3GPP TSG-RAN WG2 Meeting #121bis-e R2-230xxxx

Elbonia, 17 – 26 April 2023

**Agenda item: 7.2.2**

**Source: Nokia**

**Title: [AT121bis-e][423][POS] Sidelink positioning parameters in discovery signalling (Nokia)**

**WID/SID: NR\_pos\_enh - Release 18**

**Document for: Discussion and Decision**

# Introduction

This document is to start the following Email discussion:

* [AT121bis-e][423][POS] Sidelink positioning parameters in discovery signalling (Nokia)

 Scope: Discuss the necessary parameters in discovery signalling for identifying the involved UEs in a sidelink positioning operation and establishing a session.

 Intended outcome: Report to Monday week 2 session

 Deadline: Friday 2023-04-21 1000 UTC

# Contact Points

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

|  |  |  |
| --- | --- | --- |
| Company | Name | Email Address |
| Nokia (Rapporteur) | Stepan Kucera | stepan.kucera@nokia.com |
| Fraunhofer | Birendra Ghimire |  birendra.ghimire@iis.fraunhofer.de  |
| Qualcomm | Dan Vassilovski | dvassilo@qti.qualcomm.com |
| Intel | Ansab Ali | ansab.ali@intel.com |
| CATT | Jianxiang Li | lijianxiang@catt.cn |
| ZTE | Yu Pan | pan.yu24@zte.com.cn |
| OPPO | Yang Liu | liuyangbj@oppo.com |
| LG | Jonggil Nam | jonggil.nam@lge.com |
| Lenovo | Jie Hu | hujie14@lenovo.com |
| InterDigital | Keiichi Kubota | keiichi.kubota@interdigital.com |
| Spreadtrum | Huifang Fan | Huifang.fan@unisoc.com |
| Xiaomi | Xiaowei jiang | jiangxiaowei@xiaomi.com |
| Sony | Anders Berggren | Anders.Berggren@sony.com |
| Apple | Sasha Sirotkin | ssirotkin@apple.com |
| Ericsson | Ritesh Shreevastav | Ritesh.shreevastav@ericsson.com |
| Philips | Rob Davies | rob.j.davies@philips.com |
| Samsung | Jeongseok Yu | Jeongseok.yu@samsung.com |

# Discussion

In the context of UE discovery for sidelink positioning purposes, SA2 already made several agreements.

In the conclusion of KI#3 in 23.700-86, it is specified that

For Ranging/Sidelink Positioning device discovery, Model A and Model B Direct Discovery as defined in TS 23.304 [4] are reused for the 5G ProSe capable UE (including commercial and public safety use cases); and procedures for V2X communication over PC5 reference point as defined in TS 23.287 [3] are reused for the V2X capable UEs, with the following enhancements:

-     When 5G ProSe Direct Discovery procedures as defined in 6.3.1 of TS 23.304 [4] are used, the ProSe identifier indicates "Ranging/Sidelink Positioning";

-     When Group Member Discovery procedures as defined in 6.3.2.2 of TS 23.304 [4] are used, the Application Layer Group ID indicates a Ranging/Sidelink Positioning group that the UE belongs to;

-     When unicast mode V2X communication procedure is used, the Service Type in Layer-2 link establishment procedure indicates "Ranging/Sidelink Positioning";

-     When broadcast mode or groupcast mode V2X communication procedure is used, it is used with Service Type as "Ranging/Sidelink Positioning";

-     The expected roles of the UEs (e.g. Target UE, SL Reference UE) can be reflected in discovery procedure.

Furthermore, the clause 5.2.2 in TS 23.586 specifies that

The discovery of Located UEs follows the same principles as specified in clause 5.2.1. **The UE can indicate its role “Located UE” in its list of supported roles during discovery.**

As for the actual discovery procedures, SA2 states in 28.700-86 for example the following in clauses 6.4.2.2 (Model A) and 6.4.2.3 (Model B), respectively:

**[Model A]**

In this procedure, Reference UE and Target UE can take the design of UE Assisted and UE Based Positioning Procedure as specified in clause 6.11.1 of TS 23.273 [11] to enable the Ranging/Sidelink Positioning.

