3GPP TSG-RAN WG2 #121bis R2-23XXXXX

Online, 17th April– 26th April 2023

**Agenda item: 7.2.2**

**Source: Xiaomi**

**Title:** **[AT121bis-e][424][POS] Group positioning and multiple targets (Xiaomi/Qualcomm)**

**Document for: Discussion and Agreement**

# 1 Introduction

This document is to kick off the following Email discussion:

* [AT121bis-e][424][POS] Group positioning and multiple targets (Xiaomi/Qualcomm)

Scope: Discuss P17-P19 of R2-2302740, attempt to conclude, and evaluate whether we can reply to the SA2 LS on multiple target UEs.

Intended outcome: Report (Xiaomi) and agreeable reply LS (Qualcomm)

Deadline: Friday 2023-04-21 1000 UTC

# 2 Contact Information

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# Discussions

In LS from SA2 [8], SA2 indicates that the group management aspect can be handled by the application layer and is out of scope of SA2:

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| - A Ranging/SL Positioning layer is introduced on the Target UE/Reference UE/SL Positioning Server UE under Application layer and above AS layer to handle service request received from application layer and to control the Sidelink Positioning and Ranging operation:  - Functionalities supported by the Ranging/SL Positioning layer include discovery of the UE(s) in proximity that can participate in Sidelink Positioning and Ranging service sessions and control signalling between UEs or among a group of UEs or between UE and LMF to manage and coordinate the Sidelink Positioning and Ranging operations.  - The group management can be performed at application layer, and the application layer may provide group identifier information to the Ranging/SL Positioning layer.  NOTE 1: Potential group management within RSPP layer is out-of-scope of SA2. |

As analyzed in [3], it is similar to how group operation was designed for NR Sidelink in Rel-16, whereby any group management operations (e.g. discovery for group formation, group members entering or leaving the group, etc.) were transparent to the AS layer. The application layer group ID in this case is managed by the application layer in the UE and/or the application server, which then interacts with the ProSe Layer to determine the Destination L2 ID for use over sidelink interface. From AS layer perspective, the mapping of L2 IDs to specific UEs within the group is handled by the upper layers and no impact is foreseen in RAN2 specifications.

So rapporteur would like to ask:

1. **Whether do you agree that the group management for group positioning is handled by the upper/application layer and no impact is foreseen in RAN2?**

