**3GPP TSG RAN WG1 #108 R1-2202523**

**e-Meeting, February 21st – March 3rd, 2022**

**Source: Moderator (Intel Corporation)**

**Title: Feature Lead Summary#1 for E-mail Discussion [108-e-NR-ePos-06]**

**Agenda item: 8.5.6**

**Document for:**  **Discussion and Decision**

# Introduction

This document provides overview of contributions submitted for R17 maintenance work on NR Positioning enhancements [1]-[17]. In addition, it provides feature lead recommendations and summary of the following RAN1 e-mail discussion [108-e-NR-ePos-06]:

[108-e-R17-ePos-06] Email discussion for maintenance on RAN2-led aspects in the Others section – Alexey (Intel)

* + 1st check point: February 25
  + Final check point: March 3

# Proposed Prioritization for Discussion

**FL observation:**

It is observed that

* + Many aspects are raised for RAN1 discussion under this AI
  + Some of the aspects are in scope of other WGs (RAN2/RAN3)
  + Some of the aspects were already discussed w/o consensus reached in the previous meeting
  + Some of the aspects seems to be more relevant to discussion under other AIs

## Round-1

Considering the above comments, it is recommended for round-1 to start/prioritize discussion on the following topics:

Topic #1 (Section #3): Aspects 1-4, 7, 8

Topic #2 (Section #4): Aspects 1-4

Interested companies are welcome to provide comments for other aspects non-prioritized for round-1 discussion.

# Topic #1 NR Positioning in RRC\_INACTIVE State

## Aspect 1: DL PRS Processing Window in RRC\_INACTIVE State

RAN4 has sent to RAN1 LS (R1-2200903) with the following question:

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| **Q1: Whether the PRS processing window defined for PRS measurements outside measurement gaps can be also applied for PRS measurements in RRC\_INACTIVE state?** |

The following views were expressed by companies related to this question

[vivo, [1]]

* + In inactive state, when time domain overlapping between PRS and other DL signals/channels occurs, UE is not expected to process PRS, including
    - When PRSs are within initial DL BWP and have the same SCS as initial BWP, UE is not expected to process PRS in the symbols/slots which are overlapping with other DL signals/channels.
    - When PRSs are allocated in different BW and/or have the same/different SCS as initial DL BWP, UE is not expected to process PRS in the symbols/slots which are overlapping with other signals/channels and the gap (0.5ms or 0.25ms before/after other signals/channels).
    - Note: The time domain occupation of PRS is determined by PRS symbol/slot occupancy considering the actual nr-DL-PRS-ExpectedRSTD, nr-DL-PRS-ExpectedRSTD-Uncertainty.
  + PRS processing window is not supported in inactive state.

[ZTE, [2]]:

* + The PRS processing window defined for PRS measurements outside measurement gaps is NOT applicable for PRS measurements in RRC\_INACTIVE state.

[Nokia, [6]]:

* + The direct reuse of the current PRS processing window may not support PRS measurement outside of the initial BWP of RRC\_INACTIVE UEs RAN1 needs further discussion.

[Intel, [7]]:

* + Send reply to LS from RAN4 WG (cc to RAN2) and clarify that
    - PRS processing window is not supported for PRS measurements in RRC\_INACTIVE state

[Samsung, [12]]

* + PRS processing window should be also applied for PRS measurements in RRC\_INACTIVE state.

[Qualcomm, [13]]

* + Our current understanding is that, RAN1 has not yet discussed the applicability of PRS processing window during RRC Inactive state, and therefore, without any further agreements, configuration of PRS processing window and corresponding PRS processing within the PRS processing window is only applicable to RRC Connected state.
  + In RRC inactive, at least for the purpose of signaling a period of time that a PRS can be prioritized over other DL channels, introducing a dedicated/explicit signaling for configuring or activating a PRS processing window is unnecessary, since we have already agreed that PRS shall be lower priority than any other channel.
  + We agree that there needs to be a description of the time intervals before/after the PRS resources that need to be conflict-free for the PRS to be processed in RRC inactive, and that there needs to be a clear understanding with regards to what is considered as “collision”. However, this does not mean that there is a need to make the RRC pre-configured & MAC-CE activated/deactivated PRS processing window feature applicable in RRC inactive state.

[LGE, [14]]

* + Without introducing a measurement window in RRC inactive state, gNB needs to transmit all of PRS configured by configuration and the PRS resources cannot be used for other DL signals/channels
    - Either the longer periodicity is set or the larger value of repetition factor is configured, the more power and resources are consumed.
  + RAN1 should adopt a time window where the positioning measurement is fulfilled for UEs in RRC inactive state.
  + Since the DRX cycle is totally not considered when gNB configures PRS processing window (PPW) for the UE, a different way of configuration for the positioning measurement window in RRC inactive state needs to be considered.
  + If RAN1 agrees to support positioning measurement window in RRC inactive state, RAN1 should consider not only suitable configuration/parameters considering DRX cycle.
  + If RAN1 agrees to support positioning measurement window in RRC inactive state, RAN1 should consider the following options for configuration of PRS measurement window in RRC inactive state and adopt one of them:
    - Option #1: Implicit way
      * gNB only needs to provide UE with the duration of PRS measurement window.
      * The measurement window starting position could be related to either paging occasion or SSB and then the periodicity follows the DRX cycle.
    - Option #2: Explicit way
      * Reuse the parameters for PRS processing window
      * Introducing minim gap
        + The apparatus that saves the UE power consumption at the UE
        + Used to indicate whether the UE can monitor PRS resources or not

### Round-1

**FL comment:**

From FL perspective, RAN1 needs to conclude on applicability of PRS processing window (PPW) for RRC\_INACTIVE UEs and inform other WGs

**Proposal 3.1-1**

* + **Send reply to LS from RAN4 WG (cc to RAN2) clarifying that**
    - **PRS processing window is not supported for PRS measurements in RRC\_INACTIVE state**

Comments from companies:

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| Company Name | Comments |
| Nokia/NSB | RAN1 already agreed to support PRS measurement outside of initial BWP, so we do not think direct reuse of the current PRS processing window does work. We need to support a modified PRS processing window or another window which can support PRS measurement considering RF switching time. |
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## Aspect 2: DL PRS and DRX in RRC\_INACTIVE State

[vivo, [1]]

* + Support the LMF to request inactive DRX configurations (e.g., DRX cycle, etc.) from the cells including UE serving cell and neighboring cells that may be reselected.

