**3GPP T****SG-RAN WG2 Meeting #115-e draft-R2-2108884**

**E-Meeting: August 09-27, 2021**

**Agenda item: 8.10.3.1**

**Source: Qualcomm Incorporated**

**Title: [AT115-e][102][NTN] LCS aspects (Qualcomm)**

**Document for: Discussion and Decision**

# Introduction

Followings are agreements made in RAN2#115e regarding coarse UE location information.

Agreements:

1. If SA3 replies with concern on reporting UE location with any granularity during initial access, RAN2 will revisit agreement/solution for reporting UE location during initial access.
2. UE coarse location information refers to coarse GNSS coordinates (FFS on the details, e.g. X MSB bits out of 24 bits of longitude/latitude or GNSS coordinates with ~2km accuracy). FFS if any enhancements to validate the UE’s coarse location information is needed. FFS whether this is only used in initial access or also in connected

This document provides report of the following offline discussion.

* [AT115-e][102][NTN] LCS aspects (Qualcomm)

Scope: Continue the discussion on p2-p8 from [R2-2108848](file:///C:\Data\3GPP\RAN2\Docs\R2-2108848.zip) and then draft reply LS responses to RAN3 (contact Qualcomm) and SA3 (contact Huawei)

Intended outcome: Summary of the offline discussion with e.g.:

* + - List of proposals for agreement (if any)
    - List of proposals for further discussion
    - List of proposals that should not be pursued (if any)

Initial deadline (for companies' feedback): Thursday 2021-08-19 1600 UTC

Initial deadline (for rapporteur's summary in R2-2108884): Thursday 2021-08-19 2200 UTC

Deadline for reply LSs: Week2 (after CB session)

Proposals marked "for agreement" in R2-2108884 not challenged until Friday 2021-08-20 1000 UTC will be declared as agreed via email by the session chair (for the rest the discussion will further continue offline until the CB session in Week2).

# Discussion

## Discussion on p2-p8 from R2-2108848

Please provide your views on the proposal 2 to proposal 8 from R2-2108848 [1].

1. The coarse location information is reported in Msg5, i.e., via *RRCSetupComplete*/*RRCResumeComplete* message.

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/Not agree** | **Comments** |
| FGI | Agree |  |
| Samsung | Agree |  |
| Thales | Agree |  |
| Ericsson |  | Up to SA3 |
| OPPO |  | Up to SA3 |
| MediaTek |  | Up to SA3 |
| Xiaomi |  | Up to SA3 |
| Lenovo |  | Up to SA3 |
| Huawei, HiSilicon |  | Up to SA3 |
| CATT | **Agree** | RAN2 may go on the discussion based on the agreement so far, and may update later accordingly. So far we didn't see big concern because the coarse location information is ~2KM, rather than ~50KM which may bring concern from SA3. |
| Vodafone | **Agree** |  |
| Sony | Agree |  |
| ZTE |  | It is possible to report UE location via Msg5 from RAN2’s perspective but we have to consult SA3 if there is any security concern or privacy concern as usually we do not acquire sensitive information like measurement results or location info before AS security is activated.  Since we will have reply LS to SA3 as discussed below, maybe we can one more question in the reply LS for this location report in Msg5. |

1. For coarse UE location reporting during initial access, the location granularity (i.e., accuracy to be 2 km radius or x>2 km radius) is indicated to UE via SIB.

