3GPP TSG-RAN WG2 Meeting #116 R2-21xxxxx

Online, 01 – 12 November 2021

**Agenda item:** 8.11.x

**Source:** vivo

**Title:** Summary of [Post115-e][608][POS] PRS configuration and measurement in RRC\_INACTIVE

**Document for:** Discussion and Decision

# 1 Introduction

This document aims at capturing views related to the following e-mail discussion:

* [Post115-e][608][POS] PRS configuration and measurement in RRC\_INACTIVE (vivo)

Scope: Discuss the following potential configuration and measurement enhancements for DL-PRS in RRC\_INACTIVE (without exposing RRC state to LMF):

* Configuration enhancements:
  + RNA in the PRS configuration
  + Validity conditions in the PRS configuration
  + No impact to PRS configuration
* Assistance information from UE to gNB to help with configuration:
  + Type of reporting requested (e.g. periodic, aperiodic)
  + Payload size of LPP message
  + Start timing, measurement duration, reporting periodicity
  + No assistance information
* Measurement enhancements:
  + LMF/gNB interactions (for report size, periodicity, positioning requirements, data volume threshold)
  + Differential measurement report
  + No enhancements to measurement report

Deadline: Long

The rapporteur would like to organize this email discussion in two phases:

- Phase 1: Companies are invited to provide their views on the questions by Oct 15th, 0900 UTC.

- Phase 2: Rapporteur submit the summary with easy agreements and controversial issues, companies can further comment by Oct 20th, 0900 UTC.

This email discussion is based on the summary [18] of companies’ contributions [3]-[17], and is structured as follows:

- Section 2: Discussion of PRS configuration enhancements in RRC\_INACTIVE state.

- Section 3: Discussion of assistance information from UE to gNB to help with configuration (e.g. SDT configuration).

- Section 4: Discussion of UE measurement report enhancements in RRC\_INACTIVE state.

## Contact Points

Respondents to the email discussion are kindly asked to fill in the following table.

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| --- | --- | --- |
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## Related agreements for reference

During the last few meetings, the following agreements were made related to DL positioning in RRC\_INACTIVE state [1] [2] [19]:

Agreements (RAN2 #113, SI):

Proposal4: For DL positioning in IDLE/INACTIVE, the followings are already supported for the current spec and can be reused:

Current stage3 spec has already supported assistance data delivery for DL positioning during RRC\_CONNECTED and on-demand SI request in RRC\_IDLE/ INACTIVE for IDLE/INACTIVE positioning. (14/14)

Current stage3 spec already supports the transfer of RequestLocationInformation in RRC\_CONNECTED for PRS measurement in IDLE/INACTIVE. (14/14)

Agreements (RAN2 #114):

Any uplink LCS or LPP message can be transported in RRC\_INACTIVE from RAN2 perspective.

Follow Rel-17 SDT framework for INACTIVE UL and DL positioning:

- If the UE initiated data transmission using UL SDT, the network can send DL LCS, LPP message, and RRC message (e.g. to configure SRS (TBD on what message is used), if UL positioning supported) to the UE.

- Otherwise, if UE did not initiate UL SDT, rely on legacy operation, i.e. the network shall transition the UE to RRC\_CONNECTED, e.g. based on RAN paging.

Agreements (RAN2 #114):

Exposure of the RRC state of the UE to the LPP layer of the UE for RRC\_INACTIVE UL and DL positioning will not be specified. This does not exclude cross-layer behaviour in implementations.

The RRC state of the UE is not exposed to the LMF for INACTIVE UL and DL positioning.

Agreements (RAN2 #115):

LPP PDU and LCS message transfer:

Proposal 1: The LPP PDU Transfer Procedure in Annex A is used as baseline for further work.

NOTE 1: Some details may depend on further progress of the SDT work item.

NOTE 2: Whether such a procedure needs to be captured in Stage 2 specification or not can be decided later when the procedure has been fully developed/agreed. That is, the procedure can be considered as "running baseline".

Proposal 2: The LCS Message Transfer Procedure in Annex B is used as baseline for further work.

NOTE 1: Some details may depend on further progress of the SDT work item.

NOTE 2: Whether such a procedure needs to be captured in Stage 2 specification or not can be decided later when the procedure has been fully developed/agreed. That is, the procedure can be considered as "running baseline".

Proposal 3: UL LPP message segmentation can also be used by the UE in RRC\_INACTIVE state; i.e., a LPP message body can be sent in several shorter LPP messages instead of one long LPP message by using the SDT "Subsequent Data Transmission" phase. FFS spec impact.

DL and RAT-independent positioning:

Proposal 4: The Deferred 5GC-MT-LR Procedure with SDT for DL-only and RAT-independent positioning in Annex C is used as baseline for further work.

NOTE 1: Some details may depend on further progress of SDT work item.

NOTE 2: Whether such a procedure needs to be captured in Stage 2 specification or not can be decided later when the procedure has been fully developed/agreed. That is, the procedure can be considered as "running baseline".

NOTE 3: Once the procedure is stable from RAN2 perspective, send an LS to SA2 including the baseline procedure.

