3GPP TSG-RAN WG2 Meeting #115-e***R2-210xxxx***

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**Agenda item:** 8.11.4

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**Title:** Summary of Agenda Item 8.11.4 On-demand PRS

**Document for:**  Discussion and Decision

# 1. Introduction

This document summarizes the following contributions submitted in Agenda Item 8.11.4 on-demand PRS

1. R2-2107094 Discussion on on-demand PRS ZTE discussion
2. R2-2107148 On-demand PRS Fraunhofer IIS, Fraunhofer HHI discussion Rel-17 R2-2105734
3. R2-2107498 Discussion on on-demand PRS Huawei, HiSilicon discussion Rel-17 NR\_pos\_enh-Core
4. R2-2107638 Remaining issues of On-Demand PRS Apple discussion Rel-17 NR\_pos\_enh-Core
5. R2-2107645 Discussion on on-demand PRS vivo discussion Rel-17 NR\_pos\_enh-Core
6. R2-2107672 Support of on-demand PRS request Intel Corporation discussion Rel-17 NR\_pos\_enh
7. R2-2107686 Discussion on procedures for On-demand PRS for DL-based positioning InterDigital, Inc. discussion Rel-17 NR\_pos\_enh
8. R2-2107687 Discussion on procedure for On-demand PRS for DL+UL based positioning InterDigital, Inc. discussion Rel-17 NR\_pos\_enh
9. R2-2107828 Discussion on on-demand DL-PRS OPPO discussion Rel-17 NR\_pos\_enh-Core
10. R2-2108069 Considerations on positioning PRS On-demand Sony discussion Rel-17 NR\_pos\_enh-Core R2-2105704
11. R2-2108129 Support of On-Demand DL-PRS Lenovo, Motorola Mobility discussion Rel-17
12. R2-2108174 Positioning enhancement to on-demand DL PRS Xiaomi discussion
13. R2-2108384 On-Demand DL-PRS Qualcomm Incorporated discussion
14. R2-2108395 On demand PRS Ericsson discussion R2-2105969
15. R2-2108705 NR E-CID for UE feedback for on-demand PRS Nokia, Nokia Shanghai Bell discussion Rel-17 NR\_pos\_enh-Core
16. R2-2108774 Multiple QoS class using on-demand PRS Samsung Electronics discussion NR\_pos\_enh-Core

The proposals discussed in the various contributions are grouped as following aspects:

1. General Signalling Aspects

- Signalling Between UE and LMF

- Signalling Between NG-RAN and LMF

1. Information transferred between UE, NG-RAN and LMF

- On-demand DL-PRS configuration information

- Assistance information from UE to LMF

- Assistance information from NG-RAN to LMF

1. On-demand PRS trigger condition/criteria
2. Stage 2 procedure for on-demand PRS
3. Others

- Network control of on-demand PRS

- Supported scenarios for on-demand PRS

- Inactive on-demand PRS

- Collision of PRS

- Beam management

- Semi-persistent/A-periodic PRS

# 2. General Signalling Aspects

## 2.1 Signalling Between UE and LMF

The company proposals related to this topic are summarized in the Table below.