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/Not agree** | **Comments** |
| FGI | Not agree | Not sure if reporting X > 2km (for example, 10 bits out of 24 bits) is useful for RAN3.  We prefer the UE can report UE location information with a guaranteed accuracy of an area of ~2km radius in Msg5 during initial access if no privacy concern. |
| Samsung | See comments | We are not clear why the accuracy criterion should be configured with either 2km radius or larger than 2km radius. To the LS, it was asked “RAN2 would like to ask SA3 whether there is privacy concern if a UE reports the location information to NG-RAN with ~2km radius accuracy before AS security is established, e.g. during initial access.”, which sounds to us the accuracy criterion is 2km radius before AS security is established. What we mean is there should be one criterion to remove privacy concern, x km, then why we need additional criterion? |
| Thales | Not agree |  |
| Ericsson | Not agreed | There is no need for such. Even if we end up having coarse location reporting during initial access it does not have to be so complicated setup that would need such selection to be ordered in SIB. |
| OPPO | Not agree | There is no need to further control the granularity as long as SA3 replies with no concern. |
| MediaTek | Not agree | There is no need to control the granularity prior to RACH. |
| Xiaomi | Not agree | There is no need to indicate the location granularity, but we think network can indicate whether UE needs to report its location to network in initial access. |
| Lenovo | Not agree | There is no need to specify the location granularity and a flag indication to enable/disable is sufficient. |
| Huawei, HiSilicon | **Not agree** |  |
| CATT | No strong view | But we observe that the granularity can work for operators based on their deployment strategy. SIB seems the natural way to configure the granularity. |
| Vodafone | Not Agree | Not Necessary ! |
| **Sony** | Not agree | We also share the view with others that the need for two cases should be justified more |
| ZTE | Disagree | We do not think there is need to indicate such a granularity. We can simply define a ASN.1 to report UE location with about 2km accuracy. |

1. Enhancements to validate the UE’s coarse location information is needed in Rel-17.

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **Before AS security**  **(Yes/No)** | **After AS security**  **(Yes/No)** | **Comments** |
| FGI | No | No | We think the previous agreement is still valid.  **Agreements** **online**:  RAN2 Working Assumption: RAN2 doesn’t need to do anything to ensure that final UE location information at the core network is trustable so far (it's other WGs business to define solutions to verify the UE location) |
| Samsung | See comments | No | Whether the reporting of UE’s coarse location information is also required for RRC connected state (after AS security is activated) is FFS. With this FFS, we think after AS security, it’s early to make a decision. For the case before AS security is activated, first we would like to understand the solution better. For example, if the concern is whether the coarse location information reported by the UE is trustworthy before AS security is activated, and the solution is to add some additional information to help the gNB to validate the coarse location information, how we can trust that additional information (that is used for validation) sent by the UE before AS security is activated? |
| Thales | Yes | Yes | We believe that RAN2 should define the necessary signalling enhancement allowing other WGs to define solutions to verify the UE location.  During connected mode, the reporting of TA can be exploited by the network to verify the location.  During the initial access, having the option to send the txRxDiff info along with the reported UE coarse GNSS info will allow the network to verify the UE location and hence prevent risk of selecting wrong core network. It will be beneficial to ensure no additional delay for a connection set-up especially for emergency calls. |
| Ericsson | no | no | With our understanding this would be enough. |
| OPPO | No | No | This is out of RAN2’s scope. |
| MediaTek | No | No | This is not in RAN2 scope. |
| Xiaomi | No | No | Based on the previous RAN2 agreements, this is out of RAN2 scope. |
| Lenovo | No | No | Out of RAN2 scope. |
| Huawei, HiSilicon | No | No | It’s related to adaptations of network based positioning mechanism in NTN, and it can be considered in further release considering RAN1 needs to be involved. |
| CATT | No | No | 1. There is no need to verify the UE’s location by NG-RAN because core network is able to verify the UE’s location by itself when it needs to verify the UE’s location. For example, LCS request from AMF proposed by SA3 in its previous LS can meet such requirement.  2. NG-RAN isn’t permitted to get the UE’s accurate location info except CGI in TN. Only Core network e.g. AMF and LMF can get UE’s accurate location. So neither RX-TX nor A-GNSS measurement which is reported to LMF via LPP message in TN will be agreed to report to gNB. All the measurement report for positioning is reported to LMF instead of NG-RAN in TN.  3. TA doesn’t represent the UE’s location alone either. |
| Vodafone | no strong opinion | Yes |  |
| Sony | No | No |  |
| ZTE | No | No | We understand the UE location is mainly used to select the CN or construct the CGI by the RAN node and the CN will perform some validation later on so we understand there is no need for such validation in RAN. |

