3GPP TSG-RAN WG2 Meeting #115-e**R2-210xxxx**

Online, August 9th – 27th, 2021

**Agenda item:** 8.11.2

**Source:** Intel Corporation

**Title:** Summary of AI 8.11.2: Positioning Latency Enhancements (Intel)

**Document for:**  Discussion, Decision

# 1. Introduction

This document summarizes the following contributions submitted for Agenda Item 8.11.2 on enhancements of signalling, and procedures for positioning latency reduction:

R2-2107090 Discussion on positioning latency reduction ZTE discussion

R2-2107091 Discussion on scheduled location time ZTE discussion

R2-2107132 Discussion on Response LS on Scheduling Location in Advance to reduce Latency from SA2 CATT discussion Rel-17 NR\_pos\_enh-Core

R2-2107134 Discussion on Enhancements for Latency Reduction CATT discussion Rel-17 NR\_pos\_enh-Core

R2-2107135 Discussion on storage of UE Positioning Capabilities LS from SA2 and the granularity of response time LS from RAN1 CATT discussion Rel-17 NR\_pos\_enh-Core

R2-2107399 Further consideration of positioning latency enhancements OPPO discussion Rel-17 NR\_pos\_enh-Core

R2-2107500 Discussion on positioning latency Huawei, HiSilicon discussion Rel-17 NR\_pos\_enh-Core

R2-2107641 Discussion on latency enhancement vivo discussion Rel-17 NR\_pos\_enh-Core

R2-2107642 Discussion on Scheduling Location in Advance to reduce Latency vivo discussion Rel-17 NR\_pos\_enh-Core

R2-2107670 Scheduled location time based latency reduction Intel Corporation discussion Rel-17 NR\_pos\_enh

R2-2107673 Storing UE positioning capability in AMF Intel Corporation discussion Rel-17 NR\_pos\_enh

R2-2107680 Summary of agenda 8.11.2 Latency enhancements Intel Corporation discussion Rel-17 NR\_pos\_enh Late

R2-2107681 Discussion on Enhancements for Latency Reduction InterDigital, Inc. discussion Rel-17 NR\_pos\_enh

R2-2107962 Discussion on the response time Samsung discussion Rel-17

R2-2108127 Positioning Latency Reduction Enhancements Lenovo, Motorola Mobility discussion Rel-17

R2-2108175 Positioning enhancements on latency reduction Xiaomi discussion

R2-2108367 Scheduling Location in Advance to Reduce Latency Qualcomm Incorporated discussion

R2-2108376 [draft] Response LS on Scheduling Location in Advance to reduce Latency Qualcomm Incorporated LS out Rel-17 FS\_NR\_pos\_enh To:SA2 Cc:RAN1, RAN3

R2-2108377 LPP impacts for UE positioning capability storage Qualcomm Incorporated discussion

R2-2108378 [draft] Response LS on storage of UE Positioning Capabilities Qualcomm Incorporated LS out Rel-17 To:SA2 Cc:RAN3

R2-2108393 Utilizing Time T and other associated parameters Ericsson discussion

R2-2108397 On UE Positioning Capabilities Ericsson discussion

R2-2108536 Discussion on latency reduction for positioning CMCC discussion Rel-17 NR\_pos\_enh-Core

R2-2108704 Enhancement to reduce latency for high volume positioning Nokia, Nokia Shanghai Bell discussion Rel-17 NR\_pos\_enh-Core

R2-2108769 Handling of multiple QoS for latency reduction Samsung Electronics discussion NR\_pos\_enh-Core

R2-2108771 Latency reduction via configured grant for positioning Samsung Electronics discussion NR\_pos\_enh-Core

R2-2108773 Discussion on the scheduled location time Samsung Electronics discussion NR\_pos\_enh-Core

# 2. Overview of the main topics discussed to reduce positioning latency

|  |  |
| --- | --- |
| Topic | Company/Contribution |
| Scheduled location time | R2-2107091 ZTE  R2-2107132 CATT  R2-2107500 Huawei  R2-2107642 vivo  R2-2107670 Intel  R2-2107681 InterDigital  R2-2108127 Lenovo  R2-2108175 Xiaomi  R2-2108367 Qualcomm  R2-2108393 Ericsson  R2-2108773 Samsung |
| Preconfigured assistance data | R2-2107399 OPPO  R2-2107641 vivo  R2-2107500 Huawei  R2-2107670 Intel  R2-2107681 InterDigital  R2-2108127 Lenovo  R2-2108773 Samsung  R2-2107090 ZTE |
| Response time enhancements (including reduced granularity) | R2-2107135 CATT  R2-2107500 Huawei  R2-2107641 vivo  R2-2107681 InterDigital  R2-2107962 Samsung  R2-2108127 Lenovo  R2-2108393 Ericsson |
| Storing positioning capabilities | R2-2107135 CATT  R2-2107500 Huawei  R2-2107673 Intel  R2-2108175 Xiaomi  R2-2108377 Qualcomm  R2-2108397 Ericsson |
| Prioritization of measurements/reports | R2-2107399 OPPO  R2-2107681 InterDigital  R2-2108536 CMCC |
| Lower-layer triggered requesting of measurements | R2-2107641 vivo |
| Configured grant (CG-based) enhancements | R2-2107399 OPPO  R2-2108127 Lenovo  R2-2108175 Xiaomi  R2-2108393 Ericsson  R2-2108771 Samsung |
| Other proposed enhancements | R2-2108704 Nokia  R2- 2107134 CATT  R2-2108769 Samsung |

# 3. Discussion

## 3.1 Scheduled location time

Multiple contributions discuss the reply LS on the scheduled location time from SA2 [28] and the potential impact on RAN2 specifications.

The company proposals related to this topic are summarized in the Table below.