|  |  |
| --- | --- |
| ZTE [1] | Proposal 1: UE initiated on-demand PRS request can include explicit PRS parameters defined in an on-demand DL-PRS configuration. |
| Huawei [3]  | Proposal 2: For UE-initiated on-demand PRS request, the UE can only request PRS configuration within the scope of assistance data for on-demand PRS request provided by the network.Proposal 3: For UE-initiated on-demand PRS request, in addition to complete set of PRS configurations, the UE can also request individual PRS configuration parameters which are within the scope of the assistance data for on-demand PRS request provided by the network. Proposal 4: UE can request the parameters with different granularities of frequency layer, TRP, PRS resource set and PRS resource. Proposal 5: LMF should provide an error indication with error causes in response to the on-demand PRS request if the PRS request is not fully accepted. |
| Apple [4] | Proposal 1: a set of possible on-demand DL-PRS configurations is included in a new posSIB.Proposal 2: posSIB can be used to indicate to a UE whether the network supports on-demand PRS. |
| vivo [5] | Proposal 1: The LMF should decide the possible available on-demand DL-PRS at the very beginning, e.g., based on the available DL-PRS resources and capabilities of TRP(s).Proposal 5: The configuration of possible available on-demand DL-PRS is valid within a specific area and period.Proposal 7: The configuration of possible available on-demand DL-PRS can including a list of available PRS configurations associated with different area.Proposal 2: The activation of on-demand PRS from LMF to UE may contain an identifier associate with a PRS configuration or the ACK for the on-demand PRS request.Proposal 3: The activation of on-demand PRS can be sent to UE via LPP ProvideAssistanceData message.Proposal 6: For the UE initiated on-demand PRS, some explicit parameter can be included in the on-demand PRS configuration request.Proposal 8: If the requested on-demand PRS is not available, the LMF shall return an error indication and a timer to prevent the UE requesting for on-demand PRS again in a specific duration. |
| Intel [6] | Proposal 1: The on-demand DL-PRS request is provided within the LPP Request Assistance Data message.Proposal 2: A new LPP assistance data IE shall be defined to indicate the requested DL-PRS configuration parameters/associated identifier.Proposal 5: The UE shall only select the DL-PRS requested parameters within the indicated configuration sets and indicate the selected PRS configuration set ID to the LMF.Proposal 6: No additional signaling needs to be defined to provide assistance information to LMF to assist in the determination of on-demand DL-PRS configuration(s). |
| InterDigital [7] | Proposal 5: Support semi-static on-demand PRS request from UE to LMFProposal 7: Support sending of confirmation/rejection message from LMF to UE for indicating whether or not the PRS configuration/parameter indicated in on-demand PRS is fulfilledProposal 15: UE can send on-demand PRS request before completion of sending of configured amount of measurement reports |
| OPPO [9] | Proposal 3 RAN2 study the maximum number of PRS configurations that can be pre-configured to UE. |
| Lenovo [11] | Proposal 4: UE can at least request an updated DL-PRS configuration per positioning method. |
| Xiaomi [12] | Proposal 1: The on-demand DL-PRS request can include explicit parameter defining a DL-PRS configuration or an identifier pointing to a pre-defined on-demand DL-PRS configuration.Proposal 2: A unified IE can be considered for both predefined on-demand DL-PRS configurations and positioning assistance data pre-configuration.Proposal 4: The LMF may provide the new PRS configuration which is not requested by UE or provide an indication to indicate UE to stop sending on-demand PRS request when the requested PRS configuration can’t be provided to UE. |

Summary from rapporteur:

* **On-demand PRS request aspect:**

Background:

As for the on-demand PRS request, RAN2 already agreed that the UE initiated on-demand PRS request is enabled by enhancing the LPP Request Assistance Data message, which can include one of the predefined available PRS configurations signalled by network, i.e., the identifier of the predefined available PRS configurations.

Rapporteur's comments:

According to the above summary in the Table, the issues on whether explicit PRS parameters can be included within the on-demand PRS request are addressed.

* The explicit PRS parameters within the scope of available on-demand DL-PRS configurations provided by the network should be included. [ZTE][Xiaomi][Huawei][vivo][intel]

Since the email discussion [Post114-e][603][POS] Procedures and signalling for on-demand PRS (Ericsson) also address this issue, thus we think the issue can be handled by the email discussion.

**Open issue: The detailed message design for the on-demand PRS request.**

* A new LPP assistance data IE shall be defined to indicate the requested DL-PRS configuration parameters/associated identifier [intel]
* UE can at least request an updated DL-PRS configuration per positioning method. [Lenovo]
* Support semi-static on-demand PRS request from UE to LMF [InterDigital]

The detailed message design for the on-demand PRS request seems stage 3 related issues, proposed by different companies with different opinions.

Thus, we propose:

**Proposal 1: RAN2 to further discuss the detailed message design for the on-demand PRS request, e.g. per positioning method? Is a new LPP assistance data IE indicating the requested DL-PRS configurations required?**

* **On-demand PRS response aspect:**

Rapporteur's comments:

From the above summary in the Table, the following open issues and the corresponding company proposals are addressed, which need further discussions by RAN2.

