3GPP TSG-RAN WG2 Meeting #122***R2-2306540***

Incheon, KR, May 22 – 26, 2023

**Agenda item:** 7.2.4

**Source:** Qualcomm Incorporated

**Title:** Summary of AI 7.2.4: LPHAP

**Document for:**  Discussion

# 0. Introduction

This document summarizes the contributions submitted for AI 7.2.4 – LPHAP:

[1] R2-2304772, "Discussion on LPHAP", CATT.

[2] R2-2304799, "Discussion on LPHAP", Huawei, HiSilicon.

[3] R2-2304887, "PRS and DRX configuration alignment", Nokia, Nokia Shanghai Bell.

[4] R2-2304950, "Enhancements for supporting LPHAP", Fraunhofer IIS, Fraunhofer HHI.

[5] R2-2305069, "Alignment between DRX and PRS", Apple.

[6] R2-2305333, "Discussion on solution of LPHAP", vivo.

[7] R2-2305342, "Discussion on LPHAP", OPPO.

[8] R2-2305442, "Further considerations on LPHAP", Intel Corporation.

[9] R2-2305510, "Considerations on Low Power High Accuracy Positioning", Sony.

[10] R2-2305564, "Discussion on LPHAP", Spreadtrum Communications.

[11] R2-2305637, "Considerations on LPHAP", CMCC.

[12] R2-2305644, "Discussion on LPHAP", InterDigital, Inc.

[13] R2-2305669, "Discussion on LPHA positioning", Xiaomi.

[14] R2-2305710, "Discussion on low power high accuracy positioning", Lenovo.

[15] R2-2305822, "Enhancements for LPHAP", Qualcomm Incorporated.

[16] R2-2306021, "Discussion on Low Power High Accuracy Positioning", Ericsson.

[17] R2-2306075, "Discussion on LPHAP", ZTE Corporation.

[18] R2-2306447, "Discussion on SRS configuration in RRC\_INACTIVE", Samsung.

The objective for "Low-Power, High-Accuracy Positioning (LPHAP)" includes fourmain topics for RAN2:

- Extending eDRX cycle beyond 10.24s in RRC\_INACTIVE state.

- SRS configuration enhancements, incl.

- SRS for positioning configurations in multiple cells;

- Pre-configuration of one or multiple SRS for positioning configurations;

- SRS for positioning activation/request procedure(s).

- DL PRS measurements for a UE in RRC\_IDLE and reporting of the measurements in RRC\_CONNECTED.

- Alignment between eDRX and PRS configurations.

# 1. Extending eDRX cycle beyond 10.24s in RRC\_INACTIVE

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| CATT [1] | Proposal 1: POS WI follows the extended eDRX cycle beyond 10.24s in RRC\_INACTIVE state reached by eRedCap WI. |
| Intel [8] | Proposal 1: Send LS to RAN1, ask them to provide positioning specific value for eDRX cycle beyond 10.24s in RRC\_INACTIVE. |
| Xiaomi [13] | Proposal 7: UE sends request on eDRX cycle beyond 10.24s to LMF and LMF requests gNB to configure the eDRX cycle beyond 10.24s. |
| ZTE [17] | Proposal 14: Support to extend the PRS periodicity larger than 10240ms to suit the eDRX cycle value for eDRX paging cycle in RRC\_INACTIVE and/or RRC\_IDLE.Proposal 15: Support to wait for RedCap’s decision on RAN initiated PTW in RRC\_INACTIVE when designing the PRS/eDRX alignment. |

At RAN2#121bis-e, the following agreement was made:

Agreement:

Wait for RedCap progress on extending eDRX cycle (from RAN2 perspective).

It was already agreed in eRedCap WI that the long eDRX cycle values are the same as idle eDRX (hf2, hf4, hf8, hf16, hf32, hf64, hf128, hf256, hf512, hf1024).

Since the conclusion during the Study Item phase that "extending eDRX cycle beyond 10.24 seconds can be beneficial for meeting the battery life requirement for LPHAP" was made by RAN1 but no specific values for eDRX cycle lengths beyond 10.24 seconds were recommended, it seems reasonable to confirm with RAN1 whether the eRedCap agreed values are also suitable for positioning.

**Proposal 1:** Send a LS to RAN1 to ask/confirm whether the eRedCap agreed eDRX cycle values are also suitable/sufficient for positioning.

# 2. SRS configuration enhancements

## 2.1 SRS for positioning configurations in multiple cells

### 2.1.1 Area Validity – General

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| ZTE [17] | Proposal 1: For the UE within the SRS validity area, support UE keeps on transmitting SRS without notifying the camping gNB. LMF schedules all gNBs/TRPs in the validity area to monitor the SRS. |
| Samsung [18] | Proposal 1: RAN2 confirm that for SRS transmission within validity area, the UE can keep transmitting SRS without additional signalling to update spatial relation information/pathloss RS upon cell reselection. |

At RAN2#121 the following agreement was made:

Agreements:

When configured with SRS configuration along with SRS validity area, if the UE reselects to another cell within the SRS validity area during SRS transmission, the UE continues the SRS transmission, subject to validation for SRS transmission.

Wait for RAN1 progress for the validation of SRS transmission with issues such as interference, timing advance and spatial relation information, etc.

According to Moderator's understanding, the purpose of the "validity area" is to support mobility. I.e., if cell reselection happens during SRS transmission, the UE can continue the SRS transmission (in Rel-17, upon any cell reselection, the UE stops transmitting SRS and positioning would need to be restarted by an LMF). The new camping gNB may not need to be notified but this may also depend on potential updates on the spatial relation/pathloss reference, etc. which is under RAN1 discussion (see also RAN1 agreements in section 2.1.3 below).

Therefore, no additional Proposal is formulated at this point – i.e., wait for RAN1 progress.

### 2.1.2 Validity Timer and/or explicit release by the network

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| CATT [1] | Observation 1: Since SRS resources are not persistent from network perspective, the mechanism of releasing SRS configuration is required. Network has no idea on which cell the UE is camping on, explicit release SRS by network is unclear and complex.Proposal 2: A validity timer is configured together with the SRS configuration to limit when the resource is reserved for the UE for positioning. |
| Fraunhofer [4] | Observation 1: The TA expiration timer ensures that the UE has not moved significantly from the last time it was in connected mode, whereas the validity timer ensures that no UE continues to use old configuration provided by the network beyond a certain time. Proposal 1: The validity timer for a configuration shall be supported independent to that of TA expiration timer. Proposal 2: A UE shall stop transmitting if either the validity timer expires or the UE is outside the configured validity area. |
| vivo [6] | Proposal 6: UE will release the SRS configuration with validity area in the following scenarios:- Scenario 1: When the area-specific TA timer expires.- Scenario 2: When receiving the explicit release from the network. |
| oppo [7] | Observation 4: When the inactivePosSRS-TimeAlignmentTimer expires, the RRC will release the Positioning SRS for RRC\_INACTIVE configurations. UE should always use the RACH procedure to update the TA to still transmit the SRS.Observation 5: If the network would like to prevent the UE from keep using the pre-configured SRS, the network could simply not include the SRS configuration in the RRCRelease msg with --need R setting on the SRS configuration.Proposal 5: RAN2 to agree to neither adopt the SRS validity timer nor introduce the explicit release by the network. |
| Intel [8] | Proposal 5: Do not introduce validity timer for SRS validity area configuration. |
| Spreadtrum [10] | Proposal 4: For validity timer, RAN2 to agree using area-specific TA timer for SRS positioning validity area. |
| CMCC [11] | Proposal 3: The validity timer of the configuration could be introduced for LPHAP. |
| Ericsson [15] | Observation 2 If validity timer is introduced to release the resources, then it is not essential as NW can page the UE and release using Msg4 (RRC Release)Proposal 3 RAN2 to ask RAN1 the need of SRS validity timer |
| ZTE [17] | Proposal 10: Support UE to release the Rel-18 SRS configuration when the Rel-18 TA timer is expired. |

In RAN2#121-bis, the following agreement was made:

Agreement:

The SRS validity area configuration contains a list of cells in which it is valid. FFS validity timer or if we would depend only on explicit release by the network.