|  |  |
| --- | --- |
| Scheduled location time | |
| R2-2107091 ZTE | Observation 2: Scheduled location time should not be sent to NG-RAN and UE. It’s up to LMF implementation on when the RequestLocationInformation should be sent to UE and how to configure the value of reportingInterval or Time.  Proposal 1: RAN2 should clarify whether the scheduled location time is the time that UE should transmit the location information report, i.e. t4=0.  Proposal 2: The scheduled location time should be transparent to UE/NG-RAN node, i.e. no specification change is needed from RAN2 perspective. |
| R2-2107132 CATT | Proposal 1: RAN2 to agree and reply the LS that the Scheduled Location Time can help the reduction of the LCS latency.  Proposal 2: RAN2 to agree no need to forward the scheduled location time to gNB or UE in UE-Assisted mode.  Proposal 3: RAN2 to agree that the scheduled location time can be forwarded to UE from LMF in UE-Based mode via LPP Request Location Information message.  Proposal 4: RAN2 to agree that the format of the scheduled location time in LPP message won’t be finalized until there is a conclusion from SA2.  Proposal 5: RAN2 to reply to SA2 that RAN2 waits for the actual format of the scheduled location time in stage-3. |
| R2-2107500 Huawei | Proposal 1: Regarding the impacts of the Scheduled Location Time to RAN:   There is no RAN2 stage3 spec impacts for scheduled location time;   NRPPa spec needs to add a field of response time in the NRPPa message MEASUREMENT REQUEST;   Send a reply LS to SA2 that the scheduled location time does not help the reduction of the LCS latency from RAN2’s perspective. |
| R2-2107642 vivo | Proposal 2: For UE based and UE assisted location, the timing of UE receiving the RequestLocationInformation message can be seen as the scheduled location time.  Proposal 3: For NG-RAN node assisted location, the timing of NG-RAN node receiving the MEASUREMENT REQUEST message can be seen as the scheduled location time.  Proposal 4: It is unnecessary to send the explicit scheduled location time to NG-RAN node or UE. |
| R2-2107670 Intel | Observation: The LPP RequestLocationInformation message already includes the expected response time for the UE/NG-RAN to perform positioning measurements and additionally providing the scheduled location time may be redundant.  Proposal 1: RAN2 is proposed to confirm that Scheduled Location Time does not need to be provided to the NG-RAN and/or UE and the LMF can implicitly take it into account to scheduled positioning procedures. |
| R2-2107681 InterDigital | Proposal 1: The scheduled location time T corresponds to the time when the UE starts performing the positioning measurements |
| R2-2108127 Lenovo | Proposal 1: RAN2 to confirm the definitions of “scheduled location time” and “expected location time” from RAN perspective, where:  • Expected location time, Tscheduled: Duration between transmitting LCS request message from LCS Client/AF/UE(internal LCS Client) and receipt of LCS response message at external/internal LCS Client or AF.  • PRS Configuration time, TPRS-Configuration: Duration between transmitting LCS request message from LCS Client/AF/UE(internal LCS client) to LMF and receipt of LPP RequestLocationInformation message at UE.  Proposal 2: RAN2 to consider splitting the PRS-configuration timeline into two parts as follows, for better predictability and control and easier tracking and location service fulfilment from the RAN side:  • The LMF configuring/indicating the response time between receipt of RequestCapability and ProvideCapabilites messages.  • The LMF configuring/indicating the time between receiving the (pre-)configured assistance data (e.g. via posSIB/ProvideAssistanceData message) and receiving the RequestLocationInformation message.  Proposal 3: RAN2 to send a reply LS to SA2 indicating that no latency reduction gains have been observed or determined for scheduling location in advance. |
| R2-2108175 Xiaomi | Proposal 1: The LPP location information request message and/or NRPPa measurement request message will be sent by LMF at or near to the scheduled location time T.  Proposal 2: In order to ensure that the preparation phase can be completed before the scheduled location time T, the response time can be carried in the following messages:  · LPP capability request  · NRPPa positioning information request  · NRPPa positioning activation request  Proposal 3: The positioning latency reduction can be achieved without sending the scheduled location time T to UE or NG-RAN, so it is not necessary to send the time T to UE or NG-RAN. |
| R2-2108367 Qualcomm | **Observation 1:** The feature "Location Scheduling in Advance" [2] requires a UE, LCS Client or AF that is requesting the location of a target UE to know a time *T* at which the location should be obtained.  **Observation 2:** A scheduled location time *T* allows the latency for obtaining and reporting the location of a target device to be reduced by the duration of the location preparation phase which allows substantial reduction of latency:  DL+UL NR positioning methods: Latency reduction of more than 62 %  UL-only NR positioning methods: Latency reduction of more than 78 %  DL-only NR positioning methods: Latency reduction of more than 50 %  **Observation 3:** Latency, i.e. the delay between the time of fix and when it is available to the user, is a significant source of position error for high-accuracy positioning and a target device in motion.  **Observation 4:** With the current LPP specification, the time when the UE should obtain the measurements/location estimate cannot be controlled by an LMF. The available LPP Response Time defines the time when to send a measurement report (at the latest), but not the time when the location measurements should be obtained/valid.  **Observation 5:** With the current NRPPa specification, the time when the TRPs should obtain the measurements cannot be controlled by an LMF. A NRPPa Response Time (similar to LPP) could be realized by requesting NRPPa periodic reporting. However, similar to LPP, this would control the time when to send measurement reports, but not the time when the location measurements should be obtained/valid.  **Observation 6:** Without providing the Scheduled Location Time *T* to the UE and TRPs, the LMF cannot reliably determine the UE location at the scheduled location time, and therefore, the location estimate returned to an LCS Client for a scheduled location time cannot be treated by the LCS Client as a reliable estimate of the location of the UE at the scheduled location time.  **Observation 7:** With the Scheduled Location Time *T* provided to the UE in advance, an LMF can reliably request a time when the provided measurements/location estimate are/is to be obtained.  **Observation 8:**  With the Scheduled Location Time *T* provided to the UE in advance, the UE measurement process is not constrained by the response time. The only requirement is that the UE has location measurements available valid for the time *T*, but the time when and for how long to perform the measurements could be determined by the UE; e.g., based on radio situation. Therefore, the quality of the location measurements/estimate may generally be better with a Scheduled Location Time *T* provided to the UE.  **Observation 9:** With the Scheduled Location Time *T* provided to the TRPs in advance, an LMF can reliably request a time when the provided measurements are to be obtained.  **Observation 10:** With the Scheduled Location Time *T* provided to the TRPs in advance, the UL measurements performed at different TRPs would be obtained for the same scheduled location time *T* which would generally also improve location accuracy.  **Observation 11:** It is beneficial to send the Scheduled Location Time *T* to the UE and TRPs in order to trigger measurements at or close to the scheduled location time.  **Proposal 1:** Include a "Requested Location Time" with uncertainty window in *CommonIEsRequestLocationInformation*, defining the desired time when the location estimate is to be obtained. In the case of UE-assisted mode, the uncertainty defines the time window within which the location measurements should be performed.  **Proposal 2:** Include a "Requested Location Time" with measurement time window in the NRPPa Measurement Request message, defining the time window within which the location measurements should be performed. The existing System Frame Number/Slot Number in the NRPPa Measurement Request message could be generalized to define the "Requested Location Time". |
| R2-2108393 Ericsson | Observation 1: Sending measurement window and time T to UE and gNB is helpful to guarantee UL and DL measurement performed inside the measurement window for multi-RTT.  Observation 2: For 1st UL SRS Transmission, sending the desired measurement time at Tm (where Tm =T-t1 and T is scheduled location time, and t1 is the expected duration of the location preparation phase time needed for gNB to configure SRS and activate SRS transmission for UE and exchange SRS information with LMF) can ensure the 1st UL SRS transmission is fully utilized.  Proposal 1: Signalling of Time related to time T is supported in LPP procedure with a well-defined measurement window.  Proposal 2: Signalling of Time related to time T is supported in NRPPa to facilitate the 1st UL-SRS transmission. |
| R2-2108773 Samsung | Observation 1: For the solution of latency optimization of assistance data from SA2, from the RAN side, the scheduled location time is invisible in RAN2 specifications.  Proposal 3: RAN2 further discuss the impact of these optimizations i.e., regarding pre-configuration of necessary information and triggering command later on RAN2 specification and the necessity of and how to realize the scheduled location time. |

**Summary:**

Based on SA2 response LS, the definition of the scheduled location time is a future global time at which the UE is to be located. It can be used by the LMF to determine the time to trigger positioning procedures. In addition, SA2 has also inquired RAN2 regarding whether it may be useful to send the scheduled location time to NG-RAN and the UE in order to trigger measurements at or close to the scheduled location time. Since it seems difficult to draw any conclusion on this aspect based on company contributions, it is suggested to discuss online whether the scheduled location time can help in latency reduction as per the SA2 question.