1. The UE reports what location information (i.e., coarse UE location information or finer location information/full GNSS coordinates) to gNB in RRC\_CONNECTED, i.e., after AS security has been established.

|  |  |  |  |
| --- | --- | --- | --- |
| **Company** | **Coarse UE location**  **(Yes/No)** | **Finer UE location**  **(Yes/No)** | **Comments** |
| FGI | No | Yes | Location report of 2km accuracy provides additional benefits on scheduling and mobility enhancement. For example, [R1-2107292](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_106-e/Docs/R1-2107292.zip" \t "_blank) shows a toy example when UE reports location acquired from GNSS with the 2km accuracy. In this example, the maximum RTT estimate error is only 0.0047ms. |
| Samsung | No | Yes | We think finer UE location information is used after AS security is established unless any similar security issue is raised. We don’t think signalling overhead reduction is not the main intention, which is anyway marginal. Also UE location information can be used to determine HO or etc., which means to us finer UE location would be helpful. |
| Thales | Yes | Yes | The UE should be able to report either coarse or finer UE location as requested by the network during connected mode when AS security is activated. This depends on the service requirement |
| Ericsson | yes | yes | UE can report fine or coarse depending on situation. If fine granularity is not feasible, UE can report the coarse location. For coarse reporting it is assumed RAN2 works for a solution. For fine reporting we can use what positioning uses. |
| OPPO | No | Yes | Just follow the existing spec on reporting LocationInfo. |
| MediaTek | Yes | No | Following the current specs seem enough for Rel-17. Any enhancements to positioning accuracy can be pursued in the future releases. Evaluation of accuracy better than 2km needs to be evaluated first. |
| Xiaomi | No | Yes | The existing mechanism should be reused. |
| Lenovo | No | Yes | For RRC\_CONNECTED after AS security has been established, the existing measurement report can be reused. |
| Huawei, HiSilicon |  |  | It is pending SA3’s reply, and we can wait for SA3’s further input. |
| CATT | Yes | Yes | Finer UE location is good for other purpose. But I doubt that the finer UE location is permitted to report to NG-RAN since the local LMF in gNB has not been agreed in RAN WG. |
| Vodafone | Yes | yes | Agree with Thales and Ericsson |
| **Sony** | Yes | Yes | Finer UE location is beneficial for mobility management, border coverage identification, NTN to TN handover etc. |
| ZTE | - | - | We prefer to use the existing mechanism for connected mode after AS security is activated.  Since the existing LocationInfo-r16 is only used for MDT based on User Consent, we understand user consent is also needed if we extend the use to NTN. |

1. After AS security is established, gNB can obtain a GNSS-based location information from the UE using existing signalling method, i.e., by configuring *includeCommonLocationInfo* in the corresponding *reportConfig*.

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| --- | --- | --- |
| **Company** | **Agree/Not agree** | **Comments** |
| FGI | Agree |  |
| Samsung | Agree |  |
| Thales | Agree |  |
| Ericsson | ? | How can we agree something existing would not be possible?  We should discuss what enhancements RAN2 will specify. We have agreed location based event to trigger the report and RAN2 is working on it. The report itself should be discussed |
| OPPO | Agree | As supported by the existing spec. |
| MediaTek | Agree | Current specs allow to report this information. |
| Xiaomi | Agree |  |
| Lenovo | Agree |  |
| Huawei, HiSilicon | Not agree | In NR current LocationInfo-r16 is only used for MDT based on User Consent. If this location reporting needs to be supported in NTN feature, User Consent should also be essential precondition. And this decision should be made in SA3 too. |
| CATT | Agree | Although the agreement online is that FFS on the details, e.g. X MSB bits out of 24 bits of longitude/latitude or GNSS coordinates with ~2km accuracy), we still can discuss which message to carry the report at the same time. |
| Vodafone | Agree |  |
| Sony | Agree |  |
| ZTE | - | We share similar with HW that the existing LocationInfo-r16 is only used for MDT based on User Consent. We are fine to also use it in NTN based on user consent. |

