**3GPP TSG-RAN WG2 Meeting #113-eR2-201**

**Electronic, 25th Jan– 05th Feb, 2021**

**Source: Huawei, HiSilicon**

**Title: [Post112-e][609][POS] Positioning support in RRC\_IDLE and RRC\_INACTIVE (Huawei)**

**Agenda item: 8.11.2**

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

Introduction

During RAN2#112-e, the following agreement has been made regarding positioning in IDLE/INACTIVE.

Agreements:

Positioning measurement reporting (including location estimates for UE-based) should be supported in RRC\_INACTIVE; involvement of SDT is FFS. Reporting of specific measurements is pending RAN1 decision.

Then, email discussion is proposed to be triggered after the meeting

* [Post112-e][609][POS] Positioning support in RRC\_IDLE/RRC\_INACTIVE (Huawei)

 Scope: Discuss potential solutions for positioning support in RRC\_IDLE/RRC\_INACTIVE, distinguishing clearly between what can be supported in idle and what can be supported in inactive. Rapporteur is asked to provide update on RAN1 agreements.

 Intended outcome: Report to next meeting

 Deadline: Long

In this email discussion, first, we review related agreements made in RAN1 on IDLE/INACTIVE positioning during the SI phase and its impacts on RAN2; next, we proceed to the scope of the discussion prescribed online.

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# RAN1 agreement on IDLE/INACTIVE positioning

In the following, the agreements in RAN1 on IDLE/INACTIVE positioning would be reviewed by observations.

RAN1#102e

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| Agreement:* NR positioning for UEs in RRC\_IDLE state and UEs in RRC\_INACTIVE state will be investigated in Rel-17, including the benefits on latency, network/UE efficiency and UE power consumption
* FFS: which positioning methods to be supported, e.g., DL positioning, UL positioning, DL+UL positioning and/or Multi-RTT
* FFS: the details of how to enable the UE positioning in RRC\_IDLE state and RRC\_INACTIVE state
	+ Reference signals (e.g., based on DL PRS signals, UL SRS signals, both of them, etc.)
	+ Signaling and procedures (e.g., based on PRACH procedure, paging triggered UL SRS transmission, etc.)
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***Observation1: The above agreement is mainly for the sake of progress and does not provide substantial contents.***

RAN1#103e

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| Agreement:Capture the following observations (Editorial modifications and updates to references to be made when capturing in the TR):* The results for the UE efficiency (power saving) in the RRC\_IDLE/RRC\_INACTIVE states were analyzed by 2 sources (Huawei/HiSi, vivo) out of 17 sources (assumptions may be different between the different sources)
* In one source (Huawei/HiSi), the following observations were made:
	+ RRC\_IDLE/RRC\_INACTIVE state positioning can save about 7%-40% power consumption compared to C-DRX configuration
* In one source (vivo), the following observations were made:
	+ Positioning report in the RRC\_IDLE state can provide 44.32 % of power saving gain compared to the report in the RRC\_CONNECTED state
	+ Positioning measurement and report in the RRC\_IDLE state can provide at least 48.38 % of power saving gain compared to the measurement and report in the RRC\_CONNECTED state
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***Observation2: The simulation results from the two sources show the gain in power saving for IDLE/INACTIVE positioning.***

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| Agreement:* NR positioning for UEs in RRC\_INACTIVE state is recommended for normative work, including
	+ DL, UL and DL+UL positioning methods
	+ UE-based and UE-assisted positioning solutions
	+ Support of UE positioning measurements for UEs in RRC\_inactive state
		- Options that can be considered include DL-PRS or DL-PRS and SSB
	+ Support of gNB positioning measurements for UEs in RRC\_inactive state
* The details of how to enable the UE positioning in RRC\_INACTIVE state can be further discussed during normative work. These details may include, but are not limited to the following aspects:
	+ UL reference signals (e.g., SRS for positioning, PRACH preambles) for UL measurements
	+ Signalling and procedures for support the assistance data delivery, DL-PRS configuration, UL reference signals for positioning resource configuration, measurement reporting), which may be developed based on the enhancements of existing signalling and procedures (e.g., existing 2-step and/or 4-step PRACH procedures, paging procedure, small data transmission).
 |

***Observation3: The above two bullets are recommended for normative work and listed for future study, respectively, for positioning in RRC\_INACTIVE. They may serve as the baseline for the study of RRC\_INACTIVE positioning in RAN2.***

Agreement:

Capture the following in the TR:

From a physical layer perspective, it is feasible for a UE to perform DL positioning measurement in RRC\_IDLE state.

* Note: This does not imply that measurements have to be reported in RRC\_IDLE state.

Conclusion:

It is up to RAN2 to decide whether to support the enhancements of NR positioning reporting of DL positioning measurements and/or positioning estimates for RRC\_IDLE UEs.

***Observation4: The above agreement and conclusion may serve as the baseline for the study of RRC \_IDLE positioning in RAN2. Note that only DL positioning is considered for future study in IDLE. So, UL positioning in IDLE is not considered within the scope of study.***

***Question1: Any comment on the above observations from the rapporteur or the RAN1 agreement’s impacts on RAN2 in general?***

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| --- | --- |
| **Company** | **Comment** |
| Ericsson | A general comment is that the above conclusions from RAN1 is based upon RAN1 (physical layer) feasibility without considering signaling and procedural impacts. So RAN2 should evaluate/discuss further and not take the agreements as a final conclusion.We should also note that power saving is not the main use case here. We are not serving NB-IOT UEs. |
| CATT | RAN2 will take the agreement from RAN1 into consideration, instead of “*as the baseline”*. |
| Xiaomi | RAN2 should consider the RAN1 agreements but not take the agreements as the baseline.  |
| Huawei, HiSilicon | “as a baseline” does not mean we take the RAN1 recommendations as the final agreement, but as the background of the discussion we have in RAN2. RAN2 still needs to evaluate the feasibility, if it is within RAN2 scope, for the recommendations from RAN1. |
| vivo | RAN2 should follow RAN1 agreement, at least not against as initial considering. Upon this RAN2 can study the procedure and signals which is out of RAN1 scope. |
| Intel | Based on RAN1 agreements, RAN2 should further discuss the details on the support of INACTIVE UE. But for IDLE, RAN2 needs to decide whether it should be supported in Rel-17. |
| ZTE | We prefer to consider the RAN1 agreements. |
| InterDigital | RAN2 can accept the RAN1 agreement and proceed with a study of IDLE mode DL positioning from the RAN2 perspective. The scope of the study should include impacts on physical layers. |
| Nokia | RAN2 should use the agreements from RAN1 as the basis for RAN2 study of positioning in RRC\_IDLE and RRC\_INACTIVE. There is no point in RAN2 progressing the work in a certain area while RAN1 has no intent of working on enhancements for reference signals or measurements support (unless RAN2 can independently work on it with no RAN1 dependencies). If RAN2 study shows RRC\_IDLE positioning can be specified without additional inputs from RAN1 then RAN2 needs to make a decision whether to pursue RRC\_IDLE positioning in Rel-17 (depending on level of impact to RAN2 specifications and time units available). |
| Convida | RAN2 should evaluate the signalling impacts and feasibility of the RAN1 agreements for positioning in RRC\_IDLE and RRC\_INACTIVE. |

# Definition of IDLE/INACTIVE positioning

Before proceeding to the details, some general discussions are needed on the definition of RRC\_IDLE/INACTIVE positioning since it is still not clear what IDLE/INACTIVE positioning is. On the general procedures of positioning, the following figure is excerpted from positioning stage-2 spec [1].



**Figure 1, Location Service Support by NG-RAN**

From the figure, we can observe that only procedure 1, 3a, 3b, and 5 may involvement the action from the UE and NG-RAN, hence related to the RRC state of the UE.

**For 1 and 5,** it involve the service layer support and RAN signalling

* LCS request/response for MO-LR

**For 3a,** the NG-RAN procedures, not all NG-RAN procedures are related to the RRC states of the UE, which include both UE-associated and non-UE-associated procedures that are related to positioning of a certain UE:

* E-CID information transfer (UE-associated)
* Positioning information transfer (UE-associated)
* Measurement information transfer (non-UE-associated)

**While for 3b**, it not only includes the signalling procedure but also physical layer procedures such as the transmission/reception of reference signals

* RRC signaling (e.g., posSRS configuration)
* LPP signaling (e.g., Capability transfer, Assistance data transfer, Location information transfer)
* MAC procedure/L1 signalling (e.g., activation/deactivation for semi-persistent/aperiodic posSRS)
* Transmission of UL-PRS and reception of DL-PRS
* Reception for assistance information broadcast

From the understanding of the rapporteur, if any of the above procedures happens for a UE in RRC\_IDLE/INACTIVE, it falls within the scope of IDLE/INACTIVE positioning. Hence, we would like to ask the following question

***Question2, Do companies agree the below procedures are under the scope of IDLE/INACTIVE positioning if any of them happens for a UE in RRC\_IDLE/INACTIVE? Are there any other procedure should be under the scope of IDLE/INACTIVE positioning?***

* ***Service layer support***
	+ ***LCS request/response sent/received for MO-LR***
* ***NRPPa***
	+ ***E-CID information transfer (UE-associated)***
	+ ***Positioning information transfer (UE-associated)***
	+ ***Measurement information transfer (non-UE-associated)***
* ***Uu Signaling and procedure***
	+ ***RRC signaling (e.g., posSRS configuration)***
	+ ***LPP signaling (e.g., Capability transfer, Assistance data transfer, Location information transfer)***
	+ ***MAC procedure/L1 signalling (e.g., activation/deactivation for semi-persistent/aperiodic posSRS)***
	+ ***Transmission of UL-PRS and reception of DL-PRS***
	+ ***Reception for assistance information broadcast***

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| --- | --- | --- |
| **Company** | **Y/N** | **Comment** |
| Ericsson |  | Request of Positioning Assistance Data from Inactive mode using on demand connected mode procedure. |
| CATT | Y but | However not all Uu signaling list above should be supported in IDLE/INACITVE. We will discuss them one by one.[Rapporteur’s comments]This question is not about what will be supported for IDLE/INACTIVE positioning |
| Xiaomi | Y | The above procedures can be considered for idle/inactive UE positioning. |
| OPPO | Y |  |
| Huawei, HiSilicon | Yes | This is the superset of the impacted procedures. |
| vivo | Y |  |
| Qualcomm | Y, with modification and qualification | We consider that "under scope" just means that there is a potential for IDLE/INACTIVE support which then needs to be evaluated by RAN2.The "Service Layer Support" should also include:- Location Notification Request/Result- Periodic/Triggered Invoke Request/Result- Event Report/Acknowledgement[Rapp Comment] It is correct that the service layer also include the above procedure. Also, according to Control Plane Location Service procedures in TS 24.571, the following procedures are defined for LCS message:

|  |
| --- |
| - Messages for MO-LR operations (see 3GPP TS 24.080 [5])- Messages for LocationNotification operations (see 3GPP TS 24.080 [5])- Messages for EventReport operations (see 3GPP TS 24.080 [5])- Messages for PeriodicTriggeredInvoke operations (see 3GPP TS 24.080 [5])- Messages for CancelDeferredLocation operations (see 3GPP TS 24.080 [5])- Messages for MSCancelDeferredLocation operations (see 3GPP TS 24.080 [5])- Messages for LocationPrivacySetting operations (see 3GPP TS 24.080 [5]) |

I think for service layer support, all of these should be included. Thus, i would intend to refer to the 24.571 spec for all the supported services.  |
| Intel | Y | We assume here Rapporteur only listed procedures related to Uu interface. But Step 2, 4, 5a should also be considered for a UE in RRC\_IDLE/INACTIVE although they are unrelated to Uu interface signaling. [Rapp Comment]Your understanding is correct because 2,4,5a are not directly associated with the RRC state of the UE, but can only happen when the UE is in RRC\_CONNECED, previously.  |
| ZTE | Y |  |
| InterDigital | Y  |  |
| Apple | Y |  |
| Nokia |  | This is not the right approach to decide on the scope of idle/inactive positioning support. We need to discuss what are the scenarios and use cases for idle/inactive positioning, what measurements, reference signals and assistance data are needed and what are the solutions on the table etc. and then identify relevant impacts to the existing procedures and need for new procedures.[Rapp comments]The intention of this question is to identify the scope of study for IDLE/INACTIVE positioning. Results should be captured in section 7 of the TR 38.857 |
| Convida | Yes, with comments | These are the procedures to consider, but each of them will need to be evaluated for IDLE/INACTIVE support. |

#### Question2 Summary

Companies generally think that we can give a definition for the IDLE/INACTIVE positioning that we have discussed for clarification.

One company think it may not be the right methodology to give a definition for the IDLE/INACTIVE positioning.

[Rapp comment]

The rapporteur would like point out that this is not intended for identifying the impacts to the spec, but to define the scope of study for IDLE/INACTIVE positioning. The discussion for IDLE/INACTIVE positioning has been ambiguous in this since the beginning. For example, if the PRS measurement is performed in IDLE/INACTIVE and reported in CONNECTED, is this IDLE/INACTIVE positioning? This questions intends to give an answer for this.

