3GPP TSG-RAN WG2 Meeting #121bis-e R2-23xxxxx

Online Meeting, 17-26 April 2023

**Agenda item: 7.24.2**

**Source: CATT**

**Title: [AT121bis-e][413][POS] Positioning for remote UEs (CATT)**

**WID/SID: NR TEI18**

**Document for: Discussion and Agreement**

# 1 Introduction

This document is to kick off the following email discussion:

 [AT121bis-e][413][POS] Positioning for remote UEs (CATT)

      Scope: Discuss the proposals/TPs in R2-2303559 and R2-2303702 and attempt to converge to agreeable CRs.

      Intended outcome: Report and agreeable CRs

      Deadline: Friday 2023-04-21 1000 UTC

There will be two phases for the email discussion according to the intended outcome:

* Phase I: discuss the proposals, deadline (for companies' feedback): **Wednesday** 2023-04-19 1800 UTC
* Phase II discuss the TPs, deadline (for companies' feedback ): **Friday** 2023-04-21 1000 UTC

In this email discussion the following contributions related with Positioning of remote and relay UEs are discussed to decide if these proposals and TPs in the contributions can be agreed.

1. R2-2303559 Positioning of remote UEs MediaTek Inc., CATT, Huawei, HiSilicon, Qualcomm Incorporated, Xiaomi, Intel Corporation, vivo discussion Rel-18 TEI18
2. R2-2303702 Relay based Positioning for emergency calls and posSIB forwarding Ericsson discussion Rel-18

# 2 Contact Information

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

|  |  |
| --- | --- |
| Company | Contact: Name (E-mail) |
| Ericsson | Ritesh Shreevastav |
| MediaTek | Nathan Tenny (nathan.tenny@mediatek.com) |
| Lenovo | Jie Hu (hujie14@lenovo.com) |
| OPPO | Qianxi Lu |
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| vivo | Xiang Pan (panxiang@vivo.com) |

# 3 Discussion of proposals in R2-2303559

The document R2-2303559 discusses the case that a remote UE may have a requirement for positioning support and should be able to be positioned by the system, but there are certain restrictions in the Rel-17 relaying support that impair this functionality. So R2-2303559 further discusses the topic and proposes a way forward considering the previous inputs.

## 3.1 Remote UE indication

As R2-2303559 analysed, an indication of remote operation could be provided in several places in LPP. The indication in the LPP capability signalling does not strictly guarantee that the LMF will know the UE’s status before triggering positioning operations, but for a typical positioning session, the capability information should be available to the LMF at the beginning.

Companies proposed the indication in *CommonIEsProvideCapabilities* in R2-2303559:

**Proposal 1:** Indicate the remote UE status in the LPP IE *CommonIEsProvideCapabilities* and in the method-specific IEs for target device error causes.

TS 37.355 is silent on what events constitute such a trigger (except for the reception of the RequestCapabilities message; in addition, TS 38.305 indicates that the UE may include this message in the MO-LR case). It seems beneficial to include some guidance on such a trigger, e.g., in the field description of the remote UE status indication in CommonIEsProvideCapabilities.

**Proposal 2:** Add to the field description of the remote UE status indication in *CommonUEsProvideCapabilities* text indicating that the UE may send its capabilities due to starting or stopping operation as a L2 U2N Remote UE.

**Rapporteur’s comments**: This is an essential indication and the related field description status in the LPP IE *CommonIEsProvideCapabilities* indicates that the UE may send its capabilities due to starting or stopping operation as a L2 U2N Remote UE.

**Question 1**: Do you agree to indicate the remote UE status in the LPP IE *CommonIEsProvideCapabilities* and in the method-specific IEs for target device error causes? Please provide your views as well.