**Proposal 1:** **RAN2 is proposed to discuss whether scheduled location time can help in the reduction of the LCS latency.**

On the other hand, from the submitted contributions which discuss the need of sending this scheduled location time to NG-RAN/UE, there seem to be two schools of thought:

* Option A: The scheduled location time does not need to be indicated to the UE or NG-RAN, since the LMF can implicitly trigger the positioning procedures at or close to it. Therefore, it is transparent to UE/NG-RAN stage-3 positioning procedures.
* Option B: Latency reduction can be accomplished by sending the scheduled location time T to the UEs and TRPs in order to trigger measurements at or close to it. Therefore, LPP and/or NRPPa signaling needs to be updated to indicate this information.

Several companies in [2], [7], [9], [10], [15], [16] and [27] have expressed support for option A above, i.e. they do not see the usefulness of indicating this information to the UE/NG-RAN and think that scheduled location time can be invisible to RAN procedures. On the other hand, [17] makes several observations about how indication of the scheduled location time can lead to reduction in duration of the location preparation phase (albeit at the expense of introducing new LPP/NRPPa signaling) and proposes to support providing this indication to the UE and TRPs in order to trigger measurements at or close to this time. Similarly, in [21], it is proposed to signal scheduled location time T in LPP within a measurement window. In [3], it is proposed that scheduled location time is only forwarded to the UE from LMF in UE-based positioning mode via LPP Request Location Information message and not for the case of UE-Assisted mode. It should be noted that similar to the situation in RAN2, there is also no clear consensus whether this information should be sent to UE and NG-RAN (as mentioned in their LS). Moreover, as per the LS from RAN1[29], they also do not see this as part of the scope of their WID’s objectives. Therefore, based on the above, it is suggested to discuss and agree that RAN2 does not see foresee usefulness of sending the scheduled location time to UE/NG-RAN for reduction in LCS latency.

**Observation 1:** **On the need of indicating scheduled location time to the UE/NG-RAN, companies seem to have following interpretations (with option A having majority support):**

* **Option A: The scheduled location time does not need to be indicated to the UE or NG-RAN, since the LMF can implicitly trigger the positioning procedures at or close to it. Therefore, it is transparent to UE/NG-RAN stage-3 positioning procedures.**
* **Option B: Latency reduction can be accomplished by sending the scheduled location time T to the UEs and TRPs in order to trigger measurements at or close to it. Therefore, LPP and/or NRPPa signaling needs to be updated to indicate this information.**

**Proposal 2:** **RAN2 is proposed to discuss and agree that scheduled location time is considered transparent from UE/NG-RAN perspective and no additional specification impact is needed to support it.**

## 3.2 Preconfigured assistance data

Contributions discuss on the support of using stored/preconfigured assistance data and validity conditions/criteria (FFS from last meeting). Company proposals on this topic are summarized in the table as below:

|  |  |
| --- | --- |
| On stored/preconfigured assistance data, validity conditions/criteria and other related enhancements | |
| R2-2107399 OPPO | Proposal 3: validity condition(s) could be optionally configured with the positioning assistance data within the same LPP message or two independent LPP message for enabling usage of the positioning assistance data for more than one consecutive positioning sessions.  Proposal 4: RAN 2 to agree that the validity condition(s) of the pre-configured positioning assistance data consists of one or more of follows:    UE staying within in a certain area e.g., list of cells    A configured validity timer    A integer number defining the maximum quantitative limit for the times of using the pre-configured assistance data for positioning    Not reception of further updated assistance data or invalid indication of the pre-configured assistance data |
| R2-2107641 vivo | Proposal 5: The pre-configuration of assistance data is applicable for the deferred MT-LR.  Proposal 6: The pre-configuration of assistance data is applicable for location request with scheduled location time (if supported).  Proposal 7: The pre-configuration of assistance data is valid within a specific area and period. |
| R2-2107500 Huawei | Proposal 3: Do not support PRS pre-configuration for latency reduction.  Proposal 4: RAN2 should support the following for PRS configuration for latency reduction:   Define add/mod/release mechanism of PRS configurations; and   Have a complete definition of priority of PRS configuration for measurement, including the PRS configuration received by dedicated LPP signalling and posSIB. |
| R2-2107670 Intel | Proposal 2: Existing LPP/NRPPa and RRC procedures can be utilized for pre-configuration of positioning assistance data for measurements to the UE.  Proposal 3: The pre-configured positioning assistance data is considered valid unless explicitly modified or released by the LMF/NG-RAN.  Proposal 4: The UE shall retain the pre-configured positioning assistance information without having to perform positioning measurements until it is triggered to do so.  Proposal 5: In case of MO-LR, it is up to the UE to request to the core network to obtain pre-configured assistance data in advance of when it needs to perform positioning measurements. |
| R2-2107681 InterDigital | Proposal 2: The UE is configured with validity conditions (e.g. time validity, area validity) which are associated with preconfigured PRS configurations  Proposal 3: The UE uses the preconfigured PRS configurations for making measurements on DL-PRS so long as the associated validity conditions are met  Proposal 4: The validity conditions related to the preconfigured PRS configurations are provided to the UE using LPP assistance data transfer procedure (e.g. via LPP Assistance Data Tranfer message)  Proposal 5: For DL based positioning, support dynamic triggering of a preconfigured PRS at UE by LMF or gNB for initiating measurements on DL-PRS  Proposal 6: For DL+UL based positioning, support dynamic triggering of a preconfigured SRSp at UE by gNB for transmitting SRSp based on measurement report provided by UE |
| R2-2108127 Lenovo | Proposal 5: Existing procedures can be utilised to provide the (pre-)configured assistance data to the UE in order to obtain the location estimate for different positioning fixes.  Proposal 6: Support priority indications for multiple (pre-)configured assistance data sets corresponding to multiple position fixes for UE-based and UE-assisted positioning. |
| R2-2108773 Samsung | Proposal 1. For the scheduled location time, the pre-configured assistance data can be activated based on the condition which can be specified by the UE’s current location and/or the time.  Proposal 2. The details on how the area and/or the time information can be related to the pre-configured assistance data are discussed from SA2’s further response to the LS sent.  Proposal 3: RAN2 further discuss the impact of these optimizations i.e., regarding pre-configuration of necessary information and triggering command later on RAN2 specification and the necessity of and how to realize the scheduled location time. |