1. Which mechanism(s) is(are) configured by gNB to obtain UE location update of mobile UEs in RRC\_CONNECTED?

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Company** | **Periodic location reporting**  **(Yes/No)** | **Event triggered location reporting**  **(Yes/No)** | **Aperiodic reporting**  **(i.e., report upon gNB request, e.g. via DCI)**  **(Yes/No)** | **Comments** |
| FGI | Yes | No | No | If UE speed is 1200km/hr, then UE reports every 3 seconds to ensure UE’s location trackable with the delta distance less than 2km, which seems feasible by RRC. |
| Samsung | Yes | Yes | See comments | We think the baseline is periodic location reporting and event triggered location reporting (also possibly with event triggered periodic reporting). Then the question is whether we really need aperiodic reporting based on DCI on top of periodic location reporting and/or event triggered location reporting. Need case should be well justified. |
| Thales | Yes | Yes | No views |  |
| Ericsson | yes | yes | possible | Offline -103 is discussing location reporting. Better discuss in one place. Only location report format is excluded in that discussion. |
| OPPO | Yes | Yes | No | Just follow the existing spec where includeCommonLocationInfo can be configured for event-triggered reporting and periodical reporting. |
| MediaTek | No | Yes | No | Only event triggered reporting seems enough. |
| Xiaomi | Yes | Yes | No | The existing mechanism should be reused. |
| Lenovo | Yes | Yes | No | The existing mechanism can be reused. |
| Huawei, HiSilicon |  |  |  | This discussion can be postponed until SA3’s reply is received. |
| CATT | Yes | Yes | No | The purpose to obtain UE location update is for CGI mapping required from Core network. So we don't see the response on DCI is necessary because this request comes from NAS rather than from RAN1 within strict latency requirement. But we are fine to further discuss 3rd option in the future if there is other agreed purpose on UE’s location. |
| Vodafone | Yes | Yes | Possible | All features are useful for the operator and various use cases |
| **Sony** | Yes | Yes | Yes | Event triggered location reporting is beneficial to keep the balance between reporting overhead and performance.  On report upon gNB request, we think RRC signalling should be used. |
| ZTE | Yes | Yes | No | We understand the existing LocationInfo-r16 is only used for MDT based on User Consent, which allows both periodical report and event triggered report. We are fine to also use it in NTN based on user consent. |

## Draft reply LS responses to RAN3

The draft LS in response to RAN3 LS is provided in R2-2107568 [2]. It is given below for your convenience.

**Question 1: RAN3 would like RAN2 to confirm whether the gNB will be able to acquire UE location information with an accuracy comparable to TN cell granularity (e.g. GNSS information** **or otherwise) after AS security, and also to confirm whether it is possible to provide any level of UE location information (i.e. finer than NTN Uu cell accuracy) before AS security.**

**RAN2 answer:** RAN2 confirms that UE can report GNSS coordinates using existing mechanism in the measurement report. In addition, RAN2 has agreed that the UE will report UE location information with a guaranteed accuracy of an area of ~2km radius in Msg5 during initial access if no privacy issue is identified by SA3.

