuracy test cases are defined for both numbers of samples (can be in the same section):*
	+ *1 sample, and*
	+ *4 samples.*
* ***Proposal 13 (test cases)****: RAN4 to discuss whether to define test cases for additional path measurements.*
 |

## Open issues summary

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

#### Issue 1-1-1: Applicability of SL PRS measurement period requirements

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| *Proposals in RAN4#110bis:* **Issue 1-1-2: Applicability of SL PRS measurement period requirements**Proposals* Option 1: (Qualcomm)
	+ Limits on the number of active SL PRS resources per slot and number of active slots across all configured resource pools and across all bands defined by RAN1 in FG 41-1-1a should be included as applicability conditions for measurement period requirements for SL positioning measurements.
	+ Measurement requirements for SL RSTD apply provided the time separation between the target and reference SL PRS resources is no larger than [160 ms].
 |

* Proposals

For FG 41-1-1a,

* + Option 1: (vivo)
		- The FG 41-1-1a should not be included as applicability conditions for measurement period requirements for SL positioning measurements.
	+ Option 2: (Huawei)
		- Include FG 41-1-1a for the applicability condition of SL PRS measurement requirements when UE supports SL PRS measurement on multiple CCs or RPs.

For time separation between PRS resources from reference UE and target UE,

* + Option 1: (OPPO)
		- The condition regarding time separation between the target and reference SL PRS resource should be considered in accuracy requirements.
	+ Option 2a: (vivo, Qualcomm)
		- Performance requirements for SL RSTD apply provided the time separation between the SL PRS resources from the target and reference is no larger than 160 ms.
	+ Option 2b: (Huawei)
		- Measurement requirements for SL RSTD apply provided the time separation between the [last] SL-PRS from the reference UE and [last] SL-PRS from the target UE is no larger than [160 ms].
* Recommended WF
	+ Discuss the options.

#### Issue 1-1-2: UE behaviour and the impact on SL-PRS measurement requirements when synchronization reference source change occurs at Tx side

* Proposals
	+ Option 1: (CATT, OPPO)
		- When UE is indicated of the synchronization source change at anchor UE via SL-RTD-Info during the positioning measurements, the UE shall restart the measurements after the synchronization source change.
	+ Option 2: (Qualcomm)
		- RAN4 not to define any special UE behavior for a UE performing SL Rx-Tx measurements in the event of a synchronization reference source change at a Tx UE during the SL Rx-Tx measurement period.
		- SL Rx-Tx measurement accuracy requirements do not apply in the event of a synchronization reference source change at a Tx UE during the SL Rx-Tx measurement period.
		- If a UE receives sl-RTD-Info while performing SL RSTD or SL RTOA measurements, the UE is allowed to restart the measurements and the measurement period can be longer.
	+ Option 3: (vivo)
		- For SL RSTD and SL RTOA measurements, UE shall restart the measurement after the synchronization reference source change at Tx side.
		- For SL-PRS Rx-Tx measurements:
			* If the UE reports the transmission timestamp of a SL PRS, it shall continue the measurement after the synchronization reference source change at Tx/Rx side.
			* Else, UE shall restart the SL Rx-Tx time difference measurement.
	+ Option 4: (Huawei)
		- For synchronization reference source change occurs at Tx side, measurement accuracy requirements do not apply and no specific UE behaviour is defined.
	+ Option 5: (Ericsson)
		- For SL RTOA, UE behaviour upon the synchronization source change at the transmitting UE is the same as when upon the synchronization change at the measuring UE.
		- For SL RTOA, the same UE behaviour shall apply as for SL RSTD (as defined in TS 38.133) in case of the synchronization source change at the transmitting UE, e.g., indicated by SL-RTD-Info [TS 38.355].
* Recommended WF
	+ For SL RSTD and SL RTOA, if a UE receives *sl-RTD-Info* while performing SL RSTD or SL RTOA measurements, the UE is allowed to restart the measurements and the measurement period can be longer.
	+ For SL Rx-Tx, discuss the following options:
		- Option 1: UE is allowed to restart the measurements if UE receives *sl-RTD-Info* while performing SL Rx-Tx measurements.
		- Option 2: RAN4 not to define any special UE behaviour and the accuracy requirements do not apply.
		- Option 3: If the UE reports the transmission timestamp of a SL PRS, it shall continue the measurement after the synchronization reference source change at Tx/Rx side. Else, UE shall restart the SL Rx-Tx time difference measurement.

#### Issue 1-1-3: 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
	+ 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.