**Summary:**

Based in the FFS from the last meeting, contributions discuss the validity condition/criteria associated with the pre-configured assistance data in order to enable usage of the positioning assistance data for more than one consecutive positioning sessions. At least the following options have been proposed based on the company proposals:

* Option A: Based on a validity area (e.g. a list of cells)
* Option B: Based on a (configured) validity timer or a numerical limit on number of times it is utilized
* Option C: Based on explicit modification or release from the LMF/NG-RAN
* Option D: Based on the UE’s current location and/or the time

In [7], it is proposed to not support PRS pre-configuration for latency reduction and define an add/mod/release mechanism of PRS configurations, based on priority of PRS configuration for measurements. However, according to rapporteur’s understanding, the former has already been agreed in the last meeting. In [13], it is proposed to support dynamic triggering of a preconfigured PRS at UE by LMF or gNB for making measurements on DL-PRS for DL based positioning and dynamic triggering of a preconfigured SRS at UE by gNB for transmitting SRS based on measurement report provided by UE for DL+UL based positioning. In [15], it is proposed to support priority indications for multiple (pre-)configured data sets corresponding to multiple position fixes for UE-based and UE-assisted positioning. [1] proposes to support a more flexible configuration and reporting structure so that UE can conduct DL PRS measurement based on a subset of DL PRS or pre-configured assistance data provided by *ProvideAssistanceData* message. From rapporteur’s perspective, several of these proposed enhancements seem more related to the on-demand PRS discussion. Nevertheless, it is proposed to further discuss these enhancements in RAN2.

**Proposal 3:** **Regarding the validity conditions/criteria associated with pre-configured assistance data, it is proposed to consider at least the following options:**

* **Option A: Based on a validity area (e.g. a list of cells)**
* **Option B: Based on a (configured) validity timer or a numerical limit on number of times it is utilized**
* **Option C: Based on explicit modification or release from the LMF/NG-RAN**
* **Option D: Based on the UE’s current location and/or the time**

**Proposal 4:** **Continue discussion on the need for supporting enhancements regarding use of pre-configured assistance data for positioning measurements, including:**

* **Support of an add/mod/release mechanism of PRS configurations**
* **Support dynamic triggering of a preconfigured PRS at UE by LMF or gNB for making measurements on DL-PRS and/or dynamic triggering of a preconfigured SRS at UE by gNB for transmitting SRS based on measurement report provided by UE**
* **Support priority indications for multiple (pre-)configured assistance data sets corresponding to multiple position fixes for UE-based and UE-assisted positioning.**

## 3.3 Response time granularity

Granularity of Response time and need for related capability are discussed in contributions. The company proposals related to this topic are summarized in the Table below.

|  |  |
| --- | --- |
| Response time granularity | |
| R2-2107135 CATT | Observation 4: The minimum location response time between receipt of the RequestLocationInformation and transmission of a ProvideLocationInformation is 1s, which cannot guarantee R17 positioning latency budget requirement, i.e., 100ms.  Observation 5: The exact granularity of the location response time is determined by LMF itself based on the latency requirement within the location QoS requirement.  Proposal 3: RAN2 can introduce a finer granularity of the location response time in order to reduce latency, which has no extra SA2 impacts.  Proposal 4: Extend the field unit within the ResponseTime in TS37.355 to include “ten-mini-seconds”.  Proposal 5: Sent to RAN1 to inform RAN2 agreements on the support the location response time. Agree the draft LS provided in the Annex 2 as baseline. |
| R2-2107500 Huawei | Proposal 5: Extend the value of the “unit” field to include the “ten-milliseconds” in “ResponseTime” field in TS 37.355. |
| R2-2107641 vivo | Proposal 8: LS reply to RAN1 to inform them the finer granularity for location response time can be supported.  Proposal 9: Introduce finer granularity of unit in ResponseTime, e.g. ten-millisecondes. |
| R2-2107681 InterDigital | Proposal 9: Introduce additional “unit” fileld, unit-r17, supporting “ten-milliseconds” to indicate finer granularity for responseTime, ranging from 10ms to 1280 ms |
| R2-2107962 Samsung | Proposal 1: RAN2 to introduce sub-second level response time to meet the Rel-17 latency requirement.  Observation 4: The support of low latency response (e.g., sub-second level response time) can depend on the UE capability.  Proposal 2: RAN2 to introduce a new capability for the support of low latency response in the ProvideCapabilities message body. |
| R2-2108127 Lenovo | Observation 4: The existing configured minimum response times of 1000ms, between receipt of the RequestLocationInformation and transmission of a ProvideLocationInformation (measurement report, location estimate) do not fall within the target 100ms end-to-end latency requirements and can be further optimized.  Proposal 4: Introduce additional finer time granular values for the responseTime IE, a value range between 400ms -1000ms in steps of 100ms. |
| R2-2108393 Ericsson | Proposal 4: When T and time window is given in LPP request location information, redefine the responseTime as maximum response time as measured between the end of the measurement time window and transmission of a ProvideLocationInformation.  Proposal 5: The unit of responseTime should include finer units including ms, and 0.1 ms.  Proposal 6: UE indicates to the LMF whether the measurement was performed within the measurement time window. It may indicate yes or no for each measurement instance, and the lag for each measurement instance which was not inside the specified measurement window.  Proposal 7: For periodic location, define a new reportingInterval with a shorter time interval and more granular time intervals. |

**Summary:**

RAN1 has sent an LS to RAN2 [30], informing that from RAN1 perspective, it is beneficial to support a finer granularity for location response time in order to reduce latency and asking RAN2 to check if it can be supported and design the signaling details if supported. To this end, most companies addressing this topic are supportive of introducing a finer granularity for location response time in order to reduce latency. Therefore, it is proposed to introduce finer granularity for *responseTime* and it is FFS whether it can be done by extending the value of the “unit” field to include the “ten-mini-seconds” in TS 37.355.

In addition, [14] proposes to introduce new capability for the support of low latency response. Rapporteur thinks that this can be further discussed once it is agreed what new granularity is defined. [21] proposes to redefine the *responseTime* IE in case scheduled location time T and time window is provided in LPP to serve as the “maximum response time” as measured between the end of the measurement time window and transmission of *ProvideLocationInformation* IE. From rapporteur perspective, this is dependent on whether or not scheduled location time is included in the LPP message and can be discussed later once that aspect is resolved.