[Qualcomm, [13]]:

* + If the measurement period in RRC\_INACTIVE depends on the DRX cycle length, which is not known by the LMF, then the LMF may not be able to select an appropriate value for the response time in the location request.
  + If the DRX cycle is used in the measurement period in TS 38.331, then the LMF should be aware of that information to be able to set the response time accordingy.
  + Support LMF requesting the DRX parameters from the serving gNB of a UE.

[Lenovo, [15]]:

* + The serving gNB may provide the applicable UE’s DRX configuration to the LMF for adaptation the of the PRS measurement configuration. RAN3 to finalize the request and response signalling for UE’s DRX configuration.

### Round-1

**FL comment:**

The DRX related enhancements/issues seems to be more in scope of RAN2 / RAN3 WGs. This view was supported by many companies at RAN1#107e as captured in R1-2112571. Considering that RAN4 agreed to use DRX cycle parameters in the measurement period it seems worthwhile to discuss the aspect of LMF awareness about UE DRX cycle

**Proposal 3.2-1**

* **Discuss benefits and express RAN1 view on whether/if LMF can request the DRX parameters from the serving gNB of a UE**

Comments from companies:

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| Company Name | Comments |
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## Aspect 3: DL PRS Conflict Inside/Outside Initial DL BWP

[vivo, [1]]

* + In inactive state, when time domain overlapping between PRS and other DL signals/channels occurs, UE is not expected to process PRS, including
    - When PRSs are within initial DL BWP and have the same SCS as initial BWP, UE is not expected to process PRS in the symbols/slots which are overlapping with other DL signals/channels.
    - When PRSs are allocated in different BW and/or have the same/different SCS as initial DL BWP, UE is not expected to process PRS in the symbols/slots which are overlapping with other signals/channels and the gap (0.5ms or 0.25ms before/after other signals/channels).
    - Note: The time domain occupation of PRS is determined by PRS symbol/slot occupancy considering the actual nr-DL-PRS-ExpectedRSTD, nr-DL-PRS-ExpectedRSTD-Uncertainty.

[Xiaomi, [11]]:

* + One of two options is supported for conflict determination according to UE capability for PRS inside of the initial DL BWP:
    - O1: conflict is determined only when PRS overlapped in the symbols of DL signals/channels.
    - O2: conflict is determined when PRS is in a time window which starts from X1 symbols before DL signals/channels and ends after Y1 symbols of DL signals/channels.

[Xiaomi, [11]]:

* + For DL PRS outside of the initial DL BWP, conflict is determined when PRS is in a time window which starts from X2 symbols before DL signals/channels and ends after Y2 symbols of DL signals/channels.

[Samsung, [12]]

* + When the gap between DL PRS and other DL signals/channels is less than a threshold reported by UE, UE is not expect to measure DL PRS in this case.

[Samsung, [12]]

* + Text proposal for TS38.214 5.1.6.5 PRS reception procedure

***\*\*\* Unchanged text is omitted \*\*\****

***The UE in RRC\_INACTIVE mode is expected to prioritize the reception of any other DL signal than the reception of DL PRS when the gap between DL PRS and other DL signals/channels is less than a threshold.***

***\*\*\* Unchanged text is omitted \*\*\****

### Round-1

**FL comment:**

From FL understanding, it seems that discussion on DL PRS conflict determination was left up to RAN4 WG discussion / decision (please refer to agreements below).

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| **Agreement (RAN1#106-bis-e ):**  From RAN1 perspective, in RRC\_INACTIVE state, reception of DL PRS has lower priority than other DL signals/channels (SSB, SIB1, CORESET0, MSG2/MSGB, paging, DL SDT)   * + FFS how to determine conflicts in DL PRS and other DL signals/channels reception by UE   + FFS how to handle retuning time for the case when DL PRS and other DL signals/channels are allocated in different BW and/or have the same or different SCS as initial DL BWP   Send LS to RAN4 (cc RAN2) and ask if there is any feedback  **Agreement (RAN1#107)**  For UE in RRC\_INACTIVE state can support DL PRS processing outside and inside of the initial DL BWP:   * + For DL PRS processing outside of the initial DL BWP, the SCS, CP type of DL PRS can be the same or different as for the initial DL BWP   + For DL PRS processing inside of the initial DL BWP, the SCS, CP type of DL PRS is the same as for the initial DL BWP.   + Potential impact of retuning time and expected RSTD assistance information on DL PRS reception performance is up to RAN4   + UE capability(ies) will be defined for DL PRS processing in RRC\_INACTIVE state     - details are FFS   + Send an LS to RAN4 on agreed by RAN1 UE behavior for reception of DL PRS in RRC INACTIVE state   R1-2112741 [DRAFT] LS on DL PRS processing by UEs in RRC\_INACTIVE state Moderator (Intel Corporation)  Final LS endorsed in R1-2112742 |

**Proposal 3.3-1**

* **Discuss if additional RAN1 specification work is needed for DL PRS processing in RRC\_INACTIVE state**

Comments from companies:

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| Company Name | Comments |
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## Aspect 4: UE Capability / Modifications to the UE FGs

The following views were expressed on UE capability for NR positioning enhancements:

[Qualcomm, [13]]:

* + A per-band DL positioning capability should be defined for RRC inactive state, which includes at least
    - DL PRS processing capability in RRC inactive state (FG 27-6)
    - UE Rx-Tx measurement reporting (FG 27-18c)
    - DL RSTD measurement reporting (FG 27-18a)
    - RSRP measurement reporting (FG 27-18b)
    - Spatial Relation for positioning SRS in RRC Inactive (FG 27-19)

[Huawei, [17]]:

* + Make the following modification to the FGs.