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| Company | Agree or not | Comments |
| Ericsson | Agree | Yes no impact in RAN2 |
| Qualcomm | Partially Agree | Per TS 23.586, communication procedures as defined in 23.287 and 23.304 are used for SLPP (RSPP) when SLPP is carried over V2X or ProSe, respectively. As such, the upper/application layer performs group management through the procedures defined in 23.287 and 23.304.  As RAN2 has agreed to support SLPP session-based operation, there can be instances of sessions requiring removal and/or addition of UEs to a session. Some examples could include SLPP Capability Exchange may determine not all UEs in an application-layer provided group have necessary capabilities for a session, or due to UE mobility, some UEs are no longer in range. As such, the SLPP layer may determine the UEs constituting a session group may need to be changed and disseminate this to the application layer. Thus, the SLPP layer may also be a participant in group management, including by informing the application layer of circumstances require change in group composition. |
| OPPO | Agree | If AS layer find that radio condition of some UEs becomes worse and are not qualified for the SLPP, the AS layer should inform the application layer of the related UE AS level ID, for example, the L2 ID, and let the app layer perform the group management. |
| CATT | Not sure | We should clarify what the group positioning is and define the group positioning at first before we jump into the discussion of group positioning. I did not find any definition of group positioning in TS 23.586. Is group positioning a type of service or the positioning operations in a group which is defined in ProSe?  Can rapporteur clarify where the group positioning is defined?  [Xiaomi] From RAN2 point of view, group positioning can refer to the following agreement:  *Agreement:*  *From RAN2 perspective, if it is determined to support group positioning, it is feasible to perform at least ranging with the estimate calculation at multiple UEs.*  From SA2 point of view, they haven’t clearly definine it, but we can infer it from the LS and agreement in SA2:  *SA2 would like to inform RAN2 that during the development of the Ranging/SL Positioning support (as in TS 23.586), use cases had been identified where multiple Target UEs are involved in the same positioning session. In these cases, it is desirable to allow the Ranging/SL Positioning control to support multiple target UEs, e.g. with broadcast or groupcast support.* |
| Lenovo | See comments | We agree to some extent that group management can be handled by higher-layers. However, for the purposes of SL positioning, the application layer may not always have knowledge about the number of anchor UEs present in addition to any discoverable server UEs. The number and location quality of anchor UEs depends on the pos. technique, which is transparent to the application layer. Further discussion is needed on dynamic group formation within SLPP, where the application layer may have some missing information e.g., certain AS layer parameters. |
| LG | Agree | Under my understanding, the group positioning is for multiple target UEs. A location request will be invoked by upper/application layer (i.e. LCS) including the information with multiple target UEs. In this sense, each target UE may work as target UE or anchor UE to estimate relative positioning/ranging between multiple target UEs using RTT-type method. Absolute positioning for group positioning will not be possible due to the members of group positioning may not know their location. So, group management for group positioning completely rely on upper/application layer. There is no need to add/remove member on group positioning session in SLPP layer.  If definition of group positioning is not clear (as mentioned by CATT), we don’t make further discussion so RAN2 should send LS to SA2 on clarification for group positioning. |
| Fraunhofer | Comments | The UE that form anchors for a target UE may change due to change in radio conditions. The information about channel conditions may not be available at the application layer, so there may be involvement of SLPP layer in group management.  It also needs to be clarified how the group is related to session. |
| Intel | Agree | In our understanding, group management refers to discovery for group formation as well as addition/removal/maintenance of UEs within a group. It is clear from SA2 LS that this is out of RSPP/SLPP scope. The SLPP layer shall just follow the indication from application layer to set up the positioning session for a group of UEs |
| Spreadtrum | Agree | Yes no impact in RAN2 |
| ZTE | Agree | We see no RAN2 impact also in SL data transmission of groupcast in RAN. So the SL positioning should be same |
| Xiaomi | Agree | For group positioning, it is related to position a group of UEs. Of course, it is up to upper/application layer to form the group. And group management should also be done in upper/application layer. We are not sure how RAN can perform group management(i.e. adding/deleting member from the group) for the group formed by application layer.  Besides, we think group positioning may only be applicable to ranging/relative positioning, where the participating UEs can be pre-determined by application layer. There is no need to add member to the group. Even if server UE is needed, server UE doesn’t have to join the group. It means that a SLPP session can involve a group and also other individual UEs.  Thirdly, if a group member is unreachable, it is not necessarily mean that it has to be removed from the group. We do not see harm to keep it in the group. |
| Nokia | Agree with comments | Group management by upper layer is in principe agreeable but we also see the need for tighter management at AS / SLPP level. Primary motivation is the management of session-based and session-less management, similarly to the views to QC. We also support the arguments of Lenovo and Frauenhofer. |
| Huawei, HiSIlicon | Agree |  |
| InterDigital | Not sure | We tend to agree with CATT. It looks too early to make the conclusion. But we are fine to aim to minimize RAN2 impact. |
| vivo | Not sure | We agree with the first half of the sentence (i.e., the group management for group positioning is handled by the upper/application layer), but have different views on the second (i.e., no impact is foreseen in RAN2). If allowing one group member is added or removed by app layer during positioning execution, what happen for the ongoing positioning? Also, it may impact RAN2’s design, e.g., whether delta config of SLPP messages is feasible or not.  Actually, it may depend on the definition of group positioning, which is unclear so far. We should discuss RAN2 impact after the definition of group positioning is clear. |
| Samsung | Agree with comments | In our understanding, group management on application layer for SL positioning is based on the group member discovery over PC5 interface as similar as legacy, and it has no impact in RAN2. But we need to have clarification on relationship between group positioning and group which is managed by application layer. |

1. **If the answer to the above question is yes, do you agree that the group ID and/or L2 Destination IDs is provided by upper layers of SLPP?**

