**3GPP TSG-RAN WG2#123 R2-23XXXXX**

**Toulouse, France, 21 – 25 August, 2023**

**Agenda item:** x.x

**Source:** Intel Corporation

**Title:** Summary of [Post122][402][POS] SLPP session handling (Intel)

**Document for:**  Discussion, Agreement

# Introduction

This document is the report of the following email discussion:

* [Post122][402][POS] SLPP session handling (Intel)

Scope: Discuss the management of sessions in SLPP, including:

* whether a session identifier is explicitly needed in SLPP signalling;
* how the session is managed at the endpoints;
* how the session is managed among multiple UEs (target UE(s), anchor UE(s), and server UE); and
* the relation to groupcast cases.

Consider MO-LR and MT-LR scenarios, focussing on the UE-to-UE cases and taking into account SA2 status.

Intended outcome: Report to next meeting

Deadline: Thursday 2023-08-10 1000 UTC

Rapporteur would like to split the discussion into two phases:

**Phase 1: Companies are invited to provide comments on the questions listed in the document by Friday 2023-08-04 1000 UTC**

Rapporteur will generate the questions for second round of discussion based on companies’ input.

**Phase 2: Companies are invited to provide comments on the questions of second phase by Wednesday 2023-08-09, 1000 UTC**

Rapporteur will provide the final summary based on companies’ input.

**Note**: LMF involved case is not in the scope of the email discussion. Rapporteur would like to ask simple question on this, see the questions in section 3.2.1.

# Contact Information

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# Discussion-Phase 1

## The need of session ID in Uu based positioning

The need of session ID has been discussed for several meetings. As summarized in [1], there are two purposes of explicit session ID:

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| **Purpose 1:** The purpose to indicate session ID is to differentiate concurrent sessions between two end points. For LPP, concurrent session is supported, but session ID (except *periodicSessionID*) is not introduced in LPP message, the reason is that a routing ID is included in the NAS transport help identifying the serving LMF as well as session. While for periodic assistant data delivery session, LMF may change during the periodic assistant data delivery procedure, *periodicSessionID* is included in the LPP message to help maintaining one session during the whole assistant data delivery procedure. For SLPP, the transport layer is PC5-U, it is not possible to transmit a routing ID through PC5-U transport. Therefore, session ID has to be carried in the SLPP layer itself to distinguish different SLPP sessions.  **Purpose 2**: Session ID is needed to support multiple UEs in the same session or same UE in different sessions. Different from Uu positioning, A SL positioning session involves multiple UEs (target UE(s), anchor UEs and/or server UE). And an UE may be in parallel SL positioning sessions simultaneously. Therefore, introduce session ID in the SLPP messages is needed to identify sessions. |

Rapporteur would suggest looking at the usage of session ID in Uu based positioning first.

**As described in TS23.271:**

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| 9.3a.1 UE Assisted and UE Based Positioning and Assistance Delivery The following procedure depicts a positioning service transaction that is used by the E-SMLC to support UE based positioning, UE assisted positioning and delivery of assistance data. A single location request from the MME may invoke one or more transactions, in which each transaction may perform a single positioning service (e.g. UE assisted positioning, UE capability retrieval). RAN positioning procedures related to E-SMLC and UE communication are specified in TS 36.355 [47].    Figure 9.8e: UE Assisted and UE Based Positioning and Assistance Delivery Procedure  **Precondition:** A Correlation identifier allocated by MME had been passed to the E‑SMLC when the location session (i.e. EPC‑MT‑LR, EPC‑MO‑LR, or ECP‑NI‑LR) was initiated. The Correlation identifier must be assigned such that it can be used to identify the E‑SMLC serving the location session.  1. The E-SMLC sends a Location Information message to the MME carrying a Downlink Positioning Information and the Correlation identifier which may request location information from the UE, provide assistance data to the UE or query for the UE capabilities.  2. If the UE is not using Control Plane CIoT EPS Optimisation and if the UE is in ECM-IDLE state (e.g. if the S1 connection was previously released due to data and signalling inactivity), the MME performs a network triggered service request as defined in TS 23.401 [41] in order to establish a signalling connection with the UE.  If the UE is using Control Plane CIoT EPS Optimisation, procedures for Mobile Terminated Data Transport in Control Plane CIoT EPS optimisation as defined in TS 23.401 [41] are performed by the MME to establish a signalling connection with the UE.  3. The MME forwards the Downlink Positioning Information to the serving eNodeB in a NAS Transport message conveyed by the S1-AP Transport Message. The MME includes a Routing identifier, in the NAS transport message, representing the Correlation identifier associated with the location session between the MME and E-SMLC.  4. The eNodeB forwards the Downlink Positioning Information and Routing identifier to the UE by NAS Transport Message.  5. The UE stores any assistance data provided in the Downlink Positioning Information and performs any positioning measurements and location computation requested by the Downlink Positioning Information.  NB-IoT UEs may perform measurements for some positioning methods only when in ECM-IDLE state. In this case, the UE delays performing positioning measurements in step 5 until after the UE enters ECM-IDLE state.  6. If the UE is not using Control Plane CIoT EPS Optimisation and if the UE is in ECM-IDLE state, the UE instigates a UE triggered service request or, when User Plane CIoT EPS optimization applies, the Connection Resume procedure as defined in TS 23.401 [41] in order to establish a signalling connection with the MME.  If the UE is using Control Plane CIoT EPS Optimisation, procedures for Mobile Originated Data Transport in Control Plane CIoT EPS optimisation as defined in TS 23.401 [41] are performed by the UE to establish a signalling connection with the MME.  7. The UE returns any location information obtained in step 5 or returns any capabilities requested in step 4 to the eNodeB in an Uplink Positioning Information included in the NAS Transport message. The Uplink Positioning Information may alternatively carry a request for further assistance data. The UE shall also include the Routing identifier in the NAS Transport Message received in step 4.  8. The eNodeB forwards the Uplink Positioning Information and Routing identifier to the MME in a NAS Transport message.  9. The MME forwards the Uplink Positioning Information and the Correlation identifier to the E-SMLC, based on the received Routing identifier, in a Positioning Response. Steps 6 to 9 may be repeated if the UE needs to send multiple messages to respond to the request received in Step 4. Steps 1 to 9 may be repeated to send new assistance data, and to request further location information and further UE capabilities.  NOTE: The DL Positioning Information messages can be asynchronous. Once the E-SMLC sends at least one DL Positioning Information message towards the UE (steps 1-4), the UE can then send zero or more UL Positioning Information messages towards the E-SMLC (steps 6-9). The UE includes the same Routing identifier in each subsequent message. |