# 2 PRS configuration enhancements

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| **[3]. R2-2107829 OPPO**  Proposal 2: No additional information is needed to differentiate the assistance information for RRC\_INACTIVE and RRC\_CONNECTED.  **[6]. R2-2107149 Fraunhofer**  Proposal 1: Support providing UE with assistance data describing the DL-PRS available within the RNA, some of which may be outside the hearability region of the UE at its current location (i.e. redundant assistance data).  FFS: Whether the A/D received with a larger area scope (e.g. positioning system area) can be divided into A/D applicable to smaller area scope (e.g. cell-level), so that the AD corresponding to the area where the UE is camped can be triggered via SDT mechanism.  **[9]. R2-2107683 InterDigital**  Proposal 1: Support transmission of network-initiated DL indication to UE for initiating measurement of preconfigured PRS when in INACTIVE.  Proposal 2: Support configuring PRS configurations which are intended to be used by UE when operating in RRC INACTIVE state.  Proposal 3: The PRS configurations intended for usage during RRC INACTIVE state should ensure that at least a minimum positioning accuracy requirement (i.e. required by positioning service/LCS client) is satisfied.  Proposal 4: The PRS configurations intended for usage during RRC INACTIVE state should take into account of the parameters of SDT configuration (e.g. RA-SDT/CG-SDT resources, data volume threshold) possibly configured in UE.  Proposal 5: Support configurating validity conditions (e.g. time validity, area validity) when configuring PRS configurations intended to be used by UE during RRC INACTIVE state.  **[11]. R2-2108068 Sony**  Proposal 1: Specify configuration of UE locations measurements in RRC Inactive state for DL based measurements, and the possibility to use small data uplink transmission (SDT) and/or PUR for positioning measurement reporting.  **[13]. R2-2108703 Nokia**  Proposal 1: RAN2 to discuss whether to specify standardized triggering criteria as to when an RRC\_INACTIVE UE can initiate UL SDT transmission for signaling to the LMF and also how to control how frequently the UE can trigger signaling to LMF using UL SDT.  **[15]. R2-2107643 vivo**  Proposal 2: Introduce validity criteria for PRS configuration in RRC\_INACTIVE received in RRC\_CONNECTED.  **[16]. R2-2108764 CMCC**  Proposal 1: Introduce validity area or valid timer for the positioning related configuration.  Proposal 2: With the request from UE in RRC\_INACTIVE state, PRS configuration for specific UE can be delivered by ongoing SDT procedure in addition to the current LPP procedure and positioning SI.  Proposal 4: RAN2 is kindly asked to confirm that one or multiple sets of the SRS or DL PRS configuration can be pre-configured to the RRC\_INACTIVE UE. |

Based on the companies’ contributions, the following proposal was made in [18] concerning PRS configuration enhancements in RRC\_INACTIVE:

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| **Proposal 5: For the PRS configuration used for RRC\_INACTIVE state, consider the following alternatives:**   * **Alt 1: Configure RNA information in the PRS configuration** * **Alt 2: Configure validity conditions (e.g. time validity, area validity) in the PRS configuration** * **Alt 3: No change should be introduced in PRS configuration**   **Note: This does not necessarily mean to expose RRC state to LMF.** |

The above enhancements are further rephrased as the following options.

**Option 1: The UE reuses the pre-configuration of PRS received in RRC\_CONNECTED and follows its validity criteria.**

It was concluded that PRS configuration used in RRC\_INACTIVE can be delivered to UE via LPP message during RRC\_CONNECTED and stored in UE context when UE enters RRC\_INACTIVE. However, some or all of the PRS configurations received in RRC\_CONNECTED may become invalid due to UE mobility. For instance, when the UE moves out of a certain area, the configuration of PRS resources priority may no longer be applicable. If the UE still performs measurement according to the previous priority rules, the positioning accuracy may be affected.

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| Priority rule in TS 38.214  Within a positioning frequency layer, the DL PRS resources are sorted in the decreasing order of priority for measurement to be performed by the UE, with the reference indicated by *nr-DL-PRS-ReferenceInfo* being the highest priority for measurement, and the following priority is assumed:  - Up to 64 *dl-PRS-ID*s of the frequency layer are sorted according to priority;  - Up to 2 DL PRS resource sets per *dl-PRS-ID* of the frequency layer are sorted according to priority. |

To solve the above issue, three companies held the view that the LMF can provide certain rules or validity criteria in the pre-configuration to the UE (e.g. for deferred MT-LR) [9][15][16]. The validity criteria (e.g. cell area/RNA validity, the specific criteria is discussed in [Post115-e][605]) can be used for determining whether the PRS configuration is still valid. when the PRS configuration becomes invalid due to UE mobility, the UE can send a request to LMF to update the PRS configuration (e.g. *RequestAssistanceData* message via SDT).

**Option 2: The LMF configures the UE with available PRS configuration within the RNA.**

For the pre-configuration, one company held a view that an optimum selection of *NR-SelectedDL-PRS-IndexList* may be specific to a particular UE location within an RNA and proposed to support providing UE with assistance data describing the DL-PRS available within the RNA[6].

In rapporteur’s view, the gNB determines the RNA configuration for each UE which will enter RRC\_INACTIVE, that is, the RNA configuration is per UE. If the UE-specific RNA configuration is sent to LMF every time UE enters RRC\_INACTIVE, the RRC state of UE will be exposed to the LMF implicitly, which goes against the agreement that the RRC state of the UE is not exposed to the LMF.

**Option 3: The LMF configures the UE with PRS configuration intended to be used in RRC\_INACTIVE, meanwhile, the configuration should consider the parameters of SDT configuration (e.g. RA-SDT/CG-SDT resources, data volume threshold) possibly configured in UE.**

Three companies suggested that the PRS configurations provided by LMF to UE can be associated with RRC\_INACTIVE states [9] [11] [16]. One of them emphasized that the positioning accuracy achieved satisfies at least a minimum accuracy requirement (i.e. required by positioning service/LCS client) when operating in RRC INACTIVE state. The PRS configurations for RRC\_INACTIVE may be associated with reporting configurations (e.g. periodic, aperiodic) and report payload sizes.

Depending on whether the UE is in RRC\_CONNECTED or RRC\_INACTIVE state, and the SDT configuration provided by gNB for INACTIVE operation (e.g. RA-SDT/CG-SDT, data volume threshold), the UE can use a suitable PRS configuration when performing measurements. For example, when configured with CG-SDT the UE can use a PRS configuration and measurement reporting configurations that may result in sending periodic measurement reports with a certain moderate payload size within the configured CG resource size.

