**3GPP TSG RAN WG1#118**  **R1-2407205**

**Maastricht, NL, August 19th – 23rd, 2024**

Agenda Item: 8.1

Source: Moderator (CATT)

Title: FL Summary for maintenance on NR carrier phase positioning

Document for: Discussion and Decision

# Introduction

This document provides a summary of the maintenance issues on NR carrier phase positioning based on the submitted draft CRs ([1-3]) (Note: Draft CRs that might be considered as alignment CRs are not included here).

# Discussion

## Draft CR for measurement window in TS 38.214

***Background (R1-2406958):***

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| ***Reason for change:*** | In NR-DL-PRS-MeasurementTimeWindowsConfig, UE can be configured to measure RSCPD and/or RSCP, or measure DL RSTD, UE Rx – Tx time difference, DL PRS-RSRP, and DL PRS-RSRPP within the window. For all of these measurements, the UE expects that the indicated DL PRS resource sets across all *dl-PRS-IDs* are from one DL PRS positioning frequency layer, and that the number of indicated DL PRS resource sets associated with each *dl-PRS-ID* should be the same. However, in the current specification, such limitation exists only when UE perform RSCPD and/or RSCP measurement, which is not aligned with the agreement:

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| AgreementWhen an LMF requests the UEs, including target UE and PRU(s), to perform measurements on indicated DL PRS resource set(s) occurring within indicated time window(s)* The duration of a time window can be configured as follows:
	+ {1, 2, 4, 6, 8, 12, 16} slots.
* the number of the time windows can be:
	+ {1, 2}
	+ ~~FFS: {4, 8}~~
* the number of the indicated DL PRS resource set(s) per TRP within a time window can be {1, 2}:
	+ DL PRS resource sets across all TRPs are in one DL PFL
		- FFS: For PRS bandwidth aggregation, an indicated DL PRS resource set refers to a combination of linked PRS resource sets
	+ The number of the indicated DL PRS resource set(s) for all TRPs should be the same
* Note: Different PRS resource sets and/or PFLs can be associated with different time windows

Note: the signaling design for the indication of the DL PRS resource sets in the time windows is up to RAN2/RAN3. |

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| ***Summary of change:*** | Correct the applicability of PFL limitation and DL PRS resource set(s) number limitation for the configured measurement window. |
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| ***Consequences if not approved:*** | The PFL limitation and DL PRS resource set(s) number limitation are not applicable when UE performing DL RSTD, UE Rx – Tx time difference, DL PRS-RSRP, and DL PRS-RSRPP measurement. The applicability of PFL limitation and DL PRS resource set(s) number limitation for the configured measurement window is not correct. |

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| 5.1.6.5 PRS reception procedure<omitted text> The UE, subject to UE capability, may be requested to perform DL RSCPD and/or DL RSCP measurements on indicated DL PRS resource sets occurring within one or two time window(s) indicated by *NR-DL-PRS-MeasurementTimeWindowsConfig*. The UE, subject to UE capability, may be requested to perform DL RSTD, UE Rx – Tx time difference, DL PRS-RSRP, and DL PRS-RSRPP measurement on the indicated DL PRS resource sets only within the window(s) indicated by *NR-DL-PRS-MeasurementTimeWindowsConfig*. Otherwise, UE may use the indicated DL PRS resource set(s) occurring outside the indicated time window for these measurements in addition to the indicated DL PRS resource set(s) occurring inside the indicated time window(s).Within each window indicated by *NR-DL-PRS-MeasurementTimeWindowsConfig*, the UE expects that the indicated DL PRS resource sets across all *dl-PRS-IDs* are from one DL PRS positioning frequency layer, and that the number of indicated DL PRS resource sets associated with each *dl-PRS-ID* are the same. |

FL Comments:

The FL shares a similar view with R1-2406958 that the UE is expected to use the *NR-DL-PRS-MeasurementTimeWindowsConfig* for both CPP and legacy measurements (Note: The final CR should use the latest *CR-Form-v12.3*).

### (Round1) Proposal 1

Endorse the draft CR of R1-2406958 for TS 38.214.

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| **Company** | **comments** |
| Huawei, HiSilicon | Ok. It is just editorial adjustment, so should be included in the 214 combo CR.  |
| Qualcomm | OK |
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## Draft CR on DL PRS measurement in RRC\_IDLE mode

***Background (R1-2406167):***

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| ***Reason for change:*** | The DL PRS measurement in RRC\_IDLE state is supported in Rel-18, but there is no related description for DL PRS measurement except for RSCP/RSCPD measurement as follows.