Based on the feedback, some aspects for service layer support have been added and, we propose the following definition for IDLE/INACTIVE positioning:

**Proposal 1: The following UE positioning procedures are under the scope of RRC\_IDLE/INACTIVE positioning if any of them are performed when the UE is in RRC\_IDLE/INACTIVE. (13/14)**

* **Service layer support**
	+ **LCS messages defined in Clause 4.1.2 for location services in TS 24.571**
* **NRPPa**
	+ **E-CID information transfer (UE-associated)**
	+ **Positioning information transfer (UE-associated)**
	+ **Measurement information transfer (non-UE-associated)**
* **Uu Signaling and procedure**
	+ **RRC signaling for positioning (e.g., posSRS configuration)**
	+ **LPP signaling for positioning (e.g., Capability transfer, Assistance data transfer, Location information transfer)**
	+ **MAC procedure/L1 signalling (e.g., activation/deactivation for semi-persistent/aperiodic posSRS)**
	+ **Transmission of UL-PRS and reception of DL-PRS**
	+ **Reception for assistance information broadcast**

# RRC\_IDLE/INACTIVE positioning

In this section, we discuss the potential solutions for the procedures listed in question 2 to support RRC\_IDLE/INACTIVE positioning, including LCS request/response, E-CID positioning and UL/DL positioning related procedures. Note that uplink-downlink positioning (e.g., multi-RTT) involves solutions for both UL and DL positioning related procedures and thus considered as covered by the discussion on UL and DL positioning already.

LCS request/response for MO-LR

Location services can be instigated from the 5GC for an NI-LR or MT‑LR, or from the UE in case of an MO-LR. While in the relevance of UE signalling, we need to discuss for the cases of MT/NI-LR and MO-LR respectively.

* For MO-LR, UE initiates the LCS request in NAS message and after the LMF receives the LCS request. If this needs to be enabled in IDLE/INACTIVE, we need to study how the NAS message be transmitted.
* For MT/NI-LR, the LCS request comes from the LCS client/from the network itself and no signalling from the UE is required.

Note that in R17, we have another work item for small data transmission in RRC\_INACTIVE, mainly designed for the transmission of user plane mobile originating data. Positioning in RRC\_INACTIVE can take advantage of the uplink transmission mechanism in small data and transmit control plane NAS signalling with it. However, IDLE mode small data transmission is not supported and MT-data is also not in the scope

Based on the above discussion, rapporteur would like to ask the following questions:

***Question3a, Do companies think MO-LR request in IDLE/INACTIVE should be supported by the UE in RRC\_IDLE/INACTIVE?***

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **IDLE(Y/N)** | **INACTIVE(Y/N)** | **Comment** |
| Ericsson | N | N; but connected mode MO-LR can be used and on demand connected mode procedure can be used.[Rapp comment] There is no deferred MO-LR defined in the spec. 23.273-g50 4.1a.54.1a.5 Deferred Location RequestWith a deferred location request, an LCS client or AF sends a location request to a PLMN for a target UE (or group of target UEs) and expects to receive a response containing the indication of event occurrence and location information if requested for the target UE (or group of target UEs) at some future time (or times), which may be associated with specific events associated with the target UE (or group of target UEs). In this version of the specification, only deferred location requests for an MT-LR are supported. | SDT is not defined and specified for Control plane. So, positioning WI can neither use the SDT framework, nor extend SDT framework to support CP signalling as it would deviate from the main objective of the SDT WI. Anyways, When UE in Inactive state; it can quickly (as compared to idle) transit to connected mode. It is still CM\_CONNECTED mode. Thus, (periodic) measurement message can be relayed quickly by using NAS/LPP message.Further, in order to obtain Positioning Assistance data, on demand connected mode procedure can be also used. There should be mechanism defined on how UE in inactive state can go to connected state to obtain the on demand connected mode procedure. On NW side, there should be flexibility defined to inform UE which piece of AD is to be made available via broadcast and which by means of unicast. Thus, UE can retrieve using right procedure accordingly. |
| CATT | Maybe | Maybe | SDT only applies for RRC\_INACTIVE state, and it is used to transmit user plane data. We are wondering whether SDT can be used to transmit control plane NAS signalling As for the MO-LR request in IDLE/IANCTIVE state, control plane CIOT in E-UTRA can be used to transfer the control plane signalling with it. However, control plane CIOT is not supported in NR currently.UE still can get broadcast assistance data in idle mode by on-demand, instead of stepping into connected mode. As for the cipher key, CN may send it to UE in connected mode ahead of location service to UE.  |
| Xiaomi | N | N | Based existing mechanisms, the IDLE/INACTIVE UE can’t transmit NAS messages. For SDT item, it only can be used to transmit user plane data for inactive UE. |
| OPPO | N | N | MO-LR request/response, based on our evaluation is not the key procedure to optimize power consumption, compared to the measurement and report procedure. |
| Huawei, HiSilicon | N | Y | SDT procedure can be adapted to transmit NAS signalling with minimal changes and 5GC has already supported control plane solution for CIOT connected to 5GC in R15. MO-LR request can be supported by a general support for the transmission of uplink dedicated NAS signalling for UE in INACTIVE. Small data transmission in IDLE mode is not within the scope of small data. Hence, we prefer to delay the support to future releases when data transmission in idle mode is supported.  |
| vivo | N | Y | We can enhance C-plane CIoT for NR for idle/inactive NAS message transmission.In this way MO-LR request can be sent. |
| Qualcomm | N | N | We don't see much benefit/user case. An MO-LR Request typically results in one or more LPP and/or NRPPa positioning procedures which seems inefficient or unnecessary in idle/inactive mode. For example, an LPP Provide Assistance Data message or LPP Provide Location Information message can be several kB and may need to be segmented even in connected mode. In addition, most NR RAT dependent positioning methods require a serving RAN node with a signalling connection or signalling association to the UE. For a single/immediate location request, potential power savings may be low or even negative (e.g. if more message segmentation is needed than in connected mode).Idle/inactive mode positioning procedures would be more beneficial for deferred location requests for periodic and triggered location events, as already specified in Rel-16 (section 6.7 of TS 23.273). |
| Intel | N | Y | The support of positioning in IDLE/INACTIVE was discussed in RANP and got lots of supports. The benefit to support positioning in IDLE/INACTIVE without state transmission are:* Can allow higher number of UEs to support positioning simultaneously, esp. for IIoT scenario;
* Low power consumption;
* Low signaling overhead;
* Low latency;

It should be supported if the solution is not complex. For INACTIVE, We do agree that so far SDT only considered user data instead of CP signalling. But we do not see the blocking issue to use the same solution for CP data for INACTIVE UE. That should be easily supported under SDT WI.For IDLE mode, so far there is no existing solution or SI/WI in NR. And therefore we should not introduce it in positioning SI/WI.  |
| ZTE | N | Y | IDLE:When UE keeps in RRC\_IDLE status, there is no good way to transmit MO-LR request message to the NW. Hence, we do not prefer to support MO-LR request transmission in IDLE. But UE may be able to perform the positioning service locally and locate itself when the UE is in RRC\_IDLE.INACTIVE:We think SDT can be considered as the baseline for INACTIVE positioning. SDT mechanism can be used to solve the NAS signalling transmission. And the mechanism of SDT can be modified to support NAS signalling transmission. |
| InterDigital | N | Y | For IIoT applications, MO-LR will be useful especially when devices are in INACTIVE model. An application in the device may request for its location while it is not RRC connected to the network. We think SDT should not be ruled out and may be considered for RRC Inactive mode transmission of MO-LR request. The Rel-17 SDT framework does not preclude forwarding of NAS messages in the control plane using SRB2. As such, since the UE remains in CM-CONNECTED state it may be possible to send the MO-LR request to AMF when the UE operates in RRC Inactive mode.  |
| Apple | N | N | SDT is only for small user plane data. We are reluctant to modify SDT procedure for this case, as the overall latency reduction in RRC\_INACTIVE for MO-LR, when comparing to run LPP procedure in CONNECTED mode, is not obvious. |
| Lenovo, Motorola Mobility | N | Maybe | MO-LR Inactive positioning procedures may have a dependency on the SDT WI but needs to be clarified with respect to C-Plane signalling. The advantages of Idle positioning may arise from the MT/NI-LR (similar to LTE Idle positioning) as opposed to MO-LR procedures.  |
| Nokia |  Maybe | Y | Inactive mode procedures for MO-LR should be studied particularly targeted for IIoT use cases. If there are enough time units allocated for Rel-17 NR positioning WID then can also study Idle positioning. |
| Convida | N | Maybe | RRC\_INACTIVE for MO-LR may be able to take advantage of SDT and modified to support NAS signalling transmission. For RRC\_IDLE, there currently is no proposal/support for MO-LR. |

#### Question3a Summary

Summary of the above question is as follows:

* 0/12 companies who have not replied “maybe” think that MO-LR request in IDLE should be supported by the UE in RRC\_IDLE
* 6/11 companies who have not replied “maybe” think that MO-LR request in INACTIVE should be supported by the UE in RRC\_INACTIVE.

Hence, the following is proposed.

**Proposal2: RAN2 should discuss whether MO-LR request in INACTIVE should be supported by the UE in RRC\_INACTIVE. (6/11)**

***Question3b, Do companies think MO-LR response in IDLE/INACTIVE should be supported by the UE in RRC\_IDLE/INACTIVE?***

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| --- | --- | --- | --- |
| **Company** | **IDLE(Y/N)** | **INACTIVE(Y/N)** | **Comment** |
| Ericsson | N | N | As commented above; it is not latency critical for UE to transit to connected mode from Inactive state and perform these in connected mode. |
| CATT | Maybe | Maybe | As commented in 3a, it is possible if control plane CIOT will be supported in NR. |
| Xiaomi | N | N |  |
| OPPO | N | N | MO-LR request/response, based on our evaluation is not the key procedure to optimize power consumption, compared to the measurement and report procedure. |
| Huawei, HiSilicon | N | N | MT data for UE in IDLE/INACTIVE is out of the scope of small data and it would be a major change to support this. We prefer to consider this in the future releases when MT data is supported.  |
| vivo | N | N | It is not a technical issue to transmit NAS message in idle/inactive if we use C-Plane EDT like LTE. The only thing we need consider is the latency and whether it is necessary to response. For MO-LR, it is possible UE calculate the position without response. But it is based on case and requirement. |
| Qualcomm | N | N | See our response to Question 3a. |
| Intel | N | Y | Same as above. |
| ZTE | N | Y | Please check Q3a. |
| InterDigital | N | Y | In relation to our response to Question 3a, we think MO-LR response may be supported for the UE in RRC Inactive mode using available mechanisms |
| Apple | N | N |  |
| Lenovo, Motorola Mobility | N | Maybe | Similar to response in Q3a.  |
| Nokia | Maybe | Y | See our response to Question 3a. |
| Convida | N | Maybe | Same as above in 3a. |

#### Question3b Summary

Summary of the above question is as follows:

* 0/12 companies who have not replied “maybe” think that MO-LR response in RRC\_IDLE should be supported by the UE in RRC\_IDLE
* 4/11 companies who have not replied “maybe” think that MO-LR request in RRC\_INACTIVE should be supported by the UE in RRC\_INACTIVE.

Hence, we propose the following

**Proposal3: MO-LR response for MO-LR response in RRC\_IDLE/INACTIVE is not supported. (0/11&4/11)**

E-CID positioning

E-CID positioning is the part that has been touched neither in RAN1 nor in RAN2 for the study in RRC\_IDLE/INACTIVE positioning for R17.

In R16, early measurement has been supported by the work item of eDCCA. With early measurement, the UE can measure candidate PSCell/SCell frequencies in IDLE/INACTIVE and reports the results when the UE is in RRC\_CONNECTED, afterwards. In this way, when the UE reports these RRM measurement in CONNECTED, the network can quickly get the measurement from the UE such that the PSCell and SCell configuration can be earlier than previously when the UE can only perform and report the measurement in RRC\_CONNECTED.

Nevertheless, under the current framework of early measurement, the UE still needs to get into the RRC\_CONNECTED to upload the RRC measurement, although the measurement is performed in RRC\_IDLE/INACTIVE. There are two options for the UE to transfer the measurements to the network, as shown in the figure below:

* **Option1:**
	+ **For UE in RRC\_INACTIVE**, NW sends *RRCResume* to the UE, after the reception of which, the UE transits to the RRC\_CONNECTED. NW indicates the request for early measurement based on whether the UE supports early measurement in UE context for RRC\_INACTIVE. Then, the UE reports the measurement report in the *RRCResumeComplete*
* **Option2:**
	+ **For UE in either IDLE or INACTIVE,** the UE can indicate the availability of early measurement in *RRCSetupCompelte* or *RRCResumeComplete*. After the reception of the indication, the NW can request the report of the early measurement in *UEInformationRequest* and the UE responds with *UEInformationResponse*.



**Figure 2, Early Measurement for RRC\_IDLE/INACTIVE**

Based on the scope of eDCCA in R16, RRM measurement in RRC\_IDLE/INACTIVE is in place, which can be potentially taken advantage of for IDLE/INACTIVE mode positioning. For IDLE/INACTIVE positioning, the requirement is that the UE stays out of CONNECTED and sends the measurement to the network in IDLE/INACTIVE. Hence, rapporteur would like to ask the following question for DL E-CID and UL E-CID, respectively.