**As described in TS23.273**

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| 27. If a location estimate is needed for event reporting, the LMF may perform one or more of the positioning procedures described in clauses 6.11.1, 6.11.2, 6.11.3 and 6.11.4 and as described for step 8 in clause 6.1.1 and step 12 in clause 6.1.2. The LMF then determines the UE location using the location measurements and/or location estimate(s) obtained at this step and/or received at step 25. The LMF may also determine the timestamp of the location estimate.  NOTE 11: A precondition for the procedure in clause 6.11.1 is that an LCS Correlation identifier assigned by the serving AMF has been previously passed to the LMF. The LCS Correlation identifier is used in steps 1, 3, 6 and 7 in clause 6.11.1 to ensure that during a positioning session between the LMF and UE, positioning response messages from the UE are returned by the AMF to the correct LMF and carrying an indication (the LCS Correlation identifier) which can be recognized by the LMF. To retain this capability in step 27, the LMF shall assign a Correlation identifier indicating the LMF (and optionally a positioning session) for use at step 1 in clause 6.11.1. To enable an AMF to distinguish a Correlation identifier assigned by an LMF (used in this procedure) from a Correlation identifier assigned by the AMF (used otherwise for clause 6.11.1), the two types of Correlation identifier could be selected from different ranges, with or without a flag.  **Precondition:** A LCS Correlation identifier and the AMF identity have been passed to the LMF by the serving AMF. In the case of PRU, LCS Correlation identifier is generated by LMF and provided to AMF during PRU Registration Accept message. |

**As described in TS29.171:**

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| The Correlation ID is assigned by the MME and enables association of the location response with the location request when more than one location service request procedure is ongoing for the UE with the same E-SMLC. |

Based on above descriptions, Rapporteur has following observations:

**Observation 1:** Correlation identifier is used by the AMF to identify the correct LMF for a particular UE during a positioning session, i.e. routing purpose;

**Observation 2:** Correlation identifier is used by the LMF to associate the location response with the location request when more than one location service request procedure is ongoing for the UE with the same positioning server since there is no transaction ID concept in these messages;

**Observation 3:** Correlation identifier is assigned by the AMF and forwarded to the LMF except PRU and MT-LR for periodic, triggered Location Events, i.e. it is unrelated to MO-LR, MT-LR or NI-LR;

**Observation 4:** The serving AMF forwards the Routing identifier equal to the LCS Correlation identifier to UE using a DL NAS TRANSPORT message.

**Observation 5:** The serving AMF forwards the LPP message to the LMF indicated by the Routing identifier received from UE and includes a LCS Correlation identifier equal to the Routing identifier.

In summary, from core-network perspective, the purposes of session ID for Uu based positioning are:

**Purpose 1**: Correlation identifier is used by the AMF to identify the correct LMF for a particular UE during a positioning session, i.e. routing purpose;

**Purpose 2**: Correlation identifier is used by the LMF to associate the location response with the location request when more than one location service request procedure is ongoing for the UE with the same positioning server since there is no transaction ID concept in these messages.

**Purpose x**:?

**Question 3.1-1: For Uu based positioning (from core-network perspective), regarding the need of explicit session ID which of the purposes above do companies support? Please add if anything is missing.**

**Note: the session ID used in the messages between the LMF and the AMF is under SA2 scope.**

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| **Company** | **Purpose 1**  **Purpose 2**  **Others?** | **Remark** |
| Qualcomm | All of these | The Correlation ID identifies the location session between AMF and LMF (the messages exchanged between AMF and LMF for location services for the UE).  An AMF may have a location session with an LMF and maintains state information for this location session. For an immediate location request, the AMF assigns a correlation ID that is used to identify messages exchanged between AMF and LMF for this location session.  The LMF and UE may exchange LPP messages via AMF during the location session. However, the AMF does not need to maintain state information for communication with the UE. The AMF assigns a routing ID (also referred to as session ID) that is used to associate messages exchanged between AMF and UE with the location session between AMF and LMF. This routing ID is used to identify messages exchanged between AMF and UE whereas the correlation ID is used to identify messages exchanged between AMF and LMF for location services for the UE.  The AMF is able to associate each NAS message received from the UE with the location session between the AMF and the LMF based on the routing ID included in the NAS message by the UE.  This enables the Correlation ID (or Routing identifier) to identify an LPP session between an LMF and UE even though not included at the LPP level. |
| OPPO | At least Purpose 1 is found | The proof of Purpose 1: (TS 23.273) the LCS Correlation identifier is used in steps 1, 3, 6 and 7 in clause 6.11.1 to ensure that during a positioning session between the LMF and UE, positioning response messages from the UE are returned by the AMF to the correct LMF and carrying an indication (the LCS Correlation identifier) which can be recognized by the LMF. |
| vivo | 1,2 and others | In general, an LPP session is used between LMF, AMF and the target UE to manage the positioning procedures for one specific location request.  In addition to purposes 1 and 2, the following purposes are valid:  Purpose 3: The session ID can be used by the AMF to associate the location response with the location request.  Purpose 4: For Deferred MT-LR, the session ID can be used by the LMF to associate the Event Report with the LCS Periodic-Triggered Invoke Request. |
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**As described in TS 37.355:**