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| Company | Agree or not | Comments |
| Ericsson | Agree | However, there should be provision in the Core Network to map the L2ID with the SUPI |
| Qualcomm | Agree | We agree that the application/upper layer can provide the SLPP layer with individual UE L2 IDs, individual UE Application-layer IDs, Application-layer Group ID and L2 Group ID. More generally, as noted in our answer to Q1, the procedures defined in 23.287 and 23.304 are used for SLPP (RSPP) when SLPP is carried over V2X or ProSe, respectively. This incudes the dissemination of relevant Application-layer IDs and Destination Layer 2 IDs. |
| OPPO | Agree |  |
| CATT |  | We should clarify what the group positioning is and the definition of group positioning before we jump into the discussion of group positioning. |
| Lenovo |  | This depends on the location of the SLPP layer with respect to the V2X/ProSe layer. Since destination IDs are usually generated in the Application layer, Q2 may only be valid if the SLPP is located above the V2X/ProSe Application layer. If not provided then the V2X/ProSe layer usually manages the generation of such IDs.  [Xiaomi] We agree that destination lD should come from V2X/ProSe layer |
| LG | Agree | According to current spec, the network does not have individual L2 ID (i.e. Source Layer-2 ID and the Destination Layer-2 ID) for all UEs used in sidelink communication. In 38.331, UE sends SIdelinkUEInformationNR message to the network including Destination Layer-2 ID for groupcast/broadcast. If the network provides group ID associated to Destination L2 ID, they can be utilized in SLPP over V2X/ProSe layer via groupcast communication mode. As Q1 answer, group positioning will be used for relative positioning/ranging so that there may not be privacy/security issue for providing location information via groupcast.  In addition, for unicast between group members, all members should provide their Source L2 ID to the network, which could increase signaling overhead and complexity. Group positioning via unicast can be enhanced in next release if needed. |
| Fraunhofer |  | We need to clarify if the meaning of the group is. Does a group mean a set of one or more UEs whose location is unknown and jointly/iteratively estimated? |
| Intel | Agree |  |
| Spreadtrum | Agree |  |
| ZTE | Agree | They should not come from SLPP layer |
| Xiaomi | Agree with changes | Change to the following:  The group ID is provided by application layer, L2 Destination IDs is provided by ProSe/V2X layer. |
| Nokia | Agree but | We also support the need to identify individual UEs for SLPP layer purposes |
| Huawei, HiSilicon | Agree |  |
| InterDigital |  | We share CATT view. |
| vivo |  | Same view with CATT and InterDigital |
| Samsung | Agree |  |

In the LS from SA2 [1], SA2 askes whether the SLPP would support multiple Target UEs in the same signalling session. As analyzed in [3], if group management is performed by upper layer, multiple target UEs can be set in one group. Given that RAN2 has already confirmed that the SL positioning capability and assistance data can be sent in a groupcast/broadcast way, the groupcast of capability/assistant data to the group of multiple target UEs can trigger the session establishment at target UEs. Thus, it is technically feasible to support multiple target UEs in the same signalling session. So, rapporteur would like to ask:

1. **Whether the SLPP would support multiple Target UEs in the same signalling session?**