First, we need to understand whether the RRM measurement performed in IDLE/INACTIVE can be reported by the UE in IDLE/INACTIVE with LPP message. Note that, for the discussion of small data transmission, data transmission in RRC\_IDLE is not within the scope.

***Question4a, Do companies think reporting of RRM measurement performed in IDLE/INACTIVE in LPP should be supported by the UE in RRC\_IDLE/INACTIVE?***

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| --- | --- | --- | --- |
| **Company** | **IDLE(Y/N)** | **INACTIVE(Y/N)** | **Comment** |
| Ericsson | N | N | For LPP, MO-LR based procedure should be used. UE can (quickly as compared to idle) transit to connected mode from inactive state and provide measurement report. We do not see the need to do such enhancements for ECID based procedure. |
| CATT | Y | Y | LPP in DL E-CID can be discussed together with other methods via LPP. |
| Xiaomi | N | N | The SDT item only considers the UP data transmission. UE can transmit to RRC connected to reporting the RRM measurements. |
| OPPO | N | N | E-CID anyway is not of interest from our perspective as a target for optimization. |
| Huawei, HiSilicon | N | Y | For INACTIVE UE, UE can report measurement to the network via SDT for DL E-CID. Only small changes are need for UE to support the transport of dedicated NAS signalling in INACTIVE. For IDLE, this is difficult because data transmission in RRC\_IDLE is not within the scope and large change will be required.  |
| vivo | N | Y | We have already reached the agreement that “Positioning measurement reporting (including location estimates for UE-based) should be supported in RRC\_INACTIVE”, there’s no technical issue to send RRM measurement report in idle/inactive. Whether ECID should be discussed separately with other method can leave to WI. |
| Qualcomm | N | Qualified Y | Any of the defined positioning measurement information in LPP should be supported in inactive state in terms of providing the measurements to a serving gNB (i.e., this should not depend on the positioning method). However, we do not see the need for sending of an LPP message by the UE for DL E-CID in INACTIVE state, since the UE would need to first receive an LPP request from an LMF which would typically place the UE in CONNECTED state.For IDLE mode, please see our comment to Question 9a and 13a. |
| Intel | N | Y | It is related to question whether the UE can receive/transmit data in IDLE/INACTIVE state. As mentioned above, it is possible for INACTIVE state, and the procedure can be done without state transition.  |
| ZTE | N | Y | SDT can be considered as baseline to solve the positioning data transmission in INACTIVE. |
| InterDigital | N | Y | We think RRM measurement reporting for DL E-CID may be supported for RRC Inactive mode. Further aspects may be discussed under the framework of LPP measurement reporting in RRC Inactive mode. |
| Apple | N | N | Agree with Ericsson and Xiaomi  |
| Lenovo, Motorola Mobility | N | Y | In order save on the latency and energy inefficiencies of state transitions (to RRC\_connected), the measurement reporting should be ideally performed in the same state. Inactive state has the best opportunity to support such a feature due to the concurrent SDT WI. Idle state reporting would have to be considered for future releases, if support for transmitting UE data is available.  |
| Nokia | Maybe | Y | The discussion and question are unclear but we understood the question as asking whether UE can perform the measurement while in IDLE/INACTIVE and report the measurement when it transitions to CONNECTED or after it transitions to CONNECTED (in this case use of LPP signalling to report the measurement). We are open to studying such solutions for Inactive positioning. If there are enough time units allocated for Rel-17 NR positioning WID then can also study Idle positioning. |
| Convida | N | N | What are the use cases for doing so and justification? If it can be justified, perhaps these enhancements (e.g. SDT) can be investigated. |

#### Question4a Summary

Summary of the above question is as follows:

* 1/13 companies who have not replied “maybe” think that reporting of RRM measurement performed in RRC\_IDLE in LPP should be supported by the UE in RRC\_IDLE
* 9/14 companies think that reporting of RRM measurement performed in RRC\_INACTIVE in LPP should be supported by the UE in RRC\_INACTIVE.

Hence, we propose the following

**Proposal4: Reporting of RRM measurement performed in RRC\_INACTIVE in LPP should be supported by the UE in RRC\_INACTIVE. (9/14)**

Next, the UE can also report the RRM measurement to the gNB and then gNB reports it to the LMF with NRPPa signalling. However, currently, the NRPPa E-CID Measurement Initiation Request is assumed for the NG-RAN serving the target UE in RRC\_CONNECTED/INACTIVE state. If this is supported, some modifications to the NRPPa spec is needed for RRC\_IDLE.

***Question4b, Do companies think UE can report the RRM measurement performed in IDLE/INACTIVE to the network in RRC message and UL E-CID procedure should be enhanced for the UE in RRC\_IDLE/INACTIVE?***

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **IDLE(Y/N)** | **INACTIVE(Y/N)** | **Comment** |
| Ericsson | N | N | The NRPPa is for RAN3 to discuss. |
| CATT | N | N | We do not see the need to do such enhancement for UL E-CID based procedure. |
| Xiaomi | N | Y | For inactive, we think UE can report the RRM measurement to the network in RRC message.  |
| OPPO | N | N | E-CID anyway is not of interest from our perspective as a target for optimization. |
| Huawei, HiSilicon | N | Y | We think the current NRPPa procedure can already support this and NG-AP transports also supported the transport of NRPPa message for UE in INACTIVE. This is because the AMF does not differentiate between the UE in CONNECTED and INACTIVE. No for IDLE mode |
| vivo | N | Y | As we comment above there’s no technical issue to report, the only thing is whether UL ECID should be treated differently with other methods. This can be discussed in WI and we do not have strong idea on UL ECID enhancement. |
| Qualcomm | N | Qualified Y | For INACTIVE state, there should be no new impact to Stage 3 specifications. I.e., the UE reports the measurements available for RRM and there seems no changes to NRPPa procedures/transport required. Hence, there is nothing to enhance at an NRPPa level.For idle mode, please see our comment to Question 9a and 13a. |
| Intel | N | N |  |
| ZTE | N | Y | INACTIVE:This procedure can be supported by current NRPPa message(E-CID MEASUREMENT REPORT) with minority modification. |
| InterDigital | N | Y | We do not see other issues with reporting of RRM measurements in RRC signalling when the UE is in Inactive mode. As indicated by CATT, we also do not think there is a need for enhancements for supporting UL E-CID.  |
| Apple | N | N | We do not support to abuse legacy RRC message for the purpose of positioning w/o explicit indication of the purpose of reporting. As this may motivate gNB to configure more frequent UE measurements and RRM reports and reduce UE power efficiency. |
| Lenovo, Motorola Mobility | N | N | Should be discussed in coordination with RAN3 with respect to Inactive state. |
| Nokia | Maybe | Y (but lower priority) | The key issue to study here is the reporting of RRM measurements in IDLE/INACTIVE to gNB. The gNB can always use the existing NRPPa procedures to report available RRM measurement to LMF. We can consider this UL E-CID positioning enhancement but treat it as a lower priority. |
| Convida | N | N | Via NRPPa, the UE can report the RRM measurement performed in IDLE/INACTIVE to the network in RRC message without the need for enhancement. If any enhancement is necessary for NRPPa, this would be for RAN3 to discuss. |

#### Question4b Summary

Summary of the above question is as follows:

* 0/13 companies that have not replied “maybe” think that reporting of RRM measurement performed in RRC\_IDLE in LPP should be supported by the UE in RRC\_IDLE
* 7/14 companies think that reporting of RRM measurement performed in RRC\_INACTIVE should be supported by the UE in RRC\_INACTIVE. One company answering yes think that this should be of low priority.

[Rapp comment]

It should be noted that there may be stage3 impacts for sending RRM measurement reports by RRC to the gNB in INACTIVE state. Currently, the RRM report are only sent by the UE in RRC in CONNECTED, even for eDCCA.

Hence, we propose the following

**Proposal5: RAN2 should discuss whether UE can report the RRM measurement performed in RRC\_INACTIVE to the network in RRC message for UL E-CID. UL E-CID procedure has already been supported by NRPPa for the UE in RRC\_INACTIVE. (7/14)**

Downlink positioning

### PRS capability

Before the downlink positioning procedure performed by the UE and LMF, the UE needs first to transfer its PRS capability to the network. For MO-LR, the UE may piggyback the PRS capability with the LCS request in the NAS message. For MT/NI-LR, the LMF needs to request the capability from the UE if it does not keep the UE’s capability in its memory.

However, the UE may only need to send its PRS capability in the first time when the UE performs positioning in RRC\_CONNECTED and LMF can keep its PRS capability ever since. Hence, there may not be the need to transfer PRS capability in RRC\_IDLE/INACTIVE and it only needs to be transferred during the first fix when the UE is in RRC\_CONNECTED.

***Question5a, Do companies agree that we should support ProvideCapbilities for PRS in RRC\_IDLE/INACTIVE?***

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **IDLE(Y/N)** | **INACTIVE(Y/N)** | **Comment** |
| Ericsson | N | N | existing deferred MT-LR procedure should be used; i.e the UE can provide in RRC Connected mode.  |
| CATT | N | N | UE may send the info in *ProcvideCapbilities* (no just for PRS) to AMF or LMF (e.g. deferred MT-LR) ahead of location request to UE in connected mode. We can discuss if AMF or LMF stores the capabilities. |
| Xiaomi | N | N | The LMF can keep its PRS capability reported during RRC connected, such as the existing deferred MT-LR procedure. |
| OPPO | N | N | As commented above, LMF should be able to store the capability reported previously in RRC\_CONNECTED state. |
| Huawei, HiSilicon | N | Y | The UE can send the PRS capability along with MO-LR and this can be supported by a general support for the NAS signalling in INACTIVE. Only small changes are need for UE to support the transport of dedicated NAS signalling in INACTIVE. |
| vivo | N | Y | Our question is whether this capability is idle/inactive individual capability. Does UE have separate capability for idle/inactive or same with connection? We think capabilities for connection and idle/inactive UE are not the same, therefore, different UE capabilities should be used. In that way, we may need provide new capability, but this may be provided before UE release as well. |
| Qualcomm | N | N | This seems to imply that a complete LPP positioning session is performed in idle/inactive state. Similar to our comment in the response to Question 3a, this seems inefficient. "Idle/inactive mode positioning" can be restricted to performing and reporting measurements in idle/inactive state.  |
| Intel | N | Y | We should not assume the solution is already there. since we did not conclude yet whether the LMF can store the capability. Therefore it would be good to decouple the discussion and consider to support the procedure in INACTIVE just in case.  |
| ZTE | N | N | NW side may receive and keep the UE positioning capability when UE is in RRC\_CONNECTED status. |
| InterDigital | N | N | For operation in RRC Inactive mode, we share similar understanding with other companies that the capability information sent during RRC Connected mode and stored in AMF/LMF can be applicable. For RRC Idle mode operation, however, it is not clear if the capability information sent during RRC Connected mode will be retained since the context in CN may be released when UE transitions to idle mode.  |
| Apple | N | N | It is better to explore the option of storing the static LPP capability in NW side. |
| Lenovo, Motorola Mobility | N  | Maybe | This is based on the assumption that the UE first initiates an LPP session and thus performs the pre-requisite LPP procedures while in RRC\_CONNECTED state. Also agree that perhaps there should be a capability distinction between UEs performing positioning procedures while in Connected and Inactive/Idle state.  |
| Nokia | N | N | Agree with Qualcomm that not all LPP procedures are required to work also while the UE is in IDLE/INACTIVE. This needs further study why such a procedure is needed. If it is for latency reduction reasons, then we should keep that discussion separate as part of the latency related email discussions. |
| Convida | N | N | Agree with some of the other comments as far as the justification for this change. *ProvideCapbilities* for PRS can be sent to the network while in RRC\_CONNECTED state |

#### Question5a Summary

Summary of the above question is as follows:

* 0/14 companies think that we should support *ProvideCapbilities* for PRS in RRC\_IDLE
* 3/13 companies that have not replied “maybe” think that we should support *ProvideCapbilities* for PRS in RRC\_INACTIVE.