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| Multiple LPP sessions can be used between the same endpoints to support multiple different location requests (as required by TS 23.271 [3]).   * Reliable transmission   + Duplicate detection: A receiver shall record the most recent received sequence number for each location session. If a message is received carrying the same sequence number as that last received for the associated location session, it shall be discarded.   + NOTE: For LPP control-plane use, a target device can be aware of a location session from information provided at the NAS level for downlink transport of an LPP message.   + Retransmission: When an LPP message which requires acknowledgement is sent and not acknowledged, it is resent by the sender following a timeout period up to three times. If still unacknowledged after that, the sender aborts all LPP activity for the associated session.   + Segmentation: If the receiver receives a subsequent LPP message for the same session and transaction ID, the receiver shall assume that the new LPP message continues the segmentation of the earlier message and may store the new message if the new message indicates that more messages are on the way. * Periodic Assistance Data Transfer   + *periodicSessionID* * Error Detection   + 4> discard all stored LPP message segments for this session and LPP-TransactionID; |

In summary, from LPP management perspective, the purposes of session ID for Uu based positioning are:

**Purpose 3**: session ID is used to identify a session since reliable transmission is handled per positioning session;

**Purpose 4**: session ID is used to identify a session since error detection is handled per positioning session;

**Purpose 5**: session ID is used to identify a session since Periodic Assistance Data Transfer could be handled as separate session for different LMF;

**Purpose x**:?

**Question 3.1-2: For Uu based positioning (from LPP perspective), regarding the need of explicit session ID which of the purposes above do companies support? Please add if anything is missing.**

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| **Company** | **Purpose 3**  **Purpose 4**  **Purpose 5**  **Others?** | **Remark** |
| Qualcomm | None | The question is not completely clear, but we assume it refers to LPP Uu positioning as stated. In that case, as commented in our response to Question 3.1-1, the Correlation ID and Routing ID enable an LPP session between a UE and LMF to be identified by the LMF and UE. A new session ID in LPP is thus not needed. |
| OPPO | all | As clearly stated in the TS 37.355, all the mentioned functionalities are handled per positioning session. We think the explicit session ID is not needed to be introduced to the LPP protocol. In the current implementation, the routing ID included in the NAS message serves as the session ID. |
| vivo | 3.4.5.  Others See comments | LPP Session is used to associate positioning procedures within a session for one specific location request. That is, the LPP transport also associate with a positioning session, not just for Purpose 3-5.  Purpose 6. Associate different transactions. For example, the UE is performing two parallel positioning. When receiving a Request Location Information message after receiving two Provide Assistant Data messages separately for two sessions, the UE needs to associate the Request Location Information message with the corresponding Provide Assistant Data message, not another Provide Assistant Data message. The association is done via the session ID.  Purpose 7. The LMF and UE will perform the lifecycle management per location session. The UE could delete all the stored parameters when the location session terminates, e.g., sequence number.   |  | | --- | | TS 37.355  Sending and receiving sequence numbers shall be deleted in a server when the associated location session is terminated and shall be deleted in a target device when there has been no activity for a particular location session for 10 minutes. | |
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## Session management for Sidelink positioning

### 3.2.1 LMF involved case

RAN2 has agreed that

SLPP carried over NAS is used between UE and LMF. FFS on how to manage the session/transaction.

SA2 has agreed the procedure for SL-MO-LR in [3] and SL-MT-LR in [4], and has captured them in TS 23.273-i20, as

6.20.1 Procedures of SL-MO-LR involving LMF

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| Omitted unrelated parts:  9. The serving AMF selects an LMF serving UE1 (e.g. an LMF that supports Sidelink positioning/ranging) and sends an Nlmf\_Location\_DetermineLocation service operation towards the LMF with the information from the SL-MO-LR Request. The service operation includes a LCS Correlation identifier. |

6.20.3 Procedures of SL-MT-LR involving LMF

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| Omitted unrelated part:  9. The serving AMF selects an LMF serving UE1 (e.g. an LMF that supports Ranging/Sidelink Positioning) and sends an Nlmf\_Location\_DetermineLocation service operation towards the LMF with the information received at step 5 e.g. required location results (e.g. relative locations or ranges and directions between pairs of UEs), SL reference UE(s) in case of relative locations, Application layer IDs of the UEs if received in step 5. The service operation includes a LCS Correlation identifier.  10. The LMF sends an SL-MT-LR request to the serving AMF as a supplementary services message, using the Namf\_Communication\_N1N2MessageTransfer service operation, and the session ID parameter is set to the LCS Correlation identifier.  11. The serving AMF forwards the SL-MT-LR request and a Routing identifier equal to the LCS Correlation identifier to UE1 using a DL NAS TRANSPORT message.  14. UE1 returns a supplementary services SL-MT-LR response to the serving AMF in an UL NAS TRANSPORT message and includes the Routing identifier received in step 11.  15. The serving AMF forwards the SL-MT-LR response to the LMF indicated by the Routing identifier received at step 14 and includes a LCS Correlation identifier equal to the Routing identifier. |

6.20.4 Procedures of SL-MT-LR for periodic, triggered Location Events

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| 11. The SL-MT-LR request from AMF is Periodic-Triggered, and the Routing identifier is immediate Routing identifier.  NOTE 2: The deferred routing identifier may be global (e.g. an IP address, UUID or URI) or may be local. The deferred routing identifier is used for routing in steps 24 and 25. The immediate routing identifier included by the AMF in step 11 is used for routing in steps 14 and 15.  14. The SL-MT-LR response from UE1 is Periodic-Triggered, and Routing identifier is immediate Routing identifier. The supplementary services Periodic-Triggered SL-MT-LR response indicates whether UE1 and other UEs 2 to m accept the periodic or triggered location request and which of UEs 2 to m were discovered by UE1 at step 12.  15. The SL-MT-LR response forwarded by AMF is Periodic-Triggered, and Routing identifier is immediate Routing identifier.  24. UE1 sends a supplementary services event report message to the serving AMF using the Namf\_Communication\_N1N2MessageTransfer service operation, and includes the deferred Routing ID received in step 11. The event report indicates the type of event being reported (e.g. whether a normal event or expiration of the maximum reporting interval) and may include location results obtained at step 21. UE1 also includes the (H)GMLC contact address, the LDR reference number, whether location results are to be reported and if so the location QoS in the event report.  25. The AMF forwards the event report to the LMF indicated by the deferred Routing ID received at step 24 and includes a Correlation ID equal to the deferred Routing ID.  26. When the LMF receives the event report and if it can handle this event report, the LMF updates the status of event reporting (e.g. the number of event reports so far received from UE1 and/or the duration of event reporting so far) and returns a supplementary services acknowledgment for the event report to the serving AMF using the Namf\_Communication\_N1N2MessageTransfer service operation, and a Correlation ID identifying the LMF. The acknowledgment may optionally include a new deferred routing identifier indicating a new serving LMF or a default (any) LMF.  27. The serving AMF forwards the event report Ack and an immediate Routing ID equal to the Correlation ID to UE1 using a DL NAS TRANSPORT message. If UE1 does not receive any response from the LMF after a predefined time, i.e. the current LMF does not support the deferred location request (for temporary or permanent reasons) or due to some radio access failures, UE1 may re-send the report one or more times.  NOTE 5: Inclusion of a new deferred routing identifier in the event report acknowledgment at step 26 may be used to change the serving LMF (e.g. if a UE moves into an area that is better supported by a different LMF or if the serving LMF is overloaded) or to enable a default LMF to become a serving LMF. |

