**3GPP TSG RAN WG1#116bis**  **R1-** **2403419**

**Changsha, China, April 15 – 19, 2024**

Agenda Item: 8.2

Source: Moderator (CATT)

Title: FL Summary #1 for maintenance on NR DL and UL carrier phase positioning

Document for: Discussion and Decision

# Introduction

This document provides a summary of the maintenance issues on NR DL and UL carrier phase positioning based on the proposals from the submitted contributions ([1-9]).

# The centre frequency associated with the CPP measurement

***Background:***

|  |
| --- |
| **Agreement (RAN1#112bis-e)**The specific RF frequency associated with a DL carrier phase measurement is defined as the center frequency of the DL PFL by default.* Note: It is open to further discussion whether a frequency other than the center frequency of the DL PFL can also be the specific RF frequency for non-default case(s), if RAN1 agrees to introduce them.

**Agreement (RAN1#112bis-e)**The specific RF frequency associated with a UL carrier phase measurement is defined, by default, as the center frequency of the transmission bandwidth of the SRS for positioning purpose.* Note: It is open to further discussion whether a frequency other than the center frequency of the UL carrier can also be the specific RF frequency for a non-default case(s), if RAN1 agrees to introduce them.
 |

***Submitted Proposal:***

|  |  |  |
| --- | --- | --- |
| *Huawei, HiSilicon[1]* | ***Observation 1: The phase of the path in the channel impulse response corresponds to the phase at DC subcarrier.******Observation 2: The phase of the path in the channel impulse response does not correspond to the phase at the physical centre of the DL PFL/SRS.*** ***Proposal 3: Support option1: Adopt the following modifications on the previous agreements:***

|  |
| --- |
| **Agreement**The specific RF frequency associated with a DL carrier phase measurement is defined as the center frequency of the DL PFL. More specifically, the center frequency refers to the absolute RF frequency corresponding to RE 0 of RB N\_RB/2 where N\_RB is the total number of RBs of DL PRS in the PFL.**Agreement (RAN1#112bis-e)**The specific RF frequency associated with a UL carrier phase measurement is defined as the center frequency of the transmission bandwidth of the SRS for positioning purpose. More specifically, the center frequency refers to the absolute RF frequency corresponding to RE 0 of RB N\_RB/2 where N\_RB is the total number of RBs of the transmission bandwidth of the SRS for positioning purpose. |

 |
| *vivo[3]* | * ***The center frequency refers to the absolute RF frequency corresponding to subcarrier 0 of RB N\_RB/2.***
 |
| *CATT[5]* | **Proposal 8: Adopt TP#7 for including the definition of center frequency in the definitions of the DL RSCP and UL RSCP.**TP #7

|  |  |
| --- | --- |
| ***Reason for change:*** | There can be two interpretations of center frequency for DL/UL carrier phase measurement. The first interpretation is the RF frequency of RE 0 of PRB NRB/2, where N\_RB represents the BW of the DL PRS/UL SRS. The second interpretation is that the center frequency lies between the lowest and highest RF frequencies of and highest of the DL PRS/UL SRS. To avoid confusion, there is need to clarify which definition is adopted in the specification. |
|  |  |
| ***Summary of change:*** | In clause 5.1.42 of TS 38.215, clarify that the center frequency associated with a DL RSCP or a UL RSCP corresponds to the RE 0 of RB NRB/2, where NRB is the number of RBs for PRS or SRS for positioning purposes |
|  |  |
| ***Consequences if not approved:*** | The definition of center frequency for DL RSCP and UL RSCP is not clear. |

-------------------------------------------- Start of text proposal to TS 38.215 v18.2.0 ---------------------------------------5.1.42 DL reference signal carrier phase (DL RSCP)

|  |  |
| --- | --- |
| **Definition** | DL reference signal carrier phase (RSCP) is defined as the phase of the channel response at the 1st path delay derived from the resource elements carrying DL PRS configured for the measurement. DL RSCP is associated with the center frequency of the DL positioning frequency layer (PFL) configured for the measurement for RRC\_CONNECTED, RRC\_INACTIVE, and RRC\_IDLE modes.The center frequency is defined as the absolute RF frequency corresponding to RE 0 of RB NRB /2 where NRB is the total number of RBs for DL PRS in the PFL.For frequency range 1, the reference point for the DL RSCP shall be the antenna connector of the UE. For frequency range 2, the reference point for the DL RSCP shall be the antenna of the UE. |
| **Applicable for** | RRC\_CONNECTED,RRC\_INACTIVE,RRC\_IDLE |