**Option 4: No impact to PRS configuration for RRC\_INACTIVE.**

It was agreed that the RRC state of the UE is not exposed to the LMF for RRC\_INACTIVE positioning, that is, there is no difference on the PRS configuration at the LMF side. Thus, no need to differentiate the assistance data for RRC\_INACTIVE and RRC\_CONNECTED [3].

Thus, companies are invited to express their preference on the above described options.

**Question 1-1: As to the options related to PRS configuration enhancement for RRC\_INACTIVE, which option(s) do you prefer?**

* **Option 1: The UE reuses the pre-configuration of PRS received in RRC\_CONNECTED and follows its validity criteria.**
* **Option 2: The LMF configures the UE with available PRS configuration within the RNA.**
* **Option 3: The LMF configures the UE with PRS configuration intended to be used in RRC\_INACTIVE, meanwhile, the configuration should consider the parameters of SDT configuration (e.g. RA-SDT/CG-SDT resources, data volume threshold) possibly configured in UE.**
* **Option 4: No impact to PRS configuration for RRC\_INACTIVE.**
* **Option 5: Others, please specify.**

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| **Company** | **Option(s)?** | **Reason / Comments** |
| Huawei, HiSilicon | Option4 | We have agreed on the stage2 baseline for RRC\_INACTIVE for deferred MT-LR. For deferred MT-LR, the measurement report is sent to the network along with the event report. While it is up to the UE what to measure and under the RAN1 description for priority for PRS for the PRS under the same positioning frequency layer. We don't think this issue is singular to INACTIVE state DL positioning and we don't think any enhancement is needed other than reusing the CONNECTED mode PRS configuration.  The first thing we need to address is still to synchronize the understanding between the network and the UE what is the PRS configuration that the UE is using and what measurement the UE performs.  From our understanding, DL positioning is already complete from stage3 perspective in RAN as a baseline solution and enhancement on DL INACTIVE positioning can be considered in the future releases. |
| Qualcomm | Option4/1 | We cannot see a difference in assistance data between connected and inactive RRC states (e.g., mobility can also happen in connected state). We also understand that option 1 has no additional impacts for inactive state (i.e., same as option 4).  The assistance data "validity criteria" would need a specification also for connected state, e.g., in relation with on-demand PRS.  The optimal delivery of assistance data for low power positioning for periodic and triggered events in RRC inactive state would be the use of broadcast assistance data, which can already have a time validity (expiration time) and an area validity (SI area). |
| vivo | Option1 and Option4 | For the deferred MT-LR, if the DL location method is chosen by LMF, the LMF may send the pre-configuration of PRS to UE for the subsequent positioning procedure. From our understanding, the pre-configuration of PRS is independent of the RRC status, that is, the pre-configuration can be used for both RRC\_CONNECTED and RRC\_INACTIVE. Therefore, the UE shall store and reuse the pre-configuration of PRS received in RRC\_CONNECTED and follows its validity criteria, if any.  Meanwhile, as the RRC state of UE is invisible to LMF and is not expected to be exposed to the LPP layer of UE, the configuration from LMF to UE shall be the same for all the RRC states and no impact on PRS configuration for RRC\_INACTIVE. |
| ZTE | Option 1 and option 4 | Option 1 and option 4 share the same meaning that pre-configured assistance data configuration will not be affected by RRC state. |
| Xiaomi | Option 4 | LMF can’t provide any particular enhancements for RRC inactive UE since the LMF don’t know the RRC state of the UE. And based on current deferred MT-LR procedure, the assistance date configured in RRC connected can be used by UE when UE is in the RRC inactive. So we think there is no impact to PRS configuration for RRC inactive. |
| Apple | Options 4 and 1 | Agree with most of the comments above |
| Fraunhofer | Option 2 | The validity area of RNA is actually an example, where RNA is usually bigger than one cell. The concern of RRC state exposure can be alleviated, if we say the validity area for a set of A/D is a list of cells, and this does not change the principle. Within this area however, the optimal configuration of DL-PRS (including priority) could change, and providing more than one configuration for a broader area (e.g. list of cells) and signalling the index of which configuration is best suited for a smaller area (e.g. part of cell/ certain cell) helps address the mobility issues. Here we use an example with part of cell to motivate that the UE may be connected to a macro cell, but there may be densification of TPs for positioning purposes on a portion of cell. |
| CATT | Option 4 and option 1 | We have agreed that the RRC state of the UE is not exposed to the LMF for INACTIVE UL and DL positioning. The LMF doesn’t know if the UE will enter RRC\_CONNECTED, RRC\_INACTIVE or RRC\_IDLE after configuring PRS configuration. Hence, share the same view that the PRS configuration from LMF to UE is not only for RRC\_INACTIVE state. No further impact to PRS configuration for RRC\_INACTIVE.  The UE performs DL location measurements in RRC\_INACTIVE based on stored PRS configuration received in RRC\_CONNECTED or via broadcast assistance data. For PRS configuration for RRC\_INACTIVE, the UE can use the same principle for RRC\_CONNECTED. We can wait for the outcome of pre-configured assistance data in [Post115-e][605]. |
| OPPO | Option 4 | As agreed in previous meeting, the LMF has no information about the RRC state, thus there is no need to differentiate the PRS configuration for RRC\_connected and RRC\_inactive mode. |
| Ericsson | Option 4 |  |
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For **Option 1**, if the LMF has provided the UE with pre-configuration of PRS during RRC\_CONNECTED, one company proposed that the network can send a triggering indication to UE in RRC\_INACTIVE to initiate PRS measurement. The triggering indication can be sent to UE via initial access messages either in MSG 2/4 (in 4-step RACH procedure) or in MSG B (in 2-step RACH procedure). In this case, without having to transition to RRC\_CONNECTED, the UE can initiate the RACH procedure or use CG upon receiving the paging message for subsequently receiving the triggering indication from the network.