Support for a "validity timer" is expressed by 3 companies (CATT, Fraunhofer, CMCC). I company thinks "validity timer" should not be introduced (Intel).

Support for an "explicit release by the network" is expressed by 2 companies (vivo, Ericsson).

3 companies think that neither "validity timer" nor "explicit release by the network" is needed (e.g., TA timer is sufficient) (oppo, Spreadtrum, ZTE).

It seems clear that an "area-specific TA timer" will be introduced (see RAN1 agreements in section 2.1.3 below). However, it is Moderator's understanding that "validity timer" and "TA timer" serve a different purpose. The TA timer determines whether the UE can continue transmitting SRS (during mobility), whereas a "validity timer" defines how long a pre-configured SRS will be valid. Clearly, it can not be valid indefinitely. An "explicit release by the network" may not always be reliable.

Given that there is no clear consensus visible, it is proposed to continue the evaluation.

**Proposal 2:** RAN2 to continue discussion/evaluation whether a "validity timer" for the SRS configuration should be introduced.

One company (Ericsson) suggests asking RAN1. However, this seems clearly in RAN2's scope (e.g., validity timer for pre-configured DL-PRS was also discussed in RAN2 only).

### 2.1.3 TA validation / maintenance

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| Huawei [2] | Proposal1: On the maintenance of the area-specific TA timer for a validity area: The area-specific TA timer starts/restarts when TA command is received When the are-specific TA timer expires, the TA is considered invalid and UE should stop performing SRS transmissionProposal2: The area-specific TA timer is stopped if the UE moves out of the positioning validity area when the cell reselection happens.Proposal3: When the area-specific TAT expires, the UE does not release the SRS configuration associated with a validity area. |
| Fraunhofer [4] | Observation 3: With Rel. 17, the UE can continue transmitting as long as the last TA is valid and TA is considered valid if the RSRP measured has not deviated by a threshold.Proposal 4: A UE shall be provided multiple TA values applicable within a validity area. The applicable TA shall be selected by the UE based on DL-measurement (which may be part of cell-reselection). |
| Intel [8] | Proposal 4: Issues related to TA, interference issues, pathloss, spatial relation, and common parameters across multiple cells should be discussed in RAN1 first. |
| Sony [9] | Observation 4: Reobtaining the TA value may require the LPHAP UE to perform RACH procedure, in which it may cost a non-negligible power consumption and signaling.Proposal 9: Support the UE to adjust the TA value based on the downlink timing measurement. |
| CMCC [11] | Observation: The TA related issue should be discussed to ensure the validity of SRS configuration in RRC\_INACTIVE positioning and area-specific SRS configuration.Proposal 4: For Rel-18 LPHAP, TAT is introduced to ensure the validity of the pre-configured SRS based on the following options:Option 1: per cell TAT for Rel-17 RRC\_INACTIVE positioning is re-used for LPHAP.Option 2: area-specific TAT for SRS validity area is introduced.Proposal 5: For Rel-18 LPHAP, RSRP-threshold for Rel-17 RRC\_INACTIVE positioning could be re-used. |
| InterDigital [12] | Observation 1: RAN2 should wait for RAN1 to finalize details for configurations of UL timing of transmission of SRSp, spatial relationship for SRSp and pathloss determination of SRSp.Proposal 1: Wait for RAN1 progress on the area-specific TA timer before making any RAN2 progress. |
| Lenovo [14] | Proposal 6: RAN2 is suggested to reuse the legacy TA timer design for the validity area-specific TA timer:- UE starts/restarts the area-specific TA timer when receives the TA configuration.- UE stops the area-specific timer when it reselects to a cell out of the configured SRS validity area. - The UE shall release the SRS configuration when the area-specific TA timer expires. |
| Ericsson [15] | Proposal 4 UE establishes TA validity based upon positioning time of arrival estimation. |
| ZTE [17] | Proposal 8: Support to reuse the Rel-17 TA timer start/restart conditions for Rel-18 TA timer across multiple cells.Proposal 9: Support the new TA timer to reuse the Rel-17 TA timer behaviour on stop action(except for cell-reselection case), i.e., if RRCSetup or RRCResume is received, UE stops the SRS TA timer. |
| Samsung [18] | Proposal 3: UE needs to update TA value for SRS transmission upon cell re-selection within the validity area. RA procedure can be used for TA update with a new serving cell. |

At RAN1#112, the following agreements were made:

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| **Agreement**From RAN1 perspective, it is feasible to configure SRS positioning validity area-specific TA timer (e.g., with larger values) for a UE in RRC\_INACTIVE state. Details can be up to RAN2.* For TA validation, use of area-specific RSRP change threshold is feasible
	+ FFS: which RS is the reference RS for the RSRP change threshold

**Agreement**For the determination of UL timing to transmit SRS for positioning by UEs in RRC\_INACTIVE state within the SRS positioning validity area:* + For the UL timing advance, further study the following options, including the DL reference timing for each option:
	+ Option 1: UE maintains the TA obtained from the last serving cell within the validity area
	+ Option 2: UE autonomously adjusts the TA
		- FFS: how the UE adjusts the TA, e.g. up to UE implementation, or based on the TA from the last serving cell and the DL time difference measurement of SSBs from the last serving cell and the new camping cell.
		- FFS: whether there is RAN1 specification impact
	+ Option 3: UE maintains multiple TA values, e.g. UE obtains TA using RACH

**Agreement**For the spatial relation of an SRS for positioning configuration in multiple cells for UEs in RRC\_INACTIVE state, further study the following options: * + Option 1: Spatial relation information is absent in the configuration
		- FFS: different approaches for down selection at least include the following:
			* 1a: UE transmits SRS for positioning resources using different spatial domain transmission filter
			* 1b: UE transmits SRS for positioning resource(s) using a fixed spatial domain transmission filter
		- FFS criterion on UE determination of the fixed spatial domain transmission filter (e.g., up to UE implementation, based on a selected SSB of the camping cell, based on the configured path-loss RS such as SSB, etc.)
	+ Option 2: Spatial relation information is provided in the configuration
		- FFS details on the configuration and corresponding UE behavior, including whether the information is configured for all or subset of cells
		- FFS signaling to configure the spatial relation information, e.g., via SRS activation message.
	+ Note: UE power consumption needs to be taken into account
	+ FFS validity criteria of spatial relation for the configured RS and UE behavior if it determines that the validity criteria of spatial relation for the configured RS is not met, if any, to avoid frequent RRC connection for SRS (re)configuration.

**Agreement**For the power control of an SRS for positioning configuration in multiple cells for UEs in RRC\_INACTIVE state, further study the following options:* + Option 1: Pathloss RS is absent in the configuration.
		- FFS criterion on UE determination of pathloss RS (e.g., up to UE implementation, UE selects an SSB as the pathloss RS based on DL measurements from multiple SSBs of cells within the validity area, etc.).
	+ Option 2: Pathloss RS is provided in the configuration
		- FFS details on configuration (e.g., pathloss RS is configured as a cell-agnostic DL RS, pathloss RS is configured as a fixed SSB within the validity area, etc.), including whether the information is configured for all or a subset of cells within the validity area
		- FFS signaling to configure the pathloss RS, e.g., via SRS activation message.
	+ Note: UE Power consumption needs to be taken into account
	+ FFS: Whether p0 and alpha can be commonly configured across cells within the validity area.
	+ FFS validity criteria of pathloss RS and UE behavior if it determines that the validity criteria of pathloss RS is not met., if any, to avoid frequent RRC connection for SRS (re)configuration.
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According to the agreements above, RAN1 confirms that area-specific TA timer can be supported. However, there are still important details missing for the support of area-specific TA.

It seems for transmission timing, spatial information and pathloss determination for SRS for positioning, RAN1 needs to make further progress on down-selection of the options identified in RAN1#112.