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| Company | Yes or not | Comments |
| Ericsson | No | We would like to first have solutions with single target only and if there is time left; we can discuss this case.  We should first complete the work for single target UE case. It is already difficult with all different permutation and combination; i.e several UE roles; anchor, SL server, target and the interactions and may be for now for simplicity we should have only one target. |
| Qualcomm | Yes | We agree with the rapporteur that based on the agreements RAN2 has reached it is technically feasible to support multiple target UEs within the same signaling session. |
| OPPO | For now no. | For multiple target UEs cases, the SLPP session management involves the addition/remove of anchor UEs for multiple target UEs. If these target UEs require for different anchor UEs due to their different location distribution/accuracy demand, SLPP session management overload may become overwhelmingly large. Also, considering the time limit, we should settle down the signaling procedure for the one target UE case firstly. |
| CATT |  | Multiple Target UEs are mentioned in TS 23.859:  “The service exposure in clause 5.5 of TS 23.273 [8] is reused with enhancements. The request may indicate with corresponding events if the server requires relative distance/direction of target UEs, absolute positioning of target UEs, or both. The request shall include one or multiple target UEs and optionally it may include additional information such as the SL reference UE for relative distance/direction, the required positioning QoS, etc.”  We would like to first discuss solutions with two target UEs in SLPP for the case in TS 23.859. Under this assumption, SLPP may support multiple Target UEs in the same signalling session. |
| Lenovo | Yes , but | We think it is feasible to support multiple Target UEs in a SL positioning group, however further details need to be understood on the signalling procedures in the context of SL Positioning. Furthermore, Location Requests are normally triggered by an LCS client, further discussion is needed on whether the LCS Client supports a group location service request to support positioning of multiple target UEs. |
| LG | Yes | We see group positioning can be operated in a single SLPP session. |
| Fraunhofer | Not yet | We think it is premature to take this decision as we have not decided on a solution for a single target UE. Hence, we do not know whether it is easier to enable multiple targets in a single session or in multiple sessions. |
| Intel | Yes |  |
| Spreadtrum | For now no | We also would like to first have solutions for a single target UE. And if there is time lift, we can discuss this case.  For multiple target UE cases, if there target UEs require different location accuracy, anchor UEs may be different. SLPP session management can be very complicated. |
| ZTE | Yes | We think it is feasible of multiple target UEs in a session as there are ranging/relative positioning usecase. Besides the SL positioning capability/AD transfer in BC/GC way, we think the service request should be enhanced to include multiple target UE’s location request.  But we also agree to focus on one target UE first as Ericsson suggests |
| Xiaomi | Yes with changes | We can say that:  From RAN2 point of view, it is technically feasible to support multiple target UEs in one SLPP session, but RAN2 requires further discussion to decide whether to support multiple target UEs case. |
| Nokia | Yes but | This should not be our priority now, we first need to understand how to support a single target UE before looking at such enhancements. |
| Huawei, HiSilicon | Yes, but | No need to discus this actually. The same singaling session corresonponds to a single location request and this location request involves multiple UEs as a group |
| InterDigital | Not sure | We are not sure that multiple target UEs need to be handled by the same signalling session. We should study how multiple target UEs should be handled by SLPP signalling first and then make a decision afterwards. |
| vivo | For now no | Same view with Ericsson. RAN2 should focus on single target UE currently. Multiple Target UEs may be considered in future, not now. |
| Samsung | Yes, but | It is technically feasible to support multiple Target UEs with broadcasting/groupcasting SL positioning capability and assistance data which was confirmed before. However further details need to be clarified to support group positioning in single signaling session. For example, whether UEs within a group already exchanged SL positioning capability to form or join a group; triggering group positioning can be combined to capability transfer or assistant data delivery procedure; whether all UEs within a group share each SL positioning capability and/or location information. Baseline procedure for unicast also needs to be clarified for further discussion on group positioning e.g., discovery procedure. |

1. **If the answer to the above question is yes, do you agree the following procedure and signaling flow for sidelink based group positioning from [3] as baseline?**