In rapporteur’s view, the LMF can send the triggering indication of PRS measurement via *RequestLocationInformation*, which will follow the conclusion of LPP transmission in RRC\_INACTIVE, i.e., the message can be sent from LMF to UE in RRC\_INACTIVE only when there is ongoing SDT. As the RRC state of UE is not exposed to the LMF, the LMF may not send different triggering indications of PRS measurement to the target UE.

Thus, companies are invited to express their views on the above enhancement.

**Question 1-2: If your answer to Q1-1 includes Option1, do you suggest supporting transmission of triggering indication to UE for initiating the measurement of preconfigured PRS via initial access messages when UE is in RRC\_INACTIVE.**

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| **Company** | **Yes/No** | **Reason / Comments** |
| Huawei, HiSilicon | No |  |
| Qualcomm | No | A measurement report is triggered when the criteria in a LPP Request Location Information or LCS Periodic-Triggered Invoke Request are fulfilled. |
| vivo | No |  |
| ZTE | No | LMF should be the one to trigger measurements, not gNB. So the triggering indication of measurement in RRC\_INACTIVE should be the same as that in RRC\_CONNECTED, i.e., use RequestLocationInformation in LPP message. Only difference is that in RRC\_INACTIVEthere is ongoing SDT. |
| Xiaomi | No | This solution may require to enhance NRPPa procedure for gNB to trigger PRS measurement since current LPP RequestLocationInformation message is transparent to gNB. |
| Apple | No |  |
| CATT | No |  |
| Ericsson | No |  |
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# 3 Assistance information from UE to gNB

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| **[9]. R2-2107683 InterDigital**  Proposal 8: Support alignment between the DL-PRS reception/measurements and DRX configuration.  Proposal 9: Support transmission of assistance information from UE to gNB for aligning DL-PRS reception and DRX on-duration during INACTIVE.  **[10]. R2-2107684 InterDigital**  Proposal 1: Support transmission of assistance information from UE to gNB for ensuring suitable SDT resources (e.g. RA-SDT/CG-SDT) and data volume threshold is configured in UE.  Proposal 2: The assistance information sent by UE to gNB when supporting positioning in INACTIVE includes at least type of reporting (e.g. periodic, aperiodic), and payload size of LPP message (e.g. measurement report/location estimates).  Proposal 3: Support transmission of an indication (e.g. SDT-BSR) for requesting resource grants for transmitting NAS PDUs (e.g. containing LPP messages) in SDT-SRB2 when the payload size of the NAS PDUs is greater than the configured data volume threshold.  Proposal 7: Support transmission of assistance information from UE to gNB for indicating start timing, measurement duration and reporting periodicity such that the CG-SDT parameters can be configured to align with the positioning measurement reporting occasions. |

Based on the contributions of one company, the following proposals were made in [18] concerning assistance information from UE to gNB to help with configuration:

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| **Proposal 4: Further study the assistance information transmitted from UE to gNB. The assistance information may include following aspects:**   * **type of reporting (e.g. periodic, aperiodic)** * **payload size of LPP message (e.g. measurement report/location estimates)** * **start timing** * **measurement duration** * **reporting periodicity** |

It is agreed that any uplink LCS or LPP message can be transported in RRC\_INACTIVE via SDT from RAN2 perspective. For ensuring that suitable RA-SDT/CG-SDT resources and data volume threshold is configured for SDT-SRB2 for carrying LPP message (e.g. measurement report/location estimates) in NAS PDUs, one company suggested that the UE can indicate to gNB certain information related to the type of reporting (e.g. periodic, aperiodic), periodicity of reporting and the size of the positioning information during configuration of SDT-SRB2 [10]. To be specific, the UE can send the assistance information to gNB upon receiving the assistance data (i.e. LPP *ProvideAsistanceData* message) from LMF. The gNB can then configure the type of SDT resources (e.g. RA-SDT/CG-SDT) and the data volume threshold with the awareness of reporting configuration and size of positioning information.

Another usage of assistance data from UE to gNB is aligning the PRS configuration parameters with the DRX configurations. In this case, the UE can receive PRS in similar time slots when receiving paging messages or when transmitting initial access messages during mobility. Since the PRS configurations are received by UE in LPP/NAS messages transparently to gNB, the UE can send assistance information to gNB (via RRC signalling) for performing alignment between the PRS and DRX configurations.

From rapporteur’s understanding, for the SDT, multiple UL/DL transmission following UL SDT without transitioning to RRC\_CONNECTED is supported. If the size of UL data is bigger than that of the UL grant, UE can send the BSR in the first UL SDT which indicates there is more data needed to be transmitted, and then the network will assign the subsequent UL grant after receiving the first UL SDT. For CG-SDT, the CG configuration request from UE to gNB has not been agreed yet and will be further discussed. Therefore, rapporteur thinks we may need to wait for SDT progress to confirm whether the CG configuration request can be used to send the assistance information from UE to gNB.

For the alignment of PRS configuration and DRX configuration, generally different UE have different paging occasions, but the PRS configuration is for multiple UEs. One question is which UE’s DRX configuration should be aligned with the PRS configuration. Moreover, it may not suitable that only one UE’s DRX configuration can be aligned with the PRS configuration.

Therefore, companies are invited to express their views on the assistance information from UE to gNB.

