**3GPP TSG-RAN4 Meeting #102-e *R4-2207124***

**Electronic Meeting, February 21-March 03, 2022**

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.133** | **CR** | **2666** | **rev** | **-** | **Current version:** | **17.4.0** |  |
|  | | | | | | | | |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME | **x** | Radio Access Network |  | Core Network |  |

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| ***Title:*** | Big CR: RRM requirements for Rel-17 NR Positioning Enhancements | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Ericsson | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_pos\_enh-Core | | | | |  | ***Date:*** | | | 2022-03-09 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-17 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | To incorporate all the draft CRs related to positioning enhancements endorsed at RAN4#102-e. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | The Big CR is based on the Draft CR template endorsed in R4-2202683 at RAN4#101-bis-e.  PRS measurement requirements for the following features are specified:   * PRS measurement requirements in RRC inactive state, * PRS measurement requirements with latency reduction, * PRS measurement requirements without gaps, * Scheduling restriction requirements for PRS measurements, * PRS-RSRPP measurement requirements.   The following endorsed draft CRs are incorporated in the Big CR:   1. R4-2206984, Draft CR on PRS-RSRP measurement period without gaps, CATT 2. R4-2206985, Draft CR on PRS-RSRPP measurement period without gaps, CATT 3. R4-2206986, Draft CR to measurement period for UE Rx-Tx time difference measurement without gap, OPPO 4. R4-2206987, Draft CR to scheduling availability of UE during RSTD measurement without gap, OPPO 5. R4-2206988, DraftCR to TS 38.133: NR ePos PRS-RSRP with reduced number of samples (9.9.3.5), Intel 6. R4-2206989, Draft CR to 38.133 Introduction of RSTD measurement requirements for latency reduction , Vivo 7. R4-2206990, Draft CR to 38.133 Introduction of scheduling availability of UE during UE Rx-Tx time difference measurement without gaps, Vivo 8. R4-2206991, CR on requirements for UE Rx-Tx measurement with reduced latency, Huawei, HiSilicon 9. R4-2206992, Draft CR: PRS-RSRPP measurement requirements including latency reduction, Ericsson 10. R4-2206993, CR on RSTD measurement period requirements without gaps, Huawei, HiSilicon 11. R4-2207103, General - PRS measurement without gaps Ericsson 12. R4-2206995, CR on scheduling restriction for PRS-RSRPP measurement, Huawei, HiSilicon 13. R4-2206996, Scheduling availability of UE during PRS-RSRP measurement, Ericsson 14. R4-2207000, Draft CR on PRS-RSRPP measurement requirements in RRC\_INACTIVE state, CATT 15. R4-2207001, DraftCR – RSTD measurement requirements in RRC\_INACTIVE state, Qualcomm 16. R4-2207002, Draft CR to 38.133 Introduction of PRS RSRP measurement requirements in RRC\_INACTIVE state, vivo 17. R4-2207004, CR on general requirements for PRS measurements in RRC Inactive, Huawei 18. R4-2207005, UE Rx-Tx measurement requirements in RRC inactive state (clause 5.5.4), Ericsson | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Enhanced PRS measurement requirements for different features cannot be guanranteed. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 3,3, 5.5, 5.x1.1, 5.x1.2, 5.x1.2.1, 5.x1.2.2, 5.x1.2.3, 5.x1.2.4, 5.x1.2.5, 5.x1.3, 5.x1.3.1, 5.x1.3.2, 5.x1.3.3, 5.x1.3.4, 5.x1.3.5, 5.x1.4, 5.x1.4.1, 5.x1.4.2, 5.x1.4.3, 5.x1.4.4, 5.x1.4.5, 5.x1.5, 5.x1.5.1, 5.x1.5.2, 5.x1.5.3, 5.x1.5.4, 5.x1.5.5, 9.9.1, 9.9.1.1, 9.9.1.2, 9.9.2.5, 9.9.26, 9.9.2.7, 9.9.3.5, 9.9.3.6, 9.9.3.7, 9.9.3.7, 9.9.4.5, 9.9.4.6, 9.9.4.7, 9.9.x1, 9.9.x1.1, 9.9.x1.2, 9.9.x1.3, 9.9.x1.4, 9.9.x1.5, 9.9.x1.6, 9.9.x1.7 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | |  | **X** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | | Big draft CR template was endorsed in R4-2202683 at RAN4#101-bis-e. | | | | | | | | |

**----------------------START OF CHANGE #1----------------------------**

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [11] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [11].

AoA Angle of Arrival

AoD Angle of Departure

BFD Beam Failure Detection

BFD-RS BFD Reference Signal

BLER Block Error Rate

BM-RS Beam Management Reference Signal

BWP Bandwidth Part

CA Carrier Aggregation

CBD Candidate Beam Detection

CBW Channel Bandwidth

CC Component Carrier

CCA Clear Channel Assessment

CLI Cross Link Interference

CMR Channel Measurement Resource

CORESET Control Resource Set

CP Cyclic Prefix

CSI Channel-State Information

CSI-RS CSI Reference Signal

CSI-RSRP CSI Reference Signal based Reference Signal Received Power

CSI-RSRQ CSI Reference Signal based Reference Signal Received Quality

CSI-SINR CSI Reference Signal based Signal to Noise and Interference Ratio

CSI\_RP Received (linear) average power of the resource elements that carry NR CSI-RS signals and channels, measured at the UE antenna connector

DBT Discovery Burst Transmission

DC Dual Connectivity

DCI Downlink Control Information

DL Downlink

DL-AoD Downlink Angle-of-Departure

DL-TDOA Downlink Time Difference Of Arrival

DMRS Demodulation Reference Signal

DRX Discontinuous Reception

E-CID Enhanced Cell ID

E-UTRA Evolved UTRA

E-UTRAN Evolved UTRAN

EN-DC E-UTRA-NR Dual Connectivity

FDD Frequency Division Duplex

FR Frequency Range

HARQ Hybrid Automatic Repeat Request

HO Handover

IMR Interference Measurement Resource

L1-RSRP Layer 1 RSRP

L1 SL-RSRP Layer 1 Sidelink RSRP which corresponds to PSCCH-RSRP and/or PSSCH-RSRP

LMF Location Management Function

LPP LTE Positioning Protocol

MAC Medium Access Control

MCG Master Cell Group

MDT Minimization of Drive Tests

MG Measurement Gap

MGL Measurement Gap Length

MGRP Measurement Gap Repetition Period

MIB Master Information Block

MN Master Node

MR-DC Multi-Radio Dual Connectivity

NE-DC NR-E-UTRA Dual Connectivity

NGEN-DC NG-RAN E-UTRA-NR Dual Connectivity

NR New Radio

NR-DC NR-NR Dual Connectivity

OFDM Orthogonal Frequency Division Multiplexing

OFDMA Orthogonal Frequency Division Multiple Access

OTDOA Observed Time Difference Of Arrival

PBCH Physical Broadcast Channel

PCC Primary Component Carrier

PCell Primary Cell

PDCCH Physical Downlink Control Channel

PDSCH Physical Downlink Shared Channel

PLMN Public Land Mobile Network

PPW PRS Processing Window

PRACH Physical RACH

PRP PRS Received Power

PRS Positioning Reference Signal

PRS-RSRP Positioning Reference Signal based Reference Signal Received Power

PRS-RSRPP Positioning Reference Signal based Reference Signal Received Path Power

PSBCH Physical Sidelink Broadcast Channel

PSBCH-RSRP Physical Sidelink Broadcast Channel DMRS based Reference Signal Received Power

PSCCH Physical Sidelink Control Channel

PSCCH-RSRP Physical Sidelink Control Channel DMRS based Reference Signal Received Power

PSCell Primary SCell

PSS Primary Synchronization Signal

PSSCH Physical Sidelink Shared Channel

PSSCH-RSRP Physical Sidelink Shared Channel DMRS based Reference Signal Received Power

pTAG Primary Timing Advance Group

PUCCH Physical Uplink Control Channel

PUSCH Physical Uplink Shared Channel

QCL Quasi Co-Location

RACH Random Access Channel

RAT Radio Access Technology

RLM Radio Link Monitoring

RLM-RS Reference Signal for RLM

RMSI Remaining Minimum System Information

RRC Radio Resource Control

RRM Radio Resource Management

RSSI Received Signal Strength Indicator

RSRP Reference Signal Received Power

RSRQ Reference Signal Received Quality

RSTD Reference Signal Time Difference

RTT Round Trip Time

S-SSB Sidelink Synchronization Signal Block

S-SSB\_RP Received (linear) average power of the resource elements that carry NR S-SSB signals and channels, measured at the UE antenna connector

SA Standalone operation mode

SCC Secondary Component Carrier

SCell Secondary Cell

SCG Secondary Cell Group

SCS Subcarrier Spacing

SCSSSB SSB subcarrier spacing

SDL Supplementary Downlink

SFN System Frame Number

SFTD SFN and Frame Timing DifferenceSI System Information

SIB System Information Block

SL-RSSI Sidelink Received Signal Strength Indicator

SLSS Sidelink Synchronization Signal

SMTC SSB-based Measurement Timing configuration

SpCell Special Cell

SRS Sounding Reference Signal

SRS-RSRP Sounding Reference Signal based Reference Signal Received Power

SS-RSRP Synchronization Signal based Reference Signal Received Power

SS-RSRQ Synchronization Signal based Reference Signal Received Quality

SS-SINR Synchronization Signal based Signal to Noise and Interference Ratio

SSB Synchronization Signal Block

SSB\_RP Received (linear) average power of the resource elements that carry NR SSB signals and channels, measured at the UE antenna connector.

SSS Secondary Synchronization Signal

sTAG Secondary Timing Advance Group

SUL Supplementary Uplink

TA Timing Advance

TAG Timing Advance Group

TCI Transmission Configuration Indicator

TDD Time Division Duplex

TDOA Time Difference Of Arrival

TRP Transmission-Reception Point

TTI Transmission Time Interval

UE User Equipment

UL Uplink

**------------------------END OF CHANGE #1-------------------------------**

**----------------------START OF CHANGE #2----------------------------**

5.x1 NR measurements for positioning

5.x1.1 Introduction

This clause contains requirements for UE capable of performing NR positioning measurements defined in TS 38.215 [4], including RSTD, PRS-RSRP, UE Rx-Tx time difference and PRS-RSRPP, in RRC\_INACTIVE state.

The requirements in clauses 5.x1.2, 5.x1.3, 5.x1.4 and 5.x1.5 are applicable to PRS resources that are not overlapped with other DL signals/channels.

- If a PRS resource is within the intitial DL BWP, the PRS resource overlap with other DL signals/channels when any other DL signals/channel occurs within the PRS resource.

- If a PRS resource is outside the intitial DL BWP, the PRS resource overlap with other DL signals/channels when any of the following conditions is met:

- any other DL signals/channel occurs within the PRS resource, or

- any other signals/channel occurs within X symbols before the PRS resource, or

- any other signals/channel occurs within X symbols after the PRS resource.

where X is defined in Table 5.x1.1-1.

**Table 5.x1.1-1: Value of X number of symbols**

|  |  |  |  |
| --- | --- | --- | --- |
| **FR** |  | **NR Slot**  **length (ms)** | **X symbols** |
|  |  |
| FR1 | 0 | 1 | 7 |
| 1 | 0.5 | 14 |
| 2 | 0.25 | 28 |
| FR2 | 2 | 0.25 | 14 |
| 3 | 0.125 | 28 |
| Note 1: The FR1 value applies if one or both of the serving cell and the positioning frequency layer are in FR1. FR2 value applies both of the serving cell and the positioning frequency layer are in FR2. | | | |

All measurement requirements specified in clauses 5.x1.2, 5.x1.3, 5.x1.4 and 5.x1.5 shall apply for any DRX configuration specified in TS 38.331 [2].