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| **Features** | **Index** | **Feature group** | **Components** | **Omitted columns** | **Need for the gNB to know if the feature is supported** | **Note** | **Mandatory/Optional** |
| 27. NR\_pos\_enh | 27-6 | DL PRS processing capabilities in power efficiency mode | 1. DL PRS buffering capability  a) Type 1 – sub-slot/symbol level buffering  b) Type 2 – slot level buffering  2. Duration of DL PRS symbols N in units of ms a UE can process every T ms assuming maximum DL PRS bandwidth in MHz, which is supported and reported by UE  3. Max number of DL PRS resources that UE can process in a slot under it |  | No | Component 1 candidate values: {Type 1, Type 2}  Component 2 candidate values:  T: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms  N: {0.125, 0.25, 0.5, 1, 2, 4, 6, 8, 12, 16, 20, 25, 30, 32, 35, 40, 45, 50} ms  Component 3 candidate values:  FR1 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 15kHz, 30kHz, 60kHz  FR2 bands: {1, 2, 4, 6, 8, 12, 16, 24, 32, 48, 64} for each SCS: 60kHz, 120kHz | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-15 | Support of positioning SRS transmission in RRC\_INACTIVE state for initial BWP | 1. Max number of SRS Resource Sets for positioning supported by UE  2. Max number of [P/SP]SRS Resources for positioning  3. Max number of [P/SP]SRS Resources for positioning per slot  4. Max number of periodic SRS Resources for positioning  5. Max number of periodic SRS Resources for positioning per slot  Note: OLPC for SRS for positioning based on SSB from the last serving cell (the cell that releases UE from connection) is part of this FG. No dedicated capability signaling is intended for this component |  | Yes | Component 1 candidate values: {1, 2, 4, 8, 12, 16}  Component 2 candidate values: {1,2,4,8,16,32,64}  Component 3 candidate values: {1, 2, 3, 4, 5, 6, 8, 10, 12, 14}  Component 4 candidate values: {1,2,4,8,16,32,64}  Component 5 candidate values: {1, 2, 3, 4, 5, 6, 8, 10, 12, 14}  FFS: outside initial BWP | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-15a | Support of positioning SRS transmission in RRC\_INACTIVE state for initial BWP with semi-persistent SRS | 1. Max number of semi-persistent SRS Resources for positioning  2. Max number of semi-persistent SRS Resources for positioning per slot |  | Yes | Component 1 candidate values: {1,2,4,8,16,32,64}  Component 2 candidate values: {1, 2, 3, 4, 5, 6, 8, 10, 12, 14}  FFS: outside initial BWP | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-15b | Support of positioning SRS transmission in power efficiency mode for initial BWP | 1. Max number of SRS Resource Sets for positioning supported by UE  2. Max number of [P/SP]SRS Resources for positioning  3. Max number of periodic SRS Resources for positioning  Note: OLPC for SRS for positioning based on SSB from the last serving cell (the cell that releases UE from connection) is part of this FG. No dedicated capability signaling is intended for this component |  | No | Component 1 candidate values: {1, 2, 4, 8, 12, 16}  Component 2 candidate values: {1,2,4,8,16,32,64}  Component 3 candidate values: {1,2,4,8,16,32,64}  Need for location server to know if the feature is supported  FFS: outside initial BWP | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-15c | Support of positioning SRS transmission in power efficiency mode for initial BWP with semi-persistent SRS | 1. Max number of semi-persistent SRS Resources for positioning |  | No | Component 1 candidate values: {1,2,4,8,16,32,64}  Need for location server to know if the feature is supported  FFS: outside initial BWP | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-16 | OLPC for positioning SRS in RRC\_INACTIVE state | Same as  RRC  OLPC-SRS-Pos-r16 |  | Yes |  | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-16a | OLPC for positioning SRS in power efficiency mode | Same as  LPP  OLPC-SRS-Pos-r16 |  | No | Need for location server to know if the feature is supported. |  |
| 27. NR\_pos\_enh | 27-18a | Support of PRS measurement in power efficiency mode for DL-TDOA | Support of PRS measurement in power efficiency mode for DL-TDOA |  | No | Need for location server to know if the feature is supported.  Note: Applicable for both UE-assisted and UE-based DL-TDOA  Note: PRS capabilities for DL-TDOA measurement and reporting described in FGs in 13-3, 13-3a, 13-3b, 13-6, 13-13 are the same for power efficiency mode. | Optional with capability signaling. |
| 27. NR\_pos\_enh | 27-18b | Support of PRS measurement in power efficiency mode for DL-AoD | Support of PRS measurement in power efficiency mode for DL-AoD |  | No | Need for location server to know if the feature is supported.  Note: Applicable for both UE-assisted and UE-based DL-AoD  Note: PRS capabilities for DL-AOD measurement and reporting described in FGs 13-2, 13-2a, 13-2b, 13-5, 13-13 are the same for power efficiency mode. | Optional with capability signaling. |
| 27. NR\_pos\_enh | 27-18c | Support of PRS measurement in power efficiency mode for Multi-RTT | 1. Support of PRS measurement in power efficiency mode for Multi-RTT  2. Support of positioning SRS transmission in power efficiency mode |  | No | Need for location server to know if the feature is supported.  Note: PRS capabilities for Multi-RTT measurement and reporting described in FGs in 13-4, 13-4a, 13-4b, 13-11, 13-11a, 13-14 are the same for power efficiency mode | Optional with capability signaling. |
| 27. NR\_pos\_enh | 27-19 | Spatial relation for positioning SRS in RRC\_INACTIVE state | Same as  *RRC*  *SpatialRelationsSRS-Pos-r16* |  | Yes |  | Optional with capability signalling |
| 27. NR\_pos\_enh | 27-19a | Spatial relation for positioning SRS in power efficiency mode | Same as  *LPP*  *SpatialRelationsSRS-Pos-r16* |  | No | Need for location server to know if the feature is supported. | Optional with capability signalling |

### Round-1

**FL comment:**

The UE capability discussion is ongoing under AI 8.16.5. From FL perspective, it is better to have single thread for capability discussion in dedicated AI 8.16.5. This aspect can be considered if other essential opens are resolved in coordination with discussion on UE features.