#### Issue 1-1-4: Impact of Uu link connect

* Proposals
	+ Option 1: (Huawei)
		- RAN4 not to define any impact of Uu link connection on the measurement period.
	+ Option 2: (Ericsson)
		- It is clarified in TS 38.133 for the SL-PRS based measurements in the introduction section 12A.1:
			* NOTE 3: When a UE in RRC\_CONNECTED state is performing transmissions and/or reception for SL positioning operation, the UE shall meet all the requirements specified in Clause 6, assuming that UE has a dedicated RX/TX chain for the sidelink operation. Otherwise, the UE may interrupt the SL positioning measurements or SL-PRS transmissions in order to meet the measurement requirements specified in Clause 6.
* Recommended WF
	+ Discuss the option(s).

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

#### Issue 1-2-1: SINR side conditions

* Proposals

For SL RSTD,

* + Option 1: (CATT, vivo)
		- (-3, -6) dB for reference UE and target UE respectively.
	+ Option 2: (OPPO, Ericsson)
		- (0, -6) dB for reference UE and target UE respectively.
	+ Option 3: (Qualcomm, Huawei)
		- (0, -3) dB for reference UE and target UE respectively.

For SL UE Rx-Tx, SL RSRP(P),

* + Option 1: (CATT, OPPO, vivo, Ericsson)
		- -6 dB
	+ Option 2: (Qualcomm)
		- Define two side conditions: 0 dB and -3 dB
	+ Option 3: (Huawei)
		- -3 dB for the target UE
* Recommended WF
	+ Discuss the option(s).

#### Issue 1-2-2: Margin for RF calibration

* Proposals
	+ Option 1: (OPPO)
		- The existing margins due to frequency drift and RF calibration for DL PRS can be reused for SL PRS.
		- Consider time margins due to frequency drift to Rx-Tx time difference accuracy requirement if the UE reports the transmission timestamp of a SL PRS, and the time margins for RSTD could be reused.
	+ Option 2a: (Qualcomm)
		- Define the RF calibration margin for SL RSTD measurements in FR1 using the following structure:

|  |  |
| --- | --- |
| PRS BW (RB number) | Margin (Tc) |
| SCS=15kHz | SCS=30kHz | SCS=60kHz |
| ≥ 48 | ≥ 24 | N/A | Z1 |
| ≥ 96 | ≥ 48 | ≥ 24 | Z2 |
| N/A | ≥ 96 | N/A | Z3 |

* + - Define the RF calibration margin for SL Rx-Tx measurements in FR1 using the following structure:

|  |  |
| --- | --- |
| Min(SL PRS Rx BW, SL SRS Tx BW) (RB) | Margin (Tc) |
| SCS = 15 kHz | SCS = 30 kHz | SCS = 60 kHz |
| ≥ 48 | ≥ 24 | N/A | δ1 |
| ≥ 96 | ≥ 48 | ≥ 24 | δ2 |
| N/A | ≥ 96 | N/A | δ3 |

* + Option 2b: (vivo, Huawei)
		- Define the RF calibration margin for SL RSTD measurements in FR1 using the following structure:

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

* + - Define the RF calibration margin for SL Rx-Tx measurements in FR1 using the following structure:

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

* Recommended WF
	+ Discuss the option(s) with Option 2b as the starting point.

#### Issue 1-2-3: Value of Nsample for 48 PRB SL-PRS BW

|  |
| --- |
| *Agreements in RAN4#110:** Update the definition of Nsample as the following:
	+ = 1 for SL-PRS BW > 48 PRBs,
	+ = 4 for SL-PRS BW ≤ 48 PRBs
	+ FFS whether for 48 PRBs SL-PRS BW a lower number of samples can be used based on performance results.
 |

* Proposals
	+ Option 1: (Huawei)
		- Use Nsample = 1 for SL-PRS BW = 48 PRB.
* Recommended WF
	+ Discuss the option(s).

#### Issue 1-2-4: Measurement accuracy requirements

|  |
| --- |
| *Agreements in RAN4#110bis:***Issue 3-1-3: Assumptions to define SL PRS measurement accuracy requirements***Agreements:** Define measurement accuracy requirements for SL-PRS based RSTD, SL-PRS based UE Rx-Tx time difference, SL-PRS based RSRP and SL-PRS based RSRPP:
	+ independent of SL-PRS comb size,
	+ for same channel profiles as defined for Uu
	+ for measurement samples 1 or 4 depending on the RB number of PRS BW