…5.2.8 UL reference signal carrier phase (UL RSCP)

|  |  |
| --- | --- |
| **Definition** | UL reference signal carrier phase (RSCP) is defined as the phase of the channel response at the 1st path delay derived from the resource elements carrying sounding reference signals (SRS) configured for the measurement. UL RSCP is associated with the center frequency of the transmission bandwidth of the SRS for positioning purposes configured for the measurement.The center frequency is defined as the absolute RF frequency corresponding to RE 0 of RB NRB /2 where NRB is the total number of RBs for the SRS for positioning purposes.The reference point for UL RSCP shall be:- for type 1-C base station TS 38.104 [9]: the Rx antenna connector,- for type 1-O or 2-O base station TS 38.104 [9]: the Rx antenna (i.e., the centre location of the radiating region of the Rx antenna),- for type 1-H base station TS 38.104 [9]: the Rx Transceiver Array Boundary connector. |
| **Definition** | UL reference signal carrier phase (RSCP) is defined as the phase of the channel response at the 1st path delay derived from the resource elements carrying sounding reference signals (SRS) configured for the measurement. UL RSCP is associated with the center frequency of the transmission bandwidth of the SRS for positioning purposes configured for the measurement.The center frequency is defined as the absolute RF frequency corresponding to RE 0 of RB NRB /2 where NRB is the total number of RBs for the SRS for positioning purposes.The reference point for UL RSCP shall be:- for type 1-C base station TS 38.104 [9]: the Rx antenna connector,- for type 1-O or 2-O base station TS 38.104 [9]: the Rx antenna (i.e., the centre location of the radiating region of the Rx antenna),- for type 1-H base station TS 38.104 [9]: the Rx Transceiver Array Boundary connector. |

…------------------------------------- End of text proposal to TS 38.215 v18.2.0 ---------------------------------- |
| *Samsung[6]* | **Proposal 1: For carrier phase measurement, the “center frequency” is the average frequency of the two middle sub-carriers of:*** **the DL positioning frequency layer (PFL) for DL RSCP**
* **the SRS for positioning purposes for UL RSCP**

**Therefore, we suggest the following text proposals for TS 38.215:**5.1.42 DL reference signal carrier phase (DL RSCP)

|  |  |
| --- | --- |
| **Definition** | DL reference signal carrier phase (RSCP) is defined as the phase of the channel response at the 1st path delay derived from the resource elements carrying DL PRS configured for the measurement. DL RSCP is associated with the center frequency of the DL positioning frequency layer (PFL) configured for the measurement for RRC\_CONNECTED, RRC\_INACTIVE, and RRC\_IDLE modes. The center frequency is defined as the average frequency of the two middle sub-carriers of the DL positioning frequency layer (PFL) configured for the measurement.For frequency range 1, the reference point for the DL RSCP shall be the antenna connector of the UE. For frequency range 2, the reference point for the DL RSCP shall be the antenna of the UE. |
| **Applicable for** | RRC\_CONNECTED,RRC\_INACTIVE,RRC\_IDLE |

5.2.8 UL reference signal carrier phase (UL RSCP)

|  |  |
| --- | --- |
| **Definition** | UL reference signal carrier phase (RSCP) is defined as the phase of the channel response at the 1st path delay derived from the resource elements carrying sounding reference signals (SRS) configured for the measurement. UL RSCP is associated with the center frequency of the transmission bandwidth of the SRS for positioning purposes configured for the measurement. The center frequency is defined as the average frequency of the two middle sub-carriers of the SRS for positioning purposes configured for the measurement.The reference point for UL RSCP shall be:- for type 1-C base station TS 38.104 [9]: the Rx antenna connector,- for type 1-O or 2-O base station TS 38.104 [9]: the Rx antenna (i.e., the centre location of the radiating region of the Rx antenna),- for type 1-H base station TS 38.104 [9]: the Rx Transceiver Array Boundary connector. |

 |
| *ZTE[7]* | ***Proposal 4:*** *Adopt the following as a conclusion:** *No further discussion in RAN1 on the definition of center frequency.*
 |
| *Apple[8]* | ***Proposal 1: the center frequency of the transmission bandwidth of the DL PFL/ UL SRS is the frequency corresponds to the exact middle frequency between the lowest carrier frequency and highest carrier frequencies of the DL PPFL/UL SRS bandwidth***5.1.42 DL reference signal carrier phase (DL RSCP)