The requirements in clauses 5.x1.2, 5.x1.3, 5.x1.4 and 5.x1.5 are applicable provided that the cell selection procedure for the selected PLMN defined in TS 38.304 [1] is not triggered during PRS measurement period.

The UE is not required to perform additional SSB measurement for the SSB configured as QCL source of PRS resources.

When the UE is configured with measurement for more than one positioning requests, the measurement period for each request may be longer than measurement period when UE is configured with measurement for single positioning request.

*Editor’s Note: FFS on the defnition of “PRS resource” for defining the collision between PRS resource and other DL signals/channels.*

5.x1.2 RSTD measurements

5.x1.2.1 Introduction

The requirements in clause 5.x1.2 shall apply provided the UE has received *NR-DL-TDOA-RequestLocationInformation* message from the LMF via LPP [34] requesting the UE to measure and report DL RSTD measurements defined in TS 38.215 [4].

5.x1.2.2 Requirements Applicability

The requirements in clause 5.x1.2 apply for periodic and triggered RSTD measurements, provided:

- PRS-RSTD related side conditions given in clause 10.1.X for FR1 and FR2 are fulfilled, for a corresponding Band.

5.x1.2.3 Measurement Capability

The UE PRS RSTD measurement capability in RRC\_INACTIVE state is as indicated by the UE in *NR-DL-TDOA-ProvideCapabilities*, according to TS 37.355 [34].

5.x1.2.4 Measurement Reporting Requirements

The measurement reporting delay is defined as the time between the moment when the periodic measurement report is triggered and the moment when the UE is ready to transmit the measurement report over the air interface. If the UE supports reporting of NR positioning measurements via SDT, the UE may be able to report the measurements while it remains in RRC\_INACTIVE state; otherwise, the UE will transition to RRC\_CONNECTED state prior to transmitting the measurement report.

For RSTD measurements performed by the UE in RRC\_INACTIVE state, The measurement reporting delay excludes all of the following:

* additional delay caused other LPP signalling on the DCCH,
* delay uncertainty introduced when inserting the measurement report in the TTI of the uplink DCCH, equal to 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration,
* any delay caused by unavailability of UL resources to transmit the measurement report,
* any transmission delay needed by SDT,
* the time needed to transition to RRC\_CONNECTED state to report the measurements.

The reported RSTD measurement values contained in measurement reports shall be based on the measurement report mapping requirements specified in clauses 10.1.23.3.

The RSTD measurements performed and reported according to this section shall meet the RSTD measurement accuracy requirements in clause 10.1.X, for each measured DL PRS resource.

5.x1.2.5 Measurements Period Requirements

After receiving both *NR-TDOA-ProvideAssistanceData* message and *NR-TDOA-RequestLocationInformation* message from the LMF via LPP [34]*,* the UE shall be able to measure multiple (up to the UE capability specified in Clause 5.x1.2.3) DL RSTD measurements, defined in TS 38.215 [4], during the measurement period defined as:

Where ,

is the index of positioning frequency layer,

is total number of positioning frequency layers, and

is the periodicity of the PRS RSTD measurement in positioning frequency layer i

is the measurement period for PRS RSTD measurement in positioning frequency layer *i* as specified below:

],

where:

is the UE Rx beam sweeping factor. = 1 in FR1 and = [8] in FR2.

[ is a scaling factor for PRS-based NR positioning measurements in RRC\_INACTIVE. If the UE supports [Parallel PRS measurements in RRC\_INACTIVE state], Kcarrier\_PRS = 1; otherwise,

* If Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ, , where is defined in clause 4.2.2.4
* If Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ, , where is defined in clause 4.2.2.7. ]

is the maximum number of DL PRS resources in positioning frequency layer *i* configured in a slot.

is the time duration of available PRS in positioning frequency layer *i* to be measured during , and is calculated in the same way as PRS duration K defined in clause 5.1.6.5 of TS 38.214 [26]. [ For calculation of , only unmuted PRS resources that are not fully overlapped with other higher-priority DL signals/channels are considered. ]

is the number of PRS RSTD samples, where

* = 1 if the UE supports [M-sample measurements], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and one additional sample is not needed by the UE for Rx AGC,
* = 2 if the UE supports [M-sample measurements], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and one additional sample is needed by the UE for Rx AGC,
* = 4 otherwise.

is the measurement duration for the last PRS RSTD sample in positioning frequency layer *i*, including the sampling time and processing time, = + ,

is the periodicity of the PRS RSTD measurement in positioning frequency layer i defined as:

*=*

Where,

corresponds to [ *durationOfPRS-ProcessingSymbolsInEveryTms* ] in TS 37.355 [34],

*,* the least common multiple between and the DRX cycle length

is the periodicity of DL PRS resource with muting on positioning frequency layer *i*.

If more than one PRS periodicities are configured in positioning frequency layer *i*, the least common multiple of PRS periodicities among all DL PRS resource sets in the positioning frequency layer is used to derive , where,

, is the PRS periodicity with muting per PRS resource,

is the periodicity of PRS resource sets given by the higher-layer parameter *DL-PRS-Periodicity*.

is the scaling factor considering PRS resource muting. , where

is the muting repetition factor given by the higher-layer parameter *DL-PRS-MutingBitRepetitionFactor*, and is the size of the bitmap .

is the UE capability combination per band for RRC\_INACTIVE state where N is a duration of DL PRS symbols in ms corresponding to [*durationOfPRS-ProcessingSysmbols*] in TS 37.355 [34], T (ms) corresponds to [*durationOfPRS-ProcessingSymbolsInEveryTms*] in TS 37.355 [34], [ and T-N (>0) is the time required to process duration N of DL PRS symbols already buffered in memory], for a given maximum bandwidth supported by UE corresponding to [*supportedBandwidthPRS*] in TS 37.355 [34],

is UE capability for number of DL PRS resources that it can process in a slot [in RRC\_INACTIVE state as indicated by [*maxNumOfDL-PRS-ResProcessedPerSlot*] specified in TS 37.355 [34].

The time *s*tarts from [the first DRX cycle containing] a DL PRS resource(s) in the assistance data after both the *NR-TDOA-ProvideAssistanceData* message and *NR-TDOA-RequestLocationInformation* message are delivered from LMF to the UE via LPP [34].

Note: No per-positioning frequency layer requirement is applied in scenarios when multiple positioning frequency layers are configured.

If the DRX cycle is reconfigured during the RSTD measurement period, then the measurement period can be longer.

When PRS-RSRP is configured for DL-TDOA, RSTD and PRS-RSRP are performed over the same measurement period.

[ When PRS-RSRPP is configured for DL-TDOA, RSTD and PRS-RSRPP are performed over the same measurement period. ]

The measurement requirements do not apply to any PRS resource that always collides with other higher-priority DL signals/channels, as specified in clause 5.x1.1.

Longer PRS measurement period is expected when there are collisions between PRS resources and other higher-priority DL signals/channels.

[If changes for any PFL during the measurement period, the measurement period could be longer.]

The measurement requirements do not apply for a PRS resource, if the PRS resource is across two sampling duration of N within duration .

The measurement requirements do not apply for a PRS resource, if time span of the PRS resource instance (including at least the minimum number of repetitions specified in the accuracy requirements) is greater than UE reported capability N.

The requirements in clause 5.5.2 do not apply if the PRS configuration given by higher layer paramters *NR-DL-PRS-AssistanceData* exceeds any of the UE measurement capabilities given by *NR-DL-PRS-ResourcesCapability* in *NR-DL-TDOA-ProvideCapabilities*, and it is up to UE implementation which PRS resources are measured, subject to UE measurement capabilities*.*

If cell re-selection occurs while RSTD measurements are being performed, then the UE shall continue and complete the on-going RSTD measurements after a new cell is selected. The RSTD measurement period can be longer.

The UE shall meet the RSTD measurement accuracy requirements in clause 10.1.X.

5.x1.3 PRS-RSRP measurements

5.x1.3.1 Introduction

The requirements in clause 5.x1.3 shall apply provided the UE has received a message from LMF via LPP [34] requesting the UE to measure and report PRS-RSRP measurements defined in TS 38.215 [4]. And the UE is capable of supporting the PRS-RSRP measurement in RRC INACTIVE state.

5.x1.3.2 Requirements applicability

The requirements in clause 5.x1.3 apply for periodic and triggered PRS-RSRP measurements, provided:

- PRS-RSRP related side conditions given in clause 10.1.X are met for a corresponding Band.

5.x1.3.3 Measurement Capability

UE PRS-RSRP measurement capability is as indicated by the UE in *NR-DL-AoD-ProvideCapabilities* according to TS 37.355 [34].

5.x1.3.4 Measurement Reporting Requirements

The measurement reporting delay is defined as the time between the moment when the periodic measurement report is triggered and the moment when the UE is ready to transmit the measurement report over the air interface. If the UE supports reporting of NR positioning measurements via SDT, the UE may be able to report the measurements while it remains in RRC\_INACTIVE state; otherwise, the UE will transition to RRC\_CONNECTED state prior to transmitting the measurement report.

For PRS-RSRP measurements performed by the UE in RRC\_INACTIVE state, the measurement reporting delay excludes all of the following:

* any delay caused other LPP signalling on the DCCH,
* delay uncertainty introduced when inserting the measurement report in the TTI of the uplink DCCH which is equal to 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration,
* any delay caused by no UL resources for UE to send the measurement report,
* any transmission delay needed by SDT,
* the time needed to transition to RRC\_CONNECTED state to report the measurements.

The reported PRS-RSRP measurement values contained in measurement reports shall be based on the measurement report mapping requirements specified in clauses 10.1.X.

The PRS-RSRP measurement accuracy for all measured PRS resources shall be fulfilled according to the accuracy requriements specified in the clauses 10.1.X.

5.x1.3.5 Measurement Period Requirements

When the physical layer receives *NR-DL-AoD-ProvideAssistanceData* message and *NR-DL-AoD-RequestLocationInformation* message from LMF via LPP [34], the UE shall be able to measure multiple (up to the UE capability specified in Clause 5.x1.3.3) PRS-RSRP measurements, defined in TS 38.215 [4], from configured PRS resources for configured TRPs on configured positioning frequency layers, within ms.

where

*i* is the index of positioning frequency layer,

L is total number of positioning frequency layers,

is the periodicity of the PRS-RSRP measurement in positioning frequency layer *i*.

where

is a scaling factor for PRS-based NR positioning measurements in RRC\_INACTIVE. If the UE supports [Parallel PRS measurements in RRC\_INACTIVE state], = 1. Otherwise,

- If Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ, equals to the sum of Kcarrier in 4.2.2.4 and one positioning layer.

- If Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ, equals to the sum of Nlayer in 4.2.2.7 and one positioning layer.

is the scaling factor for Rx beam sweeping, and =1 if positioning frequency layer *i* is in FR1 and =8 if positioning frequency layer *i* is in FR2.

is the time duration of available PRS to be measured in the positioning frequency layer i to be measured during , and is calculated in the same way as PRS duration K defined in clause 5.1.6.5 of TS 38.214 [26]. For calculation of , only the PRS resources unmuted are considered.

is the maximum number of DL PRS resources of positioning frequency layer i configured in a slot,

is UE capability combination per band where N is a duration of DL PRS symbols in ms corresponding to *durationOfPRS-ProcessingSysmbols* in TS 37.355 [34] processed every T ms corresponding to *durationOfPRS-ProcessingSymbolsInEveryTms* in TS 37.355 [34] for a given maximum bandwidth supported by UE corresponding to *supportedBandwidthPRS* in TS 37.355 [34],

is UE capability for number of DL PRS resources that it can process in a slot as indicated by *maxNumOfDL-PRS-ResProcessedPerSlot* in clause 6.4.3 of TS 37.355 [34],

is the number of PRS-RSRP measurement samples and

= 1, if UE supports [M-sample measurements], and the LMF indicates the UE to perform positioning measurements with reduced number of samples, and [the condition under which AGC is not required] are met.