**Issue 3-1-4: Measurement accuracy requirements***Agreements:** RAN4 to define accuracy requirement for SL RSTD and SL Rx-Tx by considering the framework of ±(X+Y[+Z]) Tc and ±(X[+δ]) Tc, respectively.
	+ X is the simulated measurement accuracy for a given propagation condition and number of measurement samples,
	+ Y is the frequency/clock drift margin,
	+ FFS: Z and δ are the RF calibration margins.
 |

* Proposals
	+ Option 1: (Qualcomm)
		- Define SL position measurement accuracy using the following structure, aligned with the simulation assumptions.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Accuracy (Tc)** | **SL PRS Ês/Iot (dB)** | **SL PRS SCS (kHz)** | **SL PRS bandwidth (num RB)** | **Nsample** |
|
| [TBD] | (Ês/Iot)ref ≥TBD (Ês/Iot)i ≥TBD | 15 | ≥ 48 | [1] |
| ≥ 96 | 1 |
| [TBD] | 30 | ≥ 24 | 4 |
| ≥ 48 | [1] |
| ≥ 96 | 1 |
| [TBD] | 60 | ≥ 24 | 4 |

* + - At least for AWGN, define one set of measurement accuracy requirements applicable to fully staggered and partially staggered (half comb) SL PRS.
		- For measurement accuracy requirements with multiple samples (Nsample = 4), do not assume coherent combining between samples.
	+ Option 2: (Qualcomm, vivo)
		- RAN4 to define accuracy requirement for SL RSTD and SL Rx-Tx by considering the framework of ±(X+Y+Z) Tc and ±(X+**δ**) Tc, respectively.
	+ Option 3a: (vivo)
		- Define measurement accuracy requirements based on the following RB number configuration
			* 15kHz SCS: 48, 96
			* 30kHz SCS: 24, 48,
			* 60kHz SCS: 24
	+ Option 3b: (Huawei)
		- Accuracy requirements for SL PRS measurements are defined based on BW of
			* 15kHz SCS: 48 RB≤BW< 96 RBs, 96 RB≤BW
			* 30kHz SCS: 24 RB≤BW< 48 RBs, 48 RB≤BW<96 RBs
			* 60kHz SCS: 24 RB≤BW
	+ Option 4: (Ericsson)
		- Two sets of accuracy requirements are to be defined for SL positioning measurements, i.e., for:
			* 1 sample (>48 PRBs), and
			* 4 samples (≤48 PRBs)
		- The measurement accuracy requirements can be specified in the following format:

|  |  |
| --- | --- |
| Accuracy | Conditions |
| SL-PRS Ês/Iot | SL-PRS SCS | SL-PRS bandwidthNote 1 | Number of samples, S | Io Note 2 range |
| NR operating band groups Note 3 | Minimum Io  | Maximum Io |
| Tc Note 4 | dB | kHz | RB |  |  | dBm/SCS | dBm/BWChannel |
| TBD | (SL-PRS Ês/Iot)ref ≥0 dB(SL-PRS Ês/Iot)*i* ≥-6 dB | 15 | ≥ 24 | ≥ 4 | NR\_TDD\_FR1\_B | -126.5 | -50 |
| NR\_TDD\_FR1\_J | -122.5 | -50 |
| TBD | >48 | ≥ 1 | Note 5 | Note 5 | Note 5 |
| TBDTBD | 30  | ≥ 24 | ≥ 4 | NR\_TDD\_FR1\_B | -123.5 | -50 |
| NR\_TDD\_FR1\_J | -119.5 | -50 |
| TBD | >48 | ≥ 1 | Note 5 | Note 5 | Note 5 |
| TBD | 60 | ≥ 24 | ≥ 4 | NR\_TDD\_FR1\_B | -120.5 | -50 |
| NR\_TDD\_FR1\_J | -116.5 | -50 |
| TBD | >48 | ≥ 1 | Note 5 | Note 5 | Note 5 |
| NOTE 1: Minimum SL-PRS bandwidth, which is the minimum of the SL-PRS bandwidths of the reference resource and the measured neighbour resource i.NOTE 2: Io is assumed to have constant EPRE across the bandwidth.NOTE 3: NR operating band groups in FR1 are as defined in clause 3.5.2.NOTE 4: Tc is the basic timing unit defined in TS 38.211 [6].NOTE 5: The same bands and the same Io conditions for each band apply for this requirement as for the corresponding requirement with the SL-PRS bandwidth of the smallest PRB number for the corresponding SCS. |