Based on the descriptions in TS 23.273 on LMF involved SL-MO-LR and SL-MT-LR, the handling on session is same as Uu based positioning, i.e.:

**Handling 1:** Correlation identifier is assigned by the AMF and forwarded to the LMF regardless of SL-MO-LR, or SL-MT-LR, except SL-MT-LR for periodic, triggered Location Events (the LMF may include a new correlation identifier in order to change a new LMF).

**Handling 2:** Correlation identifier is assigned by the AMF and forwarded to the LMF regardless of SL-MO-LR, or SL-MT-LR;

**Handling 3:** The serving AMF forwards the Routing identifier equal to the LCS Correlation identifier to UE using a DL NAS TRANSPORT message.

**Handling 4:** The serving AMF forwards the SLPP message to the LMF indicated by the Routing identifier received from UE and includes a LCS Correlation identifier equal to the Routing identifier.

**Question 3.2.1-1: For LMF involved SL based positioning (from core-network perspective), do companies agree to follow SA2, i.e. the above handlings (1-4)? Please add if anything is missing.**

**Note: the session ID used in the messages between the LMF and the AMF is under SA2 scope.**

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| **Company** | **Yes/No** | **Remark** |
| Qualcomm | Yes | The SA2 procedures mainly describe interactions between an LMF and one particular UE in a group of UEs. That allows existing Correlation ID and Routing ID conventions to be reused for messages (e.g. LPP or SLPP) exchanged between the LMF and the one particular UE. |
| OPPO | Yes | Ok to follow the SA2. |
| vivo | Yes with comments | Handling 2 is duplicated with Handling 1. |
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Considering RAN2 already agreed that “SLPP carried over NAS is used between UE and LMF.”, therefore from SLPP perspective, explicit session ID is not needed for the SLPP between UE and LMF, i.e. same as LPP, since the routing ID is contained in NAS message.

**Question 3.2.1-2: For LMF involved SL based positioning, do companies agree that for the SLPP between UE and LMF, explicit session ID in SLPP message is not needed, i.e. same as LPP.**

**Note: the session ID used in the messages between the LMF and the AMF is under SA2 scope.**

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| **Company** | **Yes/No** | **Remark** |
| Qualcomm | Yes, with comments | While we agree that a new session ID is not needed between a UE and LMF, it would be useful for the LMF to see the SLPP session ID used to exchange SLPP messages between UEs. That could avoid error cases – e.g. where an LMF is supporting an SLPP session for 2 or more UEs (e.g. for SL-MO-LR) in that session to avoid duplicate LMF activity and providing conflicting assistance data (e.g. for SL PRS) to the UEs.  Note that a new ID for SLPP is also needed in the 'Payload Container Type' in the UL/DL NAS TRANSPORT message specified in TS 24.501. |
| OPPO | Yes | Similar with the LPP, the SLPP between UE and LMF should be located on the top of the NAS layer, so the explicit session ID is not needed for the SLPP as well. |
| vivo | not in the scope of this email. | In Uu positioning, the LMF only needs to communicate with one UE, i.e., target UE. But for sidelink positioning, the LMF may need to communicate with multiple UEs (e.g., target UE, one or more anchor UEs). It is unclear how to manage the session ID/correlation identifier for multiple UEs. We prefer to wait for SA2’s further progress before making a decision.  Besides, we suppose the LMF related LPP session handlings are for information/reference. LMF involved SLPP session handling is not in the target scope of this email. |
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**Question 3.2.1-3: Any other issues to be discussed?**

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| **Company** | **Issues** | **Remark** |
| Qualcomm | SLPP Session ID between UEs | It has been forgotten that even when an LMF is involved, a group of UEs will still exchange SLPP messages within the group. For this, an SLPP session ID is essential as commented below for later questions. |
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### 3.2.2 UE only operation (LMF not involved case)

#### 3.2.2.1 Session management

SA2 has agreed the general principles on how to support UE only operation in TS23.586, as

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| When LMF is not involved for SL Positioning/Ranging, e.g. the LMF in the serving network does not support SL Positioning, UE-only Operation SL Positioning is used, including Target UE as SL Positioning Server UE and Target UE not as SL Positioning Server UE.  When Target UE as SL Positioning Server UE, the following principles applies:  - The Target UE performs the Located UE's discovery and selection.  - The Target UE obtains the location of the Located UE(s), and the Located UE(s) may trigger a 5GC-MO-LR to retrieve its location. The Target UE uses the location of Located UE(s) together with the Ranging/SL positioning measurement data or result to estimate its own location.  - The Ranging/Sidelink positioning and the positioning of the Located UE(s) can be scheduled with the same scheduled location time (as per TS 23.273 [8]) to improve the Target UE positioning accuracy.  NOTE: Security and privacy aspects require confirmation from SA WG3.  When Target UE not as SL Positioning Server UE, the following principles applies:  - The Target UE performs the SL Positioning Server UE's discovery and selection.  - The SL Positioning Server UE can optionally determine to use the location of Located UE(s) together with the Ranging/SL positioning measurement data or result to estimate the location of Target UE.  - The Ranging/Sidelink positioning and the positioning of the Located UE(s) can be scheduled with the same scheduled location time (as per TS 23.273 [8]) to improve the Target UE positioning accuracy. |