|  |  |
| --- | --- |
| **Definition** | DL reference signal carrier phase (RSCP) is defined as the phase of the channel response at the 1st path delay derived from the resource elements carrying DL PRS configured for the measurement. DL RSCP is associated with the center frequency of the DL positioning frequency layer (PFL) configured for the measurement for RRC\_CONNECTED, RRC\_INACTIVE, and RRC\_IDLE modes. The center frequency is defined as the average frequency of the two middle sub-carriers of the DL positioning frequency layer (PFL) configured for the measurement.For frequency range 1, the reference point for the DL RSCP shall be the antenna connector of the UE. For frequency range 2, the reference point for the DL RSCP shall be the antenna of the UE. |
| **Applicable for** | RRC\_CONNECTED,RRC\_INACTIVE,RRC\_IDLE |

5.2.8 UL reference signal carrier phase (UL RSCP)

|  |  |
| --- | --- |
| **Definition** | UL reference signal carrier phase (RSCP) is defined as the phase of the channel response at the 1st path delay derived from the resource elements carrying sounding reference signals (SRS) configured for the measurement. UL RSCP is associated with the center frequency of the transmission bandwidth of the SRS for positioning purposes configured for the measurement. The center frequency is defined as the average frequency of the two middle sub-carriers of the SRS for positioning purposes configured for the measurement.The reference point for UL RSCP shall be:- for type 1-C base station TS 38.104 [9]: the Rx antenna connector,- for type 1-O or 2-O base station TS 38.104 [9]: the Rx antenna (i.e., the centre location of the radiating region of the Rx antenna),- for type 1-H base station TS 38.104 [9]: the Rx Transceiver Array Boundary connector. |

 |
| *Qualcomm[9]* | **Proposal 4: With regards to the center frequency of a CPP measurement, the previous agreement which says that*** ***the specific RF frequency associated with a DL carrier phase measurement is defined as the center frequency of the DL PFL.***

**stands, and there is no need of any further specification change.** |

FL Comments:

For the carrier phase positioning, the channel frequency response (CFR) $H\_{k}$ for the subcarrier *k* in frequency domain can be $H\_{k} $can be simplified as follows [11]:

$$H\_{k}=h\_{0}e^{-j2π(f\_{c}+kf\_{SCS})τ\_{0}}e^{-jφ\_{0}}$$

where $τ\_{0}$ is the channel delay, $f\_{scs}$ is the subcarrier spacing, and $φ\_{0}$ is the initial phase. Above formula shows that the carrier phase $∠H\_{k}$ is different for each subcarrier *k.* For carrier phase positioning, we like to obtain the phase “$-j2πf\_{CP}τ\_{0}"$, where the $f\_{CP}$ is the frequency associated DL/UL carrier phase measurements, which needs to be clearly defined.

It was agreed that the frequency $f\_{CP} $associated DL/UL carrier phase measurements corresponds to the center frequency of the DL PFL/UL SRS transmission bandwidth. There are two plausible interpretations of the center frequency.

* **Interpretation A**: The frequency is the RF frequency of a center subcarrier of the DL PFL/UL SRS transmission BW. Specifically, it corresponds to the RF frequency of RE 0 of PRB N\_RB/2, where N\_RB denotes the bandwidth of the DL PRS/UL SRS.
* **Interpretation B**: In contrast, in Interpretation B the frequency corresponds to the exact middle frequency between the lowest carrier frequency and highest carrier frequencies of the DL PPFL/UL SRS bandwidth. In this case, the carrier frequency can be calculated by averaging of the lowest and highest carrier frequencies of the DL PPFL/UL SRS.

