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

Online Meeting, August 16th – 27th 2021

**Agenda item: 8.11.4**

**Source: CATT**

**Title: [Post115-e][606][POS] MO-LR for on-demand PRS (CATT)**

**WID/SID: NR\_pos\_enh-Core**

**Document for: Discussion and Agreement**

# 1 Introduction

This document is to kick off the following email discussion related with the stage 2 procedures of on-demand PRS:

* [Post115-e][606][POS] MO-LR for on-demand PRS (CATT)

      Scope: Determine whether UE-originated request of on-demand PRS is supported via MO-LR, including the case of a client at the UE, and determine what the impact would be to the procedure agreed as a stage 2 baseline in RAN2#115-e for on-demand PRS request.

      Intended outcome: Report to next meeting

      Deadline:  Long

The rapporteur would like to organize this email discussion in two phases:

- Phase 1: Companies are invited to provide their views on the questions by Oct 15th, 1200 UTC.

- Phase 2: Rapporteur submits the summary with easy agreements and controversial issues, companies can further comment by Oct 20th, 1200 UTC.

This email discussion is structured as follows:

- Section 3: Discussion of UE-originated request of on-demand PRS via MO-LR, including whether UE-originated request of on-demand PRS is supported via MO-LR and its impact on the procedure agreed as stage 2 baseline in RAN2#115-e for on-demand PRS request.

- Section 4: Discussion of open issues left on the stage 2 procedure of on-demand PRS.

# 2 Contact Information

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

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| --- | --- |
| Company | Contact: Name (E-mail) |
| Huawei, HiSilicon | yinghaoguo@huawei.com |
| ZTE | pan.yu24@zte.com.cn |
| Qualcomm | sfischer@qti.qualcomm.com |
| Apple | Sasha Sirotkin <ssirotkin@apple.com> |
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# 3 UE-originated request of on-demand PRS via MO-LR

## 3.1 Whether to support UE originated request of on-demand PRS via MO-LR

For UE initiated on-demand PRS request, we have already concluded that it can be supported during an active LPP session in RAN2#115e[1], while whether it also can be supported via MO-LR request is still an FFS.

Companies supporting on-demand PRS request via MO-LR argue that if the client is in the UE who wants to use DL-TDOA or DL-AoD for UE-based positioning and there is no PRS, then the UE can request the PRS via MO-LR directly, and we cannot preclude such scenario.

According to MO-LR Service Support description in TS38.305 [2]:

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| --- |
| The MO-LR location service request message may carry an LPP PDU to instigate one or more LPP procedures to transfer capabilities, request assistance data, and/or transfer location information. So it seems this LPP Request Assistance Data would be the same as in an active LPP session (e.g., may include the on-demand PRS details). |

According to the description of 5GC-MO-LR Procedure in clause 6.2 in TS23.273 [3]:

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| --- |
| 2) The UE sends an MO-LR Request message included in a UL NAS TRANSPORT message. The MO-LR Request may optionally include up to three LPP positioning message(s). Different types of location services can be requested: location estimate of the UE, location estimate of the UE to be sent to an LCS client or AF, or location assistance data. …. If the UE is instead requesting location assistance data, the embedded LPP message specifies the type of assistance data and the positioning method for which the assistance data applies.  …  5) If the UE is requesting its own location, the actions described in clause 6.11 are performed. If the UE is instead requesting location assistance data, the LMF transfers this data to the UE as described in clause 6.11.1. The LMF determines the exact location assistance data to transfer according to the type of data specified by the UE, the UE location capabilities, the MO-LR subscribed assistance data and the current cell. |

According to the definition of MOLR-Type in clause 4.4.2 in TS24.080 [7]:

MOLR-Type::= ENUMERATED {

locationEstimate (0),

assistanceData (1),

deCipheringKeys (2),

... ,

…

It seems that requesting location assistance data via MO-LR is already supported in TS23.273 [3] and TS 24.080 [7].