1. The Target UE sends an Announcement message. The Announcement message may include the Type of Discovery Message, Target UE info, Ranging/Sidelink Positioning service Code, Role indication (target UE) and Target UE capability (e.g. ranging support).

2. Reference UEs monitor the Announcement message. If the Target info is the Reference UE to be discovered, the Reference UEs have the interests on the Ranging service and support the Ranging/Sidelink Positioning capability of the Target UE if any, the Reference UE performs the direct PC5 link establishment procedure with target UE as described in clause 6.4.3.1 of TS 23.304 [4].

3. The Target UE and the Reference UE perform the Ranging/Sidelink Positioning control interaction procedure to exchange the coordination & configuration information, e.g. the Ranging capability and Ranging Assistance Data, as described in clause 6.4.2.4.

**[Model B]**

In this procedure, Reference UE and Target UE can take the design of UE Assisted and UE Based Positioning Procedure as specified in clause 6.11.1 of TS 23.273 [11] to enable the Ranging/Sidelink Positioning.

1. The Reference UE sends a Solicitation message. The Solicitation message may include Type of Discovery Message, Ranging/Sidelink Positioning service Code, Reference UE info, Target UE info, Role indication (Reference UE) and Reference UE capability.

2. Target UE monitors the Solicitation message. If the Target UE decides to be discovered and ranged based on the included Target info and the Reference UE capability in the Solicitation message, the Target UE responds to the Reference UE with a Discovery response message. The Discovery response message may include the Target UE capability.

3. After the target UE discovery, the Reference UE performs the PC5 Unicast communication establishment with target UE.

From RAN2 perspective, the exchange of both discovery and SLPP messages can be used to determine peer UEs that satisfy minimal service and performance requirements for a new or existing SL positioning process. These requirements include for example

* support of a specific SL positioning role (*eg as anchor / target / server UE*) on both capability and procedural level
* support of specific SL positioning capabilities / tasks (*eg, wide-band SL PRS transmission by an RSU, or specific positioning method by a server UE*)
* contribution to SL positioning QoS and performance (eg, *avoidance of NLOS conditions / co-located anchor UEs*)
* resource and latency efficiency (*eg, reusability of already active anchor / server UE).*

An open question is then how to balance the complexity-performance trade-off between using

* ProSe for initial signalling of UE attributes for their efficient pre-filtration and/or pre-configuration, and
* SLPP for subsequent detailed (delta)-signalling and setup of well-performing positioning sessions.

In this context, the rapporteur would like to ask the following questions:

1. **Do you generally agree that discovery messages shall be used to provide information relevant to UE selection? By said information are understood specific UE capabilities, service status attributes and/or AS conditions.**

|  |  |  |
| --- | --- | --- |
| Company | YES / NO | Technical Arguments |
| Fraunhofer |  Yes with comments | We agree that the discovery messages can be used to provide information for UE selection, provided that the discovery message contain information from the AS (such as the conditions indicated in the next question). For the in-coverage scenario, the discovery messages could be used to obtain relevant information from sidelink-anchors with the above procedure. Mode-A seems suitable for MO-LR and Mode-B seems suitable for MT-LR.However, for out-of-coverage scenario, it would be systematic to discover a server UE first, and enable the server UE to identify suitable anchor UEs for the target UEs. This process is then similar to selecting an LMF and an LMF identifying suitable TRPs for positioning. A target could initiate request for a server UE. One or more server UE can respond to the request, and the target UE could select the most suitable server UE according to certain criteria.Regarding the complexity vs. performance trade-off, we observe that some measurement could already be performed using a mechanism similar to preconfigured assistance data with area validity (this could be V2X zones for example). A session-less operation (similar to performing measurement on DL-PRS) could be seen as a first step to initiating a session-based operation.  |
| Qualcomm | Up to SA2 | Our view is that from a positioning/SLPP point of view, this is not strictly needed. We understand the "application layer" may perform UE discovery, determine, and verify required services and perform group management. The "application layer" can also verify that all of the UEs support SLPP. The "application layer" then requests sidelink ranging and positioning results from the "SLPP layer". The "SLPP layer" then decides on positioning/ranging method, QoS, SL-PRS, etc. based on UE positioning capabilities. The SLPP Capability Exchange seems needed in any case, even if the "application layer" already obtained some capability information and other attributes from the discovery operation. Introducing SLPP capabilities as part of Discovery is unnecessary and may constrain forward compatibility.  |
| Intel | Yes with comment | From positioning perspective, we think it is very useful for some positioning specific information to be included in the discovery signaling. This allows the UE to be aware of e.g. which positioning methods are supported by a given anchor UE without needing to set up an SLPP session beforehand for latency efficiency. The support of SLPP capabilities (including supported positioning methods) should be known to the target UE during the discovery procedure, rather than afterwards when a unicast connection has already been set up between target and anchor UE for a positioning session.We do agree that from RAN2 perspective, we can just provide SA2 with our recommendation on the inclusion of such information in the discovery message and final decision is up to them. |
| CATT | Yes with comment | Discovery messages are related to anchor UE/ server UE selection procedure. There are two options for anchor UE/ server UE selection which have different impacts on discovery messages:* Option 1: anchor UE/ server UE selection happens after unicast SL connection establishment and SLPP capability exchange;
* Option 2: anchor UE/ server UE selection happens before unicast SL connection establishment and SLPP capability exchange.