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| Company | Yes or not | Comments |
| Qualcomm | Yes | We agree the above call flow should be supported by SLPP as a baseline call flow. Additionally, since RAN2 has agreed to support centralized positioning, where one UE performs range and/or position calculations based on measurement/location information related to itself and/or other UEs, a companion flow to the above illustrating the centralized operation should be included.    [Xiaomi] RAN2 agreement may be needed for centralized calculation for group positioning, currently, there is only agreement for distributed calculation. |
| OPPO |  | More details should be clarified for the signaling flow such as the UE roles. Is the UE1~4 in the given signaling flow are all target UEs? or anchor UEs are missing in the signaling flow?  If UE 1~4 are all target UEs, it seems that absolute positioning for them is not workable. Then we assume that only ranging/relative positioning is the main purpose of the group positioning? |
| CATT | postpone | RAN2 can discuss this issue based on the conclusion of Q1 and the progress of SA2. |
| Lenovo | Yes but | We are fine to use this as an initial baseline, but according to the diagram, the group management is performed on the SLPP layer which is contradictory to Q2. There are a few details aspects to consider including that if the group is established above SLPP, there may be no need for SLPP discovery and group management since the SL Positioning group members may act as anchor, server and target-UE, and therefore the procedure may directly start with “SLPP/RSPP Capability Exchange”. However, if the SLPP performs the “dynamic” group management, e.g., addition/removal of member UEs, we would be fine with the above signaling flow in principle.  Another issue is whether the support of multiple Target UEs is supported only for PC5-only positioning or also joint Uu/PC5 positioning? This would be useful to clarify going forward.  According to the Figure, the positioning model is assumed to be UE-based positioning, where the location calculated at each entity. Will this be supported for UE-assisted positioning, where the location of multiple target-UEs are calculated at another entity ? |
| LG | Yes | Agreed as baseline, but I think some steps can be skipped. Initiator UE (i.e. received a location request for group positioning through LPP from LMF) invite other UEs to be involved in group positioning session, then provide assistance data for RTT-type positioning via groupcast mode. After SL-PRS transmission/measurement between UEs, each target UE can calculate ranging/relative positioning from other UEs. |
| Intel | Yes with comments | We can use this as a baseline, but based on discussion in previous questions, if the group management aspect is not in the scope of the SLPP layer, the group management step should be removed. Moreover, the discovery, capability transfer and assistance data delivery steps are all needed anyway since the upper layers need to be informed of the availability of anchor UEs and the supported positioning methods, etc. for supporting group positioning.  [Xiaomi] we may have different understanding on this, to support group positioning in one session, it doesn’t necessarily mean that all the messages have to be groupcast. It also doesn’t mean that all UEs in the session have to be the group member. |
| ZTE | Yes | For the initiator UE, it should also be a line of ‘service request’ containing multiple UE’s location request if it is MT-LR.  If it is MO-LR, initiator UE should send the service request containing multiple UE’s location request to other UEs. |
| Xiaomi | Yes with comments | We are ok to adopt this figure as baseline but with the following changes or clarifications:  Firstly: We should clarify that this is only for ranging/relative positioning, it is FFS whether it is applicable to absolute positioning.  Secondly, a FFS should be added: It is FFS whether other UEs aside from the group member can join in the session or not.  Thirdly, If Q1 is agreed, then group management should be removed from the figure.  Fourthly, we need to change “SLPP/RSPP discovery” to “discovery” since the discovery may not be done at SLPP layer.  Fifthly, remove RSPP from the figure, since we agree to use SLPP.  Lastly, we share the same view as OPPO that it seems all the UEs in the figure are target UEs. In our understaning, group positioning may only be applicable to ranging/relative positioning, not for absolute positioning. For ranging/relative postioning, at least one UE(initiator) should not be the target UEs. |
| Nokia | Not sure | We can adopt this generic flowchart as a baseline but in general, we would prefer to first understand how exactly a single target UE is positioned and then look into extending the single target-UE design. In connection to the proposed figure, we also ask the above question around the nature of group management and measurement reporting. |
| Huawei, HiSIlicon | No | Not sure why we still need discovery procedure here since the group id and destination ids within the group have been provided by the upper layer.  Also, it has been mentioned in the SA2 spec that group management can be performed in the application layer. Not sure why it is needed in the RANspec/SLPP spec |
| Samsung | Postpone | We need more details to discuss baseline procedure. Considering other questions, RAN2 need clarification on exact scenario which is expected by SA2. |
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In addition, SA2 asked RAN2 about whether there is possibility of signalling the positioning results of multiple Target UEs in the same message. From rapporteur point of view, the case mentioned by SA2 is majorly about distributing location estimate of one target UE to other UEs in the group. Technically, it is feasible for SLPP to do so. But there might be security/privacy concern of exposing location estimates to other UEs, which should be addressed by SA3.

1. **Do you agree that it is technically feasible from RAN2 point of view to signal the positioning results of multiple Target UEs in the same SLPP message, and the security/privacy issue, if any, should be addressed by SA3？**

