3GPP TSG-RAN WG1 Meeting #105-e R1-21xxxxx

e-Meeting, May 10th – 27th, 2021

Agenda Item: 8.5

Source: Qualcomm

Title: Email discussion/approval for the reply LS to R1-2102306

Document for: Discussion

# 1 Introduction

SA2 sent an LS (R1-2102306) to RAN1 about Scheduling Location in Advance to reduce Latency:

SA2 has technically endorsed the attached CR to TS 23.273 to support scheduling of location of a target UE in advance using a scheduled location time at which location measurements for the target UE would be obtained by the UE (in the case of DL measurements) and/or NG-RAN (in the case of UL measurements). The scheduled location time is provided by a requesting LCS Client, AF or the UE and transferred to the LMF, which then interacts with the NG-RAN and/or UE to schedule the location measurements at the scheduled location time. The resulting location (e.g. as calculated based on the location measurements by the UE or LMF) is then provided to a recipient LCS Client, AF or the target UE, depending on the type of location request. Use of a scheduled location time allows latency to be reduced since effective latency only commences at the scheduled location time and can exclude time spent prior to this for sending the location request and scheduling the location measurements.

SA2 believes that RAN1 and RAN2 may be planning to supporting a similar capability as documented in an LS sent by RAN2 to RAN1 in R2-2102125 (“LS to capture Text Proposal for TR 38.857”) which includes an attachment R2-2102124 (“Text Proposals of latency enhancements”) with the following bullet item:

- “Latency reduction related to the reporting and request of positioning assistance data (e.g., via location scheduling in advance of the time of when the location is needed)”

Accordingly, SA2 would like to **ask RAN1 and RAN2 whether support can be provided for a scheduled location time as part of Rel-17 and as defined in the attached CR to TS 23.273.** SA2 also invite RAN1 and RAN2 to provide any other comments on support of this feature which may be applicable to support in 5GC.

**To RAN1, RAN2**

**ACTION:** SA2 kindly asks RAN1 and RAN2 to provide a response to the question above once RAN1 and RAN2 are in a position to answer.

The following related contributions are related to the discussion of the LS above:

Related contributions:

1. [R1-2104643](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_105\Docs\R1-2104643.zip) Draft reply LS to SA2 on Scheduling Location in Advance Qualcomm Incorporated
2. [R1-2105937](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_105\Docs\R1-2105937.zip) Discussion on scheduling location in advance to reduce latency Huawei, HiSilicon
3. R1-2104362 Discussion on latency enhancement for NR positioning vivo
4. R1-2104674 Enhancements for Latency Improvements for Positioning Qualcomm Incorporated
5. R1-2104908 NR Positioning Latency Reduction Intel Corporation

During the preparation phase it was identified to perform an Email Discussion/Approval during this meeting.

# Background of the SA2 LS

In some scenarios, a UE, LCS Client or AF that is requesting the location of a target UE may know a time at which the location should be obtained. Some examples of this are as follows.

- Periodic Location: With a periodic deferred 5GC-MT-LR, the location of a UE is obtained at fixed periodic intervals. Clearly, the location time is then known in advance.

- IIot Location: In a factory or warehouse with moving tools, components, packages etc., there could be a precise expectation of when a moving tool, component or package etc. will reach a specific location or will have completed a specific movement or operation. It may then be useful or critical to locate the tool, component or package etc. to confirm the expectation and make any further adjustments.

- Scheduled Location: The location of UEs may sometimes be scheduled to occur at specific times in the future. For example, vehicles on a road may all be located at the same time to provide an indication of traffic congestion as well as to assist with V2X. People, containers, transportation systems etc., may also be located at certain common times.

In the scenarios above, the objective is to determine where the UE is located at the scheduled location time. The known time (referred to as a scheduled location time) can be provided in advance to reduce the effective latency in providing location results.



# Progress in RAN2 with regards to this issue

RAN2 discussed the LS from SA2 at RAN2#113bis and sent a reply LS in [6] asking a few questions for clarification to SA2:

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| RAN2 discussed the subject matter and have some questions for clarification to enable us to better understand the feature. Before RAN2 can decide on support of the feature as defined in the SA2 endorsed CR 0151r1 to TS 23.273 in S2-2102047, RAN2 would first like to understand what the CR describes. Please see below for RAN2 questions:  1. Definition of "scheduled location time":  The definition of scheduled location time is not fully clear to RAN2 since the SA2 endorsed CR describes the scheduled location time differently in different parts of the CR and there is a different description of scheduled location time in the SA2 LS itself. RAN2 would like to have a clear definition of scheduled location time first as this may impact what is signalled to UE and/or NG-RAN. Please see below for detailed comments:  In section 4.1c it says "The request includes the scheduled location time T" which is described as the start of location preparation phase. So, time T is the scheduled location time.  Section 4.1c also says "the scheduled location time allows an external LCS Client, AF or the UE to specify a time in the future at which a current location of the UE is to be obtained". However, in Figure 4.1c-1, the time when the LCS client, AF or UE obtains the location is T+t2. The time T in the figure is shown as the time at which the UE or NG-RAN obtains the location measurements.  The SA2 LS description also states "…support scheduling of location of a target UE in advance using a scheduled location time at which location measurements for the target UE would be obtained by the UE (in the case of DL measurements) and/or NG-RAN (in the case of UL measurements)". This seem to align with the time T in Figure 4.1c-1 which show it as a scheduled measurement time.  In section 6.3.1, step 25 describes the scheduled location time as the time at which the LMF must obtain the UE location, not the time at which the LCS client receives the location or the time at which the LMF schedules the measurement.  2. In section 6.1.2, there is the following editor’s note:  "Editor's note: Feedback from RAN is needed to verify whether location measurements can be scheduled to occur at a UE or NG-RAN at a specific scheduled location time."  Please clarify the requirement whether measurements in UE/NG-RAN need to be scheduled at the scheduled location time received from 5GC or at a time before the scheduled location time received from 5GC.  3. Can SA2 clarify the time format used for the scheduled location time T which is provided to an LMF (e.g., UTC, etc.)?  4. For a Deferred 5GC-MT-LR for periodic location events, RAN2's understanding is that a scheduled location time may apply for the first periodic location report only. For each succeeding periodic location report, the  "scheduled location time" is equivalent to the periodic reporting interval. Please confirm whether RAN2's understanding is correct, or whether different location times T can apply for succeeding periodic location reports.  5. Clause 4.1c says "A scheduled location time can be used with a 5GC-MT-LR, 5GC-MO-LR or deferred 5GC-MT-LR for periodic *or triggered* location events."  RAN2 would like to understand how a scheduled location time can be applicable to triggered location events given its sporadic nature. |

# Summary of views based on RAN1 t-doc submissions

The summary based on inputs from the contributions in RAN1 #105 is given below:

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| **Company** | **Proposals** |
| Qualcomm [1][4] | Proposal 1: Send a draft Reply LS:   * RAN1 thanks SA2 for their LS on Scheduling Location in Advance to reduce Latency. * RAN1 discussed the subject matter and agrees that scheduling location in advance is within the positioning enhancement work item objective, and RAN1 will target supporting this feature in Rel-17 positioning enhancement time frame in alignment with the CR received from SA2.   Proposal 2: For UE-based positioning, a UE is expected to report a location estimate which is valid for the requested “Location Time”.  Proposal 3: For UE-assisted/network-based Positioning, support LMF sending a “Time-domain Window” configuration(s) to both UE and gNBs that define the time at which the measurements are expected to be obtained.   * Each window is defined with a start/End configuration * If startTime is provided, the device (UE/gNB) is expected to perform measurements and reporting that start no earlier than the startTime. * If EndTime is provided, the device (UE/gNB) is expected to perform measurements no later than the EndTime.   Proposal 4: With regards to the requested Time-domain measurement Window:  Study further the UE behavior when a limited number (or none) of PRS instances appears within a configured time-domain window. |
| vivo [2] | Proposal 1:   * Physical layer latency reduction should be independent of scheduled location time. * The method with scheduled location time can be considered as a further optimization to be discussed in Rel-17 if scheduled location time is supported. |
| Huawei | *Observation 1: RAN1 understands that the feature developed by SA2 does not require additional normative work for UL methods, but may require normative work for DL and DL+UL methods, which is led by RAN WG2.*  *Observation 2: We cannot see the “latency reduction” of any kind provided by TS 22.261, TR 38.857, or S2-2102047, but consider it rather as an explicit location time decoupled from the arrival time of the LCS request message.*  *Observation 3: Tolerance of T is required considering the radio interface fluctuation.*  Based on the observations, we have the following proposal to reply to SA2.  *Proposal 1: Reply to SA with the following content:*   |  | | --- | | RAN1 assumes that scheduling location in advance is within the positioning enhancement work item objective, and RAN1 thinks that supporting this feature in Rel-17 positioning enhancement time frame is up to RAN2.  However, currently RAN1 does not see a clear definition of latency, which can be reduced from scheduling location in advance.  In addition, RAN1 believes that the tolerant of T is required considering the nature of radio interface. | |
| Intel [9] | Proposal 4:   * For NR positioning latency reduction,   + Continue discussion on scheduling location and DCI based signaling mechanism once more details are clarified by SA2 with respect to definition and potential pre-configuration of scheduling location information for NR positioning |

# Discussion Phase 1

Questions to attempt to reach a common understanding of the feature?

