**3GPP TSG-RAN WG1 Meeting #114 *R1-23xxxxx***

**Toulouse, France, August 21 – 25, 2023**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *CR-Form-v12.2* | | | | | | | | |
| **DRAFT CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.214** | **CR** | **-** | **Rev** | **-** | **Current version:** | **17.6.0** |  |
|  | | | | | | | | |
| *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 | **X** | Core Network |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | | | | | | | |
| ***Title:*** | Introduction of specification support for NR NTN enhancements | | | | | | |
|  |  | | | | | | |
| ***Source to WG:*** | Nokia | | | | | | |
| ***Source to TSG:*** |  | | | | | | |
|  |  | | | | | | |
| ***Work item code:*** | NR\_NTN\_enh | | |  | ***Date:*** | | 2023-09-08 |
|  |  | |  | |  | |  |
| ***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:*** | | Introduction of specification support for NR NTN enhancements. | | | | | |
|  | |  | | | | | |
| ***Summary of change:*** | | Introduction of specification support for NR NTN enhancements. | | | | | |
|  | |  | | | | | |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***Consequences if not approved:*** | Specification does not support NR NTN enhancements. | | | |
|  |  | | | |
| ***Clauses affected:*** | 5.1.6.5 | | | |
|  |  | | | |
|  | **Y** | **N** |  |  |
| ***Other specs*** | **X** |  | Other core specifications | ... |
| ***affected:*** |  | **X** | Test specifications | ... |
| ***(show related CRs)*** |  | **X** | O&M Specifications | ... |
|  |  | | | |
| ***Other comments:*** |  | | | |
|  |  | | | |
| ***This CR's revision history:*** |  | | | |

<omitted text>

#### 5.1.6.5 PRS reception procedure

The UE can be configured with one or more DL PRS resource set configuration(s) as indicated by the higher layer parameters *NR-DL-PRS-ResourceSet* and *NR-DL-PRS-Resource* as defined by Clause 6.4.3 [17, TS 37.355]. Each DL PRS resource set consists of K≥1 DL PRS resource(s) where each has an associated spatial transmission filter. The UE can be configured with one or more DL PRS positioning frequency layer configuration(s) as indicated by the higher layer parameter *NR-DL-PRS-PositioningFrequencyLayer.* A DL PRS positioning frequency layer is defined as a collection of DL PRS resource sets which have common parameters configured by *NR-DL-PRS-PositioningFrequencyLayer*.

The UE assumes that the following parameters for each DL PRS resource(s) are configured via higher layer parameters *NR-DL-PRS-PositioningFrequencyLayer, NR-DL-PRS-ResourceSet* and *NR-DL-PRS-Resource*.

A DL PRS positioning frequency layer is configured by *NR-DL-PRS-PositioningFrequencyLayer,* consists of one or more DL PRS resource sets and it is defined by:

*- dl-PRS-SubcarrierSpacing* defines the subcarrier spacing for the DL PRS resource. All DL PRS resources and DL PRS resource sets in the same DL PRS positioning frequency layer have the same value of *dl-PRS-SubcarrierSpacing*. The supported values of *dl-PRS-SubcarrierSpacing* are given in Table 4.2-1 of [4, TS38.211], excluding the values of 240kHz, 480 kHz, and 960 kHz.

*- dl-PRS-CyclicPrefix* defines the cyclic prefix for the DL PRS resource. All DL PRS Resources and DL PRS Resource sets in the same DL PRS positioning frequency layer have the same value of *dl-PRS-CyclicPrefix.* The supported values of *dl-PRS-CyclicPrefix* are given in Table 4.2-1 of [4, TS38.211].

*- dl-PRS-PointA* defines the absolute frequency of the reference resource block. Its lowest subcarrier is also known as Point A. All DL PRS resources belonging to the same DL PRS resource set have common Point A and all DL PRS resources sets belonging to the same DL PRS positioning frequency layer have a common Point A.

The UE expects that it will be configured with *dl-PRS-ID* each of which is defined such that it is associated with multiple DL PRS resource sets. The UE expects that one of these *dl-PRS-ID* along with a *nr-DL-PRS-ResourceSetID* and a *nr-DL-PRS-ResourceID-r16* can be used to uniquely identify a DL PRS resource.

The UE may be configured by the network with *nr-PhysCellID*, *nr-CellGlobalID*, and *nr-ARFCN* [17, TS 37.355] associated with a *dl-PRS-ID*.

- If *nr-PhysCellID* or *nr-CellGlobalID* is provided, and if *nr-PhysCellID*, *nr-CellGlobalID* and *nr-ARFCN* associated with the *dl-PRS-ID*, if provided, are the same as the corresponding information of a serving cell, the UE may assume that the DL PRS is transmitted from the serving cell;

- Otherwise, the UE may assume that the DL PRS is not transmitted from a serving cell.

If the UE assumes that the DL PRS is transmitted from a serving cell, and if the serving cell is the same as the serving cell defined by the SS/PBCH block, the UE may assume that the DL PRS and the SS/PBCH block are transmitted from the same serving cell.

If the UE assumes that the DL PRS is not transmitted from a serving cell, and if *nr-PhysCellID* is provided, and is the same as physical cell ID of the SS/PBCH block from a non-serving cell of the same band as the DL PRS, the UE may assume that the DL PRS and the SS/PBCH block are transmitted from the same non-serving cell.

A DL PRS resource set is configured by *NR-DL-PRS-ResourceSet*, consists of one or more DL PRS resources and it is defined by:

*- nr-DL-PRS-ResourceSetID* defines the identity of the DL PRS resource set configuration.