Most company proposals seem reusing the legacy TA timer design as baseline, with appropriate adaptation to "area validity". However, some companies also note that the RAN1 design is not yet complete and we should wait for RAN1 to progress on the area-specific TA timer.

It seems that RAN1 concluded that "from RAN1 perspective, it is feasible to configure SRS positioning validity area-specific TA timer" but no explicit agreement was made (left to RAN2).

**Proposal 3:** Define an SRS for positioning validity-area specific TA timer (e.g., with larger values) for a UE in RRC\_INACTIVE state. FFS on the details.

**Proposal 4a:** The UE starts/restarts the area-specific TA timer when it receives the TA configuration.
The UE stops the SRS transmission when the area-specific TA timer expires.
The UE stops the area-specific TA timer when it reselects to a cell out of the SRS validity area.

However, one company proposes that the UE should release the SRS configuration when the area-specific TA timer expires (Lenovo) (which may be related to the discussion in section 2.1.2 above); one company proposes that when the area-specific TA timer expires, the UE does not release the SRS configuration associated with a validity area (Huawei).

**Proposal 4b:** RAN2 to discuss/evaluate further whether
- The UE does release the SRS configuration when the area-specific TA timer expires, or
- The UE does not release the SRS configuration when the area-specific TA timer expires.

### 2.1.4 Node determining the validity area / coordination across gNBs

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| Fraunhofer [4] | Observation 2: The configuration of the resource provided to the UE needs to be kept unused in the validity area. Proposal 3: Allow the LMF to align on same slots among cells (e.g. by polling) within the area, retrieve configuration from the serving cell (or determine some of the configuration at LMF) and distribute this configuration to cells within the validity area. |
| vivo [6] | Proposal 1: The SRS positioning validity area is determined by LMF.Proposal 2: LMF may send an indication to the serving cell when requesting the serving cell to configure SRS configuration. After receiving the indication, the serving cell should wait for the validity area before releasing the target UE to the RRC\_INACTIVE state.Proposal 3: The LMF should forward the SRS configuration received from the serving cell to neighbor cells belonging to the expected validity area and request neighbor cells to reserve radio resources for SRS transmission. And LMF can decide the final validity area based on the feedback from the neighbor cells.Proposal 4: The LMF should send the validity area to the serving cell so that the serving cell can forward it to the target UE via RRCRelease with SuspendConfig.Proposal 5: LS to RAN3 to take RAN2’s solution into consideration when RAN2 reaches a consensus on the solution of validity area for SRS configuration. |
| oppo [7] | Proposal 6: RAN2 to agree that the SRS validity area should be configured by the LMFProposal 7: RAN2 to agree that enhancement on the msg flow of the event reporting in RRC\_INACTIVE state for UL positioning in the TS 23.273 should be made to allow the LMF configure the SRS with validity area setting towards the UE. |
| Intel [8] | Proposal 8: SRS validity area is determined by the LMF based on the negotiation with related gNBs.  |
| Xiaomi [13] | Proposal 1: When UE moves out of the cell which configures the SRS with the validity area for the UE, the SRS transmission from the UE will lead to inference to other UE in the same cell, and the inference should be avoid.Proposal 2: If SRS with validity area is configured, all gNBs in the validity area should reserve the SRS in advance.Proposal 3: The SRS positioning validity area is determined by LMF.Proposal 4: UE indicates the SRS status to LMF in event report when the SRS positioning validity area is configured and LMF don’t trigger gNB to configure the SRS if the SRS configuration is still valid.Proposal 5: If UE requests gNB to provide the SRS validity area, gNB may request the SRS validity area from LMF if the SRS validity area is determined by LMF. |
| Lenovo [14] | Proposal 5: Serving gNB determines the explicit cell list to constitute the SRS validity area based on LMF request, and then transmits the determined SRS validity area configuration back to LMF. |
| Ericsson [15] | Proposal 5: Cell resources and Sequence ID co-ordination is done for UL-SRS Tx among cells which are part of the validity area. |
| ZTE [17] | Proposal 11: Support LMF to coordinate with multiple TRPs on the available Rel-18 SRS configuration before the SRS configuration is provided to the LPHAP UE. Send LS to RAN3 to notify them RAN2’s agreement. |
| Samsung [18] | Proposal 2: RAN2 to discuss which entity (e.g., LMF, gNB) can decide the validity area of the SRS configuration. |

The "validity area" comprises multiple cells. Therefore, there needs to be a coordinating entity for the SRS configuration with area validity.

Determining the validity area by an LMF is proposed by 6 companies (Fraunhofer, vivo, oppo, Intel, Xiaomi, ZTE).

Determining the validity area by the (serving) gNB is proposed by 1 company (Lenovo).

It seems sensible that an LMF coordinates the "area validity" since an LMF oversees a large part of the network (e.g., similar to DL-PRS pre-configuration).

**Proposal 5:** The "validity area" for the SRS for positioning configuration in RRC\_INACTIVE state is determined by the LMF, based on negotiation/coordination with related gNBs.

### 2.1.5 SRS Configuration Details

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| Fraunhofer [4] | Observation 7: The SRS configuration for resources where positioning signals can be transmitted in RRC\_IDLE can be split into common and UE-specific for supporting RRC\_INACTIVE positioning.Proposal 7: The SRS configuration shall be divided into common and UE-specific for RRC\_INACTIVE. The common configuration shall be coordinated among multiple cells. This may be time/frequency resources, for example. Proposal 8: The UE-specific part / complementary parameter (sequences or cyclic shift) may be derived by the UE based on UE identifiers or identifier of the last visited cell or using MT-SDT.Proposal 9: The positioning SRS in RRC\_INACTIVE mode shall be triggered to stop if the RSRP on an associated DL-RS (SSB or PRS), – reference resource, falls below a certain threshold or rises above a certain threshold configured by the network.Observation 8: Accuracy relies on a larger bandwidth for positioning reference signal but reducing the size of active BWP leads to lower power consumption.Proposal 10: The UE may signal its capability of the size of BWP for data and BWP for positioning separately.Proposal 11: SL-PRS allocation rules shall be defined to restrict conflict configurations between communication and positioning. In particular, the transmission of PUSCH and PUCCH shall be restricted to a portion of bandwidth part, depending on UE capability. |
| Intel [8] | Proposal 4: Issues related to TA, interference issues, pathloss, spatial relation, and common parameters across multiple cells should be discussed in RAN1 first. |

The above proposals seem in RAN1 scope.

## 2.2 Pre-configuration of one or multiple SRS for positioning configurations

### 2.2.1 Provisioning of pre-configured SRS

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| CATT [1] | Proposal 7: The posSIB can be used to broadcast SRS configuration.Proposal 8: When the SRSs are pre-configured via posSIB, UE can request the SRS allocation via RACH-based procedure, FFS via Msg1 or Msg3. |
| Huawei [2] | Proposal6: Support the provision of SRS configuration with positioning area by system information. |
| oppo [7] | Proposal 8: RAN2 to agree SRS Configuration Request should be only used in the case of UE confirms with the network which SRS configuration broadcast in the PosSIB to be used. |
| Intel [8] | Proposal 7: Do not support SRS configuration provided via posSIB.  |
| Sony [9] | Proposal 2: Multiple UL SRS configuration can be provided to the UE via dedicated RRC (e.g., when the UE is in connected mode) or system information (SI). |
| CMCC [11] | Proposal 2: RAN2 is kindly asked to support the broadcast of SRS configuration. |
| InterDigital [12] | Proposal 4: posSIB is not used to provide SRS configuration. |
| Lenovo [14] | Proposal 1: Support pre-configuration of multiple SRS configurations and validity area by using posSIB. |
| Qualcomm [15] | Proposal 2: RRC Reconfiguration can be used to provide SRS (pre-)configuration with or without validity area for use in RRC\_INACTIVE.Proposal 3: posSI can be used to provide SRS (pre-)configuration with or without validity area for use in RRC\_INACTIVE. |
| ZTE [17] | Proposal 12: Support to configure the Rel-18 SRS in RRC Release with Suspend Config. |
| Samsung [18] | Proposal 6: RAN2 to exclude pre-configuration of SRS via (pos)SIB for LPHAP. |

At RAN2#121-bis-e, the following agreement was made:

Agreements:

RRCRelease can be used to provide SRS configuration with validity area for use in RRC\_INACTIVE.