**Question 1:** **Do companies agree to support the UE originated request of on-demand PRS via MO-LR? Please specify the reasons or comments if any.**

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| --- | --- | --- |
| Company | Agree/Disagree | Comments |
| Huawei, HiSilicon | Agree | We think that the issue mainly lies in when does the UE perform PRS measurement with the proper PRS configuration and know which PRS to request for on-demand PRS request.  We think this can be achieved by the UE receiving PRS configuration and assistance information for the on-demand PRS request in the posSIB, even if there is no active LPP session ongoing. |
| ZTE | Agree | UE is able to request location assistance data in the MO-LR request according to 23.273. |
| Qualcomm | Agree | As summarized by the rapporteur, there are three use cases/subscriptions specified for MO-LR (23.273):  - Basic Self Location (UE can receive its own location)  - Autonomous Self Location (UE can receive location assistance data)  - Transfer to 3rd party.  For Autonomous Self Location the *MOLR-Type* is set to '*assistanceData*' (24.080), and the UE includes the details of the requested assistance data in a LPP Request Assistance Data message. For example, the UE may provide the IE *NR-DL-TDOA-RequestAssistanceData* with *nr-AdType* set to 'dl-prs'. Since the UE-initiated on-demand PRS request is enabled by enhancing LPP Request Assistance Data, additional information on the (on-demand) DL-PRS details can be provided, which however, is independent of MO-LR. |
| Apple | Agree | Same view as HW |
| Ericsson | Agree, however | As indicated by rapporteur, there is already possibility for the UE to request AD for DL-PRS. That can be reused by UE. We do not see the need to have a separate unsolicited indication for on-demand DL-PRS. |
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**Summary:**

TBD

## 3.2 Impact on the stage 2 baseline on-demand PRS request procedure

Once we agree to support the UE initiated on-demand PRS request via MO-LR, some impacts on the stage 2 baseline on-demand PRS request procedure may be introduced.

***Issues 1: how to provide the available DL-PRS configurations to UE?***

UE initiated on-demand PRS request via MO-LR is performed when there is no any LPP session. Companies will discuss if the available DL-PRS configurations for on-demand via posSIBs should be pre-condition for on-demand PRS request via MO-LR.

**Question 2: Do companies agree that the available DL-PRS configurations must be provided to UE via posSIBs for the scenario that the UE initiate the on-demand PRS request via MO-LR? Please specify the reasons or comments if any.**

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| --- | --- | --- |
| Company | Agree/Disagree | Comments |
| Huawei, HiSilicon | Agree | Since there is no active LPP session in the UE, provision of PRS configuration to the UE with posSIB seems to be the only feasible way. |
| ZTE | Agree with comments | 1. Firstly we think UE can be provided with available DL-PRS configurations before MO-LR request, but it is not mandatory. The reason is:   Even if there is no available DL-PRS configuration sent to UE before on-demand PRS request, UE can still request PRSs which satisfy its own QoS requirement in MO-LR request. For example, UE wants a 20MHz bandwidth PRS according to UE capability or UE positioning requirements, then UE can require the parameter directly.   1. If UE is provided with available DL-PRS configurations before MO-LR request, we agree that broadcast of available DL-PRS configurations should be undisputed. |
| Qualcomm | Disagree; see comment | posSIBs are desired, but not necessarily required.  For example, the UE can send a LPP *NR-DL-TDOA-RequestAssistanceData* with *nr-AdType* set to 'dl-prs'*.* This message may then include additional information on the specific PRS requested (i.e., the explicit parameter list from RAN1 (List#1 in Question 6 below)).  Alternatively, or in addition, this message could also include a request for the NW supported DL-PRS Configurations. The LMF would then provide the available DL-PRS Configurations to the UE in the LPP session shown as Step 5 in the procedure of Question 4 below and the UE could send a second LPP Request Assistance Data with the requested DL-PRS configuration ID. With reference to Figure 1 in Question 4 below:  Step 3: MO-LR with LPP Request Assistance Data incl. a request for available on-demand DL-PRS configurations.  Step 5a: LPP Provide Assistance Data with available on-demand DL-PRS configurations.  Step 5b: LPP Request Assistance Data with specific DL-PRS Configuration ID requested.  (This should also be independent of MO-LR.)  Note, any LPP Request Assistance Data is "best effort" currently since a UE does not know what an LMF supports (independent from any positioning method). With OMA LPPe for example, the UE could know the LMF capabilities, but this is not supported in LPP. |
| Apple | Agree | Agree with HW.  To ZTE – we disagree with ZTE’s point 1, we think that a UE should only request on-demand PRS using an “id”. |
| Ericsson | Agree | Yes, if there is already DL-PRS config available via posSIB or based upon request of AD based upon current framework (IE *NR-DL-TDOA-RequestAssistanceData* with *nr-AdType* set to 'dl-prs') and UE is unable to meet its positioning requirements, it may use MO-LR to ask for UE specific DL-PRS configuration which would meet UE requirements.  We do not foresee the need to increase Uu load without definite gain. |
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**Summary:**