*- dl-PRS-Periodicity-and-ResourceSetSlotOffset* defines the DL PRS resource periodicity and takes values slots, where for *dl-PRS-SubcarrierSpacing*=15, 30, 60 and 120 kHz respectively and the slot offset for DL PRS resource set with respect to SFN0 slot 0. All the DL PRS resources within one DL PRS resource set are configured with the same DL PRS resource periodicity. The UE does not expect that the product of DL PRS resource periodicity , the higher layer parameter *dl-prs-MutingBitRepetitionFactor* and the size of the bitmap of *dl-PRS-MutingOption1* exceeds , where for *dl-PRS-SubcarrierSpacing*=15, 30, 60 and 120 kHz respectively.

*- dl-PRS-ResourceRepetitionFactor* defines how many times each DL-PRS resource is repeated for a single instance of the DL-PRS resource set and takes values . All the DL PRS resources within one resource set have the same resource repetition factor.

*- dl-PRS-ResourceTimeGap* defines the offset in number of slots between two repeated instances of a DL PRS resource with the same *nr-DL-PRS-ResourceID* within a single instance of the DL PRS resource set. The UE only expects to be configured with *dl-PRS-ResourceTimeGap* if *dl-PRS-ResourceRepetitionFactor* is configured with value greater than 1. The time duration spanned by one instance of a *nr-DL-PRS-ResourceSet* is not expected to exceed the configured value of DL PRS periodicity. All the DL PRS resources within one resource set have the same value of *dl-PRS-ResourceTimeGap.*

*- dl-PRS-MutingOption1* and *dl-PRS-MutingOption2* define the time locations where the DL PRS resource is expected to not be transmitted for a DL PRS resource set. If *dl-PRS-MutingOption1* is configured, each bit in the bitmap of *dl-PRS-MutingOption1* corresponds to a configurable number provided by higher layer parameter *dl-prs-MutingBitRepetitionFactor* of consecutive instances of a DL PRS resource set where all the DL PRS resources within the set are muted for the instance that is indicated to be muted. The length of the bitmap can be {2, 4, 6, 8, 16, 32} bits. If *dl-PRS-MutingOption2* is configured each bit in the bitmap of *dl-PRS-MutingOption2* corresponds to a single repetition index for each of the DL PRS resources within each instance of a *nr-DL-PRS-ResourceSet* and the length of the bitmap is equal to the values of *dl-PRS-ResourceRepetitionFactor*. Both *dl-PRS-MutingOption1* and *dl-PRS-MutingOption2* may be configured at the same time in which case the logical AND operation is applied to the bit maps as described in Clause 7.4.1.7.4 of [4, TS 38.211].

*- NR-DL-PRS-SFN0-Offset* defines the time offset of the SFN0 slot 0 for the DL PRS resource set with respect to SFN0 slot 0 of reference provided by *nr-DL-PRS-ReferenceInfo*.

*- dl-PRS-ResourceList* determines the DL PRS resources that are contained within one DL PRS resource set.

*- dl-PRS-CombSizeN* defines the comb size of a DL PRS resource where the allowable values are given in Clause 7.4.1.7.3 of [TS38.211]. All DL PRS resource sets belonging to the same DL PRS positioning frequency layer have the same value of *dl-PRS-CombSizeN*.

*- dl-PRS-ResourceBandwidth* defines the number of resource blocks configured for DL PRS transmission. The parameter has a granularity of 4 PRBs with a minimum of 24 PRBs and a maximum of 272 PRBs. All DL PRS resources sets within a DL PRS positioning frequency layer have the same value of *dl-PRS-ResourceBandwidth*.

*- dl-PRS-StartPRB* defines the starting PRB index of the DL PRS resource with respect to reference Point A, where reference Point A is given by the higher-layer parameter *dl-PRS-PointA*. The starting PRB index has a granularity of one PRB with a minimum value of 0 and a maximum value of 2176 PRBs. All DL PRS resource sets belonging to the same DL PRS positioning frequency layer have the same value of *dl-PRS-StartPRB*.

*- dl-PRS-NumSymbols* defines the number of symbols of the DL PRS resource within a slot where the allowable values are given in Clause 7.4.1.7.3 of [4, TS38.211].

A DL PRS resource is defined by:

*- nr-DL-PRS-ResourceID* determines the DL PRS resource configuration identity. All DL PRS resource IDs are locally defined within a DL PRS resource set.

*- dl-PRS-SequenceID* is used to initialize cinit value used in pseudo random generator as described in Clause 7.4.1.7.2 of [4, TS 38.211] for generation of DL PRS sequence for a given DL PRS resource.

*- dl-PRS-CombSizeN-AndReOffset* defines the starting RE offset of the first symbol within a DL PRS resource in frequency. The relative RE offsets of the remaining symbols within a DL PRS resource are defined based on the initial offset and the rule described in Clause 7.4.1.7.3 of [4, TS 38.211].

*- dl-PRS-ResourceSlotOffset* determines the starting slot of the DL PRS resource with respect to corresponding DL PRS resource set slot offset.

*- dl-PRS-ResourceSymbolOffset* determines the starting symbol of a slot configured with the DL PRS resource.

*- dl-PRS-QCL-Info* defines any quasi co-location information of the DL PRS resource with other reference signals. The DL PRS may be configured with QCL 'typeD' with a DL PRS associated with the same *dl-PRS-ID*, or with *rs-Type* set to 'typeC', 'typeD', or 'typeC-plus-typeD' with a SS/PBCH Block from a serving or non-serving cell.

- *dl-PRS-ResourcePrioritySubset* defines a subset of DL-PRS resources for the DL PRS resource for the purpose of prioritization of measurement reporting as described in [17, TS 37.355].

The UE assumes constant EPRE is used for all REs of a given DL PRS resource.