The matter regarding the adoption of Interpretation A or B has been discussed over a number of meetings without arriving at a conclusive decision. Based on the contributions submitted to this meeting, companies still hold different views on this issue, which may be summarized as follows:

* **Interpretation A:**
	+ **Supported by:** Huawei, HiSilicon, vivo, CATT
* **Interpretation B**:
	+ **Supported by:** Samsung, Apple
* **No need to have further clarification for the center frequency**:
	+ **Supported by:** ZTE, Qualcomm

Regardless which interpretation for frequency $f\_{CP} $is finally adopted, there are different approaches to estimate the carrier phase “$-j2πf\_{CP}τ\_{0}"$ either from CFR or CIR. In [1], it provides an analysis on the carrier phase estimate from CIR, which gives the observation that “The phase of the path in the channel impulse response does not correspond to the phase at the physical centre of the DL PFL/SRS “. This observation is also obvious from the phase of $H\_{k}$ which corresponds to the phase of a subcarrier *k*, but not the middle of two subcarriers. However, it is also clear that regardless how we define $f\_{CP}$ with Interpretation A or Interpretation B, the carrier phase corresponding to $f\_{CP}$ can be obtained from either CFR or CIR, although Interpretation A might bring slightly advantage in implementation over Interpretation B.

In addition, although some companies consider the impact of adopting different interpretations might not be significant for some cases, e.g., when signal propagation time $τ\_{0}$ is small ([7][8]), it is still highly desirable for RAN1 to adopt a clear definition, either Integration A or B, to avoid potential impact.

Consider that the issue has been discussed in multiple meetings, it is highly desirable for RAN1 to reach a conclusion in this meeting.

### Proposal 2-1

Adopt one of the following options in RAN1#116bis:

* Option 1: Support the following modifications on the previous agreements:

|  |
| --- |
| **Agreement**The specific RF frequency associated with a DL carrier phase measurement is defined as the center frequency of the DL PFL. More specifically, the center frequency refers to the absolute RF frequency corresponding to RE 0 of RB N\_RB/2 where N\_RB is the total number of RBs of DL PRS in the PFL.**Agreement (RAN1#112bis-e)**The specific RF frequency associated with a UL carrier phase measurement is defined as the center frequency of the transmission bandwidth of the SRS for positioning purpose. More specifically, the center frequency refers to the absolute RF frequency corresponding to RE 0 of RB N\_RB/2 where N\_RB is the total number of RBs of the transmission bandwidth of the SRS for positioning purpose. |

* **Option 2:** As a conclusion:
	+ The center frequency of the DL RSCP/RSCPD (or the UL RSCP) measurements refers to the average frequency of the absolute RF frequencies corresponding to subcarrier 11 of RB (N\_RB/2 - 1) and subcarrier 0 of RB N\_RB/2 of the DL PFL (or the transmission bandwidth of the SRS for positioning purpose).
* **Option 3:** As a conclusion:
	+ No further discussion on the definition of center frequency of the NR carrier phase measurements in Rel-18.

|  |  |
| --- | --- |
| **Company** | **comments** |
|  |  |
|  |  |

# TP#1 Editorial corrections and parameter name alignments

***Submitted Proposals:***

|  |  |  |  |
| --- | --- | --- | --- |
| *OPPO[4]* |  Proposal 1: Adopt the following TP for TS38.214:

|  |
| --- |
| * **Reason for change:** (1) A few high layer parameter names are in [] now and are not aligned with TS 37.355. (2) The description of “DL carrier phase measurement” is not clear.
* **Summary of change:** (1) Align the high layer parameter names in 214 with that in 37.355. (2) Clarify that the UE can measure DL RSCP or DL RSCPD in RRC\_INACTIVE or RRC\_IDLE state.
* **Consequences if not approved:** The description of carrier phase positioning measurement is ambiguous.
 |
| **TS 38.214**5.1.6.5.2 PRS for carrier phase positioning\*\*\* Unchanged parts are omitted \*\*\*If the UE reports LoS/NLoS indicator(s) via higher layer parameter *nr-los-nlos-Indicator* along with a measurement report containing DL RSCP or DL RSCPD, the LoS/NLoS indicator(s) are assumed to also apply to the DL RSCP or DL RSCPD measurements. The UE may be provided with *nr-PRU-RSCP-MeasInfo* or *nr-PRU-DL-TDOA-MeasInfo* which contains DL RSCP/RSCPD measurements together with DL RSTD, DL PRS-RSRP, and/or DL PRS-RSRPP measurement(s) associated with the RSCP/RSCPD measurements performed by a positioning reference unit (PRU) [20, TS 38.305] the timestamps associated with the measurements, and the location information of the PRU. The UE may be configured to report quality metrics *NR-PhaseQuality* corresponding to the DL RSCP and RSCPD measurements which include the following fields [17, TS 37.355]:*- phaseQualityValue* which provides the uncertainty of the measurement*- phaseQualityResolution* which specifies the resolution levels used in the [*phase quality index]* field.The UE in RRC\_INACTIVE or RRC\_IDLE mode is expected to perform the DL RSCP or DL RSCPD measurement from the bandwidth of a DL PRS resource including outside of the initial downlink bandwidth part. |