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| 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. |

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| ***Summary of change:*** | Add the DL PRS measurement behavior in RRC\_IDLE state  |
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| ***Consequences if not approved:*** | Incomplete specification for the DL PRS measurement in RRC\_IDLE state. |

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| 5.1.6.5 PRS reception procedure<omitted text>The UE may be configured to measure and report, via higher layer parameter [undetermined NTN related parameter] subject to UE capability, UE Rx-Tx time difference measurements on a PRS resource associated with a *dl-PRS-ID,* and report the UE Rx-Tx time difference subframe offset and the DL timing drift as described in [7, TS 38.215].The UE in RRC\_INACTIVE or RRC\_IDLE mode is expected to prioritize the reception of any other DL signals and DL channels than the reception of DL PRS.The UE in RRC\_INACTIVE or RRC\_IDLE mode, subject to UE capability, is expected to process DL PRS outside or inside of the initial DL BWP. For DL PRS processing outside of the initial DL BWP, the UE may be configured with the same or different subcarrier spacing and CP for DL PRS resources than those of the initial DL BWP. For DL PRS processing inside of the initial DL BWP, the UE is configured with the same subcarrier spacing and CP for DL PRS resources as those of the initial DL BWP. |

***Background (R1-2406957):***

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| ***Reason for change:*** | RAN1’s agreements and UE features toward positioning depicted that UE can perform DL PRS measurement in RRC\_INACTIVE and RRC\_IDLE for CPP, RedCap UE, and bandwidth aggregation. However, the current specification only mentioned that UE can perform RSCP and RSCPD measurement in RRC\_INACTIVE and RRC\_IDLE mode, which is not aligned with RAN1’s agreements and UE features:

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| **Agreement (Bandwidth aggregation)**From RAN1 perspective, support UE performs PRS measurement across multiple aggregated PFLs in RRC\_CONNECTED, RRC\_INACTIVE and RRC\_IDLE state.**Agreement (RedCap UE positioning)**PRS Rx frequency hopping for RRC\_INACTIVE state and for RRC\_IDLE state is supported for a RedCap UE. |

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| **UE features for Bandwidth aggregation**41-4-1b DL PRS processing capabilities for aggregated PRS processing of 2 PFLs in intra-band contiguous for RRC\_IDLE and RRC\_INACTIVE41-4-1c DL PRS processing capabilities for aggregated PRS processing of 3 PFLs in intra-band contiguous for RRC\_IDLE and RRC\_INACTIVE**UE features for RedCap UE positioning**41-5-1a PRS measurement with Rx frequency hopping in RRC\_INACTIVE for RedCap UEs41-5-1b PRS measurement with Rx frequency hopping in RRC\_IDLE for RedCap UEs |