Companies are invited to provide comments on whether FGs should be discussed under AI 8.5.6 or 8.16.5

Comments from companies:

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| Company Name | Comments |
| Nokia/NSB | We are okay to discuss this in this AI or 8.16.5.  We prefer to keep RRC\_INACTIVE as RAN1 agreements were about positioning support for RRC\_INACTIVE UEs. |
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## Aspect 5: DL PRS Reception Procedure (Normal / On-demand)

[Samsung, [12]]

* + After UE receiving the end time of DL PRS transmission, the UE will stop measuring on-demand PRS and the PRS configuration will fallback to normal PRS to perform subsequent PRS measurements.

[Samsung, [12]]

* + When UE expects to receive normal PRS and on-demand PRS at the same time, the least common multiple of these PRS periodicities can be used to derive the measurement period of PRS measurement.

### Round-1

**FL comments:**

It seems there is no mechanism to differentiate DL PRS type (on-demand or normal) at UE.

Comments from companies:

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| Company Name | Comments |
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## Aspect 6: Measurement Reporting in RRC\_INACTIVE State

[Nokia, [6]]:

* + For the UE-assisted positioning for RRC\_Inactive state, the UE informs LMF if the LMF is able to jointly utilize the current positioning measurements with the previously reported positioning measurements.

### Round-1

**FL comments:**

Proposal requires additional input and possibly has typo inside. Proponents are asked to further clarify issues and formulate proposed solution more precisely

Companies are invited to express their views

Comments from companies:

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| Company Name | Comments |
| Nokia/NSB | Sorry if our proposal was unclear. We tried to clarify our suggestion as follows.  Modified proposal: The UE may report an indicator along with positioning measurements, where the indicator informs LMF of if it is possible for LMF to jointly utilize positioning measurements reported across multiple reporting instances for the location estimation.  From this feature, the LMF may be able to use measurements reported across different reporting instances when it performs location estimation algorithm such as LS. In RRC\_INACTIVE, the reporting overhead is limited and the UE could be static, so it may be necessary for the UE to report partial measurements for a part of all TRPs at each reporting instance. If the UE has not moved, the UE can inform the LMF that the partial measurements reported across different reporting instances can be jointly used for location estimation. |
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## Aspect 7: Location and BW of SRS for Positioning

[Qualcomm, [13]]:

* + The SRS for Positioning during RRC Inactive state, is associated with a BWP IE where the {locationAndBandwidth, SCS, CP} are defined in the same way as a legacy BWP.
    - Note: This means that the SRS-POS-only BWP shall be at the same CC as the initial UL BWP.

[Qualcomm, [13]]:

* + In TDD scenarios, further clarification is needed with regards to the DL BWP associate with the SRS-POS-Only UL BWP. Pick one of the following 2 options:
    - Option 1: In RRC Inactive, when SRS is configured associated to an UL non-initial BWP, an associated DL BWP is assumed to be configured also inheriting the legacy BWP restrictions.
    - Option 2: The DL-BWP of a SRS-POS-only BWP should always be the initial DL BWP.
  + Note: In that case, it would have to be explicitly clarified whether the center frequency of the SRS-POS-only BWP of the initial DL BWP (paired DL WP) need to be the same, or it can be different.

[Qualcomm, [13]]:

* + For the SRS configuration with dedicated non-initial BWP in RRC Inactive (SRS-Only BWP), A UE should be able to report whether:
    - Different numerology between the SRS-only BWP and the initial UL BWP is supported.
    - SRS operation without restriction on the BW is supported: BW of the SRS-only BWP may not include BW of the CORESET#0 and SSB
  + Based on other signalled UE capabilities, the UE supports at least one connected mode configuration where a hypothetical BWP defined by this SRS is the active BWP and switching between this active BWP and the initial BWP is supported.
  + Support reporting the capability of supporting SRS configuration outside initial BWP in a “per-band” fashion.

### Round-1

**FL comments:**

At the previous meeting RAN1 concluded on two options for SRS for positioning configuration/transmission by UEs in RRC\_INACTIVE state

It seems additional details for Option 2 need to be concluded to finalize the work

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| * The following options are supported for SRS for positioning transmission by RRC\_INACTIVE UEs:   + Option 1:     - Subject to UE capability (which is a prerequisite for option 2), a UE may be configured with an SRS for Positioning associated with the initial UL BWP and transmitted, during the RRC\_INACTIVE state, inside the initial UL BWP with the same CP and SCS as configured for initial UL BWP.   + Option 2:     - Subject to UE capability, a UE may be configured with an SRS for Positioning where the following parameters are additionally configured for the transmission of the SRS for Positioning during the RRC\_INACTIVE state: frequency location and bandwidth, SCS, CP length.       * The UE shall not transmit the SRS for Positioning when it is expected to perform UL transmissions in the initial UL BWP in RRC\_INACTIVE state |

**Proposal 7.1-1**

**For Option 2 of SRS for positioning configuration,**

* + **SRS for positioning allocation in frequency is determined by initial UL BWP IE and using corresponding LocationAndBandwidth IE**
  + **In TDD scenarios, SRS for positioning BWP should always be within the initial DL BWP**
  + **A UE should be able to indicate:**
    - **Support of different numerology between the SRS for positioning and the initial UL BWP**
    - **Whether bandwidth of SRS for positioning may not include bandwidth of the CORESET#0 and SSB**

Comments from companies:

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| Company Name | Comments |
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## Aspect 8: Switching Time b/w SRS Tx and other Tx in BWP#0

[Samsung, [12]]:

* + UE can transmit the SRS for positioning if the gap between UL transmission and UL SRS is larger than T subject to UE capability.