**Open issue1: Which message carries the on-demand PRS response from LMF to UE?**

* The activation of on-demand PRS can be sent to UE via LPP ProvideAssistanceData message. [vivo]

According to rapporteur, since the on-demand PRS request is enabled by enhancing the LPP Request Assistance Data message, naturally the on-demand PRS response from LMF to UE can be enabled via the LPP Provide Assistance Data message.

Thus, we propose:

**Proposal 2: RAN2 to agree the on-demand PRS response can be enabled by enhancing the current LPP Provide Assistance Data message.**

**Open issue2: What can be included within the on-demand PRS response?**

* PRS configuration which is not requested by UE; [Xiaomi]
* Indication to UE to stop sending on-demand PRS[Xiaomi]
* Confirm or reject message [InterDigital]
* an identifier associate with a PRS configuration or the ACK for the on-demand PRS request[vivo]
* error indication with error causes in response to the on-demand PRS request if the PRS request is not fully accepted [Huawei] [vivo]

As for what can be included within the on-demand PRS response, different companies have different opinions and it is hard for RAN2 to make decision for now. However, at least the issue can be further discussed by RAN2 with considerations on the following two cases, i.e., the on-demand PRS request can be accepted by LMF, the demand PRS request cannot be (fully) accepted by LMF.

Thus, we propose:

**Proposal 3: RAN2 to further discuss the detailed message design within the on-demand PRS response under two use cases:**

**Case 1: the on-demand PRS request is fully accepted by LMF;**

* **FFS ACK or an identifier associate with a PRS configuration;**

**Case 2: the on-demand PRS request isn’t (fully) accepted by LMF;**

* **FFS indication for UE to stop sending on-demand PRS;**
* **FFS Error indication with error causes if the PRS request is not fully accepted;**
* **FFS PRS configuration which is not requested by UE if the PRS request is not fully accepted.**
* **Pre-defined available DL-PRS configuration aspect:**

Background:

As for the pre-defined available DL-PRS configuration, RAN2 already agreed that a new LPP assistance data IE is introduced to contain a set of possible on-demand DL-PRS configurations, where each on-demand DL-PRS configuration has an associated identifier. And network can provide the available on-demand DL-PRS configurations to UE by including the new LPP assistance data IE within the LPP Provide Assistance Data message or a new posSIB.

Rapporteur's comments:

From the above summary in the Table, the following open issues and the corresponding company proposals are addressed, which need further discussions by RAN2.

Here is a proposal on predefined on-demand DL-PRS configurations and pre-configuration for latency reduction from one company.

* A unified IE can be considered for both predefined on-demand DL-PRS configurations and positioning assistance data pre-configuration. [Xiaomi]

The pre-configured positioning assistance data for latency reduction can be used directly by UE without further interaction with the LMF. However, as for the available on-demand DL-PRS configurations, only after UE request to the LMF and get confirm from the LMF about the requested on-demand PRS configuration, UE can use the requested configurations for positioning. So we propose not to combine these different features together.

**Open issues: Configurations of the pre-configured available DL-PRS**

* RAN2 study the maximum number of PRS configurations that can be pre-configured to UE. [OPPO]
* The LMF should decide the possible available on-demand DL-PRS at the very beginning, e.g., based on the available DL-PRS resources and capabilities of TRP(s). [vivo]
* The configuration of possible available on-demand DL-PRS is valid within a specific area and period. [vivo]
* The configuration of possible available on-demand DL-PRS can include a list of available PRS configurations associated with different area. [vivo]

The open issue 2 refers to the configuration details of the pre-configured available DL-PRS, different companies have different opinions and it is hard for RAN2 to make decision for now.

Thus, we propose:

**Proposal 4: RAN2 to further discuss the detailed configurations of the pre-configured available DL-PRS, i.e., FFS the maximum number of PRS configurations, FFS the list of available PRS configurations associated with different area.**

## 2.2 Signalling Between NG-RAN and LMF

The company proposals related to this topic are summarized in the Table below.