7 companies propose that the SRS for positioning configuration (with or without area validity) can also be provided via posSI (CATT, Huawei, oppo, Sony, CMCC, Lenovo, Qualcomm).

3 companies propose that the SRS for positioning configuration (with or without area validity) can not be provided via posSI (Intel, InterDigital, Samsung).

Although, SRS for positioning is UE specific, at least parts of the SRS pre-configuration may be common in a cell.

**Proposal 6:** RAN2 to discuss whether the SRS for positioning configuration for use in RRC\_INACTIVE state (with or without area validity) can also be provided via system information. FFS posSIB or normal SIB.

2 companies (Sony, Qualcomm) also propose that the SRS for positioning configuration for use in RRC\_INACTIVE state can also be provided while the UE is in connected state.

**Proposal 7:** The SRS for positioning configuration for use in RRC\_INACTIVE state (with or without area validity) can also be provided while the UE is in connected state.

### 2.2.2 Multiple SRS configurations

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| Fraunhofer [4] | Observation 4: By extending the concept of multiple assistance data to uplink, the UE can continue transmiting SRS beyond the initial validity area. This extends the intial validity area without having to send RRC\_Reconfiguration\_Request.Proposal 5: A UE shall be provided multiple configuration instances, a particular configuration shall be selected based on camped cell and (optionally) measurements. |
| vivo [6] | Observation 1: For pre-configuration of multiple SRS for positioning configurations, UE has to indicate the updated SRS transmission to the network when valid SRS configuration changes due to mobility, which achieves limited or no gain of power consumption.Proposal 10: The discussion on the pre-configuration of multiple SRS for positioning configurations is deprioritized in Rel-18. |
| Intel [8] | Proposal 6: For a single SRS validity area, the network can only provide one SRS configuration. The network may provide multiple SRS configurations for multiple SRS validity areas simultaneously.  |
| Sony [9] | Proposal 1: Support multiple UL SRS configuration supporting several gNBs for positioning of the UE to operate UL and DL+UL positioning in RRC\_INACTIVE state. |
| Spreadtrum [10] | Proposal 2: To determine the SRS configuration with validity area mechanism, a dedicated SRS configuration can associate with a cell.Proposal 3： Send LS to RAN3 regarding SRS validity area mechanism, considering dedicated SRS configuration associating with a cell. |
| InterDigital [12] | Proposal 5: Single SRS configuration is provided for the positioning operation in RRC\_INACTIVE |
| Lenovo [14] | Proposal 3: The SRS configuration information for a specific UE may contain a common set of SRS configuration parameters, which can be applied across multiple cells within the configured SRS validity area, or contain multiple sets of SRS configuration parameters, which are associated with different cells within the configured SRS validity area. |
| Qualcomm [15] | Observation 1: The pre-configuration of positioning SRS can occur during the location preparation phase of the 'Low Power Periodic and Triggered 5GC-MT-LR Procedures' (e.g., together with the pre-configuration of DL-PRS assistance data, if applicable). One or more positioning SRS configurations can be provided to the gNB/UE during the location preparation phase using modified NRPPa Positioning Information Exchange procedures. |
| Ericsson [16] | Observation 1 Using preconfigured option would require UE to make frequent updates as it selects different preconfigured SRS configuration. Hence, these updates will cause the UE battery to drain.Proposal 2 RAN2 to no longer pursue belowa. Pre-configuration of one or multiple SRS for positioning configurationsb. SRS for positioning activation/request procedure(s) |
| ZTE [17] | Proposal 3: Support to pre-configure multiple SRS configurations, each of the SRS configuration is associated with a cell ID.Observation 1: If semi-persistent SRS is (pre-)configured across multiple cells, UE is feasible to receive the DL MAC CE activation command in a cell if SDT is supported in that cell.Proposal 7:For positioning SRS (pre-)configured across multiple cells, support to (pre-)configure both periodic SRS and semi-persistent SRS. |

6 companies propose that the UE can be (pre-)configured with multiple SRS for positioning configurations (e.g., analogous to multiple instances of DL-PRS assistance data) (Fraunhofer, Intel, Sony, Lenovo, Qualcomm, ZTE).

1 company proposes that the SRS (pre-)configuration consist of a single SRS configuration only (InterDigital),

vivo proposes to deprioritize the discussion on multiple SRS configurations.

Ericsson proposes to no longer pursue "pre-configuration of one or multiple SRS for positioning configurations" and "SRS for positioning activation/request procedure(s)". However, these are clearly agreed objectives of the WID:

- Pre-configuration of one or multiple SRS for positioning configurations [RAN2, RAN3].

ZTE proposes that each SRS configuration is associated with a Cell-ID. Fraunhofer and Intel proposes that the SRS configuration is per validity area (where "area validity" is associated with Cell-IDs per previous agreements).

**Proposal 8:** The UE can be pre-configured with one or more SRS for positioning configurations for RRC\_INACTIVE state. If the SRS configuration has an "area validity", the multiple SRS configurations have a different "validity area".

## 2.3 SRS for positioning activation/request procedure(s)

### 2.3.1 "SRS configuration request" vs. "SRS activation request"

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| Ericsson [16] | Proposal 1 The purpose “at the initiation of UL positioning procedure when an event is detected” is added for the agreement “SRS configuration request can be indicated via Msg3/MsgA transmission”. |
| ZTE [17] | Proposal 5: RAN2 to clarify that the SRS configuration request only contains the SRS update request when UE moves out of the validity area.Proposal 4: Support to treat SRS in validity area and pre-configured multiple SRS as a unified feature, i.e., pre-configured multiple SRS does not need the activation request when cell reselection happens.Proposal 13: Support a unified ASN.1 design of SRS within validity area and pre-configured multiple SRSs, and take the example configuration in Annex as baseline. |
| Samsung [18] | Proposal 5: RAN2 to discuss whether the SRS configuration request via RRC message can be also used for the case without validity area.  |

At RAN2#121bis-e, the following agreement was made:

Agreement:

SRS configuration request can be indicated via Msg3/MsgA transmission. FFS if the request is in the RRC message or an accompanying MAC CE.

However, there seems confusion on what "SRS configuration request" means or refers to; i.e., "SRS update request" when UE moves out of the validity area, or "SRS activation request" for a pre-configured SRS (see also next section 2.3.2 and the discussion in the individual contributions).

At RAN2#121, the following agreement was made:

Agreements:

RAN2 assume when the UE reselects out of the positioning validity area during SRS transmission, the UE may send an RRC message to the network for SRS configuration request.

LS to RAN3 to confirm this.

Therefore, the "SRS configuration request" seems needed when --- during SRS transmission --- the UE selects a cell not in the validity area list.

As mentioned in the summary in section 2.1.1, Moderator's understanding is that the purpose of the "validity area" is to support mobility. I.e., if cell reselection happens during SRS transmission, the UE can continue the SRS transmission (in Rel-17, upon any cell reselection, the UE stops transmitting SRS and positioning would need to be restarted by an LMF). The purpose of pre-configuration is to reduce the frequent SRS configuration requests (i.e., each time an Event is triggered (see TS 23.273, sections 6.7.3/4/5)). However, there are commonalities in the signalling.

The proposals above seem to suggest a "unified approach". I.e., an UL message is sent

a. during SRS transmission when the UE reselects out of the positioning validity area (already agreed);

b. to request activation of (pre-)configured SRS when an event is detected (i.e., permission to transmit).

**Proposal 9:** RAN2 to discuss whether the SRS activation request for pre-configured SRS can be indicated via Msg3/MsgA transmission when an event is detected. FFS if the request is in the RRC message or an accompanying MAC CE.