= 2, if UE supports [M-sample measurements], and the LMF indicates the UE to perform positioning measurements with reduced number of samples, and [the condition under which AGC is not required] are not met, = 2. Otherwise,

= 4.

*= +* is the measurement duration for the last PRS-RSRP sample, including the sampling time and processing time,

is the periodicity of PRS-RSRP measurement in positioning frequency layer *i*,

corresponds to durationOfPRS-ProcessingSymbolsInEveryTms in TS 37.355 [34],

the least common multiple between and ,

is the maximum PRS resource periodicity among all PRS resources in positioning frequency layer i,

is the DRX cycle length.

If positioning frequency layer *i* has more than one DL PRS resource set with different PRS periodicities with muting, , the least common multiple of among the DL PRS resource sets is used to derive , where:

is the periodicity of PRS resource sets given by the higher-layer parameter *DL-PRS-Periodicity*.

is the scaling factor considering PRS resource muting. , where is the muting repetition factor given by the higher-layer parameter *DL-PRS-MutingBitRepetitionFactor*, and is the size of the bitmap .

When PRS-RSRP measurements are configured for DL-AoD, the time starts from [the first DRX on duration] aligned with DL PRS resources in the assistance data after both the *NR-DL-AoD-RequestLocationInformation* message and *NR-DL-AoD-ProvideAssistanceData* message from LMF via LPP [34] are delivered to the physical layer of UE.

Note: No per-positioning frequency layer requirement is applied in scenarios when multiple positioning frequency layers are configured.

When the PRS-RSRP measurement is configured together with RSTD measurement then the PRS-RSRP measurement shall meet the RSTD measurement requirements defined in clause 5.5.2.

When the PRS-RSRP measurement is configured together with UE Rx-Tx time difference measurement then the PRS-RSRP measurement shall meet the UE Rx-Tx time difference measurement requirements defined in clause 5.x1.4.

The measurement requirements do not apply for a PRS resource:

* if the PRS resource is across two sampling duration of N within duration or
* if time span of the PRS resource instance (including at least the minimum number of repetitions specified in the accuracy requirements) is greater than UE reported capability N.

Longer PRS measurement period is expected when there is collision/overlap between other DL signals/channels and PRS resources in RRC\_INACTIVE state.

The requirements in clause 5.x1.3 do not apply if the PRS configuration given by higher layer paramters *NR-DL-PRS-AssistanceData* exceeds any of the UE measurement capabilities given by *NR-DL-PRS-ResourcesCapability* in *NR-DL-AoD-ProvideCapabilities*, and it is up to UE implementation which PRS resources are measured, subject to UE measurement capabilities*.*

If the DRX cycle is reconfigured during the PRS-RSRP measurement period then the PRS-RSRP measurement period can be longer.

The UE shall continue the PRS-RSRP measurement after the cell reselection then the PRS-RSRP measurement period can be longer.

If the UE state changes from the RRC\_INACTIVE to RRC\_CONNECT during the PRS-RSRP measurement period, then the UE can continue the PRS-RSRP measurement in the RRC\_CONNECT state. The PRS-RSRP measurement period can be longer.

The UE shall meet the PRS-RSRP measurement accuracy requirements in clause 10.1.X.

5.x1.4 UE Rx-Tx time difference measurements

5.x1.4.1 Introduction

The requirements in this clause shall apply, provided the UE has received *nr-Multi-RTT-RequestLocationInformation* message from LMF via LPP [34] requesting the UE to measure and report one or more UE Rx-Tx time difference measurements defined in TS 38.215 [4].

5.x1.4.2 Requirements Applicability

The requirements in clause 5.5.4 apply for periodic and triggered UE Rx-Tx time difference measurements, provided:

- UE Rx-Tx time difference measurement related side conditions given in clause 10.1.X are met for a corresponding band.

- SRS is configured on the PCell.

5.x1.4.3 Measurement Capability

UE Rx-Tx time difference measurement capability is as indicated by the UE in *NR-Multi-RTT-ProvideCapabilities,* according to TS 37.355 [34].

5.x1.4.4 Measurement Reporting Requirements

The measurement reporting delay is defined as the time between the moment the measurement report is triggered and the moment when the UE starts to transmit the measurement report over the air interface.

This measurement reporting delay excludes the delay caused by any of the following:

* delay caused by other LPP signalling on the DCCH.
* delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH. The delay uncertainty is: 2 x TTIDCCH where TTIDCCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PUSCH with subframe or slot or subslot duration.
* delay caused due to lack of UL resources for UE to send the measurement report.
* delay required by SDT for reporting the measurement using SDT resouces.
* delay required for transition to RRC\_CONNECTED state for report the measurement in RRC\_CONNECTED.

The UE Rx-Tx time difference measurement values contained in measurement reports shall be based on the measurement report mapping requirements specified in clause 10.1.X.

The UE Rx-Tx time difference measurement accuracy for all measured DL PRS resourcesshall be fulfilled according to the accuracy requirements specified in clause 10.1.X.

5.x1.4.5 Measurement Period Requirements

When physical layer receives last of *NR-Multi-RTT-ProvideAssistanceData* message and *NR-Multi-RTT-RequestLocationInformation* message from LMF via LPP [34]*,* UE shall be able to measure multiple (up to the UE capability specified in clause 5.x1.4.3) UE Rx-Tx time difference measurements as defined in TS 38.215 [4] in configured positioning frequency layers within the measurement period ms.

Where:

* is the index of positioning frequency layer,
* is the measurement period for UE Rx-Tx time difference measurements in positioning frequency layer *i* as further defined in this clause,
* L is total number of positioning frequency layers,
* is the periodicity of the UE Rx-Tx time difference measurement in positioning frequency layer *i* as defined further in this clause.

Where:

* =1 if the UE is capable of [*Parallel PRS measurements in RRC\_INACTIVE state*] defined in [34].
* if the UE is not capable of [*Parallel PRS measurements in RRC\_INACTIVE state*] defined in [34] and if Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ; where is defined in clause 4.2.2.7.
* if the UE is not capable of [*Parallel PRS measurements in RRC\_INACTIVE state*] defined in [34] and if Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ; where is defined in clause 4.2.2.5.
* is the scaling factor for UE Rx beam sweeping:
* =1 if positioning frequency layer *i* is in FR1
* = [8] if positioning frequency layer *i* is in FR2 and the UE does not support lower Rx beam sweeping factor.
* = [*lower Rx beam sweeping factor*] if positioning frequency layer *i* is in FR2 and the UE is capable of [*lower Rx beam sweeping factor*] defined in [34].
* is the time duration of available PRS resources in the positioning frequency layer *i*, to be measured during , and is calculated in the same way as PRS duration K defined in clause 5.1.6.5 of TS 38.214 [26].
* is the maximum number of DL PRS resources of positioning frequency layer i configured in a slot,
* is UE capability combination per band where N is a duration of DL PRS symbols in ms corresponding to *durationOfPRS-ProcessingSysmbols* in TS 37.355 [34] processed every T ms corresponding to *durationOfPRS-ProcessingSymbolsInEveryTms* in TS 37.355 [34] for a given maximum bandwidth supported by UE corresponding to *supportedBandwidthPRS* in clause 4.2.7.2 of TS 37.355 [34],
* is UE capability for number of DL PRS resources that it can process in a slot corresponding to *maxNumOfDL-PRS-ResProcessedPerSlot* as specified in clause 6.4.3 of TS 37.355 [34],
* is the number of UE Rx-Tx time difference measurement samples:
* = 4 if the UE is not capable of [*M-sample measurements*] defined in [34].
* = TBD if the UE is capable of [*M-sample measurements*] defined in [34] and meets the following conditions:
  + FFS: PRS bandwidth is within the active BWP and
  + FFS: Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within [6] dB.
* = TBD if the UE is capable of [*M-sample measurements*] defined in [34] but does not meet the following conditions:
  + FFS: PRS bandwidth is within the active BWP and
  + FFS: Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within [6] dB.
* is the measurement duration for the last UE Rx-Tx time difference measurement sample in the positioning layer i, including the sampling time and processing time,  *= +*  ,
* is periodicity of UE Rx-Tx time difference measurement in positioning frequency layer *i*:

Where:

* corresponds to *durationOfPRS-ProcessingSymbolsInEveryTms* in TS 37.355 [34],
* , the least common multiple between and .
* is the DRX cycle of the UE in the serving cell.
* is the PRS resource periodicity in positioning frequency layer *i*. If the positioning frequency layer *i* has more than one DL PRS resource sets with different PRS periodicities with muting, , the least common multiple of among DL PRS resource sets is used to derive , where
  + is the periodicity of PRS resource sets given by the higher-layer parameter *DL-PRS-Periodicity*.
  + is the scaling factor considering PRS resource muting. , where is the muting repetition factor given by the higher-layer parameter *DL-PRS-MutingBitRepetitionFactor*, and is the size of the bitmap

The time starts from the first DRX cycle containing the DL PRS resources in the assistance data after both the *NR-Multi-RTT-RequestLocationInformation* message and *NR-Multi-RTT-ProvideAssistanceData* message from LMF via LPP [34] are delivered to the physical layer of UE.

Note: No per-positioning frequency layer requirement is applied in scenarios when multiple positioning frequency layers are configured.

If the RRC state transition occurs from RRC\_INACTIVE to RRC\_CONNECTED state during the UE Rx-Tx time difference measurement period then the UE shall restart the UE Rx-Tx time difference measurement after it obtains SRS configuration and Timing Advance command from the serving cell.

If cell reselection occurs during the UE Rx-Tx time difference measurement period then the UE shall restart the UE Rx-Tx time difference measurement after it obtains SRS configuration and Timing Advance command from the new serving cell.

The measurement requirements do not apply for a PRS resource:

- if the PRS resource is across two sampling duration of N within duration or

- if time span of the PRS resource instance (including at least the minimum number of repetitions specified in the accuracy requirements) is greater than UE reported capability N.

If the DRX cycle is reconfigured during the UE Rx-Tx time difference measurement period then the UE Rx-Tx time difference measurement period can be longer.

If during UE Rx-Tx time difference measurement period PRS resources overlap with other DL signals/channels then the UE Rx-Tx time difference measurement period can be longer.

When PRS-RSRP is configured for multi-RTT, the UE Rx-Tx time difference measurements and PRS-RSRP measurements are performed over the same measurement period.

The requirements in clause 5.x1.4 do not apply if the PRS configuration given by higher layer paramters *NR-DL-PRS-AssistanceData* exceeds any of the UE measurement capabilities given by *NR-DL-PRS-ResourcesCapability* in *NR-Multi-RTT-ProvideCapabilities*, and it is up to UE implementation which PRS resources are measured, subject to UE measurement capabilities*.*

If UE uplink transmission timing changes due to the network-configured Timing Advance command during the UE Rx-Tx measurement period, then the UE Rx-Tx time difference measurement period is restarted after uplink transmission timing changes, and the UE Rx-Tx time difference measurement period requirements in this clause shall not apply.