1. Do you agree with the answer to Question 1? Please provide any suggestion in comments.

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| --- | --- | --- |
| **Company** | **Agree/Not agree** | **Comments** |
| FGI | Agree |  |
| Samsung | Agree |  |
| Thales | Agree | We believe it is beneficial to clarify that  “NG-RAN is expected to do the CGI mapping based on the received UE coarse GNSS coordination information” |
| Ericsson | agree |  |
| OPPO | Agree |  |
| MediaTek | Agree |  |
| Xiaomi | Agree |  |
| Lenovo | Agree |  |
| Huawei | Not agree | The first sentence should be modified to “RAN2 confirms that UE can report GNSS coordinates using existing mechanism in the measurement report with User Consent for MDT applications”. |
| CATT | Agree |  |
| Vodafone | Agree |  |
| Sony | Agree |  |
| ZTE | - | As HW mentioned, the existing mechanism is for MDT with User Consent. We believe similar User Consent is also needed if we extend the use to NTN, Thus the privacy concern is not only for initial access per our understanding.  So we suggest to modify a little bit as follows:  *RAN2 understand the existing mechanism of reporting GNSS coordinates in the measurement report for MDT based on User Consent can also be used in NTN. Whether User Consent is also required in NTN should be discussed and decided by SA3.*  *In addition, RAN2 has agreed that the UE will report UE location information with a guaranteed accuracy of an area of ~2km radius in Msg5 during initial access if no privacy issue is identified by SA3.* |

**Question 3: RAN3 welcomes any feedback from RAN2 on the described case (i.e. the gNB to trigger inter-AMF handover when crossing country borders).**

**RAN2 answer:** The UE may report UE’s GNSS coordinates in existing measurement report. The measurement report can be transmitted periodically. In addition, location-based measurement trigger is also introduced such that the UE will trigger the measurement report if it moves by a threshold distance since its last report. Therefore, gNB will be able to determine whether UE has moved far away from the last location report. RAN2 understands it is up to the gNB to determine the crossing of country borders based on the location update and take appropriate action.

1. Do you agree with the answer to Question 3? Please provide any suggestion in comments.

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| --- | --- | --- |
| **Company** | **Agree/Not agree** | **Comments** |
| FGI | agree | However, considering the GNSS error may be 30m to 100m, periodic reporting may be more reliable than counting distance by UE. |
| Samsung | See comments | To us, it seems ok in general. However, isn’t RAN2 answer related to the previous discussions (P5 and P6) in this offline discussion? |
| Thales | Agree |  |
| Ericsson | With modification | RAN2 has not agreed “UE will trigger the measurement report if it moves by a threshold distance since its last report.”. We need to state only what is agreed by RAN2, not single company views. |
| OPPO | See comments | Same view with Samsung. |
| MediaTek | With modifications | As mentioned by Ericsson, the modification of location-based measurement report is not yet agreed. |
| Xiaomi | See comments | We can indicate the agreements on P5 and P6 to RAN3, and the how to handle the inter-AMF handover is up to RAN3. |
| Lenovo | Comments | Location triggered measurement report has not been agreed yet. |
| Huawei, HiSilicon | Not agree | It has not been agreed in RAN2 that “The UE may report UE’s GNSS coordinates in existing measurement report” for NTN feature. |
| CATT | FFS | RAN2 can further discuss the solution based on the agreement on how to obtain UE’s location. It’s too early to reply the LS. |
| Vodafone | to early to say | it is dependent on the network implementations and use case |
| Sony | Agree |  |
| ZTE | FFS | Answer to this question is related to the discussion on P5 and P6 while companies’ views are split so far. We can wait until agreements are made for P5 and P6. |

**Question 4: RAN3 requests RAN2, CT1 and SA2 to provide any feedback on above issue (i.e. which TAC should be reported by the gNB in case of multiple broadcast TAC).**

**RAN2 answer:** The gNB will be able to acquire UE location information at initial access and during connected mode periods. Therefore, it would be possible to map such a location into a TAC (since TAC areas are earth-fixed). RAN2 cannot comment however on whether this approach is appropriate for reporting towards the CN.

