**3GPP TSG RAN WG1 #107 R1-2112571**

**e-Meeting, November 11th – 19th, 2021**

**Source: Moderator (Intel Corporation)**

**Title: Feature Lead Summary#3 for E-mail Discussion
[107-e-NR-ePos-06]**

**Agenda item:** **8.5.6**

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

# Introduction

In this contribution, we provide overview of contributions [1]-[20] on NR-Positioning in RRC\_INACTIVE state and on-demand DL PRS support. In each section, we formulate tentative proposals for RAN WG1 discussion and decision, and capture views provided by companies during RAN1 e-mail discussion [107-e-NR-ePos-06]:

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| [107-e-NR-ePos-06] Email discussion/approval on RAN2-led aspects in the Others section with checkpoints for agreements on November 15 and 19 – Alexey (Intel) |

# Proposed Priority Order for Discussion

Companies are invited to provide views on all discussion aspects. Proposed priorities for upcoming GTW discussions are indicated in this section.

## Round #1-3

### NR Positioning in RRC\_INACTIVE State

It is proposed to prioritize discussion on the following aspects in the 1st round of discussion

* Aspect #1: DL PRS relationship with BWP#0
* Aspect #2: Validity criteria for SRS for positioning
* Aspect #3: Configuration of SRS for positioning
* Aspect #4: Relationship with DRX

### On demand DL PRS

It is proposed to prioritize discussion on the following aspects in the 1st round of discussion

* Aspect #1: On demand DL PRS parameters
* Aspect #2: Signaling granularity for on-demand DL PRS parameters

NR Positioning in RRC\_INACTIVE State

The following list of design aspects / enhancements was identified based on submitted contributions for NR positioning support by RRC\_INACTIVE UEs

## Aspect #1: DL PRS relationship with BWP0 (Resolved)

The following views were expressed by companies in terms of DL PRS and SRS for positioning relationship with initial DL/UL BWPs for RRC\_INACTIVE UEs.

* [ZTE, [1]]
	+ During SDT active period, SRS for positioning is transmitted only if the SRS bandwidth, SCS and CP type are aligned with the active UL BWP for SDT.
	+ For UE in RRC\_INACTIVE state, support DL PRS processing outside and inside the initial DL BWP and the SCS of DL PRS is the same or different with the initial DL BWP.
* [vivo, [2]]
	+ In inactive state, UE can process DL PRS outside and inside the initial DL BWP and the SCS of DL PRS is the same or different with the initial DL BWP.
	+ 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, up to UE buffering capability (symbol/slot level buffering capability), UE is not expected to process PRS in the symbols/slots which are overlapping with other DL signals/channels.
		- When PRS are allocated in different BW and/or have the same/different SCS as initial DL BWP, up to UE buffering capability (symbol/slot level buffering capability), 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.
		- It is up to RAN4 to consider the impact of measurement period requirement when conflicts in DL PRS and other DL signals/channels occur.
* [OPPO, [4]]
	+ When the DL PRS and other DL signals/channels are allocated in different BW and/or have the same or different SCS as initial DL BWP, Rel-17 supports a guard/transient period for UE to return between the reception of PRS and the reception of other DL signals/channels.
		- The value of guard/transient period is defined by RAN4
	+ When the DL PRS and other DL signals/channels are allocated in different BW and/or have the same or different SCS as initial DL BWP, the collision occurs once the gap between this measurement window and other DL signals/channels is less than the above-mentioned guard/transient period.
		- The above measurement window depends on the configuration of PRS, nr-DL-PRS-ExpectedRSTD and nr-DL-PRS-ExpectedRSTD-Uncertainty.
* [Intel, [7]]
	+ UE in RRC\_INACTIVE state supports DL PRS processing outside and inside the initial DL BWP and the SCS of DL PRS is the same or different with the initial DL BWP
		- FFS details of UE capability signaling
		- Note: further discussion may be needed in RAN4 with regards to the potential gaps between the DL BWP and the DL PRS when the bandwidth and SCS are different
* [Xiaomi, [8]]
	+ UE in RRC\_INACTIVE state supports DL PRS processing outside and inside the initial DL BWP and the SCS of DL PRS is the same or different with the initial DL BWP.
	+ One of two options is supported for conflict determination according to UE capability:
		- Option 1: conflict is determined only when DL signals/channels in the PRS symbols.
		- Option 2: conflict is determined when DL signals/channels in any symbols inside the PRS processing window.
* [Apple, [14]]
	+ A UE in RRC\_INACTIVE is not expected to receive DL PRS within a time window, that covers any RF tuning interruption, *nr-DL-PRS-ExpectedRSTD*, and *nr-DL-PRS-ExpectedRSTD-Uncertainty*, in which time window other DL signals/channels are expected to be received.
* [Ericsson, [19]]
	+ (for conclusion) no enhancements are necessary for the determination of conflict between DL PRS and other DL signals.
	+ Send an LS to RAN4 regarding reception of PRS in RRC INACTIVE and the impact of retuning time on PRS reception performance.

### Round #1

**Proposal 3.1-1 (DL PRS and initial DL BWP)**

* Subject to UE capability, UE in RRC\_INACTIVE state can support DL PRS processing outside and inside of the initial DL BWP
	+ SCS, CP type of DL PRS can be the same or different with the initial DL BWP
	+ Note: UE capability signaling details are to be discussed under UE feature AI
* Potential impact of retuning time and expected RSTD assistance information on DL PRS reception performance is up to RAN4
* Send an LS to RAN4 on agreed by RAN1 UE behavior for reception of DL PRS in RRC INACTIVE state

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
| ZTE | Support. The LS should also CC to RAN2.  |
| Qualcomm | Does the above mean that there will be a basic capability that only “inside the initial BWP” RRC inactive PRS processing is supported? If yes, then we also support this “additional capability signaling”. However, if we only have the above capability, it would mean that there would not be a way for a UE to report that only inside-BWP PRS processing is supported. So we make the following proposal:* *Subject to UE capabilities, UE in RRC\_INACTIVE state can support DL PRS processing inside-only, or both outside and inside of the initial DL BWP*
	+ *For PRS processing outside the DL BWP, SCS, CP type of DL PRS can be the same or different with the initial DL BWP*

*Note: UE capability signaling details are to be discussed under UE feature AI* |
| CATT | Qualcomm’s modification is fine to us. |
| ZTE2 | Don’t agree with QC’s change. The original FL proposal is to agree the proposal itself and further discuss UE feature (we are also fine to discuss in this section considering very high workload in Ralf’s session). However, it seems QC prefers two separate UE capabilities for RRC\_INACTIVE state which should be a separate discussion. In our view, one capability is quite enough to report to gNB rather than LMF in order to align with RAN2’s design. These issues can be the next step discussion. Here is our suggestion:* Subject to UE capability, UE in RRC\_INACTIVE state can support DL PRS processing outside and inside of the initial DL BWP
	+ SCS, CP type of DL PRS can be the same or different with the initial DL BWP
	+ FFS: UE capability signaling details ~~are to be discussed under UE feature AI,~~ e.g. *support DL PRS processing inside-only, or both outside and inside of the initial DL BWP*
* Potential impact of retuning time and expected RSTD assistance information on DL PRS reception performance is up to RAN4
* Send an LS to RAN4 on agreed by RAN1 UE behavior for reception of DL PRS in RRC INACTIVE state
 |
| OPPO | Support QC’s version which is clearer |
| vivo | We are fine with the QC version.In addition, to FL, will the FFS not be addressed by RAN1? It may be RAN1 related which will have impact on TS38214. For example, it is still not clear whether UE can process PRS in the symbols/slots which are overlapping with other DL signals/channels if PRS has lower priority.Agreement:* 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
 |
| Intel  | Support, OK with QC’s version  |
| Huawei, HiSilicon | Do not support the separate capabilities for inside BWP#0 and outside BWP#0. In our understanding, measurement of PRS outside BWP#0 should be the basic feature for supporting RRC\_INACTIVE state. Otherwise, UE may need to decide the priority between PRS measurement and inter-frequency cell reselection, which should not be considered. |
| Xiaomi | We are fine with QC’s version |
| CMCC | Support. |
| SONY | Support QC’s version |

### Round #2

Based on received responses, it is proposed to continue discussion on the following revised proposal

**Proposal 3.1-2 (DL PRS and initial DL BWP)**

* Select one of the following alternatives
	+ Alt.1:
		- Subject to UE capability, UE in RRC\_INACTIVE state can support DL PRS processing outside and inside of the initial DL BWP
	+ Alt.2:
		- Subject to UE capability, UE in RRC\_INACTIVE state can support DL PRS processing inside of the initial DL BWP
		- Subject to UE capability, UE in RRC\_INACTIVE state can support DL PRS processing inside and outside 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
* Send an LS to RAN4 on agreed by RAN1 UE behavior for reception of DL PRS in RRC INACTIVE state

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
| Qualcomm | Alt. 2.  |
| Nokia/NSB | We are supportive of Alt2.  |
| Apple | Alt2 |
| Ericsson | Support alt1. We should not fragment the RRC\_INACTIVE feature with too many capabilities.  |
| Futurewei | Alt 1 |
| vivo | Alt 2 |
| CATT | Alt 1 is preferred. |
| NTT DOCOMO | Alt.1 |
| Huawei, HiSilicon | Alt.1Alt.2 is problematic in the sense that restriction on PRS measurement or cell reselection procedure in RRC\_INACTIVE state will be in place for UE only supports PRS measurement in BWP#0. We have strong concern over Alt.2. |
| OPPO | Alt.2 |
| CMCC | Prefer Alt. 1. |
| ZTE | Alt.1 RAN2 has made several agreements that RRC state has no impact on PRS configuration as below, also LMF is not aware of RRC state. So it is suitable that the UE capability is reported to gNB instead of LMF. As gNB is not aware of PRS configuration, there is no need to differentiate PRS capability outside and inside intial BWP. Agreement:* Proposal 1 (modified): The PRS configuration from LMF to UE is independent of the RRC state. That is, no impact on PRS configuration for RRC\_INACTIVE (13/15) from RAN2 perspective.
 |

## Aspect #2: Validity criteria for SRS for positioning

This section provides summary of views on validity criteria of SRS for positioning transmission by RRC\_INACTIVE UEs:

* [ZTE, [1]]
	+ For both OLPC and spatial relation of SRS for positioning transmission in RRC\_INACTIVE state, Reuse validity criteria defined for RRC\_CONNECTED UE in Rel.16
		- UE fall back behavior is not specified
* [vivo, [2]]
	+ The validity criteria for SRS configuration in inactive state should be considered, at least following validity criteria can be considered:
		- UE is in the valid predefined area, e.g. the cell where RRC release containing SRS configuration is received
		- UE has valid TA
		- UE has valid power control RS
		- UE has valid spatial relation RS
	+ For SRS power control in inactive state, support to reuse the fallback behavior of OLPC mechanism in connected state, including:
		- If the UE determines that the UE is not able to accurately measure the pre-configured pathloss RS, the UE calculates pathloss using a RS resource obtained from the SS/PBCH block of the cell that the UE uses to obtain MIB, e.g. MIB of the camping cell.
	+ If spatial relation RS is configured for SRS transmission in inactive state, the following validity criteria for spatial relation RS validation can be considered.
		- Reuse criteria of RSRP based TA validation.
		- Reuse criteria of accurately pathloss RS measurement: if the UE determines that the UE is not able to accurately measure the pre-configured spatial relation RS, the spatial relation RS will not be valid.
	+ The fallback behavior should be considered when the validity criteria for SRS configuration in inactive state is not met, including:
		- Entering connected state to perform UL positioning or indicate event causing validity criteria not met and request/update the SRS configuration; or remaining in inactive state to indicate event causing validity criteria not met and request/update the SRS configuration
		- Both UE and gNBs release previous SRS configuration applied in inactive state
* [CATT, [3]]
	+ For OLPC of SRS in RRC\_INACTIVE state, fallback behavior for pathloss measurement defined for RRC\_CONNECTED Ues in Rel.16 could be supported, e.g., the UE calculates pathloss using the SSB from which the UE obtains MIB.
	+ The same validity criteria should be applied to both OLPC and spatial relation of SRS.
* [Nokia, [5]]
	+ RAN1 to discuss validity criteria to determine whether the configured spatial relation RS for a SRS resource is valid or not.
	+ RAN1 to discuss the UE behavior of RRC\_Inactive state when the UE determines that both path-loss RS and spatial relation RS configured for a SRS resource, which are transmitted from neighbor cells, are invalid.
* [Sony, [6]]
	+ As part of the validation scheme when the UE can transmit SRS for positioning in RRC\_INACTIVE state, support the following:
		- The UE can transmit SRS for positioning when the UE is still camp to the same cell or a pre-configured group of cells (This can also be discussed in RAN2).
		- The UE has valid spatial relation RS.
* [Xiaomi, [8]]
	+ Reuse validity criteria for OLPC pathloss measurement to determine whether spatial relation with configured RS is valid. If not valid, obtain new SRS configuration by entering RRC RRC\_CONNECTED state or by SDT mechanism in RRC\_INACTIVE state.
* [Quectel, [9]]
	+ If SS/PBCH is not included in the pathloss reference signal and with the pre-configured pathloss RS, the UE is not able to calculate pathloss accurately, UE should measure SS/PBCH received to obtain MIB for pathloss to determine the SRS validity.
	+ For spatial relation of SRS for positioning transmission by RRC\_INACTIVE Ues, OLPC pathloss measurement cannot be used to determine whether spatial relation with configured RS is valid.
		- If a UE OLPC pathloss measurement results show that the SRS configuration is invalid, the spatial reference signal associated with SRS is possible to be invalidate for the camping cell of the UE changes.
		- If a UE OLPC pathloss measurement results show that the SRS configuration is valid, the UE can further measure the spatial reference signal associated with SRS to verify its validity
* [CMCC, [10]]
	+ For transmission of UL SRS for positioning by Ues in RRC\_inactive state, support to reuse the validation criteria of SDT.
	+ Support defining a validation rule including a validation area.
* [Huawei, [15]]
	+ UE will suspend transmission of the corresponding SRS resource set and SRS resource if the pathloss reference RS and spatial relation RS cannot be detected, respectively.
* [Samsung, [12]]
	+ For UL positioning in RRC inactive state, if the camping cell is changed, whether the SRS configuration is assumed valid can be further discussed.
* [InterDigital,[13]]
	+ Support validity criteria for SRS for positioning by RRC INACTIVE UE to include at least TA timer, pathloss measurement and spatial relation with other RS
	+ Support indication from UE to gNB (e.g. in MAC CE) for requesting for a new SRSp configuration if the validity criteria is not satisfied
* [Ericsson, [19]]
	+ Reuse the fallback ignalin for OLPC parameters for the SRS for positioning in RRC\_INACTIVE
	+ For spatial relation validation of the SRS for positioning, the UE validates the spatial relation if it is able to receive the reference signal used for spatial relation.
	+ If the spatial relation provided for an SRS for positioning is not validated, the SRS is not transmitted.
* [Fraunhofer, [20]]
	+ Define a validity criteria of an SRS configuration including spatial relation by one or more of the following mechanisms:
		- Validity signaled to the UE as a list of cells
		- Validity of SRS configuration associated with outcome of DL-PRS measurements
		- SRS configuration split into common and UE-specific configuration, the SRS configuration is considered a valid configuration if the UE-specific part is received in a camped cell, while in inactive mode.

**Summary**

Companies have expressed diverse views on validity criteria for SRS for positioning transmission by RRC\_INACTIVE Ues. Given that RAN1 has agreed to reuse OLPC and spatial relation frameworks from RRC\_CONNECTED Ues, it seems fair to discuss validity criteria and UE fallback behaviours for at least these functionalities. Other validity criterias can be determined by RAN2.

The validity criteria for OLPC of SRS for positioning was a part of the following RAN1 agreement.

|  |
| --- |
| **Agreement:*** For OLPC of SRS for positioning transmission by RRC\_INACTIVE Ues,
	+ Reuse validity criteria for pathloss measurement defined for RRC\_CONNECTED Ues in Rel.16
		- FFS: UE fallback behavior (i.e. whether to reuse fallback to pathloss measurement by RRC\_INACTIVE UE for the cell, from which the SS/PBCH is received to obtain MIB, is not accurate)
* For spatial relation of SRS for positioning transmission by RRC\_INACTIVE Ues,
	+ FFS: Whether to define validity criteria or reuse validity criteria for OLPC pathloss measurement to determine whether spatial relation with configured RS is valid
 |

### Round #1

Based on review of contributions, the following is proposed to facilitate further discussion in RAN1:

**Proposal 3.2-1A**

* For OLPC validity criteria of SRS for positioning transmission by RRC\_INACTIVE Ues,
	+ The following UE behavior for RRC\_CONNECTED Ues is reused from Rel.16:
		- “If the UE determines that the UE is not able to accurately measure $PL\_{b,f,c}\left(q\_{d}\right)$, or the UE is not provided with *pathlossReferenceRS-Pos*, the UE calculates $PL\_{b,f,c}\left(q\_{d}\right)$ using a RS resource obtained from the SS/PBCH block of the serving cell that the UE uses to obtain *MIB*”
	+ If the UE determines that the UE is not able to accurately measure pathloss using SS/PBCH block of the serving cell that the UE uses to obtain *MIB,* then the UE suspends transmission of SRS for positioning
	+ Send LS to RAN2 to inform them on RAN1 decision

**Proposal 3.2-1B**

* For spatial relation of SRS for positioning transmission by RRC\_INACTIVE Ues,
	+ Select one of the following alternatives as validity criteria for the RS used for spatial relation
		- Alt.1: the UE validates if it is able to receive/detect the reference signal used for spatial relation
		- Alt.2: validity criteria for pathloss measurement(OLPC) is reused to determine validity of spatial relation with configured RS
		- Alt.3: validity criteria for spatial relation is not defined
	+ If the UE determines that the UE is not able to meet validity criteria for spatial relation the UE suspends transmission of SRS for positioning
	+ Send LS to RAN2 to inform them on RAN1 decision

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
| ZTE | 1A: Is the serving cell same as the one when UE is in RRC connected state? Why doesn’t UE use a RS resource obtained from any one SS/PBCH block which correspond the strongest receive power? 1B: what is the main difference between Alt 1 and Alt 2?  |
| Nokia/NSB | For 3.2-1A, we do not support this proposal. Our understanding for the proposal is that the UE would keep transmitting the SRS resources even if the UE is not able to accurately measure the pathloss reference RS transmitted from the neighbour cells. If this UE ignaling needs to be acceptable, we think at least the UE should determine the appropriate beam direction for transmission of a SRS resource so that the SRS transmission may not lead to interference. It is related to the validity of the spatial relation RS. For 3.2-1B, we need to define the validity criteria for the spatial relation RS.  |
| CATT | We are fine to reuse the fallback behaviour for OLPC parameters for the SRS for positioning in RRC\_INACTIVE. But, the UE should not transmit corresponding SRS resource set and SRS resource if the spatial relation RS cannot be detected to minimize the interference. |
| OPPO | 1A: Not support. The default behaviour is used in RRC connected state. There is no reason it cannot used for the RRC INACTIVE state1B: Alt.3. Same comments for Alt.2 as in 1A. For Alt.1, UE don’t need to always measurement the RS of spatial relation in some cases, e.g., aperiodic RS is used for the spatial relation.  |
| vivo | In general, we are okay with 3.2-1A if the validity of both the spatial relation RS and OLPC are definedFor 1B, we suggest modifying Alt 1 as follows, and we share a similar view with ZTE that the Alt 2 is unclear.* + Select one of the following alternatives as validity criteria for the RS used for spatial relation
		- Alt.1: ~~the UE validates if it is able to receive/detect~~ If the UE determines that the UE is not able to accurately measure the reference signal used for spatial relation

To ZTE1A: we think the SS/PBCH block that the UE uses to obtain MIB is UE chosen based on the RSRP, maybe we can remove “serving” to address your concernTo OPPOWithout validity criteria, the periodic SRS will always be transmitted and inference other services, which may unreasonable. And we want to confirm which case use aperiodic signals as reference signals |
| Huawei, HiSilicon | For the sake of simicity, we do not support introduce the fallback behaviour as the CONNECTED state for either OLPC and spatial relation. |
| Xiaomi | We are fine with proposal 3.2-1A. while for Proposal 3.2-1B, we prefer Alt 1 of vivo’s version for clearer. |
| CMCC | To our understanding, defining fallback behaviour is to ensure that even under some conditions that some configurations cannot be met / are not trustworthy, the UE can still transmit SRS in a fallback way. Therefore, the second main bullets for both 1A and 1B are weird to us. |
| Nokia/NSB | The views from each company look diverging. We would suggest discussing the following high-level proposal to make a consensus on this issue. Proposal: * If a UE in RRC\_Inactive state determines a configured SRS resource for positioning is invalid, the UE suspends transmission of the SRS resource for positioning.
	+ The validation criterion is based on validity of path-loss RS, spatial relation RS and/or TA.
 |
| InterDigital | Support Proposal 3.2-1B. Our preference is Alt. 1. |
| Ericsson | 1A is ok for us. For 1B, alt1 is OK.  |
| Fraunhofer | We are not supportive of introducing the fallback behaviour for the inactive state. The UE in inactive state shall suspend SRS transmission if the validity criteria does not hold. |

**Summary**

Expressed views are very diverse:

* For OLPC of SRS for positioning in RRC\_INACTIVE state
	+ Reuse validity criteria and UE fallback behavior for OLPC of SRS for positioning in RRC\_INACTIVE state
		- Supported: by CATT, OPPO, vivo, Xiaomi, CMCC, InterDigital, Ericsson
	+ Do not define UE fallback behavior for OLPC of SRS for positioning in RRC\_INACTIVE state
		- Supported by: Huawei/HiSilicon, Fraunhofer, Nokia
* For SRS for positioning spatial relation in RRC\_INACTIVE state
	+ Define validity criteria and UE fallback behavior for spatial relation in RRC\_INACTIVE state
		- Supported by vivo, Xiaomi, CMCC, Ericsson
	+ Do not define validity criteria and UE fallback behavior for spatial relation in RRC\_INACTIVE state
		- Supported by OPPO, Huawei/HiSilicon, Fraunhofer, Nokia