The UE may be indicated by the network that DL PRS resource(s) can be used as the reference for the DL RSTD, DL PRS-RSRP, DL PRS-RSRPP, and UE Rx-Tx time difference measurements in a higher layer parameter *nr-DL-PRS-ReferenceInfo*. The reference indicated by the network to the UE can also be used by the UE to determine how to apply higher layer parameters *nr-DL-PRS-ExpectedRSTD* and *nr-DL-PRS-ExpectedRSTD-Uncertainty*. The UE expects the reference to be indicated whenever it is expected to receive the DL PRS. This reference provided by *nr-DL-PRS-ReferenceInfo* may include a *dl-PRS-ID*, a DL PRS resource set ID, and optionally a single DL PRS resource ID or a list of DL PRS resource IDs [17, TS 37.355]. The UE may use different DL PRS resources or a different DL PRS resource set to determine the reference for the RSTD measurement as long as the condition that the DL PRS resources used belong to a single DL PRS resource set is met. If the UE chooses to use a different reference than indicated by the network, then it is expected to report the *dl-PRS-ID*, the DL PRS resource ID(s) or the DL PRS resource set ID used to determine the reference.

The UE may be configured to report quality metrics *NR-TimingQuality* corresponding to the DL RSTD and UE Rx-Tx time difference measurements which include the following fields:

*- timingQualityValue* which provides the best estimate of the uncertainty of the measurement

*- timingQualityResolution* which specifies the resolution levels used in the *timingQualityValue* field.

The UE expects to be configured with higher layer parameter *nr-DL-PRS-ExpectedRSTD*, which defines the time difference with respect to the received DL subframe timing the UE is expected to receive DL PRS, and *nr-DL-PRS-ExpectedRSTD-Uncertainty*, which defines a search window around the *nr-DL-PRS-ExpectedRSTD*.

For DL UE positioning measurement reporting in higher layer parameters *NR-DL-TDOA-SignalMeasurementInformation* or *NR-Multi-RTT-SignalMeasurementInformation* the UE can be configured to report the DL PRS resource ID(s) or the DL PRS resource set ID(s) associated with the DL PRS resource(s) or the DL PRS resource set(s) which are used in determining the UE measurements DL RSTD, or UE Rx-Tx time difference, respectively.

For the DL RSTD, DL PRS-RSRP, DL PRS-RSRPP, and UE Rx-Tx time difference measurements the UE reports an associated higher layer parameter *nr-TimeStamp*. The *nr-TimeStamp* can include the *dl-PRS-ID*, the SFN and the slot number for a subcarrier spacing. These values correspond to the reference which is provided by *nr-DL-PRS-ReferenceInfo*.

The UE is expected to measure the DL PRS resource outside the active DL BWP or with a numerology different from the numerology of the active DL BWP if the measurement is made during a configured measurement gap. When the UE is expected to measure the DL PRS resource, the UE may request a measurement gap via higher layer parameter *NR-PRS-MeasurementInfoList* [12, TS 38.331] or as specified in clause 6.1.3.40 of [10, TS 38.321]. The UE may be preconfigured with one or more measurement gaps each associated with a *measPosPreConfigGapId*. When the UE requests activation or deactivation of a measurement gap as specified in clause 6.1.3.40 of [10, TS 38.321]it can request one of the preconfigured measurement gaps by referring to the *measPosPreConfigGapId*. The UE may have one of the preconfigured measurement gap(s) activated or deactivated as specified in clause 6.1.3.41 of [10, TS 38.321].

The UE assumes that the DL PRS from the serving cell is not mapped to any symbol that contains SS/PBCH block from the serving cell. If the time frequency location of the SS/PBCH block transmissions from non-serving cells are provided to the UE then the UE also assumes that the DL PRS from a non-serving cell is not mapped to any symbol that contains the SS/PBCH block of the same non-serving cell.

The UE may be configured to measure and report, subject to UE capability, up to 4 DL RSTD measurements per pair of *dl-PRS-ID* with each measurement between a different pair of DL PRS resources or DL PRS resource sets within the DL PRS configured for those *dl-PRS-ID*. If the UE is not configured to report with *multiMeasInSameReport-r17*, the up to 4 measurements being performed on the same pair of *dl-PRS-ID* and all DL RSTD measurements in the same report use a single reference timing. If the UE is configured to report with *multiMeasInSameReport-r17*, the up to 4 measurements being performed on the same pair of *dl-PRS-ID* and all DL RSTD measurements in the same measurement instance of the same report use a single reference timing.

The UE may be configured to measure and report, subject to UE capability, up to 24 DL PRS-RSRP measurements on DL PRS resources associated with the same *dl-PRS-ID*. When the UE reports DL PRS-RSRP measurements from one DL PRS resource set, the UE may indicate which DL PRS-RSRP measurements associated with the same higher layer parameter *nr-DL-PRS-RxBeamIndex* [17, TS 37.355] have been performed using the same spatial domain filter for reception if for each *nr-DL-PRS-RxBeamIndex* reported there are at least 2 DL PRS-RSRP measurements associated with it within the DL PRS resource set. When the UE reports DL PRS-RSRP measurements for a DL PRS resource, the reported multiple DL PRS-RSRP measurements associated with the same or different higher layer parameter *nr-DL-PRS-RxBeamIndex* may have the same or different timestamps.

The UE may be configured to measure and optionally report, subject to UE capability, up to 24 DL PRS-RSRPP for the first detected path on DL PRS resources associated with the same *dl-PRS-ID*. When the UE reports DL PRS-RSRPP measurements for a DL PRS resource, the reported multiple DL PRS-RSRPP measurements associated with the same or different higher layer parameter *nr-DL-PRS-RxBeamIndex* may have the same or different timestamps. When the UE reports DL PRS-RSRPP measurements from one DL PRS resource set, the UE may indicate which DL PRS-RSRPP measurements associated with the same higher layer parameter *nr-DL-PRS-RxBeamIndex* [17, TS 37.355] have been performed using the same spatial domain filter for reception if for each *nr-DL-PRS-RxBeamIndex* reported there are at least 2 DL PRS-RSRPP measurements associated with it within the DL PRS resource set.