* Recommended WF
	+ Discuss the options using Option1 as the starting point:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Accuracy (Tc)** | **SL PRS Ês/Iot (dB)** | **SL PRS SCS (kHz)** | **SL PRS bandwidth (num RB)** | **Nsample** |
|
| [TBD] | (Ês/Iot)ref ≥TBD (Ês/Iot)i ≥TBD | 15 | ≥ 48 | [1] |
| ≥ 96 | 1 |
| [TBD] | 30 | ≥ 24 | 4 |
| ≥ 48 | [1] |
| ≥ 96 | 1 |
| [TBD] | 60 | ≥ 24 | 4 |

#### Issue 1-2-5: Test case configurations

|  |
| --- |
| Issue 3-1-7: Test configurations*Agreements in RAN4#110bis:** Define SL positioning test cases using only AWGN and 2-tap channel (for SL PRS RSRPP) propagation conditions.
* RAN4 to define the test cases for dedicated resource pool and shared resource pool as test configurations, and the SL PRS configurations could apply to both types of resource pool.
 |

* Proposals
	+ Option 1: (Qualcomm)
		- Define SL positioning test cases for a single carrier and single resource pool.
		- Do not define SL positioning test cases with additional path reporting.
		- Do not define SL positioning test cases with LoS/NLoS reporting.
		- Do not define SL positioning test cases with Tx/Rx ARP-ID reporting.
		- Define SL PRS configurations for SL positioning test cases that apply to both shared and dedicated resource pools
			* No TDM of SL PRS from different UEs in the same slot
			* No comb-based multiplexing of SL PRS from different UEs in the same slot
			* No FDM of SL PRS from different UEs in the same slot
	+ Option 2: (vivo)
		- Consider the following configurations for test:

|  |  |
| --- | --- |
| **SCS and BW** | **Config 1: 15 kHz SCS 48 RBs 10MHz** |
| **Config 2: 15 kHz SCS 96 RBs 20MHz** |
| **Config 3: 30 kHz SCS 48 RBs 20MHz** |
| **Coverage** | **In coverage** |
| **Synchronization source** | **gNB** |
| **SINR for test** | **For UE 1, 3dB, for other UEs, -6dB** |

* + Option 3: (Huawei)
		- Shared and dedicated resource pools are randomly used among different TCs
		- All TX and RX UEs are in coverage and using gNB as sync reference
		- Es/Iot: 3dB (to ensure 100% PSCCH decoding)
		- 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
	+ Option 4: (Ericsson)
		- SL positioning test cases are defined for 3 general NR Uu configurations:

|  |  |
| --- | --- |
| NR Uu configuration | Description |
| 1 | NR Uu: 15 kHz SSB SCS, 20 MHz bandwidth, FDD duplex mode |
| 2 | NR Uu: 15 kHz SSB SCS, 20 MHz bandwidth, TDD duplex mode |
| 3 | NR Uu: 30 kHz SSB SCS, 40 MHz bandwidth, TDD duplex mode |

* + - SL positioning test cases are defined for 3 general NR SL configurations:

|  |  |
| --- | --- |
| NR SL configuration | Description |
| 1 | SL: 15 kHz, 10 MHz bandwidth, TDD duplex mode |
| 2 | SL: 30 kHz, 10 MHz bandwidth, TDD duplex mode |
| 3 | SL: 30 kHz, 20 MHz bandwidth, TDD duplex mode |

* + - The number of SL UEs in the measurement delay test cases for SL positioning is 4:
			* 1 target UE,
			* 3 anchor UEs (1 reference anchor UE and 2 other anchor UEs).
		- The number of SL UEs in the measurement accuracy test cases for SL positioning is 3:
			* 1 target UE,
			* 2 anchor UEs (1 reference anchor UE and 1 other anchor UE).
		- For each SL positioning measurement type, measurement delay test cases are defined for both numbers of samples (can be in the same section):
			* 1 sample, and
			* 4 samples.
		- For each SL positioning measurement type (for which accuracy requirements are defined), measurement accuracy test cases are defined for both numbers of samples (can be in the same section):
			* 1 sample, and
			* 4 samples.
* Recommended WF
	+ Discuss the options considering the following aspects:
		- SL PRS configurations.
		- Parameters for test configurations, e.g., SCS and BW.
		- Whether all TX and RX UEs are in coverage and using gNB as sync reference.
		- Es/Iot.
		- The number of SL UEs in test cases.

#### Issue 1-2-6: Whether to verify accuracy of legacy measurements in SL PRS-RSRP(P) TCs

|  |
| --- |
| **Issue 1-1-8: Necessity of independent Requirements for SL PRS-RSRP(P)***Agreements in RAN4#110bis:** Further check the need for removing dedicated clauses for requirements for SL PRS-RSRP(P).
	+ Send LS to RAN2 to ask whether SL PRS-RSRP and SL PRS-RSRPP can be reported without other measurements.