### Round #2

Based on review of contributions, the following is proposed to facilitate further discussion in RAN1:

**Proposal 3.2-2A**

* For OLPC of SRS for positioning by RRC\_INACTIVE UEs,
	+ Alt.1: The following UE behavior defined for RRC\_CONNECTED UEs is reused from Rel.16:
		- “If the UE determines that the UE is not able to accurately measure $PL\_{b,f,c}\left(q\_{d}\right)$, or the UE is not provided with *pathlossReferenceRS-Pos*, the UE calculates $PL\_{b,f,c}\left(q\_{d}\right)$ using a RS resource obtained from the SS/PBCH block of the serving cell that the UE uses to obtain *MIB*”
	+ Alt.2: The following new UE behavior is introduced:
		- If the UE determines that the UE is not able to accurately measure pathloss for pathloss reference RS, UE stops SRS for positioning transmission

**Proposal 3.2-2B**

* For spatial relation of SRS for positioning by RRC\_INACTIVE UEs,
	+ Validity criteria for pathloss measurement (OLPC) is reused to determine validity of spatial relation for configured RS
	+ If the UE determines that the UE is not able to meet the above validity criteria for spatial relation then the UE stops transmission of SRS for positioning

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
| Nokia/NSB | For Alt.2, a further clarification would be necessary to clarify that it does not mean the UE stops transmission of all of the configured SRS resources. In case of Alt.1, our understanding is that the UE keep transmitting SRS resources although it fails to accurately detect the pathloss RS especially from the neighbor cells. It leads to interference signals. If the UE needs to keep transmitting SRS, at least the beam direction should be appropriate, and simply using the serving cell SSB is not an desirable way. In our understanding, the main purpose of this discussion is not to define fallback path-loss RS to support continuous SRS transmission but to define when the configured SRS is not valid. In case that we need to support that the UE keeps transmitting the SRS, we think joint consideration of path-loss RS and spatial relation RS is necessary to guarantee the beam direction, such as the following modified proposal. * + Alt.1-1:“If the UE determines that the UE is not able to accurately measure the pathloss RS from a cell/TRP the UE calculates the pathloss using a spatial relation RS transmitted from the cell/TRP.

If we go with this way, we think the proposal 3.2-2B would be necessary to define the validity of the configured SRS resources. If the beam direction is not appropriately decided by the UE, we are supportive of Alt.2 |
| Huawei, HiSilicon | 2A: Alt.2 as first preference, Alt.1 as second preference.2B: Support. |
| vivo | For proposal 3.2-2A, we think the fallback machine Alt 1 is helpful for the moving UE especially when the UE is moving in an indoor or InF, and a sub-bullet for invalidity is missed * + Alt.1: The following UE behavior defined for RRC\_CONNECTED UEs is reused from Rel.16:
		- “If the UE determines that the UE is not able to accurately measure $PL\_{b,f,c}\left(q\_{d}\right)$, or the UE is not provided with pathlossReferenceRS-Pos, the UE calculates $PL\_{b,f,c}\left(q\_{d}\right)$ using a RS resource obtained from the SS/PBCH block of the serving cell that the UE uses to obtain MIB”
		- If the UE determines that the UE is not able to accurately measure pathloss using SS/PBCH block of the ~~serving~~ cell that the UE uses to obtain MIB, then the UE suspends transmission of SRS for positioning

For proposal 3.2-2B, the validity criteria is unclear for us, we think the specific validity criteria need to be added. So, we prefer to add the description of validity rules as follows* + If the UE determines that the UE is not able to accurately measure the RS used for spatial relation, the RS used for spatial relation will not be valid
 |
| OPPO | 2A: we tend to support Alt.2 2B: we are general ok but suggest to add a bullet to ensure the reference RS is periodic RS. If it is aperiodic RS, UE only have one-shot reception. * For spatial relation of SRS for positioning by RRC\_INACTIVE UEs,
	+ The reference RS in spatial relation is a periodic RS
	+ Validity criteria for pathloss measurement (OLPC) is reused to determine validity of spatial relation for configured RS
	+ If the UE determines that the UE is not able to accurately measure the reference RS of meet the above validity criteria for spatial relation then the UE stops transmission of SRS for positioning
 |
| CMCC | No objections, but want to get some more views on “stop SRS transmission” if the validation rule is not met. Why not let the UE to entre the connected mode to request/get updated SRS configurations?  |
| ZTE | 2A: support Alt.2, we can also accept the revision fron vivo2B: support. |
| SONY | 2A: Okay with Alt.22B: Support  |
| Ericsson | OK for Alt1 in 2A, but Alt2 could work too. OK with 2B. To CMCC: This kind of procedure is normally in RAN2’s hands.  |
| vivo2 | 2A: Alt.1 as first preference, can be compromised as Alt.2 if the majority supports |

**Summary**

For proposal 3.2-2, based on responses received in the previous round, it seems majority of companies prefer Alt.2 and therefore it can be proposed to facilitate further discussion in RAN1.

### Round #3

During GTW session RAN1 agreed on validity criteria and UE behavior for spatial relation and SRS for positioning transmission. The remaining aspect to be resolved relates to OLPC.

Based on responses received in the previous round, it seems majority prefer Alt.2 and therefore it is proposed to facilitate further discussion in RAN1.

**Proposal 3.2-3**

* For OLPC of SRS for positioning by RRC\_INACTIVE UEs, the following UE behaviour is used
	+ If the UE determines that it is not able to accurately measure pathloss for pathloss reference RS, UE stops SRS for positioning transmission

Comments from companies:

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| --- | --- |
| Company Name | Comments |
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## Aspect #3: Configuration of SRS for positioning

Companies supporting SRS for positioning transmission by RRC\_INACTIVE Ues have also discussed potential options for configuration of SRS for positioning. The following views were expressed:

* [CATT, [3]]
	+ Support the following three SRS-Pos configuration methods for UL positioning in RRC\_INACTIVE state:
		- UE keeps the SRS-Pos configuration information obtained in RRC\_CONNECTED 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
* [Sony, [6]]
	+ When the UE is in RRC\_CONNECTED state, the UE receives the configuration of SRS positioning to be used in RRC\_INACTIVE state (e.g., using the SRS-PosResourceSet IE).
	+ The configuration of SRS positioning can contain the activation for a UE to transmit periodic SRS positioning when the UE is in RRC\_INACTIVE state.
* [Intel, [7]]
	+ RAN1 assumes that SRS for positioning for Ues in RRC\_INACTIVE state can be configured using the SRS-PosResourceSet IE
* [Ericsson, [19]]
	+ 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
	+ When the UE SRS has been originally configured in connected mode, the bandwith 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 ignaling
			* FFS: additional parameters beside bandwidth

**Summary**

Companies have expressed diverse views on configuration of SRS for positioning for RRC\_INACTIVE Ues. From FL perspective, configuration signaling mechanisms for SRS for positioning transmission can be directly discussed by RAN2. From RAN1 perspective, it may need to be confirmed that RRC Ies for SRS for positioning configuration can be reused.

### Round #1

Based on review of contributions the following is proposed to facilitate further discussion:

**Proposal 3.3-1**

* RAN1 assumes that SRS for positioning for Ues in RRC\_INACTIVE state is configured using the *SRS-PosResourceSet* IE
* In addition, the following parameters are used for SRS for positioning configuration (similar to BWP):
	+ Location and bandwidth
	+ Subcarrier spacing
	+ Cyclic prefix

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
| ZTE | We are fine in principle. However, it is better to clarify what ‘location’ is. Is it the reference point for the first PRB of SRS? |
| Nokia/NSB | The first bullet is okay to us. We would like to ask proponent the necessity of the 2nd bullet. |
| Qualcomm | We think SRS needs to be configured within the BWP-UldedicatedConfig, and should not have a separate SCS/CP. Also note, that RAN1 sent to RAN2 the following: In other words, there is no other BWP except the initial BWP, and this LS was sent in response to the WA from RAN2. Therefore, we do not want to add the additional parameters and this topic needs to be revisited.  |
| Lenovo, Motorola Mobility | Generally fine with proposal, whereby the first bullet will anyway be confirmed by RAN2.  |
| CATT | The first bullet is okay to us. From the previous agreement: “For RRC\_INACTIVE Ues, SRS for positioning bandwidth, SCS and CP type are configured by RRC and can be different from that of initial UL BWP configured by the system information.” It seems the parameters of the second bullet are already included in the previous agreement, except the “location”. |
| ZTE2 | This issue can also be handled by RAN2  |
| OPPO | If we understand correctly, the intention of this proposal is to reuse the same parameters as that in *SRS-PosResourceSet* IE to configure the SRS and use some additional new parameters. However, the new RRC configuration of SRS for RRC INACTIVE state and existing *SRS-PosResourceSet* IE may not be in the same parent IEs. Thus, suggest to modify the 1st bullet as below* RAN1 assumes that SRS for positioning for Ues in RRC\_INACTIVE state is configured using the same parameters as that in the existing *SRS-PosResourceSet* IE

For the 2nd bullet, we share the similar view as CATT. But we are open to keep it here.  |
| Vivo | We would like to ask the majority whether the BWP of UL SRS is the same as SDT. Furthermore, should we follow the conclusion as RA SDT or CG SDT and reverse our previous agreement?  |
| Huawei, HiSilicon | We think that configuring a dedicated BWP for SRS in RRC\_INACTIVE should be sufficient. RAN2 can handle whether the BWP can be a CG BWP. |
| CMCC | Prefer up to RAN2. |
| SONY | Support the first bullet point, the second bullet is unclear. Location, Does it mean time/frequency resources? Can it be more precised? |
| Qualcomm | We support reversing the previous agreement since it was made under the assumption of a agreement in RAN2, while Ran1 SDT was still discussing this topic. RAN2 reverting their progresagreements and yesterday agreed that:RAN2 changes the agreements and as a baseline we will focus on initial BWP for RA and CG SDT.  FFS if further work on CG SDT for non-initial BWP will be needed, based on RAN1 consensus.  |
| InterDigital | We are ok with the first bullet. It is fine to agree on this from the RAN1 perspective. |

### Round #2

Based on received responses, it is proposed to continue discussion on the following revised proposal

**Proposal 3.3-2**

* RAN1 assumes that
	+ SRS for positioning for UEs in RRC\_INACTIVE state is configured using the *SRS-PosResourceSet* IE
* Select one of the following alternatives for SRS for positioning transmission by RRC\_INACTIVE UEs
	+ Alt.1:
		- When SRS for positioning bandwidth, SCS and CP type are different from that of initial UL BWP, the dedicated UL BWP for SRS for positioning is configured by RRC using the following parameters applicable for SRS for positioning
			* Frequency location and bandwidth
			* Subcarrier spacing
			* Cyclic prefix
	+ Alt.2:
		- SRS for positioning is transmitted only within initial UL BWP
		- This reverts the following agreement made at RAN1#106bis-e

|  |
| --- |
| **Agreement:**For RRC\_INACTIVE UEs, SRS for positioning bandwidth, SCS and CP type are configured by RRC and can be different from that of initial UL BWP configured by the system information |

* Send LS to RAN2 to define signaling for SRS for positioning configuration for RRC\_INACTIVE UEs

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
| Qualcomm | Alt. 2Our understanding on the status:* RAN2 made initially an agreement that there can be a separate BWP beyond the initial BWP, and sent an LS to RAN1
* The fact that this agreement existed was used as an argument in the previous meeting for agreeing that “SRS” can have separete SCS/CP from the initial BWP.
* On the same meeting, RAn1, in the SDT session, replied that :

* Then, in this meeting (yesterday), RAN2 reverted their agreement.