The UE may be configured to optionally report a differential DL PRS-RSRPP for a DL PRS resource with reference to *nr-DL-PRS-FirstPathRSRP-Result* and/or a differential DL PRS RSRP with reference to *nr-DL-PRS-RSRP-Result* via higher layer parameter *NR-DL-AoD-AdditionalMeasurementElement*.

For each DL PRS resource, the UE may be configured, subject to UE capability, with *dl-PRS-ResourcePrioritySubset* that is associated with this DL PRS resource, where the subset of DL PRS resources associated with the DL PRS resource can be in the same or different DL PRS resource set than the DL PRS resource. The UE may include UE measurements for the subset of DL PRS resources in *NR-DL-AoD-AdditionalMeasurementElement* if the UE measurements of the associated PRS resource are reported, where the UE measurement can be DL PRS-RSRP and/or DL PRS-RSRPP. The UE may report DL PRS-RSRP and/or DL PRS-RSRPP measurements only for the subset of DL PRS resources. Subject to UE capability, the UE may be configured with boresight direction via higher layer parameter *DL-PRS-BeamInfoElement* for each DL PRS resource.

The UE may be provided with beam/antenna information via higher layer parameter *NR-TRP-BeamAntennaInfo*.

The UE may request to be provided with either expected DL-AoD/ZoD and uncertainty range(s) of expected DL-AoD/ZoD, or expected DL-AoA/ZoA and uncertainty range(s) of the expected DL-AoA/ZoA. The UE may be provided with expected DL-AoD/ZoD and uncertainty range(s) of the expected DL-AoD/ZoD. The UE may be provided with expected DL-AoA/ZoA and uncertainty range(s) of the expected DL-AoA/ZoA. The uncertainty range(s) of the expected DL-AoD/DL-AoA may be configured within [0, 60]. The uncertainty range(s) of expected DL-ZoD/DL-ZoA may be configured within [0, 30].

The UE may be configured to measure and report, subject to UE capability, up to 4 UE Rx-Tx time difference measurements corresponding to a single configured SRS resource or resource set for positioning. Each measurement corresponds to a single received DL PRS resource or resource set which can be in different DL PRS positioning frequency layers.

The UE may be configured to measure and report via higher layer parameter *additionalPaths* or *additionalPathsExt*, subject to UE capability, the timing and the quality metrics of up to 8 additional detected paths, that are associated with each RSTD or UE Rx – Tx time difference. The timing of each additional path is reported relative to the path timing used for determining *nr-RSTD* or *nr-UE-RxTxTimeDiff*. For UE positioning measurement reporting in higher layer parameters *NR-DL-TDOA-SignalMeasurementInformation* or *NR-Multi-RTT-SignalMeasurementInformation*, the UE may be configured to measure and report, subject to UE capability, the DL PRS-RSRPP of the first path and the up to 8 additional paths that are associated with each RSTD or UE Rx – Tx time difference.

The UE may be requested, subject to UE capability, to measure and report one or more of the DL RSTD, DL PRS-RSRP, DL PRS-RSRPP, or UE Rx-Tx time difference measurements with either or 4 samples, where = 1 or 2 is as defined in [11, TS 38.133], via higher layer parameter *reducedDL-PRS-ProcessingSamples* [17, TS 37.355] which applies for all DL PRS positioning frequency layers.

The UE may be requested, subject to UE capability, to report LoS/NLoS indicator(s) via higher layer parameter *nr-los-nlos-IndicatorRequest*. The UE can report LoS/NLoS indicator(s) via higher layer parameter *nr-los-nlos-Indicator* associated with each DL RSTD, DL PRS-RSRP, DL PRS-RSRPP, and UE Rx-Tx time difference measurements. The UE can report LoS/NLoS indicator(s) via higher layer parameter *nr-los-nlos-Indicator* associated with each *dl-PRS-ID* in a measurement report. For the LoS/NLoS indicator(s) associated with DL RSTD, the UE may report one indicator associated with the *dl-PRS-ID* indicated by higher layer parameter *dl-PRS-ReferenceInfo* and one indicator associated with the *dl-PRS-ID* of the DL RSTD measurement. A UE may be provided with LoS/NLoS indicator(s) via higher layer parameter *nr-los-nlos-Indicator*, and it may be associated with each DL PRS resource of each configured *dl-PRS-ID* or may be associated with each configured *dl-PRS-ID*. The values of the higher layer parameter *LOS-NLOS-Indicator* may be soft values (0, 0.1, …, 0.9, 1) or hard values (0, 1) with the values corresponding to the likelihood of LoS, with a value of 1 corresponding to LoS and a value of 0 corresponding to NLoS.

If the UE is configured with *DL-PRS-QCL-Info* and the QCL relation is between two DL PRS resources, then the UE assumes those DL PRS resources are associated with the same *dl-PRS-ID*. If *DL-PRS-QCL-Info* is configured to the UE with QCL set to 'type-D' with a source DL PRS resource then the *nr-DL-PRS-ResourceSetId* and the *nr-DL-PRS-ResourceId* of the source DL PRS resource are expected to be indicated to the UE.

The UE is expected to measure the DL PRS outside the measurement gap, subject to UE capability, if the DL PRS is inside the active DL BWP and has the same numerology as the active DL BWP and is within the DL PRS processing window indicated by higher layer parameter *DL-PPW-PreConfig*. The UE is not expected to measure the DL PRS outside the measurement gap if the expected received timing difference between the DL PRS from the non-serving cell and that from the serving cell, determined by the higher layer parameters *nr-DL-PRS-ExpectedRSTD* and *nr-DL-PRS-ExpectedRSTD-Uncertainty,* is larger than maximum Rx timing difference provided by UE capability*.* For receiving the DL PRS outside the measurement gap and within the DL PRS processing window, the priority between DL PRS and SSB is defined in [11, TS 38.133] and the UE determines the DL PRS priority as indicated by higher layer parameter *priority* subject to UE capability or as implied by UE capability, except for SSB:

- with value *'st1'* where the DL PRS is higher priority than all the DL signals and channels, or

- with value *'st2'* where the DL PRS is lower priority than PDCCH and the PDSCH scheduled by DCI formats 1\_1 or 1\_2 with the priority indicator field in the corresponding DCI format set to 1, and is higher priority than other DL signals and channels, or

- with value *'st3'* where the DL PRS is lower priority than all the DL signals and channels.