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Qualcomm  | Yes | Seems the simplest way to indicate the remote status to an LMF. In addition, in the case of a UE is not able to fulfil the location request due to being remote, an LMF can be informed in the error cause and could instigate another positioning method in a 2nd attempt (e.g., select a positioning method which is less sensitive to the UE remote status (e.g., GNSS)). |
| Ericsson | No | We see the need that AMF should be aware of remote UE prior to LMF becoming aware as there are positioning such as Cell ID based positioning. Hence, AMF may not invoke LMF if cell ID based positioning can be adequate in some cases; but for remote UE case this could be misleading and thus we see that AMF should be aware. |
| MediaTek | Yes | This seems clearly useful for the LMF, as detailed in the paper. We understand Ericsson’s comment to be orthogonal to the proposal (and notifying the AMF would be outside RAN2 scope). |
| Lenovo | Yes | The indication is essential for LMF to identify the target UE is a remote UE. |
| CATT | Yes | The indication is essential that the UE is a L2 U2N Remote UE. When remote status changes during a positioning session which may not be aware by AMF at once. So we observe that the indication to LMF is essential. And we also share the same view as MTK, which notifying the AMF is outside RAN2 scope. |
| Xiaomi | Yes with comments | Besides the error cause in LPP, we think NRPPa shall also be enhanced to indicate the remote UE error cause.The uplink positioning, mulit-RTT with aperiodic or semi-persistent SRS, preconfigured measurement and PPW can’t work for remote UE. gNB knows that the target UE is remote UE. For instance, LMF request gNB to configure aperiodic SRS for the remote UE, the gNB sends the positioning information failure message to the LMF with the error cause setting as remote UE. |
| Philips | Yes |  |
| ZTE | No | We agree with Ericsson that AMF should be aware of the UE to be a remote UE and can tell LMF. No need to include the indication in the LPP |
| Nokia |  | 1. Who exactly provides this remote UE status indication to the LMF? Is it the Relay UE or the Remote UE? How does a Remote UE provide it if it is out of coverage?2. Typically, *ProvideCapabilities* IE signals the UE’s positioning capabilities and not a dynamic change in the UE’s role i.e., switch between a regular target UE and a Remote UE role. Path switch between indirect and direct path will be supported in Rel-18.3. SL positioning is expected to have a new SLPP protocol specification. Can we not keep SL specific signalling and all support for transport of LPP PDUs in the SLPP specification and avoid tight coupling of SL related signalling and procedures in the LPP specification? |
| InterDigital | Yes | We share similar view with Qualcomm. Providing status of remote UE in LPP capability info to LMF allows selection of suitable positioning method for remote UE.  |
| vivo | Yes |  |

**Question 2**: Do you agree with the field description of the remote UE status indication in *CommonUEsProvideCapabilities* text indicating that the UE may send its capabilities due to starting or stopping operation as a L2 U2N Remote UE?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Qualcomm | Yes | Remote status may change during a positioning session (e.g., in the case of long response times, periodic reporting, etc.). |
| Ericsson  | No | This is by passing normal positioning flow where AMF should be responsible for invoking correct LMF that can handle remote UE positioning. |
| MediaTek | Yes | As discussed in the paper, the capabilities seem like the most reasonable place for the indication, and this change clarifies that the UE updates the LMF when its status changes. |
| Lenovo | No | In current positioning procedure, the exchange of capabilities between target and server can be initiated by a request or sent as “unsolicited”, we think both of the two ways can support the capability indication of a remote UE already. For consideration of minimize the spec impact and avoid also introducing similar triggering for other target UE types, not prefer to indicate additional trigger for the remote UE capability field.  |
| CATT | Yes | The capabilities seem a reasonable place for the indication, since the remote status may change during a positioning session. |
| Xiaomi |  | We think this can be left to UE implementation, since UE can report the capability in unsolicited way. |
| Philips | Yes |  |
| ZTE | No | Agree with Ericsson |
| InterDigital | Yes |  |
| vivo | Yes |  |

**Summary:**

## 3.2 SFN and DFN timelines

R2-2303559 mentioned the benefit of an SFN-DFN offset has been reviewed by companies and is established in the references, allowing the remote UE to know the SFN timeline of the serving gNB to support various positioning operations. How to contain the offset was discussed by companies as well. Considering that positioning may be infrequent and not every remote UE has requirements/support for positioning, a request-response mechanism and a capability flag are supported after companies discussed previously.