**Proposal 10:** Strive for a unified design for the "SRS configuration request" and "SRS activation request" messages.

### 2.3.2 SRS Request Message

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| CATT [1] | Proposal 3: Define a new resume cause for SRS configuration request.Proposal 4: When the network receives the RRCResumeRequest with resumeCause set as request SRS configuration, the network configure SRS for the UE via RRCRelease with suspend configuration. |
| Huawei [2] | Proposal4: SRS configuration request is indicated by the legacy RRCResumeRequest message with a new cause value. An accompanying MAC CE is not needed.Proposal7: Adopt the following procedure as the baseline for the discussion on SRS configuration with validity area |
| vivo [6] | Proposal 7: RAN2 to further discuss how to send the SRS configuration request,- Option 1: Introducing a new ResumeCause in RRCResumeRequest. (only 5 spare causes are available) - Option 2: Sending a new MAC CE along with RRCResumeRequest. (only 7 reserved LCIDs are available)- Option 3: Sending another RRC message (e.g., UE Assistance Information) along with RRCResumeRequest via SDT.Proposal 9: The pre-configuration of one SRS configuration can be realized with SP-SRS and the activation/deactivation request MAC CE can be sent from the NW to UE via ongoing SDT or along with the SRS configuration when gNB releases the UE to RRC\_INACTIVE. |
| oppo [7] | Proposal 9: RAN2 to agree that an ID representing the SRS configuration characteristic should be included in the SRS configuration Request msg for the network to know which one of SRS pre-configuration is required by the UE. |
| Intel [8] | Proposal 2: For SRS for positioning activation/request procedure(s), if allowed by the network, UE sends MAC CE to trigger SRS configuration/activation request when cell reselection occurs outside of validity area.Proposal 10: For preconfigured multiple SRS configurations, if allowed by the network, UE sends MAC CE to indicate the change of SRS configuration when different SRS configuration is selected due to cell reselection. |
| InterDigital [12] | Proposal 2 : SRS configuration request is sent by an RRC messageProposal 3: SRS configuration request includes either an identifier of a new SRSp configuration to be used in the new area or an identifier of the previously configured SRSp configuration, which is no longer used in the new area. |
| Xiaomi [13] | Proposal 6: UE may send the activation/deactivation request for semi-persistent or aperiodic SRS to gNB. |
| Lenovo [14] | Proposal 2: In the case of multiple SRS configurations associated with multiple SRS positioning validity areas are pre-configured for UEs in RRC\_INACTIVE, UE may request explicit SRS and validity area configuration to apply via RACH procedure.Proposal 4: UE transmits RRCResumeRequest message to gNB to update the SRS configuration and validity area, the serving gNB may provide updated SRS configuration and validity area information by RRCRelease message. |
| Qualcomm [15] | Proposal 4: A UE preconfigured with SRS for positioning can send an RRC message to the network for SRS for positioning activation request via Msg3/MsgA transmission (e.g., along with an RRC Resume Request) and includes an identifier of the SRS for positioning configuration requested to be activated (possibly a list in preferred order).Proposal 9: Define a UE triggered RRC message which allows the UE to request SRS for positioning deactivation from the serving gNB. This 'SRS for positioning deactivation request' message can be sent by the UE to the serving gNB along with an RRC Resume Request using SDT. |
| Samsung [18] | Proposal 4: RAN2 to confirm that RRCResumeRequest message can be used for SRS configuration request with a new resume cause value.Proposal 7: RAN2 to discuss how to activate a specific SRS configuration among multiple pre-configured SRS configurations considering the two options below.- Option 1. The UE requests the gNB to activate a specific SRS configuration.- Option 2. The UE just requests the activation of SRS and the gNB select a specific SRS configuration to activate. |

At RAN2#121bis-e, the following agreement was made:

Agreement:

SRS configuration request can be indicated via Msg3/MsgA transmission. FFS if the request is in the RRC message or an accompanying MAC CE.

For the SRS configuration/activation request, the following is proposed:

- new resume cause (3 companies) : CATT, Huawei, Samsung

- new RRC message (2 companies): InterDigital, Qualcomm

- new MAC CE (1 company): Intel

- via RACH procedure (1 company): Lenovo

However, the selection of one of the four options above may also depend on what information the SRS configuration/activation request message need to contain/provide:

- an ID defining the SRS configuration (oppo, InterDigital, Qualcomm).

To address the FFS part in the above agreement, we should first discuss/agree what information needs to be sent via the SRS configuration request/activation signalling.

**Proposal 11:** For the "SRS configuration request" and/or (depending on Proposal 9/10) "SRS activation request", select one of the following options:

- new resume cause;

- new RRC message;

- new MAC CE;

- via RACH procedure.

**Proposal 12:** Before deciding on the options in Proposal 11, RAN2 should first agree on the information required/contained in the "SRS configuration request" and/or (depending on Proposal 9/10) "SRS activation request".

### 2.3.3 SRS activation by gNB

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| Sony [9] | Proposal 3: Support network to trigger activation of UL SRS transmission via downlink signal when the UE is in RRC\_INACTIVE mode based on previous configuration. |
| Qualcomm [15] | Proposal 5: To activate a pre-configured SRS for positioning in the target device, the gNB sends a RRC message for SRS for positioning Activation. This 'RRC SRS for positioning Activation' message can be sent by the serving gNB along with an RRC Release. The 'RRC SRS for positioning Activation' message includes an identifier of the SRS for positioning configuration together with SRS for positioning configuration parameter which were not pre-configured, or which overwrite pre-configured SRS for positioning parameter.Proposal 6: The target device starts transmitting the (pre-configured) SRS for positioning once the 'RRC SRS for positioning Activation' message has been received. |

A UL request for SRS activation should also be followed by a DL activation message.

**Proposal 13:** To activate a pre-configured SRS for positioning, define a gNB triggered message.

### 2.3.4 Signalling between NG-RAN and LMF

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| Huawei [2] | Proposal5: Reuse the legacy non-UE associated NRPPa message TRP INFORMATION EXCHANGE for coordination of SRS configurations between gNBs and LMF. |
| vivo [6] | Proposal 8: The last serving cell should include the indication received from LMF in the UE context. With it, the new cell should wait for the validity area from LMF before releasing the target UE to the RRC\_INACTIVE state. |
| Intel [8] | Proposal 3: For SRS for positioning activation/request procedure(s), serving gNB forwards updated SRS configuration to the LMF via NRPPa message when receiving the request from the UE, and the LMF forwards the updated SRS configuration to measured gNBs. The details to be discussed in RAN3.Proposal 9: The measured gNB should be aware of which SRS configuration should be used for the positioning measurement.Proposal 11: For preconfigured multiple SRS configurations, serving gNB forwards updated SRS configuration to the LMF via NRPPa message when receiving the change indication from the UE, and the LMF forwards the updated SRS configuration to measured gNBs. The details to be discussed in RAN3. |
| InterDigital [12] | Proposal 6: NRPPa message is used to coordinate the SRS configuration between gNB and LMF. The details are up to RAN3. |
| Qualcomm [15] | Proposal 7: The serving gNB of the target device sends a NRPPa message to the LMF once the SRS for positioning has been activated in the target device. This NRPPa message carries information on the activated SRS for positioning and the current serving cell ID to enable the LMF to request UL measurements from TRPs.Proposal 8: Define a NRPPa message which allows an LMF to request SRS for positioning deactivation from the target device's serving gNB.Proposal 10: Define a gNB triggered 'SRS for positioning deactivation' RRC message. The target device stops transmitting the indicated SRS for positioning when the message has been received. |
| ZTE [17] | Proposal 2: Support RAN2 to wait for RAN3’s final decision on the procedure when UE reselects out of SRS validity area. |

The details of the signalling between NG-RAN and LMF are in RAN3 scope. However, RAN2 should agree on the general design/solution requirements. Form the above proposals, Moderator suggests the following:

**Proposal 14a:** Define a NRPPa message for the coordination of SRS configurations between gNBs and LMF.

**Proposal 14b:** Define a NRPPa message to provide updated SRS configuration to the LMF when receiving the request from the UE.