Inside one *DL-PPW-PreConfig* the UE is only expected to measure a single DL PRS positioning frequency layer.

When the UE is expected to measure the DL PRS outside the measurement gap in a configured DL PRS processing window with *type1A* and if the DL PRS is determined to be higher priority than the DL signals and channels inside the DL PRS processing window, those DL signals and channels are not expected to be measured by the UE. When the UE is expected to measure the DL PRS outside the measurement gap in a configured DL PRS processing window with *type1B* and if the DL PRS is determined to be higher priority than the DL signals and channels inside the DL PRS processing window, those DL signals and channels in the same band as the DL PRS are not expected to be measured by the UE. When the UE is expected to measure the DL PRS outside the measurement gap in a configured DL PRS processing window with *type2* if the DL PRS is determined to be higher priority than the DL signals and channels inside the DL PRS processing window, those DL signals and channels from the impacted serving cells are not expected to be measured by the UE on the overlapped symbols with the DL PRS, where impacted serving cells refer to the serving cell on which the *DL-PPW-PreConfig* is configured for a frequency range 1 band, and all the serving cells in the same band as the DL PRS for a frequency range 2 band. When the UE is expected to measure the DL PRS outside the measurement gap in a configured DL PRS processing window with *type1B* or *type2,* and if the DL PRS is determined to be higher priority than the DL signals and channels inside the DL PRS processing window, the UE behavior is described in [11, TS 38.133] for inter-band case for frequency range 2 for the DL signals/channels from a different frequency range 2 band than the frequency range 2 band of the DL PRS.

When the UE has an activated DL PRS processing window with *type1A* or *type1B* and the UE determines the presence of other DL signals and channels, except SSB, of higher priority than the DL PRS in the DL PRS processing window no later than *N2* symbols, defined in clause 6.4 for the subcarrier spacing of the DL PRS, before the first symbol of the DL PRS processing window, the UE is expected to receive the other DL signals and channels and drop all PRS within the DL PRS processing window. When the UE has an activated DL PRS processing window with *type2* and the UE determines the presence of other DL signals and channels, except SSB, of higher priority than the DL PRS on a symbol configured with the DL PRS no later than *N2* symbols, defined in clause 6.4 for the subcarrier spacing of the DL PRS, before the DL PRS symbol, the UE is expected to receive the other DL signals and channels and drop the DL PRS symbol.

When the UE has an activated DL PRS processing window with *type1A* or *type1B* and the UE determines the presence of other DL signals and channels, except SSB, of higher priority than the DL PRS in the DL PRS processing window later than *N2* symbols, defined in clause 6.4 for the subcarrier spacing of the DL PRS, before the first symbol of the DL PRS processing window, the UE is not required to receive the other DL signals and channels and may receive the DL PRS and consider the DL PRS as higher priority in the DL PRS processing window. When the UE has an activated DL PRS processing window with *type2* and the UE determines the presence of other DL signals and channels, except SSB, of higher priority than the DL PRS on a symbol configured with the DL PRS later than *N2* symbols, defined in clause 6.4 for the subcarrier spacing of the DL PRS, before the DL PRS symbols, the UE is not required to receive the other DL signals and channels and may receive the DL PRS symbol and consider the DL PRS as higher priority in that symbol.

Within a positioning frequency layer, the DL PRS resources are sorted in the decreasing order of priority for measurement to be performed by the UE, with the reference indicated by *nr-DL-PRS-ReferenceInfo* being the highest priority for measurement, and the following priority is assumed:

- Up to 64 *NR-SelectedDL-PRS-IndexPerTRP* of the DL PRS positioning frequency layer are sorted according to priority if *nr-SelectedDL-PRS-IndexListPerFreq* is provided, or up to 64 *NR-DL-PRS-AssistanceDataPerTRP* of the frequency layer are sorted according to priority otherwise;

- Up to 2 *DL-SelectedPRS-ResourceSetIndex* per *dl-PRS-ID* of the DL PRS positioning frequency layer are sorted according to priority if *dl-SelectedPRS-ResourceSetIndexList* is provided, or up to 2 *NR-DL-PRS-ResourceSet* per *dl-PRS-ID* of the DL PRS positioning frequency layer are sorted according to priority otherwise.

The UE DL PRS processing capability is defined in [TS 37.355]. For the purpose of DL PRS processing capability, the duration *K* msec of DL PRS symbols within *P* msec window, is calculated by

*-* Type 1 duration calculation with UE symbol level buffering capability

*-* Type 2 duration calculation with UE slot level buffering capability

*- S* is the set of slots based on the numerology of the DL PRS of a serving cell within the *P* msec window in the positioning frequency layer that contains potential DL PRS resources considering the actual *nr-DL-PRS-ExpectedRSTD*, *nr-DL-PRS-ExpectedRSTD-Uncertainty* provided for each pair of DL PRS Resource Sets.

*-* For Type 1, is the smallest interval in msec within slot corresponding to an integer number of OFDM symbols based on the numerology of the DL PRS of a serving cell that covers the union of the potential DL PRS symbols and determines the DL PRS symbol occupancy within slot , where the interval considers the actual *nr-DL-PRS-ExpectedRSTD*, *nr-DL-PRS-ExpectedRSTD-Uncertainty* provided for each pair of DL PRS resource sets (target and reference).