[Samsung, [12]]:

* + Text proposal for TS38.214 6.2.1.4 UE sounding procedure for positioning purposes

***\*\*\* Unchanged text is omitted \*\*\****

***Subject to UE capability, the UE may be configured with an SRS resource for positioning associated with the initial UL BWP, and the SRS resource is transmitted inside the initial UL BWP during RRC\_INACTIVE mode with the same CP and numerology as configured for the initial UL BWP. Subject to UE capability, the UE may be configured with an SRS resource for positioning including frequency location and bandwidth, numerology, and CP length for transmission of the SRS in RRC\_INACTIVE mode. The UE shall not transmit the SRS for positioning not associated with the initial UL BWP ~~when it is expected to perform UL transmissions~~ when the gap between UL transmission and UL SRS is less than T reported by UE in the initial UL BWP in RRC\_INACTIVE mode.***

***\*\*\* Unchanged text is omitted \*\*\****

[Huawei, [17]]:

* + Reusing BWP switching for SRS transmission outside the initial BWP interrupts UL more than necessary.
  + For SRS transmission outside initial BWP, introduce a UE capability on switching between SRS Tx and other Tx in BWP#0.
    - The capability is reported per band, and take the IE SRS-SwitchingTimeNR defined in TS 38.331.
    - If the transmission of SRS including the switching period results in the collision with other DL reception or UL transmission, the SRS transmission is dropped.

[Huawei, [17]]:

* + Introduce the following FGs for support of SRS transmission outside initial BWP.

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| 27. NR\_pos\_enh | 27-15d | Support of positioning SRS transmission in RRC\_INACTIVE state outside initial BWP | 1. SRS switching time (DL and UL)  2. Supported numerology for SRS  3. SRS bandwidth  4. SRS bandwidth with initial DL BWP | 27-15 | Yes | Component 1 candidate values: {0us, 30us, 100us, 140us, 200us, 300us, 500us, 900us} for DL and UL, respectively  Component 2 candidate values: {sameAsInitialUL-BWP, sameAsOrDifferentFromInitialUL-BWP}  Component 3 candidate values: bitmap to indicate support of { 5MHz, 10MHz, 15MHz, 20MHz, 25MHz, 30MHz, 40MHz, 45MHz, 50MHz, 60MHz, 70MHz, 80MHz, 90MHz, 100MHz}.  Component 4 candidate values: {srsBW-ContainsIntialDL-BWP, noRestriction} | Optional with capability signaling |
| 27. NR\_pos\_enh | 27-15e | Support of positioning SRS transmission in power efficiency mode outside initial BWP | SRS bandwidth | 27-15b | No | Candidate values: bitmap to indicate support of { 5MHz, 10MHz, 15MHz, 20MHz, 25MHz, 30MHz, 40MHz, 45MHz, 50MHz, 60MHz, 70MHz, 80MHz, 90MHz, 100MHz}.  Need for location server to know if the feature is supported | Optional with capability signaling |

### Round-1

**FL comments:**

* + Details of SRS for positioning transmission for Option 2 need to be finalized
  + Companies are invited to express views on the next proposal

**Proposal 8.1-1**

* + **For Option 2 of SRS for positioning transmission, a UE capability on switching between SRS Tx and other Tx in initial UL BWP is introduced**
    - **The capability is reported per band and the IE SRS-SwitchingTimeNR defined in TS 38.331 is applied**
    - **If the transmission of SRS including the switching period results in the collision with other DL reception or UL transmission, the SRS for positioning transmission is dropped**

Comments from companies:

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| Company Name | Comments |
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## Aspect 9: SRS Beam Sweeping in RRC\_INACTIVE State

[vivo, [1]]:

* + If enabling SRS beam sweeping is enabled in inactive state, the following benefit will be obtained
    - the reliability of SRS transmission in inactive state will be increased since the problem of spatial relationship failure that causes SRS transmission to stop will not exist
    - the additional measurement for validation determination will be no longer needed, which is beneficial to power consumption and complexity.
  + Support to enable SRS beam sweeping in inactive state.
    - Additional indicator in SRS configuration to enable SRS beam sweeping in inactive state is needed.
  + Adopt the following TP to enable SRS beam sweeping in inactive state.

|  |
| --- |
| TS 38.214, section 6.2.1.4  < Unchanged parts are omitted >  If the UE is not configured with the higher layer parameter *spatialRelationInfoPos* the UE may use a fixed spatial domain transmission filter for transmissions of the SRS configured by the higher layer parameter *SRS-PosResource* across multiple SRS resources or it may use a different spatial domain transmission filter across multiple SRS resources.  If the UE is not configured with the higher layer parameter *spatialRelationInfoPos* but configured with the higher layer parameter ‘*srsBeamSweeping*’ in RRC\_INACTIVE state SRS configuration, it is expected to use a different spatial domain transmission filter across multiple SRS resources in RRC\_INACTIVE.  < Unchanged parts are omitted > |

### Round-1

**FL comments:**

From FL understanding, the SRS beam sweeping in RRC\_INACTIVE state still can be used by UE implementation, if the *spatialRelationInfoPos* is not configured. Current TP seems require additional RAN1 agreements before implementation.

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
| Nokia/NSB | In our understanding, it is up to the UE implementation if the UE is not configured with *spatialRelationInfoPos.* It may not be necessary to introduce additional higher layer signalling to enable beam sweeping especially for the RRC\_INACTIVE UEs. |
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## Aspect 10: SRS for Positioning Configuration

[CATT, [4]]:

* + Support the following additional SRS-Pos configuration methods for UL positioning in RRC\_INACTIVE state:
    - UE obtains the SRS-Pos configuration information through the paging message.
    - Introducing a new RACH procedure for UE to obtain the SRS-Pos configuration information.

[Ericsson, [16]]:

* + The UE can be configured with SRS in RRC\_INACTIVE by listing in the RRC release message the applicable SRS resource sets / resource IDs currently configured SRS in RRC\_CONNECTED to be kept in RRC\_INACTIVE

[Ericsson, [16]]:

* + When the SRS has been originally configured in connected mode, the bandwidth parameters can be configured to fallback to a predetermined value if the configured bandwidth when the UE moves to RRC\_INACTIVE.
    - The predetermined value could be indicated via capability signalling
      * FFS: additional parameters beside bandwidth

### Round-1

**FL comments:**

For RRC\_INACTIVE state, methods and remaining details of SRS for positioning configuration are in scope of RAN2 WG. Proponents are encouraged to discuss additional solutions directly in RAN2.