1. Do you agree with the answer to Question 4? Please provide any suggestion in comments.

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| --- | --- | --- |
| **Company** | **Agree/Not agree** | **Comments** |
| FGI | Agree |  |
| Samsung | See comments | When the UE detects it enters into new TAC area among multiple ones and TAU update is needed, then the UE establishes RRC connection with coarse location information. Then the question is whether the coarse location information (with x > 2kms accuracy radius) is enough to determine the corresponding TAC. If not, why not TAC is directly reported by the UE? |
| Thales | Agree |  |
| Ericsson | Not agreed | We do not know yet about location reporting during initial access. Further, there is offline 107 for the TAC handling. We need to align with that. Propose not to discuss this response here further. |
| OPPO |  | Should coordinate with the output of offline 107. |
| MediaTek | Not Agreed | The location reporting during initial access needs to be agreed first. The question can be discussed in offline 107. |
| Xiaomi | Not agreed | Agree with MediaTek, |
| Lenovo | Not agreed | Location reporting during initial access has not been agreed yet. |
| Huawei, HiSilicon | Not agree | RAN2 can answer the reported TAC should be the one where UE is located. |
| CATT | Not agreed | TAC follows CGI in NTN. There is no need to discuss TAC in RAN2 because the TAC is clear once the mapping CGI is clear in NTN.  RAN2 can wait for the progress of RAN3 and not to reply this LS at this meeting. |
| Vodafone | agree in principle | it depends on the network implementation and initial access procedures , but in principle it ‘should’ be possible to perform this function |
| Sony | Agree |  |
| ZTE | - | We understand this is also related to the TAC selection issue discussed in offline 107. For example, if the UE NAS layer selects one TAC from the broadcast ones based on UE location and forward the selected TAC to AS layer, AS layer can then report it to gNB and have it included in the ULI later on. |

## Draft reply LS responses to SA3

RAN2 also received LS from SA3 and draft LS is provided in R2-2107346 [3]. It is given below for your convenience.

**Question 1: What is the purpose of sending A-GNSS based measurements after AS security has been established? Is it for core network reselection after initial core network selection?**

RAN2 answer: RAN2 believes that this is for potential core network reselection after initial core network selection. After AS security has been established, LCS procedure via LMF can be initiated to verify UE’s location and check whether UE has selected a PLMN that is allowed to operate in the country of the UE location.

1. Do you agree with the answer to the first Question? Please provide any suggestion in comments.

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| --- | --- | --- |
| **Company** | **Agree/Not agree** | **Comments** |
| FGI | Agree |  |
| Thales | Agree | However LCS procedure based on UE generated is not considered reliable by SA3-LI |
| Ericsson | agree |  |
| Xiaomi | See comments | We think the above answer is one of the purposes to send A-GNSS based measurements, but the requirements of UE location report is from SA2, so we think SA2 can answer this question. |
| Lenovo | Agree |  |
| Huawei, HiSilicon | agree | proponent |
| CATT | Agree | To Thales’s comments: LCS procedure via LMF can be initiated to verify UE’s location. |
| Vodafone | Agree |  |
| Sony | Agree | The short answer to SA3 question is Yes |
| ZTE | Agree |  |

**Question 2: Are the A-GNSS based measurements used by the applied UE positioning method during LCS procedure or used in a different procedure?**

RAN2 answer: RAN2 believes that A-GNSS based measurements are parts of A-GNSS positioning method, and it is during LCS procedure.

1. Do you agree with the answer to the second question? Please provide any suggestion in comments.

|  |  |  |
| --- | --- | --- |
| **Company** | **Agree/Not agree** | **Comments** |
| FGI | Agree |  |
| Thales | Agree |  |
| Ericsson | agree |  |
| Xiaomi | Agree |  |
| Lenovo | Agree |  |
| Huawei, HiSilicon | agree | proponent |
| CATT | Agree |  |
| Vodafone | Agree |  |
| Sony | Agree |  |
| ZTE | Agree |  |

# Conclusion

TBD…

# references

[1] R2-2108848, “[Pre115-e][102][NTN] Summary of AI 8.10.3.1 - LCS aspects only”, Qualcomm Incorporated.

[2] R2-2107568, “[Draft] Reply LS on UE location aspects in NTN”, Qualcomm Incorporated.

[3] R2-2107346, “Draft Reply LS on UE location aspects in NTN”, Huawei, HiSilicon.