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| 5.1.6.5 PRS reception procedureThe UE can be configured with one or more DL PRS resource set configuration(s) as indicated by the higher layer parameters *NR-DL-PRS-ResourceSet* and *NR-DL-PRS-Resource* as defined by Clause 6.4.3 [17, TS 37.355]. Each DL PRS resource set consists of K≥1 DL PRS resource(s) where each has an associated spatial transmission filter. The UE can be configured with one or more DL PRS positioning frequency layer configuration(s) as indicated by the higher layer parameter *NR-DL-PRS-PositioningFrequencyLayer.* A DL PRS positioning frequency layer is defined as a collection of DL PRS resource sets which have common parameters configured by *NR-DL-PRS-PositioningFrequencyLayer*.<omitted text> The UE, subject to UE capability, may be requested to perform DL RSCPD and/or DL RSCP measurements on indicated DL PRS resource sets occurring within one or two time window(s) indicated by *NR-DL-PRS-MeasurementTimeWindowsConfig*. Within each window indicated by *NR-DL-PRS-MeasurementTimeWindowsConfig*, the UE expects that the indicated DL PRS resource sets across all *dl-PRS-IDs* are from one DL PRS positioning frequency layer, and that the number of indicated DL PRS resource sets associated with each *dl-PRS-ID* are the same.The UE, subject to UE capability, may be requested to perform DL RSTD, UE Rx – Tx time difference, DL PRS-RSRP, and DL PRS-RSRPP measurement on the indicated DL PRS resource sets only within the window(s) indicated by *NR-DL-PRS-MeasurementTimeWindowsConfig*. Otherwise, UE may use the indicated DL PRS resource set(s) occurring outside the indicated time window for these measurements in addition to the indicated DL PRS resource set(s) occurring inside the indicated time window(s).The UE in RRC\_INACTIVE or RRC\_IDLE mode is expected to perform DL PRS measurement from the bandwidth of a DL PRS resource including outside of the initial downlink bandwidth part.5.1.6.5.1 PRS receiver frequency hoppingThe reduced capability UE may be configured to measure and report, subject to UE capability, via *nr-DL-PRS-RxHoppingRequest* the DL RSTD, DL PRS-RSRP, DL PRS-RSRPP, or UE Rx-Tx time difference using receiver frequency hopping for a DL PRS resource, with a requested bandwidth of all hops that may be greater than the maximum reduced capability UE bandwidth. The reduced capability UE performing receiver frequency hopping may report via *nr-ReportDL-PRS-MeasBasedOnSingleOrMultiHopRx* one measurement associated with one received frequency hop or one measurement based on multiple hops of the DL PRS. The reduced capability UE may report whether the measurement is associated with one received frequency hop or multiple frequency hops of the DL PRS. In RRC\_CONNECTED mode, the reduced capability UE is expected to use a single instance of a configured measurement gap to receive all hops of the DL PRS using receiver frequency hopping. 5.1.6.5.2 PRS for carrier phase positioningFor DL UE positioning measurement reporting in higher layer parameter *NR-DL-TDOA-SignalMeasurementInformation,* the UE may be configured to report the DL Reference Signal Carrier Phase Difference (RSCPD) [7, TS 38.215] measurement along with the DL RSTD measurement. When the UE reports RSCPD measurements, the reference *nr-DL-PRS-ReferenceInfo* is the same as the one reported, for the RSTD measurements. For DL UE positioning measurement reporting in higher layer parameter *NR-Multi-RTT-SignalMeasurementInformation*, the UE may be configured to report the DL Reference Signal Carrier Phase (RSCP) measurement [7, TS 38,215] along with the UE Rx-Tx time difference measurement. When the UE reports DL RSCPD measurement(s) along with DL RSTD measurement(s) or DL RSCP measurement(s) along with UE Rx-Tx time difference measurement(s), the DL RSCPD and/or DL RSCP measurement(s) should be measured from a single DL PRS positioning frequency layer. For a UE in RRC\_CONNECTED state, DL RSCP/RSCPD measurements are measured within the configured measurement gap.The UE is expected to obtain each DL RSCP or DL RSCPD measurement with $N\_{sample}=1$ as defined in [11, TS 38.133]. If the UE reports a DL RSTD measurement with $N\_{sample}$ = 2 or 4 samples as defined in [11, TS 38.133], up to $N\_{sample}$ DL RSCPD measurements can be reported associated with the DL RSTD measurement. If the UE reports a UE Rx-Tx time difference measurement with $N\_{sample}$ = 2 or 4 samples as defined in [11, TS 38.133], up to $N\_{sample}$ DL RSCP measurements can be reported associated with the UE Rx-Tx time difference measurement. Each DL RSCP or DL RSCPD measurement has its own timestamp. When the UE reports a timestamp associated with a DL RSCP measurement or a DL RSCPD measurement, subject to UE capability, it may include a symbol index in the timestamp.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 *phaseQualityValue* field. |

FL Comments:

In FL’s view, either draft CR of R1-2406167 or draft CR of R1-2406957 will address the DL PRS measurements in RRC\_IDLE mode. Draft CR of R1-2406167 might be preferred because it also addresses the prioritization issue of the reception of DL PRS (Note: The final CR should use the latest *CR-Form-v12.3*).

### (Round1) Proposal 2

Adopt one of the following options:

* Option 1: Endorse the draft CR in R1-2406167 for TS 38.214.
* Option 2: Endorse the draft CR in R1-2406957 for TS 38.214.

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| **Company** | **comments** |
| vivo | Option 1 is preferred. Otherwise the DL PRS measurements in RRC\_INACTIVE Mode will be repeated.  |
| Huawei, HiSilicon | Option 1.  |
| Qualcomm | Option 1 |
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# References

1. R1-2406958 Draft CR for measurement window in TS 38.214 ZTE Corporation, Sanechips
2. R1-2406167 Draft CR on DL PRS measurement in RRC\_IDLE mode vivo
3. R1-2406957 Draft CR for DL PRS measurement in TS 38.214 ZTE Corporation, Sanechips