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
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|  |  |
|  |  |
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|  |  |

## Aspect 11: LS to RAN2 on SRS-PosResourceSet

[Qualcomm, [13]]:

* + Send an LS to RAN2 to remind the RAN1 agreement that only SRS-PosResourceSet can be used in the RRC Inactive.
    - If, using SRS-Config in the SetupRelease is more appropriate from signaling & RAN2 perspective, the field description of srs-PosRRCInactiveConfig could clarify that “SRS for positioning configuration during RRC Inactive State is happening with the SRS-PosResourceSet IE.”

### Round-1

**FL comments:**

RAN1 LS was sent in R1-2112846. Seems no further action is needed.

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
| Nokia/NSB | We share the similar view with FL. |
|  |  |
|  |  |
|  |  |
|  |  |

## Aspect 12: LMF and UE RRC State

[Qualcomm, [13]]:

* + Support LMF sending to the serving gNB an assumed state related to a UE location request.
    - Note: The actual RRC state is determined by UE/gNB and the LMF is not aware, nor controls the UE RRC state.

[Lenovo, [15]]:

* + In light of RAN4’s agreement on DRX cycle measurements in RRC\_INACTIVE, RAN1 to recommend that the LMF be aware of the UE’s RRC State. Note: This does not imply that the LMF may control the UE’s RRC state.

### Round-1

**FL comments:**

Discussion on LMF signaling related to UE RRC state is in RAN2 scope. Proponents are encouraged to bring related proposals in RAN2.

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
|  |  |
|  |  |
|  |  |
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|  |  |

## Aspect 13: UL Positioning in RRC\_IDLE State

[CAICT, [10]]:

* + For UL positioning in RRC\_IDLE state, to trigger the UL positioning SRS transmission, a new paging message or a new random access process need to be specified.

### Round-1

**FL comments:**

Enhancements to support UL Positioning in RRC\_IDLE state is out of WI scope.

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
| Nokia/NS | It is out of scope in this release. |
|  |  |
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|  |  |

# Topic #2 NR Positioning in RRC\_INACTIVE State

In this section TPs, based on existing RAN1 agreements are summarized.

## Aspect 1: TP on Pathloss Validity and UE Behavior

[ZTE, [2]]:

* + Adopt the following TP for 38.213

|  |
| --- |
| ---- Unchanged texts omitted ----  7.3 Sounding reference signals  For SRS, a UE splits a linear value of the transmit power on active UL BWP of carrier of serving cell equally across the configured antenna ports for SRS. For UE in RRC \_INACTIVE state, active UL BWP b denotes the bandwidth of the SRS transmission. 7.3.1 UE behaviour <Unchanged parts are omitted>  If the UE is in the RRC\_CONNECTED state and determines that the UE is not able to accurately measure , рor the UE is not provided with *pathlossReferenceRS-Pos*, the UE calculates using a RS resource obtained from the SS/PBCH block of the serving cell that the UE uses to obtain *MIB.* If the UE is in the RRC\_INACTIVE state and determines that the UE is not able to accurately measure , the UE does not transmit the SRS resource set for positioning.  ---- Unchanged texts omitted ---- |

### Round-1

**FL comments:**

It seems that changes on UE behavior are aligned with the RAN1 agreement.

The change on “active UL BWP b” seems require more discussion considering different SRS configuration options inside and outside BWP

**Proposal 4.1-1**

* + **Discuss and adopt text proposal provided in section 4.1**

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
| Nokia/NSB | We are generally okay with this TP. |
|  |  |
|  |  |
|  |  |
|  |  |

## Aspect 2: TP on Spatial Relation Behaviour in RRC\_INACTIVE State

[CMCC, [8]]:

* + Adopt the following TP.

|  |
| --- |
| <omitted text>  If the UE in RRC\_INACTIVE state determines that the UE is not able to accurately measure the configured DL RS in *SRS-SpatialRelationInfoPos* for a SRS resource for positioning where the DL RS is semi-persistent or periodic, the UE stops transmission of the SRS resource for positioning  <omitted text> |

### Round-1

**FL comments:**

It seems to be a useful correction, as it clarifies that described UE behavior is applicable to RRC\_INACATIVE state.

**Proposal 4.2-1**

* + **Discuss and adopt text proposal provided in section 4.2**

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
| Nokia/NSB | Support TP. |
|  |  |
|  |  |
|  |  |
|  |  |

## Aspect 3: TP for DL PRS Reception

[CATT, [4]]:

* + Adopt the following TP for the reception of DL PRS:

|  |
| --- |
| ----------------Start of TP for TS38.214--------------------- 5.1.6.5 PRS reception procedure ……  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.  ……  ----------------End of TP for TS38.214--------------------- |

### Round-1

**FL comments:**

Assuming that “DL signals” can be interpreted as DL transmissions, it seems proposed change is not essential. On the other hand, the proposed wording matches to RAN1 agreement. Companies are welcome to express their views.

**Proposal 4.3-1**

* + **Discuss and adopt text proposal provided in section 4.3**

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
| Nokia/NSB | We think DL signals includes DL reference signals and channels. |
|  |  |
|  |  |
|  |  |
|  |  |

## Aspect 4: TP SRS for Positioning in RRC\_INACTIVE State

[OPPO, [3]]:

* + In order to ensure the consistency between RAN1 spec and RAN2 spec, change “RRC\_INACTIVE mode” to “RRC\_INACTIVE”.
  + Rearrange the following paragraph to ensure that the reception of DL PRS for UE in RRC\_INACTIVE is subject to UE capability.
    - The UE in RRC\_INACTIVE mode is expected to prioritize the reception of any other DL signal than the reception of DL PRS.
  + Modified the description on SRS resource(s) for positioning to ensure the consistency within TS 38.214.
    - an SRS resource for positioning -> an SRS resource configured by the higher layer parameter SRS-PosResource
  + Adopt the following TP for the draft CR.