*-* For Type 2, is the numerology of the DL PRS, and is the cardinality of the set .

The UE may be configured to report one or more measurement instances, each with its own timestamp, on DL RSTD, DL PRS-RSRP, DL PRS-RSRPP, and/or UE Rx-Tx time difference measurements, in a single measurement report.

Timing Error Group(s) (TEG(s)) at UE side are defined:

*-* UE Rx TEG is associated with one or more DL measurements, which have the Rx timing error difference within a certain margin.

*-* UE RxTx TEG is associated with one or more UE Rx-Tx time difference measurements, which have the 'Rx timing errors+Tx timing errors' difference within a certain margin.

The UE may be configured to report, subject to UE capability, via high layer parameter *nr-UE-RxTEG-Request*, the association information of DL RSTD measurement(s) with UE Rx TEG(s) via higher layer parameter *nr-UE-Rx-TEG-ID* when the UE reports the DL RSTD measurement(s). The UE may report up to 4 RSTD measurements associated with different DL PRS resources per UE Rx TEG per *dl-PRS-ID*.

The UE may report a UE Rx TEG ID via higher layer parameter *nr-UE-Rx-TEG-ID* for a RSTD reference time *dl-PRS-ReferenceInfo* and a UE Rx TEG ID for each DL RSTD measurement, where the DL RSTD can be DL RSTD measurement in *NR-DL-TDOA-MeasElement* and/or *NR-DL-TDOA-AdditionalMeasurementElement*.

If the UE reports a UE Rx TEG ID with a DL RSTD measurement, the UE may report a UE Rx TEG timing error margin value, via high layer parameter *nr-UE-RxTEG-TimingErrorMargin*, for all the UE Rx TEGs within one *NR-DL-TDOASignalMeasurementInformation.*

The UE may be configured to measure and report, via high layer parameter *measureSameDL-PRS-ResourceWithDifferentRxTEGs* subject to UE capability, RSTD measurements on a DL PRS resource associated with a *dl-PRS-ID* using up to 8 different UE Rx TEGs with the same *dl-PRS-ReferenceInfo.* The higher layer parameter *measureSameDL-PRS-ResourceWithDifferentRxTEGs* applies to all DL PRS positioning frequency layers.

The UE may be provided with association information of DL PRS resource(s) with TRP Tx TEGs via higher layer parameter *dl-prs-trp-Tx-TEG-ID* for a *dl-PRS-ID*.

The UE may be configured to report, via high layer parameter *nr-UE-RxTxTEG-Request*, subject to UE capability, the association information of UE Rx-Tx time difference measurement(s) with UE RxTx TEG(s) via higher layer parameter *nr-UE-RxTx-TEG-ID*. The UE may report up to 4 UE Rx-Tx time difference measurements associated with different DL PRS resources per UE RxTx TEG per *dl-PRS-ID*.

If the UE reports a UE RxTx TEG ID with a UE Rx-Tx time difference measurement, the UE may report a UE RxTx TEG timing error margin value, via high layer parameter *nr-UE-RxTxTEG-TimingErrorMargin*, for all the UE RxTx TEGs within one *NR-Multi-RTT-SignalMeasurementInformation.*

The UE may be configured to report, via high layer parameter *nr-UE-RxTxTEG-Request*, subject to UE capability, the association information of UE Rx-Tx time difference measurement(s) with the UE Rx TEG(s) and UE Tx TEG(s) via the higher layer parameters of *nr-UE-Rx-TEG-ID*, and *nr-UE-Tx-TEG-Index*. The UE may report up to 4 UE Rx-Tx time difference measurements associated with different DL PRS resources per UE Rx TEG per *dl-PRS-ID*.

If the UE reports a UE Rx TEG ID with a UE Rx-Tx time difference measurement, the UE may report a UE Rx TEG timing error margin value, via high layer parameter *nr-UE-RxTEG-TimingErrorMargin*, for all the UE Rx TEGs within one *NR-Multi-RTT-SignalMeasurementInformation*.

The UE may be configured to measure and report, via high layer parameter *measureSameDL-PRS-ResourceWithDifferentRxTEGs* subject to UE capability, UE Rx-Tx time difference measurements on a PRS resource associated with a *dl-PRS-ID* using up to 8 different UE Rx TEGs. The high layer parameter *measureSameDL-PRS-ResourceWithDifferentRxTEGs* applies to all DL PRS positioning frequency layers.

The UE may be configured to measure and report, via high layer parameter *measureSameDL-PRS-ResourceWithDifferentRxTxTEGs* subject to UE capability, UE Rx-Tx time difference measurements with the same UE Tx TEG using up to 8 different UE RxTx TEGs*.* The high layer parameter *measureSameDL-PRS-ResourceWithDifferentRxTxTEGs* applies to all DL PRS positioning frequency layers.

The UE may be configured to measure and report, via higher layer parameter [undetermined NTN related parameter] subject to UE capability, UE Rx-Tx time difference measurements on a PRS resource associated with a *dl-PRS-ID*. The UE shall report the [actual] index difference between the uplink subframe *j* and closest in time DL subframe *i*, and the DL timing drift due to Doppler over the radio link associated with the UE RX-TX time difference measurement period as described in [7, TS 38.215].

The UE in RRC\_INACTIVE mode is expected to prioritize the reception of any other DL signals and DL channels than the reception of DL PRS.

The UE in RRC\_INACTIVE mode, subject to UE capability, is expected to process DL PRS outside or inside of the initial DL BWP. For DL PRS processing outside of the initial DL BWP, the UE may be configured with the same or different subcarrier spacing and CP for DL PRS resources than those of the initial DL BWP. For DL PRS processing inside of the initial DL BWP, the UE is configured with the same subcarrier spacing and CP for DL PRS resources as those of the initial DL BWP.