**Question 2-1: As to the assistance information from UE to gNB to help with the SDT configuration for transmission of positioning report, which information do you think is essential?**

* **1. type of reporting (e.g. periodic, aperiodic)**
* **2. payload size of LPP message (e.g. measurement report/location estimates)**
* **3. start timing**
* **4. measurement duration**
* **5. reporting periodicity**
* **6. others, please specify**
* **7. no assistance information**

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| **Company** | **Option (s)?** | **Reason / Comments** |
| Huawei, HiSilicon | 2/3/5/6 release/setup indication | Note that this can only be applicable for CG-SDT, since RA-SDT is cell-specific configuration that is applicable for all the UEs within a cell and will only respond to the request of a single UE.  We think that the requested configuration can follow the legacy PUR-config as baseline, that within the PUR-configurationRequest, the following has been included:  PURConfigurationRequest-r16 ::= SEQUENCE {  criticalExtensions CHOICE {  purConfigurationRequest PURConfigurationRequest-r16-IEs,  criticalExtensionsFuture SEQUENCE {}  }  }  PURConfigurationRequest-r16-IEs ::= SEQUENCE {  pur-ConfigRequest-r16 CHOICE {  pur-ReleaseRequest NULL,  pur-SetupRequest SEQUENCE {  requestedNumOccasions-r16 ENUMERATED {one, infinite},  requestedPeriodicityAndOffset-r16 PUR-PeriodicityAndOffset-r16 OPTIONAL,  requestedTBS-r16 ENUMERATED {b328, b344, b376, b392, b408,  b424, b440, b456, b472, b488, b504, b536,  b568, b584, b616, b648, b680, b712, b744,  b776, b808, b840, b872, b904, b936, b968,  b1000, b1032, b1064, b1096, b1128, b1160,  b1192, b1224, b1256, b1288, b1320, b1352,  b1384, b1416, b1480, b1544, b1608, b1672,  b1736, b1800, b1864, b1928, b1992, b2024,  b2088, b2152, b2216, b2280, b2344, b2408,  b2472, b2536, b2600, b2664, b2728, b2792,  b2856, b2984},  rrc-ACK-r16 ENUMERATED {true} OPTIONAL  }  } OPTIONAL,  lateNonCriticalExtension OCTET STRING OPTIONAL,  nonCriticalExtension SEQUENCE {} OPTIONAL  }  -- ASN1STOP  Hence, we think the assistance information should include   * Release/SetupRequest * requestedNumOccasions * requestedPeriodicityAndOffset * requestedTBS   However, we think that this should be discussed/agreed (if possible) in the SDT session, with the conclusion in the positioning session that this can be useful for transporting LPP and LCS message in RRC\_INACTIVE. |
| Qualcomm | 6 | The LPP *moreMessagesOnTheWay/noMoreMessages* flag should be visible at the serving gNB when sending the RRC Resume Request + Event Report with LPP Provide Location Information (Step 3 of the baseline procedure in Annex C of R2-2108383).  This would indicate to the serving gNB that the UE will send additional UL messages (Steps 5 in Annex C) before a response from the serving AMF (Event Report ACK at Step 7a) will be received, and therefore, would avoid sending the RRC Release by the gNB (step 7b) before the event reporting is complete.  At an RRC level, this can just be an indication of more versus no more messages to follow.  [vivo]: UE can send the BSR in the first UL SDT which indicates there is more data needed to be transmitted, and then the network will not release the UE. |
| vivo | 1、3with clarification、5 | For PUR configuration request, the requestedTBS is essential as the PUR can only support one-shot transmission. On the contrary, the SDT can support subsequent transmission. Therefore, the payload size is not essential.  As to the Release/SetupRequest, they are more like stage 3 details than the assistance information from UE to gNB.  Other parameters suggested by HW are acceptable for us, i.e., requestedNumOccasions and requestedPeriodicityAndOffset.  The requestedNumOccasions indicate the requested number of PUR grant occasions. Value one corresponds to one occasion and value infinite corresponds to infinite occasions. From our view, it is equivalent to option 1, i.e. report type (aperiodic or periodic).  In summary, the following assistance information is beneficial:   * 1. type of reporting (e.g. periodic, aperiodic) * 3. start timing of first location report * 5. reporting periodicity |
| ZTE | 3,5 | Assistance information from UE to gNB has been discussed in SDT agenda, the procedure and specific parameters may be likely to follow PUR configuration in LTE. From positioning perspective, we only suggest parameters that are useful for positioning in RRC\_INACTIVE, that is option 3 and 5(if 5 is not absent that means periodic reporting). |
| Xiaomi | 6 | The SDT can be used by UE for different services, not only for positioning service, so any assistance information from UE to assist gNB to decide SDT resource should be discussed and agreed in the SDT session. |
| Apple |  | We think this should be discussed in the SDT session |
| Fraunhofer | 2,5 | The size of message and the frequency of the message could be helpful for the gNB to schedule resources for SDT. Other information could help enhance latency, but could be kept optional. |
| CATT |  | As pointed out by rapporteur, the assistance info for CG configuration from UE to gNB has not been agreed yet and will be further discussed. As it is common assistance info for CG configuration, not specific to positioning feature only, we can wait for further conclusion from SDT session.  In addition, the UE decides the SDT selection based on the total sum of Buffer Size across SDT RBs. There may be several RRC messages including LPP messages, and\or several data for transmission. It is useless to report the payload size of LPP message only. |
| OPPO |  | We think legacy BSR can be reused for UL grant request, and this should be discussed in SDT session. |
| Ericsson | 7 | There is no need to increase Uu load. It is LMF that sets the measurement periodicity, reporting Intervals and the responseTime by which the UE should reply. Thus, if any information needed then it should come from LMF and not from UE. |
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Further, as the assistance information from UE to gNB may be related to SDT WI, companies are invited to express their views on the following question.