For option 1, what parameters should be included in discovery message can be decided by SA2 since UE can acquire left parameters from SLPP capability.For option 2, RAN2 should decide AS layer parameters for anchor UE/ server UE selection, and inform SA2 to capture them in the discovery message. |
| ZTE |  | If part of the SL positioning capabilities is to be included in the discovery message before session set up, there still will be SL positioning capability exchange procedure during a session. So the latency is not reduced.If all the SL positioning capabilties is to be included in the discovery message before session set up, it may not be feasible since the discovery signaling can not expand infinitely.Therefore we support Qualcomm’s comments that this is not restricted needed and it should be SA2’s decision. |
| OPPO | Yes | SA2 has already agree to include some info related to UE selection in the discovery msg, such as UE role indication. As a result, we think SA2’s opinion is also to use the discovery msg for the UE selection. The focus is to what extent the discovery msg should be involved in the UE selection. Should we finish UE selection by using the discovery msg or just using the discovery msg as a coarse filtering tool?Our opinion is to follow the concept of the legacy positioning procedure, for example to determine the positioning method to be used after the SL positioning exchange to be finished during the already established positioning session. Note that the positioning session could be established only between the target UE and the LMF/location server UE. Anchor UEs could be added to the positioning session later, according to the SL positioning capability exchange result. |
| LG | Yes with comment | After discovery procedure, SLPP can filter candidate anchor/server UEs for SLPP capacity exchange in order to reduce signaling overhead and latency. Also, it can be useful due to avoid SLPP capability exchange procedure in some cases e.g. session-less operation. To this end, some essential parameters can be considered to add in discovery message. We agree Qualcomm that SA2 will make a decision to add essential parameters for sidelink positioning e.g. roles of UE to support sidelink positioning (e.g., ability to support SL-PRS transmission/measurement or positioning calculation). But, no hard to provide RAN/AS consideration as following discussion. Herein, considering backward and forward combability in future, too many RAN/AS parameters should not be included in discovery.  |
| Lenovo | Yes, with comments | From our view, the discovery message can be used to provide information relevant to UE candidate selection, e.g., at least candidate anchor/server UEs can be determined by discovery procedure and thereafter these anchor/server UEs can be selected from a candidate list performed during discovery. A UE can identify one or multiple UEs which satisfies minimal service and performance requirements to support the SL positioning function. The SL positioning related info are supposed to be carried in the discovery message to filter or exclude some UEs which cannot support the positioning and therefore can include some high-level indications. After determining the candidate UEs, the specific UEs/final UEs selection can be performed in SLPP layer by some defined AS conditions for positioning performance efficiency consideration. |
| InterDigital | YES but | The discovery message should carry the UE roles and high-level capability information e.g. supported positioning methods but not detailed capabilities as amount of the detailed capability information would be very large. The detailed capability information should be exchanged separately. |
| Spreadtrum | Yes | The discovery procedure can be used to filter out candidate anchor UEs in advance e.g. positioning requirement, such as UE mobility characteristic, such as UE speed, direction and UE types (RSU, PUE etc).  |
| Xiaomi | Yes | To avoid too much capability change among a large number of candidate neighbor UE, it would be beneficial to filter out the UEs that can not fulfil the required QoS. |
| Sony | Yes | The discovery message should carry information for the UE to select or down select candidates.  |
