**3GPP TSG-RAN4 Meeting #109 *R4-2321429***

**Chicago, USA, November 13-17, 2023**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.133** | **CR** | **3878** | **rev** | **1** | **Current version:** | **18.3.0** |  |
|  | | | | | | | | |
| *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)*.* | | | | | | | | |
|  | | | | | | | | |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Proposed change affects:*** | UICC apps |  | ME | **x** | Radio Access Network |  | Core Network |  |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | | | | | | | | |
| ***Title:*** | Big CR on RRM Core Requirements for Positioning Enhancement in Rel-18 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Ericsson | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_pos\_enh2-Core | | | | |  | ***Date:*** | | | 2023-11-21 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-18 |
|  | *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 specify RRM core requirements for positioning enhancement in Rel-18. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | The Big CR is based on the latest endorsed Big draft CR template in R4-2321428 at RAN#109. The Big CR incorporates the following endorsed draft CRs at RAN4#109:   1. R4-2321424, Draft CR # 18 General aspects: Introduction (include aslo general aspects of CPP), ZTE Corporation 2. R4-2321425, Draft CR # 20 General aspects: Introduction (PRS measurement requirements for RedCap in RRC\_CONNECTED state), ZTE Corporation 3. R4-2321426, DraftCR #2 General aspects and PRS-RTSD measurement requirements in RRC\_IDLE, Qualcomm 4. R4-2321427, Draft CR # 6: General aspects - introduction (inclulding general aspects of PRS measurement with bandwidth aggregation and CPP), Ericsson 5. R4-2321430, Draft CR #27: on SL Rx-Tx time difference and SL RSRPP measurement requirements, CATT 6. R4-2321431, Draft CR #28 TS 38.133 SL-AoA and SL-RTOA measurement requirements, vivo 7. R4-2321432, Draft CR #25 38133 Introduction to SL positioning measurement requirements, Ericsson 8. R4-2321433, Draft CR #26 38133 SL RSTD and SL PRS-RSRP measurement requirements, Ericsson 9. R4-2321434, Draft CR #9 on PRS based UE Rx-Tx and RSRPP measurement requirements for LPHAP in RRC\_INACTIVE state, CATT 10. R4-2321436, Draft CR # 17 UE transmit timing for positioning measurements, LG Electronics 11. R4-2321437, Draft CR #3 PRS-RSRP and PRS-RSRPP measurement requirement in RRC IDLE state, OPPO 12. R4-2321438, Draft CR #8 on RSTD and PRS-RSRP measurement requirements for LPHAP in RRC inactive state, CMCC 13. R4-2321439, DraftCR #7: Cell reselection measurement for positioning, Huawei, HiSilicon 14. R4-2321440, DraftCR #14: Cell reselection measurement for positioning for RedCap UE, Huawei, HiSilicon 15. R4-2321441, Draft CR # 7A: TA validation requirements for positioning for LPHAP in RRC inactive statem Ericsson 16. R4-2321463, Draft CR # 20A: CSSF for PRS measurement requirements in RRC connected state for RedCap, Ericsson 17. R4-2321442, Draft CR #5 on PRS-RSRP(P) measurement requirements for RedCap positioning in RRC\_IDLE state, CATT 18. R4-2321443, Draft CR # 4: PRS measurement requirements for RedCap in RRC idle state (Introduction and RSTD measurement requirements), Xiaomi 19. R4-2321444, Draft CR # 13:PRS measurement requirements for RedCap positioning in RRC INACTIVE state (Introduction), Xiaomi 20. R4-2321445, Draft CR # 16:PRS measurement requirements for RedCap positioning in RRC INACTIVE state (UE Rx-Tx time difference measurement requirements), Xiaomi 21. R4-2321446, DraftCR #22: Requirements for RedCap Rx-Tx and PRS-RSRPP measurement in CONNECTED, Huawei, HiSilicon 22. R4-2321447, Draft CR # 15 PRS measurement requirements for RedCap positioning in RRC INACTIVE state (RSTD and PRS-RSRP measurement requirements), Ericsson 23. R4-2321448, Draft CR to 38.133 to implement measurement gap patterns for RedCap positioning, Ericsson 24. R4-2321449, Draft CR # 14A: TA validation requirements for RedCap positioning in RRC inactive state, Ericsson 25. R4-2321450, Draft CR #21 on Rel-18 RSTD and PRS-RSRP Measurement Requirements for RedCap in RRC Connected State, MediaTek 26. R4-2321451, DraftCR #10: Requirements for PRS BW aggregation in INACTIVE, Huawei, HiSilicon 27. R4-2321452, Draft CR # 19 PRS measurement requirements with bandwidth aggregation in RRC CONNECTED state (RSTD and UE Rx-Tx measurement requirements), Ericsson 28. R4-2321462, Draft CR # 3A: Measurement requirements for DL RSCPD reported with RSTD, Huawei 29. R4-2321454, Draft CR # 23 Requirements for DL RSCPD reported with RSTD in RRC CONNECTED state, Ericsson 30. R4-2321455, Draft CR 38.133 #11: Measurement requirements for RSCPD reported with RSTD in RRC\_INACTIVE, Nokia, Nokia Shanghai Bell 31. R4-2321456, Draft CR 38.133 #12: Measurement requirements for DL RSCP reported with UE Rx-Tx time difference in RRC\_INACTIVE, Nokia, Nokia Shanghai Bell 32. R4-2321457, Draft CR 38.133 #24: Measurement requirements for DL RSCP reported with UE Rx-Tx time difference in RRC\_CONNECTED, Nokia, Nokia Shanghai Bell | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | The RRM core requirements for positioning enhancement in Rel-18 will be missing. The performance of the positioning features in Rel-18 cannot be guaranteed. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 2, 3.1, 3.3, 4.x1, 4.x1.1, 4.x1.2, 4.x1.3, 4.x1.4, 4.x1.5, 4.x1A, 4.x1A.1, 4.x1A.2, 4.x1A.3, 4.x1A.4, 5.6, 5.6.1, 5.6.1A, 5.6.2, 5.6.3, 5.6.6, 5.6.x1, 5.6.x2, 5.6.2.x1, 5.6.4.x1, 5.6A, 5.6A.1, 5.6A.2, 5.6A.3, 5.6A.4, 5.6A.5, 5.6A.6, 7.1.2.4, 9.1A, 9.1A.1, 9.1A.2, 9.9.1, 9.9.2, 9.9.x1, 9.9.x2, 9.9.2.x1, 9.9.4.x1, 9.9A, 9.9A.1, 9.9A.2, 9.9A.3, 9.9A.4, 9.9A.5, 12A, 12A.1, 12A.2, 12A.3, 12A.4, 12A.5, 12A.6, 12A.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:*** | |  | | | | | | | | |

**----------------------START OF CHANGE----------------------------**

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TS 38.304: "NR; User Equipment (UE) procedures in idle mode".

[2] 3GPP TS 38.331: "NR; Radio Resource Control (RRC); Protocol specification".

[3] 3GPP TS 38.213: "NR; Physical layer procedures for control".

[4] 3GPP TS 38.215: "NR; Physical layer measurements".

[5] 3GPP TS 38.533: "NR; User Equipment (UE) conformance specification; Radio Resource Management (RRM)".

[6] 3GPP TS 38.211: "NR; Physical channels and modulation”.

[7] 3GPP TS 38.321: "NR; Medium Access Control (MAC) protocol specification".

[8] 3GPP TS 38.212 "NR; Multiplexing and channel coding".

[9] 3GPP TS 38.202: "NR; Physical layer services provided by the physical layer".

[10] 3GPP TS 38.300: "NR; Overall description; Stage-2".

[11] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[12] 3GPP TS 38.423: "NG-RAN; Xn Application Protocol (XnAP)".

[13] 3GPP TS 38.104: "NR; Base Station (BS) radio transmission and reception".

[14] 3GPP TS 38.306: "NR; User Equipment (UE) radio access capabilities".

[15] 3GPP TS 36.133: "Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of radio resource management".

[16] 3GPP TS 36.331: "Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC) protocol specification".

[17] 3GPP TS 37.340: "Evolved Universal Terrestrial Radio Access (E-UTRA) and NR; Multi-connectivity", Stage 2.

[18] 3GPP TS 38.101-1: "NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone".

[19] 3GPP TS 38.101-2: "NR; User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone".

[20] 3GPP TS 38.101-3: "NR; User Equipment (UE) radio transmission and reception; Part 3: Range 1 and Range 2 Interworking operation with other radios".

[21] 3GPP TS 38.101-4: "NR; User Equipment (UE) radio transmission and reception; Part 4: Performance requirements".

[22] 3GPP TS 38.305: "NG Radio Access Network (NG-RAN); Stage 2 functional specification of User Equipment (UE) positioning in NG-RAN".

[23] 3GPP TS 36.211: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation".

[24] 3GPP TS 36.300: "Evolved Universal Terrestrial Radio Access (E-UTRA); Overall description".

[25] 3GPP TS 36.101: "Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception".

[26] 3GPP TS 38.214: "NR; Physical layer procedures for data".

[27] 3GPP TS 36.355: "Evolved Universal Terrestrial Radio Access (E-UTRA); LTE Positioning Protocol (LPP)".

[28] Void.

[29] 3GPP TS 25.133: "Requirements for Support of Radio Resource Management (FDD)".

[30] 3GPP TS 25.302: "Services provided by the Physical Layer".

[31] 3GPP TS 37.320: "Universal Terrestrial Radio Access (UTRA), Evolved Universal Terrestrial Radio Access (E-UTRA) and Next Generation Radio Access; Radio measurement collection for Minimization of Drive Tests (MDT); Overall description; Stage 2".

[32] 3GPP TS 25.214: "Physical layer procedures (FDD)".

[33] 3GPP TS 37.213: "Physical layer procedures for shared spectrum channel access"

[34] 3GPP TS 37.355: "LTE Positioning Protocol (LPP) ".

[35] 3GPP TS 38.455 : "NG-RAN; NR Positioning Protocol A (NRPPa) ".

[36] 3GPP TS 37.106: “User Equipment (UE) requirements for shared spectrum channel access”.

[37] 3GPP TS 38.355: “NR; Sidelink Positioning Protocol (SLPP)”.

**-----------------------------NEXT CHANGE------------------------------**

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [11] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [11].

**1 Rx RedCap**: RedCap UE for which requirements are derived assuming 1 Rx branch.

**2 Rx RedCap**: RedCap UE for which requirements are derived assuming 2 Rx branches.

**Active DL BWP**: Active DL bandwidth part as defined in TS 38.213 [3].

**Blackbox Approach:** Testing methodology, in which the UE internal implementation of certain specific UE functionality involved in the test, is unknown.

**CD-SSB:** Cell defining SSB as defined in TS 38.300 [10].

**Control Resource Set:** As defined in TS 38.213 [3].

**DL BWP**: DL bandwidth part as defined in TS 38.213 [3].

**EN-DC**: E-UTRA-NR Dual Connectivity as defined in clause 4.1.2 of TS 37.340 [17].

**en-gNB**: As defined in TS 37.340 [17].

FH: As defined in TS 38.214 [26].

**FR1**: Frequency range 1 as defined in clause 5.1 of TS 38.104 [13].

**FR2**: Frequency range 2 as defined in clause 5.1 of TS 38.104 [13].

**gNB**: as defined in TS 38.300 [10].

**IBM (Independent Beam Management):** As defined in TS 38.101-2 [19].

**IDC solution:** As described in TS 36.300 [24] and TS 38.300 [10].

**LMF**: as defined in TS 38.305 [22].

**Master Cell Group:** As defined in TS 38.331 [2].

**Multi-Radio Dual Connectivity:** Dual Connectivity between E-UTRA and NR nodes, or between two NR nodes, as defined in TS 37.340 [17].

**NCD-SSB:** Non cell defining SSB as defined in TS 38.300 [10].

**ng-eNB**: As defined in TS 38.300 [10].

**NE-DC**: NR-E-UTRA Dual Connectivity as defined in clause 4.1.3.2 of TS 37.340 [17].

**NGEN-DC**: NG-RAN E-UTRA-NR Dual Connectivity as defined in clause 4.1.3.1 of TS 37.340 [17].

**NR-DC**: NR-NR Dual Connectivity as defined in clause 4.1.3.3 of TS 37.340 [17].

**Primary Cell**: As defined in TS 38.331 [2].

**PRS resource instance:** An instance in time of a configured PRS resource as defined in TS 38.331 [2], which may or not overlap with a measurement gap occasion.

**Quasi Co-Location:** As defined in TS 38.214 [26].

**RedCap UE:** A UE with reduced capabilities as defined in clause 4.2 in TS 38.306 [14].

**RLM-RS resource:** A resource out of the set of resources configured for RLM by higher layer parameter RLM-RS-List [2] as defined in TS 38.213 [3].

**SA operation mode**: Operation mode when the UE is configured with at least PCell and not any MR-DC.

**Secondary Cell**: As defined in TS 38.331 [2].

**Secondary Cell Group:** As defined in TS 38.331 [2].

**Serving Cell**: As defined in TS 38.331 [2].

**SMTC**: An SSB-based measurement timing configuration configured by *SSB-MeasurementTimingConfiguration* as specified in TS 38.331 [2].

**Special Cell:** As defined in TS 38.331 [2].

**SSB:** SS/PBCH block as defined in clause 7.8.3 of TS 38.211 [6].

**Timing Advance Group**: As defined in TS 38.331 [2].

**-----------------------------NEXT CHANGE------------------------------**

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

ATG Air to Ground

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

CG-SDT Configured Grant Small Data Transmisison

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

eDRX Extended DRX

E-UTRA Evolved UTRA

E-UTRAN Evolved UTRAN

EN-DC E-UTRA-NR Dual Connectivity

FDD Frequency Division Duplex

FH Frequency Hopping

FR Frequency Range

GEO Geostationary Earth Orbit

HARQ Hybrid Automatic Repeat Request

HO Handover

GAP Refers to any of Measurement Gap, activated Pre-MG and NCSG

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

LEO Low Earth Orbit

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

ML Measurement Length

MN Master Node

MR-DC Multi-Radio Dual Connectivity

MUSIM Multi-Universal Subscriber Identity Module

NCSG Network Controlled Small Gap

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

NTN Non-Terrestrial Network

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

PRACH Physical RACH

Pre-MG Pre-configured Measurement Gap

ProSe Proximity-based Service

PRP PRS Received Power

PRS Positioning Reference Signal

PRS-RSRP Positioning Reference Signal based Reference Signal Received Power

PPW PRS Processing Window

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

PTW Paging Time Window

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

RRH Remote Radio Head

RRM Radio Resource Management

RSCP Reference Signal Carrier Phase

RSCPD Reference Signal Carrier Phase Difference

RSSI Received Signal Strength Indicator

RSRP Reference Signal Received Power

RSRPP Reference Signal Received Path Power

RSRQ Reference Signal Received Quality

RSTD Reference Signal Time Difference

RTOA Relative Time Of Arrival

RTT Round Trip Time

S-SSB Sidelink 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 or radiated interface boundary.

SA Standalone operation mode

SAB Satellite access band

SAN Satellite Access Node

SCC Secondary Component Carrier

SCCH Sidelink Control Channel

SCell Secondary Cell

SCG Secondary Cell Group

SCS Subcarrier Spacing

SCSSSB SSB subcarrier spacing

SDL Supplementary Downlink

SDT Small Data Transmission

SFN System Frame Number

SFTD SFN and Frame Timing DifferenceSI System Information

SIB System Information Block

SL Sidelink

SL AoA Sidelink AoA

SL PRS-RSRP Sidelink PRS-based RSRP

SL PRS-RSRPP Sidelink PRS-based RSRPP

SL RSTD Sidelink RSTD

SL RTOA Sidelink RTOA

SL Rx-Tx Sidelink Receive-Transmit time difference

SL-PRS Sidelink PRS

SL-RSSI Sidelink Received Signal Strength Indicator

SLPP Sidelink Positioning Protocol

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

TN Terrestrial Network

TRP Transmission-Reception Point

TTI Transmission Time Interval

UE User Equipment

UL Uplink

V2X Vehicle-to-Everything service

VIL Visible Interruption Length

VIRP Visible Interruption Repetition Period

VSAT Very Small Aperture Terminal

**-----------------------------NEXT CHANGE------------------------------**

4.x1 NR measurements for positioning

### 4.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 and PRS-RSRPP, in RRC\_IDLE state.

The requirements in clauses 4.x1.2, 4.x1.3and 4.x1.4 are applicable to PRS resources that do not collide with other DL signals/channels which include SSB, SIB1, CORESET0, MSG2/MSGB, paging and DL SDT. In addition, a UE is not expected to receive PRS resources that collide with a time interval starting at symbol *m* and ending at symbol *m + N2*, where symbol *m* is the last symbol in which the UE is configured to receive PDCCH and *N2* is defined in clause 6.4 of [26, TS 38.214] for the subcarrier spacing μ of the DL PRS.

If a PRS resource is outside or partially overlapped with the intitial DL BWP, a PRS resource instance collides with another DL signals/channel~~s~~ if any portion of the other DL signal/channel overlaps with the time interval starting X symbols before the PRS instance and ending X symbols after the PRS instance, taking into account *nr-DL- PRS-ExpectedRSTD-Uncertainty* and *nr-DL-PRS-ExpectedRSTD.* Where X is defined in Table 5.6.1-1.

All measurement requirements specified in clauses 4.x1.2, 4.x1.3 and 4.x1.4 shall apply for DRX and eDRX configurations specified in TS 38.331 [2] for RRC\_IDLE state.

The requirements in clauses 4.x1.2, 4.x1.3 and 4.x1.4 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 requirements in clauses 4.x1.2, 4.x1.3, and 4.x1.4 apply provided that all PRS resources within a PFL are within up to 2 separate windows withinTPRS,i for each positioning frequency layer *i*, where each window is up to 10ms and TPRS,i is defined in in clauses 4.x1.2, 4.x1.3, and 4.x1.4.

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.

### 4.x1.2 RSTD measurements

4.x1.2.1 Introduction

The requirements in clause 4.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].

4.x1.2.2 Requirements Applicability

The requirements in clause 4.x1.2 apply for periodic and triggered RSTD measurements, provided:

- PRS-RSTD related side conditions given in clause 10.1.23.2 for FR1 and FR2 are fulfilled, for a corresponding band.

4.x1.2.3 Measurement Capability

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

4.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. The UE will transition to RRC\_CONNECTED state prior to transmitting the measurement report.

For RSTD measurements performed by a UE in RRC\_IDLE 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,

- 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 clause 10.1.23.3.

The RSTD measurements performed and reported according to this section shall meet the RSTD measurement accuracy requirements in clause [10.1.23.2], for each measured DL PRS resource.

4.x1.2.5 Measurements Period Requirements

After receiving both *NR-DL-TDOA-ProvideAssistanceData* message and *NR-DL-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 4.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 if positioning frequency layer *i* is in FR1, and if positioning frequency layer *i* is in FR2

- equals to the value as UE reported in *supportedLowerRxBeamSweepingFactor-FR2* if the capability is reported by the UE for the band containing positioning frequency layer i, and LMF indicates *lowerRxBeamSweepingFactor-FR2* in *NR-DL-TDOA-RequestLocationInformation* .

- equals to 8, otherwise.

- is a scaling factor for PRS-based NR positioning measurements in RRC\_INACTIVE. If the UE supports [*parallelPRS-MeasRRC-Inactive-r17*], 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 Rx TEG specific scaling factor:

- =1 if the UE is not configured by the LMF to measure a PRS resource with multiple Rx TEGs via *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* [34].

- is defined as follows if the UE is configured by the LMF with *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* [34] to perform measurement on same DL PRS resource of a TRP using different Rx TEGs in *NR-DL-TDOA-RequestLocationInformation* [34]:

- , if the UE is not capable of receiving same DL PRS resource simultaneously from multiple Rx TEGs, where P is the number of UE Rx TEGs that the UE is requested by LMF to measure the same DL-PRS Resource of a TRP indicated by *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* in [34], and in case ‘n0’ is indicated, P is the maximum number of Rx TEGs with which UE can support to measure the same PRS resource as reported in *NR-UE-TEG-Capability*.

- , if the UE is capable of receiving the same DL PRS resource simultaneously from multiple Rx TEGs, where is the number of UE Rx TEGs for measuring the same DL-PRS Resource simultaneously indicated by *measureSameDL-PRS-ResourceWithDifferentRxTEGsSimul-r17* in [34].

- 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 , 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 [*supportedDL-PRS-ProcessingSamples-RRC-Inactive*] [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and meets the following conditions:

- PRS bandwidth is within the initial BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 2 if the UE supports [*supportedDL-PRS-ProcessingSamples-RRC-Inactive*] [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and does not meet the following conditions:

- PRS bandwidth is within the initial BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 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-r17* in TS 37.355 [34],

- , the least common multiple between and , where is the DRX cycle of the UE, defined in TS 38.304 [1].

- 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\_IDLE state where N is a duration of DL PRS symbols in ms corresponding to [*durationOfPRS-ProcessingSymbols-r17*] in TS 37.355 [34], T (ms) corresponds to [*durationOfPRS-ProcessingSymbolsInEveryTms-r17*] 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 [in RRC\_IDLE state as indicated by [*maxNumOfDL-PRS-ResProcessedPerSlot-RRC-Inactive-r17*] specified in TS 37.355 [34].

When the UE is configured with periodic reporting, as defined in TS 23.273, clause 4.1a.5.1,

* If the UE operates in eDRX and eDRX is configured by higher layers [1], and the eDRx cycle TeDRX, CN is smaller than or equal to the configured PRS measurement reporting periodicity given by *reportingInterval* in TS 37.355 [34], and TeDRX, CN > 10.24s, the time *s*tarts from the first DL PRS resource(s) instances in the assistance data contained inside a Paging Time Window (PTW) after both the *NR-DL-TDOA-ProvideAssistanceData* message and *NR-DL-TDOA-RequestLocationInformation* message are delivered from LMF to the UE via LPP [34]. Otherwise, the time *s*tarts from the first DRX cycle containing the DL PRS resource(s) in the assistance data after both the *NR-DL-TDOA-ProvideAssistanceData* message and *NR-DL-TDOA-RequestLocationInformation* message are delivered from LMF to the UE via LPP [34].

*Editor’s Note: FFS the applicable requirements when the starting point of the measurement period is expected to start within PTW as described above but there are no PRS resources configured within PTW.*

When the UE is not configured with periodic reporting, the time *s*tarts from the first DRX cycle containing the DL PRS resource(s) in the assistance data after both the *NR-DL-TDOA-ProvideAssistanceData* message and *NR-DL-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 UE DRX cycle changes 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.

The measurement requirements do not apply to any PRS resource that always collides with other higher-priority DL signals/channels, as specified in clause 4.x1.1.

Longer RSTD 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 4.x1.2 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 the cell selection is completed. The RSTD measurement period can be longer.

If the RRC state transition occurs from RRC\_IDLE to RRC\_CONNECTED state during the RSTD measurement period then the UE shall continue the RSTD measurement in the RRC\_CONNECTED state. The RSTD measurement period can be longer.

The UE shall meet the RSTD measurement accuracy requirements in clause [10.1.23.2].

### 4.x1.3 PRS-RSRP measurements

4.x1.3.1 Introduction

The requirements in clause 4.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]. The UE is supposed to transition to RRC\_CONNECTED state to report the measurements.

4.x1.3.2 Requirements applicability

The requirements in clause 4.x1.3 apply for periodic and triggered PRS-RSRP measurements, provided:

- PRS-RSRP related side conditions given in clause 10.1.24.2 are met for a corresponding Band.

4.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].

4.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. The UE will transition to RRC\_CONNECTED state prior to transmitting the measurement report.

For PRS-RSRP measurements performed by the UE in RRC\_IDLE 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,

- 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 clause 10.1.24.3.

The PRS-RSRP measurement accuracy for all measured PRS resources shall be fulfilled according to the accuracy requriements specified in the clause 10.1.24.2.

4.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 4.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\_IDLE. If the UE supports *parallelPRS-MeasRRC-Inactive-r17*, = 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:

* =1 if positioning frequency layer *i* is in FR1, and
* If positioning frequency layer *i* is in FR2

- equals to the value as UE reported in *supportedLowerRxBeamSweepingFactor-FR2* if the capability is reported by the UE for the band containing positioning frequency layer i, and LMF indicates *lowerRxBeamSweepingFactor-FR2* in *NR-DL-AoD-RequestLocationInformation*.

- equals to 8, otherwise.

- 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 resources that are not fully overlapped with other higher-priority DL signals/channels 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-ProcessingSymbols-r17* in TS 37.355 [34] processed every T ms corresponding to *durationOfPRS-ProcessingSymbolsInEveryTms-r17* 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-RRC-Inactive-r17* in clause 6.4.3 of TS 37.355 [34],

- is the number of PRS-RSRP measurement samples and

- = 1, if UE supports *supportedDL-PRS-ProcessingSamples-RRC-Inactive* [34], and the LMF indicates the UE to perform positioning measurements with reduced number of samples by *reducedDL-PRS-ProcessingSamples* [34], and the following conditions are met:

- PRS bandwidth is within the initial BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 2, if UE supports *supportedDL-PRS-ProcessingSamples-RRC-Inactive* [34], and the LMF indicates the UE to perform positioning measurements with reduced number of samples by *reducedDL-PRS-ProcessingSamples* [34], and the following conditions are not met

- PRS bandwidth is within the initial BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 4 otherwise

*= +* 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-r17* 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 UE is not configured with eDRX\_IDLE cycle, and is defined as T in TS 38.304[1] if UE is configured with eDRX\_IDLE cycle.

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,

- if the UE is configured with both eDRX\_IDLE cycle and PRS measurement reporting periodicity via *reportingInterval* in *RequestLocationInformation*, and the eDRX\_IDLE cycle is smaller than or equals to the configured PRS measurement reporting periodicity, the time starts from the first DRX cycle within PTW containing the 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.

- otherwise, the time starts from the first DRX cycle containing the 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 4.x1.2.

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

The requirements in clause 4.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.

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

If the UE’s RRC state changes from the RRC\_IDLE to RRC\_CONNECTED during the PRS-RSRP measurement period, then the UE shall continue the PRS-RSRP measurement in the RRC\_CONNECTED state. The PRS-RSRP measurement period can be longer.

The UE shall meet the PRS-RSRP measurement accuracy requirements in clause 10.1.24.2.

### 4.x1.4 PRS-RSRPP measurements

4.x1.4.1 Introduction

The requirements in clause 4.x1.4 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]. The UE is supposed to transition to RRC\_CONNECTED state to report the measurements.

4.x1.4.2 Requirements Applicability

The requirements in clause 4.x1.4 apply for periodic and triggered PRS-RSRPP measurements, provided:

- PRS-RSRPP related side conditions given in clause 10.1.38.2 are met for a corresponding Band.