 |
| *CATT[5]* | Proposal 6: Adopt TP #5 for correcting the names of higher layer parameters associated with NR DL carrier phase positioning.TP #5

|  |  |
| --- | --- |
| ***Reason for change:*** | The names of higher layer parameters associated with NR DL carrier phase positioning in clause 5.1.6.5.2 of TS 38.214 are still in brackets and do not match the names in TS 37.355. |
|  |  |
| ***Summary of change:*** | In clause 5.1.6.5.2 of TS 38.214, the names of higher layer parameters are changed to match the names in TS 37.355. |
|  |  |
| ***Consequences if not approved:*** | The names of higher layer parameters in clause 5.1.6.5.2 of TS 38.214 are not captured correctly. |

--------------------------------------- Start of text proposal to TS 38.214 v18.2.0 -------------------------------5.1.6.5.2 PRS for carrier phase positioning…The UE may be provided with *nr-PRU-DL-Info* which contains DL RSCP/RSCPD measurements together with DL RSTD, DL PRS-RSRP, and/or DL PRS-RSRPP measurement(s) associated with the RSCP/RSCPD measurements performed by a positioning reference unit (PRU) [20, TS 38.305] the timestamps associated with the measurements, and the location information of the PRU. The UE may be configured to report quality metrics *nr-PhaseQuality* corresponding to the DL RSCP and RSCPD measurements which include the following fields [17, TS 37.355]:*- phaseQualityIndex* which provides the uncertainty of the measurement*- phaseQualityResolution* which specifies the resolution levels used in the *phaseQualityIndex* field.------------------------------------ End of text proposal to TS 38.214 v18.2.0 -------------------------------- |
| *CATT[5]* | Proposal 7: Adopt TP #6 for correcting the description associated with RSCP/RSCPD measurements.TP #6

|  |  |
| --- | --- |
| ***Reason for change:*** | The term “DL carrier phase measurement”, which is used in TS 38.214, but not defined in TS 38.215. Instead, DL RSCP/RSCPD are defined in TS 38.215. |
|  |  |
| ***Summary of change:*** | In clause 5.1.6.5.2 of TS 38.214, change “DL carrier phase measurements” to “DL RSCP/RSCPD measurements”. |
|  |  |
| ***Consequences if not approved:*** | The undefined term “DL carrier phase measurement” is used in clause 5.1.6.5.2 of TS 38.214. |

------------------------------------- Start of text proposal to TS 38.214 v18.2.0 ------------------------------5.1.6.5.2 PRS for carrier phase positioning…The UE in RRC\_INACTIVE or RRC\_IDLE mode is expected to perform the DL RSCP/RSCPD measurements from the bandwidth of a DL PRS resource including outside of the initial downlink bandwidth part.…----------------------------------- End of text proposal to TS 38.214 v18.2.0 --------------------------------------- |
| *ZTE[7]* | *Proposal 5: Adopt TP#3-1 for TS 38.214** *Reason for change: Make the higher layer parameters in TS 38.214 aligned with TS 37.355.*
* *Summary of change: Change the higher layer parameters in TS 38.214 to be aligned with TS 37.35.*
* *Consequences if not approved: The higher layer parameters in TS 38.214 are not aligned with TS 37.355.*
* *Clause affected: 5.1.6.5.2 in 38.214.*

|  |
| --- |
| 5.1.6.5.2 PRS for carrier phase positioning<Unrelated part omitted>If the UE reports LoS/NLoS indicator(s) via higher layer parameter *nr-los-nlos-Indicator* along with a measurement report containing DL RSCP or DL RSCPD the LoS/NLoS indicator(s) are assumed to also apply to the DL RSCP or DL RSCPD measurements. The UE may be provided with *NR-PRU-DL-Info* which contains DL RSCP/RSCPD measurements together with DL RSTD, DL PRS-RSRP, and/or DL PRS-RSRPP measurement(s) associated with the RSCP/RSCPD measurements performed by a positioning reference unit (PRU) [20, TS 38.305] the timestamps associated with the measurements, and the location information of the PRU. The UE may be configured to report quality metrics *NR-PhaseQuality* corresponding to the DL RSCP and RSCPD measurements which include the following fields [17, TS 37.355]:*- phaseQualityValue* which provides the uncertainty of the measurement*- phaseQualityResolution* which specifies the resolution levels used in the *phaseQualityValue* field.The UE in RRC\_INACTIVE or RRC\_IDLE mode is expected to perform the DL carrier phase measurement from the bandwidth of a DL PRS resource including outside of the initial downlink bandwidth part. |

 |

FL Comments:

Based on the proposals from [4][5][7], suggest making the following corrections in 38.214:

* Replacing “DL carrier phase measurement” with “DL RSCP/RSCPD measurement”
* [nr-PruInformation-Ue-based-DL-CPP] 🡪 *NR-PRU-DL-Info or* NR-PRU-RSCP-MeasInfo/NR-PRU-DL-TDOA-MeasInfo
* [nr-CarrierPhaseQualityInfo]🡪 NR-PhaseQuality
* [phase quality index] 🡪 phaseQualityValue
* [phase quality resolution]🡪phaseQualityResolution

### Proposal 3-1

Adopt TP#1 in R1-2403419 Section 3 for TS38.214 Clause 5.1.6.5.2.

### TP #1

|  |  |
| --- | --- |
| ***Reason for change:*** | 1. A number of IEs in brackets in 38.214 should be replaced with the IEs defined in TS 37.355.
2. “DL carrier phase” is undefined and should be replaced with DL RSCP/RSCPD
 |
|  |  |
| ***Summary of change:*** | 1. Align the high layer parameter names in TS 38.214 with that in TS 37.355.
2. Replace “DL carrier phase” with “DL RSCP/RSCPD”
 |
|  |  |
| ***Consequences if not approved:*** | The specification is not clearly defined. |

-------------------------------------------- Start of text proposal to TS 38.214 v18.2.0 ---------------------------------------

##### 5.1.6.5.2 PRS for carrier phase positioning

…===================== Unchanged parts omitted ======================

If the UE reports LoS/NLoS indicator(s) via higher layer parameter *nr-los-nlos-Indicator* along with a measurement report containing DL RSCP or DL RSCPD the LoS/NLoS indicator(s) are assumed to also apply to the DL RSCP or DL RSCPD measurements.

The UE may be provided with *NR-PRU-DL-Info*  which contains DL RSCP/RSCPD measurements together with DL RSTD, DL PRS-RSRP, and/or DL PRS-RSRPP measurement(s) associated with the RSCP/RSCPD measurements performed by a positioning reference unit (PRU) [20, TS 38.305] the timestamps associated with the measurements, and the location information of the PRU.

The UE may be configured to report quality metrics *NR-PhaseQuality* corresponding to the DL RSCP and RSCPD measurements which include the following fields [17, TS 37.355]:

*- phaseQualityValue* which provides the uncertainty of the measurement

*- phaseQualityResolution* which specifies the resolution levels used in the *phaseQualityValue* field.

The UE in RRC\_INACTIVE or RRC\_IDLE mode is expected to perform the DL RSCP/RSCPD measurement from the bandwidth of a DL PRS resource including outside of the initial downlink bandwidth part.

-------------------------------------------- End of text proposal to TS 38.214 v18.2.0 ---------------------------------------

|  |  |
| --- | --- |
| **Company** | **comments** |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

# TP #2 DL Carrier phase measurement for UE-based CPP

***Submitted Proposal:***

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *Nokia[2]* | **Proposal 4:** Support the following text proposal of Clause 5.1.6.5.2 of TS 38.214

|  |
| --- |
| 5.1.6.5.2 PRS for carrier phase positioning<omitted text>The UE may be provided with [*nr-PruInformation-Ue-based-DL-CPP* ] which contains DL ~~RSCP/~~RSCPD measurements together with DL RSTD, DL PRS-RSRP, and/or DL PRS-RSRPP measurement(s) associated with the RSCP/RSCPD measurements performed by a positioning reference unit (PRU) [20, TS 38.305] the timestamps associated with the measurements, and the location information of the PRU. The UE is not expected to be provided with [*nr-PruInformation-Ue-based-DL-CPP* ] which does not contain DL RSCPD measurements.<omitted text> |