|  |  |
| --- | --- |
| Huawei [3]  | Proposal 6: Use the existing NRPPa message TRP Information Exchange for the LMF to request the assistance information and the gNB with on-demand PRS capability to transfer the assistance information. Proposal 7: The assistance information for LMF-initiated on-demand PRS for possible/allowed PRS configuration should share the same structure of the PRS configuration in the TRP INFORMATION RESPONSE. Proposal 8: For a certain PRS configuration in the TRP INFORMATION REPONSE, the following additional information should be included under the granularity of at least PRS resource, PRS resource set, frequency layer and TRP:• Whether PRSs within the configuration is being transmitted;• Whether this configuration can be requested. |
| Xiaomi [12] | Proposal 5: The UE associated NRPPa transport message should be introduced for LMF initiated on-demand PRS request procedure. |
| Lenovo [11] | Proposal 5: Support aperiodic on-demand DL-PRS configurations to increase flexibility and support one shot location estimation.Proposal 6: The gNB may share prioritized a DL-PRS configuration set with the LMF based on its current resource allocation status and forward this to the UE for selection. |

Summary from rapporteur:

Background:

In RAN2#114e, RAN2 agreed that the stage 2 procedures for on-demand DL-PRS should support at least the following functionality and send LS to RAN3 for the details signalling design.

* Providing the requested on-demand DL-PRS configuration information from an LMF to the gNB (e.g., explicit parameter or identifier of a predefined DL-PRS configuration), and confirmation of the request by the gNB
* Provision of (possible/allowed) on-demand DL-PRS configurations that the gNB can support from a gNB to an LMF
* TRP capability transfer (e.g., whether the RAN node supports the reconfiguration of DL-PRS, etc.)

Rapporteur's comments:

From the above summary in the Table, the following issues are addressed:

Issue 1: On-demand PRS request signalling;

Issue 2: assistance information transfer between NG-RAN and LMF, i.e., provision of (possible/allowed) on-demand DL-PRS configurations signaling, TRP capability transfer.

Since the functionality addressed by the above issues is already covered within the agreements of the RAN2 #114e, and the signaling design between NG-RAN and LMF are within the scope of RAN3. Thus, we propose RAN3 is responsible for the detailed signaling between NG-RAN and LMF.

Thus, we propose:

**Proposal 5: RAN2 to wait for RAN3’s conclusion on the on-demand PRS related detailed message design between NG-RAN and LMF.**

# 3. Information transfers between UE, NG-RAN and LMF

## 3.1 on-demand PRS configuration information

The company proposals related to this topic are summarized in the Table below.

|  |  |
| --- | --- |
| Huawei [3]  | Proposal 9: At least the ON/OFF indicator of the DL PRS in the granularity of PRS resource, PRS resource set, frequency layer and TRP should be supported for LMF-initiated on-demand PRS. |
| InterDigital [7] | Proposal 9: Parameters in DL-PRS that can be dynamically changed by sending a request for on-demand PRS includes at least: PRS resource/resource-set, periodicity, number of repetitions, muting patterns, Tx power indication, direction of beams, turn on/off beams, number of TRPs/gNBs, TRP/gNB IDsProposal 10: The number of samples in measurement is included as one of the on-demand PRS parametersProposal 14: UE can identify and indicate the LOS/NLOS paths to LMF in the on-demand PRS  |
| OPPO [9] | Proposal 4 It is up to RAN1 to decide whether and which PRS parameter can be carried in the request for UE-initiated on-demand PRS. |

Summary from rapporteur:

According to the above summary in the Table, the specific on-demand DL-PRS parameter discussed in the various contributions comprises:

* PRS on/off indicator [Huawei]
* PRS resource/resource-set [InterDigital]
* Periodicity [InterDigital]
* Number of repetitions [InterDigital]
* Muting patterns [InterDigital]
* Tx power indication [InterDigital]
* Directions of beams[InterDigital]
* Turn on/off beams [InterDigital]
* Numbers of TRPs/gNBs [InterDigital]
* TRP/gNB ID [InterDigital]
* Number of samples in measurement [InterDigital]
* LOS/NLOS [InterDigital]
* Up to RAN1 [OPPO]

It can be seen that the parameters that different companies are rather diverse and it may be hard for RAN2 to make any conclusion for now. There is also one company think that the parameters that on-demand PRS request can include should be decided by RAN1.

Besides, in RAN2#114e, RAN2 sent an LS to RAN1 indicating the parameters from P5 of R2-2106467 as candidates for the on-demand DL-PRS request, and asking them to take a decision on the needed parameters. Thus, we propose RAN2 to decide what parameters can be included within the on-demand PRS request after receiving RAN1’s response LS.