4.x1.4.3 Measurement Capability

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

4.x1.4.4 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. The UE will transition to RRC\_CONNECTED state prior to transmitting the measurement report.

For PRS-RSRPP measurements performed by the UE in RRC\_IDLE 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,

- the time needed to transition to RRC\_CONNECTED state to report the measurements.

The reported PRS-RSRPP measurement values contained in measurement reports shall be based on the measurement report mapping requirements specified in clause 10.1.38.3.

The PRS-RSRPP measurement accuracy for all measured PRS resources shall be fulfilled according to the accuracy requriements specified in the clause 10.1.38.2.

4.x1.4.5 Measurement Period Requirements

When the physical layer receives *NR-DL-AoD-ProvideAssistanceData* message and *NR-DL-AoD-RequestLocationInformation* message in RRC\_IDLE state, measurement period requirements for PRS-RSRP defined in 4.x1.3.5 is re-used for PRS-RSRPP measurement.

4.x1.5 Measurement requirements for DL RSCPD reported with RSTD

4.x1.5.1 Introduction

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

4.x1.5.2 Requirements Applicability

The requirements in clause 4.x1.5 apply for periodic and triggered RSTD and DL RSCPD measurements, provided:

- PRS-RSTD related side conditions given in clause 10.1.23.2 for FR1 and FR2 are fulfilled, for a corresponding Band.

- DL RSCPD related side conditions given in clause 10.1.x.y1 for FR1 and FR2 are fulfilled, for a corresponding Band.

4.x1.5.3 Measurement Capability

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

4.x1.5.4 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. The UE will transition to RRC\_CONNECTED state prior to transmitting the measurement report.

For RSTD and DL RSCPD measurements performed by the UE in RRC\_IDLE 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,

- 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 clause 10.1.23.3. The reported DL RSCPD measurement values contained in measurement reports shall be based on the measurement report mapping requirements specified in clause 10.1.x.y2.

The RSTD measurements performed and reported according to this section shall meet the RSTD measurement accuracy requirements in clause 10.1.23.2, for each measured DL PRS resource. The DL RSCPD measurements performed and reported according to this section shall meet the DL RSCPD measurement accuracy requirements in clause 10.1.x.y1, for each measured DL PRS resource.

4.x1.5.5 Measurements Period Requirements

*Editor’s Note: FFS: if RAN4 requirements need to be defined when the time window (Twindow) is not configured*

After receiving both *NR-DL-TDOA-ProvideAssistanceData* message and *NR-DL-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 4.x1.5.3) DL RSTD and DL RSCPD measurements, defined in TS 38.215 [4], during [TBD], if the time window is configured via [TBD] but the time window periodicity is not configured, and the start of the measurement period is the start of the window.

Otherwise, the UE shall be able to measure multiple (up to the UE capability specified in Clause 4.x1.5.3) DL RSTD and DL RSCPD measurements, defined in TS 38.215 [4], during 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 if positioning frequency layer *i* is in FR1, and if positioning frequency layer *i* is in FR2

- equals to the value as UE reported in *supportedLowerRxBeamSweepingFactor-FR2* if the capability is reported by the UE for the band containing positioning frequency layer i, and LMF indicates *lowerRxBeamSweepingFactor-FR2* in *NR-DL-TDOA-RequestLocationInformation*.

- equals to 8, otherwise.

- is a scaling factor for PRS-based NR positioning measurements in RRC\_INACTIVE. If the UE supports *parallelPRS-MeasRRC-Inactive-r17*, 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 Rx TEG specific scaling factor:

- =1 if the UE is not configured by the LMF to measure a PRS resource with multiple Rx TEGs via *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* [34].

- is defined as follows if the UE is configured by the LMF with *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* [34] to perform measurement on same DL PRS resource of a TRP using different Rx TEGs in *NR-DL-TDOA-RequestLocationInformation* [34]:

- , if the UE is not capable of receiving same DL PRS resource simultaneously from multiple Rx TEGs, where P is the number of UE Rx TEGs that the UE is requested by LMF to measure the same DL-PRS Resource of a TRP indicated by *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* in [34], and in case ‘n0’ is indicated, P is the maximum number of Rx TEGs with which UE can support to measure the same PRS resource as reported in *NR-UE-TEG-Capability*.

- , if the UE is capable of receiving the same DL PRS resource simultaneously from multiple Rx TEGs, where is the number of UE Rx TEGs for measuring the same DL-PRS Resource simultaneously indicated by *measureSameDL-PRS-ResourceWithDifferentRxTEGsSimul-r17* in [34].

- 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 , 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 in the indicated resources sets 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 *supportedDL-PRS-ProcessingSamples-RRC-Inactive* [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and meets the following conditions:

- PRS bandwidth is within the initial BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 2 if the UE supports *supportedDL-PRS-ProcessingSamples-RRC-Inactive* [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and does not meet the following conditions:

- PRS bandwidth is within the initial BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 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-r17* in TS 37.355 [34],

- , the least common multiple between , the DRX cycle length and the time window periodicity ,

- is the periodicity of DL PRS resource with muting on positioning frequency layer *i,* and when calculating , only the PRS resources in the indicated resources sets and overlapped with both the MG and the indicated time window(s) are considered

- is the maximum periodicity of the indicated time window(s).

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-ProcessingSymbols-r17* in TS 37.355 [34], T (ms) corresponds to *durationOfPRS-ProcessingSymbolsInEveryTms-r17* 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-RRC-Inactive-r17* specified in TS 37.355 [34].

The time *s*tarts from the first DRX cycle containing the DL PRS resource(s) in the assistance data after both the *NR-DL-TDOA-ProvideAssistanceData* message and *NR-DL-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.

The measurement requirements do not apply to any PRS resource that always collides with other higher-priority DL signals/channels, as specified in clause 5.6.1.

Longer RSTD 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 4.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-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 the cell selection is completed. The RSTD measurement period can be longer.

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

The UE shall meet the RSTD measurement accuracy requirements in clause 10.1.23.2.

4.x1A NR measurements for positioning for RedCap

4.x1A.1 Introduction

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

The requirements in clauses 4.x1A.2, 4.x1A.3, and 4.x1A.5 are applicable to PRS resources that do not collide with other DL signals/channels which include SSB, SIB1, CORESET0, MSG2/MSGB, paging and DL SDT. In addition, a UE is not expected to receive PRS resources that collide with a time interval starting at symbol *m* and ending at symbol *m + N2*, where symbol *m* is the last symbol in which the UE is configured to receive PDCCH and *N2* is defined in clause 6.4 of [26, TS 38.214] for the subcarrier spacing μ of the DL PRS.

If a PRS resource is outside or partially overlapped with the intitial DL BWP, a PRS resource instance collides with another DL signals/channel~~s~~ if any portion of the other DL signal/channel overlaps with the time interval starting X symbols before the PRS instance and ending X symbols after the PRS instance, taking into account *nr-DL- PRS-ExpectedRSTD-Uncertainty* and *nr-DL-PRS-ExpectedRSTD.* Where X is defined in Table 5.6.1-1.

All measurement requirements specified in clauses 4.x1A.2, 4.x1A.3, and 4.x1A.5 shall apply for DRX and eDRX configurations specified in TS 38.331 [2] for RRC\_IDLE state.

The requirements in clauses 4.x1A.2, 4.x1A.3, and 4.x1A.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 requirements in clauses 4.x1A.2, 4.x1A.3, and 4.x1A.5 apply provided that all PRS resources within a PFL are within up to 2 separate windows withinTPRS,i for each positioning frequency layer *i*, where each window is up to 10ms and TPRS,i is defined in in clauses 4.x1A.2, 4.x1A.3, and 4.x1A.5.

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.

4.x1A.2 RSTD measurements for RedCap

4.x1A.2.1 Introduction

The requirements in clause 4.x1A.2 shall apply provided the RedCap UE performing PRS measurement with Rx FH or without RX FH in RRC\_IDLE state 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].

4.x1A.2.2 Requirements Applicability

The requirements in clause 4.x1A.2 apply for periodic and triggered RSTD measurements, provided:

- PRS-RSTD related side conditions given in clause 10.1.23.x.x.x for FR1 are fulfilled, for a corresponding Band, for 1 Rx RedCap UE.

- PRS-RSTD related side conditions given in clause 10.1.23.2 for FR1 and FR2 are fulfilled, for a corresponding Band, for 2 Rx RedCap UE.

4.x1A.2.3 Measurement Capability

The UE PRS RSTD measurement capability in RRC\_IDLE state is as indicated by the UE in [*TBD]*, according to TS 37.355 [34].

4.x1A.2.4 Measurement Reporting Requirements

The measurement reporting delay shall satisfy the requirements defined in clause 4.x1.2.4, with the exception of the applicable measurement accuracy requirements, which are specified below.

The RSTD measurements performed and reported according to this section shall meet the RSTD measurement accuracy requirements in clause [TBD], for each measured DL PRS resource by 1 Rx RedCap UE without RX FH.

The RSTD measurements performed and reported according to this section shall meet the RSTD measurement accuracy requirements in clause 10.1.23.2, for each measured DL PRS resource by 2 Rx RedCap UE without RX FH.

The RSTD measurements performed and reported according to this section shall meet the RSTD measurement accuracy requirements in clause [TBD], for each measured DL PRS resource by 2 Rx RedCap UE with RX FH.

The RSTD measurements performed and reported according to this section shall meet the RSTD measurement accuracy requirements in clause [TBD], for each measured DL PRS resource by 1 Rx RedCap UE with RX FH.

4.x1A.2.5 Measurements Period Requirements without RX FH

After receiving both *NR-DL-TDOA-ProvideAssistanceData* message and [*NR-DL-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 4.x1A.2.3) DL RSTD measurements without RX FH, defined in TS 38.215 [4], during the measurement period defined in 4.x1.2.5.

The time *s*tarts from the first DRX cycle containing the DL PRS resource(s) in the assistance data after both the *NR-DL-TDOA-ProvideAssistanceData* message and *NR-DL-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.

The measurement requirements do not apply to any PRS resource that always collides with other higher-priority DL signals/channels, as specified in clause 4.x1A.2.

Longer RSTD 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 5.6.2 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 the cell selection is completed. The RSTD measurement period can be longer.

If the RRC state transition occurs from RRC\_IDLE to RRC\_CONNECTED state during the RSTD measurement period then the UE shall continue the RSTD measurement in the RRC\_CONNECTED state. The RSTD measurement period can be longer.

The UE shall meet the RSTD measurement accuracy requirements in clause 10.1.23.2.

4.x1A.2.6 Measurement Period Requirements with RX FH

*[Editor’s note: The requirement for RedCap without FH are defined in current stage. These requirements for RedCap with FH in RRC\_IDLE state can be depriotized after the requirements for RedCap with FH in RRC\_CONNECT stable enough.]*

4.x1A.3 PRS-RSRP measurements for RedCap

4.x1A.3.1 Introduction

The requirements in clause 4.x1A.3 shall apply provided the RedCap UE has received a message from LMF via LPP [34] requesting the RedCap UE to measure and report PRS-RSRP measurements defined in TS 38.215 [4]. And the RedCap UE is capable of supporting the PRS-RSRP measurement in RRC IDLE state.

4.x1A.3.2 Requirements applicability

The requirements in clause 4.x1A.3 apply for periodic and triggered PRS-RSRP measurements, provided:

- PRS-RSRP related side conditions given in clause 10.1A.x.x1 for FR1 are met for a corresponding Band for 1 Rx RedCap UE.

- PRS-RSRP related side conditions given in clause 10.1A.x.x2 for FR1 and FR2 are met for a corresponding Band for 2 Rx RedCap UE.

4.x1A.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].

4.x1A.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. The UE will transition to RRC\_CONNECTED state prior to transmitting the measurement report.

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

- any delay caused by 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,

- 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 clause 10.1.24.3.

The PRS-RSRP measurement accuracy for all measured PRS resources shall be fulfilled according to the accuracy requirements specified in the clause 10.1A.x.x1 for FR1 for 1 Rx RedCap UE.

The PRS-RSRP measurement accuracy for all measured PRS resources shall be fulfilled according to the accuracy requirements specified in the clause 10.1A.x.x2 for FR1 and FR2 for 2 Rx RedCap UE.

4.x1A.3.5 Measurement Period Requirements without FH

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 4.x1A.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\_IDLE. If the UE is capable of performing RRM measurement and PRS measurement in parallel to each other, = 1. Otherwise,

- If Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ, , where is defined in 4.2B.2.4.

- If Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ, , where Nlayer is defined in 4.2.2.7.

- is the scaling factor for Rx beam sweeping:

* =1 if positioning frequency layer *i* is in FR1 or UE has only 1 Rx branch, and if positioning frequency layer *i* is in FR2 or UE has 2 Rx branches

- equals to the value as UE reported in *supportedLowerRxBeamSweepingFactor-FR2* if the capability is reported by the UE for the band containing positioning frequency layer i, and LMF indicates *lowerRxBeamSweepingFactor-FR2* in *NR-DL-AoD-RequestLocationInformation*.

- equals to 8, otherwise.

- 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 resources that are not fully overlapped with other higher-priority DL signals/channels 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-ProcessingSymbols-r17* in TS 37.355 [34] processed every T ms corresponding to *durationOfPRS-ProcessingSymbolsInEveryTms-r17*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-RRC-Inactive-r17* in clause 6.4.3 of TS 37.355 [34],

- is the number of PRS-RSRP measurement samples and

- = 1, if UE supports *supportedDL-PRS-ProcessingSamples-RRC-Inactive* [34], and the LMF indicates the UE to perform positioning measurements with reduced number of samples by *reducedDL-PRS-ProcessingSamples* [34], and the following conditions are met:

- PRS bandwidth is within the initial BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 2, if UE supports *supportedDL-PRS-ProcessingSamples-RRC-Inactive* [34], and the LMF indicates the UE to perform positioning measurements with reduced number of samples by *reducedDL-PRS-ProcessingSamples* [34], and the following conditions are not met

- PRS bandwidth is within the initial BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 4 otherwise

*= +* 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-r17* 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 UE is not configured with eDRX. Otherwise, is defined as T in TS 38.304 [1].

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 cycle containing the 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.

- If UE is configured with eDRX:

- when eDRX cycle is smaller or equal to the configured PRS measurement reporting periodicity, TPRS-RSRP, total starts within PTW.

- when eDRX cycle is longer than the configured PRS measurement reporting periodicity or periodic PRS measurement reporting is not configured, the start of TPRS-RSRP, total is not limited to PTW.

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

Note: The PRS measurement reporting periodicity is the configured *reportingInterval* in *RequestLocationInformation*.

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 4.x1A.2.

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-RSRP measurement period is expected when there is collision/overlap between other DL signals/channels and PRS resources in RRC\_IDLE state]. *Editor’ note: No discussion and conclusion on collision between other DL signals/channels and PRS resources in RRC\_IDLE state yet.*

The requirements in clause 4.x1A.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.

If cell reselection occurs while PRS-RSRP measurement is being performed, then the UE shall continue and complete the on-going PRS-RSRP measurement after the cell selection is completed. The PRS-RSRP measurement period can be longer.

If the UE’s RRC state changes from the RRC\_IDLE to RRC\_CONNECTED during the PRS-RSRP measurement period, then the UE shall continue the PRS-RSRP measurement in the RRC\_CONNECTED state. The PRS-RSRP measurement period can be longer. *Editor’s note: Measurement period requirements with FH are still FFS.*

4.x1A.4 PRS-RSRPP measurements for RedCap

4.x1A.4.1 Introduction

The requirements in clause 4.x1A.4 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 IDLE state.

4.x1A.4.2 Requirements Applicability

The requirements in clause 4.x1A.4 apply for periodic and triggered PRS-RSRPP measurements, provided:

- PRS-RSRPP related side conditions given in clause 10.1A.x.x1 for FR1 are met for a corresponding Band for 1Rx RedCap UE.

- PRS-RSRPP related side conditions given in clause 10.1A.x.x2 for FR1 and FR2 are met for a corresponding Band for 2Rx RedCap UE.

4.x1A.4.3 Measurement Capability

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

4.x1A.4.4 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. The UE will transition to RRC\_CONNECTED state prior to transmitting the measurement report.

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

- any delay caused by 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,

- the time needed to transition to RRC\_CONNECTED state to report the measurements.

The reported PRS-RSRPP measurement values contained in measurement reports shall be based on the measurement report mapping requirements specified in clause 10.1.38.3.

The PRS-RSRPP measurement accuracy for all measured PRS resources shall be fulfilled according to the accuracy requirements specified in the clause 10.1A.x.x1 for FR1 for 1 Rx RedCap UE.

The PRS-RSRPP measurement accuracy for all measured PRS resources shall be fulfilled according to the accuracy requirements specified in the clause 10.1A.x.x2 for FR1 and FR2 for 2 Rx RedCap UE.

4.x1A.4.5 Measurement Period Requirements without FH

When the physical layer receives *NR-DL-AoD-ProvideAssistanceData* message and *NR-DL-AoD-RequestLocationInformation* message in RRC\_IDLE state, measurement period requirements for PRS-RSRP defined in 4.x1A.3.5 is re-used for PRS-RSRPP measurement.

*Editor’s note: Measurement period requirements with FH are still FFS.*

**-----------------------------NEXT CHANGE------------------------------**

## 5.6 NR measurements for positioning

### 5.6.1 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, PRS-RSRPP, RSCPD and RSCP in RRC\_INACTIVE state. For RSTD and UE Rx-Tx time difference, measurement requirements are specified both with and without aggregation of PRS resources from multiple PFLs. Requirements for RSCPD are specified only for measurements reported together with RSTD. Requirements for RSCP are specified only for measurements reported together with UE Rx-Tx time difference measurement.

The requirements in clauses 5.6.2, 5.6.3, 5.6.4, 5.6.5, 5.6.x1, and 5.6.x2 are applicable to PRS resources that do not collide with other DL signals/channels which include SSB, SIB1, CORESET0, MSG2/MSGB, paging and DL SDT. In addition, a UE is not expected to receive PRS resources that collide with a time interval starting at symbol *m* and ending at symbol *m + N2*, where symbol *m* is the last symbol in which the UE is configured to receive PDCCH and *N2* is defined in clause 6.4 of [26, TS 38.214] for the subcarrier spacing μ of the DL PRS.

If a PRS resource is outside or partially overlapped with the intitial DL BWP, a PRS resource instance collides with another DL signals/channel~~s~~ if any portion of the other DL signal/channel overlaps with the time interval starting X symbols before the PRS instance and ending X symbols after the PRS instance, taking into account *nr-DL- PRS-ExpectedRSTD-Uncertainty* and *nr-DL-PRS-ExpectedRSTD.* Where X is defined in Table 5.6.1-1.

Table 5.6.1-1: 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 if both of the serving cell and the positioning frequency layer are in FR2. | | | |

Measurement requirements specified in clauses 5.6.2, 5.6.3, 5.6.4, 5.6.5, 5.6.x1, and 5.6.x2 shall apply for any DRX and eDRX configuration specified in TS 38.331 [2].

The requirements in clauses 5.6.2, 5.6.3, 5.6.4 5.6.5, 5.6.x1, and 5.6.x2 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 requirements in clauses 5.6.2, 5.6.3, 5.6.4, 5.6.5, 5.6.x1, and 5.6.x2 apply provided that:

* all PRS resources within a PFL are within up to 2 separate windows withinTPRS,i for each positioning frequency layer *i* as defined in clauses 5.6.2, 5.6.3, 5.6.4 and 5.6.5, where each window is up to 10ms.

The requirements in clauses 5.6.x1 and 5.6.x2 apply provided that the UE is configured with a time window (TRSCPD) for RSCPD measurement together with RSTD measurement or with a time window (TRSCP) for RSCP measurement with UE Rx-Tx measurements as specified in TS 37.355 [34].

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.

**-----------------------------NEXT CHANGE------------------------------**

5.6.4.2 Requirements Applicability

The requirements in clause 5.6.4 apply for periodic and triggered UE Rx-Tx time difference measurements, provided:

- UE Rx-Tx time difference measurement related side conditions given in clause 10.1.25.2 are met for a corresponding band.

- SRS is configured on the PCell.

- UE has valid SRS configuration in the current camping cell.

**-----------------------------NEXT CHANGE------------------------------**

5.6.4.5 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 5.6.4.3) 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 *parallelPRS-MeasRRC-Inactive-r17* defined in [34].

- if the UE is not capable of *parallelPRS-MeasRRC-Inactive-r17* 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 *parallelPRS-MeasRRC-Inactive-r17* defined in [34] and if Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ; where is defined in clause 4.2.2.4.

- is the scaling factor for UE Rx beam sweeping:

- =1 if positioning frequency layer *i* is in FR1, and if positioning frequency layer *i* is in FR2.

- equals to the value as UE reported in *supportedLowerRxBeamSweepingFactor-FR2* if the capability is reported by the UE for the band containing positioning frequency layer i, and LMF indicates *lowerRxBeamSweepingFactor-FR2* in *NR-Multi-RTT -RequestLocationInformation*.

- equals to 8, otherwise.

is the Rx TEG specific scaling factor:

- = 1 if UE is not configured by LMF with measureSameDL-PRS-ResourceWithDifferentRxTxTEGs-r17 or measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17 [34].

- = measureSameDL-PRS-ResourceWithDifferentRxTxTEGs-r17 or measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17 if UE is configured by LMF to measurement same DL PRS with multiple UE RxTx TEGs or multiple UE Rx TEGs [34], and in case ‘n0’ is indicated, is the maximum number of Rx TEGs with which UE can support to measure the same PRS resource as reported in *NR-UE-TEG-Capability*.

- 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 unmuted PRS resources that are not fully overlapped with other higher-priority DL signals/channels 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-ProcessingSymbols-r17* in TS 37.355 [34] processed every T ms corresponding to *durationOfPRS-ProcessingSymbolsInEveryTms-r17* 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-RRC-Inactive-r17* 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 *supportedDL-PRS-ProcessingSamples-RRC-Inactive* defined in [34] or not configured to perform positioning measurements with reduced number of samples by *requestedDL-PRS-ProcessingSamples* [34].

- = 1 if the UE is capable of *supportedDL-PRS-ProcessingSamples-RRC-Inactive* defined in [34] and LMF requests the UE to perform positioning measurements with reduced number of samples by *requestedDL-PRS-ProcessingSamples* [34] and the following conditions are met:

- PRS bandwidth is within the initial BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 2 if the UE is capable of *supportedDL-PRS-ProcessingSamples-RRC-Inactive* defined in [34] and the LMF requests the UE to perform positioning measurements with reduced number of samples by *requestedDL-PRS-ProcessingSamples* [34] but the following conditions are not met:

- PRS bandwidth is within the initial BWP and

- 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-r17* in TS 37.355 [34],

- , the least common multiple between and .

- When UE is configured with RAN eDRX ≤ 10.24s:

- is defined as T in TS 38.304 [1] when CN eDRX ≤ 10.24s.

- is the maximum of the T inside and outside of the CN PTW when CN eDRX > 10.24s, where T inside and outside of the CN PTW are defined in TS 38.304 [1].

- When UE is configured with RAN eDRX > 10.24s:

- is the maximum of the DRX cycles within the CN PTW and the RAN PTW.

- Otherwise, 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.

- If UE is configured with RAN eDRX > 10.24s:

- when eDRX cycle is smaller or equal to configured PRS measurement reporting periodicity, TUERxTx,Total starts within PTW.

- when eDRX cycle is longer than configured PRS measurement reporting periodicity or periodic PRS measurement reporting is not configured, the start of TUERxTx,Total is not limited to PTW.

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

Note: The PRS measurement reporting periodicity is the configured *reportingInterval* in *RequestLocationInformation*.

If the RRC state transion 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.

If cell reselection occurs, and UE reselects to a cell out of the positioning validity area or if UE performs autonomous TA adjustment at reselection, then UE shall restart the measurement.

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 5.6.4 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.

The UE shall meet the UE Rx-Tx time difference measurement accuracy requirements in clause 10.1.25.2.

5.6.1A Cell re-selection for positioning

The requirements in this clause apply when UE is configured to perform SRS transmission for positioning.

The requirements in clause 5.1.2 shall apply in the following conditions.

- UE is not configured with eDRX\_IDLE, or

- UE is configured with eDRX\_IDLE but without eDRX\_INACTIVE, or

- UE is configured with both eDRX\_IDLE and eDRX\_INACTIVE, and eDRX\_INACTIVE cycle is smaller or equal to TPOS,

where TPOS is

- SRS transmission periodicity, if UE is configured to only perform SRS transmission for positioning,

- the minimum of PRS measurement reporting periodicity and SRS transmission periodicity, if UE is configured to both perform PRS measurements and to perform SRS transmission for positioning.

When UE is configured with both eDRX\_IDLE and eDRX\_INACTIVE, and eDRX\_INACTIVE cycle is larger than TPOS, the requirements in clause 5.1.2 except clause 5.1.2.2 and 5.1.2.3 shall apply, and the requirements in clause 5.6.1A.1 apply for measurement and evaluation of serving cell, and the requirements in clause 5.6.1A.2 apply for measurements of intra-frequency NR cells.

5.6.1A.1 Measurement and evaluation of serving cell

When UE is configured with both eDRX\_IDLE and eDRX\_INACTIVE, and eDRX\_INACTIVE cycle is larger than TPOS, the UE shall measure the SS-RSRP and SS-RSRQ level of the serving cell and evaluate the cell selection criterion S defined in TS 38.304 [1] for the serving cell at least once every M1\*Tserv for FR1 and N1\* Tserv for FR2; where:

- Tserv is defined as max(TDRX, TPOS), where T is

- TDRX is defined as T in clause 7.1 TS 38.304 when RAN eDRX <= 10.24s and CN eDRX <= 10.24s

- TDRX is the maximum of the T inside and outside of the CN PTW, where T inside and outside of the CN PTW are defined in clause 7.1 TS 38.304, when RAN eDRX <= 10.24s and CN eDRX > 10.24s

- TDRX is the maximum of the DRX cycles within the CN PTW and the RAN PTW when RAN eDRX > 10.24s

- M1=2 if SMTC periodicity (TSMTC) > 20 ms and Tserv ≤ 0.64 second, otherwise M1=1.

The UE shall filter the SS-RSRP and SS-RSRQ measurements of the serving cell using at least 2 measurements. Within the set of measurements used for the filtering, at least two measurements shall be spaced by, at least Tserv/2.

If the UE has evaluated according to Table 5.6.1A.1-1 or and Table 5.6.1A.1-2 in Nserv consecutive Tserv that the serving cell does not fulfil the cell selection criterion S, the UE shall initiate the measurements of all neighbour cells indicated by the serving cell, regardless of the measurement rules currently limiting UE measurement activities.