|  |  |
| --- | --- |
| ***Reason for change:*** | RAN1 made an agreement about providing PRU RSCP measurements to a UE, but there is no use case as UE-based positioning based on multi-RTT technique is not supported. RAN1 needs to resolve this issue. This issue is also under discussion in RAN2 based on RAN1 agreement, but the use case would be also unclear from their view. RAN1 needs to fix this issue to avoid unnecessary signalling of PRU measurement to a target UE.  |
|  |  |
| ***Summary of change:*** | Remove provision of the PRU RSCP measurement to a target UE. |
|  |  |
| ***Consequences if not approved:*** | It may cause confusion to RAN2 about the necessity of the signaling, which is under discussion. If they just add the signaling, an unnecessary signaling information will be added, but LMF actually will never provide this information to the UE for UE-based positioning. |

 |

FL Comments:

|  |
| --- |
| **Agreement**For UE-based carrier phase positioning, support enabling LMF to forward the DL carrier phase measurement reported by a PRU, with additional information of the same PRU to a target UE for UE-based carrier phase positioning in the positioning assistance data.* Note: Whether the forwarded DL carrier phase measurement is DL RSCP and/or DL RSCPD depends at least on which of them is (are) supported by UE capability.
* additional information of the same PRU includes at least PRU location.
	+ FFS: additional PRU information, e.g. the AoD of PRU to each TRP, etc.
 |

Based on the above agreement, the forwarded DL carrier phase measurement can be DL RSCP and/or DL RSCPD, since DL RSCPD can be obtained from DL RSCP. Thus, the proposed TP in [2] may not be needed.

### Question 4-1

Please provide your view on the above TP from **Proposal 4** in [2]:

|  |  |
| --- | --- |
| **Company** | **comments** |
|  |  |
|  |  |

# TP#2 LoS/NLoS indication associated with carrier phase measurements

***Background***

|  |
| --- |
| **Agreement**Rel-17 LOS/NLOS indication (when indicated) applies for the carrier phase measurement(s) in the same report.AgreementOnly the carrier phase measurements (i.e., DL/UL RSCP, DL RSCPD) of the first path are supported in Rel-18.TS 37.355 v18.0.0NR-DL-TDOA-AdditionalMeasurementElement-r16 ::= SEQUENCE { nr-DL-PRS-ResourceID-r16 NR-DL-PRS-ResourceID-r16 OPTIONAL, nr-DL-PRS-ResourceSetID-r16 NR-DL-PRS-ResourceSetID-r16 OPTIONAL, nr-TimeStamp-r16 NR-TimeStamp-r16, nr-RSTD-ResultDiff-r16 CHOICE { k0-r16 INTEGER (0..8191), k1-r16 INTEGER (0..4095), k2-r16 INTEGER (0..2047), k3-r16 INTEGER (0..1023), k4-r16 INTEGER (0..511), k5-r16 INTEGER (0..255), …, kMinus1-r18 INTEGER (0..16382), kMinus2-r18 INTEGER (0..32764) }, nr-TimingQuality-r16 NR-TimingQuality-r16, nr-DL-PRS-RSRP-ResultDiff-r16 INTEGER (0..61) OPTIONAL, nr-AdditionalPathList-r16 NR-AdditionalPathList-r16 OPTIONAL, …, [[ nr-UE-Rx-TEG-ID-r17 INTEGER (0..maxNumOfRxTEGs-1-r17) OPTIONAL, nr-DL-PRS-FirstPathRSRP-ResultDiff-r17 INTEGER (0..61) OPTIONAL, nr-los-nlos-IndicatorPerResource-r17 LOS-NLOS-Indicator-r17 OPTIONAL, nr-AdditionalPathListExt-r17 NR-AdditionalPathListExt-r17 OPTIONAL ]], [[ nr-RSTD-BasedOnAggregatedResources-r18 ENUMERATED {true} OPTIONAL, nr-AggregatedDL-PRS-ResourceSetID-List-r18 SEQUENCE (SIZE (2.. 3)) OF NR-AggregatedDL-PRS-ResourceSetID-Element-r18 OPTIONAL, nr-RSCPD-r18 INTEGER (0..61565) OPTIONAL, nr-PhaseQuality-r18 NR-PhaseQuality-r18 OPTIONAL, nr-RSCPD-AdditionalMeasurementsAddSample-r18 SEQUENCE (SIZE (1..nrNumOfSamples-1-r18 )) OF NR-RSCPD-AdditionalMeasurementElement-r18 OPTIONAL, nr-ReportDL-PRS-MeasBasedOnSingleOrMultiHopRx-r18 ENUMERATED { singleHop, multipleHop } OPTIONAL ]]} |