For a UE configured with preconfigured Measurement gap(s) for Positioning, when the UE receives an activation command, as described in clause 6.1.3.41 of [10, TS 38.321], for a preconfigured Measurement Gap for Positioning activation/deactivation, and when the UE would transmit a PUCCH with HARQ-ACK information in slot n corresponding to the PDSCH carrying the command, the corresponding actions in [10, TS 38.321] and the UE assumptions shall be applied starting from the first slot that is after slot where ** is the SCS configuration for the PUCCH.

For a UE configured with DL PRS Processing Window(s), when the UE receives an activation/deactivation command, as described in clause 6.1.3.42 of [10, TS 38.321], for a DL PRS processing window activation, and when the UE would transmit a PUCCH with HARQ-ACK information in slot n corresponding to the PDSCH carrying the command, the corresponding actions in [10, TS 38.321] and the UE assumptions shall be applied starting from the first slot that is after slot where ** is the SCS configuration for the PUCCH. The UE is not expected to be indicated with more than 4 activated DL PRS processing windows across all active DL BWPs and is not expected to be indicated with the activated DL PRS processing windows that overlap in time.

<omitted text>

### 6.1.7 UE procedure for determining time domain windows for bundling DM-RS

For PUSCH transmissions of PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2, PUSCH repetition Type A with a configured grant, PUSCH repetition Type B and TB processing over multiple slots, when *pusch-DMRS-Bundling* is enabled, and for PUCCH transmissions of PUCCH repetition, when *PUCCH-DMRS-Bundling* is enabled, the UE determines one or multiple nominal TDWs, as follows:

- For PUSCH transmissions of repetition Type A, PUSCH repetition Type B and TB processing over multiple slots, the duration of each nominal TDW except the last nominal TDW, in number of consecutive slots, is:

- Given by *pusch-TimeDomainWindowLength*, if configured.

- Computed as min (*maxDurationDMRS-Bundling*, M), if *pusch-TimeDomainWindowLength* is not configured, where *maxDurationDMRS-Bundling* is maximum duration for a nominal TDW subject to UE capability [13, TS 38.306], M is the time duration in consecutive slots of PUSCH transmissions, and where:

- For PUSCH transmissions of PUSCH repetition Type A, N=1 and K is the number of repetitions, as defined in Clause 6.1.2.1 or in Clause 6.1.2.3.

- For PUSCH transmissions of PUSCH repetition Type B, N=1 and K is the number of nominal repetitions, as defined in Clause 6.1.2.1 or in Clause 6.1.2.3.

- For PUSCH transmissions of TB processing over multiple slots, N is the number of slots used for TBS determination and K is the number of repetitions of the number of slots N used for TBS determination, as defined in Clause 6.1.2.1 or in Clause 6.1.2.3.

- For PUCCH transmissions of PUCCH repetition, the duration of each nominal TDW except the last nominal TDW, in number of consecutive slots, is:

- Given by *pucch-TimeDomainWindowLength*, if configured.

- Computed as min (*maxDurationDMRS-Bundling*, M), if *pucch-TimeDomainWindowLength* is not configured, where *maxDurationDMRS-Bundling* is maximum duration for a nominal TDW subject to UE capability [13, TS 38.306], M is the time duration in consecutive slots from the first slot determined for PUCCH transmissions of PUCCH repetition to the last slot determined for PUCCH transmissions of PUCCH repetition according to clause 9.2.6 of [6, TS 38.213].

- For PUSCH transmission of a PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2 and PUSCH repetition Type A with a configured grant, when *AvailableSlotCounting* is enabled, and for TB processing over multiple slots:

- The start of the first nominal TDW is the first slot determined for the first PUSCH transmission.

- The end of the last nominal TDW is the last slot determined for the last PUSCH transmission.

- The start of any other nominal TDWs is the first slot determined for PUSCH transmission after the last slot determined for PUSCH transmission of a previous nominal TDW.

- For PUSCH transmissions of a PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2 and PUSCH repetition Type A with a configured grant, when the UE is not configured with *AvailableSlotCounting* or when *AvailableSlotCounting* is disabled, and for PUSCH repetition type B:

- The start of the first nominal TDW is the first slot for the first PUSCH transmission.

- The end of the last nominal TDW is the last slot for the last PUSCH transmission.

- The start of any other nominal TDWs is the first slot after the last slot of a previous nominal TDW.

- For PUCCH transmissions of a PUCCH repetition:

- The start of the first nominal TDW is the first slot determined for the first PUCCH transmission.

- The end of the last nominal TDW is the last slot determined for the last PUCCH transmission.

- The start of any other nominal TDWs is the first slot determined for PUCCH transmission after the last slot determined for PUCCH transmission of a previous nominal TDW.

For PUSCH transmissions of a PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2, PUSCH repetition Type A with a configured grant, PUSCH repetition Type B and TB processing over multiple slots, a nominal TDW consists of one or multiple actual TDWs. The UE determines the actual TDWs as follows:

- The start of the first actual TDW is the first symbol of the first PUSCH transmission in a slot for PUSCH transmission of PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or PUSCH repetition Type A with a configured grant, or PUSCH repetition type B or TB processing over multiple slots within the nominal TDW.

- The end of an actual TDW is

- The last symbol of the last PUSCH transmission in a slot for PUSCH transmission of PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or PUSCH repetition Type A with a configured grant, or PUSCH repetition type B or TB processing over multiple slots within the nominal TDW, if the actual TDW reaches the end of the last PUSCH transmission within the nominal TDW.

- The last symbol of a PUSCH transmission before the event, if an event occurs which causes power consistency and phase continuity not to be maintained across PUSCH transmissions of PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or PUSCH repetition Type A with a configured grant, or PUSCH repetition type B or TB processing over multiple slots within the nominal TDW, and the PUSCH transmission is in a slot for PUSCH transmission of PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or PUSCH repetition Type A with a configured grant, or PUSCH repetition type B or TB processing over multiple slots.