RAN2 changes the agreements and as a baseline we will focus on initial BWP for RA and CG SDT.  FFS if further work on CG SDT for non-initial BWP will be needed, based on RAN1 consensus. * Positioning WI should respect the RAN1/RAn2 status and not confuse the situation further. We believe tha there should not be a separate BWP, nor transmissions outside BWP.
 |
| Nokia/NSB | We are okay with this proposal. |
| Apple | We share similar view as HW/HiSi and CMCC (up to RAN2). But we can live with Alt2 |
| Huawei, HiSilicon | We support Alt.1.For DL PRS reception, this can already be done outside the initial DL BWP, there should be no reason why SRS cannot, especially when we already made this agreement.In Rel-16, there is also priority handling between positioning SRS transmission and PUSCH transmission, which can also be reused also for INACTIVE state.The RF retuning issue for DL can be applied to UL. |
| vivo | OK with this proposal. We can wait for a clear conclusion from SDT regarding using of non-initial BWP, or introduce a separate BWP for positioning only then select one of Alt 1 and Alt2 in the next meeting. |
| CATT | OK with this proposal. We prefer Alt. 1.  |
| NTT DOCOMO | Considering the current situation, we slightly prefer Alt.2. |
| OPPO | Consdiering RAN2 latest progress, we prefer Alt.2. We are also open to leave it to RAN2 |
| ZTE | We support Alt.1Positioning in RRC\_INACTIVE is not equal to positioning in SDT active period. Especially in RRC\_INACTIVE state without SDT transmission, UE does nothing for UL transmission other than positioning SRS, it is unnecessary to tie SRS with intial BWP. Considering the situation, it is safer to list two alternatives and let RAN2 does the final selection.  |
| SONY | Support. We prefer Alt.1 |
| Ericsson | We support alt.1, with the understanding that the SRS will be dropped if needed to access the UL initial BWP.  |
|  |  |

### Round #3

Based on discussion during GTW call the following was captured in chair notes:

|  |
| --- |
| Continue discussion based on Alt 1 clarifying:* How SRS for positioning is used outside an SDT and within an SDT
* Potential UE capability
 |

From FL perspective the following options can be further discussed as a middle ground

* Alt.1 can be used only if UE is not configured with SDT in initial UL BWP
* Alt.2 is used only if UE is configured with SDT in initial UL BWP

Therefore it is suggested to further discuss the following revision of the previous proposal:

**Proposal 3.3-3**

* The following options are supported for SRS for positioning transmission by RRC\_INACTIVE UEs:
	+ Option 1:
		- SRS for positioning is configured by RRC using the following parameters for SRS for positioning (frequency location and bandwidth, subcarrier spacing, cyclic prefix)
	+ Option 2:
		- SRS for positioning is transmitted only within initial UL BWP with the same CP and SCS as configured for initial UL BWP
* Option 1 can be used only if UE is not configured with SDT in initial UL BWP
* Option 2 is used only if UE is configured with SDT in initial UL BWP
* RAN1 assumes that
	+ SRS for positioning for UEs in RRC\_INACTIVE state is configured using the *SRS-PosResourceSet* IE
* Send LS to RAN2 to define signaling for SRS for positioning configuration for RRC\_INACTIVE UEs

Comments from companies:

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| --- | --- |
| Company Name | Comments |
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## Aspect #4: Relationship with DRX

The following views were expressed with respect to UE DRX and NR positioning in RRC\_INACTIVE state

* [vivo, [2]]
	+ In inactive state, the impact of PRS measurement on inactive DRX configuration should be minimized.
		- E.g. UE is expected to measure PRS once in an inactive DRX cycle.
* [Huawei, [15]]
	+ Support indication of PRS processing window to the UE for PRS measurement in RRC\_INACTIVE, and the period of the PRS processing window is aligned with the RAN paging DRX cycle.
* [LGE, [16]] On DL PRS reception
	+ Regarding DL positioning for UEs in RRC\_INACTIVE state, RAN1 should support PRS reception considering DRX cycle, and the following options can be studied.
		- Option 1: UE always measures PRS within preconfigured duration periodically after every paging occasion
		- Option 2: UE obtains some information related with time window for DL PRS reception through paging and then UE measure PRSs within the configured window dynamically
	+ If paging is used for NRPP message (such as measurement request) and UE monitors every PRS resources that are in adjacent PO, it causes larger power consumption for UE.
* [LGE, [16]] On SRS for positioning transmission
	+ RAN1 should support a time window (or occasion) of SRS transmission for UE power saving when periodic SRS is supported for UE in RRC\_INACTITVE
	+ If UE can transmit SRS without going to deep sleep after Paging Occasion (PO), UE saves its power to go to sleep and wake up again
	+ RAN1 should support SRS transmission considering DRX cycle (including related procedure and signaling)
* [Lenovo, Motorola Mobility,[18]]
	+ RAN1 to consider the DL-PRS configuration impact on measurement accuracy in RRC\_INACTIVE state. FFS solutions to address this gap, e.g., separate DL-PRS configurations for RRC\_INACTIVE UEs, sharing of the UE DRX configuration with the LMF for optimal RRC\_INACTIVE measurements, etc.

**Summary**

From FL perspective, the DRX impact on specification, if any, for DL PRS reception or SRS for positioning transmission by RRC\_INACTIVE UEs, can be directly discussed in RAN2. Feedback from companies is invited.

### Round #1

**Proposal 3.4-1**

* Impact of DRX on NR positioning in RRC\_INACTIVE state is up to RAN2
* Companies are invited to provide comments on impact of DRX on RAN1 specifications for DL PRS reception or SRS for positioning transmission by RRC\_INACTIVE UEs

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
| ZTE | This is completely RAN2 issue. We noticed some similar discussion was under RAN2 email ‘Summary of [Post115-e][608][POS] PRS configuration and measurement in RRC\_INACTIVE’. So we don’t think RAN1 should take this.  |
| Nokia/NSB | WE think this issue needs to be discussed in RAN2, so we are okay to make a conclusion with the first bullet.  |
| Lenovo, Motorola Mobility | Ok with proposal, however the measurement behaviour during a DRX cycle should be concluded in RAN1. |
| CATT | It would be better to consider the DL PRS reception in RRC\_INACTIVE state to be separate from the existing DRX cycles. We are fine with the first bullet to let RAN2 to consider the impact. |
| OPPO | Agree that this issue should be discussed in RAN2.  |
| vivo | Power reduction is studied by RAN1, the benefits of considering the DRX for PRS reception or SRS for positioning transmission should be identified by RAN1. |
| Intel  | Support  |
| Huawei, HiSilicon | We support introduce PRS processing window for RRC\_INACTIVE for localized the PRS processing. The periodicity of the window can be aligned with DRX cycle. |
| Xiaomi | We are fine to leave it to RAN2 |
| CMCC | Support |
| SONY | Support, this is completely RAN2 issue |

**Summary**

Majority of companies agree that impact of DRX on NR positioning in RRC\_INACTIVE state can be left up to RAN2 discussion

### Round #2

Based on received feedback make the following conclusion in RAN1:

**Proposal 3.4-2**

Conclusion:

* + Enhancements, if any, related to DRX and NR positioning in RRC\_INACTIVE state are up to RAN2

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
| Nokia/NSB | Support |
| NTT DOCOMO | Support |
| Huawei, HiSilicon | OK for this.Howeer, we strongly recommend to discuss PRS processing window for RRC\_INACTIVE state. |
| vivo | OK |
| OPPO | Support |
| ZTE | Support the conclusion, but we think an LS to RAN2 for this is unnecessary |
| SONY | Support |
| Ericsson | Support.  |

**Summary:**

Based on received responses, seems the proposed conclusion can be endorsed by e-mail.

## Aspect #5: UL SRS for positioning relationship with UL BWP

The following views were expressed for UL SRS for positioning relationship with UL BWP.

* [ZTE, [1]]
	+ During SDT active period, SRS for positioning is transmitted only if the SRS bandwidth, SCS and CP type are aligned with the active UL BWP for SDT.
* [Huawei, [15]]
	+ RAN1 to adopt either one of the following on SRS and BWP
		- Alt.1 SRS is configured within a BWP that can be different from BWP#0
		- Alt.2 SRS is not configured within any BWP.

**Summary:**

Based on FL understanding, the following RAN1 agreement resolves the discussed aspects and implies that SRS for positioning can be configured independently of any UL BWP

|  |
| --- |
| **Agreement:*** For RRC\_INACTIVE UEs, SRS for positioning bandwidth, SCS and CP type are configured by RRC and can be different from that of initial UL BWP configured by the system information
 |

### Round #1

Based on review of contributions, the following is proposed to further clarify SRS for positioning configuration for RRC\_INACTIVE Ues in RAN1:

**Proposal 3.5-1A**

* No further discussion is needed for SRS for positioning relationship with UL BWP(s)

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
| ZTE | We would accept FL proposal if companies are also fine. Hope RAN2 experts can fix the issue.  |
| Nokia/NSB | Support |
| Qualcomm | We think SRS needs to be configured within the BWP-UldedicatedConfig, and should not have a separate SCS/CP. Also note, that RAN1 sent to RAN2 the following: In other words, there is no other BWP except the initial BWP, and this LS was sent in response to the WA from RAN2. Therefore, we do not want to add the additional parameters and this topic needs to be revisited.  |
| Vivo | We would like to ask the majority whether the BWP of UL SRS is the same as SDT. Furthermore, should we follow the conclusion as RA SDT or CG SDT and reverse our previous agreement?   |
| Intel  | Support  |
| Huawei, HiSilicon | We think that the RF retuning time should be introduced similar to DL. |
| SONY | Support |
| Qualcomm | We support reversing the previous agreement since it was made under the assumption of a agreement in RAN2, while Ran1 SDT was still discussing this topic. RAN2 reverting their progresagreements and yesterday agreed that:RAN2 changes the agreements and as a baseline we will focus on initial BWP for RA and CG SDT.  FFS if further work on CG SDT for non-initial BWP will be needed, based on RAN1 consensus.  |
| Ericsson | We think that at least for the SRS for positioning, we can use a configuration different from the UL initial BWP. Retuning time can be considered. |

## Aspect #6: UE capability for NR positioning in RRC\_INACTIVE state

The following views were expressed on UE capability for NR positioning in RRC\_INACTIVE state

* [Huawei, [15]]
	+ Introduce a UE capability on switching between SRS Tx and other Tx in BWP#0 or CG-SDT.
		- 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.
	+ Support separate UE SRS capabilities in RRC\_INACTIVE state from the RRC\_CONNECTED, including
		- SRS resource capabilities
		- Spatial relation capabilities
		- Open loop power control capabilities
	+ UE capability of receiving PRS in RRC\_INACTIVE should be reported to the gNB.
* [Qualcomm, [17]]
	+ Introduce a per-band UE capability for Ues transmitting SRS in RRC inactive state.
	+ A per-band DL positioning capability should be in inactive state, e.g. including at least
		- DL PRS processing capability in inactive state
* [Lenovo, [18]]
	+ RAN1 to support separate capabilities of Ues performing RRC\_INACTIVE positioning.