If UE uplink transmission timing changes due to the change in the NTA\_offset defined in Table 7.1.2-2 during the UE Rx-Tx measurement period, then the UE Rx-Tx time difference measurement period is restarted after uplink transmission timing changes, and the UE Rx-Tx time difference measurement period requirements in this clause shall not apply.

5.x1.5 PRS-RSRPP measurements

5.x1.5.1 Introduction

The requirements in clause 5.x1.5.5 shall apply provided the UE has received a message from LMF via LPP requesting the UE to measure and report PRS-RSRPP measurements defined in TS 38.215 [4]. And the UE is capable of supporting the PRS-RSRPP measurement in RRC INACTIVE state.

5.x1.5.2 Requirements applicability

The requirements in clause 5.x1.5 apply for periodic and triggered PRS-RSRPP measurements, provided:

- PRS-RSRPP related side conditions given in clause 10.1.x are met for a corresponding Band.

5.x1.5.3 Measurement capability

TBD

5.x1.5.4 Measurement reporting requirements

This measurement reporting delay requirements should exclude the transmission time needed by SDT or the transmission time to connected state to report positioning measurements.

The reported PRS-RSRPP measurement values contained in measurement reports shall be based on the measurement report mapping requirements specified in clauses 10.1.x.

The PRS-RSRPP measurement accuracy for all measured PRS resources shall be fulfilled according to the accuracy requriements specified in the clauses 10.1.x.

5.5.5.5 Measurement period requirements

When the physical layer receives *NR-DL-AoD-ProvideAssistanceData* message and *NR-DL-AoD-RequestLocationInformation* message in RRC\_INACTIVE state, the UE shall be able to measure multiple (up to the UE capability specified in Clause 9.9.x1.3) PRS-RSRPP measurements as defined in TS 38.215 [4] on configured positioning frequency layers, within ms.

where

*i* is the index of positioning frequency layer,

L is the total number of positioning frequency layers,

is the periodicity of the PRS-RSRPP measurement in positioning frequency layer *i*.

where

Kcarrier\_PRS is the carrier specific scaling factor for PRS-RSRPP measurements. For the UE that supports parallel PRS measurement, Kcarrier\_PRS = 1. For the UE that not supports parallel PRS measurement, Kcarrier\_PRS equals to Kcarrier as defined in section 4.2.2.4 if Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ, or equals to Nlayer in 4.2.2.7 if Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ.

is the scaling factor for Rx beam sweeping, and =1 if positioning frequency layer *i* is in FR1. If positioning frequency layer *i* is in FR2, = [8].

is the time duration of available PRS to be measured in the positioning frequency layer i to be measured during , and is calculated in the same way as PRS duration K defined in clause 5.1.6.5 of TS 38.214 [26]. For calculation of , only the PRS resources unmuted are considered.

is the maximum number of DL PRS resources of positioning frequency layer i configured in a slot,

is UE capability combination per band where N is a duration of DL PRS symbols in ms corresponding to *[high layer signaling]* in TS 37.355 [34] processed every T ms corresponding to *[high layer signaling]* in TS 37.355 [34] for a given maximum bandwidth supported by UE corresponding to *supportedBandwidthPRS* in TS 37.355 [34],

is UE capability for number of DL PRS resources that it can process in a slot as indicated by *[high layer signaling]* in TS 37.355 [34],

* *Editor’s Note: the signaling is under discussion in RAN1/2.*

is the number of PRS-RSRPP measurement samples and = 4 for the UE not supporting reduced number of samples. For the UE supporting reduced number of samples, = FFS.

*= +* is the measurement duration for the last PRS-RSRPP sample, including the sampling time and processing time,

is the periodicity of PRS-RSRPP measurement in positioning frequency layer *i*,

corresponds to durationOfPRS-ProcessingSymbolsInEveryTms in TS 37.355 [34],

is the least common multiple between and DRX cycle,

is the maximum PRS resource periodicity among all PRS resources in positioning frequency layer i,

If positioning frequency layer *i* has more than one DL PRS resource set with different PRS periodicities with muting, , the least common multiple of among the DL PRS resource sets is used to derive , where:

is the periodicity of PRS resource sets given by the higher-layer parameter *DL-PRS-Periodicity*.

is the scaling factor considering PRS resource muting. If bitmap for higher-layer parameter *DL-* is the scaling factor considering PRS resource muting. , where is the muting repetition factor given by the higher-layer parameter *DL-PRS-MutingBitRepetitionFactor*, and is the size of the bitmap .

When PRS-RSRPP measurements are configured for DL-AoD, the time starts from the first DRX cycle including the DL PRS resources in the assistance data after both the *NR-DL-AoD-RequestLocationInformation* message and *NR-DL-AoD-ProvideAssistanceData* message are delivered to the physical layer of UE.

Note: No per-positioning frequency layer requirement is applied in scenarios when multiple positioning frequency layers are configured.

If changes during the measurement period, the measurement period could be longer.

The measurement requirements do not apply for a PRS resource:

* if the PRS resource is across two sampling duration of N within duration or
* if time span of the PRS resource instance (including at least the minimum number of repetitions specified in the accuracy requirements) is greater than UE reported capability N.

The PRS-RSRPP measurement requirements in this section apply for first path.

The requirements in this section apply, provided no PRS symbols are dropped during the measurement period due to collisions with other DL signals; otherwise, a longer measurement period is expected.

The requirements in clause 5.x1.5 do not apply if the PRS configuration given by higher layer paramters *NR-DL-PRS-AssistanceData* exceeds any of the UE measurement capabilities given by *NR-DL-PRS-ResourcesCapability* in *NR-DL-AoD-ProvideCapabilities*, and it is up to UE implementation which PRS resources are measured, subject to UE measurement capabilities*.*

If the DRX cycle is reconfigured during the PRS measurement period, the PRS measurement period can be longer.

If cell reselection occurs while PRS-RSRPP measurement is being performed, then the UE shall continue and complete the on-going PRS-RSRPP measurements after a new cell is selected. The PRS-RSRPP measurement period can be longer.

If the RRC state transition occurs from RRC\_INACTIVE to RRC\_CONNECTED state during the PRS-RSRPP measurement period then the UE shall continue the PRS-RSRPP measurement. The PRS-RSRPP measurement period can be longer.

*Editor’s Note: Section 5.x1.5 will be revisited to capture the agreement from stage 2 running CR in RAN2.*

**------------------------END OF CHANGE #2-------------------------------**

**----------------------START OF CHANGE #3----------------------------**

## 9.9 NR measurements for positioning

### 9.9.1 Introduction

This clause contains requirements for UE capable of performing NR positioning measurements defined in TS 38.215 [4], including RSTD, PRS-RSRP, UE Rx-Tx time difference, NR E-CID, and PRS-RSRPP measurements.

#### 9.9.1.1 General Aspects of Gap-based Measurement

For gap-based RSTD, PRS-RSRP, UE Rx-Tx time difference, and PRS-RSRPP measurements, the requirements in clauses 9.9.2, 9.9.3, 9.9.4 and 9.9.x1 apply provided:

-  UE is configured with per-UE measurement gaps

-  No active BWP switching occurs during the measurement gaps for PRS measurement,

All measurement requirements specified in clause 9.9.2, 9.9.3, 9.9.4 and 9.9.x1 shall apply without DRX as well as for any DRX configuration specified in TS 38.331 [2].

UE is not required to perform additional SSB measurement for the SSB configured as QCL source of PRS resources.

UE is only required to measure PRS resources that are fully or partially overlapped with measurement gaps, and the requirements in clause 9.9.2, 9.9.3, 9.9.4 and 9.9.x1 are applicable to PRS resources that are fully or partially overlapped with measurement gaps.

A PRS resource is considered to be fully (partially) overlapped with measurement gaps if all (some) of its instances are overlapped with a measurement gap occasion. A PRS resource instance is considered to be overlapped with measurement gap occasion if the minimum number of unmuted repetitions of the instance taking into account *nr-DL- PRS-ExpectedRSTD-Uncertainty* and *nr-DL-PRS-ExpectedRSTD* is fully covered by the MGL excluding RF switching time, where the minimum number is given in the accuracy requirements in clause 10.1.23, 10.1.24, 10.1.25 and 10.1.X for RSTD, PRS-RSRP, UE Rx-Tx time difference and PRS-RSRPP, respectively.

When UE is configured with measurement for more than one positioning requests, the measurement period for each request may be longer than measurement period when UE is configured with measurement for single positioning request.

#### 9.9.1.2 General Aspects of Gapless Measurement

The requirements for RSTD, PRS-RSRP, UE Rx-Tx time difference, and PRS-RSRPP measurement without measurement gaps specified in clauses 9.9.2.6, 9.9.3.6, 9.9.4.6 and 9.9.x1.6 shall apply provided that:

* UE is configured with PPW,
* No active BWP switching occurs during PPW,
* PRS is within PPW and do not overlap with other signals/channels of higher priority,
* Receive timing difference between the serving cell and a neighbor cell PRS ≤ Threshold; Threshold = {CP length, 0.5 slot}, other options are not precluded,
* SCS of PRS within PPW and SCS of DL active BWP are the same.

All measurement requirements specified in clauses 9.9.2.7, 9.9.3.6, 9.9.4.6 and 9.9.x1.6 shall apply without DRX as well as for any DRX configuration specified in TS 38.331 [2].

The UE is not required to perform additional SSB measurement for the SSB configured as QCL source of PRS resources.

The UE is only required to measure PRS resources that are unmuted and fully or partially overlapped with PPW, and the requirements in clauses 9.9.2.7, 9.9.3.6, 9.9.4.6 and 9.9.x1.6 are applicable to PRS resources that are unmuted and fully or partially overlapped with PPW.

A PRS resource is considered to be fully (partially) overlapped with PPW if all (some) of its instances are overlapped with a PPW occasion. A PRS resource instance is considered to be overlapped with PPW occasion if the minimum number of unmuted repetitions of the instance taking into account Rx time difference between serving and non-serving cellis fully covered by the PPW excluding RF switching time, where the minimum number is given in the accuracy requirements in clause 10.1.23, 10.1.24, 10.1.25 and 10.1.X for RSTD, PRS-RSRP, UE Rx-Tx time difference and PRS-RSRPP, respectively.

When UE is configured with measurement for more than one positioning requests, the measurement period for each request may be longer than measurement period when UE is configured with measurement for single positioning request.

**------------------------END OF CHANGE #3-------------------------------**

**----------------------START OF CHANGE #4----------------------------**

9.9.2.5 Measurements Period Requirements

When physical layer receives last of *NR-TDOA-ProvideAssistanceData* message and *NR-TDOA-RequestLocationInformation* message from LMF via LPP [34]*,* the UE shall be able to measure multiple (up to the UE capability specified in Clause 9.9.2.3) DL RSTD measurements, defined in TS 38.215 [4], during the measurement period defined as:

Where ,

is the index of positioning frequency layer,

is total number of positioning frequency layers, and

is the periodicity of the PRS RSTD measurement in positioning frequency layer i

is the measurement period for PRS RSTD measurement in positioning frequency layer *i* as specified below:

,

where:

is the UE Rx beam sweeping factor. In FR1, = 1; and in FR2, if UE supports [Support of lower Rx beam sweeping factor] and [the LMF indicates the UE to perform positioning measurements with a reduced Rx beam sweeping factor], is equal to the value of IE [Support of lower Rx beam sweeping factor]. Otherwise, = 8.

is the carrier-specific scaling factor for NR PRS-based positioning measurements in positioning frequency layer *i* as defined in clause 9.1.5.2.

is the maximum number of DL PRS resources in positioning frequency layer *i* configured in a slot.

is the time duration of available PRS in the positioning frequency layer i to be measured during , and is calculated in the same way as PRS duration K defined in clause 5.1.6.5 of TS 38.214 [26]. For calculation of , only the PRS resources unmuted and fully or partially overlapped with MG are considered.

is the number of PRS RSTD samples and

If UE supports [M-sample measurements], and the LMF indicates the UE to perform positioning measurements with reduced number of samples, and PRS bandwidth is within the active BWP and difference between the serving cell SS-RSRP and neighboring cell/TRP PRS-RSRP is within 6 dB, = 1.