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***Issue 2: how to transfer the on-demand PRS request via MO-LR?***

Considering how to transfer the on-demand PRS request via MO-LR, the following method can be considered:

The UE sends an MO-LR Request message included in an UL NAS TRANSPORT message to the serving AMF including an LPP Request Assistance Data message which is used for on-demand DL-PRS transmission [4].

The MOLR-Type of this MO-LR Request message is assistanceData [7].

**Question 3: Do companies agree the above method for UE initiated on-demand PRS via MO-LR? Please specify the reasons or comments if any.**

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| --- | --- | --- |
| Company | Agree/ Disagree | Comments |
| Huawei, HiSilicon | Agree | In addition, the UE can also include *procideLocationInformation* to include the UE measurements e.g., E-CID measurements to assist the PRS configuration. UE can also include *provideCapability* to the network to indicate the UE’s capabilities for DL positioning. |
| ZTE | Agree | Tha above procedure is aligned with 23.273.  UE capability is not needed to be embedded in MO-LR request, since in the next ongoing LPP session, there will have capability transfer procedure. No need to have duplicated procedure. |
| Qualcomm | Agree | This is how MO-LR is currently specified and according to the agreement: "UE-initiated on-demand PRS request is enabled by enhancing LPP Request Assistance Data". Therefore, there should be no additional RAN2 impacts for MO-LR. |
| Apple | Agree |  |
| Ericsson | Agree | Agree with Huawei |
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**Summary:**

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Based on the discussion above, a general procedure for UE initiated on-demand PRS via MO-LR is provided as the following:



Figure 1: stage 2 procedure for UE initiated on-demand PRS via MO-LR

1. An LMF may provide one or more posSIBs containing a set of available on-demand DL-PRS configurations to a gNB in an NRPPa Assistance Information Control message for broadcast in positioning System Information.
2. The NG-RAN node broadcast the received available on-demand DL-PRS configurations in RRC System Information Messages
3. The UE sends an MO-LR Request message (MOLR-Type is assistanceData) included in an UL NAS TRANSPORT message to the serving AMF including a request for on-demand DL-PRS transmission. The request may in addition include a LPP Provide Capabilities message including the DL-PRS capabilities of the UE, and a LPP Provide Location Information message (e.g., providing E-CID measurements).
4. The AMF invokes the Nlmf\_Location\_DetermineLocation service operation towards the LMF.
5. The LMF may perform one or more LPP procedures; e.g. to obtain the DL-PRS positioning capabilities of the UE.
6. The LMF determines DL-PRS configuration based on the request received at Step 4 and/or the DL-PRS positioning capabilities of the UE obtained at step 5.
7. The LMF insitigates a NRPPa DL-PRS Configuration procedure with each of the gNBs determined at Step 6.
8. The gNB returns acknowledged for step 7.
9. The LMF determines the exact location assistance data and transfer to UE.
10. The LMF returns an Nlmf\_Location\_DetermineLocation Response to the AMF.
11. the AMF forwards the response to the target UE.