**Proposal 5:** **Based on RAN1’s input, RAN2 agrees to introduce finer granularity for responseTime IE. FFS if this can be accomplished by extending the ‘unit’ field to include e.g. “ten-milliseconds”.**

## 3.4 Storing Capabilities

Storage of UE positioning related capabilities in 5GC and the variability of said capabilities is discussed in contributions, with the company proposals listed in the Table below.

|  |  |
| --- | --- |
| Storing Capabilities | |
| R2-2107135 CATT | Observation 1: The UL-SRS related positioning capabilities are related with the configured band or band combination of the network within the field of FreqBandIndicatorNR, which depends on network deployment.  Observation 2: UL-SRS related positioning capabilities may be changed once the supported band or band combination by the network is changes, i.e., UE moves out of the current network deployment area.  Observation 3: All UE positioning capabilities are static except the UL-SRS related positioning capability.  Proposal 1: Whether the (updated) SRS related positioning capability is stored within the 5GC has no impact on the positioning performance enhancement.  Proposal 2: Sent to SA2 to inform RAN2 agreements on the storage of UE positioning capabilities for latency reduction. |
| R2-2107500 Huawei | Proposal 2: For AMF storing positioning capabilities for latency reduction, RAN2 should down-select from the following options:   Option1: Legacy solution for AMF storing UE radio capability (e.g., the request record of the UE positioning capability); or   Option2: AMF should store the complete capability of the UE. |
| R2-2107673 Intel | Observation 1: Storing UE positioning capability in AMF has no RAN2 impact except potential issue on whether the UE needs to indicate that the capabilities are non-variable.  Observation 2: UE positioning capability may be changed, e.g. UL SRS capability will be changed in case CA configuration is changed.  Proposal 1: Reply SA2 that:  - The positioning capability may be changed, e.g. SRS capability is related to CA configuration, and will be impacted if CA configuration is changed.  - RAN2 does not see the need to introduce the indication on whether UE positioning capability is “variable” or not, since the LMF can be aware of this based on received UE positioning capability.  - RAN2 assumes that the issue can be resolved by network implementation considering the issue also exists in Rel-16 even if positioning capability is not stored in AMF.  Proposal 2: Storing UE positioning capability in AMF has no RAN impact except potential stage 2 description. |
| R2-2108175 Xiaomi | Proposal 4: The UE positioning capability will be changed in some cases and the indication should be sent to LMF/AMF when UE positioning capabilities are changed. |
| R2-2108377 Qualcomm | Observation 1: The positioning capabilities of a UE may not be static but may vary according to user preference or other external conditions like battery level.  Observation 2: A single "Variability Indicator" in CommonIEsProvideCapabilities is sufficient to indicate to an LMF whether the provided positioning capabilities are non-variable (stable), meaning that they are fixed and cannot be changed by the UE or by a user of the UE. For positioning capabilities which are not stable, the LMF can choose not to store them.  Observation 3: The "Variability Indicator" in CommonIEsProvideCapabilities should include an "expiration time" indicating how long the provided positioning capability is stable.  Observation 4: From RAN2 perspective, the CR in [1] to support storage of UE positioning capabilities in the 5GC has only a small impact to LPP.  Proposal 1: Add an indicator to LPP CommonIEsProvideCapabilities to indicate to an LMF whether the provided positioning capabilities are non-variable (stable), meaning that they are fixed and cannot be changed by the UE or by a user of the UE. |
| R2-2108397 Ericsson | Observation 1: There is no any reason to view positioning capabilities different than the radio capabilities. Both capabilities would vary based upon different NW configurations such as band-combinations, dual-connectivity, multi-carrier etc.  Proposal 1: RAN2 to respond to SA2 saying the positioning capabilities should be viewed similar to radio capabilities and LMF may override the stored capabilities from AMF with the new unsolicited capabilities obtained from UE. |

**Summary:**

SA2 has sent an LS to RAN2 [31] regarding support of storage of UE positioning capabilities in the 5GC, asking the question on whether the UE positioning capability is variable or not and if yes, in which situation it is changed? Several companies have expressed their view on this aspect, which are summarized above. From the company comments, it seems like there is at least a majority which thinks that the positioning related UE capabilities can be variable, at least in certain cases. Therefore, at least the first part of the question can be answered based on the apparent consensus in RAN2. However, there does not seem to be a consensus on whether and how this information about the variation in UE capability needs to be indicated to the LMF. There seem to be two camps in RAN2 when it comes to whether there needs to be an indication defined to indicate this variability indication and with no clear consensus, it is proposed to discuss and resolve this aspect in online discussion. If a way forward is agreed, it is proposed to send a response LS to SA2 to inform them of our decision.

**Proposal 6: In response to the question asked by SA2 regarding UE positioning capability, it is proposed to capture that the positioning related UE capabilities can be variable, at least in certain cases.**

**Proposal 7: RAN2 further discuss if an indication shall be defined to inform the LMF on whether the UE capability is variable or not, to assist in the storage of UE positioning capabilities in the 5GC. Based on the decision, a response LS to SA2 shall be triggered.**

## 3.5 Prioritization of positioning measurements/reporting

The company proposals related to this topic are summarized in the Table below.

|  |  |
| --- | --- |
| Prioritization of measurements/reports and priority rules | |
| R2-2107399 OPPO | Observation 1: both of the allowedPHY-PriorityIndex and allowedCG-List, introduced in the R16 URLLC WI, could help reduce the latency regarding the location measurement report to be carried on the dynamic grant and configured grant, respectively.  Proposal 1: RAN2 to agree that no RAN2 impact is foreseen for reducing the latency regarding the transmission of the location report. |
| R2-2107681 InterDigital | Observation 4: The configuration of priority rules and indication of priority value for a PRS configuration can be dependent on the latency requirement of the supported positioning service  Proposal 7: Support configuring of priority rules in UE for determining prioritization of DL PRS measurement and reporting of measurements/location estimates  Proposal 8: The existing LPP and RRC/MAC procedures can be enhanced for indicating priority rules and supporting prioritized DL PRS measurements/reporting |
| R2-2108536 CMCC | Observation: In the study phase, priority rules for the reception of DL PRS are listed as the potential solution for the collision handling rule to reduce the latency.  Proposal: RAN2 is kindly asked to support physical layer priority rules for the reception of DL PRS and DL signals/channels carrying LPP signaling. |
| R2-2108127 Lenovo | Observation 5: Priority indications for measurements and reporting enable more aggressive scheduling of low latency positioning reports for computing the first location estimate fix.  Proposal 7: RAN2 considers the support and configuration of priority rules associated to the configured measurements, positioning techniques, and associated reports. FFS on how to indicate the measurement priority and optionally associated response times.  Proposal 8: RAN2 to support the dropping of low priority measurements that do not meet the required response time. The UE may explicitly indicate the dropped measurements or the LMF may implicitly infer the dropped measurements based on the provided measurement configuration. |
| R2-2107090 ZTE | Observation 1: The current defined measurement period that is used for DL PRS measurement is calculated based on all configured DL PRSs in ProvideAssistanceData message, which leads to large latency for a location information report.  Observation 2: UE can report one early location information report before the configured responseTimeEarlyFix.  Observation 3: If UE cannot transmit all measured location information to the LMF via early location information report, the location information acquired between early location information report and final location information report can only be uploaded at the end of response time, which may cause extra-latency.  Proposal 1: Support UE to conduct DL PRS measurement based on a subset of DL PRS or pre-configured assistance data provided by ProvideAssistanceData message.  Observation 4: By configuring an appropriate value of responseTimeEarlyFix for a specific positioning service, LMF can receive the early location information report earlier than before.  Proposal 2: Support of associating a subset of DL PRS with an early location information report.  Proposal 3: Support UE to report more than one early location information reports before the final response time. |