**In summary**:

* Target UE may or may not act as SL positioning server UE.
* It is target UE to select the SL positioning server UE;
* The SL positioning server UE may use the location of anchor UE together with Raning/SL positioning measurement results to estimate the location of target UE;

SA2 also agreed the general procedure for UE-only operation as

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| 6.8 Procedures of Ranging/Sidelink Positioning control Either UE-only Operation or Network-based Operation is applied in the Ranging/Sidelink Positioning control procedures.  UE-only Operation as specified in this clause is applied for the following cases:  - Neither Target UE nor SL Reference UE is served by NG-RAN.  - Network-based Operation is not supported by the 5GC network:  - When Network-based Operation is not supported by the 5GC network, indication on whether the UE is allowed to use UE-only operation to perform Ranging/ SL Positioning is included in the Policy/Parameter provisioned to UE as defined in clause 5.1.1.2, and is provisioned to the UE as defined in clause 5.1.1.1. The Target UE will take it into account to initiate UE-only operation procedure.  - SL-MO-LR request is rejected by the network.  For any other cases, Network-based Operation as specified in clauses 6.20 of TS 23.273 [8] is applied.    Figure 6.8.1-1 Procedures for Ranging/Sidelink Positioning control (UE-only operation)  1. UE1 (i.e. Target UE) may receive a Ranging/SL Positioning Service request from:  1a. SL Positioning Client UE over PC5 during procedures for Ranging/SL Positioning service exposure though PC5 as defined in clause 6.6.1.1.  For absolute location, the service request includes the SL Positioning Client UE's user info and Target UE's user info, and required positioning QoS.  For relative location or ranging information, the service request includes the SL Positioning Client UE's user info, Target UE's user info, SL Reference UE's user info(UE2/.../UEn), and Ranging/SL Positioning QoS information.  1b. RSPP application layer.  The service request includes type of the result (i.e. absolute location, relative location or ranging information) and the required QoS.  2. UE1 discovers UE2/.../UEn (i.e. SL Reference UEs/Located UEs) as defined in clause 6.4, if needed.  NOTE 1: Details of security related procedures during UE discovery are developed by SA WG3.  3. If none of UE1/.../UEn are served by NG-RAN or the serving network does not support Ranging/SL Positioning, , UE-only Operation is applied.  4. UE1 and UE2/.../UEn perform capability exchange. Step 4 may be performed during step 5 and step 6 with coordination of SL Positioning Server UE.  5. If UE1 does not support SL Positioning Server functionalities, a SL Positioning Server UE (either co-located with a SL Reference UE/Located UE, or operated by a separate UE) is discovered (if not yet discovered in step 2) and selected. If a SL Positioning Server UE that is co-located with a SL Reference UE/Located UE or operated by a separate UE, UE1 discovers and selects the SL Positioning Server UE as described in clause 6.4 and requests SL Positioning Server UE to participate in the Ranging/Sidelink positioning.  NOTE 2: Details of security and privacy related procedures during SL Positioning Server UE discovery and operation are developed by SA WG3.  6. Sidelink Positioning assistant data is transferred among UE1/ .../UEn and the SL Positioning Server UE.  7. SL-PRS measurement is performed between UE1 and UE2/.../UEn and possibly also amongst UE2/.../UEn.  8. SL-PRS measurement data is transferred to the SL Positioning Server UE or is transferred to UE1 if it supports SL Positioning Server functionalities, in order to perform result calculation. Based on the type of the result received in step 1, absolute location, relative location or ranging information is calculated at the UE.  NOTE 3: Details of step 4-8 are developed by RAN WGs.  9. Ranging/SL Positioning result is transferred to:  9a. SL Positioning Client UE over PC5 during procedures for Ranging/SL Positioning service exposure though PC5 as defined in clause 6.6.1.1;  9b. RSPP application layer. |

Based on the procedure described in TS 23.586, there is no clear MO-LR, MT-LR concept for UE-only operation. Target UE is the node who handles the Ranging/SL Positioning service request that from application layer (similar to MO-LR) or SL Positioning Client UE (Similar to MT-LR).

**Observation 6**: The Ranging/SL Positioning service request from SL Positioning Client UE can be treated as MT-LR, and the request from SLPP application layer can be treated as MO-LR;

SA2 did not define the procedure for multiple target UEs, i.e. it is unclear how an LCS Client can trigger the Ranging for multiple target UEs.

**Observation 7**: SA2 did not define the dedicated procedure on ranging for multiple target UEs;

It is difficult for RAN2 to start the discussion on how to support ranging for multiple target UEs without the information on how LCS Client triggers the session. Therefore Rapporteur would suggest to postpone the discussion on this. The main purpose of group cast is to support multiple target UEs, therefore it can also be postponed.

**Question 3.2.2.1-1: Do companies agree to postpone the discussion on the support of multiple target UEs and the group cast until SA2 defines the procedure for it?**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Remark** |
| Qualcomm | See comment | We do not see that SLPP session handling depends on the UE role. Groupcast remains valid when one UE has information to send (e.g., capabilities, SL PRS configuration(s), location results) to multiple other UEs. It does not matter what roles these other UEs have.  We also don't think that SA2's definition of "LCS Request" is a prerequisite for RAN2 defining SLPP procedure support for multiple target UEs. RAN2 agreed that "SLPP can support multiple target UEs in the same session when LCS requests". The LCS Request/Trigger mechanism seems not dependent on the number of target UEs. However, if there should be anything specific to multiple target UEs which depends on SA2, fine to wait for SA2. |
| OPPO | No | According to the updated 23.273(i20 version), support of multiple target UEs has been already solved by SA2 themselves. For example, in the section 6.20.1 Procedures of SL-MO-LR involving LMF, in the step 19, if absolute locations of located UEs (could be target UE2…N) are not received at step 18, the LMF can triggers 5GC-MT-LR to acquire the absolute locations of these target UEs using Application Layer ID, and using their locations to derive the position of the target UE1. In such a way, all the target UEs locations could be retrieved, and such kind of implementation does not enforce any RAN2 impact. |
| vivo | See comments | RAN2 should focus on a single target UE first and further study RAN2 impact to support multiple target UEs and the group cast. |
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**Following discussion is only for single target UE scenario.**