- When *pusch-WindowRestart* is enabled, the start of a new actual TDW is the first symbol of the PUSCH transmission after the event which causes power consistency and phase continuity not to be maintained across PUSCH transmissions of PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or PUSCH repetition Type A with a configured grant, or PUSCH repetition type B or TB processing over multiple slots within the nominal TDW, and the PUSCH transmission is in a slot for PUSCH transmission of PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or PUSCH repetition Type A with a configured grant, or PUSCH repetition type B or TB processing over multiple slots.

For PUCCH transmissions of PUCCH repetition, a nominal TDW consists of one or multiple actual TDWs. The UE determines the actual TDWs as follows:

- The start of the first actual TDW is the first symbol of the first PUCCH transmission in a slot determined for PUCCH transmission within the nominal TDW.

- The end of an actual TDW is

- The last symbol of the last PUCCH transmission in a slot determined for transmission of the PUCCH within the nominal TDW, if the actual TDW reaches the end of the last PUCCH transmission within the nominal TDW.

- The last symbol of a PUCCH transmission before the event, if an event occurs which causes power consistency and phase continuity not be maintained across PUCCH transmissions of PUCCH repetition within the nominal TDW, and the PUCCH transmission is in a slot determined for transmission of the PUCCH.

- When *pucch-WindowRestart* is enabled, the start of a new actual TDW is the first symbol of the PUCCH transmission after the event which causes power consistency and phase continuity not to be maintained across PUCCH transmissions of PUCCH repetition within the nominal TDW, and the PUCCH transmission is in a slot determined for transmission of the PUCCH.

Events which cause power consistency and phase continuity not to be maintained across PUSCH transmissions of PUSCH repetition type A scheduled by DCI format 0\_1 or 0\_2, or PUSCH repetition Type A with a configured grant, or PUSCH repetition type B or TB processing over multiple slots, or PUCCH transmissions of PUCCH repetition, within the nominal TDW, are:

- A downlink slot or downlink reception or downlink monitoring based on *tdd-UL-DL-ConfigurationCommon* and *tdd-UL-DL-ConfigurationDedicated* for unpaired spectrum.

- The gap between any two consecutive PUSCH transmissions, or the gap between any two consecutive PUCCH transmissions, exceeds 13 symbols for normal cyclic prefix or exceeds 11 symbols for extended cyclic prefix.

- The gap between any two consecutive PUSCH transmissions, or the gap between any two consecutive PUCCH transmissions, does not exceed 13 symbols but other uplink transmissions are scheduled between the two consecutive PUSCH transmissions or the two consecutive PUCCH transmissions.

- For PUSCH transmissions of PUSCH repetition type A, or PUSCH repetition type B or TB processing over multiple slots, a dropping or cancellation of a PUSCH transmission according to clause 9, clause 11.1 and clause 11.2A of [6, TS 38.213].

- For PUCCH transmissions of PUCCH repetition, a dropping or cancellation of a PUCCH transmission according to clause 9, clause 9.2.6 and clause 11.1 of [6, TS 38.213].

- For any two consecutive PUSCH transmissions of PUSCH repetition type A, or PUSCH repetition type B, and when two SRS resource sets are configured in *srs-ResourceSetToAddModList* or *srs-ResourceSetToAddModListDCI-0-2* with higher layer parameter *usage* in *SRS-ResourceSet* set to 'codebook' or 'noncodebook', a different SRS resource set association is used for the two PUSCH transmissions of PUSCH repetition type A, or PUSCH repetition type B, according to Clause 6.1.2.1.

- For any two consecutive PUCCH transmissions of PUCCH repetition, and when a PUCCH resource used for repetitions of a PUCCH transmission by a UE includes first and second spatial relations or first and second sets of power control parameters, as described in [10, TS 38.321] and in clause 7.2.1 of [6, TS 38.213], different spatial relations or different power control parameters are used for the two PUCCH transmissions of PUCCH repetition, according to Clause 9.2.6 of [6, TS 38.213].

- Uplink timing adjustment in response to a timing advance command according to clause 4.2 of [6, TS 38.213].

- Frequency hopping.

- For reduced capability half-duplex UEs,

- a dropping or cancellation of a PUSCH or PUCCH transmission according to clause 17.2 of [6, TS 38.213] or

- an overlapping of the gap between two consecutive PUSCH or two consecutive PUCCH transmissions and any symbol of downlink reception or downlink monitoring

The UE shall maintain power consistency and phase continuity within an actual TDW, across PUSCH transmissions of PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2, or PUSCH repetition Type A with a configured grant, or PUSCH repetition type B or TB processing over multiple slots, or across PUCCH transmissions of PUCCH repetition, in case the actual TDW is created in response to frequency hopping, or in response to the use of a different SRS resource set association for the two PUSCH transmissions of PUSCH repetition type A, or PUSCH repetition type B, or in response to the use of different spatial relations or different power control parameters for the two PUCCH transmissions of PUCCH repetition, or in response to any event not triggered by DCI or MAC-CE. The UE maintains power consistency and phase continuity within an actual TDW, across PUSCH transmissions of PUSCH repetition Type A scheduled by DCI format 0\_1 or 0\_2, or PUSCH repetition Type A with a configured grant, or PUSCH repetition type B or TB processing over multiple slots, or across PUCCH transmissions of PUCCH repetition, in case the actual TDW is created in response to an event triggered by DCI other than frequency hopping or the use of a different SRS resource set association for the two PUSCH transmissions of PUSCH repetition type A, or PUSCH repetition type B, or the use of different spatial relations or different power control parameters for the two PUCCH transmissions of PUCCH repetition, or in response to an event triggered by MAC-CE, subject to UE capability. of *dmrs-BundlingRestart* [13, TS 38.306] and when *pusch-WindowRestart* or *pucch-WindowRestart* is enabled.

<omitted text>