**Question 2-2: If your answer to Q2-1 is not Option 7, i.e. the assistance information from UE to gNB is essential from the perspective of POS WI, which option do you prefer?**

* **Option 1: Decide on the assistance information to help with the SDT configuration for transmission of positioning report and trigger the corresponding enhancement work in collaboration with SDT WI.**
* **Option 2: Wait for SDT WI progress to confirm whether UE can send assistance information to gNB to help with the SDT configuration.**
* **Option 3: Others, please specify.**

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| **Company** | **Option(s)** | **Reason / Comments** |
| Huawei, HiSIlicon | Option1 | We think that this should be discussed/agreed (if possible) in the SDT session, with the conclusion in the positioning session that this can be useful for transporting LPP and LCS message in RRC\_INACTIVE. |
| Qualcomm | Option 1 | The requirements should be defined/agreed in the Positioning WI and communicated to SDT WI for designing the details. |
| vivo | Option 1 | OK to trigger the discussion in POS WI and make the final decision in SDT WI. |
| ZTE | Option 1 | Similar as our comments in Q2-1, we decide/recommend parameters that are useful for positioning in RRC\_INACTIVE, the final decision on specific parameters in assistance information should be made in SDT agenda. When determine assistance information in RRC\_INACTIVVE, they should take multiple use cases and difference traffic into consideration |
| Xiaomi | Option 2 | The assistance information from UE should be first discussed in the SDT session. |
| Apple | Option 2 |  |
| Fraunhofer | Option 2 |  |
| CATT | Option 2 |  |
| OPPO | Option 2 |  |
| Ericsson | Option 2 |  |
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# 4 Measurement report enhancements

As to the measurement report enhancement, company contributions provided their views as follows:

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| **[3]. R2-2107829 OPPO**  Proposal 3: No optimization is introduced for positioning measurement report.  **[4]. R2-2108173 Xiaomi**  Proposal 2: Whether use SDT or transition to RRC connected to send uplink LCS and LPP messages is depended on the SDT mechanism.  **[5]. R2-2107142 CATT**  Proposal 1: LMF can provide period of Deferred positioning to assist the gNB to decide whether to release the UE into RRC\_INACTIVE, configure SDT for SRB2, or configure CG resource for SDT.  **[7]. R2-2107358 Spreadtrum**  Proposal 1: Considering the data size of positioning reports in RRC\_INACTIVE state, either RAN2 can optimize the data size of positioning reports or RAN2 can modify the SDT data volume threshold.  Proposal 2: The LMF can adjust configuration for positioning data report to adjust the data size considering the SDT data volume threshold.  Proposal 3: gNB should inform LMF the SDT data volume threshold.  Proposal 4: LMF should indicate gNB the estimated data size of measurement reports or location estimates.  Proposal 5: RAN2 can modify the SDT data volume threshold which can be discussed in SDT session.  **[9]. R2-2107683 InterDigital**  Proposal 11: Support configuring of CGs that are valid across different cells for sending periodic measurement report/location estimates when in INACTIVE.  **[10]. R2-2107684 InterDigital**  Proposal 5: Support LMF providing the UE with segmentation configuration information consisting of indications (e.g. IDs, flag, end-marker) and sequence numbers to use when segmenting and transmitting the segmented LPP messages.  Proposal 6: Support configuration of CG for SDT with parameters (e.g. periodicity) aligned with measurement reporting occasions in INACTIVE.  **[12]. R2-2108128 Lenovo**  Proposal 3: LMF can configure UE segmentation of the measurement report for large measurement report size exceeding the data volume threshold size to support SDT transmissions in RRC\_INACTIVE state based on a set of criteria. FFS threshold and segmentation criteria for the measurement report and whether to capture these aspects in Stage 2 specifications. This can also be applicable to other UL LCS messages.  Proposal 4: The LMF reporting intervals in RRC\_INACTIVE state are aligned with the CG SDT configuration for low latency delivery of the positioning measurement reports.  **[14]. R2-2108772 Samsung**  Proposal 1. There is no need to specify the BSR operation to accommodate the LPP segmentation for LPP uplink transmission in inactive state.  **[15]. R2-2107643 vivo**  Proposal 3: The data size optimization of ProvideLocationInformation should be considered.  Proposal 4: Introduce differential report to optimize the data size of report in deferred MT-LR.  **[17]. R2-2108394 Ericsson**  Proposal 1: LMF provides the configured measurement periodicity and positioning requirements to gNB.  Proposal 2: RAN2 to send an LS to RAN3 to include additional information of positioning requirements in NRPPa. |

Based on the companies’ contributions, the following proposals were made in [18] concerning measurement report enhancement:

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| **Proposal 3: For the alignment between the positioning measurement and the SDT configuration, consider the following alternatives:**   * **Alt 1: Support LMF to inform gNB the estimate data size of measurement report** * **Alt 2: Support LMF to inform gNB the measurement periodicity** * **Alt 3: Support LMF to inform gNB the positioning requirements** * **Alt 4: Support gNB to inform LMF the SDT data volume threshold** * **Alt 5: Support differential measurement report** * **Alt 6: No optimization should be introduced for positioning measurement report**   **FFS: Whether to discuss this issue in SDT agenda or positioning agenda.** |

It is agreed that the LPP message transmission in RRC\_INACTIVE will follow the Rel-17 SDT framework. That is, if the measurement report is transmitted using SDT in RRC\_INACTIVE state, it requires a transmission data size smaller than the data volume threshold. The purpose of the above enhancements is to align the period and data volume threshold of SDT with the period and data size of the measurement report.

For the measurement report reduction, the related enhancements are rephrased as the following options.

**Option 1: The gNB informs LMF of the SDT data volume threshold and the LMF can adjust configuration for positioning data report to adjust the positioning report data size.**

In current specification, the data size of positioning measurement reports or location estimates is related to the request of location information from LMF. Thus, to optimize the data size of the positioning report, one company proposed that gNB can inform the SDT data threshold to LMF [7]. Then LMF can adjust the configuration of location information request to change the amount of positioning report to adapt the SDT data threshold considering the SDT data volume threshold.

**Option 2: Introduce differential report to optimize the data size of report in deferred MT-LR.**

For periodic deferred MT-LR, the UE needs to send out the event report periodically. As the UE may be immobile or moves for a short distance during the interval, one company suggested introducing differential reports to optimize the data size of periodic reports in deferred MT-LR [15]. The differential report can represent the change/difference of the latter report compared to the previous report. It is worth noting that this enhancement is a common enhancement for both RRC\_INACTIVE and RRC\_CONNECTED positioning.

For the interaction between LMF and gNB to optimize the SDT configuration, the related enhancements are rephrased as the following options.