| Apple | Yes with comments | We acknowledge it is beneficial but we generally agree with QCOM that it is in SA2 domain.  |
| HW |  | It is beneficial if discovery msg can provide useful information for UE to perform selection and thus avoid unnecessary unicast setup. However, considering the limited payload of the discovery msg, it is not reasonable to carry all the information. Therefore, only UE role as agreed by SA2 is enough, other information can be carried by capability and assistant data transfer procedure. |
| Ericsson | Also, up to SA2 and SA3; and Pls see comments (addition of indication of PRU UE for hybrid positioning) | Agree with QC. Besides that, would it be enough to only say UE is anchor UE? who can verify that the UE is really an anchor UE? what about security token etc.? Should some certificate credential or L2ID which can be validated should also be provided. Is discovery message secure?So, some consultation with SA2 and SA3 is needed.For Hybrid Positioning (Uu+SL); we see the need that Anchor/Reference UE broadcast whether it is PRU capable or not The Target UE should be able to identify a PRU UE during discovery procedure and inform this to LMF to initiate hybrid Positioning (Uu+SL).However, this discovery procedure can be initiated also upon LMF request.Anyways, if companies insist in optimizing discovery message then we see that besides the expected roles discussed in SA2, we should also request SA2 to add PRU indication in the Discovery message. And then we agree to indicate the supported positioning methods and positioning QoS in the discovery message to find suitable anchor UEs at early phase to save latency and energy. |
| Philips | Yes | The discovery messages should enable the UE to perform a first-pass filtering of candidate anchor UEs that cannot meet the UE’s requirements. At a minimum it should include the UE roles, including the so-called “Located UE” role which is useful for a first level filtering of candidate UEs in particular if the absolute position of the target needs to be determined. Hence, we will need to specify what this means in the context of RAN2. Possibly also other information such as coverage conditions or other AS conditions (e.g. to decide whether or not to use a server UE instead of LMF) would be useful as well. |
| Samsung | Yes | In our understanding, at least UE role and SLPP support indication (i.e., via Ranging/Sidelink Positioning service Code) are provided within discovery message as concluded by SA2. And it is understood that those parameters are minimum requirement to select Anchor UE(s) or Server UE based on the service code and UE role. However UE role does not represent that the UE supports specific SL positioning method or capabilities to meet QoS requirement. If discovery message does not provide information relevant to UE selection, Target UE and all Anchor UE/Server UE need to establish PC5 unicast link and SLPP session to exchange SL positioning capabilities. Exchanging SL positioning capabilities with unsuitable Anchor UEs/Server UEs which are not supporting required SL positioning method or capabilities would be signaling overhead. Expanding the scenario, the Target UE have to exchange SL positioning capabilities between all Anchor UE/Server UE in its proximity to find/select Anchor UE and/or Server UE for SL positioning procedure even it won’t be selected due to the capabilities.We understood that including all SL positioning capabilities is not feasible due to the forward compatibility, and it is duplicated operation with SL capability exchange procedure between Anchor UE/Server UE and Target UE.But we believe part of capabilities and additional information could be useful to determine candidate Anchor UE and/or Server UE before establishment of PC5 unicast link and SLPP session. Details will be discussed in next question. |
| vivo | SA2 dependency | Agree with QC and HW. The payload size of the SL positioning info may have an impact on the discovery message. RAN2 already agreed that the SLPP capability can be broadcast/groupcast, the duplicated info is not needed in the discovery message.RAN2 should ask SA2 about the payload restriction of discovery before reaching an agreement on the SL positioning info in discovery. |