**Question 1:**

* Do you consider the scheduling location in advance feature one potential positioning enhancement that is within the scope of the WI objectives of Rel-17?

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| Company | Answer |
| Nokia/NSB | If the feature can really result in reduction in latency, then it is within the scope of the WI objectives of Rel-17. We do not see the scheduled location provides any latency gain in signalling on any interface between LCS client all the way up to UE. On the other hand it increases the signalling now due to additional LPP and NRPPa signalling of time T and it increases the processing in LMF, gNB and UE. So, we do not see a latency gain in the solution and so we do not see it being within the scope of the WI objectives of Rel-17. |
| ZTE | In our view, this topic is irrelevant of positioning latency reduction. The scheduled location time is more like a location information report that should measured within a specific time window and reported at a specific time, which may be implemented by configuring a proper response time for the location information report. It may have spec impact in RAN2. Therefore, we think it’s outside the WI objectives of Rel-17. If RAN2 identifies spec impacts that is needed to specify, we can further discuss whether WID can be updated to include “scheduled location time”. |
| Huawei, HiSilicon | We do not see the latency reduction gain, but rather consider this enhancement as an explicit location time decoupled from the arrival time of the LCS request message for immediate location. |
| vivo | Strictly speaking, scheduling location in advance simply move the time required for positioning request around and make it not count as part of total latency. At least for PHY layer, there’s no real latency reduction.  It is up to RAN2 whether they want to consider this as an enhancement. |
| OPPO | Share similar views as other companies that we don’t see latency reduction from RAN1 perspective |
| Lenovo, Motorola Mobility | Share similar views this is not a latency reduction enhancement. This is rather a feature to shift the location configuration and scheduling signalling ‘T’ time units in advance (the individual procedures incur the same amount of latency) before performing measurements. The actual latency for the various signalling components remains the same as in Rel-16. |
| CATT | We failed to see the role of the scheduling location in advance feature for latency reduction. However, it looks like this feature is similar to Measurement Time window which discussed in 8.5.1 but with different motivations. |
| Qualcomm | For the scenarios that location time is known in advance, we understand the latency reduction is happening by decoupling the preparation/configuration phase from the actual measurement phase.   * The latency of each components remain the same, but some are done in advance, so in an actual system, and compared to rel-16 procedures, the latency reduction will be observed.   Configuring a different response time will not enable this feature. If that was possible, SA2 would not have worked on specifying a new feature in their specifications.   * When the UE gets a response time, a UE is expected to start measuring right away, and the response time corresponds to the “worst-case” response from the UE. The response time does NOT say, when the UE/gNBs should do the measurements, rather says, the latest time a UE/gNB should provide a response. * Lets say, the LCS wants to know UE’s location exactly 1 min from now. In current spec, the LCS would have to “approximate" how much time all the preparation phase will need, and include a large enough response time. Since it is not clear when the UE will do measurements, (e.g. at 500 msec mark), then the reported timestamps will not be for the time the LCS wants the measurements.   For the above reasons, we can see the latency reduction in those scenarios.  Also, related RAN1 specification changes are already being discussed in the other subagendas, (e.g. configured measurement window), and therefore we consider this feature to be in scope. |

**Question 2:**

* Do you agree that, from RAN1 perspective, support can be provided for a scheduled location time as part of Rel-17 and as defined in the attached CR to TS 23.273? If not, please provide an explanation.

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| Company | Answer |
| Nokia/NSB | No. Please clarify first what the impact is to RAN1 specifications for the solution as defined in the attached CR to TS 23.273. The proposal overall needs clarification. On the other hand, if this solution impacts measurements we are wondering how it impacts the UE measurement performance defined by RAN4 and any RAN1 defined UE measurement behaviour (e.g., in 38.214). |
| ZTE | No. We need to decide whether this is within the WI objectives of Rel-17 first. Then what’s the expected RAN1 specification impact? |
| Huawei, HiSilicon | We believe whether this can be supported depends majorly on RAN2. |
| Vivo | We don’t see any RAN1 impact and don’t think RAN1 should decide whether to support or not. It is up to RAN2 whether they want to consider this as an enhancement in Rel-17. |
| OPPO | It is not clear what the impact on RAN1 spec is. |
| Lenovo, Motorola Mobility | No, at this stage we don’t see any impact to the measurement and processing procedures. As noted in RAN2’s LS there are quite a few open issues regarding this feature, e.g. the basic definition of scheduled location time, which needs further clarification and any RAN1 support cannot be made at this stage. |
| CATT | We think scheduled location time can be discussed together with measurement time window as part of Rel-17 in 8.5.1 but with different motivations. |
| Qualcomm | There can potentially be RAN1 agreements that facilitate the feature further (e.g. configured measurement window already discussed in other subagendas), which can be done by RAN1, strictly speaking not for the purpose of the “scheduled in advanced feature”, but still applicable to that scenario also. |