**Option 3: The LMF indicates gNB the estimated data size of measurement reports or location estimates to guide the SDT data volume threshold configuration at the gNB side.**

In the SDT framework, the network can configure a suitable SDT data threshold associated with the size of the PDUs to be carried in UL using SDT. At present, it is up to the gNB implementation to configure the suitable SDT data volume threshold. Therefore, to configure the suitable SDT data threshold, one company suggested that the LMF should indicate gNB the estimated data size of measurement reports or location estimates [7].

**Option 4: The LMF indicates gNB the period of Deferred positioning to guide the CG-SDT resource configuration at the gNB side**

Currently whether to release a UE into RRC\_INACTIVE is up to NG-RAN node implementation. The deferred 5GC-MT-LR procedure for periodic location events has a special signalling transmission pattern, i.e. UE reports location events periodically. However, gNB is not aware of it when LMF decides DL-only and RAT-Independent positioning for the deferred MR-LR location service. If LMF can provide the period of Deferred positioning to the gNB in this case, the gNB can decide whether to release the UE into RRC\_INACTIVE if there is no data transmission in the future or decide to configure SDT for SRB2 for periodic deferred location event reporting. Moreover, the gNB can configure suitable CG resources for SDT with the assistance info [5].

**Option 5: The LMF indicates gNB the QoS requirements (i.e. response time) to guide the CG-SDT resource configuration at the gNB side**

To enhance the CG-SDT configuration, one company proposed that the LMF can inform the needed positioning QoS in terms of latency and accuracy [17]. A broad level accuracy categorization can be provided by LMF in terms of positioning accuracy. If the requirement in terms of accuracy is high, it is expected that the UE has to provide large data, similarly, if the accuracy requirement is low, the resulting measurement report from UE does not need to be large. The positioning QoS information from LMF to gNB can help gNB to decide what sort of UL grant be required by the UE; whether a large UL grant with a small periodicity or a small UL grant with large periodicity is enough.

**Option 6: No enhancement for positioning measurement report for RRC\_INACTIVE.**

Unlike other options, one company held a view that no optimization shall be introduced for positioning measurement report. To be specific, the SDT already supports subsequent transmission, that is, the data volume will be counted as the whole data size during the entire SDT procedure. And to enable the transmission, SDT also supports RLC segmentation if the current available grant is not able to accommodate the whole PDU to be transmitted, similar as in RRC\_CONNECTED, BSR can also be carried for UL grant request. Furthermore, SDT has not defined the data volume threshold yet. It is too early to optimize the measurement reporting at this stage. It is suggested to simply follow the current data transmission mechanism, i.e. either transmit the measurement report via SDT or trigger a state transition to RRC\_CONNECTED [3].

Therefore, companies are invited to express their preference on the above described options.

**Question 3-1: As to the options related to measurement report enhancement for RRC\_INACTIVE, which option do you prefer?**

* **Option 1: The gNB informs LMF of the SDT data volume threshold and the LMF can adjust configuration for positioning data report to adjust the positioning report data size.**
* **Option 2: Introduce differential report to optimize the data size of report in deferred MT-LR.**
* **Option 3: The LMF indicates gNB the estimated data size of measurement reports or location estimates to guide the SDT data volume threshold configuration at the gNB side.**
* **Option 4: The LMF indicates gNB the period of Deferred positioning to guide the CG-SDT resource configuration at the gNB side**
* **Option 5: The LMF indicates gNB the QoS requirements (i.e. response time) to guide the CG-SDT resource configuration at the gNB side**
* **Option 6: No enhancement for positioning measurement report for RRC\_INACTIVE.**
* **Option 7: Others, please specify**
* **Option8: not needed**

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| **Company** | **Option(s)** | **Reason / Comments** |
| Huawei, HiSilicon | Option8 | The LMF may not really know the size of the report of the periodicity and the assistance information for measurement is more suitable to be reported by the UE to the gNB, as discussed in section 3 |
| Qualcomm | Option 8 | The SDT data volume threshold may be decided by a deployment suitable for all supported applications. As agreed previously, positioning should follow the general SDT framework. "Large" UL messages can be segmented when needed (see also our response to Question 2.1).  The UL LCS/LPP messages may not happen at precisely defined intervals (e.g., even for periodic events variations of several seconds may happen), which generally makes it impossible to precisely predict when an UL message is going to be transmitted. |
| vivo | Option 2 | For Option 1, as the RRC state of UE is invisible to LMF, the configuration from LMF to UE shall be the same for all the RRC states and no impact on PRS configuration for RRC\_INACTIVE.  For Option 2, the differential report of different PRS resources for one measurement has been introduced to reduce the report size. Similarly, the differential reporting of multiple consecutive measurements can further reduce report size. It is an enhancement independent of the RRC state and introduces few spec impacts.  Option 3 to 5 depend on the conclusion of Q2, that is, no duplicate assistance info from both UE and LMF. |
| ZTE | Option 6/8 | If assistance information from UE to gNB is agreed, then there is no need to enhance UE measurement report(option 2 is not needed), not to mention the LMF-involved enhancements(option 1, 3, 4, 5 are not needed). That means in RRC\_INACTIVE, LMF will perform nothing different with the behaviour in RRC\_CONNECTED. |
| Xiaomi | Option 4 | The assistance information from LMF to gNB for SDT configuration can be discussed and agreed in positioning session, and the positioning measurement report period can be provided to gNB to assist gNB to decide proper SDT configuration. |
| Apple | Option 6/8 |  |
| Fraunhofer | Option 6 |  |
| CATT | Option 4 | According to the period of deferred positioning, the gNB can be aware of the activity of the UE and decide whether to release the UE into RRC\_INACTIVE. Furthermore, if the gNB decides to release the UE into RRC\_INACTIVE, the gNB can configure suitable CG-SDT resource for the UE according to the period of deferred positioning.  Compared with the assistance info reporting from the UE discussed in Q2-1, why not send the period directly to gNB from LMF? So both radio resource and latency can be saved. |
| OPPO | Option 6/8 |  |
| Ericsson | Option 4, 5 | We agree with CATT; instead of increasing Uu load; this can be easily solved by NW.  Further, knowledge of priority of positioning session is important information for gNB in order to prioritize the radio resource among multiple users. This should also be considered. |

For the SDT, multiple UL/DL transmission following UL SDT without transitioning to RRC\_CONNECTED is supported. Accordingly, it was agreed that UL LPP message segmentation can also be used by the UE in RRC\_INACTIVE state to fit in with the data volume threshold of SDT, i.e., an LPP message body can be sent in several shorter LPP messages instead of one long LPP message by using the SDT "Subsequent Data Transmission" phase. The specification impact is FFS.