**Summary 1**: TBD.

**Proposal 1**: TBD.

1. **Assuming discovery messages carry auxiliary information as per Q1, which information from the following list shall be included?**

***Capability***

* + - 1. **capability to serve as anchor UE**
			2. **capability to serve as server UE for self and/or other nodes**
			3. **support of specific positioning method(s)**

***Status***

1. **active anchor UE status (eg, for fast reuse purposes)**
2. **active server UE status (eg, for fast reuse purposes)**
3. **“located UE” status (ie position is known by self or other node like LMF)**

***Condition***

1. **LOS/NLOS condition wrt discovering UE**
2. **synchronization information (eg, source)**
3. **measurement report (eg, to indicate co-location with / distance from other candidate anchors)**
4. **mobility-related information (eg, mobile/stationary, speed)**

***Network***

1. **PLMN ID**
2. **cell ID**
3. **network coverage status (IC, OOC)**
4. **area / zone information**

***Other***

1. **other**

|  |  |  |
| --- | --- | --- |
| Company | YES / NO | Technical Arguments |
| Fraunhofer | Yes | All of the above information could be parameters that can be included as optional parameters. A UE can select another UE (in a different role) based on the information it has received based on some selection criteria. The selection criteria may be specified by the network or UE-implementation specific. A UE may be configured to include one or more auxiliary messages by the network in the discovery message. We also see further parameters that could also be useful in selecting anchors/server UEs.  Capability: o1: Bandwidth/update rate Status: o2: Battery power at anchor UE / server UEo3: Processing load at UE.  |
| Intel |  | Only the essential information in order to support a positioning procedure should be included to minimize signaling overhead. Therefore, we think only capability related information may be needed (i.e. c1,c2,c3). We assume the rest of the information can be subsequently exchanged once the positioning session is initialized. |
| CATT |  | As comment in Q1, if option 2 is agreed, the information for anchor UE / server UE selection should be included in the discovery message. Therefore, c1,c2,c3 and n1,n2,n3 are useful.* For LOS/NLOS, it can be detected by AS layer. It is not necessary obtained from discovery message.
* For synchronization information, the UEs with different sync source can’t interpret SL discovery/communication each other. Hence, it is useless to include synchronization information in the discovery message.
* For measurement report of other UE, it is not stable and not related to anchor UE / server UE selection directly.
* For mobile/stationary, speed and area / zone information, they are not essential information. It can be considered as optimization.
 |
| ZTE |  | Currently we think SA2’s conclusion on what to be reflected in the discovery message is necessary and it is enough, e.g., UE roles, and the support of SLPP |
| OPPO |  | Non-AS level info is needed, such as c1, c2, s3, d4, n3, Information such as the supported positioning method could be exchanged in the positioning capability. Not sure about the meanings of the s1. active anchor UE status (eg, for fast reuse purposes) and s2. active server UE status (eg, for fast reuse purposes). In our opinion, if the UE are not active in the SLPP positioning, it should not send the discovery msg including the UE roles. UE roles should imply that the related UE currently is OK to serve in the SLPP tasks. |
| LG |  | To avoid duplication between discovery and SLPP capability exchange, we think parameters should be classified two groups, static and dynamic, where dynamic parameters are changeable but static parameters are not. During SLPP operation (i.e. in the middle of sidelink positioning operation), dynamic parameters can be changed and delivered/exchanged between UEs via SLPP signaling. Therefore, discovery message should include static parameters as below;* Supported roles of UE (i.e. c1,c2 in Question)
* Supported sidelink positioning methods (i.e. c3 in Question)
* Type of UE (e.g., stationary UE, moving/mobile UE, normal UE, RSU, VRU, etc)
* Supported frequency range (e.g., FR1, FR2, NR-U, etc)