**Question 3:**

* Could there be potential impacts to RAN1 work and/or specifications to support or enable this feature?

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| Company | Answer |
| Nokia/NSB | Possibily, yes. UE measurement behavior may need to be defined. There are also on going discussions on configuratble time windows in RAN1 which appear may be related however those enhancements have initially been targeted for Rx/Tx timing error mitigation.  From the RAN2 reply LS it seems clear there is not common understanding among companies and WGs what is being proposed and what specification work is needed. |
| ZTE | It’s outside current WID. We also think it’s different from what we have discussed for multiple measurement instances in AI 8.5.1. The multiple measurement instances are to address timing error shift. |
| Huawei, HiSilicon | We believe whether the measurement window can be used also depends on whether T-info can be provided to the UE/NG-RAN, which is subject to RAN2 decision. |
| Vivo | We have not identified any potential RAN1 impact yet. |
| OPPO | Not clear what RAN1 impact is |
| Lenovo, Motorola Mobility | No identified RAN1 impact. The LMF configured response time already encapsulates the time between receipt of *RequestLocationInformation* and transmission of *ProvideLocationInformation*, i.e., the time between T and T+t2 in SA2 CR. The Measurement window discussed in other AIs such 8.5.1 and 8.5.5 have motivations related to time drift tracking via timestamp reporting and LOS/NLOS measurements, respectively. |
| CATT | We think the RAN1 impact of this feature is similar with that of measurement time window, which need to specify the time windows, in which the UE or TRP measurement instances are obtained. For example, configure and indicate the start time and length of the time window. |
| Qualcomm | There can potentially be RAN1 agreements that facilitate the feature further (e.g. configured measurement window already discussed in other subagendas), which can be done by RAN1 not only for the purpose of the “scheduled in advance feature”.  If the feature is supported, a configured measurement window will be needed, this will have also RAN1 impact. For example, we would have to say in Ran1 that the UE is expected to measure PRS resources within the measurement.  There are already proposals in other subagendas that include these within RAN1 scope; not for the purpose of the scheduling in advance feature, but still, these proposals will enable this feature further.  The fact that a enhancement already discussed in RAN1 (e.g. configured measurement window) can enable multiple enhancements within RAN1 and other groups, is not a problem for us. Some features are general enough that can enable multiple aspects |

**Question 4:**

* Any additional comments you would like to provide?

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| Company | Comments |
| Nokia/NSB | Perhaps the proponents could clarify the RAN1 expected impact and the gains that would be achieved. |
| Huawei, HiSilicon | We should consider the tolerance of T due to the uncertainty of radio interface. |
| Vivo | It’s no clear to us about the intention of question 1 to 3. Are they intended to be part of reply LS from RAN1 to SA2? BTW, is the common understanding that RAN1 will for sure have a reply LS to SA2 considering RAN2 alerady replied? |
| Qualcomm | In the “Actions” requested by SA2, it says, “once RAN1 is in a position to answer”. If RAN1 is not yet ready in a position to answer, then there will not be a need to reply now. |

# Conclusions

TBD

# References

1. [R1-2104643](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_105\Docs\R1-2104643.zip) Draft reply LS to SA2 on Scheduling Location in Advance., Qualcomm
2. [R1-2105937](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_105\Docs\R1-2105937.zip) Discussion on scheduling location in advance to reduce latency Huawei, HiSilicon
3. R1-2104362 Discussion on latency enhancement for NR positioning vivo
4. R1-2104674 Enhancements for Latency Improvements for Positioning, Qualcomm
5. R1-2104908 NR Positioning Latency Reduction, Intel Corporation
6. R2-2104420 Response LS on Scheduling Location in Advance to reduce Latency, RAN2.
7. [S2-2102047](https://www.3gpp.org/ftp/tsg_sa/WG2_Arch/TSGS2_143e_Electronic/INBOX/S2-2102047.zip) Addition of a Scheduled Location Time, Qualcomm