**Proposal 3:** Introduce an SFN-DFN offset in the *RRCReconfigurationSidelink* message, in which the offset is requested explicitly by the remote UE with the *RemoteUEInformationSidelink* message when it starts a positioning operation.

**Rapporteur’s comments**:

SFN-DFN offset is essential info for the positioning of remote UEs. This is a comprised proposal which has been supported by seven companies.

**Question 3**: Do you agree to introduce an SFN-DFN offset in the *RRCReconfigurationSidelink* message, in which the offset is requested explicitly by the remote UE with the *RemoteUEInformationSidelink* message when it starts a positioning operation? Please provide your views.

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Qualcomm | Yes | This enables the remote UE to determine the SFN of the "serving cell", if needed. |
| MediaTek | Yes | The remote UE intrinsically knows the DFN timeline, and this allows it to convert to the SFN timeline. |
| Lenovo | Yes | Agree the intention to indicate the SFN-DFN offset to remote UE, and a request -response mechanism shows benefit on signalling reduction. |
| OPPO | Comment | We understand the target scenario is for remote UE, being out of (SIB) coverage, to make use of RAT-dependent positioning method (mainly DL PRS based method?). Yet we are not super sure whether such out-of-coverage remote UE can really benefit from DL PRS based method.  |
| CATT | Yes | RAT-Dependent positioning methods will be supported within the SFN-DFN. It is still possible for remote UE to receive the DL-PRS considering the coverage of serving cell is not the same as DL-PRS.  |
| Xiaomi | Yes | Remote UE can determine the SFN of the cell according to the SFN-DFN timeline. |
| Philips  | Yes |  |
| ZTE | Not sure | SIB12 has an IE sl-OffsetDFN. Is it the same thing as the SFN-DFN timeline? Or the SFN-DFN timeline can be inferred by the sl-OffsetDFN?Since SIB12 can be forwarded to the remote UE, so if the above is correct then SFN-DFN timeline is not necessary? |
| Nokia |  | It is feasible to use the *RRCReconfigurationSidelink* and *RemoteUEInformationSidelink* messages for the stated purpose. However, we are not sure if the Remote UE knowing this SFN-DFN offset information will enable support for DL PRS-based positioning methods for a Remote UE if the Remote UE is out-of-coverage. I have seen the paper where it says it is possible for Remote UE to measure PRS when it is out-of-coverage but we are sceptical about this. |
| InterDigital | Yes | We share same view with MTK |
| vivo | Yes |  |

**Summary:**

## 3.3 posSIB request

It seems clear that there is no fundamental limitation preventing use of the posSIBs by a remote UE analysed in R2-2303559. Certain assistance data are not fully applicable for a remote UE, but the UE is aware of which assistance data would be useful and can request only what it can use.

**Proposal 4:** The SIB request mechanism from the remote UE is extended to allow requesting the posSIBs.

Furthermore, R2-2303559 mentioned that it may be useful to have a capability on the sidelink for posSIB forwarding by the relay UE, so that a remote UE does not make futile requests for posSIBs—e.g., a relay UE without positioning capability may not implement interpretation of the posSchedulingInfoList at all, and the remote UE should be aware that such a relay cannot receive and forward the posSIBs.

**Question 4**: Do you agree with the SIB request mechanism from the remote UE is extended to allow requesting the posSIBs? Please provide your views.