Issue 3-1-6: Test case list*Agreements:** 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.
* Accuracy requirements for SL PRS-RSRP/RSRPP are verified when configured together with RSTD/RX-TX, respectively.
	+ Option 1a: separate section for testing SL PRS-RSRP/PRS-RSRPP, without verifying the accuracy of the other (SL RSTD/Rx-Tx) measurement, respectively
	+ Option 1b: separate section for testing SL PRS-RSRP/PRS-RSRPP, with verifying also the accuracy of the other (SL RSTD/Rx-Tx) measurement, respectively
	+ Option 2: same section for SL PRS-RSRP/RSRPP and SL RSTD/Rx-Tx, but different test cases - with and without SL PRS-RSRP/RSRPP.
 |

* Proposals
	+ Option 1: (CATT)
		- 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: (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 in a separate section.
	+ Option 3: (vivo, Huawei)
		- 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.
* Recommended WF
	+ Discuss the option(s).

#### Issue 1-2-7: Test case for additional path measurements

* Proposals
	+ Option 1: (Ericsson)
		- RAN4 to discuss whether to define test cases for additional path measurements.
* Recommended WF
	+ Discuss the option(s).

## CRs

**CRs for SL positioning core requirements maintenance**

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Title** |
| R4-2409263 | Huawei, HiSilicon | draftCR on RRM requirements for SL positioning |
| R4-2409370 | Ericsson | Draft CR to 38.133 on SL positioning RRM core requirements |

**CRs for SL positioning performance requirements**

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Title** |
| R4-2407519 | CATT | (Set 1-4 & 10-2) Draft CR for SL PRS configuration and SL Rx-Tx measurement delay TC in FR1 |
| R4-2407880 | OPPO | [2-14] Draft CR on Measurements Accuracy for SL PRS-RSRPP |
| R4-2408297 | vivo | Draft CR on measurement delay test cases for SL positioning - Sets 10-3 10-4 |
| R4-2409272 | Huawei, HiSilicon | draftCR on performance requirements for SL positioning |
| R4-2409372 | Ericsson | Draft CR to 38.133 on SL positioning RRM performance |

# Topic #2: Carrier Phase Positioning Requirements

## Companies’ contributions summary

**Carrier phase positioning core requirements maintenance:**

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2407490 | CATT | **CPP:** **Proposal 2: When multiple PFLs are configured and UE is requested to perform CPP with time window(s) not indicated or FG 41-2-3 not supported, on which PFL the CPP is performed depends on UE implementation.** **Proposal 3: When multiple PFLs and time window(s) are configured and UE is requested to perform CPP with FG 41-2-8/9 not supported, existing requirements without time window apply for legacy measurements, but UE is not required to report the carrier phase measurements on the PRS resources outside the time window.**  |
| R4-2407877 | OPPO | **Proposal 3: 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, .**

**Proposal 4: When time window is not configured, the existing requirements for RSTD/Rx-Tx without time window should apply.** **Proposal 5: Update the measurement period for legacy RSTD, UE Rx-Tx and RSRP(P) with time window if configured and supported by UE capability.**  |
| R4-2407968 | Qualcomm Incorporated | **Proposal 4: 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.**

**Proposal 5: 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.**

**Proposal 6a: No DL RSCPD measurement requirements are defined for UEs that do not support FG 41-2-8.****Proposal 6b: No DL RSCP measurement requirements are defined for UEs that do not support FG 41-2-9.****Proposal 7: When multiple PFLs are configured in the DL PRS assistance data, if the LMF does not configure time window(s) or the UE does not support FG 41-2-3 (Measurement on indicated DL PRS resource sets within the indicated time window(s) for UE based and UE assisted)*** **Carrier phase measurements are performed on a single PFL**
* **If the LMF does not indicate a PFL for CPP measurements, the selection of the PFL for CPP measurements is up to UE implementation.**
* **Measurement requirements are independent of the time windows (if configured). i.e. for the indicated PFL *j* is calculated counting PRS resources outside the time windows.**
 |
| R4-2409262 | Huawei, HiSilicon | **Proposal 7: When LMF does not configure measurement time window(s) for a PFL or UE does not support FG 41-2-3, for the case of multiple PFLs,** * **Existing requirements without time window apply for both legacy and CP measurement,**
* **UE is only required to report CP for one PFL,**
* **The selection of PFL for CP measurement is based on LMF indication if provided, otherwise up to UE implementation.**