**Summary**

From FL perspective, UE capabilities for NR positioning support by Ues in RRC\_INACTIVE state can be directly discussed in AI 8.16.5 UE features for NR positioning enhancements. There is no plan to have dedicated discussion on UE capabilities for RRC\_INACTIVE state in this AI unless such discussion facilitates work progress on design aspects or remaining open issues are addressed

### Round #1

Based on review of contributions, the following is proposed to facilitate further discussion:

**Proposal 3.6-1**

* To avoid duplication, continue discussion on UE capabilities for NR positioning support by Ues in RRC\_INACTIVE state in AI 8.16.5 “UE features for NR positioning enhancements”, unless there is remaining time left to discuss it in this AI.

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
| ZTE | OK |
| Nokia/NSB | Support |
| Qualcomm | We disagree. We should prioritize a proposal that basic features on RRC Inactive should be introduced.  |
| Lenovo, Motorola Mobility | Since it a new feature, it would be better to identify the key capabilities. |
| Intel  | Support  |
| Huawei, HiSilicon | OK to discuss it as QC suggested. UE feature thread is already overloaded. |
| CATT | Okay |

## Aspect #7: UE Rx-Tx Time Difference Measurement Support

Two companies proposed to support UE Rx-Tx time difference measurements by RRC-INACTIVE Ues

* [Intel, [7]]
	+ For the DL+UL positioning by RRC\_INACTIVE Ues, support UE Rx-Tx time difference measurement
* [Qualcomm, [17]]
	+ Support UE Rx-Tx measurement reporting in RRC Inactive state

**Summary**

Based on FL understanding support of UE Rx-Tx time difference measurement for RRC\_INACTIVE Ues was endorsed by RAN1 as a part of draft CR R1-2112426 “Introduction of NR positioning enhancements”

### Round #1

**Proposal 3.7-1**

* No need for further discussion
* Support of UE Rx-Tx time difference measurement for Ues in RRC\_INACTIVE state was agreed by endorsing draft CR R1-2112426 “Introduction of NR positioning enhancements”

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
| ZTE | No need further discussion  |
| Qualcomm | Suggest to have an agreement, which can be endorsed through email discussion.  |
| Intel  | OK with the QC’s suggestion  |
| Huawei, HiSilicon | OK |
| InterDigital | We are ok to have an agreement if traceability is needed. |

## Aspect #8: Triggering of SRS for positioning transmission

The following views were expressed for triggering of SRS for positioning transmission by Ues in RRC\_INACTIVE state:

* [Sony, [6]]
	+ The UE can be triggered to transmit aperiodic SRS / semi-persistent SRS in RRC\_INACTIVE state by the reception of downlink transmission in RRC\_INACTIVE state (e.g. paging message, RACH procedure, SDT). The details are to be defined by RAN2.
* [Samsung, [12]]
	+ Support Paging DCI or MAC CE in paging MAC PDU to activate/deactivate SRS.

### Round #1

Considering the RAN1 agreement provided below, the relevant aspects are expected to be further discussed in RAN2.

|  |
| --- |
| * Send LS to RAN2 with the outcome of RAN1 discussion on types of SRS for positioning to be supported by Ues in RRC\_INACTIVE state
* From RAN1 perspective, support of semi-persistent SRS for positioning by RRC\_INACTIVE Ues is feasible
* It is up to RAN2 to confirm support of semi-persistent SRS for positioning by RRC\_INACTIVE Ues and determine necessary ignaling details
 |

**Proposal 3.8-1**

* No need for further discussion in RAN1. Necessary signaling details for triggering/activation or deactivation of SRS for positioning transmissions by RRC\_INACTIVE Ues are determined by RAN2

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
| ZTE | No need further discussion  |
| Nokia/NSB | Okay. |
| CATT | Okay |
| OPPO | Support |
| vivo | Okay |
| Intel  | Support  |
| Huawei, HiSilicon | OK. |
| SONY | Okay |
| Fraunhofer | Agree |
| NTT DOCOMO | Suppport |

## Aspect #9: RACH for NR positioning in RRC\_INACTIVE state

The following views were expressed by selected companies regarding the use of RACH for NR positioning by RRC\_INACTIVE Ues:

* [Xiaomi, [8]]
	+ Random access procedure can be reused for UL and DL&UL positioning of RRC\_INACTIVE UE
	+ Random access preamble can be reused as UL reference signal for RRC\_INACTIVE UE
* [CAICT, [11]]
	+ The UL positioning reference signal can be SRS-pos signal or RACH preambles
* [Samsung,[12]]
	+ Support RACH preamble for UL positioning and DL+UL positioning in RRC \_INACTIVE state.

**Summary**

This aspect has been discussed at the previous meetings. Last time it was mentioned that UL E-CID is enhanced as a part of the TEI-17 work, then use of RACH preamble for gNB measurements can be applicable to UE in RRC\_INACTIVE state without specification impact. From FL perspective, the discussion on this aspect can be skipped at this meeting.

### Round #1

Based on review of contributions, the following is proposed to facilitate further discussion:

**Proposal 3.9-1**

* No need to discuss usage of RACH preamble for NR UL positioning and DL+UL positioning measurements in this AI

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
| ZTE | No need further discussion  |
| Nokia/NSB | Support. |
| OPPO | Support |
| Intel  | Support  |
| Huawei, HiSilicon | OK. |
| Xiaomi | Our preference is to support RACH preamble for positioning because of no TA issue, no spatial relation info issue, etc. if majority companies prefer no need, we can accept it. |
| Fraunhofer | Agree |
| NTT DOCOMO | Support |

## Aspect #10: Aperiodic SRS for Positioning Support

This section provides summary of views on aperiodic SRS for positioning support by RRC\_INACTIVE Ues.

* [OPPO, [4]]
	+ For transmission of SRS for positioning by Ues in RRC \_INACTIVE state for UL and DL+UL positioning, aperiodic SRS for positioning is not supported in Rel-17.
* [Sony, [6]]
	+ Support aperiodic SRS for positioning in RRC\_INACTIVE state
* [Samsung, [12]]
	+ Support aperiodic SRS transmission for UL and DL+UL positioning in RRC \_INACTIVE state.

**Summary:**

Based on provided inputs it seems there is no common view on support of aperiodic SRS for positioning by RRC\_INACTIVE Ues.

1. Aperiodic SRS for positioning is not supported: OPPO
2. Aperiodic SRS for positioning is supported: Sony, Samsung

RAN1 has already discussed types of SRS for positioning to be supported by RRC\_INACTIVE Ues. Many companies have not provided further inputs based on the following RAN1 agreement reached at the previous meeting:

|  |
| --- |
| * Send LS to RAN2 with the outcome of RAN1 discussion on types of SRS for positioning to be supported by Ues in RRC\_INACTIVE state
* From RAN1 perspective, support of semi-persistent SRS for positioning by RRC\_INACTIVE Ues is feasible
* It is up to RAN2 to confirm support of semi-persistent SRS for positioning by RRC\_INACTIVE Ues and determine necessary ignaling details
 |

### Round #1

Companies are invited to provide feedback on the following proposal from feature lead:

**Proposal 3.10-1**

* Do not pursue further RAN1 discussion on aperiodic SRS for positioning support by RRC\_INACTIVE Ues in Rel.17

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
| ZTE | OK considering this is the last RAN1 meeting |
| Nokia/NSB | Support FL proposal |
| OPPO | Ok |
| vivo | Okay |
| Intel  | Support  |
| Huawei, HiSilicon | OK. |
| Fraunhofer | Agree |

## Aspect #11: Other aspects of NR positioning in RRC\_INACTIVE

Additionally companies raised the following discussion points for NR Positioning support by RRC\_INACTIVE Ues:

* [Xiaomi, [8]]
	+ Consider to pre-configure the PRS for inactive UE when UE in connected mode.
* [Qualcomm, [17]]
	+ From RAN1 perspective, it is beneficial the measurement period requirements for RRC Inactive state positioning include both single sample and 4- defined sample processing.
* [Nokia, [5]]
	+ RAN1 to study partial updates of PRS AD for Ues in RRC\_INACTIVE mode to reduce overhead and power consumption.
	+ For the UE-assisted positioning for RRC\_Inactive state, the Ues report an indicator along with the positioning measurements, where the indicator informs LMF of whether to jointly utilize the currently reported positioning measurements with the previously reported positioning measurements.
* [Lenovo, [18]]
	+ RAN1 to consider the DL-PRS configuration impact on measurement accuracy in RRC\_INACTIVE state. FFS solutions to address this gap, e.g., separate DL-PRS configurations for RRC\_INACTIVE Ues, sharing of the UE DRX configuration with the LMF for optimal RRC\_INACTIVE measurements, etc.
* [LGE,[16] ]
	+ RAN1 should support a time window (or occasion) of SRS transmission for UE power saving when periodic SRS is supported for UE in RRC\_INACTITVE

### Round #1

**Proposal 3.11-1**

* Companies are invited to provide comments on other aspects for NR positioning support by RRC\_INACTIVE Ues

Comments from companies:

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

On-Demand DL PRS Support

## Aspect #1: On-demand DL PRS parameters

The following views were expressed by companies for on-demand DL PRS parameters:

* [ZTE,[1]]
	+ 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
	+ If DL PRS QCL information in an on-demand PRS request from UE includes DL PRS resource ID(s) or SSB index(s), the measured L1-RSRP of corresponding DL PRS resource or SSB should be larger than a threshold.
		- Inform RAN4 to define the threshold
* [vivo, [2]]
	+ Support the following list of parameters for UE-initiated on-demand DL PRS request
		- Number of TRPs
		- Beam related information
	+ Support the following list of parameters for LMF-initiated on-demand DL PRS request
		- DL PRS ResourceSetSlotOffset, DL-PRS Resource Slot Offset, DL-PRS Resource Symbol Offset
		- DL PRS Muting Option ½
		- Indicator of TRPs
		- Indicator of frequency layers
		- Beam related information
	+ Support the ON/OFF indicator of the on-demand PRS in the following levels: frequency layer level, TRP level, resource set level or resource level.
* [OPPO, [4]]
	+ For Rel-17 on-demand PRS,
		- Not support DL PRS resource time gap
		- Not support DL-PRS start PRB
		- At most support one of
			* beam directions
			* number of DL PRS resources per DL PRS resource set
		- Not support MG-less PRS processing indicator
		- FFS: any request triggered by UE to gNB via RRC signaling
* [Nokia, [5]]
	+ RAN1 to support MG-less processing indicator as an additional parameter for UE-initiated on-demand DL PRS request.
	+ RAN1 to include UE-initiated on/off indicator as an additional parameter for on-demand DL PRS request.
	+ Support of indication of expected AoD/ZoD value and uncertainty (of the expected AoD/ZoD value) range(s) is signaled by the LMF to gNBs/TRPs at least for LMF-initiated on-demand PRS.
* [Intel, [7]]
	+ Include Beam Directions parameter into the list of on-demand DL PRS parameters supported for UE and LMF initiated request:
		- Beam Directions parameter specifies the recommended azimuth and zenith angles of the boresight directions in which the DL PRS resources are transmitted by the TRP
	+ Include Number of TRPs parameter into the list of on-demand DL PRS parameters supported for UE and LMF initiated request:
		- In case of UE initiated request, Number of TRPs parameter specifies the total number of TRPs including the serving and eighbor gNBs per frequency layer
		- In case of LMF initiated request, Number of TRPs parameters specifies the total number of TRPs for each gNB per frequency layer
* [Quectel, [9]]
	+ Considering the requirement of different scenarios, the DL PRS can be ON/OFF with different granularity in LMF initiated request for power saving, interference mitigation and latency reduction.
* [CMCC, [10]]
	+ The following list of parameters is supported for UE-initiated and/or LMF initiated on-demand DL PRS request:
		- Beam direction;
		- Number of DL PRS resources per DL PRS resource set;
		- Number of TRP (UE-initiated only).
* [CAICT, [11]]
	+ Lists of parameters for UE / LMF initiated on-demand DL PRS request can also include participating positioning base station information (e.g. number of TRPs and beam directions).
* [Qualcomm, [17]]
	+ In both UE-initiated and network-initiated include the option the UE/LMF to request the transmission of PRS resources on specific beam directions.
	+ UE/LMF requests specific {Azimuth and zenith} boresight angles to be used for transmission of PRS resources from a specific TRP
	+ Support LMF sending to the serving gNB of a UE a recommendation of keeping the UE in RRC connected state or RRC Inactive state.
	+ Support LMF sending to the serving gNB an inquire of the DRX parameters configured to the UE.
* [Fraunhofer, [20]]
	+ Support including beam direction indication within the parameters for on-demand DL-PRS
* [Lenovo,[18] ]
	+ Support the remaining (not yet agreed) UE-initiated and LMF-initiated parameters as shown in Table 1 in [[18]]
	+ Support the ON/OFF indicator per TRP for LMF-initiated on-demand PRS.
	+ Support TRP Priority order indication as part of UE-initiated On-demand PRS.
* [Huaewi,[15]]
	+ The followings are supported for UE-initiated on-demand PRS.
		- Priority order of TRPs and PRS resource sets
			* For each positioning frequency layer, UE may suggest a new TRP sequence in the updated assistance data
			* For each TRP that has more than one PRS resource sets, UE may suggest a new DL-PRS resource set sequence in the updated assistance data
		- Scell information
			* UE reports the Scell information, similar to the Pcell information with or without reception of any initial assistance data
			* Parameters that are optional without a default value, including Rel-17 new parameters
			* This means that UE would request the parameter to be provided if not in the initial assistance data or without any initial assistance data, instead of being a specific value

### Round #1

The following is proposed to facilitate further discussion for on-demand DL PRS parameters as supported by majority of companies:

**Proposal 4.1-1**

* The following on-demand DL PRS parameters are supported for UE and LMF-initiated on-demand DL PRS requests
1. Beam directions
2. Number of TRPs

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
| ZTE | We are fine with the second bullet. For the first bullet, we are not convinced why this is needed. How could LMF/UE know the preferred beam directions of each TRP before UE measures SSB. Even this is supported, we think it is only applicable for LMF-initiated on-demand PRS. For UE initiated on-demand PRS, UE even doesn’t know the TRP’s location. It is not meaningful for UE to request such information in such case.  |
| Nokia/NSB | We propose adding MG-less processing indicator. From our understanding, resource efficiency and latency are the main purpose of introducing on-demand functionality. As we mentioned in our Tdoc, the target PRS transmission by on-demand PRS request should consider the UE’s preference on mode (MG-less or MG-based). In case the UE needs to keep receiving the data, but if the UE should switch over to MG-mode to receive the on-demand PRS, the UE may try to repeatedly request another PRS to the LMF in order to receive MG-less mode. This may result in unnecessary latency and resource inefficiency. In the current system, the LMF has no knowledge of active BWP about target UE and hence, it is necessary for the UE to inform LMF that it can receive PRS in MG-less mode and another PRS in MG-based mode at least for the pre-configured PRS.  |
| Qualcomm | To ZTE: A UE may know approximately its location by any of the technologies that it may support. The UE may want to do UE-based DL-AoD, and since it has already the knowledge of the TRP locations, it can request beams at specific angles to be used. There is NO need to measure SSB, or any other PRS in order to derive what beams are useful. Similarly, an LMF may know where a UE with a first method, and request PRS resources on specific directions. Again, there is no need to know specific SSBs, or other PRS resources. Our understanding is that a UE/LMF would be able to request a specific ARFCN, or generally a UE/LMF request a specific Band, or at least FR. We think that it is good to add also a “band-ID/ARFCN/ or FR”. To Nokia: UE-initiating PRS processing window is also discussed in the Latency Agenda. We are not sure that it needs to be within the on-demand PRS framework. The request goes to the gNB, since the gnB makes the decision whether to schedule PRS processing window or not. It is unclear why send such request to the LMF.  |
| Lenovo, Motorola Mobility | Generally supportive of FL’s listed on-demand PRS parameters. |
| CATT | We suggest changing “beam direction” to “DL beam information”. For example, for UE-initiated on-demand PRS, a UE may not know the beam direction unless it knows its own position and TRP’s position. But, the UE may have the information of the measured DL beam information from the SSB/CSI-RS from the surrounding TRPs. Similarly, we suggest changing “Number of TRPs” to “TRP information”. From DL RRM measurements, UE may already have the information of surrounding cell/TRP IDs. These information should be useful for the on-demand PRS configuration. |
| OPPO | We support CATT’s suggestion for the 2nd parameter. |
| Vivo | Even though we are supportive of “beam direction”, we have a similar understanding with ZTE that accurate boresight angle cannot be achieved by UE. In other words, if UE can achieve so accurate location why needs to introduce on-demand PRS. In addition, if the method is only adopted to UE-based positioning, it is not a basic solution.For us, based on the measurement, UE/LMF request to configure the on-demand PRS in a certain angle range is reasonable and useful.In addition, we support CATT’s suggestion for the 2nd parameter. |
| Intel  | Support  |
| Huawei, HiSilicon | Do not support either.For UE-based DL-AOD with known apriori location, instead of requesting beam direction, why wouldn’t UE simply provide its location in the MO-LR request?For number of TRPs, the context should be clear when UE does the request. Is it prior to UE receiving any assistance data or is it after UE receiving some initial assistance data in a sense that it wants more? Why would the LMF provides the number of TRPs matching UE capabilities in the first place. |
| CMCC | We are open to support the two parameters; however, we think that they should only be supported for UE-initiated. |
| SONY | Support |
| Nokia/NSB | To Qualcomm: The suggested MG-less processing indicator may be assigned from frequency resource perspective. For example, the UE may inform LMF that it can receive PRS in the active BWP and another PRS outside of BWP. The indicator may or may not be tied to time window depending on if the time window is already configured or not. |
| InterDigital | We are ok with both bullets. |
| Ericsson | Don’t think either is necessary. Regarding rel17 features like MG-less measurements, we don’t think we should put these in scope for on-demand PRS, as RAN2 won’t be able to add all these features in time for the release completion.  |
| Futurewei | Support item 1 (beam direction). For clarification, these are parameters that are provided as part of the on-demand DL PRS? So, for UE-initiated DL PRS, it does not mean that the UE needs to know the preferred DL beam direction of the DL PRS, but instead is provided the beam direction as part of the DL PRS. Is this understanding correct? |
| Fraunhofer | Okay with the proposal; at least Beam directions needs to be included |

**Summary**

Although majority of companies prefer to support additional parameters (including beam directions and the number of TRPs), it seems there is no full consensus in the group to support new parameters on top of the already agreed ones.

### Round #2

The following is proposed for additional on-demand DL PRS parameters:

**Proposal 4.1-2**

* Make a conclusion
	+ No consensus to support additional on-demand DL PRS parameters for UE and LMF-initiated on-demand DL PRS request in Rel.17

Comments from companies:

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| --- | --- |
| Company Name | Comments |
| Qualcomm | We think that it is needed for UE/LMF to be able to associate their request with a specific band-ID or at least a FR-ID. For example, the QCL information is actually “band-specific”. An SSB/PRS is configured in a band and the UE is requested On demand PRS associated with specific SSB/PRS. Such associations are intra-band only. In short, when a BW, comb, periodicity, QCL, etc, is requested, the UE/LMF are making such requests under specific assumption of what would be the band/FR used.  |
| Nokia/NSB | We prefer to have further discussion at least for in this meeting. |
| Huawei, HiSilicon | Inclusion of band ID/TRP ID/FR can be automatically introduced by RAN2 when RAN1 agree some parameter can be per band/per TRP/per FR requested. |
| Vivo | We also think an indicator of frequency layers or point A information is useful for on-demand PRS requests. And if band ID/TRP ID/FR can be automatically introduced by RAN2, do we need to add a note to illustrate in 4.2And we also think the Round #1 parameters are helpful. |
| OPPO | We are ok with the conlcusion |
| ZTE | Support the conclusion.  |
| Sony | We can still further discuss it and no need to make above conclusion |
| Ericsson | Support the conclusion.  |

### Round #3

Considering that companies still want to continue discussion on additional on-demand DL PRS parameters, the round-3 discussion is opened with the intention that companies can reach consensus on additional parameters to be supported in Rel.17:

**Proposal 4.1-3**

* Companies are invited to continue discussion and propose additional parameters for on-demand DL PRS support that are deemed agreeable or critical for Rel.17 operation

Comments from companies:

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| Company Name | Comments |
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## Aspect #2: Signaling Granularity of On-demand DL PRS Parameters

In this section, we summarize views on granularity of signaling for on-demand DL PRS request:

* [OPPO, [4]]
	+ Regarding whether on-demand DL PRS parameters are resource-specific, TRP-specific, or PFL-specific, down-select one of the following alternatives:
		- Alt.1: follow the same IE level of LPP signaling in the current spec
			* if a parameter is configured by LPP as resource-specific, the parameter for on-demand PRS is also resource-specific.
			* if a parameter is configured by LPP as PFL-specific, the parameter for on-demand PRS is also PFL-specific.
		- Alt.2: all the parameters for on-demand PRS are PFL-specific
		- Alt.2 is our first preference
* [InterDigital, [13]]
	+ The following parameters are TRP specific on-demand PRS parameters : QCL information, repetition factor, number of symbols, comb size
	+ The following parameters are PFL specific : periodicity, resource bandwidth, start/end time, frequency layers
* [Huawei, [15]]
	+ Support the following parameter request granularity and value range for UE initiated on-demand PRS.

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Request granularity** | **Value range** |
| NR-DL-PRS-Periodicity | Per FR | All candidate values in LPP |
| dl-PRS-ResourceBandwidth | Per UE | {5MHz, 20MHz, 50MHz, 100MHz, 200MHz, 400MHz}Note: In Rel-17, 200MHz and 400MHz only applies to FR2. |
| DL-PRS-QCL-Info | Per FR | {Requested} |
| startTimeOfDLPRS | Per UE | SFN of the PCell |
| endTimeOfDLPRS | Per UE | SFN of the PCell |
| dl-PRS-ResourceRepetitionFactor | Per UE | All candidate values in LPP |
| dl-PRS-NumSymbols | Per UE | All candicate values in LPP |
| dl-PRS-CombSizeN | Per UE | All candidate values in LPP |
| dl-PRS-NumPosFreqLayers | Per FR | {1,2,3,4} |

* + For LMF initiated on-demand PRS, the parameter list offered by RAN1 should be further checked by RAN3, and decided by RAN3.