Dynamic parameters should be provided in SLPP capabilities exchanged. FFS detailed parameters for now and can be discussed in stage 3.  |
| Lenovo |  | High-level capability indications described by c1/c2 is suggested to be included in discovery message.As the comments on Q1, the purpose for discovery procedure is to filter potential UEs, which can support SL positioning, then at least the capability information should be indicated in the discovery message. This also aligns with SA2’s solution in UE roles and capability indication for the SL positioning/ranging discovery procedures.For other AS conditions including c3, Status (s), Condition (d), and Network (n), we tend to agree it is useful to determine the UE with optimal performance, but it is not the essential information that needs to be transferred to upper layer and carried in discovery messages. It can be regarded as the AS layer conditions in SLPP layer to perform final UE selection from the candidate UEs. |
| InterDigital |  | For capability, high-level capability indications of c1/c2/c3 are essential. In addition, it’s beneficial to include an RSU flag for anchor/located UE because RSU is an infrastructure node, which can have known location, no mobility, high-quality oscillator (better timing) and so it looks better to prioritise RSU during the anchor UE selection.For conditions, c1/c2/c3/c4 can be included.For network, n1 is essential and n3/n4 could be useful. |
| Spreadtrum |  | For capability, high level info is needed to filter out candidate anchor UEs in advance., including:* D4: mobility-related information (eg, speed, direction)
* O1: type of UE (eg, RSU, VRU, etc)
* O2: positioning requirement(eg, ranging, relative positioning or absolute positioning)
 |
| Xiaomi | C1-c3D1, d2, d4N3 | C1-C2 already agreed by SA2 by using UE role.C3 is useful to decides the candidate UEs that are capable of the intented positioning method for the required QoSD1, D4 will impact the positioing QoS.D2 is needed to determine the anchor UEs that can be synchronized to do SL positioning, e.g. SL-TDOAN3 is used to decide whether LMF will need to participate in the SL positioning for partical coverage case. |
| Sony |  | Relevant Information to be included - Roles (Anchor UE/Server UE)- Own location available/or good chance to make new estimation. (Y/N)- Mobility info (moving or stationary)- LoS/RF signal quality? (Y/N)- PLMN ID |
| Apple | C1 and C2 | In general we would like to limit the information in discovery messages. Of course some corner-case usage may be found for almost every parameters but we don’t think this is a strong enough argument.  |
| Ericsson | Pls see comments | Capability & credentials.capability to serve as PRU UE & ID which can be verified. Example the target UE may have preconfigured L2ID of PRUs. Hence, target UE can check and include such UEs.others:Ranging QoS Requirements: Depending on applications, different Ranging/SL positioning QoS in terms of accuracy latency will be imposed. Sending out QoS requirement by target UE or the QoS supported by the anchor UE, would implicitly imply conditions d1 and the measurement report. we can create some mapping between QoS that is needed and that can be potentially fulfilled by anchor UE. Example: The bitmap can be 5 bits; where 1 would imply stringent Ranging QoS requirements, i.e. a must LOS and 5 could imply ranging with large uncertainty is also ok; i.e. NLOS anchor UE could also be ok. Example target UE advertises BITMAP 1 and if anchor UE is in LOS; it can also respond with bitmap 1. This can minimize the size of discovery message.  |
| Philips | C1-c2,s1-s3, d4, n1, n3 | Discovery messages should aid in first level anchor UE/server UE selection so at least the capability information related to roles (c1, c2,) should be included. From the status attributes, at least s3 is essential in order to discover the role of “Located UE”, needed for absolute positioning, but the other two status attributes seem useful as well. Also network information in particular IC/OOC is useful in order to determine whether to select server UE or connect to LMF. Also some form of mobility indication may be useful such as d4. More detailed information can be exchanged over SLPP. |
| Samsung | c1, c2, c3, s1, s2, s3, n1, n2, n3 | CapabilityIn our understanding, c1 and c2 is already agreed by SA2 that the UE can indicates its role in its list of supported roles during discovery.We think c3 is useful to have additional information on capability, FFS details e.g., supported frequency range, SCS, bandwidth, positioning methods.StatusFor s1 and s2. The UE will include its role in its list of supported roles during discovery if it is able to do at that time.For s3, similar to s1 and s2, RAN2 does not need to do additional work referring draft TS 23.586; RAN2 don’t need to discuss about location status and Located UE role.NOTE: The role of being “Located UE” is dynamic and can change over time, in particular if the Located UE is moving. Hence, the discovery results need to be refreshed if there is a (significant) delay between discovery and initiating of a ranging procedure with a discovered Located UE. How often this is done is up to UE implementation. Conditiond1~d4 are not essential information.Networkn1, n2, n3 can be useful for NW assisted SL positioning or hybrid positioning. |
| vivo |  | We are open to the info that is not in the SLPP capability, e.g., d4 n3, which may help with the anchor UE selection.However, the explicit parameters can be further discussed after SA2 feedback on the feasibility and payload restriction for positioning info in the discovery message. |

**Summary 2**: TBD.

**Proposal 2**: TBD.

#  Conclusion

TBD.