**Table 5.6.1A.1-1: Nservfor UE configured with eDRX INACTIVE cycle ≥ TPOS (FR1)**

|  |  |  |  |
| --- | --- | --- | --- |
| **eDRX\_IDLE cycle length [s]** | **eDRX INACTIVE cycle length[s]** | **Tserv [s]** | **Nserv [number of Tserv]** |
| 2.56 ≤eDRX\_IDLE cycle length ≤10485.76 | eDRX INACTIVE cycle length ≥ TPOS | 0.32 ≤ Tserv < 1.28 | [4\*M1] |
| 1.28 ≤ Tserv | [2] |

**Table 5.6.1A.1-2: Nservfor UE configured with eDRX INACTIVE cycle ≥ TPOS (FR2-1)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **eDRX\_IDLE cycle length [s]** | **eDRX INACTIVE cycle length[s]** | **Tserv [s]** | **Scaling Factor (N1)** | **Nserv [number of Tserv]** |
| 2.56 ≤eDRX\_IDLE cycle length ≤10485.76 | eDRX INACTIVE cycle length ≥ TPOS | 0.32 ≤ Tserv < 0.64 | 8 | [4\*M1\*N1] |
| 0.64 ≤ Tserv < 1.28 | 5 | [4\*M1\*N1] |
| 1.28 ≤ Tserv < 2.56 | 4 | [2\*N1] |
| 2.56 ≤ Tserv | 3 | [2\*N1] |

If the UE in RRC\_INACTIVE has not found any new suitable cell based on searches and measurements using the intra-frequency, inter-frequency and inter-RAT information indicated in the system information during the time T’, the UE shall initiate cell selection procedures for the selected PLMN as defined in TS 38.304 [1], where

- [T’ = MAX (10 s, one eDRX\_INACTIVE cycle) for FR1, or

- T’= MAX (10 s, N1\* eDRX\_INACTIVE cycle) for FR2.]

5.6.1A.2 Measurements of intra-frequency NR cells

When UE is configured with both eDRX\_IDLE and eDRX\_INACTIVE, and eDRX\_INACTIVE cycle is larger than TPOS, the requirements defined in section 5.1.2.3 shall apply with Tdetect,NR\_Intra, Tmeasure,NR\_Intra and Tevaluate,NR\_Intra defined in Table 5.6.1A.2-1 and Table 5.6.1A.2-2, where

- Tserv is defined as max(TDRX, TPOS), where T is determined according to clause 7.1 in [1],

- TDRX is defined as T in clause 7.1 TS 38.304 when RAN eDRX <= 10.24s and CN eDRX <= 10.24s

- TDRX is the maximum of the T inside and outside of the CN PTW, where T inside and outside of the CN PTW are defined in clause 7.1 TS 38.304, when RAN eDRX <= 10.24s and CN eDRX > 10.24s

- TDRX is the maximum of the DRX cycles within the CN PTW and the RAN PTW when RAN eDRX > 10.24s

- M2 = 1.5 if SMTC periodicity of measured intra-frequency cell > 20 ms; otherwise M2=1.

**Table 5.6.1A.2-1: Tdetect, Tmeasure and Tevaluate for UE configured with eDRX INACTIVE cycle ≥ TPOS (FR1)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **eDRX\_IDLE cycle length [s]** | **Tserv [s]** | **Tdetect,NR\_Intra (number of Tserv)** | **Tmeasure,NR\_Intra (number of Tserv)** | **Tevaluate,NR\_Intra (number of Tserv)** |
|
| 2.56 ≤eDRX\_IDLE cycle length ≤ 10485.76 | 0.32 ≤ Tserv < 0.64 | [36 x M2] | [4 x M2] | [16 x M2] |
| 0.64 ≤ Tserv < 1.28 | [28] | [2] | [8] |
| 1.28 ≤ Tserv < 2.56 | [25] | [1] | [5] |
| 2.56 ≤ Tserv | [23] | [1] | [3] |
| NOTE 1: Tdetect,NR\_Intra, Tmeasure,NR\_Intra and Tevaluate,NR\_Intra in seconds depend on the number *N* of Tserv and are calculated as N \* Tserv. | | | | |

**Table 5.6.1A.2-2: Tdetect, Tmeasure and Tevaluate for UE configured with eDRX INACTIVE cycle ≥ TPOS (FR2-1)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **eDRX\_IDLE cycle length [s]** | **Tserv [s]** | **Scaling Factor (N1)** | **Tdetect,NR\_Intra (number of Tserv)** | **Tmeasure,NR\_Intra (number of Tserv)** | **Tevaluate,NR\_Intra (number of Tserv)** |
|
| 2.56 ≤eDRX\_IDLE cycle length ≤ 10485.76 | 0.32 ≤ Tserv < 0.64 | 8 | [36 x N1 x M2] | [4 x N1 x M2] | [16 x N1 x M2] |
| 0.64 ≤ Tserv < 1.28 | 5 | [28 x N1] | [2 x N1] | [8 x N1] |
| 1.28 ≤ Tserv < 2.56 | 4 | [25 x N1] | [1 x N1] | [5 x N1] |
| 2.56 ≤ Tserv | 3 | [23 x N1] | [1 x N1] | [3 x N1] |
| NOTE 1: Tdetect,NR\_Intra, Tmeasure,NR\_Intra and Tevaluate,NR\_Intra in seconds depend on the number *N* of Tserv and are calculated as N \* Tserv. | | | | | |

5.6.2 RSTD measurements

5.6.2.1 Introduction

The requirements in clause 5.6.2 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].

5.6.2.2 Requirements Applicability

The requirements in clause 5.6.2 apply for periodic and triggered RSTD measurements, provided:

- PRS-RSTD related side conditions given in clause 10.1.23.2 for FR1 and FR2 are fulfilled, for a corresponding Band.

5.6.2.3 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].

5.6.2.4 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 clause 10.1.23.3.

The RSTD measurements performed and reported according to this section shall meet the RSTD measurement accuracy requirements in clause 10.1.23.2, for each measured DL PRS resource.

5.6.2.5 Measurements Period Requirements

After receiving both *NR-DL-TDOA-ProvideAssistanceData* message and *NR-DL-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 5.6.2.3) 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 if positioning frequency layer *i* is in FR1, and if positioning frequency layer *i* is in FR2

- equals to the value as UE reported in *supportedLowerRxBeamSweepingFactor-FR2* if the capability is reported by the UE for the band containing positioning frequency layer i, and LMF indicates *lowerRxBeamSweepingFactor-FR2* in *NR-DL-TDOA-RequestLocationInformation* .

- equals to 8, otherwise.

- is a scaling factor for PRS-based NR positioning measurements in RRC\_INACTIVE. If the UE supports *parallelPRS-MeasRRC-Inactive-r17*, 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 Rx TEG specific scaling factor:

- =1 if the UE is not configured by the LMF to measure a PRS resource with multiple Rx TEGs via *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* [34].

- is defined as follows if the UE is configured by the LMF with *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* [34] to perform measurement on same DL PRS resource of a TRP using different Rx TEGs in *NR-DL-TDOA-RequestLocationInformation* [34]:

- , if the UE is not capable of receiving same DL PRS resource simultaneously from multiple Rx TEGs, where P is the number of UE Rx TEGs that the UE is requested by LMF to measure the same DL-PRS Resource of a TRP indicated by *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* in [34], and in case ‘n0’ is indicated, P is the maximum number of Rx TEGs with which UE can support to measure the same PRS resource as reported in *NR-UE-TEG-Capability*.

- , if the UE is capable of receiving the same DL PRS resource simultaneously from multiple Rx TEGs, where is the number of UE Rx TEGs for measuring the same DL-PRS Resource simultaneously indicated by *measureSameDL-PRS-ResourceWithDifferentRxTEGsSimul-r17* in [34].

- 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 , 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 *supportedDL-PRS-ProcessingSamples-RRC-Inactive* [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and meets the following conditions:

- PRS bandwidth is within the initial BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 2 if the UE supports *supportedDL-PRS-ProcessingSamples-RRC-Inactive* [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and does not meet the following conditions:

- PRS bandwidth is within the initial BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 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-r17* in TS 37.355 [34],

- , the least common multiple between and

- is defined as following:

- is DRX cycle length when no extended DRX (eDRX) cycle is configured

- is defined as T in clause 7.1 TS 38.304 when RAN eDRX <= 10.24s and CN eDRX <= 10.24s

- is the maximum of the T inside and outside of the CN PTW, where T inside and outside of the CN PTW are defined in clause 7.1 TS 38.304, when RAN eDRX <= 10.24s and CN eDRX > 10.24s

- is the maximum of the DRX cycles within the CN PTW and the RAN PTW when RAN eDRX > 10.24s

- 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-ProcessingSymbols-r17* in TS 37.355 [34], T (ms) corresponds to *durationOfPRS-ProcessingSymbolsInEveryTms-r17* 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-RRC-Inactive-r17* specified in TS 37.355 [34].

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

- When UE is configured with RAN eDRX > 10.24s, if eDRX cycle is smaller or equal to configured PRS measurement reporting periodicity, the time starts within PTW. If eDRX cycle is longer than configured PRS measurement reporting periodicity or periodic PRS measurement reporting is not configured, is not limited to PTW.

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

Note 1: PRS measurement reporting periodicity is the configured *reportingInterval* in *RequestLocationInformation.*

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.

The measurement requirements do not apply to any PRS resource that always collides with other higher-priority DL signals/channels, as specified in clause 5.6.1.

Longer RSTD 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 5.6.2 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 the cell selection is completed. The RSTD measurement period can be longer.

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

The UE shall meet the RSTD measurement accuracy requirements in clause 10.1.23.2.

5.6.2.x1 Measurements Period Requirements with Bandwidth Aggregation

The requirements in this clause apply provided that UE receives requests from LMF to perform PRS measurement on aggregated positioning frequency layers (PFLs) via [*TBD LPP signaling*].

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 5.6.2.3) DL RSTD measurements, defined in TS 38.215 [4], during the measurement period defined as:

Where:

- is the total measurement period for aggregated measurements, and

- is the total measurement period for non-aggregated measurements, and

- When both and are non-zero, , where the maximum is across all the PFL combination(s) and non-aggregated PFL(s) configured for positioning measurements; otherwise is equal to zero.

is zero if every resource set on every PFL is linked for aggregation to at least one other resource set on another PFL. Otherwise, is as defined in clause 5.6.2.5 except that

- only PFLs containing resource set(s) not linked to any other resource set(s) are considered in

- on each PFL , only resource set(s) not linked to any other resource set(s) are considered in , and

- = 2 if the UE supports the capability of positioning measurements with reduced number of samples as indicated by *supportedDL-PRS-ProcessingSamples-RRC-Inactive* specified in TS 37.355 [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples.

is zero if no resourse sets on any PFL are linked for aggregation with other resource sets on other PFLs. Otherwise, is defined as

where:

- is the index of PFL combination,

- is total number of PFL combinations,

- is the periodicity of the PRS measurement in PFL combination ,

- is the measurement period for PRS RSTD measurement in PFL combination as specified below.

where:

- is a scaling factor for PRS measurements in RRC\_INACTIVE, and is defined as TBD,

- is a scaling factor for PRS measurements with multiple Rx TEGs, and is defined as TBD,

- is a scaling factor for PRS measurements with multiple Rx beams, and is defined as

- = 1 if PFL combination *m* is in FR1,

- is defined as follows if PFL combination *m* is in FR2

- equals to the value as UE reported in [*supportedLowerRxBeamSweepingFactor-FR2*] if the capability is reported by the UE for the band containing PFL combination *m*, and LMF indicates *lowerRxBeamSweepingFactor-FR2* in *NR-DL-TDOA-RequestLocationInformation*,

- equals to 8 otherwise

- is the maximum number of DL PRS resources in PFLcombination *m* configured in a slot, and only the PRS resources in resource set(s) linked to other resource set in PFL combination *m* are counted

- is the UE capability on maximum number of DL PRS resources that can be processed in a slot for PFL combination *m* as indicated by [TBD] specified in TS 37.355 [34].

- is the time duration of available PRS resources in PFL combination *m* 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 in resource set(s) linked to other resource set in PFL combination *m* and that are not fully overlapped with other higher-priority DL signals/channels are considered.

- is the UE capability on duration of DL PRS resources in ms for PFL combination *m* as indicated by [TBD] specified in TS 37.355 [34].

- is number of PRS measurement samples,

- = 2 if the UE supports the capability of positioning measurements with reduced number of samples as indicated by [TBD] specified in TS 37.355 [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples,

- = 4 otherwise.

- is the periodicity of the PRS measurement in PFL combination ,

- is the UE capability on time for processing of DL PRS resources in ms for PFL combination *m* as indicated by [TBD] specified in TS 37.355 [34].

- , the least common multiple between and the DRX cycle length , where is the periodicity of DL PRS resource with muting on PFL combination .

- If more than one PRS periodicities are configured in PFL combination , the least common multiple of PRS periodicities among all DL PRS resource sets that are linked to other resource set in PFL combination , is used to derive , and for each applicable PRS resource set,

- , is the PRS periodicity with muting per PRS resource, and

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

- 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 measurement duration for the last PRS sample in PFL combination , including the sampling time and processing time, .

The timestarts from the first DRX cycle containing the 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 separate requirement on aggregated measurement based on or on non-aggregated measurement based on is applied.

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.

The measurement requirements do not apply to any PRS resource that always collides with other higher-priority DL signals/channels, as specified in clause 5.6.1.

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

If changes for any PFL or any PFL combination 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 5.6.2 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 the cell selection is completed. The RSTD measurement period can be longer.

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

The UE shall meet the RSTD measurement accuracy requirements in clause 10.1.23.

5.6.3 PRS-RSRP measurements

5.6.3.1 Introduction

The requirements in clause 5.6.3 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.

5.6.3.2 Requirements applicability

The requirements in clause 5.6.3 apply for periodic and triggered PRS-RSRP measurements, provided:

- PRS-RSRP related side conditions given in clause 10.1.24.2 are met for a corresponding Band.

5.6.3.3 Measurement Capability

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

5.6.3.4 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 clause 10.1.24.3.

The PRS-RSRP measurement accuracy for all measured PRS resources shall be fulfilled according to the accuracy requriements specified in the clause 10.1.24.2.

5.6.3.5 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 5.6.3.3) 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 *parallelPRS-MeasRRC-Inactive-r17*, = 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:

* =1 if positioning frequency layer *i* is in FR1, and if positioning frequency layer *i* is in FR2

- equals to the value as UE reported in *supportedLowerRxBeamSweepingFactor-FR2* if the capability is reported by the UE for the band containing positioning frequency layer i, and LMF indicates *lowerRxBeamSweepingFactor-FR2* in *NR-DL-AoD-RequestLocationInformation*.

- equals to 8, otherwise.

- 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 resources that are not fully overlapped with other higher-priority DL signals/channels 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-ProcessingSymbols-r17* in TS 37.355 [34] processed every T ms corresponding to *durationOfPRS-ProcessingSymbolsInEveryTms-r17*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-RRC-Inactive-r17* in clause 6.4.3 of TS 37.355 [34],

- is the number of PRS-RSRP measurement samples and

- = 1, if UE supports *supportedDL-PRS-ProcessingSamples-RRC-Inactive* [34], and the LMF indicates the UE to perform positioning measurements with reduced number of samples by *reducedDL-PRS-ProcessingSamples* [34], and the following conditions are met:

- PRS bandwidth is within the initial BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 2, if UE supports *supportedDL-PRS-ProcessingSamples-RRC-Inactive* [34], and the LMF indicates the UE to perform positioning measurements with reduced number of samples by *reducedDL-PRS-ProcessingSamples* [34], and the following conditions are not met

- PRS bandwidth is within the initial BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 4 otherwise

*= +* 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-r17* 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 defined as following:

- is DRX cycle length when no extended DRX (eDRX) cycle is configured

- is defined as T in clause 7.1 TS 38.304 when RAN eDRX <= 10.24s and CN eDRX <= 10.24s

- is the maximum of the T inside and outside of the CN PTW, where T inside and outside of the CN PTW are defined in clause 7.1 TS 38.304, when RAN eDRX <= 10.24s and CN eDRX > 10.24s

- is the maximum of the DRX cycles within the CN PTW and the RAN PTW when RAN eDRX > 10.24s

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 cycle containing the 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.

- When UE is configured with RAN eDRX > 10.24s, if eDRX cycle is smaller or equal to configured PRS measurement reporting periodicity, the time starts within PTW. If eDRX cycle is longer than configured PRS measurement reporting periodicity or periodic PRS measurement reporting is not configured, is not limited to PTW.

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

Note 1: PRS measurement reporting periodicity is the configured *reportingInterval* in *RequestLocationInformation.*

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 5.6.2.

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 5.6.4.

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-RSRP 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 5.6.3 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.

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

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

The UE shall meet the PRS-RSRP measurement accuracy requirements in clause 10.1.24.2.

**-----------------------------NEXT CHANGE------------------------------**

5.6.4.x1 Measurements Period Requirements with Bandwidth Aggregation

The requirements in this clause apply provided that UE receives requests from LMF to perform PRS measurement on aggregated positioning frequency layers (PFLs) via [*TBD LPP signaling*].

When physical layer receives last of *NR-Multi-RTT-ProvideAssistanceData* message and *NR-Multi-RTT-RequestLocationInformation* message from LMF via LPP [34],the UE shall be able to measure multiple (up to the UE capability specified in Clause 5.6.4.3) UE Rx-Tx time difference measurements, defined in TS 38.215 [4], during the measurement period defined as:

Where:

- is the total measurement period for aggregated measurements, and

- is the total measurement period for non-aggregates measurements, and

- is , if both and are non-zero, where is the from both PFL combination(s) and non-aggregated PFL(s) which are configured for positioning measurement; otherwise equals to zero.

is zero if every resourse set on every PFL is linked for aggregation with at least one other resource set on another PFL. Otherwise, is as defined in clause 5.6.4.5 except that

- only PFLs containing resource set(s) not linked to any other resource set(s) are considered in

- on each PFL , only resource set(s) not linked to any other resource set(s) are considered in , and

- = 2 if the UE supports the capability of positioning measurements with reduced number of samples as indicated by *supportedDL-PRS-ProcessingSamples-RRC-Inactive* specified in TS 37.355 [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples.

is zero if no resourse sets on any PFL are linked for aggregation with other resource sets on other PFLs. Otherwise, is defined as

where:

- is the index of PFL combination,

- is total number of PFL combinations,

- is the periodicity of the PRS measurement in PFL combination ,

- is the measurement period for UE Rx-Tx time difference measurement in PFL combination as specified below.

where:

- is a scaling factor for PRS measurements in RRC\_INACTIVE, and is defined as TBD,

- is a scaling factor for PRS measurements with multiple Rx TEGs, and is defined as TBD,

- is a scaling factor for PRS measurements with multiple Rx beams, and is defined as

- = 1 if PFL combination *m* is in FR1,

- is defined as follows if PFL combination *m* is in FR2

- equals to the value as UE reported in [*supportedLowerRxBeamSweepingFactor-FR2*] if the capability is reported by the UE for the band containing PFL combination *m*, and LMF indicates *lowerRxBeamSweepingFactor-FR2* in *NR-DL-TDOA-RequestLocationInformation*,

- equals to 8 otherwise

- is the maximum number of DL PRS resources in PFLcombination *m* configured in a slot, and only the PRS resources in resource set(s) linked to other resource set in PFL combination *m* are counted

- is the UE capability on maximum number of DL PRS resources that can be processed in a slot for PFL combination *m* as indicated by [TBD] specified in TS 37.355 [34].

- is the time duration of available PRS resources in PFL combination *m* 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 in resource set(s) linked to other resource set in PFL combination *m* and that are not fully overlapped with other higher-priority DL signals/channels are considered.

- is the UE capability on duration of DL PRS resources in ms for PFL combination *m* as indicated by [TBD] specified in TS 37.355 [34].

- is number of PRS measurement samples,

- = 2 if the UE supports the capability of positioning measurements with reduced number of samples as indicated by [TBD] specified in TS 37.355 [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples,

- = 4 otherwise.

- is the periodicity of the PRS measurement in PFL combination ,

- is the UE capability on time for processing of DL PRS resources in ms for PFL combination *m* as indicated by [TBD] specified in TS 37.355 [34].

- , the least common multiple between and the DRX cycle length , where is the periodicity of DL PRS resource with muting on PFL combination .

- If more than one PRS periodicities are configured in PFL combination , the least common multiple of PRS periodicities among all DL PRS resource sets that are linked to other resource set in PFL combination , is used to derive , and for each applicable PRS resource set,

- , is the PRS periodicity with muting per PRS resource, and

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

- 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 measurement duration for the last PRS sample in PFL combination , including the sampling time and processing time, .

The timestarts from the first DRX cycle containing the 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 separate requirement on aggregated measurement based on or on non-aggregated measurement based on is applied.

If the RRC state transion 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 changes for any PFL or any PFL combination during the measurement period, the measurement period could 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 5.6.4 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.

The UE shall meet the UE Rx-Tx time difference measurement accuracy requirements in clause 10.1.25.

**-----------------------------NEXT CHANGE------------------------------**

5.6.6 TA validation requirements for positioning

5.6.6.1 Introduction

The requirements in clause 5.6.6 shall apply when the UE is configured with the SRS transmission on the PCell and with *inactivePosSRS-RSRP-ChangeThreshold* for the time alignment (TA) validation before the SRS transmission [2].

5.6.6.2 TA validation requirements

When *inactivePosSRS-RSRP-ChangeThreshold* [2] is configured for TA validation based on the RSRP change criterion according to clause 5.26.2 in [7], the UE is allowed to transmit the SRS using the timing derived using the latest available value as specified in subclause 7.1 provided that the following conditions are met:

- the first RSRP (RSRP1) measurement and the second RSRP (RSRP2) measurements used in the TA validation are valid measurements and,

- TA for the SRS transmission is valid according to the TA validation criteria in clause 5.26.2 in [7].

RSRP1 and RSRP2 are considered valid provided that the conditions in Table 5.6.6.2-1 and Table 5.6.6.2-2 are met for FR1 and FR2-1 respectively.

**Table 5.6.6.2-1 Valid measurement for FR1**

|  |  |
| --- | --- |
| **Measurement** | **FR1** |
| RSRP1 | (T1 – min(640ms, M1\*TDRX)) ≤ T1’ ≤ (T1 + min(640ms, M1\*TDRX)) |
| RSRP2 | (T2 – min(640ms, M1\*TDRX)) ≤ T2’ ≤ T2 |

**Table 5.6.6.2-2 Valid measurement for FR2-1**

|  |  |
| --- | --- |
| **Measurement** | **FR2-1** |
| RSRP1 | (T1 – max(480ms, 8\*SMTC periodicity)) ≤ T1’ ≤ (T1 + max(480ms, 8\*SMTC periodicity)) |
| RSRP2 | (T2 – max(480ms, 8\*SMTC periodicity)) ≤ T2’ ≤ T2 |

If at least one of RSRP1 and RSRP2 is invalid based on the above conditions, then the UE shall not validate the SRS transmission using RSRP1 and RSRP2 and shall not transmit the SRS. The UE shall not transmit in an SRS resource that occurs more than 640 ms after T2.

Where:

- T1 is the time when:

- *RRCRelease* with *SRS-PosRRC-InactiveConfig* [2] is received by the UE, or

- the latest TA is received by the UE while the UE is in RRC\_INACTIVE state.

- T1’ is the time when the UE has completed RSRP1.

- T2 is the time when the UE performs TA validation as defined in clause 5.26.2 in [7] for the SRS transmission.

- T2’ is the time when the UE has completed RSRP2.

- TDRX is the DRX cycle length in ms.

- M1 the scaling factor as defined in clause 4.2.2.2.

5.6.6.3 TA validation requirements when configured with validity area

The requirement in this section shall apply when the UE is configured with:

* *inactivePosSRS-RSRP-ChangeThreshold* [2] for TA validation based on the RSRP change criterion according to clause 5.26.2 in [7] and
* *SRS-PosRRC-InactiveValidityAreaConfig* [2] for SRS for positioning configuration which is valid during RRC\_INACTIVE state across the cells included in *srs-PosRRC-InactiveValidityArea area* [2].

The UE is allowed to transmit the SRS using the timing derived using the latest available value as specified in subclause 7.1 and is allowed to perform the cell reselection to a cell included in *srs-PosRRC-InactiveValidityArea area* [2], provided that the following conditions are met:

* the first RSRP (RSRP1) measurement and the second RSRP (RSRP2) measurements used in the TA validation are valid measurements and,
* TA for the SRS transmission is valid according to the TA validation criteria defined in clause 5.26.2 in [7].

RSRP1 and RSRP2 are measured by the UE from the same camped cell. RSRP1 and RSRP2 are considered valid provided that the conditions in Table 5.6.6.3-1 and Table 5.6.6.3-2 are met for FR1 and FR2-1 respectively.

**Table 5.6.6.3-1 Valid measurement for FR1**

|  |  |
| --- | --- |
| **Measurement** | **FR1** |
| RSRP1 | (T1 – min(640ms, M1\*TDRX)) ≤ T1’ ≤ (T1 + min(640ms, M1\*TDRX)) |
| RSRP2 | (T2 – min(640ms, M1\*TDRX)) ≤ T2’ ≤ T2 |

**Table 5.6.6.3-2 Valid measurement for FR2-1**

|  |  |
| --- | --- |
| **Measurement** | **FR2-1** |
| RSRP1 | (T1 – max(480ms, 8\*SMTC periodicity)) ≤ T1’ ≤ (T1 + max(480ms, 8\*SMTC periodicity)) |
| RSRP2 | (T2 – max(480ms, 8\*SMTC periodicity)) ≤ T2’ ≤ T2 |

If at least one of RSRP1 and RSRP2 is invalid based on the above conditions, then the UE shall not validate the SRS transmission using RSRP1 and RSRP2 and shall not transmit the SRS. The UE shall not transmit in an SRS resource that occurs more than 640 ms after T2.

Where:

- T1 is the time when:

- *RRCRelease* with *SRS-PosRRC-InactiveConfig* [2] is received by the UE, or

- the latest TA is received by the UE while in RRC\_INACTIVE state, or

- according to clause 7.1E, the UE while in RRC\_INACTIVE state has autonomously adjusted the TA during the cell reselection to a cell included in *srs-PosRRC-InactiveValidityArea area* [2].

- T1’ is the time when the UE has completed RSRP1.

- T2 is the time when the UE performs TA validation as defined in clause 5.26.2 in [7] for the SRS transmission.

- T2’ is the time when the UE has completed RSRP2.

- TDRX is the DRX cycle length in ms.

- M1 the scaling factor as defined in clause 4.2.2.2.

**-----------------------------NEXT CHANGE------------------------------**

5.6.x1 Measurement requirements for DL RSCPD reported with RSTD

#### 5.6.x1.1 Introduction

The requirements in clause 5.6.x1 shall apply provided the UE has received *NR-DL-TDOA-RequestLocationInformation* message with *nr-UE-RSCPD-Request* from the LMF via LPP [34] requesting the UE to measure and report RSCPD measurement with DL RSTD measurements defined in TS 38.215 [4].