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Qualcomm | Yes | We can not see a reason why this can not be supported.  |
| Ericsson | No | UE cannot decide; it is unclear as how UE can decide which posSIBs are applicable for remote UE or not. It should be NW decision. Positioning comes with requirement and liability so UE should not blindly send something. NW should inform what is ok to send and what is not. |
| MediaTek | Yes | The argument for this functionality is already in the paper, and we find Ericsson’s comment deeply mysterious. The whole point of posSIBs is that the network distributes them for whichever UEs need them; we shouldn’t inject positioning functionality into the gNB to make some sort of artificial decision on which posSIBs should be allowed for specific UEs. The applicability of the posSIBs is already governed by upper layers (e.g., whether the UE is enabled to decipher a particular posSIB). |
| Lenovo | Yes | Regarding the remote UE in connected, gNB can provide SIB via dedicated signalling to remote UE via relay UE; while for remote UE in INACTIVE/IDLE state, UE can receive the PosSIB information from relay UE only when it requests explicitly since gNB have no knowledge on it. So, extend the SIB request to PosSIB seems natural. |
| CATT | Yes | It is natural that remote UE requires posSIB if positioning of remote UE is enabled, since the SIB request mechanism from the remote UE is supported already.  |
| Xiaomi | Yes |  |
| Philips | Yes, with comments | We are also supportive of proposal 3 from R2-2301296 that information on which posSIBs can be relayed is provided to the Relay UE by the NW, pehaps by a flag in the posSIB message. This would allow transmission of posSIBs to the Relay UE but prevent them from being forwarded to the Remote UE, even if requested by the Remote UE, if the content is considered not appropriate based on, e.g., cell, area, timing or some other factor. We agree with Ericsson that the Relay UE itself is not necessarily best placed to make the decision whether to forward or not. |
| ZTE | Yes | It is missing feature and should be supported |
| Nokia |  | Yes, it is feasible but before agreeing to this, we would like to get a better understanding of the solution for positioning a Remote UE that is out of coverage and how DL PRS-based methods are feasible and how does a Remote UE out of coverage send the status indication to LMF. |
| InterDigital | Yes |  |
| vivo | Yes |  |

**Summary:**

## 3.4 posSIB timing

One company analysed in [7], if a posSIB is forwarded to the remote UE according to current procedures, the remote UE does not know the time at which the posSIB was received by the relay UE. This loss of information could impair the interpretation of GNSS-ReferenceTime, which in certain circumstances provides the GNSS system time “at time of reception of the IE GNSS-ReferenceTime by the target device” ([9], section 6.5.2.2).

The proposal in [7] was to indicate the time of reception of each posSIB according to the DFN timeline. So R2-2303559 proposed to further discuss the potential enhancement.

**Proposal 5:** Discuss the possible need to indicate the reception time of a posSIB in the DFN timeline to the remote UE.

**Question 5**: Do you agree to discuss the possible need to indicate the reception time of a posSIB in the DFN timeline to the remote UE? Please provide your views.

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Qualcomm | Yes | According to R2-2303123, it seems the biggest "latency contributor" would be the SL-DRX. If this delay can indeed be up to 10.24 seconds, then a time stamp could be useful. However, for a 10.24 second delay, a SFN or DFN time stamp seems not sufficient (i.e., frame wrap-around)? |
| MediaTek | OK to discuss | We agree that substantial delays can occur, and the magnitude depends on the SL configuration, including SL-DRX, availability of radio resources, etc. This can be pursued under the proposal in R2-2303123. |
| Lenovo | No | In the case of SFN-DFN time offset are indicated to remote UE, this issue can be solved to some extent. |
| OPPO | No | If DRX is the main concern, then considering the SL DRX is designed as a Tx-centric manner, the relay has the freedom to reconfigure the SL DRX to a smaller DRX cycle, then this problem can be solved. From that pers, there seems no need to pursue this change.  |
| CATT | Ok to discuss | We may further discuss what the candidate solutions are. Solution from OPPO also can be one of the candidate solutions. |
| Xiaomi | Yes | According to R2-2303123, the additional delay can range from mili-seconds to 10.24 seconds. Furthermore, even if the delay is relatively small, the additional delay may still result in the transmission delay between location server and remote UE exceeding the accuracy requirement, i.e. +/- 3 seconds. Because the relay UE’s posSIB reception time may not be the ideal reference time. Therefore, we understand it’s essential to indicate the posSIB timing, so that remote UE can derive the reference correctly.Following fig in R2-2303123 shows an example of signalling flow. Remote UE would consider D as reference time, however D may have been delayed more than 3 seconds from ideal reference time, even if the additional delay, i.e. (B, D), is not very large.  |
| ZTE | Ok to discuss | We can postpone the issue and further discuss to see the necessity |
| InterDigital | Ok to discuss | We are ok to further discuss whether/how the DFN can be used to indicate the posSIB reception timing  |
| vivo | OK to discuss | It’s an enhancement to reduce the impact of transmission delay between remote and relay UEs |
|  |  |  |