***Submitted Proposal:***

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *Nokia/NSB[9]* | **Proposal 5:** Support the following text proposal of Clause 5.1.6.5.2 of TS 38.214

|  |
| --- |
| 5.1.6.5.2 PRS for carrier phase positioning<omitted text>If the UE reports LoS/NLoS indicator(s) via higher layer parameter *nr-los-nlos-Indicator* along with a measurement report containing DL RSCP or DL RSCPD the LoS/NLoS indicator(s) are assumed to also apply to the DL RSCP or DL RSCPD measurements. The UE is not expected to report the DL RSCP or DL RSCPD measurement for additional detected paths. If the LoS/NLoS indicator of the first detected path is not greater than that of any one of additionally detected paths, the UE is expected to report the DL RSCP or DL RSCPD measurement associated with the largest LoS/NLoS indicator. <omitted text> |

|  |  |
| --- | --- |
| ***Reason for change:*** | For the carrier phase measurement, the UE is only allowed to report the measurement of the first detected path according to the agreement. In the current TS 37.355 structure, the UE reports a main measurement and additional measurements through additional measurement container. For the timing measurement, the UE can report multiple measurement and LoS/NLoS indicators for the detected paths. However, the first detected path is not guaranteed as LoS path. The LoS/NLoS indicator of the first path could be less than that of the 2nd detected path. In this case, LMF could choose the 2nd detected path as a first path based on the provided information. There was no issue on the legacy DL-TDOA tehcnique, but carrier phase positioning does not support measurements for additional paths. Thus, it is necessary to fix this issue. |
|  |  |
| ***Summary of change:*** | Clarify the UE behavior of the DL RSCP or DL RSCPD measurement reporing by adding UE behavior into TS 38.214. |
|  |  |
| ***Consequences if not approved:*** | Even if the LoS/NLoS indicator of the first path is not the largest one, the UE may still report the carrier phase measurements based on the supported signal measurement container. |

 |

FL Comments:

|  |
| --- |
| **Agreement**Rel-17 LOS/NLOS indication (when indicated) applies for the carrier phase measurement(s) in the same report.AgreementOnly the carrier phase measurements (i.e., DL/UL RSCP, DL RSCPD) of the first path are supported in Rel-18. |

Considering that the first detected path is not guaranteed as LoS path, and the LoS/NloS indicator of the first path could be less than that of the 2nd detected path, it was proposed in [9] that the carrier phase measurement should be reported with the largest LOS/NLOS indicator. The above TP was discussed in the previous meeting without conclusion. Interested companies are encouraged provide their views on the TP to see if it is needed.

### Question 5-1

Please provide your view on the above TP from **Proposal 5** in [2]:

|  |  |
| --- | --- |
| **Company** | **comments** |
|  |  |
|  |  |

# References

1. [R1-2402035](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2402035.zip) Maintenance of Rel-18 positioning Huawei, HiSilicon
2. [R1-2402092](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2402092.zip) Maintenance on Expanded and Improved NR Positioning Nokia
3. [R1-2402212](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2402212.zip) Maintenance on Rel-18 Positioning vivo
4. [R1-2402300](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2402300.zip) Text Proposals on Expanded and Improved NR Positioning OPPO
5. [R1-2403410](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2403410.zip) Maintenance on Expanded and Improved NR Positioning CATT, CICTCI
6. [R1-2402432](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2402432.zip) Remaining Issues on NR positioning Samsung
7. [R1-2402701](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2402701.zip) Maintenance on expanded and improved NR positioning ZTE Corporation
8. [R1-2402865](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2402865.zip) Remaining Issues on Expanded and Improved Positioning Apple
9. [R1-2403170](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2403170.zip) Maintenance on Expanded and Improved NR Positioning Qualcomm Incorporated
10. [R1-2401487](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_116b/Docs/R1-2401487.zip) FL Summary #3 for NR DL and UL carrier phase positioning Moderator (CATT)
11. R1-2203469 Discussion on improved accuracy based on NR carrier phase measurement, CATT