#### 5.6.x1.2 Requirements Applicability

The requirements in clause 5.6.x1 apply for periodic and triggered reporting of RSCPD with RSTD measurements, provided:

- PRS-RSTD related side conditions given in clause 10.1.23.2 for FR1 and FR2 are fulfilled, for a corresponding Band.

- RSCPD related side conditions given in clause 10.1.x for FR1 and FR2 are fulfilled, for a corresponding Band.

#### 5.6.x1.3 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].

5.6.x1.4 Measurement Reporting Requirements

The measurement reporting delay shall satisfy the requirements defined in clause 5.6.2.4, and the applicable measurement report mapping and measurement accuracy requirements are specified below.

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

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

The RSTD measurements performed and reported according to this section shall meet the RSTD measurement accuracy requirements in clause 10.1.23.2, for each measured DL PRS resource.

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

#### 5.6.x1.5 Measurements Period Requirements

After receiving both *NR-DL-TDOA-ProvideAssistanceData* message and *NR-DL-TDOA-RequestLocationInformation* message with *nr-UE-RSCPD-Request* from the LMF via LPP [34]*,* the UE shall be able to measure multiple (up to the UE capability specified in Clause 5.6.x1.3) DL RSTD and RSCPD measurements, defined in TS 38.215 [4], during the measurement period defined as:

,

where:

* , , , , , , , and are defined in clause 5.6.2.5

- is the time duration of available PRS in the positioning frequency layer 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.

- When periodic time window(s) are configured by the LMF, , the least common multiple between , the DRX cycle length and Twindow being the maximum periodicity of the indicated time window(s). is defined in clause 5.6.2.5.

- and are calculated by only considering the PRS resources in the indicated resources sets overlapping with the indicated time window(s).

- When periodic time window(s) are not configured by the LMF, , the least common multiple between and the DRX cycle length . is defined in clause 5.6.2.5.

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

If the DRX cycle is reconfigured during the 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.

The measurement requirements do not apply to any PRS resource that always collides with other higher-priority DL signals/channels, as specified in clause 5.6.1.

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

If changes for the PFL during the measurement period, 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 5.6.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-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 RSCPD and RSTD measurements are being performed, then the UE shall continue and complete the on-going RSCPD and RSTD measurements after the cell re-selection is completed. The measurement period can be longer.

If the RRC state transition occurs from RRC\_INACTIVE to RRC\_CONNECTED state during the measurement period then the UE shall continue the RSCPD and RSTD measurements in the RRC\_CONNECTED state. The measurement period can be longer.

The UE shall meet the RSTD measurement accuracy requirements in clause 10.1.23.2 and the RSCPD measurement accuracy requirements in clause 10.1.x.

5.6.x2 Measurement requirements for DL RSCP reported with UE Rx-Tx time difference

#### 5.6.x2.1 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 DL RSCP measurements with UE Rx-Tx time difference measurements defined in TS 38.215 [4].

#### 5.6.x2.2 Requirements Applicability

The requirements in clause 5.x2.4 apply for periodic and triggered UE Rx-Tx time difference measurements, provided:

- UE Rx-Tx time difference measurement related side conditions given in clause 10.1.25.2 are met for a corresponding band.

- DL RSCP related side conditions given in clause 10.1.x for FR1 and FR2 are fulfilled, for a corresponding Band.

- SRS is configured on the PCell.

#### 5.6.x2.3 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].

#### 5.6.x2.4 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 10.1.25.3.

The DL RSCP 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 10.1.25.2.

The DL RSCP measurement accuracy for all measured DL PRS resourcesshall be fulfilled according to the accuracy requirements specified in clause 10.1.x.

#### 5.6.x2.5 Measurement Period Requirements

When physical layer receives last of *NR-Multi-RTT-ProvideAssistanceData* message and *NR-Multi-RTT-RequestLocationInformation* message with *[indication from LMF requesting to measure DL RSCP]* from LMF via LPP [34]*,* UE shall be able to measure multiple (up to the UE capability specified in clause 5.6.x2.3) UE Rx-Tx time difference measurements as defined in TS 38.215 [4] in configured positioning frequency layers within the measurement period ms.

,

where:

- =1 if the UE is capable of *parallelPRS-MeasRRC-Inactive-r17* defined in [34].

- if the UE is not capable of *parallelPRS-MeasRRC-Inactive-r17* 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 *parallelPRS-MeasRRC-Inactive-r17* defined in [34] and if Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ; where is defined in clause 4.2.2.4.

- is the scaling factor for UE Rx beam sweeping:

- =1 if the positioning frequency layer is in FR1, and if positioning frequency layer is in FR2:

- equals to the value as UE reported in *supportedLowerRxBeamSweepingFactor-FR2* if the capability is reported by the UE for the band containing positioning frequency layer i, and LMF indicates *lowerRxBeamSweepingFactor-FR2* in *NR-Multi-RTT -RequestLocationInformation*.

- equals to 8, otherwise.

- is the Rx TEG specific scaling factor:

- = 1 if UE is not configured by LMF with measureSameDL-PRS-ResourceWithDifferentRxTxTEGs-r17 or measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17 [34].

- = measureSameDL-PRS-ResourceWithDifferentRxTxTEGs-r17 or measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17 if UE is configured by LMF to measurement same DL PRS with multiple UE RxTx TEGs or multiple UE Rx TEGs [34], and in case ‘n0’ is indicated, is the maximum number of Rx TEGs with which UE can support to measure the same PRS resource as reported in *NR-UE-TEG-Capability*.

- is the time duration of available PRS resources in the positioning frequency layer, 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 maximum number of DL PRS resources of the positioning frequency layer configured in a slot,

- is UE capability combination per band where N is a duration of DL PRS symbols in ms corresponding to *durationOfPRS-ProcessingSymbols-r17* in TS 37.355 [34] processed every T ms corresponding to *durationOfPRS-ProcessingSymbolsInEveryTms-r17* 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-RRC-Inactive-r17* as specified in clause 6.4.3 of TS 37.355 [34],

- is the number of measurement samples:

- = 4 if the UE is not capable of *supportedDL-PRS-ProcessingSamples-RRC-Inactive* defined in [34] or not configured to perform positioning measurements with reduced number of samples by *requestedDL-PRS-ProcessingSamples* [34].

- = 1 if the UE is capable of *supportedDL-PRS-ProcessingSamples-RRC-Inactive* defined in [34] and LMF requests the UE to perform positioning measurements with reduced number of samples by *requestedDL-PRS-ProcessingSamples* [34] and the following conditions are met:

- PRS bandwidth is within the initial BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 2 if the UE is capable of *supportedDL-PRS-ProcessingSamples-RRC-Inactive* defined in [34] and the LMF requests the UE to perform positioning measurements with reduced number of samples by *requestedDL-PRS-ProcessingSamples* [34] but the following conditions are not met:

- PRS bandwidth is within the initial BWP and

- 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, including the sampling time and processing time,  *= +*  ,

- is periodicity of the DL RSCP with UE Rx-Tx time difference measurement in the positioning frequency layer:

where:

- corresponds to *durationOfPRS-ProcessingSymbolsInEveryTms-r17* in TS 37.355 [34],

- When periodic time window(s) are configured by the LMF, , the least common multiple between , and Twindow being the maximum periodicity of the indicated time window(s).

- and are calculated by only considering the PRS resources in the indicated resources sets overlapping with the indicated time window(s).

- When periodic time window(s) are not configured by the LMF, , the least common multiple between and the DRX cycle length .

- is the DRX cycle of the UE in the serving cell.

- is the PRS resource periodicity in the positioning frequency layer. If the positioning frequency layer 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 time window (TDL RSCP) configured by LMF within 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.

If the RRC state transion occurs from RRC\_INACTIVE to RRC\_CONNECTED state during the measurement period then the UE shall continue the DL RSCP measurement and 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 measurement period then the UE shall restart the DL RSCP and UE Rx-Tx time difference measurements 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 measurement period then the measurement period can be longer.

If during the measurement period, PRS resources overlap with other DL signals/channels then the 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 5.6.x2 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.

If UE uplink transmission timing changes due to the network-configured Timing Advance command or due to the change in the NTA\_offset defined in Table 7.1.2-2 during the measurement period, the UE may continue and complete the DL RSCP measurement.

**-----------------------------NEXT CHANGE------------------------------**

5.6A NR measurements for positioning for RedCap

### 5.6A.1 Introduction

This clause contains requirements for RedCap 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 5.6A.4, 5.6A.5, 5.6A.6 and 5.6A.7 are applicable to PRS resources that do not collide with other DL signals/channels which include SSB, SIB1, CORESET0, MSG2/MSGB, paging and DL SDT. In addition, a UE is not expected to receive PRS resources that collide with a time interval starting at symbol *m* and ending at symbol *m + N2*, where symbol *m* is the last symbol in which the UE is configured to receive PDCCH and *N2* is defined in clause 6.4 of [26, TS 38.214] for the subcarrier spacing μ of the DL PRS.

If a PRS resource is outside or partially overlapped with the intitial DL BWP, a PRS resource instance collides with another DL signals/channel~~s~~ if any portion of the other DL signal/channel overlaps with the time interval starting X symbols before the PRS instance and ending X symbols after the PRS instance, taking into account *nr-DL- PRS-ExpectedRSTD-Uncertainty* and *nr-DL-PRS-ExpectedRSTD.* Where X is defined in Table 5.6.1-1.

All measurement requirements specified in clauses 5.6A.4, 5.6A.5, 5.6A.6 and 5.6A.7 shall apply for DRX and eDRX configuration specified in TS 38.331 [2].

The requirements in clauses 5.6A.4, 5.6A.5, 5.6A.6 and 5.6A.7 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 requirements in clauses 5.6A.4, 5.6A.5, 5.6A.6 and 5.6A.7 apply provided that all PRS resources within a PFL are within up to 2 separate windows withinTPRS,i for each positioning frequency layer *i*, where each window is up to 10ms. TPRS,i is defined in clauses 5.6A.4, 5.6A.5, 5.6A.6 and 5.6A.7.

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.

5.6A.2 Cell re-selection for positioning

The requirements in this clause apply for RedCap UE, when the UE is configured to perform SRS transmission for positioning.

The requirements in clause 5.1B.2 shall apply in the following conditions.

- UE is not configured with eDRX\_IDLE, or

- UE is configured with eDRX\_IDLE but without eDRX\_INACTIVE, or

- UE is configured with both eDRX\_IDLE and eDRX\_INACTIVE, and eDRX\_INACTIVE cycle is smaller or equal to TPOS,

where TPOS is

- SRS transmission periodicity, if UE is configured to only perform SRS transmission for positioning,

- the minimum of PRS measurement reporting periodicity and SRS transmission periodicity, if UE is configured to both perform PRS measurements and to perform SRS transmission for positioning.

When UE is configured with both eDRX\_IDLE and eDRX\_INACTIVE, and eDRX\_INACTIVE cycle is larger than TPOS, the requirements in clause 5.1B.2 except clause 5.1B.2.2 and 5.1.2B.3 shall apply, and the requirements in clause 5.6A.2.1 apply for measurement and evaluation of serving cell, and the requirements in clause 5.6A.2.2 apply for measurements of intra-frequency NR cells.

5.6A.2.1 Measurement and evaluation of serving cell

When a RedCap UE is configured with both eDRX\_IDLE and eDRX\_INACTIVE, and eDRX\_INACTIVE cycle is larger than TPOS, the UE shall measure the SS-RSRP and SS-RSRQ level of the serving cell and evaluate the cell selection criterion S defined in TS 38.304 [1] for the serving cell at least once every M1\*Tserv for FR1 and N1\* Tserv for FR2; where:

- Tserv is defined as max(TDRX, TPOS), where T is

- TDRX is defined as T in clause 7.1 TS 38.304 when RAN eDRX <= 10.24s and CN eDRX <= 10.24s

- TDRX is the maximum of the T inside and outside of the CN PTW, where T inside and outside of the CN PTW are defined in clause 7.1 TS 38.304, when RAN eDRX <= 10.24s and CN eDRX > 10.24s

- TDRX is the maximum of the DRX cycles within the CN PTW and the RAN PTW when RAN eDRX > 10.24s

- M1=2 if SMTC periodicity (TSMTC) > 20 ms and Tserv ≤ 0.64 second, otherwise M1=1.

The UE shall filter the SS-RSRP and SS-RSRQ measurements of the serving cell using at least 2 measurements. Within the set of measurements used for the filtering, at least two measurements shall be spaced by, at least Tserv/2.

If the UE has evaluated according to Table 5.6A.2.1-1 or and Table 5.6A.2.1-2 in Nserv consecutive Tserv that the serving cell does not fulfil the cell selection criterion S, the UE shall initiate the measurements of all neighbour cells indicated by the serving cell, regardless of the measurement rules currently limiting UE measurement activities.

**Table 5.6.1A.1-1: Nservfor UE configured with eDRX INACTIVE cycle ≥ TPOS (FR1)**

|  |  |  |  |
| --- | --- | --- | --- |
| **eDRX\_IDLE cycle length [s]** | **eDRX INACTIVE cycle length[s]** | **Tserv [s]** | **Nserv [number of Tserv]** |
| 2.56 ≤eDRX\_IDLE cycle length ≤10485.76 | eDRX INACTIVE cycle length ≥ TPOS | 0.32 ≤ Tserv < 1.28 | [4\*M1] |
| 1.28 ≤ Tserv | [2] |

**Table 5.6.1A.1-2: Nservfor UE configured with eDRX INACTIVE cycle ≥ TPOS (FR2-1)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **eDRX\_IDLE cycle length [s]** | **eDRX INACTIVE cycle length[s]** | **Tserv [s]** | **Scaling Factor (N1)** | **Nserv [number of Tserv]** |
| 2.56 ≤eDRX\_IDLE cycle length ≤10485.76 | eDRX INACTIVE cycle length ≥ TPOS | 0.32 ≤ Tserv < 0.64 | 8 | [4\* M1\*N1] |
| 0.64 ≤ Tserv < 1.28 | 5 | [4\* M1\*N1 |
| 1.28 ≤ Tserv < 2.56 | 4 | [2\*N1] |
| 2.56 ≤ Tserv | 3 | [2\*N1] |

If the UE in RRC\_INACTIVE has not found any new suitable cell based on searches and measurements using the intra-frequency, inter-frequency and inter-RAT information indicated in the system information during the time T’, the UE shall initiate cell selection procedures for the selected PLMN as defined in TS 38.304 [1], where

- [T’ = MAX (10 s, one eDRX\_INACTIVE cycle) for FR1, or

- T’= MAX (10 s, N1\* eDRX\_INACTIVE cycle) for FR2.]

5.6A.2.2 Measurements of intra-frequency NR cells

When a RedCap UE is configured with both eDRX\_IDLE and eDRX\_INACTIVE, and eDRX\_INACTIVE cycle is larger than TPOS, the requirements defined in section 5.1B.2.3 shall apply with Tdetect,NR\_Intra, Tmeasure,NR\_Intra and Tevaluate,NR\_Intra defined in Table 5.6A.2.2-1 and Table 5.6A.2.2-2, where

- Tserv is defined as max(TDRX, TPOS), where T is

- TDRX is defined as T in clause 7.1 TS 38.304 when RAN eDRX <= 10.24s and CN eDRX <= 10.24s

- TDRX is the maximum of the T inside and outside of the CN PTW, where T inside and outside of the CN PTW are defined in clause 7.1 TS 38.304, when RAN eDRX <= 10.24s and CN eDRX > 10.24s

- TDRX is the maximum of the DRX cycles within the CN PTW and the RAN PTW when RAN eDRX > 10.24s

- M2 = 1.5 if SMTC periodicity of measured intra-frequency cell > 20 ms; otherwise M2=1.

**Table 5.6A.2.2-1: Tdetect, Tmeasure and Tevaluate for UE configured with eDRX INACTIVE cycle ≥ TPOS (FR1)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **eDRX\_IDLE cycle length [s]** | **Tserv [s]** | **Tdetect,NR\_Intra (number of Tserv)** | **Tmeasure,NR\_Intra (number of Tserv)** | **Tevaluate,NR\_Intra (number of Tserv)** |
|
| 2.56 ≤eDRX\_IDLE cycle length ≤ 10485.76 | 0.32 ≤ Tserv < 0.64 | [36 x M2] | [4 x M2] | [16 x M2] |
| 0.64 ≤ Tserv < 1.28 | [28] | [2] | [8] |
| 1.28 ≤ Tserv < 2.56 | [25] | [1] | [5] |
| 2.56 ≤ Tserv | [23] | [1] | [3] |
| NOTE 1: Tdetect,NR\_Intra, Tmeasure,NR\_Intra and Tevaluate,NR\_Intra in seconds depend on the number *N* of Tserv and are calculated as N \* Tserv. | | | | |

**Table 5.6A.2.2-2: Tdetect, Tmeasure and Tevaluate for UE configured with eDRX INACTIVE cycle ≥ TPOS (FR2-1)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **eDRX\_IDLE cycle length [s]** | **Tserv [s]** | **Scaling Factor (N1)** | **Tdetect,NR\_Intra (number of Tserv)** | **Tmeasure,NR\_Intra (number of Tserv)** | **Tevaluate,NR\_Intra (number of Tserv)** |
|
| 2.56 ≤eDRX\_IDLE cycle length ≤ 10485.76 | 0.32 ≤ Tserv < 0.64 | 8 | [36 x N1 x M2] | [4 x N1 x M2] | [16 x N1 x M2] |
| 0.64 ≤ Tserv < 1.28 | 5 | [28 x N1] | [2 x N1] | [8 x N1] |
| 1.28 ≤ Tserv < 2.56 | 4 | [25 x N1] | [1 x N1] | [5 x N1] |
| 2.56 ≤ Tserv | 3 | [23 x N1] | [1 x N1] | [3 x N1] |
| NOTE 1: Tdetect,NR\_Intra, Tmeasure,NR\_Intra and Tevaluate,NR\_Intra in seconds depend on the number *N* of Tserv and are calculated as N \* Tserv. | | | | | |

5.6A.3 TA validation requirements for positioning SRS

5.6A.3.1 Introduction

The requirements in clause 5.6A.3 shall apply when the UE is configured with the SRS transmission on the PCell and with *inactivePosSRS-RSRP-ChangeThreshold* for the time alignment (TA) validation before the SRS transmission [2]. The requirements in clause 5.6A.3 are applicable for both 1 Rx RedCap UE and 2 Rx RedCap UE.

5.6A.3.2 TA validation requirements

The requirements in clause 5.6.6.2 shall apply when the UE is configured with *inactivePosSRS-RSRP-ChangeThreshold* [2] for TA validation based on the RSRP change criterion according to clause 5.26.2 in [7].

5.6A.3.3 TA validation requirements when configured with validity area

The requirements in clause 5.6.6.3 shall apply when the UE is configured with:

* *inactivePosSRS-RSRP-ChangeThreshold* [2] for TA validation based on the RSRP change criterion according to clause 5.26.2 in [7] and

*SRS-PosRRC-InactiveValidityAreaConfig* [2] for SRS for positioning configuration which is valid during RRC\_INACTIVE state across the cells included in *srs-PosRRC-InactiveValidityArea area* [2].

### 5.6A.4 RSTD measurements for RedCap

#### 5.6A.4.1 Introduction

The requirements in clause 5.6A.4.5 shall apply provided the RedCap UE has received *NR-DL-TDOA-RequestLocationInformation* message from the LMF via LPP [34] requesting the RedCap UE to measure and report DL RSTD measurements defined in TS 38.215 [4] without FH via *nr-DL-PRS-RxHopping-Request*.

The requirements in clause 5.6A.4.6 shall apply provided the RedCap 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] with FH via *nr-DL-PRS-RxHopping-Request*.

#### 5.6A.4.2 Requirements applicability

The requirement in clause 5.6A.4.5 apply for periodic and triggered RSTD measurements, provided:

* PRS-RSTD related side conditions given in clause 10.1A.23.x.x.x for FR1 are fulfilled, for a corresponding band, for 1 Rx RedCap UE.
* PRS-RSTD related side conditions given in clause 10.1.23.2 for FR1 and FR2 are fulfilled, for a corresponding band, for 2 Rx RedCap UE.

The requirement in clause 5.6A.4.6 apply for periodic and triggered RSTD measurements, provided:

* PRS-RSTD related side conditions given in clause 10.1A.23.x.x.x for FR1 are fulfilled, for a corresponding band, for 1 Rx RedCap UE.
* PRS-RSTD related side conditions given in clause 10.1A.23.x.x.x for FR1 and FR2 are fulfilled, for a corresponding band, for 2 Rx RedCap UE.

#### 5.6A.4.3 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].

#### 5.6A.4.4 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, with and without FH, 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 clause 10.1.23.3.

The RSTD measurements performed and reported according to this section shall meet the RSTD measurement accuracy requirements in clause 10.1A.23.x.x.x, for each measured DL PRS resource by 1 Rx RedCap UE without FH.

The RSTD measurements performed and reported according to this section shall meet the RSTD measurement accuracy requirements in clause 10.1A.23.x.x.x, for each measured DL PRS resource by 1 Rx RedCap UE with FH.

The RSTD measurements performed and reported according to this section shall meet the RSTD measurement accuracy requirements in clause 10.1.23.2, for each measured DL PRS resource by 2 Rx RedCap UE without FH.

The RSTD measurements performed and reported according to this section shall meet the RSTD measurement accuracy requirements in clause 10.1A.23.x.x.x, for each measured DL PRS resource by 2 Rx RedCap UE with FH.

#### 5.6A.4.5 Measurement period requirement without FH

After receiving both *NR-DL-TDOA-ProvideAssistanceData* message and *NR-DL-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 5.6A.4.3) 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 if positioning frequency layer *i* is in FR1 or UE has only 1Rx branch,

- equals to the value as UE reported in *supportedLowerRxBeamSweepingFactor-FR2,* if positioning frequency layer *i* is in FR2 or the UE has 2Rx branches, and the capability is reported by the UE for the band containing positioning frequency layer i, and LMF indicates *lowerRxBeamSweepingFactor-FR2* in *NR-DL-TDOA-RequestLocationInformation* .

- equals to 8, otherwise.

- is a scaling factor for PRS-based NR positioning measurements in RRC\_INACTIVE. If the UE supports *parallelPRS-MeasRRC-Inactive-r17*, Kcarrier\_PRS = 1; otherwise,

- If Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ, , where is defined in clause 4.2B.2.4

- If Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ, , where is defined in clause 4.2.2.7.

- is the Rx TEG specific scaling factor:

- =1 if the UE is not configured by the LMF to measure a PRS resource with multiple Rx TEGs via *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* [34].

- is defined as follows if the UE is configured by the LMF with *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* [34] to perform measurement on same DL PRS resource of a TRP using different Rx TEGs in *NR-DL-TDOA-RequestLocationInformation* [34]:

- , if the UE is not capable of receiving same DL PRS resource simultaneously from multiple Rx TEGs, where P is the number of UE Rx TEGs that the UE is requested by LMF to measure the same DL-PRS Resource of a TRP indicated by *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* in [34], and in case ‘n0’ is indicated, P is the maximum number of Rx TEGs with which UE can support to measure the same PRS resource as reported in *NR-UE-TEG-Capability*.

- , if the UE is capable of receiving the same DL PRS resource simultaneously from multiple Rx TEGs, where is the number of UE Rx TEGs for measuring the same DL-PRS Resource simultaneously indicated by *measureSameDL-PRS-ResourceWithDifferentRxTEGsSimul-r17* in [34].

- 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 , 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 *supportedDL-PRS-ProcessingSamples-RRC-Inactive* [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and meets the following conditions:

- PRS bandwidth is within the initial BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 2 if the UE supports *supportedDL-PRS-ProcessingSamples-RRC-Inactive* [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and does not meet the following conditions:

- PRS bandwidth is within the initial BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 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-r17* in TS 37.355 [34],

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

* When UE is configured with RAN eDRX\_INACTIVE ≤ 10.24s:
  + TDRX is calculated as T defined in TS 38.304 [1] when CN eDRX\_INACTIVE ≤ 10.24s.
  + TDRX is calculated as max(Tinside, Toutside), where Tinside and Toutside of the CN PTW as defined in TS 38.304 [1].
* When UE is configured with RAN eDRX\_INACTIVE > 10.24s:
  + TDRX is calculated as max(TDRX\_RAN, TDRX\_CN), TDRX\_RAN and TDRX\_CN are DRX cycles with the RAN PTW and CN PTW defined in TS 38.304 [1].
* Otherwise, TDRX is the DRX cycle of the UE in the serving cell.

- 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 the duration of DL PRS symbols in ms corresponding to *durationOfPRS-ProcessingSymbols-r17* in TS 37.355 [34], T (ms) corresponds to *durationOfPRS-ProcessingSymbolsInEveryTms-r17* 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-RRC-Inactive-r17* specified in TS 37.355 [34].

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

When UE is configured with eDRX\_INACTIVE cycle > 10.24s:

* starts within PTW if the configured eDRX\_INACTIVE cycle is smaller or equal to the LMF configured PRS measurement reporting periodicity via *reportingInterval* in *RequestLocationInformation* as specified in TS 37.355 [34].
* Start of is not limited to PTW if the configured eDRX\_INACTIVE cycle is longer than the LMF configured PRS measurement reporting periodicity via *reportingInterval* in *RequestLocationInformation* as specified in TS 37.355 [34] or PRS measurement reporting periodicity is not configured by LMF.

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.

If eDRX\_INACTIVE 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.

The measurement requirements do not apply to any PRS resource that always collides with other higher-priority DL signals/channels, as specified in clause 5.6A.1.

Longer RSTD 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 5.6A.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-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 the cell selection is completed. The RSTD measurement period can be longer.

If the RRC state transition occurs from RRC\_INACTIVE to RRC\_CONNECTED state during the RSTD measurement period, then the UE shall continue the RSTD measurement in the RRC\_CONNECTED state. The RSTD measurement period can be longer.

#### 5.6A.4.6 Measurement period requirement with FH

After receiving both *NR-DL-TDOA-ProvideAssistanceData* message and *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] with FH via *nr-DL-PRS-RxHopping-Request,* the UE shall be able to measure multiple (up to the UE capability specified in Clause 5.6A.4.3) 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* with FH as specified below:

[ ,]

### 5.6A.5 PRS-RSRP measurements for RedCap

#### 5.6A.5.1 Introduction

The requirements in clause 5.6A.5.5 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.

The requirements in clause 5.6A.5.6 shall apply provided the RedCap UE has received *NR-DL-AoD-RequestLocationInformation* message from the LMF via LPP [34] requesting the UE to measure and report DL RSRP measurements defined in TS 38.215 [4] with FH via *nr-DL-PRS-RxHopping-Request*.