**Proposal 8: When LMF does not request the UE to perform legacy measurements in the measurement time window or UE does not support FG 41-2-8/9,** * **existing requirements without time window apply for legacy measurements,**
* **existing requirements without time window apply for CP measurement provided that the resource associated to the time window have occasions only within the time window.**

**Proposal 9: 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 10: RAN4 not to define UE behavior related to AGC adjustment.**  |
| R4-2409575 | 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. |
| R4-2409580 | Ericsson | **Proposal 1**: For UE configured for CPP measurement with legacy measurement with multiple PFLs, when LMF does not configure measurement time window(s) for a PFL or UE does not support FG 41-2-3, * Carrier phase positioning measurement is performed on per PFL basis.
	+ UE reports the carrier phase measurement as *nr-RSCPD-r18* defined in 37.355.
* Existing requirements for RSTD/UE Rx-Tx without time window apply.

**Proposal 2**: For UE configured for CPP measurement with legacy measurement with multiple PFLs, when UE is configured with time window but does not support FG 41-2-8/41-2-9, existing requirements without time window apply for legacy measurements. The UE is not required to report carrier phase measurement if the resource set(s) associated to the configured time window have occasions outside of the time window.  |

**Carrier phase positioning performance requirements:**

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2407495 | 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.**  |
| R4-2407885 | OPPO | **Proposal 1: On top of simulated CPP measurement results, additional margins for frequency drift and RF calibration should be considered when defining RSCPD and relative RSCP accuracy requirements.****Proposal 2: The periodicity of time window should be [2 times of DRX cycle] in RRC\_INACTIVE.** **Proposal 3: Not verify the accuracy requirements for legacy RSTD/Rx-Tx measurement in the RSCPD/RSCP TC.** |
| R4-2407970 | Qualcomm Incorporated | **Proposal 1: RAN4 not to define enhancements to mitigate impact of carrier frequency offset on CPP measurements in Rel-18.****Observation 1: Explicit assumptions about carrier frequency errors are missing in the CPP simulation assumptions (R4-2321459).****Proposal 2: RAN4 to define an applicability condition for DL RSCPD accuracy requirements based on the time proximity between the target and reference PRS resources used to calculate the DL RSCPD measurement.****Proposal 3: DL RSCPD accuracy requirements are defined and apply when the target and reference PRS resources are measured in the same time slot. FFS the maximum time separation between the resources within a slot.****Proposal 4: RSCPD accuracy derived from RAN4 simulations applies assuming zero carrier frequency error at the UE and TRPs.****Proposal 5: RAN4 to add margin to the RSCPD accuracy derived from RAN4 simulations to account for residual frequency errors.** |
| R4-2409280 | Huawei, HiSilicon | **Proposal 1: For defining CP measurement accuracy requirements, add additional margin on top of simulation results to account for the impact of residual frequency error.****Proposal 2: RAN4 to define the tests for CPP with periodic time window*** **Periodicity and offset: 2 times of PRS resource periodicity**
* **Offset: same as PRS resource offset**
* **Duration: covering all PRS resources from all TRPs**

**Proposal 3: For accuracy TCs for RSCPD/RSCP, the accuracy of the other measurement configured and reported together with RSCPD/RSCP is not verified.** |
| R4-2409593 | Ericsson | **Observation 1: For carrier phase measurement-based positioning to work, accuracy requirement for both (carrier phase measurement and the corresponding legacy measurement) measurements needs to be fulfilled.**1. **UE is required to meet the accuracy requirements for both measurements, carrier phase measurement and the associated legacy measurement, to pass the accuracy requirement test cases for RSCPD reported together with RSTD measurement and RSCP reported together with UE Rx-Tx measurement under AWGN propagation condition.**
2. **RAN4 to avoid defining separate margins for the measurements that are performed together by the UE.**
3. **Do not update simulation assumptions for carrier phase measurement.**
 |

## Open issues summary

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

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

|  |
| --- |
| *Agreements in RAN4#110bis:* Issue 2-1-2: Clarification on the PRS measurement period requirements for DL RSCP/DL RSCPDFFS: * For UE configured for CPP measurement with legacy measurement with multiple PFLs, When LMF does not configure measurement time window(s) for a PFL or UE does not support FG 41-2-3,
	+ Carrier phase positioning measurement is only performed on single PFL.
		- FFS which PFL is measured.
	+ Existing requirements for RSTD/UE Rx-Tx without time window apply.
* For UE configured for CPP measurement with legacy measurement with multiple PFLs, when UE is configured with time window and does not support FG 41-2-8/41-2-9,
	+ Option 1:
		- Existing requirements for RSTD/UE Rx-Tx without time window apply.
	+ Option 2:
		- Existing requirements without time window apply for legacy measurements, but UE is not required to report CP if the resource set(s) associated to the window have occasions outside the time window.
	+ Option 3:
		- Not to define requirements for this case.
 |