Following is the specification of the LPP message segmentation excerpt from 37.355:

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| 4.3.5 LPP Message Segmentation An LPP message body may be sent in several shorter LPP messages instead of one long LPP message to deliver a large amount of information (e.g., in case the LPP message size exceeds the maximum message size supported by lower layers). When a sender employs LPP message segmentation, the sender shall include the IE *SegmentationInfo* in each LPP message segment. The sender shall indicate in all but the final message segment that more messages are on the way. |

Based on the above description, one company thought the message size threshold for LPP segmentation is up to UE implementation and has no specification impact [14]. On the contrary, two companies suggested that the LMF can provide the UE with segmentation configuration information [10] [12], which will introduce specification impact.

Therefore, companies are invited to express their views on LPP segmentation in RRC\_INACTIVE.

**Question 3-2: As to the options related to the LPP segmentation in RRC\_INACTIVE, which option do you prefer?**

* **Option 1: The message size threshold for LPP segmentation is up to UE implementation.**
* **Option 2: The LMF provides segmentation configuration information to the UE for ensuring suitable LPP segmentation in RRC\_INACTIVE.**
* **Option 3: Others, please specify**

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| **Company** | **Option(s)** | **Reason / Comments** |
| Huawei, HiSilicon | Option3 | We don't think there is any RAN impacts regarding LPP segmentation and the transport of LPP message in SDT in RRC\_INACTIVE. There might be some SA2 clarifications needed but this can be discussed/specified in SA2. |
| Qualcomm | Option 3 | The UE should know the data volume/maximum message size allowed for SDT and should segment a large LPP message accordingly. A gNB can know whether additional UL message segments will be sent by a UE, and therefore, could wait until message transmission is complete before sending a RRC Release message (see our response to Question 2.1).  However, the LPP message segmentation within an LCS Event Report requires clarification/specification, since currently not explicitly supported. This is probably in the realm of SA2 but requires close cooperation with RAN2. Therefore, if the baseline procedure in Annex C of R2-2108383 can be agreed, it should be provided to SA2 (e.g., in an LS). A small clarification may then also be needed in LPP and/or 38.305. |
| vivo | Option 1 with clarification | The RRC state is not expected to be visible to LPP layer of UE, that is, the LPP of UE cannot perform finer segmentation even if the LMF provides segmentation configuration information to UE. Therefore, no spec impact in RAN is expected for LPP segmentation in RRC\_INACTIVE.  As to the concern raised by HW and QC, we think it is a common issue independent of the RRC state. To be specific, the event report from UE to LMF is an LCS message, which may include the LPP message ProvideLocationInformation. The Providelocationinformation can also be segmented in RRC\_CONNECTED. Therefore, an LS to SA2 to address the concern is OK for us.  Based on the comments of HW and QC, Option1 can be rephrased as follows:  • Option 1: The message size threshold for LPP segmentation is up to UE implementation and has no specification impact in RAN side. |
| ZTE | Option 1 | Agree with option 1 that vivo modified |
| Xiaomi | Option 1 | As RAN2 will not specify any solution to exposure the RRC state of the UE to the LPP layer of the UE, so we think the LPP segmentation in RRC inactive has not any issues, UE can handle it as RRC connected. |
| Apple | Option 1 | Agree with vivo |
| Fraunhofer | Option 1 | Agree with vivo and others. |
| CATT | Option 1 | Agree with vivo and others. The impact on SA2 protocol can be discussed in SA2. |
| OPPO | Option 1 | Agree with vivo. |
| Ericsson | Option 3 | We have mentioned prior that segmenting LPP message just so that UE can fit into SDT should not be allowed. There is a risk that if LPP segmentation if done just for the sake of SDT, it may incur latency and in fact consume more power as there would be several subsequent transmissions. If LPP data size is larger than configured data volume threshold; UE shall use connected mode. |
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# 5 Summary

TBD

# References

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3. R2-2107829, Supporting positioning in RRC\_INACTIVE state, OPPO.
4. R2-2108173, Discussion on positioning for UEs in RRC Inactive, Xiaomi.
5. R2-2107142, Discussion on Positioning for UEs in RRC\_INACTIVE state, CATT.
6. R2-2107149, Considerations on positioning in RRC\_INACTIVE mode, Fraunhofer IIS; Fraunhofer HHI
7. R2-2107358, Discussion on positioning in RRC\_INACTIVE state, Spreadtrum Communications
8. R2-2107671, Support of Positioning in RRC\_INACTIVE, Intel Corporation
9. R2-2107683, Discussion on Positioning in RRC INACTIVE state, InterDigital, Inc.
10. R2-2107684, Discussion on reporting of Positioning Information with SDT, InterDigital, Inc.
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12. R2-2108128, On Positioning in RRC\_INACTIVE state, Lenovo, Motorola Mobility
13. R2-2108703, Considerations on positioning in RRC\_INACTIVE, Nokia, Nokia Shanghai Bell
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16. R2-2108764, Considerations on Positioning in RRC\_INACTIVE state, CMCC
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19. R2-2108835, Report from session on positioning and sidelink relay, Session Chair (MediaTek).