**Proposal 14c:** Define a NRPPa message to provide the updated SRS configuration to the measured TRPs.

**Proposal 14d:** Define a NRPPa message to enable an LMF to request SRS deactivation.

NOTE: The NRPPa message(s) above may be existing NRPPa message(s) and/or new NRPPa message(s) depending on RAN3.

## 2.4 Other

The Proposals below may be discussed if time permits but may also be addressed via Proposals above (e.g., Proposals 14) and/or are in RAN1 scope.

***The "over listening" issue of gNBs***

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| CATT [1] | Observation 2: When the configured SRS is UE-specific, the steps of event report and SRS configure in legacy procedure can be omitted, and it is possible for the network to identify the identity of the UE and its positioning requirement by detecting SRS.Proposal 5: A dedicate preamble for positioning feature can be used by UE to trigger the network to start detecting and performing measurement on the SRS.Proposal 6a: After sending the dedicate preamble for positioning feature, the UE will transmit the SRS base on SRS configuration.Proposal 6b: After detecting the dedicate preamble for positioning feature, the network will detecting SRS to identify the identity of the UE and perform corresponding measurements. |
| Ericsson [16] | Observation 3 As compared to RRC Connected mode, the RRC Inactive mode would require over provisioning of RPs as it lacks the spatial directivity and power control.Proposal 6 The solution should not require the gNB to monitor multiple SRS configuration simultaneously for a UEProposal 7 Send LS to RAN3/RAN1 requesting to analyse if over provisioning of RPs are required to support this feature. |

***Contention scenarios***

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| Fraunhofer [4] | Observation 5: Contention scenarios similar to PRACH can occur when transmission of SRS in RRC\_INACTIVE/RRC\_IDLE is enabled without coordination.Observation 6: Two UEs may have transmission on same REs within the positioning area, and be separated along code-domain (e.g. sequences or cyclic shifts).Proposal 6: A SRS configuration shall be mapped to a downlink reference signal, the measurement on the DL reference signal indicates to the UE whether some other UE in the network is currently using the uplink SRS configuration or not. |

# 3. DL PRS measurements for a UE in RRC\_IDLE state

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| Huawei [2] | Observation1: The current spec can already support the measurement report in RRC\_CONNECTED after security activation.Proposal11: UE can perform the DL PRS measurements in RRC\_IDLE state and report them in RRC\_CONNECTED state to the LMF with the current SA2 stage2 procedure in Clause 6.3.1 in TS 23.273. Send a LS to SA2 to confirm the understanding. |
| vivo [6] | Proposal 17: UE positioning measurements in RRC\_IDLE state in NB-IoT can be used as a baseline for R18 positioning in RRC\_IDLE.Proposal 18: Take the TP in Annex A as the baseline for stage 2 specification of positioning in RRC\_IDLE. |
| oppo [7] | Proposal 2: RAN2 to agree that the DL-PRS configuration to be applied in the RRC\_Idle state could be sent towards the UE in the LPP msg when the UE is still in the RRC\_Connected state and the LMF indicates to the UE that DL positioning will be used for subsequent location reporting events when the UE in RRC\_IDLE state.Proposal 3: RAN2 to agree that the DL-PRS configuration to be applied in the RRC\_Idle state could be valid in a large area, i.e., list of cells, to keep the continuity of the positioning service in the RRC\_Idle state.Proposal 4: RAN2 to agree to let UE be enabled for the cipheration and integrity protection before transmission of the DL-PRS measurement results. |
| Intel [8] | Proposal 12: RAN2 to send LS to SA2, to inform them that RAN has agreed to support “DL PRS measurements for a UE in RRC\_IDLE state and reporting of the measurements in RRC\_CONNECTED state” and would like to check whether the CN can handle the measurement reports from the UE in RRC\_CONNECTED, while the positioning was performed in RRC\_IDLE for MO-LR, MT-LR and NI-LR. |
| Spreadtrum [10] | Proposal 5: RAN2 to send LS to SA2 to check how CN can handle the the measurement reports from the UE in RRC\_CONNECTED, while the positioning was performed in RRC\_IDLE for MO-LR, MT-LR and NI-LR. |
| InterDigital [12] | Proposal 9: Study when the UE can transition to RRC\_CONNECTED to send the measurement report that contains measurements made during RRC\_IDLE |
| Lenovo [14] | Proposal 9: For DL measurement reporting in RRC\_IDLE state, RAN2 is suggested to consider request RAN1 to evaluate the power saving benefit for Alt 1 and SA2/SA3 to provide feedback on potential AS context/security issues for Alt 2. |
| Qualcomm [15] | Proposal 11: The 'Low Power Periodic and Triggered 5GC-MT-LR Procedures' in RRC\_INACTIVE state defined in clause 6.7 of TS 23.273 are also applicable to DL-PRS measurements in RRC\_IDLE state and reporting of the measurements in RRC\_CONNECTED state, but without using SDT for event/measurement reporting. Instead of using SDT for event/measurement reporting, a UE triggered service request would be used which moves the UE to connected state for event/measurement reporting. It is up to SA2 to decide whether this should be captured in TS 23.273 or not.Proposal 12: Performing DL-PRS measurements (or any other positioning measurements) for a UE in RRC\_IDLE state and reporting of the measurements in RRC\_CONNECTED state can already be supported with existing signalling. If considered useful, a clarification can be added to Stage 2 38.305. |
| Ericsson [16] | Observation 6 In RRC Idle mode UE can obtain AD using posSIB and can perform measurement in RRC idle mode to save UE power.Observation 7 Positioning Measurement reporting in RRC Inactive would be inefficient as it may need subsequent transmission implying longer duration and prolonged battery consumption. RRC Connected mode can be efficient. Further the report should be sent after security mode procedure.Proposal 11 The idle mode measurement is sent in RRC Connected mode after the security mode procedure. |
| ZTE [17] | Proposal 21: Support UE to utilize the positioning assistance data through posSIB or pre-configured assistance data in RRC\_CONNECTED when UE is to perform positioning in RRC\_IDLE. |

From the above Proposals and contributions, it is unclear to the Moderator what requires new agreements/specification. I.e.,

- measurement reporting in connected state is supported since NR Rel-15

- measurements in connected state can be reported after security activation

- DL-PRS configurations can be pre-configured and/or provided via posSI.

However, DL-PRS measurements in idle mode require corresponding measurement applicability in TS 38.215 and measurement requirements (TS 38.133), which are in RAN1 and RAN4 responsibility, respectively.

Some companies suggest sending an LS to SA2 for confirmation (Huawei, Intel, Spreadtrum).

**Proposal 15:** Send an LS to SA2 to inform them that RAN2 has agreed to support "DL PRS measurements for a UE in RRC\_IDLE state and reporting of the measurements in RRC\_CONNECTED state" and ask SA2 whether there are any impacts to the LCS procedures in SA2 specifications, and if so, request SA2 to consider the RAN2 agreement for updating the SA2 specifications.