**Question 4: Do companies agree the above stage 2 procedure for UE initiated on-demand PRS via MO-LR? Please specify the reasons or comments if any.**

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| --- | --- | --- |
| Company | Agree/Disagree | Comments |
| Huawei, HiSilicon | Agree, but see the comments | We are generally fine with the overall procedure but have the following comments regarding the details of some of the steps   * Before step1, the LMF should acquire necessary information from the TRP with NRPPa message (e.g., TRP INFORMATION EXCHANGE) with which the LMF can compose the assistance data for PRS configuration and on-demand PRS configuration, to be broadcasted in posSIB. * Step1 should also include the PRS configuration for the UE to measure * Step5 can be very much performed in step3, that the UE sends un-solicited provideCapabilities to the network piggybacked in the LCS request message. * Step7, RAN3 has already agree on the NRPPa message for the on-demand PRS request as PRS CONFIGURATION REQUEST, PRS CONFIGURATION RESPONSE, and PRS CONFIGURATION FAILURE. Please refer to the baseline CR in R3-212779 * Step 9 can be merged to one box with the other LPP messages, such as provideLocationInformation that the UE sends to the LMF after PRS measurement and/or location estimate. Check Clause 6.2 in 23.273 |
| ZTE | Agree with comments | 1. Step 5 and step 3 have duplicate UE DL-PRS capability transfer procedure. Since now there is no capability transfer procedure in MO-LR Request message, and UE capability transfer means not only the PRS capability, so we suggest to delete capability transfer procedure in step 3, and remain the capability transfer procedure in step 5, which has less spec impact. 2. Step 9 may consist of many procedures like Fig 6.2-1 step 5 in 23.273, so it should be in a box. |
| Qualcomm | Agree | Step 1/2 would be optional.  Step 5 could for example be used for the LMF to provide the available DL-PRS configurations to the UE and the UE could send a LPP Request Assistance Data with specific DL-PRS configuration requested as mentioned in our response to Question 2. |
| Apple | Agree with comments | On the high level the procedure is OK, but if the proposal would be to capture it in the spec we will have more detailed comments. |
| Ericsson | Agree | Also Agree with below two Huawei comments   * Before step1, the LMF should acquire necessary information from the TRP with NRPPa message (e.g., TRP INFORMATION EXCHANGE) with which the LMF can compose the assistance data for PRS configuration and on-demand PRS configuration, to be broadcasted in posSIB. * Step1 should also include the PRS configuration for the UE to measure |
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**Summary:**

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# 4 Open issues left on the stage 2 procedure of on-demand PRS

There are still two open issues left on the stage 2 procedure of on-demand PRS according to the discussion

***Issue 1: Whether it is mandatory to provide the available PRS for on-demand before UE initiate the on-demand PRS request?***

In RAN2#114e, RAN2 made the following agreement:

The network can signal predefined PRS configurations to the UE and the UE can select one to request. FFS if the UE can request a configuration with different parameters and exactly which parameters are flexible.

We agreed that UE can initiate the on-demand PRS request based on the available DL-PRS configurations, however it is still an FFS that whether the UE can also initiate the on-demand PRS request under the scenario that NW didn’t provide the available DL-PRS configurations to UE. And this need to be confirmed since it has impact on the stage 2 procedures, i.e., once we confirmed, the procedure that LMF interact with NG-RAN to obtain the available DL-PRS as well as NW provide the available DL-PRS to UE is mandatory.

**Rapporteurs comment:** NW should control the UE initiated on-demand PRS to avoid such autonomous UE behaviours, i.e., only the UE that was provided the available DL-PRS by NW can be allowed to initiate the on-demand PRS.

**Question 5: Do companies agree that it is mandatory to provide the available PRS before UE initiate the on-demand PRS request? Please specify the reasons or comments if any.**