#### 5.6A.5.2 Requirements applicability

The requirements in clause 5.6A.5.5 apply for periodic and triggered PRS-RSRP measurements, provided:

* PRS-RSRP related side conditions given in clause 10.1A.24.x.x.x for FR1 are fulfilled, for a corresponding band, for 1 Rx RedCap UE.
* PRS-RSRP related side conditions given in clause 10.1.24.2 are met for a corresponding Band, for 2Rx RedCap UE.

The requirements in clause 5.6A.5.6 apply for periodic and triggered PRS-RSRP measurements, provided:

* PRS-RSRP related side conditions given in clause 10.1A.24.x.x.x for FR1 are fulfilled, for a corresponding band, for 1 Rx RedCap UE.
* PRS-RSRP related side conditions given in clause 10.1A.24.x.x.x are met for a corresponding Band, for 2Rx RedCap UE.

#### 5.6A.5.3 Measurement Capability

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

#### 5.6A.5.4 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 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 clause 10.1.24.3.

The PRS-RSRP measurement accuracy for all measured PRS resources shall be fulfilled according to the accuracy requriements specified in the clause 10.1.24.x.x.x, for each measured DL PRS resource by 1 Rx RedCap UE without FH.

The PRS-RSRP measurement accuracy for all measured PRS resources shall be fulfilled according to the accuracy requriements specified in the clause 10.1A.24.x.x.x, for each measured DL PRS resource by 1 Rx RedCap UE with FH.

The PRS-RSRP measurement accuracy for all measured PRS resources shall be fulfilled according to the accuracy requriements specified in the clause 10.1.24.2, for each measured DL PRS resource by 2 Rx RedCap UE without FH.

The PRS-RSRP measurement accuracy for all measured PRS resources shall be fulfilled according to the accuracy requriements specified in the clause 10.1A.24.x.x.x, for each measured DL PRS resource by 2 Rx RedCap UE with FH.

#### 5.6A.5.5 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 5.6.3.3) 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 *parallelPRS-MeasRRC-Inactive-r17*, Kcarrier\_PRS = 1; otherwise,

- If Srxlev ≤ SnonIntraSearchP or Squal ≤ SnonIntraSearchQ, , where is defined in clause 4.2B.2.4

- If Srxlev > SnonIntraSearchP and Squal > SnonIntraSearchQ, , where is defined in clause 4.2.2.7.

- is the UE Rx beam sweeping factor:

- = 1 if positioning frequency layer *i* is in FR1 or UE has only 1Rx branch,

- equals to the value as UE reported in *supportedLowerRxBeamSweepingFactor-FR2,* if positioning frequency layer *i* is in FR2 or the UE has 2Rx branches, and the capability is reported by the UE for the band containing positioning frequency layer i, and LMF indicates *lowerRxBeamSweepingFactor-FR2* in *NR-DL-TDOA-RequestLocationInformation*.

- equals to 8, otherwise.

- 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 resources that are not fully overlapped with other higher-priority DL signals/channels 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-ProcessingSymbols-r17* in TS 37.355 [34] processed every T ms corresponding to *durationOfPRS-ProcessingSymbolsInEveryTms-r17* 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-RRC-Inactive-r17* in clause 6.4.3 of TS 37.355 [34],

- is the number of PRS-RSRP measurement samples and

- = 1, if UE supports *supportedDL-PRS-ProcessingSamples-RRC-Inactive* [34], and the LMF indicates the UE to perform positioning measurements with reduced number of samples by *reducedDL-PRS-ProcessingSamplesrequestedDL-PRS-ProcessingSamples* [34], and the following conditions are met:

- PRS bandwidth is within the initial BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 2, if UE supports *supportedDL-PRS-ProcessingSamples-RRC-Inactive* [34], and the LMF indicates the UE to perform positioning measurements with reduced number of samples by *reducedDL-PRS-ProcessingSamples* [34], and the following conditions are not met

- PRS bandwidth is within the initial BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 4 otherwise

-  *= +* 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-r17* in TS 37.355 [34],

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

* When UE is configured with RAN eDRX\_INACTIVE ≤ 10.24s:
  + TDRX is calculated as T defined in TS 38.304 [1] when CN eDRX\_INACTIVE ≤ 10.24s.
  + TDRX is calculated as max(Tinside, Toutside), where Tinside and Toutside of the CN PTW as defined in TS 38.304 [1].
* When UE is configured with RAN eDRX\_INACTIVE > 10.24s:
  + TDRX is calculated as max(TDRX\_RAN, TDRX\_CN), TDRX\_RAN and TDRX\_CN are DRX cycles with the RAN PTW and CN PTW defined in TS 38.304 [1].
* Otherwise, TDRX is the DRX cycle of the UE in the serving cell.

- 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 UE is configured with DRX\_cycle, the time starts from the first DRX cycle containing the 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.

When UE is configured with eDRX\_INACTIVE cycle > 10.24s:

* starts within PTW if the configured eDRX\_INACTIVE cycle is smaller or equal to the LMF configured PRS measurement reporting periodicity via *reportingInterval* in *RequestLocationInformation* as specified in TS 37.355 [34].
* Start of is not limited to PTW if the configured eDRX\_INACTIVE cycle is longer than the LMF configured PRS measurement reporting periodicity via *reportingInterval* in *RequestLocationInformation* as specified in TS 37.355 [34] or PRS measurement reporting periodicity is not configured by LMF.

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 5.6A.5.5.

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 5.6A.5.X.

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-RSRP 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 5.6A.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-RSRP measurement period, then the PRS-RSRP measurement period can be longer.

If the eDRX\_INACTIVE cycle is reconfigured during the PRS-RSRP measurement period, then the PRS-RSRP 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-RSRP measurement after the cell selection is completed. The PRS-RSRP measurement period can be longer.

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

#### 5.6A.5.6 Measurement period requirement with FH

After receiving both *NR-DL-AoD-ProvideAssistanceData* message and *NR-DL-AoD-RequestLocationInformation* message from the LMF via LPP [34] requesting the UE to measure and report DL RSRP measurements defined in TS 38.215 [4] with FH via *nr-DL-PRS-RxHopping-Request,* the UE shall be able to measure multiple (up to the UE capability specified in Clause 5.6A.4.3) DL RSRP 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 RSRP measurement in positioning frequency layer i

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

[ ,]

### 5.6A.6 UE Rx-Tx time difference measurements for RedCap

5.6A.6.1 Introduction

The requirements in clause 5.6A.6.5 shall apply, provided the RedCap UE has received [*nr-Multi-RTT-ReqstLocationInformation]* 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] without FH via [*nr-DL-PRS-RxHopping-Request*].

The requirements in clause 5.6A.6.6 shall apply, provided the RedCap UE has received [*nr-Multi-RTT-ReqstLocationInformation]* 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] with FH via [*nr-DL-PRS-RxHopping-Request*].

5.6A.6.2 Requirements Applicability

The requirements in clause 5.6A.6 apply for periodic and triggered UE Rx-Tx time difference measurements, provided:

* UE Rx-Tx time difference measurement related side conditions given in clause 10.1A.25.x.x.x for FR1 are fulfilled, for a corresponding band, for 1 Rx RedCap UE.

- UE Rx-Tx time difference measurement related side conditions given in clause 10.1.25.2 are met for a corresponding band, for 2Rx RedCap UE.

- SRS is configured on the PCell.

The requirements in clause 5.6A.6 apply for periodic and triggered UE Rx-Tx time difference measurements, provided:

* UE Rx-Tx time difference measurement related side conditions given in clause 10.1A.25.x.x.y for FR1 are fulfilled, for a corresponding band, for 1 Rx RedCap UE.

- UE Rx-Tx time difference measurement related side conditions given in clause 10.1.25.x.x.y are met for a corresponding band, for 2RX RedCap UE.

- SRS is configured on the PCell.

5.6A.6.3 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].

5.6A.6.4 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 10.1.25.3.

The UE Rx-Tx time difference measurement performed and reported according to this section shall meet the UE Rx-Tx time difference measurement accuracy requirements in clause 10.1A.25.x.x.x, for each measured DL PRS resource by 1 Rx RedCap UE without FH.

The UE Rx-Tx time difference measurement performed and reported according to this section shall meet the UE Rx-Tx time difference measurement measurement accuracy requirements in clause 10.1A.25.2., for each measured DL PRS resource by 2 Rx RedCap UE without FH.

The UE Rx-Tx time difference measurement performed and reported according to this section shall meet the UE Rx-Tx time difference measurement measurement accuracy requirements in clause 10.1.25.x.x.y, for each measured DL PRS resource by 1 Rx RedCap UE with FH.

The UE Rx-Tx time difference measurement performed and reported according to this section shall meet the UE Rx-Tx time difference measurement measurement accuracy requirements in clause 10.1A.25.x.x.z, for each measured DL PRS resource by 2 Rx RedCap UE with FH.

5.6A.6.5 Measurement Period Requirements without FH

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 5.6.4.3) UE Rx-Tx time difference measurements as defined in TS 38.215 [4] in configured positioning frequency layers within the measurement period ms defined in 5.6.4.5.

If the RRC state transion 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 5.6.4 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.

The UE shall meet the UE Rx-Tx time difference measurement accuracy requirements in clause 10.1.25.2.

5.6A.6.6 Measurement Period Requirements with FH

*[Editor’s note: The requirement for RedCap without FH are defined in current stage. These requirements for RedCap with FH in RRC\_IDLE state can be depriotized after the requirements for RedCap with FH in RRC\_CONNECT stable enough.]*

**-----------------------------NEXT CHANGE------------------------------**

7.1.2.4 UE transmit timing for positioning measurements

If cell reselection occurs in RRC\_Inactive within *srs-PosRRC-InactiveValidityArea area*, the UE shall have capability to follow the frame timing change of the reference cell when transmiting SRS for positioning. The uplink frame transmission takes place before the reception of the first detected path (in time) of the corresponding downlink frame from the reference cell. The UE shall use the current camping cell as reference cell for deriving the UE transmit timing. Gradual timing adjustment requirements are defined in the following requirements.

When *ueAotonomousTaAdjustment* is configured, the following requirements apply to the UE supporting [*AutonomousAdjustOneStepUL-Timing-r18*]:

* If the DL timing difference is ≥ CP/4, UE autonomously adjusts the TA based on twice of the DL timing difference

- The UE UL transmission timing error after autonomous TA adjustment shall be less than or equal to ±Te in clause 7.1.2.3.

* If the DL timing difference is < CP/4, UE follows the DL timing of the new camping cell by performing gradual timing adjustment as defined in clause 7.1.2.1.

The above DL timing difference is timing difference between the last camping cell and current camping cell.

**-----------------------------NEXT CHANGE------------------------------**

## 9.1A General measurement requirement for RedCap

### 9.1A.1 Introduction

This clause contains general requirements on the RedCap UE regarding measurement reporting in RRC\_CONNECTED state. The requirements are split in intra-frequency, inter-frequency, inter-RAT E-UTRAN FDD, inter-RAT E-UTRAN TDD, and L1-RSRP measurements requirements. These measurements may be used by the NG-RAN. The measurement quantities are defined in TS38.215 [4], the measurement model is defined in TS38.300 [10], TS37.340 [17] and measurement accuracies are specified in clause 10. Control of measurement reporting is specified in TS 38.331 [2].

The SSB and SMTC in this section applies for both CD-SSB and NCD-SSB if it is not additional specified.

### 9.1A.2 Measurement gap

If the UE requires measurement gaps to identify and measure intra-frequency cells and/or inter-frequency cells and/or inter-RAT E-UTRAN cells, and the UE does not support independent measurement gap patterns for different frequency ranges as specified in Table 5.1-1 in [18, 19, 20], in order for the requirements in the following clauses to apply the network must provide a single per-UE measurement gap pattern for concurrent monitoring of all frequency layers.

If the UE requires measurement gaps to identify and measure intra-frequency cells and/or inter-frequency cells and/or inter-RAT E-UTRAN cells, and the UE supports independent measurement gap patterns for different frequency ranges as specified in Table 5.1-1 in [18, 19, 20], in order for the requirements in the following clauses to apply the network must provide either per-FR measurement gap patterns for frequency range where UE requires per-FR measurement gap for concurrent monitoring of all frequency layers of each frequency range independently, or a single per-UE measurement gap pattern for concurrent monitoring of all frequency layers of all frequency ranges.

If the UE is configured via LPP [34] to measure PRS for any RSTD, PRS-RSRP, UE Rx-Tx time difference measurement and PRS-RSRPP measurement with or without FH defined in TS 38.215 [4], in order for the requirements in clauses 9.9A.2, 9.9A.3, 9.9A.4 and 9.9A.5 to apply, the network must provide:

- a single per-UE measurement gap pattern for concurrent monitoring of all positioning frequency layers and intra-frequency, inter-frequency and/or inter-RAT frequency layers of all frequency ranges, or

- if UE supports independent measurement gap patterns for different frequency ranges for PRS measurement, i.e. supporting *independentGapConfigPRS-r17*, per-FR measurement gap pattern for the frequency range for concurrent monitoring of all positioning frequency layers and intra-frequency, inter-frequency cells and/or inter-RAT frequency layers in the corresponding frequency range.

During the per-UE or per-FR measurement gaps the UE:

- is not required to conduct reception/transmission from/to the corresponding NR serving cell for SA (with single carrier) except the reception of signals used for RRM measurement(s), and the signals used for random access procedure according to [7].

UEs shall support the measurement gap patterns listed in Table 9.1A.2-1 based on the applicability specified in Table 9.1A.2-2. UE determines measurement gap timing based on gap offset configuration and measurement gap timing advance configuration provided by higher layer signalling as specified in TS 38.331 [2] and TS 36.331 [16].

Table 9.1A.2-1: Gap Pattern Configurations

|  |  |  |
| --- | --- | --- |
| Gap Pattern Id | Measurement Gap Length (MGL, ms) | Measurement Gap Repetition Period  (MGRP, ms) |
| 0 | 6 | 40 |
| 1 | 6 | 80 |
| 2 | 3 | 40 |
| 3 | 3 | 80 |
| 4 | 6 | 20 |
| 5 | 6 | 160 |
| 6 | 4 | 20 |
| 7 | 4 | 40 |
| 8 | 4 | 80 |
| 9 | 4 | 160 |
| 10 | 3 | 20 |
| 11 | 3 | 160 |
| 12 | 5.5 | 20 |
| 13 | 5.5 | 40 |
| 14 | 5.5 | 80 |
| 15 | 5.5 | 160 |
| 16 | 3.5 | 20 |
| 17 | 3.5 | 40 |
| 18 | 3.5 | 80 |
| 19 | 3.5 | 160 |
| 20 | 1.5 | 20 |
| 21 | 1.5 | 40 |
| 22 | 1.5 | 80 |
| 23 | 1.5 | 160 |
| 24 | 10 | 80 |
| 25 | 20 | 160 |

**-----------------------------NEXT CHANGE------------------------------**

#### 9.1A.5.2 Monitoring of multiple layers within gaps

The carrier-specific scaling factor CSSFwithin\_gap\_RedCap,i for a measurement object *i* derived in this chapter is applied to following measurement types:

- SSB-based intra-frequency measurement object with no measurement gap in clause 9.2B.5, when all of the SMTC occasions of this intra-frequency measurement object are overlapped by the measurement gap.

- SSB-based intra-frequency measurement object with measurement gap in clause 9.2B.6.

- SSB-based inter-frequency measurement object with measurement gap in clause 9.3B.4.

- SSB-based inter-frequency measurement object without measurement gap for UE capable of *interFrequencyMeas-NoGap* in clause 9.3B.7, when

-all of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap, or

- part of the SMTC occasions of this inter-frequency measurement object are overlapped by the measurement gap but the flag *interFrequencyConfig-NoGap-r16* is not configured by the Network- E-UTRA Inter-RAT measurement object in clauses 9.4A.2 and 9.4A.3.

- NR PRS-based measurements for positioning in clause 9.9A.

UE is expected to conduct the measurement of this measurement object *i* only within the measurement gaps.

If the higher layer signaling in TS 38.331 [2] of *smtc2* is present and *smtc1* is fully overlapping with measurement gaps and *smtc2* is partially overlapping with measurement gaps, CSSFwithin\_gap\_RedCap,i and requirements derived from CSSFoutside\_gap\_RedCap,i are not specified.

##### 9.1A.5.2.1 SA mode: carrier-specific scaling factor for SSB measurements performed within gaps

When one or more measurement objects are monitored within measurement gaps, the carrier specific scaling factor for a target measurement object with index *i* is designated as CSSFwithin\_gap\_RedCap,i and is derived as described in this clause.

For each measurement gap *j* count the total number of intra-frequency measurement object and inter-frequency/inter-RAT measurement objects which are candidates to be measured within the gap *j*.

- An NR measurement object with SSB measurement configured is a candidate to be measured in a gap if its SMTC duration is fully covered by the MGL excluding RF switching time. For intra-frequency NR measurement object, if the higher layer in TS 38.331 [2] signaling of *smtc2* is configured, the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc2*; otherwise the assumed periodicity of SMTC occasions corresponds to the value of higher layer parameter *smtc1*.

- For UEs which support and are configured with per FR gaps, the counting is done on a per FR basis, and for UEs which are configured with per UE gaps the counting is done on a per UE basis.

- Mintra\_RedCap,i,j: Number of intra-frequency measurement objects, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Mintra,i,j equals 0.

- Minter\_RedCap,i,j : Number of NR inter-frequency layers and EUTRA inter-RAT, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Minter\_RedCap,i,j equals 0.

- Mtot\_RedCap,i,j = Mintra\_RedCap,i,j + Minter\_RedCap,i,j : Total number of intra-frequency, inter-frequency and inter-RAT frequncy layers, which are candidates to be measured in gap *j* where the measurement object *i* is also a candidate. Otherwise Mtot\_RedCap,i,j equals 0.

The carrier specific scaling factor CSSFwithin\_gap\_RedCap,i is given by:

If *measGapSharingScheme* is equal sharing, CSSFwithin\_gap\_RedCap,i= max(ceil(Ri×Mtot\_RedCap,i,j)), where *j*=0…(160/MGRP)-1

If *measGapSharingScheme* is not equal sharing and

- measurement object *i* is an intra-frequency measurement object, CSSFwithin\_gap\_RedCap,i is the maximum among

- ceil(Kintra×Mintra\_RedCap,i,j) in gaps where Minter\_RedCap,i,j≠0, where *j*=0…(160/MGRP)-1

- ceil(Mintra\_RedCap,i,j) in gaps where Minter\_RedCap,i,j=0, where *j*=0…(160/MGRP)-1

- measurement object *i* is an inter-frequency or inter-RAT measurement object, CSSFwithin\_gap\_RedCap,i is the maximum among

- ceil(Kinter×Minter\_RedCap,i,j) in gaps where Mintra\_RedCap,i,j ≠0, where *j*=0…(160/MGRP)-1

- ceil(Minter\_RedCap,i,j)in gaps where Mintra\_RedCap,i,j=0, where *j*=0…(160/MGRP)-1

##### 9.1A.5.2.2 SA mode: carrier-specific scaling factor for PRS measurements performed within gaps

The CSSF defined in clause 9.1.5.2.5 applies to PRS measurements performed by RedCap UEs within measurement gaps with and without FH.

**-----------------------------NEXT CHANGE------------------------------**

### 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, PRS-RSRPP, RSTD based on aggregated PRS resources from multiple PFLs, UE Rx-Tx time difference based on aggregated PRS resources and aggregated SRS resources from multiple PFLs, DL RSCPD reported with RSTD, DL RSCP reported with UE Rx-Tx time difference measurements in RRC\_CONNECTED state.

The measurement reporting delay can be longer for the measurement reporting requirements in this clause when IDC autonomous denial is configured.

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

For gap-based RSTD, RSTD based on aggregated PRS resources from multiple PFLs, PRS-RSRP, UE Rx-Tx time difference, UE Rx-Tx time difference based on aggregated PRS resources and aggregated SRS resources from multiple PFLs, PRS-RSRPP, DL RSCPD reported with RSTD, DL RSCP reported with UE Rx-Tx time difference measurements, the requirements in clauses 9.9.2.5, 9.9.2.x1, 9.9.3.5, 9.9.4.5, 9.9.4.x1, 9.9.6.5, 9.9.x1, 9.9.x2 apply provided:

- the UE is configured or pre-configured with measurement gaps or configured with concurrent measurement gaps

- all positioning frequency layers are measured or associated with only one per-UE measurement gap, or

- for the UE supporting *independentGapConfigPRS-r17*, all positioning frequency layers in the same FR are measured or associated with only one per-FR measurement gap in the corresponding FR.

- if the measurement gap is pre-configured, the gap must be activated throughout the measurement period, and

- if concurrent measurement gaps are configured, one of the gap combinations specified in clause 9.1.8.2 is configured, and

- if the UE does not support *independentGapConfigPRS-r17*, the configured or pre-configured gap used to perform the PRS measurements must be of per-UE type, and

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

All measurement requirements specified in clause 9.9.2.5, 9.9.2.x1, 9.9.3.5, 9.9.4.5, 9.9.4.x1, 9.9.6.5, 9.9.x1 and 9.9.x2 shall apply without DRX as well as for any DRX configuration specified in TS 38.331 [2].

UE is only required to measure PRS resources that are fully or partially overlapped with measurement gaps, and the requirements in clause 9.9.2.5, 9.9.2.x1, 9.9.3.5, 9.9.4.5, 9.9.4.x1, 9.9.6.5, 9.9.x1 and 9.9.x2 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.x1, 10.1.24, 10.1.25, 10.1.x2 and 10.1.38 for RSTD, RSTD based on aggregated PRS resources from multiple PFLs, PRS-RSRP, UE Rx-Tx time difference and UE Rx-Tx time difference based on aggregated PRS resources and aggregated SRS resources from multiple PFLs, 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.

If a positioning measurement gap is configured via *PosGapConfig* and activated by MAC CE, the measurement requirements in clause 9.9.2.5, 9.9.2.x1, 9.9.3.5, 9.9.4.5, 9.9.4.x1, 9.9.6.5, 9.9.x1 and 9.9.x2 apply provided that no other MGs are configured, and only one measurement gap configured via *PosGapConfig* is activated.

#### 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 9.9.2.7, 9.9.3.6, 9.9.4.6 and 9.9.6.6 shall apply provided that:

Positioning frequency layer to be measured is within an active BWP,

UE is configured with PPW, and the PPW for the active BWP containing the positioning frequency layer to be measured is activated,

No active BWP switching occurs during the measurement period specified in clauses 9.9.2.7, 9.9.3.6, 9.9.4.6, and 9.9.6.6,

PRS is within PPW and does not overlap with other signals/channels of higher priority,

- for PPW type 1A/1B, the PPW does not overlap with any symbol for SSB-based RLM/BFD/CBD/L1-RSRP/L1-SINR measurement on any CC or for SSB based RRM measurement on any MOs that are measured outside measurement gaps,

- for PPW type 2, PRS does not overlap with any symbol for SSB-based RLM/BFD/CBD/L1-RSRP/L1-SINR measurement on any CC or for SSB based RRM measurement on any MOs that are measured outside measurement gaps,

max∣ΔT∣≤ THR, where

∆T is the time difference between the start of a slot containing PRS from the neighbor cell/TRP and the start of the closest slot from the serving cell;

the range of ∆T is determined by the expected RSTD and expected RSTD uncertainty in the assistance data;

THR is the threshold as reported in UE capability *prs-MeasurementWithoutMG-r17*.

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, 9.9.4.6and 9.9.6.6 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 9.9.6.6 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 , where the minimum number is given in the accuracy requirements in clause 10.1.23, 10.1.24, 10.1.25 and 10.1.38 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.

**-----------------------------NEXT CHANGE------------------------------**

### 9.9.2 RSTD measurements

#### 9.9.2.1 Introduction

The requirements in clause 9.9.2 shall apply provided the UE has received *NR-DL-TDOA-RequestLocationInformation* message from LMF via LPP [34] requesting the UE to measure and report DL RSTD measurements defined in TS 38.215 [4].

#### 9.9.2.2 Requirements Applicability

The requirements in clause 9.9.2 apply for periodic and triggered RSTD measurements, provided:

- PRS-RSTD related side conditions given in clause 10.1.23 for FR1 and FR2 are fulfilled, for a corresponding Band.

- PRS-RSTD related side conditions given in clause 10.1.23.x for FR1 and FR2 are met for PRS aggregation from multiple PFLs.

- All PFLs to be aggregated by the UE are transmitted by the TRP using common RF components or common RF bandwidth and the same transmit antenna reference point.

**-----------------------------NEXT CHANGE------------------------------**

#### 9.9.4.2 Requirements Applicability

The requirements in clause 9.9.4 apply for periodic and triggered UE Rx-Tx time difference measurements, provided:

- UE Rx-Tx time difference measurement related side conditions given in clause 10.1.25 are met for a corresponding band.

- UE Rx-Tx time difference measurement related side conditions given in clause 10.1.25.x are met for PRS aggregation from multiple PFLs.

- SRS is configured on at least one of the PCell, PSCell and SCell.

- The UE transmits SRS within [-160, 160] msec of at least one DL PRS resource of each of the TRPs in the assistance data.

- All PFLs to be aggregated by the UE are transmitted by the TRP using single Tx chain and the same transmit antenna reference point.

- All PFLs to be aggregated by the TRP are transmitted by the UE using single Tx chain and the same transmit antenna reference point.

**-----------------------------NEXT CHANGE------------------------------**

### 9.9.x1 Measurement requirements for DL RSCPD reported with RSTD

#### 9.9.x1.1 Introduction

The requirements in clause 9.9.x1 shall apply provided the UE has received *NR-DL-TDOA-RequestLocationInformation* message with *nr-UE-RSCPD-Request* from LMF via LPP [34] requesting the UE to measure and report RSCPD measurement with DL RSTD 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 reporting of RSCPD with RSTD measurements, provided:

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

- RSCPD related side conditions given in clause 10.1.x for FR1 and FR2 are fulfilled, for a corresponding Band.

#### 9.9.x1.3 Measurement Capability

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

#### 9.9.x1.4 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 starts to transmit the measurement report over the air interface. This requirement assumes that the measurement report is not delayed by other LPP signalling on the DCCH. This measurement reporting delay excludes a 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. This measurement reporting delay excludes any delay caused by no UL resources for UE to send the measurement report.

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 reported RSCPD measurement values contained in the measurement reports shall be based on the measurement report mapping requirements specified in clauses 10.1.x.

The RSTD measurements performed and reported according to this section shall meet the RSTD measurement accuracy requirements in clause 10.1.23, for the measured DL PRS resource.