If UE supports [M-sample measurements], and the LMF indicates the UE to perform positioning measurements with reduced number of samples, and PRS bandwidth is not within the active BWP or difference between the serving cell SS-RSRP and neighboring cell/TRP PRS-RSRP is more than 6 dB, = 2. Otherwise,

= 4.

is the measurement duration for the last PRS RSTD sample in positioning frequency layer *i*, including the

sampling time and processing time. If all of the PRS resources to be measured are available in the same MG occasion during Tavailabe, = +MGL. Otherwise, = + ,

is the periodicity of the PRS RSTD measurement in positioning frequency layer i defined as:

*=*

Where,

corresponds to *durationOfPRS-ProcessingSymbolsInEveryTms* in TS 37.355 [34],

*,* the least common multiple between and .

is the repetition periodicity of the measurement gap applicable for measurement in the PRS frequency layer i. is the periodicity of DL PRS resource with muting on positioning frequency layer *i*.

If more than one PRS periodicities are configured in positioning frequency layer *i*, the least common multiple of PRS periodicities among all DL PRS resource sets in the positioning frequency layer is used to derive , where,

, is the PRS periodicity with muting per PRS resource,

is the periodicity of PRS resource sets given by the higher-layer parameter *DL-PRS-Periodicity*.

is the scaling factor considering PRS resource muting. , where

is the muting repetition factor given by the higher-layer parameter *DL-PRS-MutingBitRepetitionFactor*, and is the size of the bitmap .

* Note: For the purpose of calculating TPRS,i, only the PRS resources fully or partially covered by the MG are considered.

is UE capability combination per band where N is a duration of DL PRS symbols in ms corresponding to *durationOfPRS-ProcessingSysmbols* in TS 37.355 [34] processed every T ms corresponding to *durationOfPRS-ProcessingSymbolsInEveryTms* in TS 37.355 [34] for a given maximum bandwidth supported by UE corresponding to *supportedBandwidthPRS* in TS 37.355 [34].

is UE capability for number of DL PRS resources that it can process in a slot as indicated by *maxNumOfDL-PRS-ResProcessedPerSlot* specified in TS 37.355 [34].

The time *s*tarts from the first MG instance aligned with a DL PRS resource(s) in the assistance data after both the *NR-TDOA-ProvideAssistanceData* message and *NR-TDOA-RequestLocationInformation* message are delivered from LMF to the physical layer of UE via LPP [34].

Note: No per-positioning frequency layer requirement is applied in scenarios when multiple positioning frequency layers are configured.

If during the measurement period of one or more positioning frequency layers, the MG pattern is reconfigured, the measurement period can be longer. When PRS-RSRP is configured for DL-TDOA, RSTD and RSRP are performed over the same measurement period.

When PRS-RSRP is configured for DL-TDOA, RSTD and RSRP are performed over the same measurement period.

The measurement requirements in this clause apply, provided no PRS symbols are dropped during the measurement period TRSTD,Total within measurement gaps due to collisions with other signals; otherwise, the measurement period can be longer.

If CSSF changes during the measurement period, the measurement period could be longer.

The measurement requirements do not apply for a PRS resource, if the PRS resource is across two sampling duration of N within duration .

The measurement requirements do not apply for a PRS resource, if time span of the PRS resource instance (including at least the minimum number of repetitions specified in the accuracy requirements) is greater than UE reported capability N.

The requirements in clause 9.9.2 do not apply if the PRS configuration given by higher layer paramters *NR-DL-PRS-AssistanceData* exceeds any of the UE measurement capabilities given by *NR-DL-PRS-ResourcesCapability* in *NR-DL-TDOA-ProvideCapabilities*, and it is up to UE implementation which PRS resources are measured, subject to UE measurement capabilities*.*

If handover occurs while RSTD measurements are being performed, then the UE shall continue and complete the on-going RSTD measurements. The RSTD measurement period can be longer. The UE shall meet the RSTD measurement accuracy requirements in clause 10.1.23.

Editor’s note: FFS: Applicable requirements at serving cell change which is not HO.

#### 9.9.2.6 Measurements Period Requirements without Measurement Gaps

When physical layer receives last of *NR-TDOA-ProvideAssistanceData* message and *NR-TDOA-RequestLocationInformation* message from LMF via LPP [34]*,* the UE shall be able to measure multiple (up to the UE capability specified in Clause 9.9.2.3) DL RSTD measurements, defined in TS 38.215 [4], on positioning frequency layer *i* during the measurement period defined as:

,

where:

is the UE Rx beam sweeping factor. In FR1, = 1; and in FR2, = FFS.

is the carrier-specific scaling factor for NR PRS-based positioning measurements in positioning frequency layer *i* as defined in clause TBD.]

*Editor’s Note: whether is applicable is related to priority between PRS and SSB when PRS and SSB collide within PPW, and it can be revisted based on RAN4 conclusion.*

is the maximum number of DL PRS resources in positioning frequency layer *i* configured in a slot.

is the time duration of available PRS in the positioning frequency layer i to be measured during , and is calculated in the same way as PRS duration K defined in clause 5.1.6.5 of TS 38.214 [26]. For calculation of , only the PRS resources unmuted and fully or partially overlapped with PPW are considered.

is the number of PRS RSTD samples and

if UE does not support [TBD, IE for capability on reduced sample number], or UE is not indicated by LMF to perform measurement with reduced sample number, = 4;

if UE supports [TBD, IE for capability on reduced sample number] and is indicated by LMF to perform measurement with reduced sample number, = 1 if the following conditions are met; = 2 otherwise.

PRS bandwidth is within the active BWP, and

Difference between the serving cell SS-RSRP and neighbor cell/TRP PRS-RSRP is within [6] dB.

is the measurement duration for the last PRS RSTD sample in positioning frequency layer *i*, including the sampling time and processing time, = FFS,

is the periodicity of the PRS RSTD measurement in positioning frequency layer i defined as:

*=*

Where,

corresponds to *durationOfPRS-ProcessingSymbolsInEveryTms* in TS 37.355 [34],

*,* the least common multiple between and .

is the repetition periodicity of the PRS processing window applicable for measurements in the positioning frequency layer *i*.

is the periodicity of DL PRS resource with muting on positioning frequency layer *i*.

If more than one PRS periodicities are configured in positioning frequency layer *i*, the least common multiple of PRS periodicities among all DL PRS resource sets in the positioning frequency layer is used to derive , where,

, is the PRS periodicity with muting per PRS resource,

is the periodicity of PRS resource sets given by the higher-layer parameter *DL-PRS-Periodicity*,

is the scaling factor considering PRS resource muting. , where is the muting repetition factor given by the higher-layer parameter *DL-PRS-MutingBitRepetitionFactor*, and is the size of the bitmap .

* Note: For the purpose of calculating , only the PRS resources fully or partially covered by the PPW are considered.

is UE capability combination per band where N is a duration of DL PRS symbols in ms corresponding to *durationOfPRS-ProcessingSysmbols* in TS 37.355 [34] processed every T ms corresponding to *durationOfPRS-ProcessingSymbolsInEveryTms* in TS 37.355 [34] for a given maximum bandwidth supported by UE corresponding to *supportedBandwidthPRS* in TS 37.355 [34].

is UE capability for number of DL PRS resources that it can process in a slot as indicated by *maxNumOfDL-PRS-ResProcessedPerSlot* specified in TS 37.355 [34].

The time *s*tarts from the first instance of the activated PPW for measurement of positioning frequency layer *i* aligned with a DL PRS resource(s) in the assistance data after both the *NR-TDOA-ProvideAssistanceData* message and *NR-TDOA-RequestLocationInformation* message are delivered from LMF to the physical layer of UE via LPP [34].

If during the measurement period of one or more positioning frequency layers, the MG pattern is reconfigured or PPW is reactivated, the measurement period can be longer.

When PRS-RSRP is configured for DL-TDOA, RSTD and RSRP are performed over the same measurement period.

The measurement requirements in this clause apply, provided no PRS symbols are dropped during the measurement period within measurement gaps due to collisions with other signals; otherwise, the measurement period can be longer.

The measurement requirements do not apply for a PRS resource, if the PRS resource is across two sampling duration of N within duration .

The measurement requirements do not apply for a PRS resource, if time span of the PRS resource instance (including at least the minimum number of repetitions specified in the accuracy requirements) is greater than UE reported capability N.

The requirements in clause 9.9.2 do not apply if the PRS configuration given by higher layer paramters *NR-DL-PRS-AssistanceData* exceeds any of the UE measurement capabilities given by *NR-DL-PRS-ResourcesCapability* in *NR-DL-TDOA-ProvideCapabilities*, and it is up to UE implementation which PRS resources are measured, subject to UE measurement capabilities*.*

If handover occurs while RSTD measurements are being performed, then the UE shall continue and complete the on-going RSTD measurements. The RSTD measurement period can be longer. The UE shall meet the RSTD measurement accuracy requirements in clause 10.1.23.

9.9.2.7 Scheduling Availability of UE during RSTD Measurement

If Cap. 1A UE capable of supporting priority options 1,2, and 3 is configured with priority state 1 for PRS RSTD measurement, then UE is not expected to receive PDCCH/PDSCH/CSI-RS on all symbols within PRS processing window.

If Cap.1A UE capable of supporting priority option 2 is configured with priority state 2 for PRS RSTD measurement, then UE is not expected to receive PDSCH/CSI-RS on all symbols within PRS processing window but is expected to receive PDCCH and URLLC PDSCH within PRS processing window.

If Cap. 1B UE capable of supporting priority options 1,2, and 3 is configured with priority state 1 for PRS RSTD measurement, then UE is not expected to receive PDCCH/PDSCH/CSI-RS from a certain [band or CC] on all symbols within PRS processing window.

If Cap. 1B UE capable of supporting priority option 2 is configured with priority state 2 for PRS RSTD measurement, then UE is not expected to receive PDSCH/CSI-RS from a certain [band or CC] but is expected to receive PDCCH and URLLC PDSCH from a certain [band or CC] on all symbols within PRS processing window.

If Cap. 2 UE capable of supporting priority options 1,2, and 3 is configured with priority state 1 for PRS RSTD measurement, then the UE is not expected to receive PDCCH/PDSCH/CSI-RS on the symbols overlapped with DL PRS within PRS processing window.

If Cap. 2 UE capable of supporting priority option 2 is configured with priority state 2 for PRS RSTD measurement, then UE is not expected to receive PDSCH/CSI-RS on the symbols overlapped with DL PRS within PRS processing window but is expected to receive PDCCH and URLLC PDSCH on the symbols overlapped with DL PRS within PRS processing window.