* Proposals
	+ Option 1a: (CATT)
		- When multiple PFLs are configured and UE is requested to perform CPP with time window(s) not indicated or FG 41-2-3 not supported, on which PFL the CPP is performed depends on UE implementation.
		- When multiple PFLs and time window(s) are configured and UE is requested to perform CPP with FG 41-2-8/9 not supported, existing requirements without time window apply for legacy measurements, but UE is not required to report the carrier phase measurements on the PRS resources outside the time window.
	+ Option 1b: (Huawei)
		- When LMF does not configure measurement time window(s) for a PFL or UE does not support FG 41-2-3, for the case of multiple PFLs,
			* Existing requirements without time window apply for both legacy and CP measurement,
			* UE is only required to report CP for one PFL,
			* The selection of PFL for CP measurement is based on LMF indication if provided, otherwise up to UE implementation.
		- When LMF does not request the UE to perform legacy measurements in the measurement time window or UE does not support FG 41-2-8/9,
			* existing requirements without time window apply for legacy measurements,
			* existing requirements without time window apply for CP measurement provided that the resource associated to the time window have occasions only within the time window.
	+ Option 2: (OPPO)
		- When time window is not configured, the existing requirements for RSTD/Rx-Tx without time window should apply.
	+ Option 3: (Qualcomm)
		- No DL RSCPD measurement requirements are defined for UEs that do not support FG 41-2-8.
		- No DL RSCP measurement requirements are defined for UEs that do not support FG 41-2-9.
		- When multiple PFLs are configured in the DL PRS assistance data, if the LMF does not configure time window(s) or the UE does not support FG 41-2-3 (Measurement on indicated DL PRS resource sets within the indicated time window(s) for UE based and UE assisted)
			* Carrier phase measurements are performed on a single PFL
			* If the LMF does not indicate a PFL for CPP measurements, the selection of the PFL for CPP measurements is up to UE implementation.
			* Measurement requirements are independent of the time windows (if configured). i.e. for the indicated PFL j is calculated counting PRS resources outside the time windows.
	+ Option 4: (Ericsson)
		- For UE configured for CPP measurement with legacy measurement with multiple PFLs, when LMF does not configure measurement time window(s) for a PFL or UE does not support FG 41-2-3,
			* Carrier phase positioning measurement is performed on per PFL basis.
				+ UE reports the carrier phase measurement as *nr-RSCPD-r18* defined in 37.355.
			* Existing requirements for RSTD/UE Rx-Tx without time window apply.
		- For UE configured for CPP measurement with legacy measurement with multiple PFLs, when UE is configured with time window but does not support FG 41-2-8/41-2-9, existing requirements without time window apply for legacy measurements. The UE is not required to report carrier phase measurement if the resource set(s) associated to the configured time window have occasions outside of the time window.
* Recommended WF
	+ For UE configured for CPP measurement with legacy measurement with multiple PFLs, when LMF does not configure measurement time window(s) for a PFL or UE does not support FG 41-2-3,
		- Carrier phase measurements are performed on a single PFL
		- If the LMF does not indicate a PFL for CPP measurements, the selection of the PFL for CPP measurements is up to UE implementation.
		- Existing requirements for RSTD/UE Rx-Tx without time window apply.
		- FFS:
			* Measurement requirements are independent of the time windows (if configured). i.e. for the indicated PFL j is calculated counting PRS resources outside the time windows.
	+ For UE configured for CPP measurement with legacy measurement with multiple PFLs, when UE is configured with time window and does not support FG 41-2-8/41-2-9, discuss the following options:
		- Option 1:
			* Existing requirements without time window apply for legacy measurements.
			* Existing requirements without time window apply for CP measurement provided that the resources associated to the time window have occasions only within the time window.
			* UE is not required to report the carrier phase measurements on the PRS resources outside the time window.
		- Option 2:
			* No DL RSCPD measurement requirements are defined for UEs that do not support FG 41-2-8.
			* No DL RSCP measurement requirements are defined for UEs that do not support FG 41-2-9.

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

* Proposals
	+ 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, .
* Recommended WF
	+ Discuss the option(s).