In the procedure, UE1 (target UE) acts the important role as the AMF:

* The Target UE shall discover and select a SL Positioning Server UEs that are in the same or different serving PLMN of the Target UE and the Reference UE(s) (section 5.2.3 of TS23.586).
* The Target UE is the node that handles the Ranging/SL Positioning service request and provides the Ranging/SL Positioning service response back;
* Target UE shall establish PC5 connection with each SL Positioning server UE, Anchor UEs (reference UE in SA2)

So far, for Uu based positioning procedure, AMF is responsible for the session management, e.g. start a session when receive the LCS request, and release the session upon the completion of the positioning procedure or upon error case, e.g. HO. There is not separate session management procedure, e.g. establishment/modification/release in other entities (LMF, gNB and UE).

If we follow Uu based positioning procedure, same as AMF, the target UE should be in the best position to be responsible for the session management, and the session management should be transparent to other UEs except the release of PC5 connection.

**Question 3.2.2.1-2: Which UE should be responsible for the session management? Target UE, one of Anchor UE (reference UE/located UE in SA2), or SL Positioning Server UE? Please add if anything is missing.**

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| --- | --- | --- |
| **Company** | **Target UE**  **Anchor UE**  **Server UE**  **Others?** | **Remark** |
| Qualcomm | Other | The UE which initiates or triggers an SLPP session (which should be independent of the UE role). Note that an SLPP session (or, more generically, an SLPP positioning activity) must be initiated or triggered by a UE when no LMF is involved. It cannot happen without such an event. The UE which performs the initiation or triggering is in the best position to perform the session management. |
| OPPO | Target UE first and then the SL positioning server UE | 1. We wonder what’s the meaning of establishment/modification/release in the context of the session management, Especially the ‘modification’? does it imply the change of involved UEs, e.g., anchor UEs, for the SL positioning? 2. According to the section 4.2 Common LPP Session Procedure in the TS 373.55, the LPP session could be initiated by the target or the server, and is terminated by a final transaction N in which LPP msgs will be exchanged between two endpoints.   we could accept that target UE or server UE to take the responsibility of the session management, and should be captured in the TS 38.355. |
| vivo | See comments | The UE acts as a positioning server should be responsible for session management, i.e., target UE if target UE acts as server UE, or server UE if target UE does not act as server UE. |
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**Question 3.2.2.1-3: Do companies agree that the session management, e.g. establishment/ release is transparent to other UEs than the UE who is responsible for session management except the release of PC5 connection? Please elaborate your reason if you have different view.**

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| **Company** | **Yes/No** | **Remark** |
| Qualcomm | No | Each UE in a session needs to be aware of each other UE in the session and when the session has started and ended, e.g., to assign and later release resources, state information, etc. If UEs are not aware of this, the following problems could arise:   * a UE continues (trying to) transmit and/or measure SL PRS after a session has ended * a UE continues trying to measure SL PRS that was transmitted by another UE which has now left the session * a UE does not measure SL PRS or obtain SL PRS measurements from another UE which has recently joined the session * a UE does not know which other UEs are transmitting SL PRS or providing location results which could not only prevent location determination for these other UEs but also impede a UE locating itself * some V2X and PS use cases might not be supported – where UEs are expected to know which other UEs they are interacting with |
| OPPO | Yes | For the LPP, the session is initiated when either the target or the server sends an LPP for an initial LPP transaction j to the other endpoint B, and is further ended by a final transaction N LPP msg. If the SLPP follows such rule, it is hard to let UEs other than the transmitting/reception UE of the initial/final SLPP msg to know the start/end of the SLPP. To achieve such goal, we need to introduce a lot of redundant notification signaling msgs in the SLPP signaling procedure, which is unnecessary.  On the other hand, we think the anchor UE should just perform according to the received signaling msg and that’s it. For example, regarding the case of time-frequency resource allocated by the network, the UE should perform positioning measurement according to the SL-PRS configuration received from the location server; regrading the case of UE autonomous time-frequency resource determination case, a positioning measurement window could be set, and the UE only needs to perform the positioning measurement of the target SL-PRSs informed by the location server.  Regarding the 4th bullet mentioned by Qualcomm, we don’t understand the point. Why a UE does not know which other UEs are transmitting SL PRS or providing location results could prevent location determination for these other UEs |
| vivo | Yes | Similar to Uu positioning, explicit session management is not needed. A UE may release the positioning session when there has been no activity for a particular location session for a specific time. |
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**Question 3.2.2.1-4: Any other issues to be discussed?**

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| **Company** | **Issues** | **Remark** |
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#### 3.2.2.2 The need of explicit session ID for UE-only operation

As discussed in the section 3.1, the purposes of session ID for Uu based positioning are:

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| From core-network perspective, the purposes of session ID for Uu based positioning are:   * **Purpose 1**: Correlation identifier is used by the AMF to identify the correct LMF for a particular UE during a positioning session, i.e. routing purpose; * **Purpose 2**: Correlation identifier is used by the LMF to associate the location response with the location request when more than one location service request procedure is ongoing for the UE with the same positioning server since there is no transaction ID concept in these messages. |

**[Rapporteur] For purpose 1 and 2,** it is unclear whether the session ID is needed for UE only operation since the LCS client has direction connection with the target UE. The target UE can associate the location response with the location request even if there is concurrent positioning session for the same target UE since target UE is responsible for the selection of anchor UEs and server UE for the Location request.