Hence, ***ProvideCapbilities* for PRS cannot be sent in RRC\_IDLE/INACTIVE**

***Question5b, Do companies agree that we should support RequestCapbilities for PRS in RRC\_IDLE/INACTIVE?***

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **IDLE(Y/N)** | **INACTIVE(Y/N)** | **Comment** |
| Ericsson | N | N | existing deferred MT-LR procedure should be used; i.e the UE can provide in RRC Connected mode.  |
| CATT | N | N | Please see the comments in 5a. |
| Xiaomi | N | N | The LMF can keep its PRS capability reported during RRC connected, such as the existing deferred MT-LR procedure. |
| OPPO | N | N | As commented above, LMF should be able to store the capability reported previously in RRC\_CONNECTED state. |
| Huawei, HiSilicon | N | N | LMF can request the UE capability in RRC\_CONNECTED and keep the capability after the UE moves to INACTIVE.  |
| vivo | N | Y | Same comments as 5a above. |
| Qualcomm | N | N | Same as our response to Question 5a. |
| Intel | N | Y | We should not assume the solution is already there. since we did not conclude yet whether the LMF can store the capability. Therefore it would be good to decouple the discussion and consider to support the procedure in INACTIVE just in case.  |
| ZTE | N | N | If the NW side can keep the UE positioning capability, this step is not necessary any more. |
| InterDigital | N | N | Please refer to our answer in 5a |
| Apple | N | N | Same as Q5a |
| Lenovo, Motorola Mobility | N  | N | Depending on if MT data transmissions is within scope of the SDT WI, which currently seems not the case.  |
| Nokia | N | N | See our response to Question 5a. |
| Convida | N | N | Agree with some of the other comments as far as the justification for this change. *RequestCapbilities* for PRS can be sent from the network while in RRC\_CONNECTED state and these capabilities can be retained by the network  |

#### Question5b Summary

Summary of the above question is as follows:

* 0/14 companies think that we should support *RequestCapbilities* for PRS in RRC\_IDLE
* 2/14 companies think that we should support *RequestCapbilities* for PRS in RRC\_INACTIVE.

For the above two questions, we propose the following

**Proposal6: *Request/ProvideCapbilities* for PRS cannot be sent in RRC\_IDLE/INACTIVE (0/14, 3/13, 0/14, 2/14)**

### DL-PRS configuration

For MO-LR, the UE needs to request assistance data, including e.g. PRS configuration, from the network. This message can be encapsulated within the same NAS message along with LCS request and *ProvideCapabilities* to be sent to the network. Excerpt from clause 7.3.3 of TS 38.305 is shown as below.

|  |
| --- |
| 1. The UE sends an MO-LR Request included in a UL NAS TRANSPORT message as specified in TS 24.501 [29] to the AMF. The MO-LR request may carry an LPP PDU to instigate one or more LPP procedures to transfer capabilities, request assistance data, request location information and/or transfer location information. |

Rapporteur would like to ask the following question:

***Question6, Do companies agree that we should support RequestAssistanceData for DL-PRS for UE in RRC\_IDLE/INACTIVE?***

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **IDLE(Y/N)** | **INACTIVE(Y/N)** | **Comment** |
| Ericsson | N | N | The support to request AD is already there via on-demand broadcast connected mode procedure.  |
| CATT | N | N | UE can get AssistanceData in SI for DL-PRS in IDLE or CONNECTED mode before the location request to it in existing mechanism. |
| Xiaomi | N | N | We think On-demand SI procedure can be reused for requesting the assistance information in positioning SIB. |
| OPPO | N | N | AD delivery via SI can be utilized here, and thus on-demand request via RRC message can be used by UE in RRC\_IDLE/INACTIVE to acquire it. |
| Huawei, HiSilicon | N | Y | This can be supported with a general support for the transport of dedicated NAS signalling for INACTIVE. Only small changes are need for UE to support the transport of dedicated NAS signalling in INACTIVE. |
| vivo | N | Y | See comments in 5a. |
| Qualcomm | N | N | Same as our response to Question 5a.A LPP Request Assistance Data results in an LPP Provide Assistance Data, which can be a rather large message and seems inefficient in idle/inactive mode.  |
| Intel | N | Y | Agree, the broadcast AD can be used. But to be safe, it would be good to support the procedure in INACTIVE since there is no additional efforts on it if CP data can be supported in SDT.  |
| ZTE | N | N | Most PRS related assistance data can be found by UE in the pos-SI. The rest of the assistance data(optional) can either be sent from LMF before a UE requests it in RRC\_INACTVE or RRC\_CONNECTED or be added into the pos-SI. |
| InterDigital | N | N | The request for AD can be piggybacked with the MO-LR request in the NAS message (please refer to our response to 3a). Alternatively, the on-demand SI procedure can be used when requesting AD. |
| Apple | N | N | On-demand retrieval of posSIB is already supported |
| Lenovo, Motorola Mobility | N | Maybe | The existing on-demand SI can be reused and relies on the broadcast of the posSIB to multiple UEs. Share the view that sufficient need for dedicated delivery of assistance data to the UE while initially in Inactive state would depend on the progress of the SDT WI and MO-LR support. [Rapp Comment] For deferred MT-LR, the assistance information in the broadcast for PRS can also be used.  |
| Nokia | N | Maybe | Not all LPP procedures are required to work also while the UE is in IDLE/INACTIVE. This needs further study why such a procedure is needed. Broadcast assistance data and on-demand broadcast assistance data can be used for IDLE/INACTIVE positioning. If any dedicated signalling of assistance can be justified, then we can focus on INACTIVE case alone for such signalling. |
| Convida | N | N | Same as 5a/b. This may also be discussed within the scope of the on demand DL-PRS objectives. |

#### Question6 Summary

Summary of the above question is as follows:

* 0/14 companies think that we should support RequestAssistanceData for DL-PRS for UE in RRC\_IDLE
* 3/14 companies think that we should support RequestAssistanceData for DL-PRS for UE in RRC\_INACTIVE.

Hence, we propose the following

**Proposal7: RequestAssistanceData for DL-PRS cannot be sent for UE in RRC\_IDLE/INACTIVE.(0/14, 3/14)**

With the UE PRS capability sent to the LMF, we can discuss the delivery of DL-PRS assistance data. In general, for positioning in IDLE/INACTIVE, we think there are two approaches for PRS configuration:

* **Option 1**: The network broadcasts *posSIB*.
	+ UE requests the system information if it is not broadcasted and acquires the assistance information by reading the system information; Note that in this case, no stage3 spec change is needed.
* **Option 2:** The LMF sends PRS assistance data via LPP message to UE
1. UE receives the LPP message in RRC\_CONNECTED and keeps it when the UE moves to INACTIVE; Note that in this case, no stage3 spec change is needed
2. The UE/GMLC transmits the LCS request for the UE in RRC\_IDLE/INACTIVE and the UE receives LPP message for PRS configuration in IDLE/INACTIVE

**For Option1**, we think this is already supported in R16, with the definition of *RRCSystemInfoReqeust* as a CCCH message. UE can request the DL-PRS configuration by on-demand SI request in IDLE/INACTIVE by sending the *RRCSystemInfoRequest*.

|  |
| --- |
| ***RRCSystemInfoRequest message***-- ASN1START-- TAG-RRCSYSTEMINFOREQUEST-STARTRRCSystemInfoRequest ::= SEQUENCE {criticalExtensions CHOICE { rrcSystemInfoRequest RRCSystemInfoRequest-IEs, criticalExtensionsFuture-r16 CHOICE { rrcPosSystemInfoRequest-r16 RRC-PosSystemInfoRequest-r16-Ies, criticalExtensionsFuture SEQUENCE {} }}}RRCSystemInfoRequest-Ies ::= SEQUENCE {requested-SI-List BIT STRING (SIZE (maxSI-Message)), --32bitsspare BIT STRING (SIZE (12))}RRC-PosSystemInfoRequest-r16-Ies ::= SEQUENCE {requestedPosSI-List BIT STRING (SIZE (maxSI-Message)), --32bitsspare BIT STRING (SIZE (11))}-- TAG-RRCSYSTEMINFOREQUEST-STOP-- ASN1STOP |

**For Option 2(a)**, while the UE is initially in RRC\_CONNECTED, the network can send LPP message with DL-PRS configuration to the UE. The UE can then keep this configuration when the UE transits to RRC\_IDLE/INACTIVE. For UE initially in IDLE/INACTIVE, the AMF would initiate a network triggered service request to establish a signalling connection with the UE. The AMF can then transfer the LPP PDU to the UE in CONNECTED, as descripted in TS 38.305. For both cases, NG-RAN can then release the UE back into the INACTIVE/IDLE, when the UE can use this configuration.

***Question7a, Do companies agree that the Option1 and 2a are already supported by the current stage3 spec and can be reused for PRS measurement IDLE/INACTIVE positioning?***

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comment** |
| Ericsson | Yes |  |
| CATT | Yes |  |
| Xiaomi | Yes |  |
| OPPO | Yes |  |
| Huawei, HiSilicon | Yes |  |
| vivo | Yes |  |
| Qualcomm | Yes |  |
| Intel | Yes | But option 2a only works if positioning is triggered when the UE is in CONNECTED. It cannot work for the scenario that the positioning is triggered when the UE is in INACTIVE.  |
| ZTE | Yes |  |
| InterDigital | Yes |  |
| Apple | Yes |  |
| Lenovo, Motorola Mobility | Yes |  |
| Nokia | Yes | Agree we can already leverage the broadcast assistance data support. Also, it is possible to leverage the assistance data received in connected state and store and use it for Idle/Inactive positioning. |
| Convida | Yes |  |

#### Question7a Summary

All the companies think that the current stage3 spec have already supported AD delivery during RRC\_CONNECTED and on-demand SI request in RRC\_IDLE/ INACITVE for IDLE/INACTIVE positioning and can be reused for PRS measurement IDLE/INACTIVE positioning

**Proposal8: Current stage3 spec has already supported assistance data delivery for DL positioning during RRC\_CONNECTED and on-demand SI request in RRC\_IDLE/ INACITVE for IDLE/INACTIVE positioning. (14/14)**

**For option 2(b),** the network sends the PRS configuration to the UE while the UE is in RRC\_IDLE/INACTIVE with LPP message. In order to reduce the procedure latency, and avoid the UE resuming the RRC connection wasting UE power consumption, NG-RAN can transfer the LPP PDU to UE while keeping the UE in IDLE/INACTIVE. The procedure is depicted in Figure 3 and this LPP message delivery solution can be used for any UE terminated LPP messages.



**Figure 3, DL-PRS Configuration in IDLE/INACTIVE**

An important note that for the discussion in small data transmission in R17, we only support MO-data transmission and MT-data transmission is not part of the scope. However, if the support for MO-data is in place, the spec impacts to support MT-data will not be large. Also, data transmission in RRC\_IDLE is out of the scope for small data in R17.

***Question7b, Do companies agree that we should support DL-PRS configuration delivery to the UE in RRC\_IDLE/INACTIVE?***

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **IDLE(Y/N)** | **INACTIVE(Y/N)** | **Comment** |
| Ericsson | N | N | As such RRC release should not be massive msg. The PRS AD may be large and we need to see if RRC release msg is good to carry such info.We would prefer to use existing procedure deferred MO-LR/MT-LR |
| CATT | N | N | We don’t think DL-PRS configuration delivery to UE should happen in RRC\_IDLE/INACTIVE. The existing mechanism supports UE to get the broadcast AD. |
| Xiaomi | N | N | We think option 1 and option 2a are enough. For option 2a, if the DL PRS configuration is out of data, UE can trigger service request to send LPP assistance information request to LMF. |
| OPPO | N | N | As replied to Q6, AD delivery via SI can be utilized here as the main method. |
| Huawei, HiSilicon | N | N | The UE can get the assistance information for PRS from either LPP in CONNECTED or by broadcast and perform measurement in INACTIVE.  |
| vivo | N | N | As mentioned above, PRS configuration can be delivered by SI |
| Qualcomm | N | N | This scenario seems unlikely. In order for the LMF to send an LPP Provide Assistance Data to the UE, there would normally have to be a previous MO-LR request from the UE or a previous interaction with the UE for an MT-LR or NI-LR (e.g. the UE has instigated an emergency call in the case of NI-LR or the AMF notified the UE for an MT-LR or the LMF requested and obtained the UE LPP capabilities). The previous interaction will put the UE in Connected mode unless conducted in Idle/Inactive mode which, as we commented above, is not efficient.In addition, the Rel-16 mechanism Option 1/2a seems sufficient. It may be revisited in later Releases, e.g., as part of small data transmission work.This applies to any DL LPP message (i.e., not restricted to DL-PRS configuration). |
| Intel | N | Y | Agree, the broadcast AD can be used. But to be safe, it would be good to support the procedure in INACTIVE since there is no additional efforts on it if CP data can be supported in SDT and we cannot assume every network will support broadcast AD.  |
| ZTE | N | N | UE can receive the PRS assistance data from broadcast when it is in either RRC\_INACTIVE or RRC\_IDLE. |
| InterDigital | N | Y | For reducing any further signalling and latency associated with having to transition to RRC Connected mode (as in Option 2a), we think it is beneficial to support delivery of AD to UE while remaining in RRC Inactive mode.  |
| Apple | N | N | As replied to Q6, posSIB delivery via on-demand SI can be utilized here. |
| Lenovo, Motorola Mobility | N | Maybe | Option 1/2a is already supported but there is a benefit in terms of reducing state transitions while receiving a dedicated configuration in Inactive state as noted in Option 2b. An uncertain issue is if the spec impact outweighs the effort to support Option 2b in this Release and dependency on MT transmissions in the SDT WI.  |
| Nokia | N | Maybe | Not all LPP procedures are required to work also while the UE is in IDLE/INACTIVE. This needs further study why such a procedure is needed. Broadcast assistance data and on-demand broadcast assistance data can be used for IDLE/INACTIVE positioning. If any dedicated signalling of assistance can be justified, then we can focus on INACTIVE case alone for such signalling. |
| Convida | N | Maybe | This may be a discussion for the on-demand PRS objective as stated for Q6. |

#### Question7b Summary

Summary of the above question is as follows:

* 0/14 companies think that we should support DL-PRS configuration delivery to the UE in RRC\_IDLE
* 2/11 companies that have not replied “maybe” think that we should support DL-PRS configuration delivery to the UE in RRC\_INACTIVE.