Thus, we propose:

**Proposal 6: RAN2 to further discuss on how to support on-demand PRS parameters after receiving the RAN1’s response LS on the on-demand PRS parameters.**

## 3.2 Assistance information from UE to LMF

The company proposals related to this topic are summarized in the Table below.

|  |  |
| --- | --- |
| Fraunhofer [2] | Proposal 1: Enable the LMF to request an activation/deactivation for the on-demand DL-PRS resources based on the UE measurements of configured DL-PRS resources. |
| InterDigital [7] | Proposal 11: UE indicates to LMF information on the PRS configurations used (i.e. IDs of non-on-demand PRS/on-demand PRS configurations) during measurements in the measurement reportProposal 13: For UE-based positioning, UE indicates to LMF on whether on-demand PRS configuration is used to estimate location information |
| Lenovo [11] | Proposal 7: Support the following UE assistance information to LMF for providing an updated DL-PRS configuration:• Indication of course location information, e.g., E-CID, TRP/beam (group) indices.• Indication of change in radio conditions, e.g., beam-failure indication, candidate beams for re-selection.• Indication of measurement quality metrics such as LOS/NLOS and other relevant quality estimates to LMF. |
| Ericsson [14] | Proposal 2 UE provides the reasons as why current configuration is not suitable.Proposal 7 RAN2 to discuss what sort of feedback and how those feedbacks can be provided by UE identifying the needed TRPs/beams for DL-PRS transmission to ensure 3gpp ecosystem provides energy efficient solution.Proposal 8 RAN2 to send an LS to RAN3 to provide solution/signalling for providing PRS beam utilization in NRPPa to reduce PRS overhead as provided in R2-2105973.Proposal 9 GDOP results, DL-PRS RSRP and positioning ranging error/uncertainties are provided to LMF by UE.Proposal 10 RAN2 to discuss ways on how UE operating in UE based mode can provide feedback in order to obtain suitable DL-PRS configurations.Proposal 11 LOS/NLOS classification, if known, is used to identify suitable TRPs from a certain location. |
| Nokia [15] | Proposal 1: For on-demand PRS management in NR positioning, network should use SS-RSRP, SS-RSRQ, CSI-RSRP, CSI-RSRQ measurements.Proposal 2: LMF should properly configure target UE on when and whether the target UE updates the UE feedback for on-demand PRS, using the periodic or triggered reporting of SS-RSRP, SS-RSRQ, CSI-RSRP, CSI-RSRQ measurements using the commonIEsRequestLocationInformation IE in LPP RequestLocationInformation message. |

Summary from rapporteur:

From the above summary in the Table, the following open issues on what assistance information can be provided by UE to LMF to assist the on-demand PRS are addressed:

Open issue 1: what assistance information can be provided by UE to LMF?

* UE measurements of configured DL-PRS resources [Fraunhofer];
* PRS configuration used for the positioning measurements [InterDigital];
* Indication of course location information, e.g., E-CID, TRP/beam (group) indices [Lenovo];
* Indication of change in radio conditions, e.g., beam-failure indication, candidate beams for re-selection[Lenovo];
* Indication of measurement quality metrics such as LOS/NLOS and other relevant quality estimates to LMF[Lenovo];
* Reasons why current PRS configuration is not suitable [Ericsson];
* GDOP results, DL-PRS RSRP and positioning ranging error/uncertainties[Ericsson];
* SS-RSRP, SS-RSRQ, CSI-RSRP, CSI-RSRQ measurements [Nokia];

According to rapporteur, there is not any agreement that whether the UE assistance information is required for on-demand PRS, as well as how to transfer the UE assistance information to LMF. Before RAN2 to decide what assistance information can be included, RAN2 need to confirm the above two issues firstly. Since the email discussion [Post114-e][603][POS] Procedures and signalling for on-demand PRS (Ericsson) also address what assistance information is, thus we think the detailed assistance information can be handled by the email discussion.

However Proposal 11 RAN2 agrees the need of additional assistance information is useful, however the content and how to convey such additional information is FFS has covered the discussion above. So there is no proposal here.