**Summary:**

[13] proposes to support priority rules for determining prioritization of DL PRS measurement and reporting of measurements/location estimates. Accordingly, LMF can determine the priority rules and inform the UE or gNB via LPP/NRPPa message. [23] mentioned that for the DL signals/channels carrying LPP signaling, DCI can be reused to configure the priority to UE and the priority is informed to the gNB via NRPPa message from the LMF. According to [6], both of the allowedPHY-PriorityIndex and allowedCG-List, introduced in the R16 URLLC WI, can be reused to reduce the latency regarding the location measurement report to be carried on the dynamic grant and configured grant and no additional RAN1 impact is foreseen regarding transmission of the measurement report. [15] proposes to support of priority rules associated to measurements and reporting as well as enhancements to drop low priority measurement in order to increasing reporting signal efficiency and meet latency budget. It is proposed in [1] to support associating a subset of DL PRS with an early location report such that UE can perform measurements before the *responsTimeEarlyFix* to avoid incurring large latency.

Based on the company contributions, the following enhancements regarding the prioritization of PRS measurements/reporting are identified:

* Option A: Support of prioritization handling of DL PRS measurement
* Option B: Support of prioritization handling of reporting of measurements/location estimates
* Option C: Support of prioritization handling of DL signals/channels carrying LPP signaling
* Option D: Support of prioritization handling of DL PRS measurement associated with early location report

From the rapporteur’s perspective, the prioritization of the positioning measurement/reporting and priority rules for the reception of DL PRS in general is in RAN1 scope and it is not clear what, if any, impact is foreseen from RAN2 perspective. It should also be noted that this aspect was discussed and excluded from RAN2 scope in RAN plenary during WID discussion [RP-210817, RP-210819]. Therefore, it is suggested that discussions on this topic are down-prioritized in RAN2, at least until higher priority issues are resolved.

**Proposal 8 (Low priority): RAN2 is proposed to discuss if enhancements regarding the prioritization of PRS measurements/reporting should be supported in this release, considering at least the following proposed enhancements:**

* **Option A: Support of prioritization handling of DL PRS measurement**
* **Option B: Support of prioritization handling of reporting of measurements/location estimates**
* **Option C: Support of prioritization handling of DL signals/channels carrying LPP signaling**
* **Option D: Support of prioritization handling of DL PRS measurement associated with early location report**

## 3.6 Lower-layer triggered measurement request

The company proposals related to this topic are summarized in the Table below.

|  |  |
| --- | --- |
| lower-layer triggered requesting of measurements | |
| R2-2107641 vivo | Observation 1: With lower-layer triggered location request and response, the latency can be reduced by 16.5-19.5 ms.  Observation 2: With lower-layer triggered location request including the location measurement indication, the latency can be reduced by 21.5-28 ms.  Proposal 1: The lower-layer triggered requesting of measurements should be supported, which includes:  - Request location information from LMF to RAN-node via NRPPa;  - Request location information from RAN-node to UE via RRC, MAC-CE and/or DCI.  Proposal 2: The lower-layer triggered providing of measurements should be supported, which includes:  - Provide location information from UE to RAN-node via RRC, MAC-CE and/or DCI;  - Provide location information from RAN-node to LMF via NRPPa.  Proposal 3: Considered to include the Location Measurement Indication in the lower-layer triggered request to further reduce the latency.  Proposal 4: LS to RAN1 and RAN3 to inform them to support the lower layer triggered measurements requesting and providing. |

**Summary:**

It is proposed in [8] to support lower layer triggered request of measurement as well as lower-layer triggered provision of measurements to the LMF, and the associated introduction of new NRPPa procedures/signaling to support it. It is observed that this can accomplish latency reduction in the overall procedure (which admittedly comes at the cost of the new signaling to be defined).

From rapporteur’s perspective therefore, there is an obvious cost to this enhancement in terms of more specification impact and cross-WG impact. Moreover, the lower layer triggered request/response mechanism would change the positioning structure significantly since it makes the positioning procedure visible to the gNB (unlike the current RAT independent positioning procedure). It is also unclear how the content of RequestLocationInformation and ProvideLocationInformation is included in DCI, MAC and/or RRC. Finally, this also means more cross-layer specification work to exchange this information between LPP and lower layers, which is something we should aim to avoid at this stage of the WI. Therefore, it is proposed to postpone discussion on this issue for this release.

**Proposal 9: RAN2 is proposed to down-prioritize discussion on enhancements related to lower-layer triggering of measurement request/reporting for latency reduction for this release.**

## 3.7 Configured UL grant for location reports

The company proposals related to this topic are summarized in the Table below.

|  |  |
| --- | --- |
| Configured UL grant for location reports | |
| R2-2107399 OPPO | Observation 2: sending the location measurement/ estimation results on the dynamic UL grant is considered to be time-consuming.  Proposal 2: RAN2 to agree that NRPPa msg should support the transmission of the PRS measurement period and starting position in time of the other TPRS to the serving gNB from LMF for configuring proper CG for UE to send location measurement/location estimation results towards the serving gNB for deferred 5GC-MT LR. |
| R2-2108127 Lenovo | Observation 6: Although CG-based solution is intended for ProvideLocationInformation messages, it can be equally applicable to other UL LPP messages.  Observation 7: The impact of CG-based measurement reporting will also be tackled during the RRC\_INACTIVE positioning discussion.  Proposal 9: Support CG-based solution for reporting the positioning measurements or location estimate in RRC\_CONNECTED state. CG-SDT solution of UL LCS messages is assumed to be supported for RRC\_INACTIVE states. RAN3 input may be required for associated impacts.  Proposal 10: Introduce additional finer time granular values for the reportingAmount and reportingInterval IEs corresponding to a periodical reporting configuration. FFS the values to be supported to align with the CG-based solution. |
| R2-2108175 Xiaomi | Proposal 5: The LMF can provide assistance information to gNB and then gNB decides to configure/activate CG resource or deactivate/release the CG resource for UE transmitting location measurements or location estimate based on the assistance information. |
| R2-2108771 Samsung | Observation 1. In LMF based CG configuration indication case, the reduction of latency related to getting UL grant (SR, BSR, and UL grant reception) is on the cost of one additional delay of NRPPa (13~29 ms).  Observation 2. In UE based CG configuration indication case, the reduction of latency related to getting UL grant (SR, BSR, and UL grant reception) is on the cost of no additional delay or 2 additional RRC procedures (26~27ms).  Proposal 1. RAN2 discuss which method between LMF based or UE based CG configuration indication is better to reduce the total latency on measurement reporting. |