|  |
| --- |
| **TP (based on draft CR[6])**  **Section 5.1.6.5**  ~~The UE in RRC\_INACTIVE mode is expected to prioritize the reception of any other DL signal than the reception of DL PRS.~~  The UE in RRC\_INACTIVE ~~mode~~, subject to UE capability, is expected to process DL PRS outside and inside of the initial DL BWP. The UE may be configured with the same or different numerology and CP for PRS resources than those of the initial DL BWP for DL PRS processing outside of the initial DL BWP. The UE may be configured with the same numerology and CP for PRS resources as those of the initial DL BWP for DL PRS processing inside of the initial DL BWP. The UE in RRC\_INACTIVE is expected to prioritize the reception of any other DL signal than the reception of DL PRS.  **Section 6.2.1.4**  When the SRS is configured by the higher layer parameter *SRS-PosResource* and if the higher layer parameter *spatialRelationInfoPos* is configured*,* it contains the ID of the configuration fields of a reference RS according to Clause 6.3.2 of [TS 38.331]. The reference RS can be an SRS configured by the higher layer parameter *SRS-Resource* or *SRS-PosResource*, CSI-RS, SS/PBCH block, or a DL PRS configured on a serving cell or a SS/PBCH block or a DL PRS configured on a non-serving cell. If the UE is configured for transmission of SRS resource(s) configured by the higher layer parameter *SRS-PosResource* in RRC\_INACTIVE ~~mode~~, the configured *spatialRelationInfoPos* is also applicable.  …  Subject to UE capability, the UE may be configured with an SRS resource by the higher layer parameter *SRS-PosResource* ~~for positioning~~ associated with the initial UL BWP, and the SRS resource is transmitted inside the initial UL BWP during RRC\_INACTIVE ~~mode~~ with the same CP and numerology as configured for the initial UL BWP. Subject to UE capability, the UE may be configured with an SRS resource by the higher layer parameter *SRS-PosResource* ~~for positioning~~ including frequency location and bandwidth, numerology, and CP length for transmission of the SRS in RRC\_INACTIVE ~~mode~~. The UE shall not transmit the SRS ~~for positioning~~ not associated with the initial UL BWP when it is expected to perform UL transmissions in the initial UL BWP in RRC\_INACTIVE ~~mode~~.  If the UE determines that the UE is not able to accurately measure the configured DL RS in *SRS-SpatialRelationInfoPos* for ~~a~~ an SRS resource ~~for positioning~~ configured by the higher layer parameter *SRS-PosResource* where the DL RS is semi-persistent or periodic, the UE stops transmission of the SRS resource ~~for positioning~~ |

### Round-1

**FL comments:**

It seems proposed changes are not essential/critical rather editorial in nature. Not sure if proposed corrections are really needed.

**Proposal 4.1-1**

* + **Discuss the necessity of the proposed modifications for the TP provided in section 4.4**

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
| Nokia/NSB | Not needed. |
|  |  |
|  |  |
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|  |  |

# Topic #3 On-demand DL PRS Support

## Aspect 1: On-demand DL PRS Parameters

[vivo, [1]]

* + Support the following list of parameters for UE-initiated on-demand DL PRS request
    - Number of TRPs
    - Beam related information
      * Beam related information should be an expected angle range
  + Support the following list of parameters for LMF-initiated on-demand DL PRS request
    - Indicator of TRPs
    - Indicator of frequency layers or DL PRS PointA information
    - Beam related information
    - DL PRS Muting Option 1/2

[vivo, [1]]

* + Support two options for indication of beam related information, either
    - Option 1: per resource per resource set per positioning frequency layer per FR
      * UE recommends a beam information
    - Option 2: per resource per resource set per positioning frequency layer per FR
      * UE requests to provide the beam information in the assistance data

[vivo, [1]]:

* + Support the ON/OFF indicator of the on-demand PRS in the following granularity: per frequency layer, per TRP, per resource set and per resource.

[vivo, [1]]:

* + Support the request of explicit parameters at least for UE-initiated on-demand DL-PRS.

[ZTE, [2]]:

* + On-demand DL-PRS request should include the preferred transmission time window within which DL PRS is transmitted
    - The time window parameters at least include window length

[China Telecom, [5]]:

* + Rel-17 should support the following parameters for UE-initiated and LMF initiated on-demand DL PRS:
    - Number of TRPs
    - Beam direction.

[Nokia, [6]]:

* + RAN1 to support PRS processing outside of MG indicator as an additional parameter for UE-initiated on-demand DL PRS request.

[CMCC, [8]]:

* + The following list of parameters is supported for UE-initiated and/or LMF initiated on-demand DL PRS request:
    - Number of DL PRS resources per DL PRS resource set;
    - Number of TRP (UE-initiated only).
  + For UE-initiated on-demand DL PRS, the following signaling granularity is supported:
    - Number of DL PRS resources per DL PRS resource set is per resource set.
    - Number of TRP is per PFL.
  + For LMF-initiated on-demand DL PRS, signaling granularity of number of DL PRS resources per DL PRS resource set is per resource set.

[CAICT, [10]]:

* + The information of TRPs and Beam directions may be useful for on demand PRS configuration.

[Lenovo, [15]]:

* + Support TRP Priority order/indications as part of UE-initiated On-demand PRS.

### Round-1

**FL comments:**

Many of proposed on-demand parameters were discussed at the previous meeting. There was no consensus to introduce them. It seems there is no essential/critical issue.

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
| Nokia/NSB | We support PRS processing outside of MG indicator as an additional parameter for UE-initiated on-demand DL PRS request |
|  |  |
|  |  |
|  |  |
|  |  |

## Aspect 2: On-demand Measurement Gap

[vivo, [1]]:

* + Support to introduce on-demand measurement gap for on-demand PRS in Rel-17.
    - LMF requests on-demand measurement gap should be supported.

[vivo, [1]]:

* + The on-demand measurement gap can be requested and configured along with the on-demand DL PRS.
  + The on-demand measurement gap can be requested along with the request of on-demand DL PRS.
  + The on-demand measurement gap can be configured after gNB receives the request of on-demand DL PRS.

[China Telecom, [5]]:

* + Rel-17 should support the on-demand MG for on-demand DL PRS measurement.

### Round-1

**FL comments:**

The similar set of proposals was made at the previous meeting (please refer to R1-2112571) and inputs provided there. Proponents are encouraged to clarify why the existing MG framework is not sufficient.