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

* Proposals
	+ Option 1: (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.
	+ 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: (Qualcomm)
		- RAN4 not to define enhancements to mitigate impact of carrier frequency offset on CPP measurements in Rel-18.
		- RAN4 to define an applicability condition for DL RSCPD accuracy requirements based on the time proximity between the target and reference PRS resources used to calculate the DL RSCPD measurement.
		- DL RSCPD accuracy requirements are defined and apply when the target and reference PRS resources are measured in the same time slot. FFS the maximum time separation between the resources within a slot.
		- RSCPD accuracy derived from RAN4 simulations applies assuming zero carrier frequency error at the UE and TRPs.
* Recommended WF
	+ Discuss the option(s).

#### Issue 2-1-4: Update measurement period requirements for RSTD, UE Rx-Tx and PRE-RSRP(P) with time window configured

*Background: Companies mention that the time window can be configured for legacy measurements with RSCPD/RSCP measurements not requested. Hence the measurement period requirements for legacy measurements need to be updated.*

* Proposals
	+ Option 1: (OPPO)
		- Update the measurement period for legacy RSTD, UE Rx-Tx and RSRP(P) with time window if configured and supported by UE capability.
* Recommended WF
	+ Discuss the option(s).

#### Issue 2-1-5: UE behaviour due to AGC adjustment

* Proposals
	+ Option 1: (Huawei)
		- RAN4 not to define UE behaviour related to AGC adjustment.
* Recommended WF
	+ RAN4 not to define UE behaviour related to AGC adjustment.

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

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

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| Issue 4-1-7: Test requirements*Agreements in RAN4#110bis:** For carrier phase-based positioning, test cases are only defined for the case where the UE is configured to perform carrier phase measurement with legacy positioning measurements within the configured measurement time window.
* Further discussion is needed on whether to verify in the RSCPD/RSCP TC the accuracy of the other measurement configured and reported together with RSCPD/RSCP.
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* Proposals
	+ Option 1: (CATT, 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 for frequency drift and RF calibration

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| Issue 4-1-2: DL RSCPD absolute accuracy requirements*Agreements in RAN4#110bis:** Accuracy requirements for DL RSCPD and relative DL RSCP are defined using the same PRB numbers as used in existing RSTD and UE Rx-Tx accuracy requirements.
* FFS: On top of simulated CPP measurement results, additional margins for frequency drift and RF calibration should be considered when defining RSCPD and relative RSCP accuracy requirements.
* FFS: whether simulation assumptions need to be updated.
 |

* Proposals
	+ Option 1a: (OPPO)
		- On top of simulated CPP measurement results, additional margins for frequency drift and RF calibration should be considered when defining RSCPD and relative RSCP accuracy requirements.
	+ Option 1b: (Qualcomm, Huawei)
		- RAN4 to add margin to the RSCPD accuracy derived from RAN4 simulations to account for residual frequency errors.
	+ Option 2: (Ericsson)
		- RAN4 to avoid defining separate margins for the measurements that are performed together by the UE.
		- Do not update simulation assumptions for carrier phase measurement.
* Recommended WF
	+ Discuss the option(s).

#### Issue 2-2-3: Test configurations

* Proposals
	+ Option 1: (OPPO)
		- The periodicity of time window should be [2 times of DRX cycle] in RRC\_INACTIVE.
	+ Option 2: (Huawei)
		- RAN4 to define the tests for CPP with periodic time window
			* Periodicity and offset: 2 times of PRS resource periodicity
			* Offset: same as PRS resource offset
			* Duration: covering all PRS resources from all TRPs
* Recommended WF
	+ Discuss the option(s).

## CRs

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

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| **T-doc number** | **Company** | **Title** |
| R4-2409264 | Huawei, HiSilicon | draftCR on RRM requirements for CPP |
| R4-2409581 | Ericsson | DraftCR to 38.133 on core requirements for CPP |

**CRs for carrier phase positioning performance requirements**

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| **T-doc number** | **Company** | **Title** |
| R4-2407520 | CATT | (Set 7-3 & 7-4) Draft CR for RSCPD with RSTD measurement delay TC in RRC\_INACTIVE in FR1 and FR2 |
| R4-2407834 | Xiaomi | Draft CR – Test cases for UE Rx-Tx measurement delay with PRS BW aggregation, Sets 5-5, 5-6, 5-7, 5-8 |
| R4-2409166 | Nokia | Sets (2-9), (7-5) and (7-6) DL CPP performance requirements and measurement delay TCs for RSCP with UE Rx-Tx in RRC\_CONNECTED for FR1 and FR2 |
| R4-2409270 | Huawei, HiSilicon | draftCR on time window configuration |
| R4-2409594 | Ericsson | DraftCR to 38.133 to introduce measurement delay test case for RSCPD with RSTD measurement for NR positioning |