**Summary:**

There are diverse proposals regarding enhancements for configured UL grants for location reporting in order to accomplish latency reduction. According to company contribution [26], there are two ways to deliver the CG information to the gNB, either via UE or via LMF directly and RAN2 is proposed to discuss which method is better to reduce the total latency on measurement reporting. In [15], it is support the CG-based solution for measurement reporting in RRC\_CONNECTED mode, with the understanding that it is assumed to be supported for RRC\_INACTIVE state. Moreover, to align with CG-based solution, additional finer time granularities need to be introduced for both *reportingAmount* and *reportingInterval* IEs, which are part of the *periodicalReporting* configuration in LPP. Additionally, [6] mentioned that NRPPa message should support the transmission of the PRS measurement period and starting position in time of the other TRPs to the serving gNB from LMF for configuring proper CG for UE.

Based on the above, the following possible enhancements for CG-based solution in RRC\_CONNECTED mode are identified:

* How the CG parameters are configured:
  + Based on the PRS measurement period and starting position in time of the other TRPs
  + Definition of additional finer time granularities for both reportingAmount and reportingInterval IEs within the periodicalReporting configuration in LPP message
* How the CG information is indicated to the gNB:
  + CG configuration information via LMF
  + CG configuration information via UE

From rapporteur perspective, it should be noted that the CG based solution was discussed in the SI phase and subsequently, it was discussed and excluded from RAN2 scope in RAN plenary during WID discussion [RP-210817, RP-210819]. Therefore, it is not clear if RAN2 should spend more time discussing CG based enhancements related to measurement reporting for latency reduction. Therefore, it is suggested that discussions on this topic are down-prioritized in RAN2, at least until other higher priority aspects are resolved.

**Proposal 10 (Low priority): With regard to configured UL grant for location reporting, RAN2 can discuss the following aspects for CG-based solution in RRC\_CONNECTED mode:**

* **How the CG parameters are configured:**
  + **Based on the PRS measurement period and starting position in time of the other TRPs**
  + **Definition of additional finer time granularities for both reportingAmount and reportingInterval IEs within the periodicalReporting configuration in LPP message**
* **How the CG information is indicated to the gNB:**
  + **CG configuration information via LMF**
  + **CG configuration information via UE**

## 3.8 Other proposed enhancements

There are a few contributions discussing specific aspects related to latency reduction enhancements. The company proposal related to this topic is summarized in the Table below:

|  |  |
| --- | --- |
| Miscellaneous | |
| R2-2108704 Nokia | Observation 1: The current NR LPP positioning protocol is not suitable for efficiently positioning group(s) of UEs (high volume positioning), in terms of latency, accuracy and network efficiency.  Proposal 1: NR positioning should support broadcast/groupcast of positioning-related signaling messages in downlink, including capability request, assistance data, configuration of reference signals and measurements, and location request.  Proposal 2: NR positioning should support UEs or external LCS client to request position information of a group of UEs (which might include requesting UEs) and should enable network to share this information via a broadcast or groupcast message. |
| R2-2107134  CATT | Observation 1: When upper layers request a PDCP entity re-establishment, the transmitting PDCP entity shall:  - for SRBs, discard all stored PDCP SDUs and PDCP PDUs [2];  Observation 2: When upper layers request a PDCP entity re-establishment, the receiving PDCP entity shall:  Observation 3: All LPP message carried in ULInformationTransfer are discarded during the handover because of the exisiting mechanism of PDCP entity re-establishment.  Observation 4: This is a challeng of latency if the LPP messages from UE to LMF or from LMF to UE are lost during the handover, not only for RAT-Independent but also for DL RAT-Dependent positioning methods.  Proposal 1: Latency can be reduced if there is a mechanism to make sure LPP messages won’t be lost during the handover.  Proposal 2: UE can follow the existing mechanism to retransmisit ulInformationTransfer message for the corresponding target cell during the handover to reduce the latency so the LPP messages won’t be sent/receive correctly. |
| R2-2108769 Samsung | Observation 1. In current LPP procedure, the indicated Qos in first requested location information is not fulfilled, another location information procedure will be requested, and sequential processing of location measurement/estimate makes unnecessary latency for obtaining meaningful location estimate at LMF, when LMF is requested for multipleQoS class service.  Proposal 1. Introduce multiple QoS level information i.e., multiple accuracy values to LPP location information request procedure when LMF receives the service request with multipleQoS class from LCS client. |

**Summary:**

In [24], it is observed that the current LPP mechanism is not suited to high number of UEs and so NR positioning should support broadcast/groupcast of positioning related signaling, including capability request, assistance data, configuration of reference signals, measurements and reporting. The rapporteur notes that it is not clear if technically speaking, this enhancement is in scope of the WID. In [4], it is proposed to define a new mechanism to retransmit the LPP message for the target cell during handover to reduce latency. [25] proposes to introduce multiple QoS class/level information in LPP whereby the LMF can indicate multiple QoS levels to the target UE such that if the UE cannot meet the associated accuracy value when performing the measurements, it can switched to the next/lower QoS class/level. From rapporteur perspective, these enhancement does not seem to be directly in the scope of this WID, so it is suggested to postpone discussion on these aspects at least until some of the more critical issued discussed in earlier sections are resolved.

**Proposal 11: RAN2 is proposed to postpone discussion on additional proposed enhancements at least until higher priority issues are resolved.**

# Summary of Proposals for Discussion

Based on the discussion above on contributions related to latency reduction, the following is proposed :

**Proposal 1:** **RAN2 is proposed to discuss whether scheduled location time can help in the reduction of the LCS latency.**

**Observation 1:** **On the need of indicating scheduled location time to the UE/NG-RAN, companies seem to have following interpretations (with option A having majority support):**

* **Option A: The scheduled location time does not need to be indicated to the UE or NG-RAN, since the LMF can implicitly trigger the positioning procedures at or close to it. Therefore, it is transparent to UE/NG-RAN stage-3 positioning procedures.**
* **Option B: Latency reduction can be accomplished by sending the scheduled location time T to the UEs and TRPs in order to trigger measurements at or close to it. Therefore, LPP and/or NRPPa signaling needs to be updated to indicate this information.**

**Proposal 2:** **RAN2 is proposed to discuss and agree that scheduled location time is considered transparent from UE/NG-RAN perspective and no additional specification impact is needed to support it.**

**Proposal 3:** **Regarding the validity conditions/criteria associated with pre-configured assistance data, it is proposed to consider at least the following options:**