**Question 3.2.2.2-1: For UE only operation, regarding the need of explicit session ID which of the purposes above do companies support? Please add if anything is missing.**

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| --- | --- | --- |
| **Company** | **Purpose 1**  **Purpose 2**  **Others?** | **Remark** |
| Qualcomm | Other | LMF/AMF Correlation ID and Routing ID are not relevant to SLPP interactions between UEs.  The SLPP Session ID is used to identify a sidelink positioning location/ranging session (i.e., all SLPP transactions and SLPP messages belonging to this session). It allows endpoints (i.e. UEs) to distinguish SLPP messages for one session from SLPP messages for other sessions. One UE may simultaneously participate in multiple SLPP sessions. Each separate SLPP session may be with a different individual UE, with a different group of UEs, or with overlapping groups of UEs. The UE must maintain knowledge and status of each distinct SLPP session it is engaged in, including the session participants and session requirements. The UE may have the same or a different role within each location/ranging session it is involved in and there may be different QoS, different SL-PRS configurations and different measurements. Not distinguishing different sessions in a multi-session scenario risks being unable to support the unique requirements of each session. |
| OPPO |  | Not convinced by Qualcomm. For example, regarding the measurement, the UE could simply act according to the received SL-PRS configuration and the signaling msg received such as the SL Location Information Request informing the UE of which type of positioning measurement is requested and the response time required. All required is to associate the response signaling msg with the request signaling msg. |
| vivo | Others | Similar to Uu positioning, an SLPP session can be used between UEs to manage the positioning procedures for one specific location request.  - SLPP session can be used to associate different transactions. For example, the UE is performing two parallel positionings. When receiving a Request Location Information message after receiving two Provide Assistant Data messages separately for two sessions, the UE needs to associate the Request Location Information message with the corresponding Provide Assistant Data message, not another Provide Assistant Data message. The association is done via the session ID.  - UEs can manage the AD/ variables per SLPP session. |
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| * Reliable transmission   + Duplicate detection: A receiver shall record the most recent received sequence number for each location session. If a message is received carrying the same sequence number as that last received for the associated location session, it shall be discarded.   + NOTE: For LPP control-plane use, a target device can be aware of a location session from information provided at the NAS level for downlink transport of an LPP message.   + Retransmission: When an LPP message which requires acknowledgement is sent and not acknowledged, it is resent by the sender following a timeout period up to three times. If still unacknowledged after that, the sender aborts all LPP activity for the associated session.   + Segmentation: If the receiver receives a subsequent LPP message for the same session and transaction ID, the receiver shall assume that the new LPP message continues the segmentation of the earlier message and may store the new message if the new message indicates that more messages are on the way. * Periodic Assistance Data Transfer   + *periodicSessionID* * Error Detection   + 4> discard all stored LPP message segments for this session and LPP-TransactionID;   From LPP management perspective, the purposes of session ID for Uu based positioning are:   * **Purpose 3**: session ID is used to identify a session since reliable transmission is handled per positioning session; * **Purpose 4**: session ID is used to identify a session since error detection is handled per positioning session; * **Purpose 5**: session ID is used to identify a session since Periodic Assistance Data Transfer could be handled as separate session for different LMF; |

**Rapporteur’s understanding:**

**For purpose 3**

* **duplicate detection,** session ID may not be needed if sequence number (size 256) can be unique for messages between same pair of UEs among different sessions.
* **Retransmission:** Session ID may not be needed since if still unacknowledged after the condition, the UE shall aborts all SLPP activity for the pair of UEs for all sessions involved;
* **Segmentation:** session ID may not be needed if transaction id (size 256) can be unique for messages between same pair of UEs among different sessions.

**For purpose 4:** See the comments on the purpose 3.

**For purpose 5:** Not applied since SLPP does not support GNSS;

During offline discussion, some companies commented that session ID is needed to support multiple UEs in the same session or same UE with different/same role in different session.

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| **Purpose 6**: Session ID is needed to support multiple UEs in the same session or same UE in different sessions. Different from Uu positioning, A SL positioning session involves multiple UEs (target UE(s), anchor UEs and/or server UE). And an UE may be in parallel SL positioning sessions simultaneously. Therefore, introduce session ID in the SLPP messages is needed to identify sessions. |

**Rapporteur’s understanding:**

**For purpose 6:** so far RAN2 has agreed following messages

1. SL Positioning Capability Transfer

2. SL Positioning Assistance Data exchange

3. SL Location Information Transfer

4. Error handling

5. Abort

* Messages “Positioning Capability Transfer” and “Abort” are not session specific procedure.
* Message “Error handling” is related to purpose 4;
* Message “SL Positioning Assistance Data exchange” and “SL Location Information Transfer” can be session specific. However the UE can know the relationship between assistance data and requested location information based on positioning method since both assistance data and requested location information are contained as positioning method specific IEs.
* For a positioning session involving multiple UEs, e.g. ranging, the Tx UE does not need to know for which session the SL PRS is transmitted to. The Rx UE only needs to know which positioning method should be done based on the received assistance data (it can be reflected based on positioning method specific IE for both assistance data and measurement results). According to SA2 procedure, target UE is responsible for reference UEs selection based on the input from LCS service request, and therefore it can know which pair of ranging results should be sent back to the LCS client.
* For a UE involving in multiple positioning session simultaneously, same as above, the information should be maintained by target UE. If the UE acts as anchor UE, the UE may not need to know the session information.

**Question 3.2.2.2-2: For UE only operation, regarding the need of explicit session ID which of the purposes above do companies support? Please add if anything is missing.**