## 3.3 Assistance information from NG-RAN to LMF

The company proposals related to this topic are summarized in the Table below.

|  |  |
| --- | --- |
| Huawei [3] | Proposal 8: For a certain PRS configuration in the TRP INFORMATION REPONSE, the following additional information should be included under the granularity of at least PRS resource, PRS resource set, frequency layer and TRP:• Whether PRSs within the configuration is being transmitted;• Whether this configuration can be requested. |
| Apple [4] | Proposal 3: if assistance information (e.g. measurements) for LMF to select the on-demand PRS configuration is considered beneficial, ask RAN3 to define the relevant measurements in NRPPa. |

Summary from rapporteur:

From the above summary in the Table, the following open issues on what assistance information can be provided by NG-RAN to LMF to assist the on-demand PRS are addressed:

Open issue 1: what assistance information can be provided by NG-RAN to LMF?

* Indications on whether PRSs within the configuration is being transmitted [Huawei];
* Indications on whether the configuration can be requested[Huawei];
* Measurement results [Apple];

RAN2 agreed that provision of (possible/allowed) on-demand DL-PRS configurations that the gNB can support from a gNB to an LMF and sent an LS to RAN3 in R2-2106594. We propose the detailed interaction can be discussed in RAN3 now. So there is no summary proposal here.

# 4. On-demand PRS trigger condition/criteria

The company proposals related to this topic are summarized in the Table below.

|  |  |
| --- | --- |
| ZTE [1] | Proposal 3: NOT to specify triggering condition/criteria for UE-initiated and LMF-initiated on-demand PRS request. |
| Fraunhofer [2] | Proposal 2: Enable the LMF to provide UE with assistance information to trigger measurement on certain on-demand DL-PRS configurations based on the measurement of configured DL-PRS. |
| Intel [6] | Proposal 4: No additional triggering criteria or events need to be specified to allow/disallow the UE from triggering on-demand PRS request. |
| InterDigital [7] | Proposal 1: Support configuring of triggering conditions (parameters and thresholds) that can be monitored by UE for sending on-demand PRS Proposal 2: The parameters in triggering conditions that can be monitored by UE for sending on-demand PRS includes at least: RSRP, TDoA (for timing-based positioning method), number of multipaths, positioning QoS (e.g. accuracy, latency)Proposal 3: Support configuring of rules/criteria for the UE to identify the PRS parameters/configurations in the on-demand PRS based on detection of triggering conditionsProposal 4: Triggering conditions and rules/criteria for supporting on-demand PRS are provided to UE as assistance information in LPP messages (e.g. ProvideAssistanceData) or posSIB |
| InterDigital [8] | Proposal 1: Support on-demand PRS for DL+UL positioning methodProposal 2: Support configuring of triggering conditions (parameters and thresholds) that can be monitored by UE for sending on-demand PRS requesting PRS configuration/parameters and/or SRSp configurationsProposal 3: Support configuring of rules/criteria for the UE to identify the PRS parameters/configurations and/or SRSp configurations based on detection of triggering conditionsProposal 4: Triggering conditions and rules/criteria for supporting on-demand PRS for DL+UL method are provided to UE as assistance information in LPP messages and/or in RRC signalling |
| OPPO [9] | Proposal 2 It is left to implementation to trigger the request for both UE-initiated and LMF-initiated on-demand PRS. |
| Sony [10] | Proposal 3: On demand PRS can be triggered to meet the required positioning service level. |
| Lenovo [11] | Proposal 1: RAN2 to specify UE-initiated trigger criteria in the Stage 2 description based on at least measurement quality and change/disruption in radio conditions, e.g., beam failure, LOS/NLOS measurements.Proposal 2: LMF-initiated triggering criteria can be left up to network implementation. |
| Xiaomi [12] | Proposal 3: When and why UE to send on-demand PRS request to LMF can be left to UE implementation. |
| Samsung [16] | Proposal 1. Introduce the multiple QoS information in the location information request where the response to this request includes measurement result according to the lower QoS level fulfilment, and triggers on-demand DL PRS configuration at LMF. |

Summary from rapporteur:

According to the above summary in the Table, the issues on the on-demand PRS trigger condition/criteria are addressed. Since the email discussion [Post114-e][603][POS] Procedures and signalling for on-demand PRS (Ericsson) also address this issue, thus we think the issue can be handled by the email discussion.