### Round #1

RAN1 need to conclude on signaling granularity for agreed on-demand DL PRS parameters. Companies are invited to fill in the table below to continue discussion on this aspect.

1. **Table 1: Signaling granularity of on-demand DL-PRS parameters**

|  |  |  |  |
| --- | --- | --- | --- |
| **Parameter** | **Granularity choice** | **LMF-initiated** | **UE-initiated** |
| *DL PRS Periodicity* | Per Resource | {Insert company name} | {Insert company name} |
| Per Resource Set | Intel, Huawei, HiSilicon, Nokia/NSB |  |
| Per TRP |  |  |
| Per gNB |  |  |
| Per PFL | QC, OPPO, vivo | QC, OPPO, vivo, Intel, IDC, Nokia/NSB |
| Per FR | CATT | CATT, Huawei, HiSilicon |
| Per UE | ZTE | ZTE |
| *DL PRS Resource Bandwidth* | Per Resource |  |  |
| Per Resource Set | Intel, Huawei, HiSilicon |  |
| Per TRP |  |  |
| Per gNB |  |  |
| Per PFL | QC, OPPO, vivo, Nokia/NSB | QC, OPPO, vivo, Intel, IDC, Nokia/NSB |
| Per FR | CATT | CATT |
| Per UE | ZTE | ZTE, Huawei, HiSilicon |
| *DL PRS QCL-Info* | Per Resource | QC, CATT, OPPO, vivo, Nokia/NSB | QC, CATT, OPPO, vivo, Nokia/NSB |
| Per Resource Set | Intel, Huawei, HiSilicon |  |
| Per TRP |  | IDC |
| Per gNB |  |  |
| Per PFL |  | Intel |
| Per FR |  | Huawei, HiSilicon |
| Per UE | ZTE | ZTE |
| *Start/end time of DL PRS transmission* | Per Resource |  |  |
| Per Resource Set | Intel, Huawei, HiSilicon |  |
| Per TRP |  |  |
| Per gNB |  |  |
| Per PFL |  | Intel |
| Per FR |  |  |
| Per UE | ZTE, QC, CATT, OPPO, Nokia/NSB | ZTE, QC, CATT, OPPO, vivo, Huawei, HiSilicon, Nokia/NSB |
| *DL PRS Resource Repetition Factor* | Per Resource |  |  |
| Per Resource Set | Intel, Huawei, HiSilicon, Fraunhofer |  |
| Per TRP |  | IDC |
| Per gNB |  |  |
| Per PFL | QC, OPPO, vivo, Nokia/NSB | QC, OPPO, vivo, Intel, Nokia/NSB |
| Per FR | CATT | CATT |
| Per UE | ZTE | ZTE, Huawei, HiSilicon |
| *Number of DL PRS Resource Symbols per DL PRS Resource* | Per Resource |  |  |
| Per Resource Set | Intel, Huawei, HiSilicon, Fraunhofer |  |
| Per TRP | ZTE | ZTE, IDC |
| Per gNB |  |  |
| Per PFL | QC, OPPO, Nokia/NSB | QC, OPPO, Intel, Nokia/NSB |
| Per FR | CATT | CATT |
| Per UE |  | Huawei, HiSilicon |
| *DL-PRS CombSizeN* | Per Resource |  |  |
| Per Resource Set | Intel, Huawei, HiSilicon, Fraunhofer |  |
| Per TRP | ZTE,  | ZTE,IDC |
| Per gNB |  |  |
| Per PFL | QC, OPPO, vivo, Nokia/NSB | QC, OPPO, vivo, Intel, Nokia/NSB |
| Per FR | CATT | CATT |
| Per UE |  | Huawei, HiSilicon |
| *Number of DL PRS frequency layers* | Per Resource |  |  |
| Per Resource Set |  |  |
| Per TRP |  |  |
| Per gNB | Huawei, HiSilicon |  |
| Per PFL |  |  |
| Per FR | QC, CATT, OPPO, Intel, Nokia/NSB | QC, CATT, OPPO, Intel, Huawei, HiSilicon, Nokia/NSB |
| Per UE | ZTE | ZTE |
| *ON/OFF indicator (for LMF initiated request only)* | Per Resource | QC, vivo, Huawei, HiSilicon, Fraunhofer, Nokia/NSB |  |
| Per Resource Set | Vivo, Intel , Huawei, HiSilicon |  |
| Per TRP | Vivo, Huawei, HiSilicon, Nokia/NSB |  |
| Per gNB |  |  |
| Per PFL | vivo |  |
| Per FR |  |  |
| Per UE | ZTE, CATT, OPPO |  |
| [*Beam Directions*] | Per Resource |  |  |
| Per Resource Set |  |  |
| Per TRP | QC, CATT, ZTE, OPPO, vivo, Intel, Fraunhofer, Nokia/NSB | QC, CATT, vivo, Intel, Fraunhofer, Nokia/NSB |
| Per gNB |  |  |
| Per PFL |  |  |
| Per FR |  |  |
| Per UE |  |  |
| [*Number of TRPs*] | Per Resource |  |  |
| Per Resource Set |  |  |
| Per TRP |  |  |
| Per gNB |  |  |
| Per PFL | QC, OPPO (prefer TRP information rather than # of TRPs), vivo, Intel, Nokia/NSB | QC, OPPO (prefer TRP information rather than # of TRPs), vivo, Nokia/NSB |
| Per FR |  | Intel |
| Per UE | ZTE, CATT | ZTE, CATT |

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
| Qualcomm | We interpret the above table as follows (using an example):* If the BWP request is per PFL it means that, a UE/LMF could request X number of PFLs, for each PFL, request a specific BWP.
* If the QCL-Info is per PRS resource, it means, that a UE/LMF could request X PFLs, and for each PFL, request for each PRS resource of a set of a TRP, a specific QCL-info

We think that It is important a UE/LMF to be able to request, for each requested PFL, a band-ID/ARFCN or at least FR. In other words, when the UE requests a PFL, it should be able to request specific Band, BW, Number of TRPs, etc.  |
| ZTE | For QCL-Info, we think a list a list of QCL reference RS, e.g. SSB related parameters can be included, where multiple QCL reference RSs can be from different TRPs. Hence, it is not needed to request QCL-Info per PRS resource. Moreover, if DL PRS QCL information in an on-demand PRS request from UE includes DL PRS resource ID(s) or SSB index(s), we think the measured L1-RSRP of corresponding DL PRS resource or SSB should be larger than a threshold. The threshold can be signalled or defined in RAN4. |
| vivo | Per UE on-demand PRS is weird for us, why gNB needs to separate the on-demand PRS per UE. So, we would like to confirm how to understand per UE |
| Huawei, HiSilicon | The entries on the LMF initiated case are strange to us. How can it be per PFL or per UE? |
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**Summary**

Views from companies are captured in Tables of this section.

### Round #2

Based on received feedback, the following is proposed to facilitate further discussion for signaling granularity of on-demand DL PRS parameters:

**Proposal 4.2-2A**

* For LMF-initiated request of on-demand DL PRS, the following group of on-demand DL PRS parameters is defined and signaled
	+ per resource set per positioning frequency layer
1. DL PRS Periodicity
2. DL PRS Resource Bandwidth
3. DL PRS Resource Repetition Factor
4. Number of DL PRS Resource Symbols per DL PRS Resource
5. DL-PRS CombSizeN
	* per resource per resource set per positioning frequency layer
6. DL PRS QCL-Info
	* per FR
7. Number of DL PRS frequency layers
	* either per resource set per positioning frequency layer or per UE
8. Start/end time of DL PRS transmission
	* either per resource, or per resource set, or per UE
9. ON/OFF indicator (for LMF initiated request only)

**Proposal 4.2-2B**

* For UE-initiated request of on-demand DL PRS, the following group of on-demand DL PRS parameters is defined and signalled
	+ per positioning frequency layer
1. DL PRS Periodicity
2. DL PRS Resource Bandwidth
3. DL PRS Resource Repetition Factor
4. Number of DL PRS Resource Symbols per DL PRS Resource
5. DL-PRS CombSizeN
	* per FR
6. Number of DL PRS frequency layers
	* per UE
7. Start/end time of DL PRS transmission
	* per resource
8. DL PRS QCL-Info

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
|  | 2A:2B: |
| Qualcomm | For 2A: why would the Bandwidth and combN be requested in a “per set” level when the Bandwidth/combN is per PFL configured? For both 2A/2B: We think that the “per positioning frequency layer” should be “per positioning frequency layer in a FR/Band” . The UE/LMF would not be able to do good requests of specific Periodicity/BW/repetition/comb for a PFL without associating it at least with a specific FR ID / Band ID. E.g., * the BW is an obvious example, since some BWs are only applicable to FR2.
* The QCL-info is another example: QCL information is actually “band-specific”. An SSB/PRS is configured in a band and the UE is requested On demand PRS associated with specific SSB/PRS. Such associations are intra-band.
 |
| Nokia/NSb | 2A: We have one question. For repetition factor, bandwidth, and combsize, out understanding is that the majority looks per PFL. We are not sure why they are suggested as set level. |
| Huawei, HiSilicon | 2A: Anything related to LMF-based should be PRS resource set level or PRS resource level, since that the NRPPa meassge can be already addressed to a TRP. There is no frequency layer concept in NRPPa.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description | Criticality | Assigned Criticality |
| Message Type | M |  | 9.2.3 |  | YES | reject |
| NRPPa Transaction ID | M |  | 9.2.4 |  | - |  |
| **TRP List** |  | *0 ..1* |  |  | YES | ignore |
| **>TRP Item** |  | *1 .. <maxnoTRPs>* |  |  | EACH | ignore |
| >>TRP ID | M |  | 9.2.24 |  | - |  |
| **TRP Information Type List** |  | *1* |  |  |  |  |
| **>TRP Information Type Item** |  | *1 .. <maxnoTRPInfoTypes>* |  |  | EACH | reject |
| >>TRP Information Type Item | M |  | ENUMERATED (nr pci, ng-ran cgi, nr arfcn, prs config, ssb config, sfn init time, spatial direction info, geo-coordinates, …)  |  |  |  |