Hence, we propose the following

**Proposal9: DL-PRS configuration delivery to the UE in RRC\_IDLE/INACTIVE is not supported. (0/14,2/11)**

### PRS measurement triggering

During the RAN1 discussion in the SI, the following agreements have been made on the PRS measurement and highlighted below

|  |
| --- |
| Agreement:* NR positioning for UEs in RRC\_INACTIVE state is recommended for normative work, including
	+ DL, UL and DL+UL positioning methods
	+ UE-based and UE-assisted positioning solutions
	+ Support of UE positioning measurements for Ues in RRC\_inactive state
		- Options that can be considered include DL-PRS or DL-PRS and SSB
	+ Support of gNB positioning measurements for Ues in RRC\_inactive state
* The details of how to enable the UE positioning in RRC\_ INACTIVE state can be further discussed during normative work. These details may include, but are not limited to the following aspects:
	+ UL reference signals (e.g., SRS for positioning, PRACH preambles) for UL measurements
	+ Signalling and procedures for support the assistance data delivery, DL-PRS configuration, UL reference signals for positioning resource configuration, measurement reporting), which may be developed based on the enhancements of existing signalling and procedures (e.g., existing 2-step and/or 4-step PRACH procedures, paging procedure, small data transmission).

Agreement:Capture the following in the TR:From a physical layer perspective, it is feasible for a UE to perform DL positioning measurement in RRC\_IDLE state.* Note: This does not imply that measurements have to be reported in RRC\_IDLE state.

Conclusion:It is up to RAN2 to decide whether to support the enhancements of NR positioning reporting of DL positioning measurements and/or positioning estimates for RRC\_IDLE Ues. |

In order to support UE to measure PRS in IDLE/INACTIVE, the first issue is to trigger UE for the positioning measurements. There are two cases how the *RequestLocationInformation* message can be sent to the UE:

* **Option1, *RequestLocationInformation* in RRC\_CONNECTED**
	+ The current spec can already support this with deferred MT-LR and there is no specification impact for this. The LMF can send the message to the UE while the UE is in CONNECTED by setting the type for the request as *periodicalReporting* and the UE can continue the measurement in IDLE/INACTIVE
* **Option2, *RequestLocationInformation* in RRC\_INACTIVE/IDLE**
	+ The network can send this to the UE with the similar procedure depicted in Figure 2. It can also be sent along with the DL-PRS assistance information sent in *RRCRelease* as showed in Figure 2.

In R16, PRS measurement is only defined for RRC\_CONNECTED in 38.215. From the agreement from RAN1 above, it can be seen that PRS measurement in RRC\_INACTIVE has already been agreed. Similar to DL-PRS configuration delivery, the procedure depicted in Figure 3 can be used for any UE terminated LPP messages.

Assuming that PRS measurement is supported for both IDLE/INACITVE, rapporteur would like to ask the following two questions.

***Question8a, Do companies agree that the current stage3 spec already supports the transfer of RequestLocationInformation in RRC\_CONNECTED for PRS measurement in IDLE/INACTIVE?***

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comment** |
| Ericsson | Y | For Inactive state it is fine. However, we need to ensure there is provision of measurement reporting also for UE operating in UE based mode. |
| CATT | Y |  |
| Xiaomi | Y | The existing deferred MT-LR procedure already supports it. |
| OPPO | Y |  |
| Huawei, HiSilicon | Y | UE can store the PRS AD by its own implementation when the UE transits to the INACTIVE since the PRS is not part of the RRC UE context.  |
| vivo | Y |  |
| Qualcomm | Y |  |
| Intel  | Yes, but | We need to consider the scenario that the positioning needs to be triggered when the UE is in INACTIVE. OPTION 1 cannot work for it since the UE has to be transferred to CONNECTED first. [Rapp Comment]This is addressed by Question8b |
| ZTE | Y |  |
| InterDigital | Y |  |
| Apple | Y |  |
| Lenovo, Motorola Mobility | Y |  |
| Nokia | Y |  |
| Convida | Y |  |

#### Question8a Summary

All the companies think that the current stage3 spec already supports the transfer of RequestLocationInformation in RRC\_CONNECTED for PRS measurement in IDLE/INACTIVE.

Hence, we propose the following

**Proposal10: Current stage3 spec already supports the transfer of RequestLocationInformation in RRC\_CONNECTED for PRS measurement in IDLE/INACTIVE. (14/14)**

Again, one note is that MT-data transmission in INACTIVE and data transmission in IDLE is not part of the scope in small data.

***Question8b, Do companies agree that we should support the transfer of RequestLocationInformation when the UE is in RRC\_IDLE/INACTIVE?***

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **IDLE(Y/N)** | **INACTIVE(Y/N)** | **Comment** |
| Ericsson | N | N | We should have mechanism such as deferred MT-LR/MO-LR procedure and based upon configured periodicity UE transits to connected state from inactive and provides the necessary information. |
| CATT | N | N | We prefer to transfer *RequestLocationInformation* in RRC\_CONNECTED if CIOT not supported in NR. |
| Xiaomi | N | N | We prefer option 1. |
| OPPO | N | N | Option-1 as the existing solution should be sufficient from our perspective. |
| Huawei, HiSilicon | N | N | MT data for IDLE/INACTIVE is not in the scope of small data and major changes need to be made.  |
| vivo | N | N | We wonder if we have enough time to support both MO and MT, and MT transmission is much more complicated. |
| Qualcomm | N | N | See our response to Question 5a and 7b. |
| Intel | N | Y | We need to consider the scenario that the positioning needs to be triggered when the UE is in INACTIVE. OPTION 1 cannot work for it since the UE has to be transferred to CONNECTED first. It would be good to support the procedure in INACTIVE since there is no additional efforts on it if CP data can be supported in SDT.  |
| ZTE | N | N | Request location info message can be transmitted when UE is in RRC\_CONNECTED.  |
| InterDigital | N | Y | Similar to our response to 7b, we think it is beneficial for supporting the transfer of RequestLocationInformation while the UE remains in RRC Inactive state.  |
| Apple | N | N |  |
| Lenovo, Motorola Mobility | N | Maybe | The scenario where a state transition is not required can reduce any transitional latency. Furthermore, MT support needs to be checked in coordination with the SDT WI for Inactive state. |
| Nokia | N | Maybe | Not all LPP procedures are required to work also while the UE is in IDLE/INACTIVE. This needs further study why such a procedure is needed (use case, scenario?). If any dedicated signalling of request for location information can be justified, then we can focus on INACTIVE case alone for such signalling. |
| Convida | N | Maybe | May be possible to leverage enhancements for SDT |

#### Question8b Summary

Summary of the above question is as follows:

* 0/14 companies think that we should support the transfer of RequestLocationInformation when the UE is in RRC\_IDLE
* 2/11 companies that have not replied “maybe” think that we should support the transfer of RequestLocationInformation when the UE is in RRC\_INACTIVE.

Hence, we propose the following

**Proposal11: Transfer of RequestLocationInformation when the UE is in RRC\_IDLE/INACTIVE is not supported (0/14, 2/11)**

### UE measurement reporting

During the RAN1 discussion in the SI, the following agreements have been made on the PRS measurement reporting and highlighted below

|  |
| --- |
| Agreement:* NR positioning for UEs in RRC\_INACTIVE state is recommended for normative work, including
	+ DL, UL and DL+UL positioning methods
	+ UE-based and UE-assisted positioning solutions
	+ Support of UE positioning measurements for Ues in RRC\_inactive state
		- Options that can be considered include DL-PRS or DL-PRS and SSB
	+ Support of gNB positioning measurements for Ues in RRC\_inactive state
* The details of how to enable the UE positioning in RRC\_ INACTIVE state can be further discussed during normative work. These details may include, but are not limited to the following aspects:
	+ UL reference signals (e.g., SRS for positioning, PRACH preambles) for UL measurements
	+ Signalling and procedures for support the assistance data delivery, DL-PRS configuration, UL reference signals for positioning resource configuration, measurement reporting), which may be developed based on the enhancements of existing signalling and procedures (e.g., existing 2-step and/or 4-step PRACH procedures, paging procedure, small data transmission).

Agreement:Capture the following in the TR:From a physical layer perspective, it is feasible for a UE to perform DL positioning measurement in RRC\_IDLE state.* Note: This does not imply that measurements have to be reported in RRC\_IDLE state.

Conclusion:It is up to RAN2 to decide whether to support the enhancements of NR positioning reporting of DL positioning measurements and/or positioning estimates for RRC\_IDLE Ues. |

Note that for the discussion in this section, the assumption is still that PRS measurement can be performed in both IDLE/INACTIVE.

After the receiving the *RequestLocationInformation* message and the indication of continuing the measurement in IDLE/INACTIVE, the UE can then measure PRS of multiple TRPs and report the measurement results to the network in RRC\_IDLE/INACTIVE.

For UE in INACTIVE, the positioning measurement reporting can also be supported for UE in INACTIVE based on the framework of small data in Rel-17. It can transfer the positioning data to the core network by sending *RRCResumeRequest*, potentially with a proper cause value. The gNB can then send the RRC Release message to keep the UE in INACTIVE, to save the power of the UE. The AMF also has the context of this UE in INACTIVE, it can transfer the LPP data to LMF using a UE-associated message. For UE in IDLE, small data transmission in Rel-17 is not supported. Also, for UE in IDLE, the AMF does not have the UE context and it might be difficult to transfer the LPP data to the LMF.

The rapporteur thus would like to ask the following question

***Question9a, Do companies agree that we should support the*** ***report of PRS measurement performed in IDLE/INACTIVE when the UE is in RRC\_IDLE/INACTIVE?***

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **IDLE(Y/N)** | **INACTIVE(Y/N)** | **Comment** |
| Ericsson | N | N | We do not see the need of SDT especially when it does not support CP signalling.UE can transit quickly from inactive to connected mode and provide the result using NAS/LPP message; existing event report deferred MT-LR procedure can be used. |
| CATT | Maybe | Maybe | Control plane CIOT in E-UTRA can be used to transfer the control plane signalling with it. However, control plane CIOT is not supported in NR currently.We prefer to report the measurement in connected mode if CIOT not supported in NR. |
| Xiaomi | N | N | SDT is used to transmit user plane data and we think inactive/idle UE can transit to RRC connected to report the measurement. |
| OPPO | N | Y | R17 SDT can act as a start point, which is though limited to UP so far, to develop the LPP message delivery for RRC\_INACTIVE state.For RRC\_IDLE state, considering all the signalling exchange at RAN and CN which cannot be optimized/saved, there is no much gain from designing a new method. |
| Huawei, HiSilicon | N | Y | For INACTIVE UE, UE can report measurement to the network via SDT. Only small changes are need for UE to support the transport of dedicated NAS signalling in INACTIVE. While for IDLE, the change is major. Hence we prefer to support the reporting only for INACTIVE.  |
| vivo | N | Y | Wehave made the decisionPositioning measurement reporting (including location estimates for UE-based) should be supported in RRC\_INACTIVE, there’s no reason we do not support it. |
| Qualcomm | N | Y | In principle, we support reporting in idle mode as well. However, given that the Small Data Transmission work considers RRC inactive state only in Rel-17, it may be better to support idle mode reporting in a future Release.  |
| Intel | N | Y | Share the same view with OPPO,Huawei and Qualcomm.  |
| ZTE | N | Y | SDT with small modification can be used to solve the measurement report transportation when UE is in RRC\_INACTIVE. |
| InterDigital | N | Y | We share similar understanding with Oppo on sending LPP messages in RRC Inactive mode. Since the Rel-17 SDT framework does not preclude forwarding of NAS messages in CP, it may be possible for using SDT (in SRB2) for sending LPP messages carrying measurement reports or location estimates. We also think the gain realized for supporting LPP measurement reporting in RRC Idle mode may not be significant to justify the specification workload involved.We also agree with Qualcomm that reporting measurements during idle mode may be revisited in a future release.  |
| Apple | N | Y | Consider to use SDT solution in RRC\_INACTIVE |
| Lenovo, Motorola Mobility | N | Y | Reporting can be supported at least in Inactive state to reduce state transition latencies when reporting positioning measurements.  |
| Nokia | N | Y | We are open to studying the reporting of measurements while in RRC\_INACTIVE and RRC\_IDLE. Yet, we agree with views above from Intel, Qualcomm, Huawei and OPPO that reporting in RRC\_IDLE is better suited for a future Release. |
| Convida | N | Maybe | We support enhancements for reporting measurements for Idle/Inactive based on the solutions for SDT. Since Idle mode is not in scope, this should be limited to RRC\_INACTIVE. |

#### Question9a Summary

Summary of the above question is as follows:

* 0/13 companies who has not replied “maybe” think that we should support the report of PRS measurement performed in IDLE/INACTIVE when the UE is in RRC\_IDLE
* 10/12 companies who has not replied “maybe” think that we should support the report of PRS measurement performed in IDLE/INACTIVE when the UE is in RRC\_INACTIVE

Hence, reporting of PRS measurement performed in IDLE/INACTIVE should be supported when the UE is in RRC\_INACTIVE.