*FFS: scheduling availability for a UE indicating PRS measurement is lower priority than PDCCH/PDSCH/TRS/CSI-RS.*

**------------------------END OF CHANGE #4-------------------------------**

**-------------------------START OF CHANGE #5------------------------**

9.9.3.5 Measurement Period Requirements

When the physical layer receives *NR-DL-AoD-ProvideAssistanceData* message and *NR-DL-AoD-RequestLocationInformation* message from LMF via LPP [34], the UE shall be able to measure multiple (up to the UE capability specified in Clause 9.9.3.3) or single up to the UE capability “*M-sample measurements* “ specified in [TBD] PRS-RSRP measurements, defined in TS 38.215 [4], from configured PRS resources for configured TRPs on configured positioning frequency layers, within ms.

where

*i* is the index of positioning frequency layer,

L is total number of positioning frequency layers,

is the periodicity of the PRS-RSRP measurement in positioning frequency layer *i*.

where

is the carrier specific scaling factor for PRS-RSRP measurements specified in clause 9.1.5.2,

is the scaling factor for Rx beam sweeping, and =1 if positioning frequency layer *i* is in FR1 and =8 if positioning frequency layer *i* is in FR2, if UE does not support [TBD, IE for capability on reduced beam sweeping factor], otherwise equals to the indicated value in [TBD, IE for capability on reduced beam sweeping factor] ,

is the time duration of available PRS to be measured in the positioning frequency layer i to be measured during , and is calculated in the same way as PRS duration K defined in clause 5.1.6.5 of TS 38.214 [26]. For calculation of , only the PRS resources unmuted and fully or partially overlapped with MG are considered.

is the maximum number of DL PRS resources of positioning frequency layer i configured in a slot,

is UE capability combination per band where N is a duration of DL PRS symbols in ms corresponding to *durationOfPRS-ProcessingSysmbols* in TS 37.355 [34] processed every T ms corresponding to *durationOfPRS-ProcessingSymbolsInEveryTms* in TS 37.355 [34] for a given maximum bandwidth supported by UE corresponding to *supportedBandwidthPRS* in TS 37.355 [34],

is UE capability for number of DL PRS resources that it can process in a slot as indicated by *maxNumOfDL-PRS-ResProcessedPerSlot* in clause 6.4.3 of TS 37.355 [34],

is the number of PRS-RSRP measurement samples and

= 4, if UE does not support “*M-sample measurements* “ capability specified in [TBD]

= 2, if UE support “*M-sample measurements* “ capability specified in [TBD] but the conditions [TBD, for M2=0] is not met.

= 1, if UE support “*M-sample measurements* “ capability specified in [TBD] and the conditions [TBD, for M2=0] is met

*= +* is the measurement duration for the last PRS-RSRP sample, including the sampling time and processing time, if not all PRS resources to be measured are available in the same measurement gap occasion during , otherwise = + ,

is the periodicity of PRS-RSRP measurement in positioning frequency layer *i*,

corresponds to durationOfPRS-ProcessingSymbolsInEveryTms in TS 37.355 [34],

the least common multiple between and ,

is the maximum PRS resource periodicity among all PRS resources in positioning frequency layer i,

is the measurement gap repetition period in positioning frequency layer i.

If positioning frequency layer *i* has more than one DL PRS resource set with different PRS periodicities with muting, , the least common multiple of among the DL PRS resource sets is used to derive , where:

is the periodicity of PRS resource sets given by the higher-layer parameter *DL-PRS-Periodicity*.

is the scaling factor considering PRS resource muting. If bitmap for higher-layer parameter *DL-* is the scaling factor considering PRS resource muting. , where is the muting repetition factor given by the higher-layer parameter *DL-PRS-MutingBitRepetitionFactor*, and is the size of the bitmap .

Note: For the purpose of calculating TPRS,i, only the PRS resources fully or partially covered by the MG are considered.

When PRS-RSRP measurements are configured for DL-AoD, the time starts from the first MG instance aligned with DL PRS resources in the assistance data after both the *NR-DL-AoD-RequestLocationInformation* message and *NR-DL-AoD-ProvideAssistanceData* message from LMF via LPP [34] are delivered to the physical layer of UE.

Note: No per-positioning frequency layer requirement is applied in scenarios when multiple positioning frequency layers are configured.

When the PRS-RSRP measurement is configured together with RSTD measurement then the PRS-RSRP measurement shall meet the RSTD measurement requirements defined in clause 9.9.2.

When the PRS-RSRP measurement is configured together with UE Rx-Tx time difference measurement then the PRS-RSRP measurement shall meet the UE Rx-Tx time difference measurement requirements defined in clause 9.9.4.

If CSSF changes during the measurement period, the measurement period could be longer.

The measurement requirements do not apply for a PRS resource:

* if the PRS resource is across two sampling duration of N within duration or
* if time span of the PRS resource instance (including at least the minimum number of repetitions specified in the accuracy requirements) is greater than UE reported capability N.

If during the measurement period of one or more positioning frequency layers, the MG pattern is reconfigured either per UE request or not per UE request, the measurement period can be longer.

The requirements in this section apply, provided no PRS symbols are dropped during the measurement period within measurement gaps due to collisions with other signals; otherwise, a longer measurement period may be used.

The requirements in clause 9.9.3 do not apply if the PRS configuration given by higher layer paramters *NR-DL-PRS-AssistanceData* exceeds any of the UE measurement capabilities given by *NR-DL-PRS-ResourcesCapability* in *NR-DL-AoD-ProvideCapabilities*, and it is up to UE implementation which PRS resources are measured, subject to UE measurement capabilities*.*

If handover occurs while PRS-RSRP measurements are being performed then the UE shall complete the ongoing PRS-RSRP measurements session. The PRS-RSRP measurement period can be longer. The UE shall meet the PRS-RSRP measurement accuracy requirements in clause 10.1.24.

9.9.3.6 Measurement Period Requirements without Measurement Gaps

When the physical layer receives *NR-DL-AoD-ProvideAssistanceData* message and *NR-DL-AoD-RequestLocationInformation* message from LMF via LPP [34], the UE shall be able to measure multiple (up to the UE capability specified in Clause 9.9.3.3) PRS-RSRP measurements as defined in TS 38.215 [4] without measurement gap, on configured positioning frequency layers, within ms.

where

*i* is the index of positioning frequency layer,

L is the total number of positioning frequency layers,

is the periodicity of the PRS-RSRP measurement in positioning frequency layer *i*.

where

is the carrier specific scaling factor for PRS-RSRP measurements, and = FFS.

is the scaling factor for Rx beam sweeping, and =1 if positioning frequency layer *i* is in FR1. If positioning frequency layer *i* is in FR2, = [8],

is the time duration of available PRS to be measured in the positioning frequency layer i to be measured during , and is calculated in the same way as PRS duration K defined in clause 5.1.6.5 of TS 38.214 [26]. For calculation of , only unmuted PRS resource instances that meet the applicability conditions and fully or partially overlapped with PRS processing window are considered.

is the maximum number of DL PRS resources of positioning frequency layer i configured in a slot,

is UE capability combination per band where N is a duration of DL PRS symbols in ms corresponding to *durationOfPRS-ProcessingSysmbols* in TS 37.355 [34] processed every T ms corresponding to *durationOfPRS-ProcessingSymbolsInEveryTms* in TS 37.355 [34] for a given maximum bandwidth supported by UE corresponding to *supportedBandwidthPRS* in TS 37.355 [34],

is UE capability for number of DL PRS resources that it can process in a slot as indicated by *maxNumOfDL-PRS-ResProcessedPerSlot* in clause 6.4.3 of TS 37.355 [34],

is the number of PRS-RSRP measurement samples and = [4].

*= +* is the measurement duration for the last PRS-RSRP sample, including the sampling time and processing time,

is the periodicity of PRS-RSRP measurement in positioning frequency layer *i*,

corresponds to durationOfPRS-ProcessingSymbolsInEveryTms in TS 37.355 [34],

is the least common multiple between and ,

is the maximum PRS resource periodicity among all PRS resources in positioning frequency layer i,

is the PRS processing window repetition period in positioning frequency layer i.

If positioning frequency layer *i* has more than one DL PRS resource set with different PRS periodicities with muting, , the least common multiple of among the DL PRS resource sets is used to derive , where:

is the periodicity of PRS resource sets given by the higher-layer parameter *DL-PRS-Periodicity*.

is the scaling factor considering PRS resource muting. If bitmap for higher-layer parameter *DL-* is the scaling factor considering PRS resource muting. , where is the muting repetition factor given by the higher-layer parameter *DL-PRS-MutingBitRepetitionFactor*, and is the size of the bitmap .

Note: For the purpose of calculating TPRS,i, only the PRS resources within PRS processing window are considered.

When PRS-RSRP measurements are configured for DL-AoD, the time starts from the first PRS processing window instance aligned with DL PRS resources in the assistance data after both the *NR-DL-AoD-RequestLocationInformation* message and *NR-DL-AoD-ProvideAssistanceData* message from LMF via LPP [34] are delivered to the physical layer of UE.

Note: No per-positioning frequency layer requirement is applied in scenarios when multiple positioning frequency layers are configured.

When the PRS-RSRP measurement is configured together with RSTD measurement then the PRS-RSRP measurement shall meet the RSTD measurement requirements defined in clause 9.9.2.

When the PRS-RSRP measurement is configured together with UE Rx-Tx time difference measurement then the PRS-RSRP measurement shall meet the UE Rx-Tx time difference measurement requirements defined in clause 9.9.4.

If CSSF changes during the measurement period, the measurement period could be longer.

The measurement requirements do not apply for a PRS resource:

* if the PRS resource is across two sampling duration of N within duration or
* if time span of the PRS resource instance (including at least the minimum number of repetitions specified in the accuracy requirements) is greater than UE reported capability N.

The requirements in this section apply provided UE indicate that PRS is higher priority than other signals within PRS processing window.

The requirements in clause 9.9.3 do not apply if the PRS configuration given by higher layer paramters *NR-DL-PRS-AssistanceData* exceeds any of the UE measurement capabilities given by *NR-DL-PRS-ResourcesCapability* in *NR-DL-AoD-ProvideCapabilities*, and it is up to UE implementation which PRS resources are measured, subject to UE measurement capabilities*.*

If handover occurs while PRS-RSRP measurements are being performed then the UE shall complete the ongoing PRS-RSRP measurements session. The PRS-RSRP measurement period can be longer. The UE shall meet the PRS-RSRP measurement accuracy requirements in clause 10.1.24.

*Editor’s Note: PRS-RSRP measurement requirements without gaps, scheduling restriction.*

9.9.3.7 Scheduling Availability of UE during PRS-RSRP Measurement

If Cap. 1A UE capable of supporting priority options 1,2, and 3 is configured with priority state 1 for PRS-RSRP measurement, then UE is not expected to receive PDCCH/PDSCH/CSI-RS inside PPW.

If Cap.1A UE capable of supporting priority option 2 is configured with priority state 2 for PRS-RSRP measurement, then UE is not expected to receive PDSCH/CSI-RS inside PPW but is expected to receive PDCCH and URLLC PDSCH inside PPW.

If Cap. 1B UE capable of supporting priority options 1,2, and 3 is configured with priority state 1 for PRS-RSRP measurement, then UE is not expected to receive PDCCH/PDSCH/CSI-RS in the same band as DL PRS inside PPW.

If Cap. 1B UE capable of supporting priority option 2 is configured with priority state 2 for PRS-RSRP measurement, then UE is not expected to receive PDSCH/CSI-RS in the same band as DL PRS inside PPW but is expected to receive PDCCH and URLLC PDSCH in the same band as DL PRS inside PPW.

If Cap. 2 UE capable of supporting priority options 1,2, and 3 is configured with priority state 1 for PRS-RSRP measurement, then the UE is not expected to receive PDCCH/PDSCH/CSI-RS on overlapped symbols with DL PRS inside PPW.