2B: OK with others except QCL info for the sake of progress. For QCL info, we interpret it as request to provide the QCL information (as Futurewei attempts to make the clarification earlier in 4.1), instead of requesting a specific QCL configuration, because we do not think it is necessary.The SSB source could be already supported by UE providing unsolicitated E-CID measurement to the LMF. |
| vivo | But the on-demand request information is new IE, and the requested SRS configuration for the UE includes the choice IE for Bandwidth and SRS frequency.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE Type and Reference | Semantics Description |
| Number Of Periodic Transmissions | C-ifResourceTypePeriodic |  | INTEGER (0..500,…) | The number of periodic SRS transmissions requested. The value of ‘0’ represents an infinite number of periodic SRS transmissions. |
| Resource Type | M |  | ENUMERATED (periodic, semi-persistent, aperiodic, …) |  |
| CHOICE *Bandwidth* | M |  |  |  |
| >FR1 |  |  | ENUMERATED (5mHz, 10mHz, 20mHz, 40mHz, 50mHz, 80mHz, 100mHz, ...) |  |
| >FR2 |  |  | ENUMERATED (50mHz, 100mHz, 200mHz, 400mHz,…) |  |
| **SRS Resource Set List** |  | *0.. 1* |  |  |
| **>SRS Resource Set Item** |  | *1..<* *maxnoSRS-ResourceSets>* |  |  |
| >>Number of SRS Resources Per Set | O |  | INTEGER (1..16,...) | The number of SRS Resources per resource set for SRS transmission.  |
| **>>Periodicity List** |  | *0.. 1* |  |  |
| **>>>Periodicity List Item** |  | *1..<maxnoSRS-ResourcePerSet>* |  |  |
| >>>>PeriodicitySRS | M |  | ENUMERATED (0.125, 0.25, 0.5, 0.625, 1, 1.25, 2, 2.5, 4, 5, 8, 10, 16, 20, 32, 40, 64, 80, 160, 320, 640, 1280, 2560, 5120, 10240, …) | Milli-seconds |
| >>Spatial Relation Information | O |  | 9.2.34 |  |
| >>Pathloss Reference Information | O |  | 9.2.53 |  |
| SSB Information | O |  | 9.2.54 |  |
| SRS Frequency | O |  | INTEGER(0..3279165) | NR ARFCN The carrier frequency of SRS transmission bandwidth. |

So, for us, we prefer 2A with modification * + per resource set per positioning frequency layer
1. DL PRS Periodicity
2. ~~DL PRS Resource Bandwidth~~
3. DL PRS Resource Repetition Factor
4. Number of DL PRS Resource Symbols per DL PRS Resource
5. ~~DL-PRS CombSizeN~~
	* per resource per resource set per positioning frequency layer
6. DL PRS QCL-Info
	* per FR
7. Number of DL PRS frequency layers
8. DL PRS Resource Bandwidth
9. DL-PRS CombSizeN
	* either per resource set per positioning frequency layer or per UE
10. Start/end time of DL PRS transmission
	* either per resource, or per resource set, or per UE
11. ON/OFF indicator (for LMF initiated request only)
 |
| OPPO | At least, the paramters configured per PLF in Rel-16 LPP signaling should be moved to the group of “per FL”, e.g., dl-PRS-ResourceBandwidth, dl-PRS-CombSizeN |
| CMCC | 2A: We share similar views as HW that for LMF-initiated parameter, it should be either per resource set or per resource.2B: Regarding the QCL, our understanding is that a UE would like to request on-demand PRS under a certain direction and use this information to indicate to the NW, and hence we don’t think it should be per resource. |
| ZTE | For QCL, we have the similar view as Huawei and CMCC, providing a list of QCL reference for each PRS resource set or each TRP is enough.  |

### Round #3

Based on received feedback, the following is proposed to facilitate further discussion for signaling granularity of on-demand DL PRS parameters:

**Proposal 4.2-3A**

* From RAN1 perspective, for LMF-initiated request of on-demand DL PRS, the following group of on-demand DL PRS parameters is defined and signaled
	+ per resource set per positioning frequency layer per FR
1. DL PRS Periodicity
2. DL PRS Resource Bandwidth
3. DL PRS Resource Repetition Factor
4. Number of DL PRS Resource Symbols per DL PRS Resource
5. DL-PRS CombSizeN
	* ~~per resource~~ per resource set per positioning frequency layer
6. Request to provide DL PRS QCL-Info
	* per FR
7. Number of DL PRS frequency layers
	* either per resource set per positioning frequency layer or per UE
8. Start/end time of DL PRS transmission
	* either per resource, or per resource set, or per UE
9. ON/OFF indicator (for LMF initiated request only)

|  |  |
| --- | --- |
| Company Name | Comments |
|  | 3A: |
|  |  |
|  |  |

**Proposal 4.2-3B**

* From RAN1 perspective, for UE-initiated request of on-demand DL PRS, the following group of on-demand DL PRS parameters is defined and signalled
	+ per positioning frequency layer per FR
1. DL PRS Periodicity
2. DL PRS Resource Bandwidth
3. DL PRS Resource Repetition Factor
4. Number of DL PRS Resource Symbols per DL PRS Resource
5. DL-PRS CombSizeN
	* per FR
6. Number of DL PRS frequency layers
	* per UE
7. Start/end time of DL PRS transmission
	* per resource set per positioning frequency layer per FR
8. Request to provide DL PRS QCL-Info

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
|  | 3B: |
|  |  |
|  |  |

## Aspect #3: On-demand DL PRS & UE/gNB measurements

One company expressed the view that UE/gNB measurements are beneficial for on-demand DL PRS framework:

* [CATT, [3]]:
	+ 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.
	+ 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.
	+ 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

Considering lack of feedback/discussion on this aspect, comments from companies are invited:

**Proposal 4.3-1**

* Companies are invited to provide comments on reporting of UE/gNB measurements to support on-demand DL PRS framework

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
| ZTE | Don’t support. The current measurement results have included those information.  |
| Qualcomm | Not support |
| Lenovo, Motorola Mobility | Generally supportive of sending UE assistance information to assist the LMF with the provision of the on-demand PRS configuration. Reporting of measurements may be supported depending on whether the on-demand PRS request is based on an already available PRS configuration or a first-time PRS configuration. |
| CATT | Support. To ZTE: While the serving gNB may have the UE RRM measurements, the LMF does not have these information.  |
| vivo | Reporting of UE/gNB measurements to support on-demand DL PRS can be discussed |
|  |  |
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|  |  |

## Aspect #4: Request for on-demand DL PRS support

The following views were expressed for request of on-demand DL PRS transmission

* [CAICT, [11]]
	+ For supporting on-demand PRS, requesting mechanism can be considered to use uplink RACH channel as a candidate

### Round #1

Based on review of contributions the following is proposed to facilitate further discussion:

**Proposal 4.4-1**

* Companies are invited to provide comments on request for on-demand DL PRS.

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
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|  |  |
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|  |  |
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## Aspect #5: On-demand DL PRS and measurement gap

The following views were expressed on measurement gap for on-demand DL PRS measurements

* [vivo, [2]]
	+ Support to introduce on-demand measurement gap for on-demand PRS in Rel-17.
	+ LMF requests on-demand measurement gap should be supported.
	+ 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.

### Round #1

Based on review of contributions the following is proposed to facilitate further discussion:

**Proposal 4.5-1**

* Companies are invited to provide comments on support of on-demand DL PRS measurement gap and LMF request of measurement gaps

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
| ZTE | It is useful to support on-demand PRS measurement gap request from LMF/UE. Then, PRS transmission can match well the gap. Considering we have agreed PRS measurement periodicity and slot offset, we think just **measurement gap length is needed**. In such case, we can assume the periodicity and offset of measurement gap follows what we agreed for PRS.  |
| vivo | Same view as ZTE |
| Ericsson | We think the existing MG framework will be sufficient. |
|  |  |
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## Aspect #6: Other aspects for on-demand DL PRS support

The following list of additional aspects was discussed by

* [CAICT,[11]]
	+ For UL positioning in RRC\_IDLE state, to trigger the UL positioning signal transmission, a new paging message or a new random access process need to be specified.
	+ For on demand PRS, the potential signaling can be system information broadcasting or RRC signaling.
* [Fraunhofer, [20]]
	+ Support the LMF and UE to request an update of one or more parameters to the list of preconfigured PRS resources.
* [vivo, [2]]
	+ The priority of on-demand DL PRS and normal PRS should be considered
	+ Support the request of explicit parameters at least for UE-initiated on-demand DL-PRS
	+ 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
* [Sony, [6]]
	+ Support LMF to assist gNBs to facilitate the two-stage beam sweeping operation. It can be performed such as LMF configures sweeping beam directly by on-demand PRS, or LMF sent assistance information to gNB (e.g., the expected AoD range, beam width).
	+ Support two-stage beam sweeping for DL-AOD and DL-TDOA positioning

### Round #1

Based on review of contributions the following is proposed to facilitate further discussion:

**Proposal 4.6-1**

* Companies are invited to express views on any other aspects for on-demand DL PRS support

Comments from companies:

|  |  |
| --- | --- |
| Company Name | Comments |
| vivo | At least, the priority of on-demand PRS can be discussed |
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Other Aspects

One company proposed to continue discussion on DL PRS optimizations.

* [LGE, [16]]
	+ NR should consider cyclic shift based SFN transmission of PRS.
		- Study on benefit of the simultaneous transmission of a common PRS sequence with different intentional cyclic time-domain delays.
	+ Support 1-symbol PRS resource for Rel-17 NR positioning.

Conclusion

In this document, we provided review of the submitted contributions for RRC\_INACTIVE UEs, on-demand DL PRS and prepared set of proposals to facilitate further discussion/decision by RAN WG1 during the RAN1#107-e meeting.

References

1. R1-2110961 Discussion on items led by RAN2 for NR positioning ZTE
2. R1-2111018 Remaining issues on inactive state positioning and on-demand PRS vivo
3. R1-2111261 Remaining issues on on-demand DL PRS and positioning for UEs in RRC\_ INACTIVE state CATT
4. R1-2111294 Discussion on positioning for UE in RRC\_INACTIVE and on-demand PRS OPPO
5. R1-2111369 Additional views on Inactive Mode Positioning and on-demand PRS Nokia, Nokia Shanghai Bell
6. R1-2111402 Remaining Aspects of On-demand PRS and positioning in RRC Inactive Mode Sony
7. R1-2111500 Remaining Details for On-demand DL PRS Signaling and NR Positioning in RRC\_INACTIVE state Intel Corporation
8. R1-2111577 On-demand PRS and positioning for UE in RRC\_INACTIVE state Xiaomi
9. R1-2111596 Positioning in RRC\_INACTIVE mode and on-demand PRS request Quectel
10. R1-2111612 Discussion on RAN2-led items for positioning CMCC
11. R1-2111655 Discussion on enhancements of INACTIVE mode positioning and on-demand PRS CAICT
12. R1-2111743 Discussion on on demand positioning and positioning in inactive state Samsung
13. R1-2111802 On-demand PRS and positioning during INACTIVE mode InterDigital, Inc.
14. R1-2111879 DL-PRS conflict resolution for UE in RRC\_INACTIVE Apple
15. R1-2111932 Discussion on INACTIVE state positioning and on-demand PRS Huawei, HiSilicon
16. R1-2111978 Discussion on other enhancements for positioning LG Electronics
17. R1-2112222 Remaining issues on enhancements Related to On Demand PRS And Positioning in RRC Inactive State Qualcomm Incorporated
18. R1-2112327 Discussion on On-Demand PRS and RRC\_INACTIVE Positioning Lenovo, Motorola Mobility
19. R1-2112344 Further details for on-demand PRS reception and SRS in RRC\_INACTIVE Ericsson
20. R1-2112369 Considerations for on-demand PRS and positioning in RRC\_INACTIVE state Fraunhofer IIS, Fraunhofer HHI