* **Option A: Based on a validity area (e.g. a list of cells)**
* **Option B: Based on a (configured) validity timer or a numerical limit on number of times it is utilized**
* **Option C: Based on explicit modification or release from the LMF/NG-RAN**
* **Option D: Based on the UE’s current location and/or the time**

**Proposal 4:** **Continue discussion on the need for supporting enhancements regarding use of pre-configured assistance data for positioning measurements, including:**

* **Support of an add/mod/release mechanism of PRS configurations**
* **Support dynamic triggering of a preconfigured PRS at UE by LMF or gNB for making measurements on DL-PRS and/or dynamic triggering of a preconfigured SRS at UE by gNB for transmitting SRS based on measurement report provided by UE**
* **Support priority indications for multiple (pre-)configured assistance data sets corresponding to multiple position fixes for UE-based and UE-assisted positioning.**

**Proposal 5:** **Based on RAN1’s input, RAN2 agrees to introduce finer granularity for responseTime IE. FFS if this can be accomplished by extending the ‘unit’ field to include e.g. “ten-milliseconds”.**

**Proposal 6: In response to the question asked by SA2 regarding UE positioning capability, it is proposed to capture that the positioning related UE capabilities can be variable, at least in certain cases.**

**Proposal 7: RAN2 further discuss if an indication shall be defined to inform the LMF on whether the UE capability is variable or not, to assist in the storage of UE positioning capabilities in the 5GC. Based on the decision, a response LS to SA2 shall be triggered.**

**Proposal 8 (Low priority): RAN2 is proposed to discuss if enhancements regarding the prioritization of PRS measurements/reporting should be supported in this release, considering at least the following proposed enhancements:**

* **Option A: Support of prioritization handling of DL PRS measurement**
* **Option B: Support of prioritization handling of reporting of measurements/location estimates**
* **Option C: Support of prioritization handling of DL signals/channels carrying LPP signaling**
* **Option D: Support of prioritization handling of DL PRS measurement associated with early location report**

**Proposal 9: RAN2 is proposed to down-prioritize discussion on enhancements related to lower-layer triggering of measurement request/reporting for latency reduction for this release.**

**Proposal 10 (Low priority): With regard to configured UL grant for location reporting, RAN2 can discuss the following aspects for CG-based solution in RRC\_CONNECTED mode:**

* **How the CG parameters are configured:**
  + **Based on the PRS measurement period and starting position in time of the other TRPs**
  + **Definition of additional finer time granularities for both reportingAmount and reportingInterval IEs within the periodicalReporting configuration in LPP message**
* **How the CG information is indicated to the gNB:**
  + **CG configuration information via LMF**
  + **CG configuration information via UE**

**Proposal 11: RAN2 is proposed to postpone discussion on additional proposed enhancements at least until higher priority issues are resolved.**

# References

1. R2-2107090 Discussion on positioning latency reduction ZTE discussion
2. R2-2107091 Discussion on scheduled location time ZTE discussion
3. R2-2107132 Discussion on Response LS on Scheduling Location in Advance to reduce Latency from SA2 CATT discussion Rel-17 NR\_pos\_enh-Core
4. R2-2107134 Discussion on Enhancements for Latency Reduction CATT discussion Rel-17 NR\_pos\_enh-Core
5. R2-2107135 Discussion on storage of UE Positioning Capabilities LS from SA2 and the granularity of response time LS from RAN1 CATT discussion Rel-17 NR\_pos\_enh-Core
6. R2-2107399 Further consideration of positioning latency enhancements OPPO discussion Rel-17 NR\_pos\_enh-Core
7. R2-2107500 Discussion on positioning latency Huawei, HiSilicon discussion Rel-17 NR\_pos\_enh-Core
8. R2-2107641 Discussion on latency enhancement vivo discussion Rel-17 NR\_pos\_enh-Core
9. R2-2107642 Discussion on Scheduling Location in Advance to reduce Latency vivo discussion Rel-17 NR\_pos\_enh-Core
10. R2-2107670 Scheduled location time based latency reduction Intel Corporation discussion Rel-17 NR\_pos\_enh
11. R2-2107673 Storing UE positioning capability in AMF Intel Corporation discussion Rel-17 NR\_pos\_enh
12. R2-2107680 Summary of agenda 8.11.2 Latency enhancements Intel Corporation discussion Rel-17 NR\_pos\_enh Late
13. R2-2107681 Discussion on Enhancements for Latency Reduction InterDigital, Inc. discussion Rel-17 NR\_pos\_enh
14. R2-2107962 Discussion on the response time Samsung discussion Rel-17
15. R2-2108127 Positioning Latency Reduction Enhancements Lenovo, Motorola Mobility discussion Rel-17
16. R2-2108175 Positioning enhancements on latency reduction Xiaomi discussion
17. R2-2108367 Scheduling Location in Advance to Reduce Latency Qualcomm Incorporated discussion
18. R2-2108376 [draft] Response LS on Scheduling Location in Advance to reduce Latency Qualcomm Incorporated LS out Rel-17 FS\_NR\_pos\_enh To:SA2 Cc:RAN1, RAN3
19. R2-2108377 LPP impacts for UE positioning capability storage Qualcomm Incorporated discussion
20. R2-2108378 [draft] Response LS on storage of UE Positioning Capabilities Qualcomm Incorporated LS out Rel-17 To:SA2 Cc:RAN3
21. R2-2108393 Utilizing Time T and other associated parameters Ericsson discussion
22. R2-2108397 On UE Positioning Capabilities Ericsson discussion
23. R2-2108536 Discussion on latency reduction for positioning CMCC discussion Rel-17 NR\_pos\_enh-Core
24. R2-2108704 Enhancement to reduce latency for high volume positioning Nokia, Nokia Shanghai Bell discussion Rel-17 NR\_pos\_enh-Core
25. R2-2108769 Handling of multiple QoS for latency reduction Samsung Electronics discussion NR\_pos\_enh-Core
26. R2-2108771 Latency reduction via configured grant for positioning Samsung Electronics discussion NR\_pos\_enh-Core
27. R2-2108773 Discussion on the scheduled location time Samsung Electronics discussion NR\_pos\_enh-Core
28. R2-2106918 Reply LS to SA2 on Scheduling Location in Advance (R1-2106312; contact: Qualcomm) RAN1 LS in Rel-17 NR\_pos\_enh To:SA2 Cc:RAN2, RAN3
29. R2-2107133 Draft Response LS to SA2 on the scheduled location time CATT LS out Rel-17 NR\_pos\_enh-Core To:SA2 Cc:RAN1, RAN3
30. R2-2106919 LS on granularity of response time (R1-2106316; contact: Huawei) RAN1 LS in Rel-17 NR\_pos\_enh To:RAN2
31. R2-2106971 LS on storage of UE Positioning Capabilities (S2-2105153; contact: Qualcomm) SA2 LS in Rel-17 5G\_eLCS\_ph2 To:RAN2 Cc:RAN3