If Cap. 2 UE capable of supporting priority option 2 is configured with priority state 2 for PRS-RSRP measurement, then UE is not expected to receive PDSCH/CSI-RS on overlapped symbols with DL PRS inside PPW but is expected to receive PDCCH and URLLC PDSCH on overlapped symbols with DL PRS inside PPW. For Cap.2 UE capable of supporting priority option 2, the symbols for PRS measurement includes serving cell PRS symbols, and serving cell symbols mapped with non-serving cell PRS.

**------------------------END OF CHANGE #5-------------------------------**

**----------------------START OF CHANGE # 6----------------------------**

9.9.4.5 Measurement Period Requirements

When physical layer receives last of *NR-Multi-RTT-ProvideAssistanceData* message and *NR-Multi-RTT-RequestLocationInformation* message from LMF via LPP [34]*,* UE shall be able to measure multiple (up to the UE capability specified in clause 9.9.4.3) UE Rx-Tx time difference measurements as defined in TS 38.215 [4] in configured positioning frequency layers within the measurement period ms.

*.*

where is the index of positioning frequency layer,

is the measurement period for UE Rx-Tx time difference measurements in positioning frequency layer *i* as further defined in this clause,

L is total number of positioning frequency layers, and

is the periodicity of the UE Rx-Tx time difference measurement in positioning frequency layer *i* as defined further in this clause.

Where

is the carrier-specific scaling factor for NR PRS-based measurement in the positioning frequency layer *i* as defined in clause 9.1.5.2,

is the scaling factor for Rx beam sweeping, and =1 if positioning frequency layer *i* is in FR1 and =8 if positioning frequency layer *i* is in FR2, if UE does not report [TBD, IE for capability on reduced beam sweeping factor], otherwise equals to the indicated value in [TBD, IE for capability on reduced beam sweeping factor],

is the time duration of available PRS resources in the positioning frequency layer *i*, to be measured during , and is calculated in the same way as PRS duration K defined in clause 5.1.6.5 of TS 38.214 [26]. For calculation of , only the PRS resources unmuted and fully or partially overlapped with MG are considered.

is the maximum number of DL PRS resources of positioning frequency layer i configured in a slot,

is UE capability combination per band where N is a duration of DL PRS symbols in ms corresponding to *durationOfPRS-ProcessingSysmbols* in TS 37.355 [34] processed every T ms corresponding to *durationOfPRS-ProcessingSymbolsInEveryTms* in TS 37.355 [34] for a given maximum bandwidth supported by UE corresponding to *supportedBandwidthPRS* in clause 4.2.7.2 of TS 37.355 [34],

is UE capability for number of DL PRS resources that it can process in a slot corresponding to *maxNumOfDL-PRS-ResProcessedPerSlot* as specified in clause 6.4.3 of TS 37.355 [34],

is the number of UE Rx-Tx time difference measurement samples and

if UE does not support [TBD, IE for capability on reduced sample number], or UE is not indicated by LMF to perform measurement with reduced sample number, = 4;

if UE supports [TBD, IE for capability on reduced sample number] and is indicated by LMF to perform measurement with reduced sample number, = 1 if the following conditions are met; = 2 otherwise.

PRS bandwidth is within the active BWP, and

Difference between the serving cell SS-RSRP and neighbor cell/TRP PRS-RSRP is within [6] dB.is the measurement duration for the last UE Rx-Tx time difference measurement sample in the positioning layer i, including the sampling time and processing time,  *= +*  ,

is periodicity of UE Rx-Tx time difference measurement in positioning frequency layer *i*:

where

corresponds to *durationOfPRS-ProcessingSymbolsInEveryTms* in TS 37.355 [34],

, the least common multiple between and

is the measurement gap repetition periodicity in positioning frequency layer *i*.

is the PRS resource periodicity in positioning frequency layer *i*. If the positioning frequency layer *i* has more than one DL PRS resource sets with different PRS periodicities with muting, , the least common multiple of among DL PRS resource sets is used to derive , where

is the periodicity of PRS resource sets given by the higher-layer parameter *DL-PRS-Periodicity*.

is the scaling factor considering PRS resource muting. , where is the muting repetition factor given by the higher-layer parameter *DL-PRS-MutingBitRepetitionFactor*, and is the size of the bitmap

Note: For the purpose of calculating TPRS,i, only the PRS resources fully or partially covered by the MG are considered.

The time starts from the first MG instance aligned with DL PRS resources in the assistance data after both the *NR-Multi-RTT-RequestLocationInformation* message and *NR-Multi-RTT-ProvideAssistanceData* message from LMF via LPP [34] are delivered to the physical layer of UE.

Note: No per-positioning frequency layer requirement is applied in scenarios when multiple positioning frequency layers are configured.

The UE Rx-Tx time difference measurement period is restarted if HO occurs during the measurement period and after SRS reconfiguration on the target cell is complete.

The measurement requirements do not apply for a PRS resource:

- if the PRS resource is across two sampling duration of N within duration or

- if time span of the PRS resource instance (including at least the minimum number of repetitions specified in the accuracy requirements) is greater than UE reported capability N.

If during the measurement period of one or more positioning frequency layers, the MG pattern is reconfigured either per UE request or not per UE request, the measurement period can be longer.

The requirements in this section apply, provided no PRS symbols are dropped during the measurement period TUERxTx,Total within measurement gaps due to collisions with other signals; otherwise, a longer measurement period may be used.

When PRS-RSRP is configured for multi-RTT, the UE Rx-Tx time difference measurements and PRS-RSRP measurements are performed over the same measurement period.

The requirements in clause 9.9.4 do not apply if the PRS configuration given by higher layer paramters *NR-DL-PRS-AssistanceData* exceeds any of the UE measurement capabilities given by *NR-DL-PRS-ResourcesCapability* in *NR-Multi-RTT-ProvideCapabilities*, and it is up to UE implementation which PRS resources are measured, subject to UE measurement capabilities*.*

When PSCell or SCell addition or release does not cause SRS reconfiguration during the measurement period, UE continues the UE Rx-Tx time difference measurement, and the measurement period requirements apply.

When PSCell or SCell addition or release causes SRS reconfiguration during the measurement period, UE shall restart the UE Rx-Tx time difference measurement after the SRS reconfiguration on the target cell is complete.

*Editor’s note:* FFS when SRS is reconfigured without cell change during the measurement period, UE shall restart the UE Rx-Tx time difference measurement after the SRS reconfiguration on the target cell is complete.

If UE uplink transmission timing changes due to the network-configured Timing Advance command during the UE Rx-Tx measurement period, then the UE Rx-Tx time difference measurement period is restarted after uplink transmission timing changes, and the UE Rx-Tx time difference measurement period requirements in this clause shall not apply.

If UE uplink transmission timing changes due to the change in the NTA\_offset defined in Table 7.1.2-2 during the UE Rx-Tx measurement period, then the UE Rx-Tx time difference measurement period is restarted after uplink transmission timing changes, and the UE Rx-Tx time difference measurement period requirements in this clause shall not apply.

#### 9.9.4.6 Measurement Period Requirements without Measurement Gaps

When physical layer receives last of *NR-Multi-RTT-ProvideAssistanceData* message and *NR-Multi-RTT-RequestLocationInformation* message from LMF via LPP [34]*,* UE shall be able to measure multiple (up to the UE capability specified in clause x.x.x) UE Rx-Tx time difference measurements as defined in TS 38.215 [4] in configured positioning frequency layers within the measurement period ms.

*.*

*FFS: whether only one PFL is assumed to be measured without gap.*

where is the index of positioning frequency layer,

is the measurement period for UE Rx-Tx time difference measurements in positioning frequency layer *i* as further defined in this clause,

L is total number of positioning frequency layers, and

is the periodicity of the UE Rx-Tx time difference measurement in positioning frequency layer *i* as defined further in this clause.

Where

is the carrier-specific scaling factor for NR PRS-based measurement in the positioning frequency layer *i* as defined in clause [x.x.x.x],

is the scaling factor for Rx beam sweeping, and =1 if positioning frequency layer *i* is in FR1 and =8 if positioning frequency layer *i* is in FR2,

is the time duration of available PRS resources in the positioning frequency layer *i*, to be measured during , and is calculated in the same way as PRS duration K defined in clause 5.1.6.5 of TS 38.214 [26]. For calculation of , only the unmuted PRS resources that meet the applicability conditions and fully or partially overlapped with PRS processing window are considered.

is the maximum number of DL PRS resources of positioning frequency layer i configured in a slot,

is UE capability combination per band where N is a duration of DL PRS symbols in ms corresponding to [*durationOfPRS-ProcessingSysmbols*] in TS 37.355 [34] processed every T ms corresponding to [*durationOfPRS-ProcessingSymbolsInEveryTms*] in TS 37.355 [34] for a given maximum bandwidth supported by UE corresponding to [*supportedBandwidthPRS*] in clause 4.2.7.2 of TS 37.355 [34],

is UE capability for number of DL PRS resources that it can process in a slot corresponding to [*maxNumOfDL-PRS-ResProcessedPerSlot*] as specified in clause 6.4.3 of TS 37.355 [34],

is the number of UE Rx-Tx time difference measurement samples.

=4 for UE not supporting reduced number of PRS samples.

=1 for UE supporting reduced number of PRS samples and the difference between the serving cell SS-RSRP and target neighbour cell PRS-RSRP is within [6]dB.

=2 for UE supporting reduced number of PRS samples and the difference between the serving cell SS-RSRP and target neighbour cell PRS-RSRP equals to or larger than [6]dB.

is the measurement duration for the last UE Rx-Tx time difference measurement sample in the positioning layer i, including the sampling time and processing time,  *= +*  ,

is periodicity of UE Rx-Tx time difference measurement in positioning frequency layer *i*:

where

corresponds to [*durationOfPRS-ProcessingSymbolsInEveryTms*] in TS 37.355 [34],

, the least common multiple between and

is the PRS processing window repetition periodicity in positioning frequency layer *i*.

is the PRS resource periodicity in positioning frequency layer *i*. If the positioning frequency layer *i* has more than one DL PRS resource sets with different PRS periodicities with muting, , the least common multiple of among DL PRS resource sets is used to derive , where

is the periodicity of PRS resource sets given by the higher-layer parameter *DL-PRS-Periodicity*.

is the scaling factor considering PRS resource muting. , where is the muting repetition factor given by the higher-layer parameter *DL-PRS-MutingBitRepetitionFactor*, and is the size of the bitmap

Note: For the purpose of calculating TPRS,i, only the PRS resources that meet the applicability conditions and fully or partially covered by the PRS processing window are considered.

The time starts from the first PRS processing window instance aligned with DL PRS resources in the assistance data after both the *NR-Multi-RTT-RequestLocationInformation* message and *NR-Multi-RTT-ProvideAssistanceData* message from LMF via LPP [34] are delivered to the physical layer of UE.

Note: No per-positioning frequency layer requirement is applied in scenarios when multiple positioning frequency layers are configured.

The UE Rx-Tx time difference measurement period is restarted if HO occurs during the measurement period and after SRS reconfiguration on the target cell is complete.

The measurement requirements do not apply for a PRS resource:

- if the PRS resource is across two sampling duration of N within duration or

- if time span of the PRS resource instance (including at least the minimum number of repetitions specified in the accuracy requirements) is greater than UE reported capability N.

If during the measurement period of one or more positioning frequency layers, the PRS processing window is reconfigured either per UE request or not per UE request, the measurement period can be longer.

The requirements in this section apply, provided no PRS symbols are dropped during the measurement period TUERxTx\_wo\_gap,Total within PRS processing window due to collisions with other signals; otherwise, a longer measurement period may be used.

When PRS-RSRP is configured for multi-RTT, the UE Rx-Tx time difference measurements and PRS-RSRP measurements are performed over the same measurement period.