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| --- | --- | --- |
| Company | Agree/Disagree | Comments |
| Huawei, HiSilicon | Agree | We think the PRS should be provided to the UE before the UE can make request. Only after measuring the PRS, can the UE know what PRS it likes and what PRS it does not like. In order to let the UE make informed decisions on the PRS request, the UE should measure on the PRS provided by the network first.  Additionally, it would increase the possibility for the request to be accepted by the network, which may improve the device efficiency to avoid invalid request.  Hence, we think the PRS configuration provision to the UE before PRS request is necessary. |
| ZTE | Disagree | Like our comments in Q2, even if there is no available DL-PRS configuration sent to UE before on-demand PRS request, UE can still request PRSs which satisfy its own QoS requirement in MO-LR request. For example, UE wants a 20MHz bandwidth PRS according to UE capability or UE positioning requirements, then UE can require the parameter directly.  To HW:  Available DL-PRS configurations do not mean TRP should actually send all these DL-PRSs. They can be seen as TRP capability, to let UE know about which PRSs the TRPs have the capability to send. |
| Qualcomm | Disagree; see comments. | We don't think this has to be mandatory. It should be up to NW implementation. However, an optimal deployment would support posSIBs and provide the available DL-PRS in advance. But as mentioned in our response to Questions 2 above, any LPP Request Assistance Data is "best effort" currently and the NW may provide what it can support (e.g., this is the case for any positioning method, such as GNSS, etc.). However, the LPP Request Assistance Data should give the NW a good idea of what is desired by the UE (but any decision on specific assistance data will be made by the NW anyhow). We also think this is independent of MO-LR. |
| Apple | Agree with comments | “Mandatory” may not be the right word (as the functionality is up to the network), but the point is that a UE should only request (as we have already agreed) on-demand PRS using an id of a predefined RPS configuration. |
| Ericsson | Agree | Yes, if there is already DL-PRS config available via posSIB or based upon request of AD based upon current framework (IE *NR-DL-TDOA-RequestAssistanceData* with *nr-AdType* set to 'dl-prs') and UE is unable to meet its positioning requirements, it may use MO-LR to ask for UE specific DL-PRS configuration which would meet UE requirements.  We do not foresee the need to increase Uu load without definite gain. |
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**Summary:**

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***Issue 2: Whether*** ***UE can only request the configurations, i.e., identifier associated with the available DL-PRS or the explicit DL-PRS parameters if agreed, within the available DL-PRS provided by NW?***

If Question 5 that it is mandatory to provide the available PRS before UE initiates the on-demand PRS request is agreed, we may discuss the relations between the explicit parameters UE can request, i.e., List #1 and the available DL-PRS configurations provided by NW, i.e., List #3.

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| --- |
| Agreement:   * The following lists of on-demand DL-PRS parameters are discussed/prepared by RAN1 and provided as input to RAN2:   + List#1: List of parameters for UE-initiated on-demand DL PRS request   + List#2: List of parameters for LMF-initiated on-demand DL PRS request * For the following lists of on-demand DL-PRS parameters, send an LS to RAN2 to check whether RAN2 would like RAN1 to send the list of parameters and request feedback as early as possible:   + List #3: List of parameters for UE-initiated on-demand DL PRS request associated with pre-configured set of on-demand DL PRS configurations   + List #4: List of parameters for LMF-initiated on-demand DL PRS request associated with pre-configured set of on-demand DL PRS configurations |

The reply LS to RAN1 on on-demand DL PRS parameters at 115-e meeting is agreed as below:

RAN2 needs to know the list of parameters that can be dynamically adjusted for UE-initiated/LMF-initiated on-demand DL PRS request. RAN2 does not expect RAN1 to send the list of parameters for on-demand DL PRS request associated with pre-configured set of on-demand DL PRS since how to handle DL PRS pre-configuration will be discussed in RAN2.[6]

According to rapporteur's opinion, once UE is allowed to request the DL-PRS configurations outside the available DL-PRS provided by NW, the efficiency of on-demand PRS is quite limited since NW probably rejects the request initiated by UE. Before what the pre-configuration DL PRS, i.e., List #3 from LMF to UE is discussed by RAN2, we may discuss the principle at first.