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
|  |  |
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|  |  |
|  |  |
|  |  |

## Aspect 3: On-demand DL PRS and Interference Handling

[vivo, [1]]:

* + Interference caused by on-demand PRS to regular UEs should be considered and solved by RAN1.
  + To solve the interference caused by on-demand PRS to regular UEs, support switching off certain PRS resources for regular UEs.
    - PRS resource level muting can be considered.
    - Note: It is not to completely switch off the PRS resources, but to allow the transmission of these PRS resources based on regular PRS configuration
  + To solve the interference caused by on-demand PRS to regular UEs, support indicating on-demand PRS configuration to regular UEs and corresponding serving gNB.

### Round-1

**FL comments:**

There is no differentiation in terms of on-demand or normal DL PRS transmission. It seems proposed changes are optimizations rather than essential corrections.

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

## Aspect 4: Priority of On-demand DL PRS

[vivo, [1]]:

* + The priority of on-demand DL PRS and normal PRS should be considered (motivation is priority of UE measurements)

### Round-1

**FL comments:**

It seems there is no mechanism for UE to differentiate DL PRS types (on-demand or normal). It seems there is no need for further Rel.17 specification work on this aspect.

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

## Aspect 5: DL Measurements for On-demand DL PRS

[CATT, [4]]:

* + For UE-initiated on-demand DL PRS, the UE may provide the following information to the gNB and/or LMF when the UE sends an on-demand PRS request to the LMF:
    - DL measurements available in UE, which may include SS-RSRP, CSI-RSRP, etc., measured from the serving gNB and neighboring gNBs.

[CATT, [4]]:

* + For LMF-initiated on-demand DL PRS, the LMF may request UE to provide the following information to the LMF before LMF sends an on-demand PRS request to the gNBs:
    - DL measurements available in UE, which may include SS-RSRP, CSI-RSRP, etc., measured from the serving gNB and neighboring gNBs.

[CATT, [4]]:

* + When a serving gNB sends the response to LMF-initiated on-demand DL PRS for a UE, the serving gNB may provide the following information to the LMF in addition to the allocated DL PRS resources for supporting the on-demand DL PRS:
    - DL measurements reported by the UE if available at the serving gNB, which may include SS-RSRP, CSI-RSRP, etc., measured from the DL RS of serving gNB and neighboring gNBs;
    - UL measurements related to the UE if available at the gNB, which may include SRS-RSRP, etc., measured by the serving gNB.

### Round-1

**FL comments:**

It seems to be an optimization with impact on higher layer protocols. It was presented at the previous meeting(s) without converged view from companies. It seems proposal is not an essential correction that resolves critical issue in NR positioning operation.

Comments from companies:

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| --- | --- |
| Company Name | Comments |
|  |  |
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|  |  |
|  |  |

## Aspect 6: On-demand DL PRS Request for Subset of Parameters

[InterDigital, [9]]:

* + The on-demand PRS configurations/parameters received by UE in dedicated signalling (e.g. LPP assistance data) or via posSIB are not exhaustive and may correspond to only a subset of PRS configurations/parameters allowed and/or supported by network
  + For UE-initiated on-demand PRS, RAN1 defines different sets of on-demand PRS parameters that are allowed to be requested by UE in on-demand PRS.
  + The UE can send on-demand PRS to request for PRS configuration or PRS parameters, irrespective of whether the requested PRS configuration/parameter are available via dedicated LPP signalling or posSIB or found to be valid/invalid as per any validity conditions.

### Round-1

**FL comments:**

It seems discussion on request for subset of on-demand DL PRS parameters is up to RAN2.

Comments from companies:

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| --- | --- |
| Company Name | Comments |
|  |  |
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|  |  |
|  |  |

## Aspect 7: On-demand DL PRS request and QCL info

[Ericsson, [16]]:

* + In the PRS on-demand request from the UE, the dl-PRS-QCL-Info can only be for the PRS resource/resource set, and an SSB cannot be requested as a source.

### Round-1

**FL comments:**

It seems agreement for on-demand DL PRS QCL Info was made w/o restriction of QCL reference sources to DL PRS only and by default implies both references. It seems there is no critical issue to keep both DL PRS and SSB in UE-initiated DL PRS request as QCL information is under gNB control.

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
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|  |  |
|  |  |

Conclusions

In this document, we have provided overview of the contributions submitted to RAN1#108e for R17 NR positioning maintenance for RRC\_INACTIVE UEs and on-demand DL PRS framework.

References

1. R1-2201098 Maintenance on inactive state positioning and on-demand PRS vivo
2. R1-2201198 Remaining issues on items led by RAN2 for NR positioning ZTE
3. R1-2201244 Discussion on positioning for UE in RRC\_INACTIVE and on-demand PRS OPPO
4. R1-2201366 Remaining issues on on-demand DL PRS and positioning for UEs in RRC\_ INACTIVE state CATT
5. R1-2201440 Discussion on remaining issue for on-demand DL PRS China Telecom
6. R1-2201639 Maintenance of Inactive Mode Positioning and on-demand PRS Nokia, Nokia Shanghai Bell
7. R1-2201701 Maintenance of Rel.17 NR positioning solutions for RRC\_INACTIVE UEs Intel Corporation
8. R1-2201860 Remaining issues on RAN2-led items CMCC
9. R1-2201891 Remaining issues for on-demand PRS InterDigital, Inc.
10. R1-2201910 Discussion on enhancements of INACTIVE mode positioning and on-demand PRS CAICT
11. R1-2201949 Remaining issues on positioning for UE in RRC\_INACTIVE state Xiaomi
12. R1-2202019 Discussion on on demand positioning and positioning in inactive state Samsung
13. R1-2202145 Maintenance on enhancements Related to On Demand PRS And Positioning in RRC Inactive State Qualcomm Incorporated
14. R1-2202295 Discussion on other enhancements for positioning LG Electronics
15. R1-2202372 On-Demand PRS and RRC\_INACTIVE Positioning Maintenance Lenovo, Motorola Mobility
16. R1-2202394 Further details for on-demand PRS reception and SRS in RRC\_INACTIVE Ericsson
17. R1-2202421 Maintenance of RRC\_INACTIVE state positioning Huawei, HiSilicon