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

#### 9.9.x1.5 Measurements Period Requirements for DL RSCPD reported with RSTD

When physical layer receives last of *NR-TDOA-ProvideAssistanceData* message and *NR-TDOA-RequestLocationInformation* message with *nr-UE-RSCPD-Request* from LMF via LPP [34]*,* the UE shall be able to measure RSTD and RSCPD measurement on the common PFL between reference and neighbor TRPs, defined in TS 38.215 [4], during the measurement period defined as:

,

where:

* , , , , , , , and are defined in clause 9.9.2.5.
* = 1 or 2 as defined in clause 9.9.2.5.
* is the time duration of available PRS in the positioning frequency layer 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].
* When periodic time window(s) are configured by the LMF, , otherwise . is the maximum periodicity of the configured time window(s). and are defined in clause 9.9.2.5.
* and are calculated by only considering the PRS resources in the indicated resources sets overlapping with both the MG and the indicated time window(s).

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

Except for deferred MT-LR as defined in clause 4.1a.5 [TS 23.273], the time TRSCPD with RSTD *s*tarts from the first time window (TRSCPD) configured by LMF within 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].

For deferred MT-LR with other event than “Periodic Location” as defined in clause 4.1a.5.1 [TS 23.273], the time TRSCPD with RSTD starts from the first time window (TRSCPD) configured by LMF within MG instance aligned with a DL PRS resource(s) in the assistance data after the associated event(s) occurs.

For deferred MT-LR with event “Periodic Location” as defined in clause 4.1a.5.1 [TS 23.273], the UE shall perform the RSCPD with RSTD measurement in each reporting period within the time window(TRSCPD) configured by LMF within MG instance and activate the location report at the time when the periodic timer expires.

If during the measurement period, the MG pattern is reconfigured or time window (TRSCPD) for RSCPD measurement is reconfigured, the measurement period can be longer. When PRS-RSRP is also configured to UE, RSCPD with 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 TRSCPD with RSTD 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.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-TDOA-ProvideCapabilities*, and it is up to UE implementation which PRS resources are measured, subject to UE measurement capabilities*.*

If handover occurs while RSTD and RSCPD measurements are being performed together by UE, then the UE shall continue and complete the on-going RSTD and RSCPD measurements. The measurement period for RSCPD with RSTD measurement can be longer. The UE shall meet the RSTD measurement accuracy requirements in clause 10.1.23. The UE shall also meet the RSCPD measurement accuracy requirements in clause 10.1.x.

### 9.9.x2 Measurement requirements for DL RSCP reported with UE Rx-Tx time difference

9.9.x2.1 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 DL RSCP measurements with UE Rx-Tx time difference measurements defined in TS 38.215 [4].

9.9.x2.2 Requirements Applicability

The requirements in clause 9.9.x2 apply for periodic and triggered UE Rx-Tx time difference measurements, provided:

- UE Rx-Tx time difference measurement related side conditions given in clause 10.1.25 are met for a corresponding band.

- DL RSCP related side conditions given in clause 10.1.x for FR1 and FR2 are fulfilled, for a corresponding Band.

- SRS is configured on at least one of the PCell, PSCell and SCell.

- The UE transmits SRS within [-160, 160] msec of at least one DL PRS resource of each of the TRPs in the assistance data.

9.9.x2.3 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].

9.9.x2.4 Measurement Reporting Requirements

This requirement assumes that the measurement report is not delayed by other LPP signalling on the DCCH. This measurement reporting delay excludes a 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. This measurement reporting delay excludes any delay caused by no UL resources for UE to send the measurement report.

The UE Rx-Tx time difference measurement values contained in measurement reports shall be based on the measurement report mapping requirements specified in clause 10.1.25.

The DL RSCP 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 10.1.25.

The DL RSCP measurement accuracy for all measured DL PRS resourcesshall be fulfilled according to the accuracy requirements specified in clause 10.1.x.

9.9.x2.5 Measurement Period Requirements for DL RSCP and UE Rx-Tx time difference

When physical layer receives last of *NR-Multi-RTT-ProvideAssistanceData* message and *NR-Multi-RTT-RequestLocationInformation* message with *[indication from LMF requesting to measure DL RSCP]* from LMF via LPP [34]*,* UE shall be able to measure multiple (up to the UE capability specified in clause 9.9.x2.3) UE Rx-Tx time difference and DL RSCP measurements as defined in TS 38.215 [4] in configured positioning frequency layers within the measurement period ms.

,

where:

* is the carrier-specific scaling factor for NR PRS-based measurement in the positioning frequency layer as defined in clause 9.1.5.2,
* is the scaling factor for measurement of same PRS resource with multiple Rx TEGs.

=1 if UE is not requested by LMF to measure a PRS resource with multiple Rx TEGs via *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* or *measureSameDL-PRS-ResourceWithDifferentRxTxTEGs-r17* [34] in *NR-Multi-RTT-RequestLocationInformation*;

otherwise,

=, if UE is not capable of receiving same DL PRS resource simultaneously from multiple Rx TEGs, and

= if UE is capable of receiving the same DL PRS resource simultaneously from multiple Rx TEGs.

where

is the number of Rx TEGs or RxTx TEGs with which UE is requested to measure a PRS resource indicated via *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* or *measureSameDL-PRS-ResourceWithDifferentRxTxTEGs-r17* [34] in *NR-Multi-RTT-RequestLocationInformation*, and in case ‘n0’ is indicated, is the maximum number of Rx TEGs with which UE can support to measure the same PRS resource as reported in *NR-UE-TEG-Capability*, and

is the number of Rx TEGs UE can measure simultaneously which is reported via *measureSameDL-PRS-ResourceWithDifferentRxTEGsSimul*.

- is a scaling factor for a positioning frequency layer to be measured within the associated measurement gap pattern, which is defined as = Ntotal / Navailable for UE configured with concurrent measurement gap, and = 1 for UE not configured with concurrent measurement gap.

For a window W of duration max(, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE MG and per-FR MG within the same FR as the positioning frequency layer, and starting at the beginning of any associated gap occasions covering the PRS occasion:

Ntotal is the total number of associated gap occasions covering PRS occasions within the window, including both dropped and non-dropped instances of the associated measurement gap within the window, and

Navailable is the number of non-dropped associated gap occasions covering PRS occasions within the window W, after further accounting for MG collisions by applying the selected gap collision rule

Requirements do not apply if Navailable =0.

- is the scaling factor for Rx beam sweeping, and =1 if positioning frequency layer is in FR1 and if positioning frequency layer is in FR2, is equal to the value reported by the UE in *supportedLowerRxBeamSweepingFactor-FR2* if the UE supports the capability for the band containing positioning frequency layer, and the LMF indicates *lowerRxBeamSweepingFactor-FR2* in *NR-Multi-RTT-RequestLocationInformation*. is equal to 8, otherwise.

- is the time duration of available PRS resources in the positioning frequency layer, 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 the positioning frequency layer 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 measurement samples, where

- = 4 if the UE is not capable of *supportedDL-PRS-ProcessingSamples-RRC-CONNECTED* defined in [34].

- = 1 if the UE is capable of *supportedDL-PRS-ProcessingSamples-RRC-CONNECTED* defined in [34] and LMF requests the UE to perform positioning measurements with reduced number of samples by *reducedDL-PRS-ProcessingSamples* [34] and the following conditions are met:

- PRS bandwidth is within the active BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 2 if the UE is capable of *supportedDL-PRS-ProcessingSamples-RRC-CONNECTED* defined in [34] and the LMF requests the UE to perform positioning measurements with reduced number of samples by *reducedDL-PRS-ProcessingSamples* [34] but the following conditions are not met:

- PRS bandwidth is within the active BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 4 otherwise.

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

- is periodicity of the DL RSCP with UE Rx-Tx time difference measurement in the positioning frequency layer:

where

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

When periodic time window(s) are configured by the LMF, , the least common multiple between , and Twindow being the maximum periodicity of the indicated time window(s).

- and are calculated by only considering the PRS resources in the indicated resources sets overlapping with the indicated time window(s).

When periodic time window(s) are not configured by the LMF, , the least common multiple between and *MGRP*.

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

is the PRS resource periodicity in the positioning frequency layer. If the positioning frequency layer 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, only the PRS resources fully or partially covered by the MG are considered.

Except for deferred MT-LR as defined in clause 4.1a.5 [TS 23.273], the time starts from the first time window (TDL RSCP) configured by LMF within MG instance aligned with DL PRS resource(s) 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.

For deferred MT-LR with other event than “Periodic Location” as defined in clause 4.1a.5.1 [TS 23.273], the time starts from the first time window (TDL RSCP) configured by LMF within MG instance aligned with DL PRS resource(s) in the assistance data after the associated event(s) occurs.

For deferred MT-LR with event “Periodic Location” as defined in clause 4.1a.5.1 [TS 23.273], the UE shall perform the DL RSCP with UE Rx-Tx time difference measurement in each reporting period and activate the location report at the time when the periodic timer expires.

The DL RSCP with 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 the positioning frequency layer, 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.

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.x2 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 shall continue and complete the DL RSCP and UE Rx-Tx time difference measurements, and the measurement period requirements apply.

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

When SRS is reconfigured without serving cell change during the measurement period, UE shall restart the DL RSCP and UE Rx-Tx time difference measurement after the SRS reconfiguration is complete.

When a serving cell change occurs during the measurement period, the UE shall restart DL RSCP and UE Rx-Tx time difference measurements.

If UE uplink transmission timing changes due to the network-configured Timing Advance command during the measurement period, then the UE Rx-Tx time difference measurement 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 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 UE autonomous timing adjustment defined in clause 7.1.2 during the measurement period, then:

- UE Rx-Tx measurement period requirements in this clause shall apply for a cell, which is also the downlink reference cell (defined in section 7.1.1) for SRS transmission.

- UE Rx-Tx measurement period requirements in this clause shall not apply for a cell, which is not the downlink reference cell (defined in section 7.1.1) for SRS transmission. The UE Rx-Tx time difference measurement period may be restarted in such case.

If UE uplink transmission timing changes due to the network-configured Timing Advance command or due to the change in the NTA\_offset defined in Table 7.1.2-2 or due to the UE autonomous timing adjustment defined in clause 7.1.2 during the DL RSCP with UE Rx-Tx measurement period, the UE may continue and complete the DL RSCP measurement.

**-----------------------------NEXT CHANGE------------------------------**

9.9.2.x1 Measurements Period Requirements with Bandwidth Aggregation

When physical layer receives last of *NR-TDOA-ProvideAssistanceData* message and *NR-TDOA-RequestLocationInformation* message from LMF via LPP [34] with a request to perform measurement by aggregating PRS resources from multiple PFLs via [*nr-DL-PRS-JointMeasurementRequested*]*,* the UE shall be able to perform RSTD measurement by aggregating PRS resources from multiple PFLs (up to the UE capability specified in Clause 9.9.2.3) defined in TS 38.215 [4], during the measurement period TRSTD\_aggregated, Total defined as:

TRSTD\_aggregated, Total = Tnon\_aggregate\_RSTD + Taggregated\_RSTD + Tmargin,

where,

Tnon\_aggregate\_RSTD is the total measurement period for RSTD measurement on PFLs that do not contain PRS resources for aggregation.

Calculation of Tnon\_aggregate\_RSTD is based on clause 9.9.2.5, such that Tnon\_aggregate\_RSTD is calculated by considering PRS resources that are not aggregated by UE, based on the configuration received from the LMF.

Tnon\_aggregate\_RSTD is equal to zero if UE is not configured to perform non-aggregated measurements by the LMF.

Tmargin is delay margin to account for delay between RSTD measurement performed by UE on PFLs that contain PRS resources for aggregation and RSTD measurement performed by UE on PFLs that do not contain PRS resources for aggregation. Tmargin is calculated as max(Teffect,i), by considering both aggregated PFLs and non-aggregated PFLs configured for positioning measurement. Tmargin is only applicable when UE is configured to perform measurements on PFLs that contain PRS resources for aggregation and on PFLs that do not contain PRS resources for aggregation.

If UE is only configured to perform measurements on PFLs that contain PRS resources for aggregation or if UE is only configured to perform measurements on PFLs that do not contain PRS resources for aggregation, then Tmargin = 0.

If UE is capable of performing latency reduced positioning measurements and is configured to perform latency reduced positioning measurement by LMF via *reducedDL-PRS-ProcessingSamples-r17* [34], then Nsample = 2 shall be considered in calculations of Taggregate\_RSTD and Tnon-aggregate\_RSTD.

If UE is not capable to perform latency reduced positioning measurements or is not configured to perform latency reduced positioning measurement by LMF via *reducedDL-PRS-ProcessingSamples-r17* [34], then Nsample = 4 shall be considered in calculations of Taggregate\_RSTD and Tnon-aggregate\_RSTD.

Taggregate\_RSTD, total measurement period for RSTD measurements performed by UE by aggregating PRS resources from multiple PFLs as defined in TS 38.214 [26], is defined as:

where

is the index of effective PFL, corresponding to the group of PFLs containing linked PRS resource sets to be aggregated for RSTD measurement,

G denotes the number of effective PFLs that UE is configured to perform aggregated measurements on. G is configured by LMF and is provisioned to UE via *nr-DL-PRS-AggregationInfo.*

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

,

where:

* is the UE Rx beam sweeping factor.
  + In FR1, = 1.
  + In FR2, is equal to the value reported by the UE in *supportedLowerRxBeamSweepingFactor-FR2* if the UE supports the capability for the band containing effective positioning frequency layer , and the LMF indicates *lowerRxBeamSweepingFactor-FR2* in*NR-DL-TDOA-RequestLocationInformation*. is equal to 8, otherwise.
* is the carrier-specific scaling factor for NR PRS-based positioning measurements in effective positioning frequency layer as defined in clause 9.1.5.2.
* is the scaling factor for measurement of same PRS resource with multiple Rx TEGs.
  + = 1 if UE is not requested by LMF to measure a PRS resource with multiple Rx TEGs via *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* [34] in *NR-DL-TDOA-RequestLocationInformation*;
  + otherwise,
    - = , if UE is not capable of receiving same DL PRS resource simultaneously from multiple Rx TEGs, and
    - = if UE is capable of receiving the same DL PRS resource simultaneously from multiple Rx TEGs.

where

* is the number of Rx TEGs with which UE is requested to measure aggregated PRS resource indicated via *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* [34] in *NR-DL-TDOA-RequestLocationInformation*, and in case ‘n0’ is indicated, is the maximum number of Rx TEGs with which UE can support to measure the same PRS resource as reported in *NR-UE-TEG-Capability*, and
* is the number of Rx TEGs UE can measure simultaneously which is reported via *measureSameDL-PRS-ResourceWithDifferentRxTEGsSimul*.
* is a scaling factor for effective positioning frequency layer to be measured within the associated measurement gap pattern, which is defined as = Ntotal / Navailable for UE configured with concurrent measurement gap, and = 1 for UE not configured with concurrent measurement gap.
  + For a window W of duration max(, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE MG and per-FR MG within the same FR as the effective positioning frequency layer, and starting at the beginning of any associated gap occasions covering the PRS occasion:

- Ntotal is the total number of associated gap occasions covering PRS occasions within the window, including both dropped and non-dropped instances of the associated measurement gap within the window, and

- Navailable is the number of non-dropped associated gap occasions covering PRS occasions within the window W, after further accounting for MG collisions by applying the selected gap collision rule

- Requirements do not apply if Navailable = 0.

* is the maximum number of DL PRS resources in effective positioning frequency layer configured in a slot.
* is the time duration of available PRS in the effective positioning frequency layer 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 and satisfying the conditions for PRS BW aggregation are considered.

is the number of PRS RSTD measurement samples.

is the measurement duration for the last PRS RSTD sample in the effective positioning frequency layer, 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\_agg, = + MGL. Otherwise, = Tagg,i + ,

is the periodicity of the PRS RSTD measurement in the effective positioning frequency layer 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 effective PRS frequency layer i.
* is the periodicity of DL PRS resources meeting the bandwidth aggregation conditions with muting on effective positioning frequency layer . If more than one PRS periodicities are configured in effective positioning frequency layer the least common multiple of PRS periodicities among all DL PRS resource sets in the effective positioning frequency layer is used to derive , where,
  + , is the PRS periodicity with muting per PRS resource configured for aggregation,
  + 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\_agg,i, only the PRS resources fully or partially covered by the MG and PRS resources that satisfy the conditions for PRS BW aggregation are considered.

* {Nagg, Tagg}is UE capability combination per band to aggregate PRS resources from multiple PFLs within an effective PFL where Nagg is a duration of DL PRS symbols in ms corresponding to [*durationOfPRS-ProcessingSysmbols*] in TS 37.355 [34] processed every Tagg 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].

Except for deferred MT-LR as defined in clause 4.1a.5 [TS 23.273], the time *s*tarts from the first MG instance aligned with DL PRS resources in the assistance data for aggregation 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] including a request to perform measurement by aggregating PRS resources from multiple PFLs via [*nr-DL-PRS-JointMeasurementRequested*].

For deferred MT-LR with other event than “Periodic Location” as defined in clause 4.1a.5.1 [TS 23.273], the timestarts from the first MG instance aligned with DL PRS resources in the assistance data after the associated event(s) occurs.

For deferred MT-LR with event “Periodic Location” as defined in clause 4.1a.5.1 [TS 23.273], the UE shall perform the aggregated RSTD measurement in each reporting period and activate the location report at the time when the periodic timer expires.

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

The measurement requirements in this clause apply, provided no PRS symbols are dropped during the measurement period TRSTD\_aggregated,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 aggregated PRS resources, if the PRS resources to be aggregated are across two sampling duration of Nagg within duration .

The measurement requirements do not apply, if time span of the instance of the PRS resources to be aggregated (including at least the minimum number of repetitions specified in the accuracy requirements) is greater than UE reported capability Nagg.

The requirements in clause 9.9.2.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-TDOA-ProvideCapabilities*, and it is up to UE implementation which aggregated PRS resources are measured, subject to UE measurement capabilities*.*

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

**-----------------------------NEXT CHANGE------------------------------**

9.9.4.x1 Measurements Period Requirements with Bandwidth Aggregation

When physical layer receives last of *NR-Multi-RTT-ProvideAssistanceData* message and *NR-Multi-RTT-RequestLocationInformation* message from LMF via LPP [34] with a request to perform measurement by aggregating PRS resources from multiple PFLs via [*nr-DL-PRS-JointMeasurementRequested*]*,* the UE shall be able to perform RSTD measurement by aggregating PRS resources from multiple PFLs (up to the UE capability specified in Clause 9.9.2.3) defined in TS 38.215 [4], during the measurement period TUE\_RxTx\_aggregated, Total defined as:

TUE\_RxTx\_aggregated, Total = Tnon-aggregate\_RxTx + Taggregated\_RxTx + Tmargin,

where,

Tnon\_aggregate\_RxTx is the total measurement period for UE Rx-Tx time difference measurement on PFLs that do not contain PRS resources for aggregation.

Calculation of Tnon\_aggregate is based on clause 9.9.4.5, such that Tnon\_aggregate\_RxTx is calculated by considering PRS resources that are not aggregated by UE, based on the configuration received from the LMF.

Tnon\_aggregate\_RxTx is equal to zero if UE is not configured to perform non-aggregated measurements by the LMF.

Taggregate\_RxTx is the total measurement period for UE Rx-Tx time difference measurements performed by UE by aggregating PRS resources from multiple PFLs as defined in TS 38.214 [26].

Tmargin is delay margin to account for delay between Rx-Tx measurement performed by UE on PFLs that contain PRS resources for aggregation and Rx-Tx measurement performed by UE on PFLs that do not contain PRS resources for aggregation. Tmargin is calculated as max(Teffect,i), by considering both aggregated PFLs and non-aggregated PFLs configured for positioning measurement. Tmargin is only applicable when UE is configured to perform measurements on PFLs that contain PRS resources for aggregation and on PFLs that do not contain PRS resources for aggregation.

If UE is only configured to perform measurements on PFLs that contain PRS resources for aggregation or if UE is only configured to perform measurements on PFLs that do not contain PRS resources for aggregation, then Tmargin = 0.

If UE is capable of performing latency reduced positioning measurements and is configured to perform latency reduced positioning measurement by LMF via *reducedDL-PRS-ProcessingSamples-r17* [34], then Nsample = 2 shall be considered in calculations of Taggregate\_RxTx and Tnon-aggregate\_RxTx.

If UE is not capable to perform latency reduced positioning measurements or is not configured to perform latency reduced positioning measurement by LMF via *reducedDL-PRS-ProcessingSamples-r17* [34], then Nsample = 4 shall be considered in calculations of Taggregate\_RxTx and Tnon-aggregate\_RxTx.

Taggregate\_RxTx, total measurement period for UE Rx-Tx time difference measurements performed by UE by aggregating PRS resources from multiple PFLs as defined in TS 38.214 [26], is defined as:

where

is the index of effective PFL, corresponding to the group of PFLs containing linked PRS resource sets to be aggregated for UE Rx-Tx time difference measurement,

G denotes the number of effective PFLs that UE is configured to perform aggregated measurements on. G is configured by LMF and is provisioned to UE via *nr-DL-PRS-AggregationInfo.*

is the measurement period for UE Rx-Tx time difference measurement in the effective positioning frequency layer *i* as specified below:

,

where:

* is the UE Rx beam sweeping factor.
  + In FR1, = 1.
  + In FR2, is equal to the value reported by the UE in *supportedLowerRxBeamSweepingFactor-FR2* if the UE supports the capability for the band containing effective positioning frequency layer , and the LMF indicates *lowerRxBeamSweepingFactor-FR2* in *NR-Multi-RTT-RequestLocationInformation*. is equal to 8, otherwise.
* is the carrier-specific scaling factor for NR PRS-based positioning measurements in effective positioning frequency layer as defined in clause 9.1.5.2.
* is the scaling factor for measurement of same PRS resource with multiple Rx TEGs.
  + = 1 if UE is not requested by LMF to measure a PRS resource with multiple Rx TEGs via *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* [34] or *measureSameDL-PRS-ResourceWithDifferentRxTxTEGs-r17* [34] in *NR-Multi-RTT-RequestLocationInformation*;
  + otherwise,
    - = , if UE is not capable of receiving same DL PRS resource simultaneously from multiple Rx TEGs, and
    - = if UE is capable of receiving the same DL PRS resource simultaneously from multiple Rx TEGs.

where

* is the number of Rx TEGs with which UE is requested to measure aggregated PRS resource indicated via *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* or *measureSameDL-PRS-ResourceWithDifferentRxTxTEGs-r17* [34] in *NR-Multi-RTT-RequestLocationInformation*, and in case ‘n0’ is indicated, is the maximum number of Rx TEGs with which UE can support to measure the same PRS resource as reported in *NR-UE-TEG-Capability*, and
* is the number of Rx TEGs UE can measure simultaneously which is reported via *measureSameDL-PRS-ResourceWithDifferentRxTEGsSimul*.
* is a scaling factor for effective positioning frequency layer to be measured within the associated measurement gap pattern, which is defined as = Ntotal / Navailable for UE configured with concurrent measurement gap, and = 1 for UE not configured with concurrent measurement gap.
  + For a window W of duration max(, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE MG and per-FR MG within the same FR as the effective positioning frequency layer, and starting at the beginning of any associated gap occasions covering the PRS occasion:

- Ntotal is the total number of associated gap occasions covering PRS occasions within the window, including both dropped and non-dropped instances of the associated measurement gap within the window, and

- Navailable is the number of non-dropped associated gap occasions covering PRS occasions within the window W, after further accounting for MG collisions by applying the selected gap collision rule

- Requirements do not apply if Navailable = 0.

* is the maximum number of DL PRS resources in effective positioning frequency layer configured in a slot.
* is the time duration of available PRS in the effective positioning frequency layer 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 and satisfying the conditions for PRS BW aggregation are considered.
* is the number of UE Rx-Tx time difference measurement samples.
* is the measurement duration for the last UE Rx-Tx time difference measurement sample in the effective positioning frequency layer, 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\_agg, = + MGL. Otherwise, = Tagg,i + ,

is the periodicity of the UE Rx-Tx time difference measurement in the effective positioning frequency layer 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 effective PRS frequency layer i.
* is the periodicity of DL PRS resources meeting the bandwidth aggregation conditions with muting on effective positioning frequency layer . If more than one PRS periodicities are configured in effective positioning frequency layer the least common multiple of PRS periodicities among all DL PRS resource sets in the effective positioning frequency layer is used to derive , where,
  + , is the PRS periodicity with muting per PRS resource configured for aggregation,
* 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\_agg,i, only the PRS resources fully or partially covered by the MG and PRS resources that satisfy the conditions for PRS BW aggregation are considered.

* {Nagg, Tagg}is UE capability combination per band to aggregate PRS resources from multiple PFLs within an effective PFL where Nagg is a duration of DL PRS symbols in ms corresponding to [*durationOfPRS-ProcessingSysmbols*] in TS 37.355 [34] processed every Tagg 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].

Except for deferred MT-LR as defined in clause 4.1a.5 [TS 23.273], the time *s*tarts from the first MG instance aligned with DL PRS resources in the assistance data for aggregation after both the *NR-Multi-RTT-RequestLocationInformation* message and *NR-Multi-RTT-ProvideAssistanceData* messagemessage are delivered from LMF to the physical layer of UE via LPP [34] including a request to perform measurement by aggregating PRS resources from multiple PFLs via [*nr-DL-PRS-JointMeasurementRequested*].

For deferred MT-LR with other event than “Periodic Location” as defined in clause 4.1a.5.1 [TS 23.273], the timestarts from the first MG instance aligned with DL PRS resources in the assistance data after the associated event(s) occurs.

For deferred MT-LR with event “Periodic Location” as defined in clause 4.1a.5.1 [TS 23.273], the UE shall perform the aggregated UE Rx-Tx time difference measurement in each reporting period and activate the location report at the time when the periodic timer expires.

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

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

The requirements in clause 9.9.4.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-Multi-RTT-ProvideCapabilities*, and it is up to UE implementation which aggregated 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.

When SRS is reconfigured without serving cell change during the measurement period, UE shall restart the UE Rx-Tx time difference measurement after the SRS reconfiguration 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.

When a serving cell change occurs during the measurement period, the UE shall continue and complete the UE Rx-Tx time difference measurement provided that the serving cell change does not impact SRS configuration for the UE Rx-Tx time difference measurement.

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.

If UE uplink transmission timing changes due to the UE autonomous timing adjustment defined in clause 7.1.2 during the UE Rx-Tx measurement period, then:

* UE Rx-Tx measurement period requirements in this clause shall apply for a cell, which is also the downlink reference cell (defined in section 7.1.1) for SRS transmission.
* UE Rx-Tx measurement period requirements in this clause shall not apply for a cell, which is not the downlink reference cell (defined in section 7.1.1) for SRS transmission. The UE Rx-Tx time difference measurement period may be restarted in such case.

**-----------------------------NEXT CHANGE------------------------------**

9.9A NR measurements for positioning for RedCap

### 9.9A.1 Introduction

This clause contains requirements for RedCap 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.

The measurement reporting delay can be longer for the measurement reporting requirements in this clause when IDC autonomous denial is configured.