# 5. Stage 2 procedure for on-demand PRS

The company proposals related to this topic are summarized in the Table below.

|  |  |
| --- | --- |
| ZTE [1] | Proposal 2: Support above procedures in section 2.2 for on-demand PRS in 38.305. |
| Huawei [3] | Proposal 11: Adopt the text proposal in Section 3 for on-demand PRS request for TS 38.305. |
| vivo [5] | Proposal 4: Capture the overall procedure of on-demand PRS into the stage 2 specification. |
| Intel [6] | Proposal 7: RAN2 is proposed to capture the on demand PRS procedure detailed above in the stage 2 specification. |
| OPPO [9] | Proposal 1 On-demand PRS procedure shown in the figure can be studied as a baseline. |
| Xiaomi [12] | Proposal 6: The above on-demand PRS procedures can be considered for stage 2 procedure. |
| Qualcomm [13] | Proposal 1: Agree on the Text Proposal in section 2 as baseline for Stage 2. |

Summary from rapporteur:

According to the above summary in the Table, the issues on the stage 2 procedures of on-demand PRS are addressed. Most of companies who submitted the procedure proposals shared the similar understanding on the LPP and NRPPa procedures in Figure 5-1a, 5-1b and 5-1c, which was also proposed as P5 in the summary of [Post114-e][603][POS] Procedures and signalling for on-demand PRS (Ericsson). So no more proposal on the LPP and NRPPa procedures here.



Figure 5-1a On-demand DL-PRS Procedure



Figure 7.x.4-1: UE-initiated on-demand DL-PRS request procedure.

Figure 5-1b



Figure 7.x.3-1: DL-PRS Configuration Exchange Procedure.

Figure 5-1c

The overall sequences of operations that may occur in the LMF, AMF, NG-RAN and UE for on-demand DL-PRS was proposed in Figure 5-2 [13].



Figure 7.x.2-1: On-demand DL-PRS Procedure.

Figure 5-2

The overall sequences of operations that may occur in the LMF, AMF, NG-RAN and UE for on-demand DL-PRS was not discussed yet in the email discussion before so RAN2 needs further discussion (e.g. step 2a) on the overall sequences in Figure 5-2.

Thus, we propose:

**Proposal 7: RAN2 to further discuss the overall sequences of operations proposed by [13](Figure 5-2) via email discussion.**

# 6. Others

## 6.1 Network control of on-demand PRS

The company proposals related to this topic are summarized in the Table below.

|  |  |
| --- | --- |
| Huawei [3] | Proposal 10: TRP capability exchange is already implicitly included under the functionality of TRP Information Exchange that no special treatment is needed. |
| Intel [6] | Proposal 3: The UE can only send the on-demand PRS request if LMF enables this via LPP message ProvideAssistanceData, i.e. by providing preconfiguration sets to the UE. |
| InterDigital [7] | Proposal 12: UE can receive from LMF the indication to report measurements made using only on-demand PRS configuration |
| OPPO [9] | Proposal 6 UE always follow the latest PRS configuration for PRS measurement. Proposal 5 A prohibit timer is introduced to limit the frequency of on-demand PRS request. |
| Ericsson [14] | Proposal 1 RAN2 to strive for solution where NW can learn what is the optimum DL PRS Tx depending upon different traffic hours without constantly getting request from the UE.Proposal 3 To minimize signalling, NW may indicate that the UE logs its preferred configuration or worst contributor.Proposal 4 On demand PRS is subject to the complete NW deployment and not limited to few subsets or pre-configured selection.Proposal 5 RAN2 to agree the objective of on demand PRS irrespective of UE-initiated or LMF initiated is for the NW to learn and optimize the DL-PRS configuration to serve all the UEs in the NW.Proposal 6 RAN2 to agree to provide solution which leads to reduction of energy consumption for DL-PRS transmission. |

## 6.2 Supported scenarios for on-demand PRS

The company proposals related to this topic are summarized in the Table below.