# 4. Alignment between eDRX and PRS

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| CATT [1] | Observation 3: The potential PF and PO of a cell can be determined by the cell level parameters, e.g. PF\_offset, N and minimum DRX cycle (i.e., rf32), these potential PF and PO is the complete set of the monitoring time of all the UEs in the cell.Proposal 9: Support PRS alignment with fixed DRX. The fixed DRX refer to the potential PF and PO of the cell, which can be determined by the cell level parameters, e.g. PF\_offset, N and minimum DRX cycle.Proposal 10: There are some impacts on RAN3 to support alignment between DRX and PRS. Send RAN2 agreement to RAN3 to trigger the discussion. |
| Huawei [2] | Proposal8: For the PRS alignment with fixed DRX for UE in RRC\_IDLE, the legacy UE-based on-demand PRS procedure can be sent in RRC\_CONNECTED with no stage-3 impacts.Proposal9: For the PRS alignment with fixed DRX for UE in RRC\_INACTIVE, the legacy UE-based on-demand PRS procedure can be sent in RRC\_CONNECTED or RRC\_INACTIVE by SDT with no stage-3 impacts.Proposal10. Deprioritize DRX alignment with fixed PRS for Rel-18. |
| Nokia [3] | Observation 1: The option where (e)DRX configuration is aligned for a given/fixed PRS configuration may negatively impact the (e)DRX performance.Observation 2: UE mobility necessitates changes to (e)DRX configuration if the DRX configuration is aligned for a given/fixed PRS configuration and this may impact the (e)DRX performance of other UEs.Proposal 1: The option (a) where PRS is aligned with fixed (e)DRX should be considered as the solution to align PRS and (e)DRX configuration for power saving of LPHAP UE.Proposal 2: The LMF shall acquire the (e)DRX configuration for support of option (a). Details FFS.Proposal 3: The LMF can indicate to LPHAP UE to selectively measure PRS or transmit SRS so as to align (e)DRX configuration for UE power consumption. |
| Apple [5] | Observation 1: TS 22.104 use-case 6 “tracking of workpiece in assembly area” and usage of DL positioning are likely to require the UE to be in RRC\_CONNECTED, therefore only C-DRX needs to be considered for PRS alignment (according to TS 22.104).Proposal 1: to agree which RRC states (RRC\_CONNECTED, RRC\_INACTIVE, RRC\_IDLE) the solution for DRX and PRS alignment is applicable to.Observation 2: the solution for DRX/PRS alignment may be different for different RRC states.Proposal 2: to agree on the general solution direction: PRS alignment to fixed DRX, DRX alignment to fixed PRS, or both.Proposal 3: if RAN2 is to standardize both solutions (alignment of PRS to fixed DRX and alignment of DRX to fixed PRS), these should be separate features with separate UE capabilities. |
| vivo [6] | Proposal 11: LMF should be informed about the eDRX, DRX and default paging configuration in advance, and then it may take the information into account when setting the periodicity and/or response time of deferred MT-LR. Proposal 12: To align the PRS configuration with fixed eDRX, the following solution can be considered:- LMF should negotiate PRS configuration with selected TRP(s) to ensure there is valid PRS around PO within PTW. (in RAN3 scope) - UE should perform PRS measurement around PO within PTW. (RAN1/RAN4 related)Proposal 13: LS to RAN1/RAN3/RAN4 to trigger the discussion on aligning PRS configuration with fixed eDRX when RAN2 reaches a consensus on the solution.Proposal 14: Considering the following aspects, the discussion on aligning eDRX with fixed PRS can be de-deprioritized in Rel-18.- It is not feasible to align the eDRX of multiple target UEs with fixed PRS considering that different UEs have different PO.- The DRX cycle can be set depending on the data delay tolerance and power-saving requirements. In this sense, the eDRX cannot be adjusted significantly for positioning purposes. |
| oppo [7] | Observation 1: alignment between eDRX and PRS configurations should be done between serving gNB, LMF and anchor gNBs since the DRX configuration comes from the serving gNB and the DL-PRS configuration comes from the LMF not only collecting the configuration from the serving gNB but also from the anchor TRPs.Observation 2: if aligning the DRX with the fix DL-PRS timing pattern is applied, all UEs sharing the same DRX setting with the UE with the DL-PRS configuration will be impacted in terms of the DRX setting.Proposal 1: RAN2 to agree to align the DL-PRS timing pattern with the fixed DRX.Observation 3: no spec impact is foreseen by reusing the UE-initiated on-demand PRS configuration Request msg to align the DL-PRS configuration with the fixed DRX. |
| Intel [8] | Proposal 13: Confirm SA2 conclusion that during the positioning procedure, AMF provides the LPHAP indication to the LMF, and the LMF also sends LPHAP indication to RAN in the NRPPa message (stage 2 and RAN3 impact). Proposal 14: For DRX alignment with fixed PRS configurations, it is up to RAN to align DRX configuration with fixed PRS based on LPHAP indication obtained from the LMF and available PRS configuration in RAN. Proposal 15: For PRS alignment with fixed DRX configurations, it can be archived by on-demand PRS request without stage 3 impact. If the UE wants to change PRS configuration to align with DRX configuration, the UE can send on-Demand PRS request to the LMF with suitable recommended PRS configuration. |
| Sony [9] | Proposal 7: In case of aperiodic/event triggered PRS transmission let the LMF align the PRS transmission to the UE DRX cycle/PO, Proposal 8: In case of periodic PRS transmission let the AMF (or gNB) align the UE DRX/PO to the Periodic PRS transmissions by adding an Offset to the UE-ID for PO calculation, similarto the solution in LTE for MuSIM as specified in 36.304 and 23.502 used for avoiding paging collision. |
| Spreadtrum [10] | Proposal 1: PRS alignment with fixed DRX is preferred by reusing on demand PRS procedure. |
| InterDigital [12] | Proposal 7: Standardise the alignment of PRS configuration with fixed DRX only.Proposal 8: Reuse the legacy UE-initiated on-demand PRS signalling for the alignment of PRS with fixed DRX |
| Xiaomi [13] | Proposal 8: PRS is aligned with eDRX for alignment between eDRX and PRS.Proposal 9: UE requests LMF to align PRS with eDRX by LPP request assistance information and UE may provide the eDRX parameters to LMF.Proposal 10: LMF requests gNB to align PRS with eDRX by NRPPa message and LMF may acquire the eDRX parameters of UE from UE or serving cell and send it to gNB. |
| Lenovo [14] | Proposal 7: In the case of LMF performs the alignment, e-DRX configurations depending on the UE’s RRC state should be shared with the LMF from the gNB or from the UE.Proposal 8: In the case of gNB performs the alignment, gNB should be indicated to perform the alignment between e-DRX and PRS configuration explicitly or implicitly. |
| Qualcomm [15] | Observation 2: The "radio capabilities" (i.e., eDRX in this case) are usually selected based on "service requirements" (i.e., LCS activity) and not the other way around (i.e., adapt the service request (LCS reporting activity or DL-PRS periodicity) to the eDRX).Proposal 1: It should be possible for a network to align the eDRX cycle with the UE positioning reporting activity (e.g., reporting interval) and PRS/SRS periodicity.Proposal 13: For the (e)DRX alignment with configured DL-PRS, support adding the UE configured LCS reporting activity and configured DL-PRS information (e.g., DL-PRS periodicity) to the IE 'Core Network Assistance Information for RRC INACTIVE' (TS 38.413). Inform RAN3 and SA2 on RAN2's decision.Proposal 14: For the DL-PRS alignment with configured (e)DRX, the LPP Request Assistance Data for on-demand DL-PRS is used. The UE may set the dl-prs-ResourceSetPeriodicityReq according to the configured LCS reporting activity and (e)DRX configuration. FFS whether additional parameter are needed (e.g., DL-PRS slot offset). |
| Ericsson [16] | Observation 4 Solution where UEs wake up at the same occasion can help to align PRS and eDRX. Otherwise, it would imply that PRS needs to be transmitted all the time.Proposal 8 Cell specific wake up occasion for LPHA users can be configured so that PRS can be aligned with the LPHA users wake up occasion.Proposal 9 Send an LS to RAN4 for gNB to configure suitable Paging time window to complete the PRS measurement in one PTW.Observation 5 gNB is aware of UE specific DRX/eDRX values which it would have received from AMF in the Core Network Assistance Information.Proposal 10 Send LS to RAN3 to request for NRPPa/OAM signaling support for cell/UE specific DRX/eDRX configurations. |
| ZTE [17] | Observation 2: The final paging location(PF/PO/MO location) that UE adopts in the current cell is determined by many network configuration and pre-defined criteria. In addition, in RRC\_INACTIVE or RRC\_IDLE, UE may adopt different paging location(PF/PO/MO location) for different cells when cell-reselection happens. So it is harder to adjust DRX than adjust PRS.Proposal 16: Support to use UE-initiated on-demand PRS procedure for PRS to align with fixed DRX.Proposal 17: In LPP on-demand PRS request message, support UE to request the PRS time offset associated with each requested PRS periodicity to better align the actual paging location.Proposal 18: In LPP on-demand PRS request message, support UE to request separate PRS periodicities in order to align with the paging cycle inside-PTW and outside-PTW, respectively.Proposal 19: In LPP on-demand PRS request message, support UE to use dl-prs-StartTime-and-Duration to request the PRS reception within the PTW(if existed).Proposal 20: Support LMF to include UE’s requested PRS periodicities or PRS time offsets in the NRPPa PRS CONFIGURATION REQUEST message. |

There are several Proposals and discussions in the related contributions dealing with DRX and PRS alignment (e.g., even C-DRX). However, the objective of the WID is clearly:

- Specify solutions for alignment between eDRX and PRS configurations [RAN2]

One company (Apple) proposes to clarify which RRC states the "alignment solution" is applicable. Given the input contributions, Moderator also thinks a clarification is required.