The requirements in clause 9.9.4.6 do not apply if the PRS configuration given by higher layer paramters *NR-DL-PRS-AssistanceData* exceeds any of the UE measurement capabilities given by [*NR-DL-PRS-ResourcesCapability*] in [*NR-Multi-RTT-ProvideCapabilities*], and it is up to UE implementation which PRS resources are measured, subject to UE measurement capabilities*.*

When PSCell or SCell addition or release does not cause SRS reconfiguration during the measurement period, UE continues the UE Rx-Tx time difference measurement, and the measurement period requirements apply.

When PSCell or SCell addition or release causes SRS reconfiguration during the measurement period, UE shall restart the UE Rx-Tx time difference measurement after the SRS reconfiguration on the target cell is complete.

*Editor’s note:* FFS when SRS is reconfigured without cell change during the measurement period, UE shall restart the UE Rx-Tx time difference measurement after the SRS reconfiguration on the target cell is complete.

If UE uplink transmission timing changes due to the network-configured Timing Advance command during the UE Rx-Tx measurement period, then the UE Rx-Tx time difference measurement period is restarted after uplink transmission timing changes, and the UE Rx-Tx time difference measurement period requirements in this clause shall not apply.

If UE uplink transmission timing changes due to the change in the NTA\_offset defined in Table 7.1.2-2 during the UE Rx-Tx measurement period, then the UE Rx-Tx time difference measurement period is restarted after uplink transmission timing changes, and the UE Rx-Tx time difference measurement period requirements in this clause shall not apply.

#### 9.9.4.7 Scheduling Availability of UE during UE Rx-Tx Time Difference Measurement

The following scheduling restriction applies due to UE Rx-Tx time difference measurement without measurement gap:

- If Cap. 1A UE capable of supporting priority options 1,2, and 3 is configured with priority state 1 for UE Rx-Tx time difference measurement, then UE is not expected to receive PDCCH/PDSCH/CSI-RS for all DL CCs in the PRS processing window.

- If Cap.1A UE capable of supporting priority option 2 is configured with priority state 2 for UE Rx-Tx time difference measurement, then UE is not expected to receive PDSCH/CSI-RS for all DL CCs in the PRS processing window but is expected to receive PDCCH and URLLC PDSCH for all DL CCs in the PRS processing window.

- If Cap. 1B UE capable of supporting priority options 1,2, and 3 is configured with priority state 1 for UE Rx-Tx time difference measurement, then UE is not expected to receive PDCCH/PDSCH/CSI-RS in the same band as DL PRS in the PRS processing window.

- If Cap. 1B UE capable of supporting priority option 2 is configured with priority state 2 for UE Rx-Tx time difference measurement, then UE is not expected to receive PDSCH/CSI-RS in the same band as DL PRS in the PRS processing window but is expected to receive PDCCH and URLLC PDSCH in the same band as DL PRS in the PRS processing window.

- If Cap. 2 UE capable of supporting priority options 1,2, and 3 is configured with priority state 1 for UE Rx-Tx time difference measurement, then the UE is not expected to receive PDCCH/PDSCH/CSI-RS on overlapped symbols with DL PRS in the PRS processing window.

- If Cap. 2 UE capable of supporting priority option 2 is configured with priority state 2 for UE Rx-Tx time difference measurement, then UE is not expected to receive PDSCH/CSI-RS on overlapped symbols with DL PRS in the PRS processing window but is expected to receive PDCCH and URLLC PDSCH on overlapped symbols with DL PRS in the PRS processing window.

**------------------------END OF CHANGE #6-------------------------**

**-------------------------START OF CHANGE #7------------------------**

### 9.9.x1 PRS-RSRPP measurements

#### 9.9.x1.1 Introduction

The requirements in clause 9.9.x1.5 shall apply when UE is performing PRS measurement in the configured MG and provided the UE has received a message from LMF via LPP requesting the UE to measure and report PRS-RSRPP measurements defined in TS 38.215 [4].

The requirements in clause 9.9.x1.6 shall apply when UE is performing PRS measurement without gap and provided the UE has received a message from LMF via LPP requesting the UE to measure and report PRS-RSRPP measurements defined in TS 38.215 [4].

#### 9.9.x1.2 Requirements applicability

The requirements in clause 9.9.x1 apply for periodic and triggered PRS-RSRPP measurements, provided:

- PRS-RSRPP related side conditions given in clause 10.1.X are met for a corresponding Band.

#### 9.9.x1.3 Measurement capability

TBD

#### 9.9.x1.4 Measurement reporting requirements

TBD

#### 9.9.x1.5 Measurement period requirements

For PRS measurement within MG configured to UE, measurement period requirements for PRS-RSRP defined in 9.9.3.5 is re-used for PRS-RSRPP. Measurement period requirement with reduced number of samples for PRS-RSRP measurement with MG is also re-used for PRS-RSRPP.

*Editor’s note: Based on the output of stage 2 running CR in RAN2 9.9.x1.3 and 9.9.x1.4 will be updated. Depending on response to R4-2202780 from RAN1 changes relevant to 9.9.x1 may be done.*

9.9.x1.6 Measurement Period Requirements without Measurement Gaps

When the physical layer receives *NR-DL-AoD-ProvideAssistanceData* message and *NR-DL-AoD-RequestLocationInformation* message from LMF via LPP [34], the UE shall be able to measure multiple (up to the UE capability specified in Clause 9.9.6.y) PRS-RSRPP measurements as defined in TS 38.215 [4] without measurement gap, on configured positioning frequency layers, within ms.

where

*i* is the index of positioning frequency layer,

L is the total number of positioning frequency layers,

is the periodicity of the PRS-RSRPP measurement in positioning frequency layer *i*.

where

is the carrier specific scaling factor for PRS-RSRPP measurements, and = FFS.

is the scaling factor for Rx beam sweeping, and =1 if positioning frequency layer *i* is in FR1. If positioning frequency layer *i* is in FR2, = [8].

is the time duration of available PRS to be measured in the positioning frequency layer i to be measured during , and is calculated in the same way as PRS duration K defined in clause 5.1.6.5 of TS 38.214 [26]. For calculation of , only unmuted PRS resource instances that meet the applicability conditions and fully or partially overlapped with PRS processing window are considered.

is the maximum number of DL PRS resources of positioning frequency layer i configured in a slot,

is UE capability combination per band where N is a duration of DL PRS symbols in ms corresponding to *durationOfPRS-ProcessingSysmbols* in TS 37.355 [34] processed every T ms corresponding to *durationOfPRS-ProcessingSymbolsInEveryTms* in TS 37.355 [34] for a given maximum bandwidth supported by UE corresponding to *supportedBandwidthPRS* in TS 37.355 [34],

is UE capability for number of DL PRS resources that it can process in a slot as indicated by *maxNumOfDL-PRS-ResProcessedPerSlot* in clause 6.4.3 of TS 37.355 [34],

is the number of PRS-RSRPP measurement samples and = [4].

*= +* is the measurement duration for the last PRS-RSRPP sample, including the sampling time and processing time,

is the periodicity of PRS-RSRPP measurement in positioning frequency layer *i*,

corresponds to durationOfPRS-ProcessingSymbolsInEveryTms in TS 37.355 [34],

is the least common multiple between and ,

is the maximum PRS resource periodicity among all PRS resources in positioning frequency layer i,

is the PRS processing window repetition period in positioning frequency layer i.

If positioning frequency layer *i* has more than one DL PRS resource set with different PRS periodicities with muting, , the least common multiple of among the DL PRS resource sets is used to derive , where:

is the periodicity of PRS resource sets given by the higher-layer parameter *DL-PRS-Periodicity*.

is the scaling factor considering PRS resource muting. If bitmap for higher-layer parameter *DL-* is the scaling factor considering PRS resource muting. , where is the muting repetition factor given by the higher-layer parameter *DL-PRS-MutingBitRepetitionFactor*, and is the size of the bitmap .

Note: For the purpose of calculating TPRS,i, only the PRS resources within PRS processing window are considered.

When PRS-RSRPP measurements are configured for DL-AoD, the time starts from the first PRS processing window instance aligned with DL PRS resources in the assistance data after both the *NR-DL-AoD-RequestLocationInformation* message and *NR-DL-AoD-ProvideAssistanceData* message from LMF via LPP [34] are delivered to the physical layer of UE.

Note: No per-positioning frequency layer requirement is applied in scenarios when multiple positioning frequency layers are configured.

If CSSF changes during the measurement period, the measurement period could be longer.

The measurement requirements do not apply for a PRS resource:

* if the PRS resource is across two sampling duration of N within duration or
* if time span of the PRS resource instance (including at least the minimum number of repetitions specified in the accuracy requirements) is greater than UE reported capability N.

The PRS-RSRPP measurement requirements in this section apply for first path.

The requirements in this section apply provided UE indicate that PRS is higher priority than other signals within PRS processing window.

The requirements in clause 9.9.x1 do not apply if the PRS configuration given by higher layer paramters *NR-DL-PRS-AssistanceData* exceeds any of the UE measurement capabilities given by *NR-DL-PRS-ResourcesCapability* in *NR-DL-AoD-ProvideCapabilities*, and it is up to UE implementation which PRS resources are measured, subject to UE measurement capabilities*.*

If handover occurs while PRS-RSRPP measurements are being performed then the UE shall complete the ongoing PRS-RSRPP measurements session. The PRS-RSRPP measurement period can be longer. The UE shall meet the PRS-RSRPP measurement accuracy requirements in clause 10.1.x.

*Editor’s Note: Section 9.9.x1.6 will be revisited to capture the agreement from stage 2 running CR in RAN2.*

9.9.x1.7 Scheduling Availability of UE during PRS-RSRPP Measurement

When the UE performs PRS-RSRPP outside measurement gap, the following restrictions apply due to the measurement.

- If Cap. 1A UE capable of supporting priority options 1, 2 and 3 is configured with priority state 1 for PRS-RSRP measurement, then UE is not expected to receive PDCCH/PDSCH/CSI-RS inside PPW.

- If Cap.1A UE capable of supporting priority option 2 is configured with priority state 2 for PRS-RSRP measurement, then UE is not expected to receive PDSCH/CSI-RS inside PPW.

- If Cap. 1B UE capable of supporting priority options 1, 2 and 3 is configured with priority state 1 for PRS-RSRP measurement, then UE is not expected to receive PDCCH/PDSCH/CSI-RS in the same band as DL PRS inside PPW.

- If Cap. 1B UE capable of supporting priority option 2 is configured with priority state 2 for PRS-RSRP measurement, then UE is not expected to receive PDSCH/CSI-RS in the same band as DL PRS inside PPW.

- If Cap. 2 UE capable of supporting priority options 1, 2 and 3 is configured with priority state 1 for PRS-RSRP measurement, then the UE is not expected to receive PDCCH/PDSCH/CSI-RS on overlapped symbols with DL PRS inside PPW.

- If Cap. 2 UE capable of supporting priority option 2 is configured with priority state 2 for PRS-RSRP measurement, then UE is not expected to receive PDSCH/CSI-RS on overlapped symbols with DL PRS inside PPW but is expected to receive PDCCH and URLLC PDSCH on overlapped symbols with DL PRS inside PPW.

For UE supporting PRS processing type 2, the overlapped symbols include serving cell PRS symbols, and serving cell symbols mapped with non-serving cell PRS.

*Editor’s Note: FFS on the definition of serving cell symbols mapped with non-serving cell PRS.*

*Editor’s Note: FFS on whether there is scheduling restriction for DL signals/channels of higher priority.*

**------------------------END OF CHANGE #7-------------------------**