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| **Company** | **Purpose 3**  **Purpose 4**  **Purpose 5**  **Purpose 6**  **Others?** | **Remark** |
| Qualcomm | All and Others | As noted in our response to Question 3.2.2.2-1, the Session ID is principally used to identify a location/ranging session (i.e., all SLPP transactions and all SLPP messages belonging to this session). It allows endpoints to distinguish messages for one session from messages for other sessions. One UE may be involved in multiple location/ranging sessions (and with the same or different roles in these sessions). The other purposes (Purposes 3-6) are also all supported.  We believe the concept has already been agreed in RAN2:   |  | | --- | | Agreement:  Sidelink positioning supports a session-based concept in SLPP, in which signalling messages within a session can be associated with one another by the involved UEs. The relationship to upper-layer designs from SA2 can be discussed during normative work.  FFS if there is also sessionless operation and what aspects of session-based operation would not be included. |   The remaining question seems to be how this can be realized in SLPP, and we think a Session ID in each SLPP message is a rather obvious/simple realization. |
| vivo | All and others | See comments to Question 3.2.2.2-1.  The rapporteur seems to imply that explicit session ID is not needed, and sequence number & transaction id are enough. But we think they are not sufficient. For instance, the rapporteur says “the UE can know the relationship between assistance data and requested location information based on positioning method since both assistance data and requested location information are contained as positioning method specific IEs”. However, there is no strict one-to-one mapping between AD and positioning methods, e.g., different SL sessions may use the same method but the reference UEs for ranging are not the same, and the corresponding ADs may include different anchor UEs.  Besides, this approach is not aligned with the previous RAN2 agreement that for session-based SLPP, a single SLPP session is created to support a single location request. And the UE cannot perform the lifecycle management per location session  Therefore, we think that explicit SLPP session ID is needed. |
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**Question 3.2.2.2-3: Any other issues to be discussed?**

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| **Company** | **Issues** | **Remark** |
| Qualcomm | - how the session is managed at the endpoints;  - how the session is managed among multiple UEs (target UE(s), anchor UE(s), and server UE); and  - the relation to groupcast cases (managed groupcast and unmanaged groupcast). | It seems Phase 1 covers only the first item of the email discussion scope:  **-** whether a session identifier is explicitly needed in SLPP signalling; |
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# Discussion-Phase 2

# Conclusion

The discussion above can be summarized in the form of the following proposals:

[TBF]

# Reference

[1] R2-2306671 [AT122][401][POS] Sidelink positioning summary proposals (Xiaomi) Xiaomi

[2] R2-2304302 Report of [AT121bis-e][429][POS] Session-based SLPP (Samsung) Samsung

[3] S2-2307552 (CR) 23.273 CR0322R10 (Rel-18, 'B'): Ranging and Sidelink Positioning MO-LR procedure.

[4] S2-2307514 (CR) 23.273 CR0321R11 (Rel-18, 'B'): Support of MT-LR for Ranging and Sidelink Positioning.

[5] S2-2307553 (LS OUT) [DRAFT] LS on assistance information provided to UE. (Source: Xiaomi EV Technology).

# SLPP related agreements (for information only)

RAN2#119

Agreement:

Proposal 3 (modified): In order to enable sidelink positioning, SLPP/RSPP shall support at least the following functionalities:

1. SL Positioning Capability Transfer

2. SL Positioning Assistance Data exchange

3. SL Location Information Transfer

4. Error handling

5. Abort

This agreement does not imply any specific signalling structure.

Agreement:

Proposal 4 (modified): Align with SA2/RAN1 on the terms for sidelink positioning, and introduce the following terms of UE role as the baseline for further discussion:

- Target UE: UE to be positioned

- Anchor UE: UE supporting positioning of target UE, e.g., by transmitting and/or receiving reference signals for positioning, providing positioning-related information, etc., over the SL interface. FFS: clarification of the knowledge of the anchor UE.

Additional roles can be considered.

RAN2#121

Agreement:

Sidelink positioning supports a session-based concept in SLPP, in which signalling messages within a session can be associated with one another by the involved UEs. The relationship to upper-layer designs from SA2 can be discussed during normative work.

FFS if there is also sessionless operation and what aspects of session-based operation would not be included.

Agreement:

At least in the case that positioning methods are supported that do not require a mutual exchange of SLPP messages associated with one another among UEs, SLPP sessionless operation can be supported. FFS if sessionless operation can be operated with security.

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.

Agreement:

RAN2 confirm that for cases without LMF involvement, besides method determination, assistant data distribution and anchor UE selection (agreed in RAN2), the SL positioning server UE may perform SL-PRS configuration coordination and location calculation.

Agreement:

With respect to the overall signaling procedure for PC5-only positioning (including at least IC and OOC; FFS if there are differences for PC), it is proposed to agree that the sidelink positioning procedure comprises the following series of steps as a baseline, between the LMF/positioning server UE/NG-RAN/candidate Anchor UE(s) and Target UE(s):

1. Triggering event
2. Sidelink positioning capability exchange

3. Sidelink positioning assistance data transfer

4. SL Positioning Request Location Information

5. Measurement of SL-PRS

6. Location calculation

7. SL Positioning Provide Location Information

Some steps may have dependencies on SA2 and can be revisited in this light. The order is subject to further discussion. FFS if discovery and selection of anchor UEs and/or server UE are part of the positioning layer in RAN2 scope.

LS to SA2 to ask for confirmation and guidance on the SA2 aspects.

RAN2#121bis

WA: RAN2 understand that group positioning is to acquire location estimates of multiple target UEs (absolute positioning) or multiple UE pairs (Ranging/relative positioning) per LCS request, in line with the guidance already received from SA2.

WA: At least part of the group management for group positioning is performed at upper/application layer.

Agreements:

R2 agree that for session-based SLPP, a SLPP session is used among UEs in PC5-only case in order to obtain location related measurements/location estimates, to transfer assistance data, or to exchange of capabilities.

RAN2 agree that for session-based SLPP, a single SLPP session is created to support a single location request at least in case of a single target UE; FFS how sessions work if there are multiple target UEs in a single location request.

TP in R2-2304005 is postponed.

RAN2 agree that, for session-based SLPP, SLPP transactions are indicated at the SLPP protocol level with a transaction ID in order to associate messages with one another (e.g., request and response)”

RAN2 agree that for session-based SLPP, messages within a transaction are linked by a common transaction identifier.

RAN2#122

Agreements:

SLPP over PC5-U/Uu will support reliable transport for at least unicast. FFS groupcast.

Inform SA2 about our agreements on sidelink positioning, with “take into account” action.

SLPP carried over NAS is used between UE and LMF. FFS on how to manage the session/transaction.

Agreements:

SLPP can support multiple target UEs in the same session when LCS requests.

RAN2 will not specify group management for multiple target UEs. RAN2 assumption is that a group ID will be provided from upper layers.

FFS how session IDs are managed between multiple UEs.