**Proposal12: The report of PRS measurement performed in RRC\_IDLE/INACTIVE when the UE is in RRC\_INACTIVE is supported, not supported when the UE is in IDLE. (0/13, 10/12)**

 [Rapp Comments]

It should be noted that there is no direct RRC state transition from RRC\_IDLE to RRC\_INACTIVE, as shown by the following figure in the RRC spec. But PRS measurement performed in IDLE still can be reported when the UE transits from IDLE to CONNECTED then to INACTIVE.

|  |
| --- |
| Figure 4.2.1-1: UE state machine and state transitions in NR |

Furthermore, for PRS measurement performed in RRC\_IDLE/INACTIVE, UE should be able to report these measurement results to the network when the UE transits to RRC\_CONNECTED. This was supported for NB-IOT positioning, for which, measurement is performed during IDLE and measurement report is sent to the network during RRC\_CONNECTED.

***Question9b, Do companies agree that we should support the report of PRS measurement performed in RRC\_IDLE/INACTIVE when the UE is in RRC\_CONNECTED?***

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comment** |
| Ericsson  | Y | UE can transit quickly from inactive to connected mode and provide the result using NAS/LPP message; existing event report deferred MT-LR procedure can be used. |
| CATT | Y | UE provide measurement report in RRC\_CONNECTED. |
| Xiaomi | Y |  |
| OPPO | Y with comment | Our answer (Y) is based on the assumption that Q9b is based on the legacy/existing procedure.[Rapp Comment]This cannot be supported by legacy/existing procedure since PRS measurement in IDLE/INACTIVE is not defined yet for in 38.215 R16 spec. For NB-IOT, this is supported, but it is based on measurement for LTE PRS.  |
| Huawei, HiSilicon | Y |  |
| vivo | Y with comment | PRS measurement report can be sent both in connection and idle/inactive state. |
| Qualcomm | Y | In our understanding, this is already supported since Rel-15. I.e., a NW typically moves a UE to idle mode if there is no data and signalling activity on NG for some time (i.e., NW inactivity timer shorter than LPP response time; see also section 6.4.2 in 38.305). |
| Intel | Y with comment | Share the same view as OPPO. Yes is based on the assumption that we do not need to change anything.  |
| ZTE | Y |  |
| InterDigital | Y (with comments) | It may be fine for the UE to transition to Connected mode using existing procedure for aperiodic reporting. However, it may be useful to consider other mechanisms for avoiding cycling back and forth between inactive mode and connected mode for periodic/semi-persistent reporting. [Rapp Comment]If the proposal in Question 9a is agreed, the issue mentioned above will be solved.  |
| Apple | Y with comments | Share the same view as OPPO and Intel |
| Lenovo, Motorola Mobility | Y | This would be inline with the standard operation and provides a further option for Connected state reporting in addition to Inactive state reporting.  |
| Nokia | Y | The reporting of PRS measurements in connected where the measurements are done while UE is in Idle/Inactive should be supported. |
| Convida | Y | Legacy Rel-16 procedures should already support this. |

#### Question9b Summary

All the comments think that we should support the report of PRS measurement performed in RRC\_IDLE/INACTIVE when the UE is in RRC\_CONNECTED. Hence, we propose the following

**Proposal13: The report of PRS measurement performed in RRC\_IDLE/INACTIVE when the UE is in RRC\_CONNECTED is supported. (14/14)**

Uplink positioning

For uplink positioning, the last RAN1 meetings have made the following agreements, which are highlighted below.

|  |
| --- |
| Agreement:* NR positioning for UEs in RRC\_INACTIVE state is recommended for normative work, including
	+ DL, UL and DL+UL positioning methods
	+ UE-based and UE-assisted positioning solutions
	+ Support of UE positioning measurements for Ues in RRC\_inactive state
		- Options that can be considered include DL-PRS or DL-PRS and SSB
	+ Support of gNB positioning measurements for Ues in RRC\_inactive state
* The details of how to enable the UE positioning in RRC\_ INACTIVE state can be further discussed during normative work. These details may include, but are not limited to the following aspects:
	+ UL reference signals (e.g., SRS for positioning, PRACH preambles) for UL measurements
	+ Signalling and procedures for support the assistance data delivery, DL-PRS configuration, UL reference signals for positioning resource configuration, measurement reporting), which may be developed based on the enhancements of existing signalling and procedures (e.g., existing 2-step and/or 4-step PRACH procedures, paging procedure, small data transmission).

Agreement:Capture the following in the TR:From a physical layer perspective, it is feasible for a UE to perform DL positioning measurement in RRC\_IDLE state.* Note: This does not imply that measurements have to be reported in RRC\_IDLE state.

Conclusion:It is up to RAN2 to decide whether to support the enhancements of NR positioning reporting of DL positioning measurements and/or positioning estimates for RRC\_IDLE Ues. |

In this chapter, we discuss the uplink positioning under the assumption that SRS is transmitted in INACTIVE

### SRS capability

To help the NG-RAN to decide to include the SRS configurations in the RRC release message, or help the NG-RAN to decide to release the UE to INACTIVE to sending SRS when there is no data service, an indication or information can be sent from the LMF to the NG-RAN. Namely, LMF can provide assistant information to NG-RAN to help NG-RAN to decide configuring the UE to continuing sending SRS when the UE is released to INACTIVE. Additionally, the UE can report the corresponding capabilities to the LMF, such as the capability of sending SRS in INACTIVE. Then LMF can select the proper UL positioning method with this capability information.

***Question10, Do companies think we should support the reporting of*** ***SRS capability for UE in INACTIVE?***

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comment** |
| Ericsson | N | UL SRS Transmission in Inactive has several drawbacks.Positioning involves UE which is on move. UL SRS Transmission require:a) Which direction to transmitb) what power to use;c) What TA value to use.d) How to identify listening nodes (dynamically change) if UE is on moveThus, it adds lot of complexity without much gain.[Rapporteur’s comment]This question only concerns whether to report SRS capability for INACTIVE state if SRS is transmitted for UL positioning in INACTIVE. It would be appreciated if a response can be provided for the question that has been asked. |
| CATT | N | UE may report the *SRS capability* ahead of location request. |
| Xiaomi | N | We prefer to study DL positioning with priority in Rel-17. UL SRS transmission in inactive will lead more UE power consuming. And we think the UE capability of transmission SRS in idle/inactive should be considered if we finally decide to support UL positioning for idle/inactive UE. |
| OPPO | N | Same view as Ericsson, there is no clear motivation to support UL-method for RRC\_INACTIVE/IDLE state. |
| Huawei, HiSilicon | Y | For the UE capability in RRC, since the UE is in INACTIVE and the network can keep the SRS configuration in the UE context, there is no need for the UE to report it again. For the UE capability in LPP, this can be supported by the general support for the transport of dedicated NAS signalling in INACTIVE. Only small changes are needed for UE to support the transport of dedicated NAS signalling in INACTIVE. |
| vivo | Y | Same question with 4.3.1, whether this capability is a common capability or idle/inactive individual capability? We think idle/inactive SRS capability should have difference with connection state. |
| Qualcomm | Maybe | An LPP capability indicating that a UE can transmit UL SRS in INACTIVE state could be useful, which can then be indicated to NG-RAN using NRPPa. However, an alternative to this would be an LPP capability indicating UE support for positioning in INACTIVE state or a per position method capability flag for support of INACTIVE state. |
| Intel | Y | We see the benefit to support this at least for Multi-RTT when the UE is in INACTIVE. And then the procedure is similar to CONNECTED mode.  |
| ZTE | N |  The NW side may received and keep the UE positioning capability(including the SRS capability) when UE is in RRC\_CONNECTED status.  |
| InterDigital | Y | While we agree that there may be certain complications related to use of suitable power and TA, we think the support for UL based positioning methods when the UE operates in RRC Inactive is beneficial. As such, it is reasonable to consider the reporting of capability for transmitting SRS for positioning when in RRC Inactive mode.  |
| Apple | N | As answered in earlier question, we do not support report capability in general while UE is in RRC\_INACTIVE. As the static capability can be stored in NW.  |
| Lenovo, Motorola Mobility | Maybe | Reporting the SRS UE capability to the LMF and indicating support for SRS transmissions while in Inactive state has potential benefits as listed above. In this case, a UE capability distinction between the different states is needed. |
| Nokia | Maybe | Question and description in 4.4.1 are vague. It is unclear if the SRS capability is a single capability parameter or a set of capability parameters. We need to see a bit more detail about the solution for UL positioning method in Inactive to decide on this. It can be considered when the solution becomes clear. |
| Convida | No | This seems unnecessary, as the network can retain the UE capabilities obtained when the UE is in CONNECTED mode. If there is a more compelling use case, this can be revisited. |

#### Question10 Summary

4/11 comapnies that do not reply “maybe” think that we should support the reporting of SRS capability for UE in INACTIVE. Hence, we propose the following:

**Proposal14: Reporting of SRS capability for UE in INACTIVE is not supported. (4/11)**

### SRS configuration

If the UE can transmit SRS during INACTIVE, the UE first needs to get the SRS configuration from the network. The key issue now is how to configure UE to send SRS when entering IDLE/INACTIVE. There are two cases for UE in different states:

* **Option1**: For CONNECTED
	+ A natural solution is to include the SRS configurations in *RRCRelease* message when the UE is in CONNECTED. Similar solution has been adopted in PUR for NB-IoT and eMTC for IDLE/INACTIVE UL transmission.
* **Option2**: For INACTIVE
	+ Delivery of SRS configuration when the UE is in INACTIVE without entering CONNECTED.

For option 1, the UE needs to transfer into CONNECTED state if the UE is initially in IDLE/INACTIVE state. This would lead to extra signalling latency and cause extra power consumption. Another option is to configure SRS to UE without transfer UE into CONNECTED state. An example of the procedure of configuring SRS for the UE in INACTIVE state is illustrated in Figure 3.



**Figure 4, SRS configuration in INACTIVE**

Base on the discussion above, the rapporteur would like to ask the following question:

***Question11a, Do companies think we should support the delivery of SRS configuration for UE SRS transmission in INACTIVE when the UE is in CONNECTED?***

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comment** |
| Ericsson  | N |  |
| CATT | Y | When UE responds the LCS request, UE enters RRC\_CONNECTED. So UE will get the SRS configuration within option1, following the similar mechanism.  |
| Xiaomi | Maybe | If UE is moving out of the serving cell, the SRS configuration is not effective any more. |
| OPPO | N | See reply to Q10. |
| Huawei, HiSilicon | Y | SRS configuration can be transferred to the UE in CONNECTED, either by RRCReconfiguration+RRCRelease with suspend or RRCReleas with suspend |
| vivo | Y | Configuration can be sent in connection, but SRS sending and measurement can be done in idle/inactive state. |
| Qualcomm | Y | There are several possible solutions in terms of how SRS can be configured (e.g. see our answer to 11b). |
| Intel | Y | But it is related to the assumption whether state transition is needed for positioning in IDLE/INACTIVE. Our understanding is no. And therefore the solution is need to let the INACTIVE UE know the SRS configuration.  |
| ZTE | N | SRS configuration may invalid after UE performs cell reselection. |
| InterDigital | Y (with comments) | Option 1 may be suitable for a UE which is already in RRC Connected mode or is required to transition to Connected mode for other non-positioning related procedures  |
| Apple | N | SRS-based positioning methods are supposed to be used by CONNECTED UE. Not sure if SRS configuration can be used in a RNA area. |
| Lenovo, Motorola Mobility | Y | This would enable SRS transmission in Inactive state but would require a state transition which would incur latency. |
| Nokia | Y | Signalling solution details need to be discussed later but we agree that UE needs to be provided the SRS configuration to help it decide on SRS transmission while in Inactive state. |
| Convida | Y | It is reasonable to configure the UE in RRC\_CONNECTED  |

#### Question11a Summary

9/13 comapnies that do not reply “maybe” think that we should support the delivery of SRS configuration for UE SRS transmission in RRC\_INACTIVE when the UE is in RRC\_CONNECTED. Hence, we propose the following:

**Proposal15: Delivery of SRS configuration for UE SRS transmission in INACTIVE when the UE is in CONNECTED if SRS transmission is supported in RRC\_INACTIVE. (9/13)**

***Question11b, Do companies think we should support the delivery of SRS configuration for UE SRS transmission when the UE is in INACTIVE?***

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comment** |
| Ericsson | N |  |
| CATT | N |  |
| Xiaomi | N |  |
| OPPO | N | See reply to Q10. |
| Huawei, HiSIlicon | N |   |
| vivo | N |  |
| Qualcomm | Y | This can be combined with 11a. The SRS configuration provided in connected state or inactive state can be a full SRS configuration or could be a delta-configuration relative to a previously received configuration. It may in some cases also be just an index which points to a previous SRS configuration. |
| Intel  | Y | Share the same view as Qualcomm |
| ZTE | N |  |
| InterDigital | Y | Given the benefits associated with reduced signalling and latency, similar to the delivery of AD for DL-PRS, we think delivery of the SRS configuration while retaining the UE in RRC Inactive mode should be supported. We also share similar understanding with Qualcomm for minimizing the payload size when delivering the SRS configuration in RRC Inactive mode. |
| Apple | N |  |
| Lenovo, Motorola Mobility | Maybe | This would enable standalone SRS transmission during Inactive state without the need for a state transition, which would reduce transition latency. |
| Nokia | Y |  Signalling solution details need to be discussed later but we agree that UE needs to be provided the SRS configuration to help it decide on SRS transmission while in Inactive state. |
| Convida | Maybe | The details for this signalling would need to be evaluated. As SRS configuration can be provided in RRC\_CONNECTED, it may not be necessary. |

#### Question11b Summary

4/12 comapnies think that we should support the delivery of SRS configuration for UE SRS transmission when the UE is in INACTIVE. Hence, we propose the following:

**Proposal16: Delivery of SRS configuration for UE SRS transmission when the UE is in INACTIVE is not supported if SRS transmission is supported in RRC\_INACTIVE. (4/12)**

### SRS-related signalling in NRPPa

When LMF determines to perform uplink positioning for a UE, it first requests the SRS configuration from the gNB with NRPPa message POSITIONING INFORMATION REQUEST. Then, the network responds with POSITIONING INFORMATION RESPONSE to the LMF with the configured SRS to the UE and update the SRS configuration to the LMF with POSITIONING INFORMATION UDPATE when it happens.