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| Company | Yes or not | Comments |
| Ericsson | Down prioritize this scenario for now | We should first complete the work for single target UE case. It is already difficult with all different permutation and combination; i.e several UE roles; anchor, SL server, target and the interactions and may be for now for simplicity we should have only one target.  [Xiaomi] This is not to say that RAN2 will support this scenario, but only to provide views on the technical feasibility. |
| Qualcomm | Yes | We agree that it is technically feasible for SLPP to distribute positioning results of multiple Target UEs in the same SLPP message. From a security point of view, we see no impediment to doing so, since for unicast there is a well-established security mechanism, and for Groupcast/Broadcast SA3 has indicated security is feasible and is currently designing a security solution. From a privacy point of view, 3GPP RAN2 current V2X design already supports distribution of UE position and UE position accuracy to multiple UEs through application-layer signaling carried as V2X payload (e.g., CAM, BSM, etc.). Since SLPP signaling can be carried as V2X payload, SLPP signaling should not pose a privacy concern. |
| OPPO |  | The security concern should be address by SA3. It is feasible from RAN2 perspective |
| CATT | Yes | It is technically feasible for SLPP to distribute positioning results of multiple Target UEs in the same SLPP message, at least for unicast message. |
| Lenovo | No | We are not sure how this would work in principle. If the absolute location is transmitted then a groupcast message from one of the member UEs to other target-UEs may be fine, but if the range or relative position is transmitted, it always with respect to a single UE, which is not clear from such a single groupcast message. In addition, SA3 involvement may be needed on determining if there is any security/privacy issue as RAN2 cannot recommend any action on this issue.  [Xiaomi] For relative positioning/ranging, location estimate is regarding the distance/anchor between two UEs. So, the location estimate will include the two UE IDs. |
| LG | Yes | Same as Q2, group positioning will be used for relative positioning/ranging so that there may not be privacy/security issue for sharing location information within group members via groupcast. If certain UE cannot share its positioning result with other UEs within a group positioning, UE could reject the invite to involve a group positioning. |
| Fraunhofer | No | We prefer that a session is related to one target UE. With this approach, there can be multiple sessions for each target UEs. |
| Intel | Yes pending SA3 design | In the particular scenario in Q3 and Q4, we assume that all the signaling for capability transfer, assistant data delivery and location information transfer is done in a groupcast manner. While we still await SA3 input on security solution for groupcast/broadcast of SL positioning capability and assistance data, they have already indicated that security is feasible. |
| Spreadtrum | Down prioritize this scenario for now | We also would like to first have solutions for a single target UE. And if there is time lift, we can discuss multiple target UEs case. |
| ZTE | Yes but | We think it is feasible to include multiple UE’s location in one SLPP message, for example, one UE gathers all the other UE’s location estimate and sends all of them to another UE which can reach LMF via LPP. However this is complex scenario which should be deprioritized. |
| Xiaomi | Yes | Technically, from RAN2 point of view, it is feasible to signal the positioning results of multiple Target UEs in the same SLPP message. and if there is the security/privacy issue, it should be addressed by SA3. So, we think there is no harm to response SA2 from technical point of view. And SA2 just want us to answer this question from technical point of view. |
| Nokia | Yes but | While we currently prefer the focus on a single target UE, we also see this proposal technically feasible in both RAN2 and SA3. However, we see a need for further study of specific technical details, for example on how exactly payload is encrypted to ensure session/group-specific protection. We analyze the basic principles in R2-2300254 based on reusing the Uu design for LMF in relation to ciphering key management which may have some impact on SLPP itself. |
| Huawei | Down prioritize this scenario for now |  |
| InterDigital |  | We would like to know how the SLPP signalling work for the scenario first. Besides, we share the view with Intel with regard to security aspects.  Down-prioritising the multiple target UEs scenario sounds good idea to us. |
| vivo | Down prioritize this scenario for now | For now, RAN2 should not discuss it before the work for single target UE case is completed. |
| Samsung | Yes for first part with comments | In our understanding, a UE which is reporting positioning results, and multiple Target UEs to be reported are in a same group in this context. Reporting positioning results of multiple Target UEs within a message (e.g., to LMF or initiator UE) is technically feasible. SA3 should address security issue when group members are allowed to share their location information via groupcast, or collect information for reporting. However, as SA3 mentioned, detailed scenario or procedure need to be confirmed before addressing security issue. |

# Reference

## R2-2302448 LS on support of multiple Target UEs (S2-2303837; contact: Qualcomm) SA2 LS in Rel-18 Ranging\_SL To:RAN2 Cc:RAN1

1. R2-2302503 Discussion on sidelink positioning CATT discussion Rel-18 NR\_pos\_enh2
2. R2-2302740 Further considerations on sidelink positioning Intel Corporation discussion Rel-18 NR\_pos\_enh2
3. R2-2302958 Discussion on sidelink positioning vivo discussion Rel-18 FS\_NR\_pos\_enh2
4. R2-2303497 Discussion on sidelink positioning ZTE Corporation discussion Rel-18 NR\_pos\_enh2
5. R2-2303591 Sidelink Positioning Protocol (SLPP) Signaling and Procedures Qualcomm Incorporated discussion
6. R2-2304033 Discussion on SL positioning Xiaomi discussion Rel-18
7. S2-2301786, Reply LS on SL positioning groupcast and broadcast.