**Question 6: Do companies agree the UE can only request the configurations within the available DL-PRS provided by NW? Please specify the reasons or comments if any.**

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| --- | --- | --- |
| Company | Agree/Disagree | Comments |
| Huawei, HiSilicon | Agree | Our understanding is that the intention from the above FFS is that it should be further studied whether the UE can request PRS configuration out of the assistance data for on-demand PRS request.  For the above question, we think that the UE should only be allowed to request the PRS based on the assistance data for PRS request provided by the LMF in order to make reasonable request. For example, if a TRP ony supports PRS bandwidth of 10MHz while the UE requests PRS of 20 MHz, the request will not be satisfied anyway. |
| ZTE | disagree | When UE sends on-demand PRS request without available PRS configuration received, the on-demand PRS request is likely to beyond the scope of available PRS provided by NW. TRP is the one to final decide whether to satisfy UE’s request, even if UE makes the reasonable on-demand PRS request, TRP is also able to ignore it anyway(based on TRP implementation). Therefore, it doesn’t matter that UE’s on-demand PRS request is beyond the TRP capability. If that happens, TRP can send UE the PRS with TRP’s best capability. |
| Qualcomm | Disagree | We don't see a need to restrict an LPP Request Assistance Data. The more details a UE can provide on what is desired should be beneficial for an LMF to select a proper DL-PRS configuration based on NW capabilities and other factors (such as DL-PRS or location requests from/or for other UEs nearby to the target UE which are received by the LMF at about the same time). For example, if a TRP supports a max. 10MHz DL-PRS but a UE requests a e.g., 20 MHz DL-PRS, a DL-PRS with 10 MHz could still be provided. |
| Apple | Agree | PRS configuration negotiations between the UE and the network would increase positioning latency, which goes against the objectives of the WI. |
| Ericsson | Agree | Agree with Apple and Huawei comments |
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**Summary:**

TBD

# 5 Conclusion

TBD

# 6 References

1. RAN2-115-e-Positioning-Relay-2021-08-27-0330.docx
2. TS 38.305 Stage 2 functional specification of User Equipment (UE) positioning in NG-RAN V16.5.0
3. TS 23.273 5G System (5GS) Location Services (LCS); Stage 2 V16.3.0
4. R2-2108384 On-Demand DL-PRS Qualcomm Incorporated
5. R2-2108827 Summary of Agenda Item 8.11.4 On-demand PRS CATT discussion Rel-17 NR\_pos\_enh-Core
6. R2-2109123 Reply LS to RAN1 on on-demand DL PRS parameters Intel LS out Rel-17 NR\_pos-Core To:RAN1

# 7. Related agreements

**RAN2#111e**：

RAN2 to study positioning in idle/inactive mode, on-demand PRS and latency analysis in the study phase.

**RAN2#112e**：

Agreements on on-demand PRS:

RAN2 study on-demand PRS mechanism for DL-based, UL&DL-based methods (e.g. multi-RTT), and UE-Based and UE-assisted positioning methods in this SI.

**RAN2#113b**

Agreements:

UE-initiated on-demand PRS request is enabled by enhancing LPP RequestAssistanceData. FFS how much control the network has over the UE request.

The UE-initiated mechanism is enabled by the UE request triggering a request from the LMF, and the actual PRS changes are requested by the LMF irrespective of whether the procedure is UE- or LMF-initiated.

Put the stage 2 description for UE-initiated and LMF-initiated PRS request under the same framework.

**RAN2#114**

Agreements:

The network can signal predefined PRS configurations to the UE and the UE can select one to request. FFS if the UE can request a configuration with different parameters and exactly which parameters are flexible.

Agreements:

Proposal 2: Define a new LPP assistance data IE which can contain a set of possible on-demand DL-PRS configurations, where each on-demand DL-PRS configuration has an associated identifier.

Proposal 3 (modified): The new LPP assistance data IE from Proposal 2 can be included in an LPP Provide Assistance Data message and/or a new posSIB.

Agreement:

Proposal 4 (modified): The procedure(s) for on-demand DL-PRS should support at least the following functionality (up to RAN3 what is in NRPPa vs. OAM, etc.):

- 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.)

**RAN2#115**

Agreements:

Before providing available DL-PRS configuration to the UE, the LMF may obtain configuration information on what DL-PRS can be supported from one or more TRPs via NRPPa.

Capture the steps provided above as a baseline, along with a note indicating it remains FFS if the UE can send the MO-LR to request on-demand PRS.

FFS if we indicate to SA2 that MO-LR can be used to trigger on-demand PRS procedure.

It is up to Network (LMF) implementation on the steps to follow (accept/reject/ignore) on receiving request from UE for changing the DL-PRS configurations.