**Summary:**

## 3.5 Stage 2 impact

After the previous discussion, companies agree that there are two features that fundamentally cannot work with a remote UE:

1. Uplink positioning and multi-RTT with aperiodic or semi-persistent SRSp, which depends on an activation command in the MAC layer;

2. Measurement gaps/PPW, which cannot currently be supported on sidelink.

So R2-2303559 proposed:

**Proposal 6:** Include NOTEs in TS 38.305 indicating that uplink positioning and multi-RTT with aperiodic or semi-persistent SRS cannot be used with a remote UE, and that measurement gaps and PPW are not supported for a remote UE.

**Question 6**: Do you agree to include NOTEs in TS 38.305 indicating that uplink positioning and multi-RTT with aperiodic or semi-persistent SRS cannot be used with a remote UE, and that measurement gaps and PPW are not supported for a remote UE? Please provide your views.

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Qualcomm |  | No strong view. But O.K. if considered helpful. |
| MediaTek | Yes | This helps to clarify the applicability of the positioning methods to the remote UE case. |
| Lenovo | Yes | In the case of positioning of remote UE is captured, it can help to clarify the use cases.  |
| CATT | Yes |  |
| Xiaomi | Yes |  |
| Philips | Okay | No strong view. |
| ZTE | Yes |  |
| Nokia |  | Agree but we fail to see how DL PRS-based methods can work for a Remote UE that is out of coverage. Even for UL SRS using periodic transmission from UE, if the Remote UE is out of coverage, we are not sure how the TRP can perform the measurements. |
| InterDigital |  | After checking the TP in R2-2303559, we could not find any notes for measurement gaps. We are ok to include the note regarding PPW since it is currently not supported in sidelink. |
| vivo | Yes |  |

**Summary:**

# 4 Discussion of proposals in R2-2303702

The document R2-2303702 focus on the emergency use case; i.e; network initiated location request (NI-LR) or Mobile Terminated Location Request (MT-LR) for the regulatory location services.

Both Positioning of remote UEs and Relay based Positioning for emergency calls discussed the candidate solutions in U2N scenario. Here we will discuss the proposals on Relay Positioning for emergency call in the document R2-2303702.

The document R2-2303702 focus on the emergency use case; i.e; network initiated location request (NI-LR) or Mobile Terminated Location Request (MT-LR) for the regulatory location services.

**Observation 1** It would naturally become essential to support NI-LR or MT-LR use case when relay-based positioning would be supported.

**Observation 2** Cell ID based positioning will not work for when relay-based positioning is supported. AMF should be aware that the UE is remote UE and the maximum supported relay UE to remote UE distance to support relay-based positioning.

**Observation 3** AMF should be aware that UE is remote UE.

With the analysis of the emergency call, R2-2303702 proposed to wait for SA2 on supporting emergency call for relay-based positioning:

**Proposal 1** RAN2 does not declare that relay-based positioning is supported until solution for NI-LR emergency call positioning is in place.

**Proposal 2** Wait for SA2 to address key issue on supporting emergency call and how NI-LR positioning (emergency call positioning) or MT\_LR for regulatory services and cell ID based positioning work for relay-based positioning.

**Rapporteur’s comments**:

Clause 5.4.4 Support of emergency service from 5G ProSe Remote UE via 5G ProSe UE-to-Network Relay in TS 23.304 V18.1.0 (2023-03) says:

The existing positioning function as applicable is reused for the 5G ProSe Remote UE. If no other information is available, the location of the 5G ProSe UE-to-Network Relay can be used as Remote UE location estimate.