After the SRS configuration of the UE, if semi-persistent or aperiodic SRS is configured to the UE, the LMF needs to activate/deactivate the SRS for the UE (not) to transmit by sending the POSITIONING ACTIVATION REQUEST and POSITIONING DEACTIVATION.

When the SRS is transmitted by the UE, the LMF request the TRP measurement with the NRPPa message MEASUREMENT REQUEST sent to the corresponding TRPs.

For these NRPPa messages, they are transported to the gNB by the NRPPa transport in the NG-AP. Note that from the perspective of NG-AP, it does not differentiate between CM-CONNECTED with RRC\_CONNECTED or with RRC\_INACTIVE. So from the understanding of the rapporteur, the above NRPPa signalling for INACTIVE is already supported.

***Question12, Do companies agree that the current stage3 spec already supports the NRPPa message for uplink positioning for UE in INACTIVE?***

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comment** |
| Ericsson | N | For UL SRS based positioning method; Measurement request and report between LMF and NG-RAN is Non-UE associated; however, the procedure needs tight synchronization among UE and listening nodes; it may be difficult to achieve such tight synchronizing while UE is in Inactive state. Because of this, there may be need to define a new NRPPa signalling configuration or have adaptive TRPs (change of TRPs depending upon UE movement)This needs also RAN3 discussion and input. |
| CATT | N | RAN3 should be involved in WI. |
| Xiaomi | N | It depends on RAN3. |
| OPPO | N | See reply to Q10. |
| Huawei, HiSilicon | Y | Already supported as described above.There is no TU for SI in RAN3. OK to involve RAN3 in the study but this can only be done in the WI phase.  |
| vivo | Y | Agree with rapporteur the above NRPPa signalling are already supported, but this is RAN3 scope，should be replied and discussed in RAN3. |
| Qualcomm | Y | Since the UE remains CM connected, there should be no impact to NRPPa signalling. |
| Intel | Y  | Agree with Rapporteur’s analysis.  |
| ZTE | \_ | RAN3 should be involved in WI. |
| InterDigital | Y (with comments) | While we are inclined to agree with Rapporteur’s remarks on coordination between RAN and LMF to be transparent to the RRC state of UE, we would like to understand further if the ”tight synchronization” as indicated by Ericsson may have any impacts to NRPPa signalling.  |
| Apple | N | Need RAN3 to decide |
| Lenovo, Motorola Mobility | N | Requires RAN3 input. |
| Nokia | Y | Agree with Rapporteur |
| Convida |  | For discussion in RAN3 |

#### Question12 Summary

6/12 companies that has not left a blank answer  think that the current stage3 spec already supports the NRPPa message for uplink positioning for UE in RRC\_INACTIVE. Hence, we propose the following:

**Proposal17: RAN2 should discuss whether the current stage3 spec already supports the NRPPa message for uplink positioning for UE in RRC\_INACTIVE. (6/12)**

## General discussion on NAS/NG-AP signalling transport in IDLE/INACTIVE

Finally, rapporteur would like to touch on the general support of NAS signalling transport for UE in IDLE/INACTIVE.

From the above sections, we have generally discussed the support of transmission of UL message for positioning which are transported with uplink NAS message, such as, *ProvideLocationInformation, LCS request, etc;* and DL message for positioning, which are transported with downlink NAS message, such as, *RequestLocationInformation, ProvideAssistanceData, etc.* While for the NAS transport, it consists of two parts: (a) the RRC signalling where dedicated NAS message are sent from the UE to the NG-RAN with SRB2; (b) the NG-AP NAS transport within which the NAS message are transported from the NG-RAN to the AMF.

Note that the inputs from different companies on these questions shall be aligned with the responses above.

***Question13a, Do companies think we should support the transport of UL NAS message in IDLE/INACTIVE for IDLE/INACTIVE positioning?***

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **IDLE(Y/N)** | **INACTIVE(Y/N)** | **Comment** |
| Ericsson | N | N | We should use Deferred MT-LR/MO-LR procedure that is already defined by SA2. Further SA2 may need to be involved on deciding NGAP transport |
| CATT | maybe | maybe | Control plane CIOT in E-UTRA can be used to transfer the control plane signalling with it. However, control plane CIOT is not supported in NR currently. |
| Xiaomi | N | N | At now, there is on mechanism to support the transport of UL NAS message in IDLE/INACTIVE.Moreover, SDT is used to transmit user plane data. |
| OPPO | N | Y | As replied to Q9a, PRS measurement report during RRC\_INACTIVE state is beneficial from our perspective to save power.While there is no much gain to achieve for a design in RRC\_IDLE state. |
| Huawei, HiSilicon | N | Y | Only small change is needed to support the general transport of dedicated NAS message transport in INACTIVE.  |
| vivo | N | Y | It is possible to send UL NAS message using mechanism similar with C-Plane CIoT in LTE. |
| Qualcomm | N | Y | For LCS Event Report with LPP Provide Location Information. We note that this may provide large gains in UE power saving for CIoT UEs with small batteries which perform tracking and other location monitoring functions.In principle, we support reporting in idle mode as well. However, given that the Small Data Transmission work considers RRC inactive state only in Rel-17, it may be better to support idle mode reporting in a future Release.  |
| Intel | N | Y | Share the same view with OPPO. For the question, should not it partially overlapping with question on whether LPP messages are needed for capability, assistance data and location, etc? |
| ZTE | N | Y | SDT with a little modification can be used to handle the UL NAS transportation when UE is in RRC\_INACTIVE status. |
| InterDigital | N | Y | We do share similar understanding with Oppo. Given the benefits of low signalling/latency and echoing our response in 9a, transmission of LPP messages in UL NAS (SRB2) while the UE is in RRC Inactive mode should be supported.  |
| Apple | N | See comments | We support to use SDT to carry certain LPP messages in uplink (i.e, PRS measurements). Not clear why the general support of UL NAS transport needs to be discussed in NR Positioning enhancement SI, but not in another more proper WI?[Rapp Comments]We have clarified in the question that this is the general support of UL NAS message transport in RRC\_IDLE/INACTIVE for positioning. SO, this should be discussed in the positioning WI.  |

#### Question13a Summary

Summary of the above question is as follows:

* 0/10 companies that has not replied “maybe”  think that we should support the transport of UL NAS message in IDLE for IDLE positioning.
* 7/9 companies that has not replied “maybe” or “See comments” think that we should support the transport of UL NAS message in INACTIVE for INACTIVE positioning.

Hence, we propose the following:

**Proposal18: The transport of UL NAS message in INACTIVE is supported for INACTIVE positioning. (7/9)**

[Rapp Comment]

An implication of the above proposal will be that, if we support the general transport of UL NAS message for positioning in RRC\_INACTIVE, we will not exclude any LPP message/LCS message that can be transported in RRC\_INACTIVE. This is related to the discussion in Section 4.1 for MO-LR, Section 4.3.1 for PRS capability report, and Section 4.4.1 for SRS capability report.

***Question13b, Do companies think we should support the transport of DL NAS message in IDLE/INACTIVE for IDLE/INACTIVE positioning?***

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **IDLE(Y/N)** | **INACTIVE(Y/N)** | **Comment** |
| Ericsson | N | N | We should use Deferred MT-LR/MO-LR procedure that is already defined by SA2. Further SA2 may need to be involved on deciding NGAP transport |
| CATT | N | N | We prefer to use existing mechanism in connected mode.  |
| Xiaomi | N | N | Based on the previous questions, we prefer to receive and transmit NAS message in connected mode. |
| OPPO | N | N | No target scenario identified for this yet. |
| Huawei, HiSIlicon` | N | N |  |
| vivo | N | N |  |
| Qualcomm | N | Qualified Y | We support this for a final response from an LMF (e.g. an acknowledgement of an Event Report).However, we don't think DL LCS and LPP messages need to be supported in idle/inactive state when some further message or response is needed from the UE. E.g., Assistance Data and Location Request can be provided while the UE is in connected state, as already specified for deferred MT-LR in Rel-16. |
| Intel | N | Y | It can be used for step 5c, i.e. LMF sends the location results back to the UE for MO-LR case. Also for other LPP DL messages.For the question, should not it partially overlapping with question on whether LPP messages are needed for capability, assistance data and location, etc? |
| ZTE | N | N |  |
| InterDigital | N | Y | Similar to our response in 7b, the delivery of DL NAS messages can be supported while the UE is in RRC Inactive mode (e.g. using similar procedure as described in Fig. 3)  |
| Apple | N | N | This seems has already been discussed in earlier Q7. Again, we think a general support of DL NAS transport in RRC\_INACTIVE is not in the scope of this SI. |
| Lenovo, Motorola Mobility | N | Y | Since the SDT WI focuses on Inactive state transmissions of small data, this can be the initial priority, while in the case of Idle state this can be revisited at a later stage if supported by the NR framework. |
| Nokia | N | Y | In principle we support UL NAS message for INACTIVE positioning.  |
| Convida | N | Maybe | SDT could be leveraged to transport UL e.g. measurements |

#### Question13b Summary

Summary of the above question is as follows:

* 0/14 companies think that we should support the transport of DL NAS message in IDLE for IDLE positioning.
* 5/13 companies that have not replied “maybe” think that we should support the transport of DL NAS message in INACTIVE for INACTIVE positioning.

Hence, we propose the following:

**Proposal19: The transport of DL NAS message in IDLE/INACTIVE for IDLE/INACTIVE positioning is not supported. (5/13)**

Then, for UL positioning methods, such as UL-AOA, TL-TDOA, and UL-ECID, NRPPa message will be utilized for LMF to notify the measurement in the gNB. For DL positioning methods, the network needs to obtain the PRS information with the message TRP INFORAMTION REQUEST/RESPONSE. There are two classes of NRPPa messages, as mentioned by the following text in [1]

|  |
| --- |
| Positioning and data acquisition transactions between a LMF and NG-RAN node are modelled by using procedures of the NRPPa protocol. There are two types of NRPPa procedures:- UE associated procedure, i.e. transfer of information for a particular UE, including the procedures supporting the Positioning Information Transfer and E-CID Location Information Transfer functions;- Non UE associated procedure, i.e. transfer of information applicable to the NG-RAN node and associated TRP, including the procedures supporting the OTDOA Information Transfer, Assistance Information Transfer, TRP Information Transfer, and Measurement Information Transfer functions. |

 From our understanding, both UE-associated and non-UE associated procedures are related to the positioning in IDLE/INACTIVE. In the NG-AP protocol, the UL and DL NRPPa message are transported with DOWNLINK (NON-)UE ASSOCIATED NRPPA TRANSPORT and UPLINK (NON-)UE ASSOCIATED NRPPA TRANSPORT, respectively.

Note that from the perspective of NG-AP, it does not differentiate between CM-CONNECTED with RRC\_CONNECTED or RRC\_INACTIVE. So from the understanding of the rapporteur, the NRPPa transport for INACTIVE is already supported.

Note that the inputs from different companies on these questions shall be aligned with the responses above.