This clause applies to both RedCap positioning with and without FH.

#### 9.9A.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 9.9A.2, 9.9A.3, 9.9A.4 and 9.9A.5 apply provided:

- the RedCap UE is configured or pre-configured with measurement gaps or configured with concurrent measurement gaps

- all positioning frequency layers are measured or associated with only one per-UE measurement gap, or

- for the RedCap UE supporting *independentGapConfigPRS-r17*, all positioning frequency layers in the same FR are measured or associated with only one per-FR measurement gap in the corresponding FR.

- if the measurement gap is pre-configured, the gap must be activated throughout the measurement period, and

- if concurrent measurement gaps are configured, one of the gap combinations specified in clause 9.1.8.2 is configured, and

- if the RedCap UE does not support *independentGapConfigPRS-r17*, the configured or pre-configured gap used to perform the PRS measurements must be of per-UE type, and

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

All measurement requirements specified in clause 9.9A.2, 9.9A.3, 9.9A.4 and 9.9A.5 shall apply without DRX as well as for any DRX configuration specified in TS 38.331 [2].

RedCap UE is only required to measure PRS resources that are fully or partially overlapped with measurement gaps, and the requirements in clause 9.9A.2, 9.9A.3, 9.9A.4 and 9.9A.5 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 without FH for 2Rx RedCap UEs in clause 10.1.x.x1, 10.1.x.x1, 10.1.x.x3 and 10.1.x.x4, and

- the minimum number is given in the accuracy requirements without FH for 1Rx RedCap UEs in clause 10.1.x.x5, 10.1.x.x6, 10.1.x.x7 and 10.1.x.x8.

- the minimum number is given in the accuracy requirements with FH for 2Rx RedCap UEs in clause 10.1.x.9, 10.1.x.x10, 10.1.x.x11 and 10.1.x.x12, and

- the minimum number is given in the accuracy requirements with FH for 1Rx RedCap UEs in clause 10.1.x.x13, 10.1.x.x14, 10.1.x.x15 and 10.1.x.x16.

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

If a positioning measurement gap is configured via *PosGapConfig* and activated by MAC CE, the measurement requirements in clause 9.9A.2, 9.9A.3, 9.9A.4 and 9.9A.5 apply provided that no other MGs are configured, and only one measurement gap configured via *PosGapConfig* is activated.

#### 9.9A.1.2 General Aspects of Gapless Measurement for RedCap positioning without FH

The requirements for RSTD, PRS-RSRP, UE Rx-Tx time difference, and PRS-RSRPP measurement without measurement gaps specified in clauses 9.9A.2, 9.9A.3, 9.9A.4 and 9.9A.5 shall apply provided that:

Positioning frequency layer to be measured is within an active BWP,

UE is configured with PPW, and the PPW for the active BWP containing the positioning frequency layer to be measured is activated,

No active BWP switching occurs during the measurement period specified in clauses 9.9A.2, 9.9A.3, 9.9A.4 and 9.9A.5,

PRS is within PPW and does not overlap with other signals/channels of higher priority,

- for PPW type 1A/1B, the PPW does not overlap with any symbol for SSB-based RLM/BFD/CBD/L1-RSRP/L1-SINR measurement on any CC or for SSB based RRM measurement on any MOs that are measured outside measurement gaps,

- for PPW type 2, PRS does not overlap with any symbol for SSB-based RLM/BFD/CBD/L1-RSRP/L1-SINR measurement on any CC or for SSB based RRM measurement on any MOs that are measured outside measurement gaps,

max∣ΔT∣≤ THR, where

∆T is the time difference between the start of a slot containing PRS from the neighbor cell/TRP and the start of the closest slot from the serving cell;

the range of ∆T is determined by the expected RSTD and expected RSTD uncertainty in the assistance data;

THR is the threshold as reported in UE capability *prs-MeasurementWithoutMG-r17*.

SCS of PRS within PPW and SCS of DL active BWP are the same.

All measurement requirements specified in clauses 9.9A.2, 9.9A.3, 9.9A.4 and 9.9A.5 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 9.9A.2, 9.9A.3, 9.9A.4 and 9.9A.5 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 , where

- the minimum number is given in the accuracy requirements without FH for 2Rx RedCap UEs in clause 10.1.x.x1, 10.1.x.x1, 10.1.x.x3 and 10.1.x.x4, and

- the minimum number is given in the accuracy requirements without FH for 1Rx RedCap UEs in clause 10.1.x.x5, 10.1.x.x6, 10.1.x.x7 and 10.1.x.x8.

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.

#### 9.9A.1.3 Scheduling Availability of UE during PRS Measurement without Measurement Gaps for RedCap positioning without FH

The requirements in this clause apply for RedCap UE performing RSTD, PRS-RSRP, UE Rx-Tx time difference and PRS-RSRPP measurement without measurement gaps.

If Cap. 1A UE capable of supporting priority options 1, 2 and 3 is configured with priority state 1 for PRS 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 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 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 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 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 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.

When PRS is lower priority than the DL signals/channels the following applies for cap1A and 1B UEs:

- If UE determines the presence of other DL signals/channels except SSB of higher priority than PRS in the PPW no later than N2 symbols, defined in clause 6.4 of [26, TS38.214] for the subcarrier spacing of the DL PRS, before the start of the PPW, UE expects to receive the DL signals/channels and drop all DL PRS in the PPW.

- If UE determines the presence of other DL signals/channels except SSB of higher priority than PRS in the PPW later than N2 symbols, defined in clause 6.4 of [26, TS38.214] for the subcarrier spacing of the DL PRS, before the start of the PPW, UE is not required to receive the other DL signals/channels except SSB of higher priority and may receive the DL PRS in the PPW.

When PRS is lower priority than the DL signals/channels the following applies for cap 2 UEs:

- If UE determines the presence of other DL signals/channels except SSB of higher priority than PRS on a PRS symbol no later than N2 symbols, defined in clause 6.4 of [26, TS38.214] for the subcarrier spacing of the DL PRS, before the PRS symbol, UE expects to receive the DL signals/channels and drop the PRS symbol.

- If UE determines the presence of other DL signals/channels except SSB of higher priority than PRS on a PRS symbol later than N2 symbols, defined in clause 6.4 of [26, TS38.214] for the subcarrier spacing of the DL PRS, before the PRS symbol, UE is not required to receive the other DL signals/channels except SSB of higher priority and may receive the PRS symbol.

For inter-band case for FR2 for the DL signals/channels from a different FR2 band than the FR2 band of the DL PRS, if the same Rx beam is used for both FR2 bands and the DL PRS is determined to be higher priority, capability 1B and 2 UEs are not expected to receive the DL signals/channels.

### 9.9A.2 RSTD measurements for RedCap

9.9A.2.1 Introduction

The requirements in clause 9.9A.2 shall apply provided the RedCap UE has received *NR-DL-TDOA-RequestLocationInformation* message from LMF via LPP [34] requesting the RedCap UE to measure and report DL RSTD measurements defined in TS 38.215 [4].

The requirements in clause 9.9A.2.5 shall apply provided the RedCap UE does not support, or support but not configured, to measure PRS resources with Frequency Hopping (FH), subject to UE capability indicated via [TBD].

The requirements in clause 9.9A.2.6 shall apply provided the RedCap UE supports and is configured to measure PRS resources with Frequency Hopping (FH), subject to UE capability indicated via [TBD].

9.9A.2.2 Requirements Applicability

The requirements in clause 9.9A.2.5 apply for periodic and triggered RSTD measurements without FH, provided:

- PRS-RSTD related side conditions for 2 Rx RedCap UE given in clause 10.1A.x.1 for FR1 and FR2 are fulfilled, for a corresponding Band, or

- PRS-RSTD related side conditions for 1 Rx RedCap UE given in clause 10.1A.x.2 for FR1 are fulfilled, for a corresponding Band.

The requirements in clause 9.9A.2.6 apply for periodic and triggered RSTD measurements with FH, provided:

- PRS-RSTD related side conditions for 2 Rx RedCap UE given in clause 10.1A.x.3 for FR1 and FR2 are fulfilled, for a corresponding Band. or

- PRS-RSTD related side conditions for 1 Rx RedCap UE given in clause 10.1A.x.4 for FR1 are fulfilled, for a corresponding Band.

9.9A.2.3 Measurement Capability

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

9.9A.2.4 Measurement Reporting Requirements

The requirements in clause 9.9.2.4 shall apply except for RSTD measurement accuracy. The RSTD measurements performed and reported according to this section shall meet the RSTD measurement accuracy requirements in clause 10.1A.x for each measured DL PRS resource.

9.9A.2.5 Measurements Period Requirements without FH

9.9A.2.5.1 Measurements Period Requirements without FH with MG

When physical layer receives last of *NR-TDOA-ProvideAssistanceData* message and *NR-TDOA-RequestLocationInformation* message from LMF via LPP [34]*,* the RedCap UE shall be able to measure multiple (up to the RedCap UE capability specified in Clause 9.9A.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 RedCap UE Rx beam sweeping factor. In FR1 (for 2 Rx or 1 Rx RedCap UE), = 1;

and in FR2 (for 2 Rx RedCap UE only), is equal to the value reported by the UE in *supportedLowerRxBeamSweepingFactor-FR2* if the UE supports the capability for the band containing positioning frequency layer i, and the LMF indicates *lowerRxBeamSweepingFactor-FR2* in*NR-DL-TDOA-RequestLocationInformation*. is equal to 8, otherwise.

is the carrier-specific scaling factor for NR PRS-based positioning measurements in positioning frequency layer *i* as defined in clause 9.1A.5.2.

is the scaling factor for measurement of same PRS resource with multiple Rx TEGs.

=1 if UE is not requested by LMF to measure a PRS resource with multiple Rx TEGs via *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* [34] in *NR-DL-TDOA-RequestLocationInformation*;

otherwise,

=, if UE is not capable of receiving same DL PRS resource simultaneously from multiple Rx TEGs, and

= if UE is capable of receiving the same DL PRS resource simultaneously from multiple Rx TEGs.

where

is the number of Rx TEGs with which UE is requested to measure a PRS resource indicated via *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* [34] in *NR-DL-TDOA-RequestLocationInformation*, and in case ‘n0’ is indicated, is the maximum number of Rx TEGs with which UE can support to measure the same PRS resource as reported in *NR-UE-TEG-Capability*, and

is the number of Rx TEGs UE can measure simultaneously which is reported via *measureSameDL-PRS-ResourceWithDifferentRxTEGsSimul*.

is a scaling factor for a positioning frequency layer to be measured within the associated measurement gap pattern, which is defined as = Ntotal / Navailable for UE configured with concurrent measurement gap, and = 1 for UE not configured with concurrent measurement gap.

- For a window W of duration max(, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE MG and per-FR MG within the same FR as the positioning frequency layer, and starting at the beginning of any associated gap occasions covering the PRS occasion:

- Ntotal is the total number of associated gap occasions covering PRS occasions within the window, including both dropped and non-dropped instances of the associated measurement gap within the window, and

- Navailable is the number of non-dropped associated gap occasions covering PRS occasions within the window W, after further accounting for MG collisions by applying the selected gap collision rule

- Requirements do not apply if Navailable =0.

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 measurement samples, where

- = 1 if the UE supports *supportedDL-PRS-ProcessingSamples-RRC-CONNECTED* [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and meets the following conditions:

- PRS bandwidth is within the active BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 2 if the UE supports *supportedDL-PRS-ProcessingSamples-RRC-CONNECTED* [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and does not meet the following conditions:

- PRS bandwidth is within the active BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 4 otherwise.

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].

Except for deferred MT-LR as defined in clause 4.1a.5 [TS 23.273], 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].

For deferred MT-LR with other event than “Periodic Location” as defined in clause 4.1a.5.1 [TS 23.273], the timestarts from the first MG instance aligned with a DL PRS resource(s) in the assistance data after the associated event(s) occurs.

For deferred MT-LR with event “Periodic Location” as defined in clause 4.1a.5.1 [TS 23.273], the UE shall perform the RSTD measurement in each reporting period and activate the location report at the time when the periodic timer expires.

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.

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 9.9A.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 10.1A.x.

9.9A.2.5.2 Measurements Period Requirements without FH without MG

When physical layer receives last of *NR-DL-TDOA-ProvideAssistanceData* message and *NR-DL-TDOA-RequestLocationInformation* message from LMF via LPP [34]*,* the RedCap UE shall be able to measure multiple (up to the RedCap UE capability specified in Clause 9.9A.2.3) DL RSTD measurements, defined in TS 38.215 [4], during the measurement period defined as:

, if any of the positioning frequency layers are in Case 1, or

, if all the positioning frequency layers are in Case 2,

Where,

is the index of positioning frequency layer, and

is total number of positioning frequency layers, and

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

is the time from the start of the first PPW occasion for positioning frequency layer i to the start of measurement period .

A positioning frequency layer is in Case 1 if UE reports *ppw-durationOfPRS-Processing1-r17* for the band containing the positioning frequency layer, and a positioning frequency layer is in Case 2 if UE reports *ppw-durationOfPRS-Processing2-r17* for the band containing the positioning frequency layer.

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 (for 2 Rx or 1 Rx RedCap UE), = 1; and in FR2 (for 2 Rx RedCap UE only), is equal to the value reported by the UE in *supportedLowerRxBeamSweepingFactor-FR2* if the UE supports the capability for the band containing positioning frequency layer i, and the LMF indicates *lowerRxBeamSweepingFactor-FR2* in *NR-DL-TDOA-RequestLocationInformation*. is equal to 8, otherwise.

is the scaling factor for measurement of same PRS resource with multiple Rx TEGs.

=1 if UE is not supported *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* or not requested by LMF to measure a PRS resource with multiple Rx TEGs via *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* [34] in *NR-DL-TDOA-RequestLocationInformation*;

otherwise,

=, if the UE is not capable of receiving same DL PRS resource simultaneously from multiple Rx TEGs, and

= if the UE is capable of receiving the same DL PRS resource simultaneously from multiple Rx TEGs.

Where

is the number of Rx TEGs with which UE is requested to measure a PRS resource indicated via *measureSameDL-PRS-ResourceWithDifferentRxTEGs-r17* [34] in *NR-DL-TDOA-RequestLocationInformation*, and in case ‘n0’ is indicated, is the maximum number of Rx TEGs with which UE can support to measure the same PRS resource as reported in *NR-UE-TEG-Capability*, and

is the number of Rx TEGs UE can measure simultaneously which is reported via *measureSameDL-PRS-ResourceWithDifferentRxTEGsSimul*.

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, if positioning frequency layer i is in Case 1, or

only the PRS resources unmuted and fully or partially overlapped with the first (PPWL-T2) ms of PPW are considered, if positioning frequency layer i is in Case 2, where PPWL is the PPW length and T2 corresponds to *ppw-durationOfPRS-ProcessingSymbolsT2*.

is the number of PRS RSTD measurement samples, where

- = 1 if the UE supports *supportedDL-PRS-ProcessingSamples-RRC-CONNECTED* [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and meets the following conditions:

- PRS bandwidth is within the active BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- =2 if the UE supports *supportedDL-PRS-ProcessingSamples-RRC-CONNECTED* [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and does not meet the following conditions:

- PRS bandwidth is within the active BWP and

- 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 PRS RSTD sample in positioning frequency layer *i*, including the sampling time and processing time.

If positioning frequency layer *i* is in Case 1 and all of the PRS resources to be measured are available in the same PPW occasion during Tavailable, then = +PPWL, else

if positioning frequency layer *i* is in Case 2 and all of the PRS resources to be measured are available in the same PPW occasion during Tavailable, then = PPWL;

otherwise, = + .

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

*=*

Where,

corresponds to *ppw-durationOfPRS-ProcessingSymbolsT* in TS 37.355 [34] if positioning frequency layer *i* is in Case 1, or corresponds to the sum of *ppw-durationOfPRS-ProcessingSymbolsT2* and *ppw-*durationOfPRS*-ProcessingSymbolsN2* in TS 37.355 [34] if positioning frequency layer *i* is in Case 2,

, 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 that meet the conditions for PRS measurement outside measurement gaps as defined in clause 9.9.1.2 are considered.

is a duration of DL PRS symbols in ms corresponding to *ppw-durationOfPRS-ProcessingSymbolsN* in TS 37.355 [34] if positioning frequency layer i is in Case 1, or corresponding to *ppw-durationOfPRS-ProcessingSymbolsN2* in TS 37.355 [34] if positioning frequency layer i is in Case 2.

is UE capability for number of DL PRS resources that it can process in a slot as indicated by *ppw-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-DL-TDOA-ProvideAssistanceData* message and *NR-DL-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 PPW is re-configured or 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 PPW 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 9.9A.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 10.1A.x.

If any positioning frequency layer is in Case 2, the requirements in this clause apply provided that the PPWL corresponding to the positioning frequency layer is larger than (T2+X) ms.

The requirements in this clause apply provided that a single positioning frequency layer is configured for measurement in each PPW.

9.9A.2.5.3 Measurements Period Requirements without FH with both MG and PPW

If the RedCap UE is configured with both MG applicable to positioning measurement and PPW, the UE shall measure positioning frequency layer *i* within

- MG, if PRS resources on positioning frequency layer *i* are overlapped with MG, or

- PPW, if PRS resources on positioning frequency layer *i* are overlapped with PPW.

The measurement period is defined as:

,

Where

- is defined in clause 9.9A.2.5.1 and includes all positioning frequency layers to be measured within MG,

- is defined in clause 9.9A.2.5.2 and includes all positioning frequency layers to be measured within PPW,

- is the maximum Teffect defined in clauses 9.9A.2.5.1 and 9.9A.2.5.2 among all PFLs.

The requirements apply provided the following conditions are satisfied:

- MGs and PPWs do not overlap in time;

- Each PFL in the assistance data can be measured completely (all PRS resources) either within MG or within activated PPW.

9.9A.2.6 Measurements Period Requirements with FH

9.9A.2.6.1 Measurements Period Requirements with FH with MG

When physical layer receives last of *NR-TDOA-ProvideAssistanceData* message and *NR-TDOA-RequestLocationInformation* message from LMF via LPP [34]*,* requesting RedCap UE to measure DL RSTD measurement with FH, the RedCap UE shall be able to measure multiple (up to the RedCap UE capability specified in Clause 9.9A.2.3) DL RSTD measurements, defined in TS 38.215 [4], during the measurement period defined in Clause 9.9A.2.5.1 with using the following definition for :

is the number of PRS RSTD measurement samples, where

- = 2 if the RedCap UE supports *supportedDL-PRS-ProcessingSamples-RRC-CONNECTED* [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples.

- = 4 otherwise.

Measurement sample under FH is defined as a PRS measurement over multiple hops within a single measurement gap occasion.

The number of hops within a single MG occasion is FFS

*Editor Note: FFS details of measurement period requirements with FH*

### 9.9A.3 PRS-RSRP measurements for RedCap

9.9A.3.1 Introduction

The requirements in clause 9.9A.3 shall apply provided the RedCap UE has received a message from LMF via LPP [34] requesting the RedCap UE to measure and report PRS-RSRP measurements defined in TS 38.215 [4].

The requirements in clause 9.9A.3.5 shall apply provided the RedCap UE does not support, or support but not configured, to measure PRS resources with Frequency Hopping (FH), subject to UE capability indicated via [TBD].

The requirements in clause 9.9A.3.6 shall apply provided the RedCap UE supports and is configured to measure PRS resources with Frequency Hopping (FH), subject to UE capability indicated via [TBD].

9.9A.3.2 Requirements applicability

The requirements in clause 9.9A.3.5 apply for periodic and triggered PRS-RSRP measurements without FH, provided:

- PRS-RSRP related side conditions for 2 Rx RedCap UE given in clause 10.1A.x.1 for FR1 and FR2 are met for a corresponding Band, or

- PRS-RSRP related side conditions for 1 Rx RedCap UE given in clause 10.1A.x.2 for FR1 are met for a corresponding Band.

The requirements in clause 9.9A.3.6 apply for periodic and triggered PRS-RSRP measurements with FH, provided:

- PRS-RSRP related side conditions for 2 Rx RedCap UE given in clause 10.1A.x.3 for FR1 and FR2 are met for a corresponding Band, or

- PRS-RSRP related side conditions for 1 Rx RedCap UE given in clause 10.1A.x.4 for FR1 are met for a corresponding Band.

9.9A.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].

9.9A.3.4 Measurement Reporting Requirements

The requirements in clause 9.9.3.4 shall apply except for PRS-RSRP measurement accuracy. The PRS-RSRP measurement accuracy for all measured PRS resources shall be fulfilled according to the accuracy requriements specified in the clauses 10.1A.x.

9.9A.3.5 Measurements Period Requirements without FH

9.9A.3.5.1 Measurement Period Requirements without FH with MG

When the physical layer receives *NR-DL-AoD-ProvideAssistanceData* message and *NR-DL-AoD-RequestLocationInformation* message from LMF via LPP [34], the RedCap UE shall be able to measure multiple (up to the RedCapUE capability specified in Clause 9.9A.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 the carrier specific scaling factor for PRS-RSRP measurements specified in clause 9.1A.5.2,

is a scaling factor for a positioning frequency layer to be measured within the associated measurement gap pattern, which is defined as = Ntotal / Navailable for UE configured with concurrent measurement gap, and = 1 for UE not configured with concurrent measurement gap.

For a window W of duration max(, MGRP\_max), where MGRP max is the maximum MGRP across all configured per-UE MG and per-FR MG within the same FR as the positioining frequency layer, and starting at the beginning of any associated gap occasions covering the PRS occasion:

Ntotal is the total number of associated gap occasions covering PRS occasions within the window, including both dropped and non-dropped instances of the associated measurement gap within the window, and

Navailable is the number of non-dropped associated gap occasions covering PRS occasions within the window W, after further accounting for MG collisions by applying the selected gap collision rule

Requirements do not apply if Navailable =0.

is the scaling factor for Rx beam sweeping, and =1 if positioning frequency layer *i* is in FR1 (for 2 Rx or 1 Rx RedCap UE) and if positioning frequency layer *i* is in FR2 (for 2 Rx RedCap UE only), is equal to the value reported by the UE in *supportedLowerRxBeamSweepingFactor-FR2* if the UE supports the capability for the band containing positioning frequency layer i, and the LMF indicates *lowerRxBeamSweepingFactor-FR2* in *NR-DL-TDOA-RequestLocationInformation*. is equal to 8, otherwise.

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, where

- = 1 if the UE supports *supportedDL-PRS-ProcessingSamples-RRC-CONNECTED* [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and meets the following conditions:

- PRS bandwidth is within the active BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 2 if the UE supports *supportedDL-PRS-ProcessingSamples-RRC-CONNECTED* [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and does not meet the following conditions:

- PRS bandwidth is within the active BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 4 otherwise.

*= +* 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. , 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, except for deferred MT-LR as defined in clause 4.1a.5 [TS 23.273], 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.

For deferred MT-LR with other event than “Periodic Location” as defined in clause 4.1a.5.1 [TS 23.273], the timestarts from the first MG instance aligned with a DL PRS resource(s) in the assistance data after the associated event(s) occurs.

For deferred MT-LR with event “Periodic Location” as defined in clause 4.1a.5.1 [TS 23.273], the UE shall perform the PRS-RSRP measurement in each reporting period and activate the location report at the time when the periodic timer expires.

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 9.9A.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 10.1A.x.

9.9A.3.5.2 Measurement Period Requirements without FH without MG

When the physical layer receives *NR-DL-AoD-ProvideAssistanceData* message and *NR-DL-AoD-RequestLocationInformation* message from LMF via LPP [34], the RedCap UE shall be able to measure multiple (up to the RedCap UE capability specified in Clause 9.9A.3.3) PRS-RSRP measurements as defined in TS 38.215 [4] without measurement gap, on configured positioning frequency layer *i*, within ms.

if any of the positioning frequency layers are in Case 1, or

, if all the positioning frequency layers are in Case 2,

Where,

is the index of positioning frequency layer, and

is total number of positioning frequency layers, and

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

is the time from the start of the first PPW occasion for positioning frequency layer i to the start of measurement period .

A positioning frequency layer is in Case 1 if UE reports *ppw-durationOfPRS-Processing1-r17* for the band containing the positioning frequency layer, and a positioning frequency layer is in Case 2 if UE reports *ppw-durationOfPRS-Processing2-r17* for the band containing the positioning frequency layer.

is the measurement period for PRS-RSRP measurement in positioning frequency layer *i* as specified below.

where

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

is the scaling factor for Rx beam sweeping, and =1 if positioning frequency layer *i* is in FR1 (for 2 Rx or 1 Rx RedCap UE). If positioning frequency layer *i* is in FR2 (for 2 Rx RedCap UE only), is equal to the value reported by the UE in *supportedLowerRxBeamSweepingFactor-FR2* if the UE supports the capability for the band containing positioning frequency layer i, and the LMF indicates *lowerRxBeamSweepingFactor-FR2* in *NR-DL-TDOA-RequestLocationInformation*. is equal to 8, otherwise.

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, if positioning frequency layer i is in Case 1, or

only the PRS resources unmuted and fully or partially overlapped with the first (PPWL-T2) ms of PPW are considered, if positioning frequency layer i is in Case 2, where PPWL is the PPW length and T2 corresponds to *ppw-durationOfPRS-ProcessingSymbolsT2*.

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 *ppw-durationOfPRS-ProcessingSymbolsN*  in TS 37.355 [34] if positioning frequency layer *i* is in Case 1, or corresponding to *ppw-durationOfPRS-ProcessingSymbolsN2* in TS 37.355 [34] if positioning frequency layer *i* is in Case 2,

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

is the number of PRS RSRP measurement samples, where

- = 1 if the UE supports *supportedDL-PRS-ProcessingSamples-RRC-CONNECTED* [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and meets the following conditions:

- PRS bandwidth is within the active BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 2 if the UE supports *supportedDL-PRS-ProcessingSamples-RRC-CONNECTED* [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples, and does not meet the following conditions:

- PRS bandwidth is within the active BWP and

- Magnitude of difference between the serving cell’s SS-RSRP and the neighbor cell’s PRS-RSRP is within 6 dB.

- = 4 otherwise.

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

If positioning frequency layer *i* is in Case 1 and all of the PRS resources to be measured are available in the same PPW occasion during Tavailable, then = +PPWL, else

if positioning frequency layer *i* is in Case 2 andall of the PRS resources to be measured are available in the same PPW occasion during Tavailable, then = PPWL;

otherwise, = + .

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

corresponds to *ppw-durationOfPRS-ProcessingSymbolsT*  in TS 37.355 [34] if positioning frequency layer *i* is in Case 1, or corresponds to the sum of *ppw-durationOfPRS-ProcessingSymbolsT2* and *ppw-durationOfPRS-ProcessingSymbolsN2* in TS 37.355 [34] if positioning frequency layer *i* is in Case 2

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 that meet the applicability conditions and fully or partially covered by the 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 9.9A.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 9.9A.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 clause 9.9A.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 during the measurement period of one or more positioning frequency layers, the PPW is reconfigured or reactivated, the PRS-RSRP measurement period can be longer.