**Proposal 16:** "eDRX" in the objective
"Specify solutions for alignment between eDRX and PRS configurations [RAN2]"
refers to the idle and inactive eDRX configuration.

There are 3 different views on the solution direction:

(a) eDRX alignment with configured/fixed DL-PRS;

(b) DL-PRS alignment with configured/fixed eDRX (CATT, Huawei, Nokia, vivo, oppo, Sony, Spreadtrum, InterDigital, Xiaomi, ZTE)

(c) both (Intel, Qualcomm).

For the alignment between DL-PRS and configured/fixed eDRX, a common proposal seems to be using the on-demand DL-PRS procedures (Huawei, oppo, Intel, Spreadtrum, InterDigital, Xiaomi, Qualcomm, ZTE).

**Proposal 17:** For the DL-PRS alignment with configured/fixed eDRX, the UE-initiated on-demand DL-PRS procedures are used.

# 5. Other

The Proposals below are not directly WID objectives and/or not in RAN2 scope and may be discussed if time permits.

***Aligning SRS with (e)DRX***

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| vivo [6] | Observation 2: Aligning SRS configuration with fixed eDRX can also be beneficial towards meeting the battery life requirement for LPHAP.Proposal 15: RAN2 to consider aligning SRS configuration with fixed eDRX (especially for the eDRX cycle beyond 10.24s). The solution can be:- LMF acquires the eDRX configuration and takes it into account when setting the periodicity of the requested SRS.- LMF indicates the serving gNB to configure the SRS close to the paging occasion.Proposal 16: LS to RAN1/RAN3 to trigger further discussion on aligning SRS configuration with fixed eDRX when RAN2 reaches a consensus on the requirements and initial solutions. |
| Sony [9] | Proposal 6: Support aligning the DRX on duration and UL SRS transmission for positioning |

***MT SDT***

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| Sony [9] | Observation 1: Network triggered MT-LR procedures for UEs in Idle/Inactive is currently not supported. Observation 2: Network triggered MT-LR procedure using MT-SDT would preferably be discussed in conjunction with the SDT session.Observation 3. Depending on the scenario the UE may have to be configured in Idle/Inactive mode, if not configured while released from Connected mode.Proposal 4: Both alternatives, configuration triggered via MT-SDT or configured via RRC release should be considered.Proposal 5: Introduce new parameter “positioning trigger indication”, in relation to the MT-SDT procedure to initiate/trigger the positioning procedure/measurements. |
| CMCC [11] | Proposal 1: RAN2 is kindly asked to support MT-LR for positioning in RRC\_INACTIVE state. Assuming limited enhancement on the R18 MT-SDT. |
| ZTE [17] | Proposal 6: Support MT-LR for Rel-18 SRS enhancement of LPHAP UE |

***Relaxed PRS measurement***

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| --- | --- |
| ZTE [17] | Observation 3: Regarding use case 6, reducing the PRS reception chance of these low mobility LPHAP UE will not have huge impact on the positioning accuracy.Proposal 22: Support relaxed PRS measurement for LPHAP by reducing the PRS reception chance according to some criteria, e.g., UE not at cell edge criteria or low mobility criteria for relaxed RRM measurement can be reused. |

# 6. Summary

**Extending eDRX cycle beyond 10.24s in RRC\_INACTIVE**

**Proposal 1:** Send a LS to RAN1 to ask/confirm whether the eRedCap agreed eDRX cycle values are also suitable/sufficient for positioning.

**SRS configuration enhancements**

Validity Timer and/or explicit release by the network

**Proposal 2:** RAN2 to continue discussion/evaluation whether a "validity timer" for the SRS configuration should be introduced.

TA validation / maintenance

**Proposal 3:** Define an SRS for positioning validity-area specific TA timer (e.g., with larger values) for a UE in RRC\_INACTIVE state. FFS on the details.

**Proposal 4a:** The UE starts/restarts the area-specific TA timer when it receives the TA configuration.
The UE stops the SRS transmission when the area-specific TA timer expires.
The UE stops the area-specific TA timer when it reselects to a cell out of the SRS validity area.

**Proposal 4b:** RAN2 to discuss/evaluate further whether
- The UE does release the SRS configuration when the area-specific TA timer expires, or
- The UE does not release the SRS configuration when the area-specific TA timer expires.

Node determining the validity area / coordination across gNBs

**Proposal 5:** The "validity area" for the SRS for positioning configuration in RRC\_INACTIVE state is determined by the LMF, based on negotiation/coordination with related gNBs.

Provisioning of pre-configured SRS

**Proposal 6:** RAN2 to discuss whether the SRS for positioning configuration for use in RRC\_INACTIVE state (with or without area validity) can also be provided via system information. FFS posSIB or normal SIB.

**Proposal 7:** The SRS for positioning configuration for use in RRC\_INACTIVE state (with or without area validity) can also be provided while the UE is in connected state.

Multiple SRS configurations

**Proposal 8:** The UE can be pre-configured with one or more SRS for positioning configurations for RRC\_INACTIVE state. If the SRS configuration has an "area validity", the multiple SRS configurations have a different "validity area".

"SRS configuration request" vs. "SRS activation request"

**Proposal 9:** RAN2 to discuss whether the SRS activation request for pre-configured SRS can be indicated via Msg3/MsgA transmission when an event is detected. FFS if the request is in the RRC message or an accompanying MAC CE.

**Proposal 10:** Strive for a unified design for the "SRS configuration request" and "SRS activation request" messages.

SRS Request Message

**Proposal 11:** For the "SRS configuration request" and/or (depending on Proposal 9/10) "SRS activation request", select one of the following options:

- new resume cause;

- new RRC message;

- new MAC CE;

- via RACH procedure.

**Proposal 12:** Before deciding on the options in Proposal 11, RAN2 should first agree on the information required/contained in the "SRS configuration request" and/or (depending on Proposal 9/10) "SRS activation request".

SRS activation by gNB

**Proposal 13:** To activate a pre-configured SRS for positioning, define a gNB triggered message.

Signalling between NG-RAN and LMF

**Proposal 14a:** Define a NRPPa message for the coordination of SRS configurations between gNBs and LMF.

**Proposal 14b:** Define a NRPPa message to provide updated SRS configuration to the LMF when receiving the request from the UE.

**Proposal 14c:** Define a NRPPa message to provide the updated SRS configuration to the measured TRPs.

**Proposal 14d:** Define a NRPPa message to enable an LMF to request SRS deactivation.

NOTE: The NRPPa message(s) above may be existing NRPPa message(s) and/or new NRPPa message(s) depending on RAN3.

**DL PRS measurements for a UE in RRC\_IDLE state**

**Proposal 15:** Send an LS to SA2 to inform them that RAN2 has agreed to support "DL PRS measurements for a UE in RRC\_IDLE state and reporting of the measurements in RRC\_CONNECTED state" and ask SA2 whether there are any impacts to the LCS procedures in SA2 specifications, and if so, request SA2 to consider the RAN2 agreement for updating the SA2 specifications.

**Alignment between eDRX and PRS**

**Proposal 16:** "eDRX" in the objective
"Specify solutions for alignment between eDRX and PRS configurations [RAN2]"
refers to the idle and inactive eDRX configuration.

**Proposal 17:** For the DL-PRS alignment with configured/fixed eDRX, the UE-initiated on-demand DL-PRS procedures are used.