***Question14a, Do companies think we should support the transport of UE-associated NRPPa message in IDLE/INACTIVE for IDLE/INACTIVE positioning?***

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **IDLE(Y/N)** | **INACTIVE(Y/N)** | **Comment** |
| Ericsson | N | N | We should use deferred MT-LR/MO-LR procedure; where UE receives all the needed configuration in connected mode. Then UE may go to inactive state to perform DL PRS based measurement and report at predefined time ”T” in connected state using MT-LR procedure.Further, We think RAN2 group may not be able to decide this. It is RAN3/SA2 who need to disucss this transport. |
| CATT | N | N | The issue need to be discussed in RAN3 or SA2. |
| Xiaomi | N | N | This may be out of the scope of RAN2. |
| OPPO | N | N |  |
| Huawei, HiSilicon | N | Y | Already supported as mentioned above |
| vivo | N | Y | This is RAN3 scope. For RAN2 we define which methods should be support and which signals should be used. |
| Qualcomm | N | Y | For inactive state, this should already be supported (see our response to Question 12). For idle state, there seems more specification work required which could be deferred to later Releases (see also our response to Question 9a). |
| Intel | N | Y | From NRPPa perspective, there is no difference between INACTIVE and CONNECTED mode UE.  |
| ZTE | N | Y | Though we think UE-associated NRPPa message should be supported in RRC\_INACTIVE, this should be discussed in RAN3. |
| InterDigital | N | Y |  |
| Apple | N | N |  |
| Lenovo, Motorola Mobility | N | N |  |
| Nokia | N | Y | For similar reasons as already mentioned above by Qualcomm, Intel, Huawei and others, the UE-associated NRPPa message should be supported at least in INACTIVE. |
| Convida | N | Y, with comments | This should already be supported. RAN3 can discuss any necessary enhancements. |

#### Question14a Summary

Summary of the above question is as follows:

* 0/14 companies think that we should support the transport of UE-associated NRPPa message in IDLE/INACTIVE for IDLE/INACTIVE positioning.
* 8/14 companies think that we should support the transport of UE-associated NRPPa message in INACTIVE for INACTIVE positioning.

[Rapp Comment]

As explained above, NG-AP does not differentiate between UE in CM\_CONNECTED with RRC\_CONNECTED or CM\_CONNECTED with RRC\_INACTIVE. But, this is indeed RAN3 scope and RAN3 needs to further verify on this.

Hence, we propose the following:

**Proposal20: Transport of UE-associated NRPPa message in RRC\_INACTIVE for RRC\_INACTIVE positioning has already been supported. This should be further verified by RAN3. (8/14)**

While for non-UE-associated signalling, since it is “non-UE-associated” and not related to the RRC state of the UE, we don’t need to support the transport for non-UE associated NRPPa message.

***Question14b, Do companies agree that we don’t need to discuss the transport of non-UE-associated NRPPa message in IDLE/INACTIVE for IDLE/INACTIVE positioning?***

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comment** |
| Ericsson | Y  | As per the definition of RRC INACTIVE IN 38.300 as it does not include non-UE associated message: ”RRC\_INACTIVE is a state where a UE remains in CM-CONNECTED and can move within an area configured by NG-RAN (the RNA) without notifying NG-RAN. In RRC\_INACTIVE, the last serving gNB node keeps the UE context and the UE-associated NG connection with the serving AMF and UPF.”For UL SRS based positioning method; Measurement request and report between LMF and NG-RAN is Non-UE associated; however, it needs tight synchronization; it may be difficult to achieve such while UE is in Inactive state |
| CATT | Y | The issue need to be discussed in RAN3 or SA2. |
| Xiaomi | Y | This may be out of the scope of RAN2. |
| OPPO | Y |  |
| Huawei, HiSIlicon | Y |  |
| vivo | Y |  |
| Qualcomm | Y, but… | …it needs to be included in the overall framework for idle/inactive positioning (e.g., Stage 2). However, there seems no additional Stage 3 impacts.[Rapp Comment]Same view.  |
| Intel | Y |  |
| ZTE | Y |  |
| InterDigital | Y |  |
| Apple | Y |  |
| Lenovo, Motorola Mobility | Y |  |
| Nokia | Y |  |
| Convida | Y | If necessary, RAN3 may discuss this. |

#### Question14b Summary

All the companies participating in the discussion think that we don’t need to discuss the transport of non-UE-associated NRPPa message in IDLE/INACTIVE for IDLE/INACTIVE positioning. Hence, we propose the following

**Proposal21: RAN2 doesn’t need to discuss the transport of non-UE-associated NRPPa message in IDLE/INACTIVE for IDLE/INACTIVE positioning (14/14)**

Discussion on RAT-independent positioning

In addition to the above positioning methods for RAT-dependent positioning, 3GPP also supports RAT-independent positioning, including Barometric pressure sensor, WLAN, Bluetooth, TBS, Motion Sensor, A-GNSS, etc. From our understanding, if general support for NAS signalling transport is supported for IDLE/INACTIVE, these positioning methods can also be supported.

***Question15, Do companies agree that RAT-independent positioning can also be supported for IDLE/INACTIVE positioning, if NAS signalling transport is generally supported?***

|  |  |  |
| --- | --- | --- |
| **Company** | **Y/N** | **Comment** |
| Ericsson | N | We should use Deferred MT-LR/MO-LR procedure that is already defined by SA2. |
| CATT | Y |  |
| Xiaomi | Y |  |
| OPPO | Y | If a general support of UL LPP message delivery is designed, there seems no reason to prevent it. |
| Huawei, HiSilicon | Y | This can be naturally supported, at least for measurement/location reporting |
| vivo | Y |  |
| Qualcomm | Y | This is generally independent on the positioning method. |
| Intel | Y |  |
| ZTE | Y |  |
| InterDigital | Y |  |
| Apple | Y |  |
| Lenovo, Motorola Mobility | Y |  |
| Nokia | Y | IDLE/INACTIVE positioning support should also involve RAT-independent positioning |
| Convida | Y | Yes if the NAS signalling procedures are supported. |

#### Question15 Summary

13/14 companies think that RAT-independent positioning can also be supported for IDLE/INACTIVE positioning, if NAS signalling transport is generally supported.

**Proposal22: Support RAT-Independent positioning in RRC\_IDLE/INACTIVE. FFS the procedures that can be supported. (13/14)**

[Rapp comment]

If the transport of UL NAS message is generally supported, *provideAssistanceInforamtion* can be supported for RAT-independent positioning such that UE measurement and location estimate can be sent to the network. However, it is still unclear whether UL/DL message, such as *provideCapability, RequestLocationInformation,* etc, can be supported. The supported procedures for RAT-Independent positioning need to be further studied.

Any other issues

If companies find other issues that need to be addressed, they can be input here.

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Ericsson | Overall, IDLE/INACTIVE positioning would require a lot of work especially for UL SRS based and would impact other groups RAN3, SA2, etc. The benefits is also rather unclear compared to already existing procedure such as deferred MT-LR.[Rapporteur’s comment]Uplink positioning in INACTIVE has been recommended for normative work from RAN1 as a conclusion. From RAN2 perspective, we can evaluate the feasibility but we should not discuss whether to support UL positioning again with no technical issues being found in RAN2. The feasibility of transmission of SRS in INACTIVE state is not supposed to be checked by RAN2, as we see the majority of work lies in RAN1 and RAN1 have already recommended for normative work. From SA2 and RAN3 perspective, it is not clear why they are involved for feasibility check of SRS transmission from a CM-CONNECTED UE. |
| Qualcomm | RAN2 should confirm that UE-based DL-only positioning with UE internal LCS client can be supported in idle/inactive mode already in Rel-16.[Rapp comment]We can include this as FFS in the conclusion and discuss it during online of RAN2#113e |
| Intel | One general question is whether Support positioning in IDLE/INACTIVE means without state transmission?If the UE still needs to transfer to CONNECTED mode, then it is already supported. [Rapp comment]I think this question is related to the definition of IDLE/INACTIVE positioning discussed in Section 3. If, for example, for DL positioning, DL-PRS measurement is performed in IDLE/INACTIVE, which was not supported in R16, and the measurement report is sent in CONNECTED, I think this still falls within the scope of IDLE/INACTIVE positioning. This is because we still need to define the requirement for IDLE/INACTIVE measurement, which is probably the scope of RAN1/4 though. So, in this case, there is state transition, from IDLE/INACTIVE to CONNECTED, but it is still part of IDLE/INACTIVE positioning |
| Nokia | Overall, we need to agree on the priority use cases and scenarios and focus on a manageable (from a schedule perspective) set of use cases and scenarios. We need to prioritize positioning in INACTIVE than positioning in IDLE. We need to support whatever RAT-dependent methods in INACTIVE that is supported by RAN1. Leverage existing functionalities like broadcast assistance and on-demand SI and avoid new dedicated signalling solutions for positioning in IDLE (if agreed to go forward in Rel-17). Don’t have to adapt every LPP procedure in CONNECTED also for IDLE and INACTIVE. |

Conclusions

In this contribution, we have an email discussion on RRC\_IDLE/INACTIVE positioning and based on the opinions from different companies, we propose the following:

Easy Agreement

***Scope of IDLE/INACTIVE positioning***

**Proposal 1: The following UE positioning procedures are under the scope of RRC\_IDLE/INACTIVE positioning if any of them are performed when the UE is in RRC\_IDLE/INACTIVE.**

* **Service layer support**
	+ **LCS messages defined in Clause 4.1.2 for location services in TS 24.571**
* **NRPPa**
	+ **E-CID information transfer (UE-associated)**
	+ **Positioning information transfer (UE-associated)**
	+ **Measurement information transfer (non-UE-associated)**
* **Uu Signaling and procedure**
	+ **RRC signaling for positioning (e.g., posSRS configuration)**
	+ **LPP signaling for positioning (e.g., Capability transfer, Assistance data transfer, Location information transfer)**
	+ **MAC procedure/L1 signalling (e.g., activation/deactivation for semi-persistent/aperiodic posSRS)**
	+ **Transmission of UL-PRS and reception of DL-PRS**
	+ **Reception for assistance information broadcast**

***Downlink Positioning***

**Proposal6: *Request* for PRS cannot be sent in RRC\_IDLE/INACTIVE. (0/14, 3/13) *ProvideCapbilities* for PRS cannot be sent in RRC\_IDLE/INACTIVE (0/14, 2/14)**

**Proposal7: RequestAssistanceData for DL-PRS cannot be sent for UE in RRC\_IDLE/INACTIVE. (0/14, 3/14)**

**Proposal8: Current stage3 spec has already supported assistance data delivery for DL positioning during RRC\_CONNECTED and on-demand SI request in RRC\_IDLE/ INACITVE for IDLE/INACTIVE positioning. (14/14)**

**Proposal9: DL-PRS configuration delivery to the UE in RRC\_IDLE/INACTIVE is not supported. (0/14, 2/11)**

**Proposal10: Current stage3 spec already supports the transfer of RequestLocationInformation in RRC\_CONNECTED for PRS measurement in IDLE/INACTIVE. (14/14)**

**Proposal11: Transfer of RequestLocationInformation when the UE is in RRC\_IDLE/INACTIVE is not supported (0/14, 2/11)**

**Proposal12: The report of PRS measurement performed in RRC\_IDLE/INACTIVE when the UE is in RRC\_INACTIVE is supported, not supported when the UE is in IDLE. (0/13, 10/12)**

**Proposal13: The report of PRS measurement performed in RRC\_IDLE/INACTIVE when the UE is in RRC\_CONNECTED is supported. (14/14)**

***RAT-Independent Positioning***

**Proposal22: Support RAT-Independent positioning in RRC\_IDLE/INACTIVE. FFS the procedures that can be supported. (13/14)**

To further discuss

***MO-LR/Location services***

**Proposal2: RAN2 should discuss whether MO-LR request in INACTIVE should be supported by the UE in RRC\_INACTIVE. (6/11)**

**Proposal3: MO-LR response for MO-LR response in RRC\_IDLE/INACTIVE is not supported. (0/11&4/11)**

***E-CID positioning***

**Proposal4: Reporting of RRM measurement performed in RRC\_INACTIVE in LPP should be supported by the UE in RRC\_INACTIVE. (9/14)**

**Proposal5: RAN2 should discuss whether UE can report the RRM measurement performed in RRC\_INACTIVE to the network in RRC message for UL E-CID. UL E-CID procedure has already been supported by NRPPa for the UE in RRC\_INACTIVE. (7/14)**

***Uplink Positioning***

**Proposal14: Reporting of SRS capability for UE in INACTIVE is not supported. (4/11)**

**Proposal15: Delivery of SRS configuration for UE SRS transmission in INACTIVE when the UE is in CONNECTED if SRS transmission is supported in RRC\_INACTIVE. (9/13)**

**Proposal16: Delivery of SRS configuration for UE SRS transmission when the UE is in INACTIVE is not supported if SRS transmission is supported in RRC\_INACTIVE. (4/12)**

**Proposal17: RAN2 should discuss whether the current stage3 spec already supports the NRPPa message for uplink positioning for UE in RRC\_INACTIVE. (6/12)**

***General NAS/NG-AP transport***

**Proposal18: The transport of UL NAS message in INACTIVE is supported for INACTIVE positioning. (7/9)**

**Proposal19: The transport of DL NAS message in IDLE/INACTIVE for IDLE/INACTIVE positioning is not supported. (5/13)**

**Proposal20: Transport of UE-associated NRPPa message in RRC\_INACTIVE for RRC\_INACTIVE positioning has already been supported. This should be further verified by RAN3.  (8/14)**

**Proposal21: RAN2 doesn’t need to discuss the transport of non-UE-associated NRPPa message in IDLE/INACTIVE for IDLE/INACTIVE positioning (14/14)**

References

[1] TS 38.305, Stage 2 functional specification of User Equipment (UE) positioning in NG-RAN, 3GPP