If any positioning frequency layer is in Case 2, the requirements in this clause apply provided that the PPWL corresponding to the positioning frequency layer is larger than (T2+X) ms.

The requirements in this clause apply provided that a single positioning frequency layer is configured for measurement in each PPW.

9.9A.3.5.3 Measurements Period Requirements without FH with both MG and PPW

If the RedCap UE is configured with both MG applicable to positioning measurement and PPW, the UE shall measure positioning frequency layer *i* within

- MG, if PRS resources on positioning frequency layer *i* are overlapped with MG, or

- PPW, if PRS resources on positioning frequency layer *i* are overlapped with PPW.

The measurement period is defined as:

,

Where

- is defined in clause 9.9A.3.5.1 and includes all positioning frequency layers to be measured within MG,

- is defined in clause 9.9A.3.5.2 and includes all positioning frequency layers to be measured within PPW,

- is the maximum Teffect defined in clauses 9.9A.3.5.1 and 9.9A.3.5.2 among all PFLs.

The requirements apply provided the following conditions are satisfied:

- MGs and PPWs do not overlap in time;

- Each PFL in the assistance data can be measured completely (all PRS resources) either within MG or within activated PPW.

9.9A.3.6 Measurements Period Requirements with FH

9.9A.3.6.1 Measurements Period Requirements with FH with MG

When the physical layer receives *NR-DL-AoD-ProvideAssistanceData* message and *NR-DL-AoD-RequestLocationInformation* message from LMF via LPP [34], requesting RedCap UE to measure PRS-RSRP measurement with FH, the RedCap UE shall be able to measure multiple (up to the RedCapUE capability specified in Clause 9.9A.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 as defined Clause 9.9A.3.5.1 with using the following definition for :

is the number of PRS RSRP measurement samples, where

- = 2 if the UE supports *supportedDL-PRS-ProcessingSamples-RRC-CONNECTED* [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples.

- = 4 otherwise.

Measurement sample under FH is defined as a PRS measurement over multiple hops within a single measurement gap occasion.

The number of hops within a single MG occasion is FFS

*Editor Note: FFS details of measurement period requirements with FH*

### 9.9A.4 UE Rx-Tx time difference measurements for RedCap

9.9A.4.1 Introduction

The requirements in this clause apply for RedCap UE, when the UE 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].

If UE does not support RX frequency hopping (FH) for PRS measurement as indicated by UE capability [TBD], or if LMF does not request UE to use RX FH for PRS measurement as indicated via [TBD] in the measurement request, the requirements in clause 9.9A.4.5, 9.9A.4.6 and 9.9A.4.7 shall apply for applicable configurations.

If UE supports RX frequency hopping (FH) for PRS measurement as indicated by UE capability [TBD], and LMF requests UE to use RX FH for PRS measurement as indicated via [TBD] in the measurement request, the requirements in clause 9.9A.4.8 shall apply.

9.9A.4.2 Requirements Applicability

The requirements in clause 9.9.4.2 shall apply.

9.9A.4.3 Measurement Capability

The requirements in clause 9.9A.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 [TBD] are met for a corresponding band.

- SRS is configured on at least one of the PCell, PSCell and SCell.

- The UE transmits SRS within [-160, 160] msec of at least one DL PRS resource of each of the TRPs in the assistance data.

9.9A.4.4 Measurement Reporting Requirements

The requirements in clause 9.9.4.4 shall apply except that the UE Rx-Tx time difference measurement accuracy for all measured DL PRS resources shall be fulfilled according to the accuracy requirements specified in clause [TBD].

9.9A.4.5 Measurement Period Requirements without FH with MG

The requirements in clause 9.9.4.5 shall apply.

9.9A.4.6 Measurement Period Requirements without FH without MG

The requirements in clause 9.9.4.6 shall apply.

9.9A.4.7 Measurements Period Requirements without FH with both MG and PPW

The requirements in clause 9.9.4.8 shall apply.

9.9A.4.8 Measurements Period Requirements with FH

The requirements in this clause apply when a RedCap UE is request by the LMF to perform measurements with FH, and UE reports measurement based on multiple hops.

The requirements in clause 9.9A.4.5 shall apply with the following modifications.

- = 2 if the UE supports the capability of positioning measurements with reduced number of samples as indicated by *[TBD]* specified in TS 37.355 [34], and the LMF requests the UE to perform positioning measurements with reduced number of samples.

- Number of hops within a single MG occasion is defined as [FFS]

- Measurement sample under FH is defined as a PRS measurement over multiple hops within a single measurement gap.

*Editor Note: FFS modification to the existing measurement period requirements*

9.9A.5 PRS-RSRPP measurements for RedCap

9.9A.5.1 Introduction

The requirements in this clause apply for RedCap UE, when the UE received *NR-DL-AoD-RequestLocationInformation* message from LMF via LPP [34] requesting the UE to measure and report one or more PRS-RSRPP measurements defined in TS 38.215 [4].

If UE does not support frequency hopping (FH) for PRS measurement as indicated by UE capability [TBD], or if LMF does not request UE to use FH for PRS measurement as indicated via [TBD] in the measurement request, the requirements in clause 9.9A.5.5, 9.9A.5.6 and 9.9A.5.7 shall apply for applicable configurations.

If UE supports frequency hopping (FH) for PRS measurement as indicated by UE capability [TBD], and LMF requests UE to use FH for PRS measurement as indicated via [TBD] in the measurement request, the requirements in clause 9.9A.5.8 shall apply.

9.9A.5.2 Requirements Applicability

The requirements in clause 9.9A.5 apply for periodic and triggered PRS-RSRPP measurements, provided:

- PRS-RSRPP related side conditions given in clause [TBD] are met for a corresponding Band.

9.9A.5.3 Measurement Capability

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

9.9A.5.4 Measurement Reporting Requirements

This requirement assumes that the measurement report is not delayed by other LPP signalling on the DCCH. This measurement reporting delay excludes the delay uncertainty caused by inserting the measurement report into 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. This measurement reporting delay excludes any delay caused by no UL resources for UE to send the measurement report.

The reported PRS-RSRPP measurement values contained in measurement reports shall be based on the measurement report mapping requirements specified in clauses 10.1.38.3.

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

9.9A.5.5 Measurement Period Requirements without FH with MG

For PRS measurement within MG configured to UE, measurement period requirements for PRS-RSRP defined in 9.9A.3.5 is re-used for PRS-RSRPP.

9.9A.5.6 Measurement Period Requirements without FH without MG

For PRS measurement without MG configured to UE, measurement period requirements for PRS-RSRP defined in 9.9A.3.6 is re-used for PRS-RSRPP.

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

9.9A.5.7 Measurements Period Requirements without FH with both MG and PPW

If the UE is configured with both MG applicable to positioning measurement and PPW, the measurement period requirements for PRS-RSRP defined in 9.9A.3.7 is re-used for PRS-RSRPP.

9.9A.5.8 Measurements Period Requirements with FH

The measurement period requirements for PRS-RSRP defined in 9.9A.3.5 are re-used for PRS-RSRPP.

**-----------------------------NEXT CHANGE------------------------------**

12A NR Sidelink Measurements for Positioning

12A.1 Introduction

Clause 12A contains requirements for UE capable of V2X or 5G ProSe operation, which is also capable of performing SL positioning measurements defined in TS 38.215 [4], including SL RSTD, SL PRS-RSRP, SL Rx-Tx time difference, SL PRS-RSRPP measurements, SL AoA, and SL RTOA, provided that:

- The SL PRS are received on NR PC5 interface within a single sidelink BWP on a single carrier,

- The UE is in any cell selection state or the UE is inside NG-RAN coverage while configured for SL positioning operation on a sidelink carrier, which is dedicated to only sidelink operation, and configured with only a PCell on WAN carrier, and

- The UE is not required to monitor PSCCH, which is associated with SL-PRS in the same slot, outside the SL-DRX active time.

NOTE 1: Any cell selection state refers to a UE that is out of network coverage and is not associated with a serving cell on any carrier as defined in TS 38.304 [1].

NOTE 2: When a UE in RRC\_CONNECTED state is performing transmissions and/or reception for SL positioning operation, the UE shall meet all the requirements specified in Clause 9 assuming that UE has a dedicated RX/TX chain for the sidelink operation. Otherwise, the UE may interrup the SL positioning measurements in order to meet the measurement requirements specified in Clause 9.

[Prior to performing SL-PRS based measurements, the UE may need to perform the discovery procedure according to TBD].

12A.2 SL-RSTD measurements

### 12A.2.1 Introduction

The requirements in clause 12A.2 shall apply provided the UE has received [*SLPP-RequestLocationInformation*] message from LMF or another UE via SLPP [37] requesting the UE to measure and report SL RSTD measurements defined in TS 38.215 [4] based on SL-PRS.

### 12A.2.2 Requirements Applicability

The requirements in clause 12A.2 apply for periodic, aperiodic, and triggered RSTD measurements, provided:

- SL RSTD related side conditions given in clause TBD for FR1 are fulfilled, for a corresponding Band.

### 12A.2.3 Measurement Capability

UE SL RSTD measurement capability is as indicated by the UE in [*sl-TDOA-ProvideCapabilities*], according to TS 38.355 [37].

### 12A.2.4 Measurement Reporting Requirements

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

For UE reporting to LMF, this requirement assumes that the measurement report is not delayed by other SLPP signalling on the DCCH. This measurement reporting delay excludes a 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 PSSCH with subframe or slot or subslot duration.

For UE reporting to another UE, this requirement assumes that the measurement report is not delayed by other SLPP signalling on the STCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the transmitted STCH. The delay uncertainty is: 2 x TTISTCH where TTISTCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PSSCH with subframe or slot or subslot duration.

This measurement reporting delay excludes any delay caused by no SL resources for UE to send the measurement report.

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

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

### 12A.2.5 Measurements Period Requirements

When the physical layer receives last of [*sl-TDOA-ProvideAssistanceData*] message and [*sl-TDOA-RequestLocationInformation*]message from LMF or another UE via SLPP [37]*,* the UE shall be able to perform at least [TBD] SL RSTD measurements, with each SL RSTD measurement including measurement on the measured target link and the reference link, defined in TS 38.215 [4], during the measurement period defined as:

,

where

S is the number of samples per measured link, define below:

= 1 for SL-PRS BW>48 PRBs,

= 4 for 24 PRBs ≤SL-PRS BW≤48 PRBs,

is defined as:

, for *s*<*S*, provided that , where and are the beginning of the first slot corresponding to the next and current SL-PRS samples, respectively, in which the UE is configured to receive SL-PRS for performing the SL-RSTD measurement,

for *s*=*S*,

is the SL-PRS duration for SL-PRS sample *s* of the SL RSTD measurement,

is the processing time.

If the synchronization reference source changes during T… at the measuring UE or [at the UE configured to transmit SL-PRS] for the target measured or reference link [37, clause TBD] for the SL RSTD measurement, while the UE is performing the SL RSTD measurement, then the UE shall restart the SL RSTD measurement after the synchronization reference source change.

[FFS: If the synchronization reference source changes at the measuring UE or at the UE configured to transmit SL-PRS for the target measured or reference link for the SL RSTD measurement, while the measuring UE is performing the SL RSTD measurement, then the measuring UE shall restart the SL RSTD measurement and shall send the measurement report no later than:

,

where K is the number of restarts due to the synchronization source changes.]

12A.3 SL-RSRP measurements

### 12A.3.1 Introduction

The requirements in clause 12A.3 shall apply provided the UE has received [*SLPP-RequestLocationInformation*] message from LMF or another UE via SLPP [37] requesting the UE to measure and report SL PRS-RSRP measurements defined in TS 38.215 [4] based on SL-PRS.

### 12A.3.2 Requirements Applicability

The requirements in clause 12A.3 apply for periodic, aperiodic, and triggered SL PRS-RSRP measurements, provided:

- SL PRS-RSRP related side conditions given in clause TBD for FR1 are fulfilled, for a corresponding Band.

### 12A.3.3 Measurement Capability

UE SL PRS-RSRP measurement capability is as indicated by the UE in [*sl-TDOA-ProvideCapabilities, sl-RTT-ProvideCapabilities, sl-AOA-ProvideCapabilities,* or *sl-TOA-ProvideCapabilities*], according to TS 38.355 [37].

### 12A.3.4 Measurement Reporting Requirements

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

For UE reporting to LMF, this requirement assumes that the measurement report is not delayed by other SLPP signalling on the DCCH or SCCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the uplink DCCH or SCCH. The delay uncertainty is: 2 x TTIDCCH/SCCH where TTIDCCH/SCCH 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.

For UE reporting to another UE, this requirement assumes that the measurement report is not delayed by other SLPP signalling on the STCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the transmitted STCH. The delay uncertainty is: 2 x TTISTCH where TTISTCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PSSCH with subframe or slot or subslot duration.

This measurement reporting delay excludes any delay caused by no SL resources for UE to send the measurement report.

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

The SL PRS-RSRP measurements performed and reported according to this section shall meet the SL PRS-RSRP measurement accuracy requirements in clause TBD, for each measured SL-PRS resource.

### 12A.3.5 Measurements Period Requirements

When physical layer receives last of:

- [*sl-TDOA-ProvideAssistanceData*] message and [*sl-TDOA-RequestLocationInformation*]message, or

- [*sl-AOA-ProvideAssistanceData*] message and [*sl-AOA-RequestLocationInformation*]message, or

- [*sl-TOA-ProvideAssistanceData*] message and [*sl-TOA-RequestLocationInformation*]message, or

- [*sl-RTT-ProvideAssistanceData*] message and [*sl-RTT-RequestLocationInformation*]message,

from LMF or another UE via SLPP [37]*,* the UE shall be able to perform at least [TBD] SL PRS-RSRP measurements, defined in TS 38.215 [4], during the measurement period defined as:

,

where

S is the number of samples per measured link, defined below:

= 1 for SL-PRS BW>48 PRBs,

= 4 for 24 PRBs ≤SL-PRS BW≤48 PRBs,

, for *s*<*S*, provided that , where and are the beginning of the first slot corresponding to the next and current SL-PRS samples, respectively, in which the UE is configured to receive SL-PRS for performing the SL-RSTD measurement,

for *s*=*S*,

is the SL-PRS duration for SL-PRS sample *s* of the SL PRS-RSRP measurement,

is the processing time.

If the synchronization reference source changes at the measuring UE or [at the UE configured to transmit SL-PRS for the SL PRS-RSRP] measurement [37, clause TBD], while the measuring UE is performing the SL PRS-RSRP measurement, then the UE shall continue performing the SL PRS-RSRP measurement after the synchronization reference source change, while meeting the measurement period defined in this clause and the accuracy requirements in clause TBD.

12A.4 SL-Rx-Tx measurements

12A.4.1 Introduction

The requirements in clause 12A.4 shall apply provided the UE has received [*NR-SL-RxTx-RequestLocationInformation*] from LMF or another UE via SLPP [TBD] requesting the UE to measure and report SL Rx-Tx time difference measurements defined in TS 38.215 [4] based on SL-PRS.

12A.4.2 Requirements Applicability

The requirements in clause 12A.4 apply for [periodic,] aperiodic, and triggered SL Rx-Tx time difference measurements, provided:

- SL Rx-Tx time difference related side conditions given in clause [TBD] for FR1 are met for a corresponding Band.

- The actual time difference between the corresponding SL-PRS transmission and reception used to derive the measurement is no larger than [160] ms.

12A.4.3 Measurement Capability

SL Rx-Tx time difference measurement capability is as indicated by the UE in [*NR-SL-RxTx-ProvideCapabilities*] according to TS 38.355 [TBD].

12A.4.4 Measurement Reporting Requirements

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

For UE report to LMF, this requirement assumes that the measurement report is not delayed by other SLPP signalling on the DCCH. This measurement reporting delay excludes a 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 PSSCH with subframe or slot or subslot duration.

For UE report to another UE, this requirement assumes that the measurement report is not delayed by other SLPP signalling on the STCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the sidelink STCH. The delay uncertainty is: 2 x TTISTCH where TTISTCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PSSCH with subframe or slot or subslot duration.

The measurement reporting delay excludes any delay caused by no SL resources for UE to send the measurement report.

The reported SL Rx-Tx time difference measurement values contained in measurement reports shall be based on the measurement report mapping requirements specified in clause [TBD].

The SL Rx-Tx time difference measurements performed and reported according to this section shall meet the SL Rx-Tx time difference measurement accuracy requirements in clause [TBD], for each measured SL-PRS resource.

12A.4.5 Measurement Period Requirements

When the physical layer receives [*NR-SL-RxTx-ProvideAssistanceData*] message from [*NR-SL-RxTx-RequestLocationInformation*] message from LMF or another UE via SLPP [TBD], the UE shall be able to perform multiple at least TBD [FFS: (up to the UE capability specified in Clause [TBD])] SL Rx-Tx time difference measurements, defined in TS 38.215 [4], during defined as:

Where,

S is the number of samples for a single SL Rx-Tx measurement defined below:

= 1 for SL-PRS BW>48 PRBs,

= 4 for 24 PRBs ≤SL-PRS BW≤48 PRBs

is defined as:

, for s<S, provided that , where and are the start of the s-th and (s+1)-th slot, respectively, where UE is configured to measure SL-PRS.

for *s*=*S*,

is the duration of SL-PRS resources of the s-th sample,

is the processing time.

is defined as below:

* If the UE reports the transmission timestamp of a SL PRS as defined in TS 38.215 [4], and the SL PRS transmission occurs after the SL PRS reception used to derive the measurement, is the additional time delay from the SL PRS reception until the actual SL PRS transmission.
* Otherwise, .

*Editor’s note: The SL PRS measurement period for measurement on SL-PRS for multiple UEs is FFS.*

[FFS: If the synchronization reference source changes at the measuring UE or at the UE configured to transmit SL-PRS for the measurement, while the measuring UE is performing the SL Rx-Tx time difference measurement, then the measuring UE shall restart the SL Rx-Tx time difference measurement and shall send the measurement report no later than:

,

where K is the number of restarts due to the synchronization source changes.]

*Editor’s note: FFS whether to limit the number of restarting.*

12A.5 SL-RSRPP measurements

12A.5.1 Introduction

The requirements in clause 12A.5 shall apply provided the UE has received [*NR-SL-RSRPP-RequestLocationInformation*] from LMF or another UE via SLPP requesting the UE to measure and report SL PRS-RSRPP measurements defined in TS 38.215 [4].

12A.5.2 Requirements Applicability

The requirements in clause 12A.5 apply for [periodic and] triggered SL PRS-RSRPP measurements, provided:

- SL PRS-RSRPP related side conditions given in clause [TBD] for FR1 are met for a corresponding Band.

12A.5.3 Measurement Capability

SL PRS-RSRPP measurement capability is as indicated by the UE in [*NR-SL-RSRPP-ProvideCapabilities*] according to TS 38.355 [TBD].

12A.5.4 Measurement Reporting Requirements

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

For UE report to LMF, this requirement assumes that the measurement report is not delayed by other SLPP signalling on the DCCH. This measurement reporting delay excludes a 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 PSSCH with subframe or slot or subslot duration.

For UE report to another UE, this requirement assumes that the measurement report is not delayed by other SLPP signalling on the STCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the sidelink STCH. The delay uncertainty is: 2 x TTISTCH where TTISTCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PSSCH with subframe or slot or subslot duration.

This measurement reporting delay excludes any delay caused by no SL resourcesfor UE to send the measurement report.

The reported SL PRS-RSRPP measurement values contained in measurement reports shall be based on the measurement report mapping requirements specified in clauses [TBD].

The SL PRS-RSRPP measurements performed and reported according to this section shall meet the SL PRS-RSRPP measurement accuracy requirements in clause [TBD], for each measured SL-PRS resource.

12A.5.5 Measurement Period Requirements

When the physical layer receives [*NR-SL-RSRPP-ProvideAssistanceData*] message from [*NR-SL-RSRPP-RequestLocationInformation*] message from LMF or another UE via SLPP, the measurement period requirements for SL PRS-RSRP defined in 12A.3.5 is re-used for PRS-RSRPP measurement.

12A.6 SL-AoA measurements

12A.6.1 Introduction

The requirements in clause 12A.6.5 shall apply provided the UE has received [*NR-SL-AOA-RequestLocationInformation*] from LMF or another UE via SLPP requesting the UE to measure and report SL AoA measurements defined in TS 38.215 [4].

12A.6.2 Requirements Applicable

The requirements in clause 12A.6 apply for periodic, aperiodic, and triggered SL AoA measurements, provided:

- SL AoA related side conditions given in clause [TBD] for FR1 are met for a corresponding Band.

12A.6.3 Measurement Capability

SL AoA measurement capability is as indicated by the UE in [*NR-SL-AOA-ProvideCapabilities*] according to TS 38.355 [37].

12A.6.4 Measurement Reporting Requirements

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

For UE reporting to LMF, this requirement assumes that the measurement report is not delayed by other SLPP signalling on the DCCH. This measurement reporting delay excludes a 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 PSSCH with subframe or slot or subslot duration.

For UE reporting to another UE, this requirement assumes that the measurement report is not delayed by other SLPP signalling on the STCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the sidelink STCH. The delay uncertainty is: 2 x TTISTCH where TTISTCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PSSCH with subframe or slot or subslot duration.

The measurement reporting delay excludes any delay caused by no SL resources or no SL-PRS resources for UE to send the measurement report.

The reported SL AoA measurement values contained in measurement reports shall be based on the measurement report mapping requirements specified in clauses [TBD].

[The SL AoA measurements performed and reported according to this section shall meet the SL AoA measurement accuracy requirements in clause [TBD], for each measured SL-PRS resource.]

*Editor’s note: FFS whether to define accuracy requirements for SLAoA.*

12A.6.5 Measurement Period Requirements

When the physical layer receives [*NR-SL-AOA-ProvideAssistanceData*] message from [*NR-SL-AOA-RequestLocationInformation*] message from LMF or another UE via SLPP, the UE shall be able to measure multiple [FFS: (up to the UE capability specified in Clause [TBD])] SL AoA measurements, defined in TS 38.215 [4], during defined as:

,

where,

*S* is the number of samples for the SL AoA measurement, defined as below:

* + *S* = 1 for SL-PRS BW>48 PRBs,
  + *S* = 4 for 24 PRBs ≤SL-PRS BW≤48 PRBs,

is defined as below,

, for *s*<*S*, provided that , where and are the start of the *s*-th and (*s*+1)-th slot, respectively, where UE is configured to measure SL-PRS,

for *s*=*S*,

is the SL-PRS duration for SL-PRS sample *s* of the SL AoA measurement,

is the processing time.

*Editor’s note: The SL PRS measurement period for measurement on SL-PRS for multiple UEs is FFS.*

The requirements in clause 12A.6 do not apply if the SL-PRS configuration given by [*NR-SL-PRS-AssistanceData* exceeds] exceeds any of the UE measurement capabilities given by [*NR-SL-PRS-ResourcesCapability* in *NR-SL-AOA-ProvideCapabilities*]*.*

When a synchronization reference source change occurs at the measuring UE or at the UE configured to transmit SL-PRS for the SL AoA measurement, while the UE is performing the SL AoA measurement, then the UE shall continue and complete the on-going SL AoA measurements while meeting the measurement period requirement in this clause[ and the accuracy requirements in clause [TBD]].

12A.7 SL-RTOA measurements

12A.7.1 Introduction

The requirements in clause 12A.7.5 shall apply provided the UE has received [*NR-SL-RTOA-RequestLocationInformation*] from LMF or another UE via SLPP requesting the UE to measure and report SL RTOA measurements defined in TS 38.215 [4].

12A.7.2 Requirements Applicable

The requirements in clause 12A.7 apply for periodic, aperiodic, and triggered SL RTOA measurements, provided:

- SL RTOA related side conditions given in clause [TBD] for FR1 are met for a corresponding Band.

12A.7.3 Measurement Capability

SL RTOA measurement capability is as indicated by the UE in [*NR-SL-RTOA-ProvideCapabilities*] according to TS 38.355 [37].

12A.7.4 Measurement Reporting Requirements

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

For UE reporting to LMF, this requirement assumes that the measurement report is not delayed by other SLPP signalling on the DCCH. This measurement reporting delay excludes a 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 PSSCH with subframe or slot or subslot duration.

For UE reporting to another UE, this requirement assumes that the measurement report is not delayed by other SLPP signalling on the STCH. This measurement reporting delay excludes a delay uncertainty resulted when inserting the measurement report to the TTI of the sidelink STCH. The delay uncertainty is: 2 x TTISTCH where TTISTCH is the duration of subframe or slot or subslot when the measurement report is transmitted on the PSSCH with subframe or slot or subslot duration.

The measurement reporting delay excludes any delay caused by no SL resources or no SL-PRS resources for UE to send the measurement report.

The reported SL RTOA measurement values contained in measurement reports shall be based on the measurement report mapping requirements specified in clauses [TBD].

[The SL RTOA measurements performed and reported according to this section shall meet the SL RTOA measurement accuracy requirements in clause [TBD], for each measured SL-PRS resource.]

*Editor’s note: FFS whether to define accuracy requirements for SL RTOA.*

12A.7.5 Measurement Period Requirements

When the physical layer receives [*NR-SL-RTOA-ProvideAssistanceData*] message from [*NR-SL-RTOA-RequestLocationInformation*] message from LMF or another UE via SLPP, the UE shall be able to measure multiple [FFS: (up to the UE capability specified in Clause [TBD])] SL RTOA measurements, defined in TS 38.215 [4], during defined as:

,

where,

*S* is the number of samples for the SL RTOA measurementdefined as below:

* + *S* = 1 for SL-PRS BW>48 PRBs,
  + *S*4 for 24 PRBs ≤SL-PRS BW≤48 PRBs,

, for *s*<*S*, provided that , where and are the start of the *s*-th and (*s*+1)-th slot, respectively, where UE is configured to measure SL-PRS

for *s*=*S*,

is the SL-PRS duration for SL-PRS sample *s* of the SL RTOA measurement,

is the processing time.

*Editor’s note: The SL PRS measurement period for measurement on SL-PRS for multiple UEs is FFS.*

The requirements in clause 12A.6 do not apply if the SL-PRS configuration given by [*NR-SL-PRS-AssistanceData* exceeds] exceeds any of the UE measurement capabilities given by [*NR-SL-PRS-ResourcesCapability* in *NR-SL-RTOA-ProvideCapabilities*]*.*

[If the synchronization reference source changes at the measuring UE, while the UE is performing the SL RTOA measurements, the UE shall restart the SL RTOA measurements after the synchronization reference source change.]

*Editor’s note: FFS whether to limit the number of restarting.*

**----------------------END OF CHANGE----------------------------**