The TS say ‘The existing positioning function as applicable is reused for the 5G ProSe Remote UE.’ So the SA2 assumption actually supports that positioning for the remote UE with the existing functionality can be enabled, including A-GNSS and RAT-Dependent positioning methods. If there is no remote UE indication to LMF, the LMF may not select proper positioning method for the remote UE. And without the SFN-DFN timeline, some existing positioning methods may then fail.

**Question 7**: Do you agree NOT to support any relay-based positioning until solution for NI-LR emergency call positioning is in place? Please provide your views.

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Qualcomm | No | NI-LR/MT-LR/MO-LR has no impact to LPP/RRC.  |
| MediaTek | No | The rationale in the paper is not clear to us. As Qualcomm note, these procedures do not affect LPP or RRC. |
| Lenovo | No | We tend to support the relay-based positioning, but the solutions are supposed to be comprised by current positioning procedures and avoid unnecessary enhancements as possible. |
| CATT | No | NI-LR is only one of LCS service. The positioning of remote UEs can be triggered by MO-LR.  |
| Xiaomi | No | We think the positioning method is determined by the LMF, and LMF will not choose the cell ID based positioning for the remote UE. If there is no LMF deployment, it is not related to positioning.  |
| ZTE |  | This can be checked with SA2 on whether MT-LR or NI-LR is supported for relay-based positioning |
| Nokia |  | We prefer working on relay-based positioning solutions as part of a work item so that all requirements, including positioning for Layer 3 Relay support for positioning a Remote UE can be taken into account especially when we so far had provided parity of functionality between Layer 2 relays and Layer 3 relays. This will allow us to work with SA2 who is working on Layer 3 relay support. |
| InterDigital | No |  |
| vivo | No |  |
|  |  |  |
|  |  |  |

**Summary:**

# 5 Discussion of TPs in Phase II

According to the discussion of the proposals in R2-2303559 and R2-2303702 in the email discussion, the candidate TPs are discussed here:

**TBD**

# 6 Conclusion

Companies discussed the proposals and TPs in R2-2303559 and R2-2303702 in the email discussion, here are the proposals:

**TBD**

# 7 Reference

[1] R2-2208314, “Positioning support for remote UEs”, MediaTek Inc./CATT/Huawei/HiSilicon, RAN2#119-e

[2] R2-2208315, “Downlink positioning support and posSIB request for L2 UE-to-network remote UE”, MediaTek Inc./CATT/Huawei/HiSilicon, RAN2#119-e

[3] R2-2208317, “Indication to LMF of operation as a L2 UE-to-network remote UE”, MediaTek Inc./CATT/Huawei/HiSilicon, RAN2#119-e

[4] R2-2208319, “Positioning method support for L2 UE-to-network remote UE”, MediaTek Inc./CATT/Huawei/HiSilicon, RAN2#119-e

[5] R2-2210367, “On Positioning Support for L2 UE-to-Network Remote UEs”, Qualcomm Incorporated, RAN2#119bis-e

[6] R2-2301649, “Positioning for remote UEs”, MediaTek Inc./CATT/Huawei/HiSilicon, RAN2#121

[7] R2-2205319, “Discussion on how to support posSIB(s) forwarding, Xiaomi, RAN2#118

[8] R2-2301296, “Relay based positioning procedure”, Ericsson, RAN2#121

[9] TS 37.355

[10] TS 23.271

[11] TS 23.304 Proximity based Services (ProSe) in the 5G System (5GS) V18.1.0 (2023-03)

[12] R2-2303559 Positioning of remote UEs MediaTek Inc., CATT, Huawei, HiSilicon, Qualcomm Incorporated, Xiaomi, Intel Corporation, vivo discussion Rel-18 TEI18

[13] R2-2303702 Relay based Positioning for emergency calls and posSIB forwarding Ericsson discussion Rel-18