|  |  |
| --- | --- |
| Huawei [3] | Proposal 1: UE-initiated on-demand PRS can be supported for deferred MT-LR. RAN2 should study whether UE-initiated on-demand PRS is supported for the other location services, e.g., MO-LR, NI-LR, immediate MT-LR. |
| InterDigital [8] | Proposal 1: Support on-demand PRS for DL+UL positioning methodProposal 5: Support dynamic updating of spatial relation between SRSp and PRS in a DL+UL positioning method with on-demand PRS |
| Lenovo [11] | Proposal 3: RAN2 to support dedicated delivery of assistance data (DL) and UE assistance/feedback (UL) for on-demand DL-PRS in RRC\_INACTIVE state. SDT framework can be used to support these mechanisms. |

## 6.3 Inactive on-demand PRS

The company proposals related to this topic are summarized in the Table below.

|  |  |
| --- | --- |
| Lenovo [11] | Proposal 3: RAN2 to support dedicated delivery of assistance data (DL) and UE assistance/feedback (UL) for on-demand DL-PRS in RRC\_INACTIVE state. SDT framework can be used to support these mechanisms. |

## 6.4 Collision of PRS

The company proposals related to this topic are summarized in the Table below.

|  |  |
| --- | --- |
| Sony [10] | Proposal 1: On-demand PRS can be transmitted in relation with the legacy / periodic PRS transmission. Both on-demand and periodic PRS can be multiplexed in FDM and TDM. |

## 6.5 Beam management

The company proposals related to this topic are summarized in the Table below.

|  |  |
| --- | --- |
| InterDigital [8] | Proposal 5: Support dynamic updating of spatial relation between SRSp and PRS in a DL+UL positioning method with on-demand PRS |

## 6.6 Semi-persistent/A-periodic PRS

The company proposals related to this topic are summarized in the Table below.

|  |  |
| --- | --- |
| Sony [10] | Proposal 2: Support semi-persistent and a-periodic transmission and reception of DL PRS that can be used for DL-TDOA and Multi-RTT. |

Summary from rapporteur:

On these aspects, there are either not enough proponents, or the idea for the proposals is still not clear enough and needs further clarification. RAN2 can stay open to these proposals and the proponents of these can provide further clarifications in the future meetings.

Thus, we propose:

**Proposal 8: RAN2 to further discuss the following other issues of on-demand PRS:**

* **Network control of on-demand PRS**
* **Supported scenarios for on-demand PRS**
* **Inactive on-demand PRS**
* **Collision of PRS**
* **Beam management**
* **Semi-persistent/A-periodic PRS**

# 7. Conclusion

Based on the summary in the previous sections, we propose following:

## Easily Agreeable

## **Proposal 2: RAN2 to agree the on-demand PRS response can be enabled by enhancing the current LPP Provide Assistance Data message.**Need Further Discussion

Stage-2 impacts:

**Proposal 7: RAN2 to further discuss the** **overall sequences of operations proposed by [13](Figure 5-2) via email discussion.**

Stage-3 impacts:

**Proposal 1: RAN2 to further discuss the detailed message design for the on-demand PRS request, e.g. per positioning method? Is a new LPP assistance data IE indicating the requested DL-PRS configurations required?**

**Proposal 3: RAN2 to further discuss the detailed message design within the on-demand PRS response under two use cases:**

**Case 1: the on-demand PRS request is fully accepted by LMF;**

* **FFS ACK or an identifier associate with a PRS configuration;**

**Case 2: the on-demand PRS request isn’t (fully) accepted by LMF;**

* **FFS indication for UE to stop sending on-demand PRS;**
* **FFS Error indication with error causes if the PRS request is not fully accepted;**
* **FFS PRS configuration which is not requested by UE if the PRS request is not fully accepted.**

**Proposal 4: RAN2 to further discuss the detailed configurations of the pre-configured available DL-PRS, i.e., FFS the maximum number of PRS configurations, FFS the list of available PRS configurations associated with different area.**

**Proposal 5: RAN2 to wait for RAN3’s conclusion on the on-demand PRS related detailed message design between NG-RAN and LMF.**

**Proposal 6: RAN2 to further discuss on how to support on-demand PRS parameters after receiving the RAN1’s response LS on the on-demand PRS parameters.**

**Proposal 8: RAN2 to further discuss the following other issues of on-demand PRS:**

* **Network control of on-demand PRS**
* **Supported scenarios for on-demand PRS**
* **Inactive on-demand PRS**
* **Collision of PRS**
* **Beam management**
* **Semi-persistent/A-periodic PRS**