3GPP TSG-RAN WG2 #116-bis R2-21xxxxx

Electronic meeting, 2022-01-17 - 2021-01-25

**Agenda item: 8.11.4**

**Source: Ericsson**

**Title: [Post116-e][601][POS] Procedures and signalling for on-demand PRS (Ericsson)**

**Document for: Discussion and Agreement**

# 1 Introduction

This document is to kick off the following email discussion:

* [Post116-e][601][POS] Procedures and signalling for on-demand PRS (Ericsson)

 Scope: Discuss the level of network control of the UE request for on-demand PRS, and the content of the UE request:

* Whether the UE is required to receive on-demand PRS parameters before requesting PRS
* Other network control mechanisms for the UE’s request for on-demand PRS (prohibit timer, reattempt timer, stop message)
* Whether the UE can request preferred PRS configurations that go beyond what the network indicated (if the network indicated anything)
* Whether the UE can request explicit on-demand PRS parameters from the network, and if so, the content of the request
	+ Taking RAN1 conclusions into account
* Whether posSI can be the response to the on-demand PRS request

 Intended outcome: Report to next meeting

 Deadline: Dec 17th

The agreements so far in this area have been provided in section 6 for reference/recap.

# 2 Contact Information

|  |  |
| --- | --- |
| Company | Contact: Name (E-mail) |
| Fraunhofer | birendra.ghimire@iis.fraunhofer.de  |
| CATT | lijianxiang@datangmobile.cn |
| vivo | panxiang@vivo.com |
| Apple | ssirotkin@apple.com |
| Qualcomm | sfischer@qti.qualcomm.com |
| Intel | ansab.ali@intel.com |
| Nokia | mani.thyagarajan@nokia.com |
| OPPO | youxin@oppo.com |
| Xiaomi | lixiaolong1@xiaomi.com |
| Lenovo, Motorola Mobility | rthomas7@lenovo.com |
| InterDigital | jaya.rao@interdigital.com, fumihiro.hasegawa@interdigital.com |
| Huawei, HiSilicon | yinghaoguo@huawei.com |
| Ritesh Shreevastav | Ritesh.shreevastav@ericsson.com |
|  |  |

# 3 Discussions

## 3.1 Explicit Indication

## RAN1 Input

RAN1 has agreed on below On-Demand PRS list.

|  |
| --- |
| RAN1#106-e AgreementAt least the following list of on-demand DL PRS parameters is supported for UE-initiated and LMF-initiated on-demand DL PRS requests:1. DL PRS Periodicity
2. DL PRS resource bandwidth
3. DL PRS QCL information

Conclude on remaining parameters at RAN1#106-bis-eRAN1#106bis-e Agreement1. The following list of parameters is supported for UE-initiated and LMF initiated on-demand DL PRS request
2. Start/end time of DL PRS transmission
3. DL PRS resource repetition factor
4. Number of DL PRS resource symbols per DL PRS resource
5. DL-PRS CombSizeN
6. Number of DL PRS frequency layers
7. ON/OFF indicator (for LMF initiated request only)

FFS values for requested on-demand DL PRS parameters and whether parameters are resource-specific, TRP-specific, or PFL-specific |

|  |
| --- |
| RAN1#107-e Agreement**Agreement*** From RAN1 perspective, for LMF-initiated request of on-demand DL PRS, the following group of on-demand DL PRS parameters is defined and signaled
	+ per resource set per positioning frequency layer per FR
1. DL PRS Periodicity
2. DL PRS Resource Bandwidth
3. DL PRS Resource Repetition Factor
4. Number of DL PRS Resource Symbols per DL PRS Resource
5. DL-PRS CombSizeN

Two options for indication of DL PRS QCL-Info, either* + Option 1: per resource set per positioning frequency layer per FR
* LMF recommends a list of QCL sources
	+ Option 2: per resource set per positioning frequency layer per FR
		- LMF requests to provide the QCL information in the assistance data in NRPPa
	+ per FR
		- Number of DL PRSggf frequency layers
	+ either per resource set per positioning frequency layer or per UE
		- Start/end time of DL PRS transmission
	+ either per resource, or per resource set, or per UE
		- ON/OFF indicator (for LMF initiated request only)

**Agreement*** From RAN1 perspective, for UE-initiated request of on-demand DL PRS, the following group of on-demand DL PRS parameters is defined and signalled
	+ per positioning frequency layer per FR
1. DL PRS Periodicity
2. DL PRS Resource Bandwidth
3. DL PRS Resource Repetition Factor
4. Number of DL PRS Resource Symbols per DL PRS Resource
5. DL-PRS CombSizeN
	* per FR
6. Number of DL PRS frequency layers
	* per UE
7. Start/end time of DL PRS transmission

Two options for indication of DL PRS QCL-Info, either* + Option 1: per resource set per positioning frequency layer per FR
		- UE recommends a list of QCL sources
	+ Option 2: per resource set per positioning frequency layer per FR
		- UE requests to provide the QCL information in the assistance data
 |

## ASN.1

Considering the above 1 and 2 DL-PRS parameters (Periodicity and BW), the indexing from NW side may be provided as an example below.

For simplicity for DL-PRS-Periodicity instead of exact 37.355 definition; a simple illustration is kept.

-- ASN1START

onDemandPRS-IndexList-r17 ::= SEQUENCE (SIZE (1..maxNumberOfIndex)) OF onDemandPRS-Index-r17

onDemandPRS-Index-r17 ::= SEQUENCE {

 dl-PRS-Periodicity ENUMERATED {p1, p2, p3, p4} OPTIONAL,

 dl-PRS-ResourceBandwidth INTEGER (1..63) OPTIONAL

}

-- ASN1STOP

|  |
| --- |
| NW Provided IndexIndex 1 can be:  dl-PRS-Periodicity p1 dl-PRS-ResourceBandwidth 10Index 2 can be:  dl-PRS-Periodicity p2 dl-PRS-ResourceBandwidth 20Index 3 can be:  dl-PRS-Periodicity p3 dl-PRS-ResourceBandwidth 30 |

The question here is; is UE allowed to request only using Index or can UE request be for example:

|  |
| --- |
| UE Requestdl-PRS-Periodicity p3dl-PRS-ResourceBandwidth 10 |

Please note the DL-PRS parameters and values that are requested are still within what NW provides/supports.

From NW perspective, the index is not written in stone/fixed and it should be allowed to be changed further depending upon several factors; one of them should be based upon UE’s input. The NW should be able to take into account the granular reporting (precise request) and thus provide a new Index or replace current index with the new index/configuration; for example:

|  |
| --- |
| Index 4:dl-PRS-Periodicity p3dl-PRS-ResourceBandwidth 10 |

Further, RAN1#107e agreement says below:

* for UE-initiated request of on-demand DL PRS, the following group of on-demand DL PRS parameters is defined and signalled
	+ per positioning frequency layer per FR
1. DL PRS Periodicity
2. DL PRS Resource Bandwidth
3. DL PRS Resource Repetition Factor
4. Number of DL PRS Resource Symbols per DL PRS Resource
5. DL-PRS CombSizeN
	* per FR
6. Number of DL PRS frequency layers
	* per UE
7. Start/end time of DL PRS transmission

This suggests that explicit signaling is allowed from RAN1 perspective.

**Question 1: Companies are invited to provide input on whether explicit indication is allowed or not; at least for the case when the UE request is within the allowed parameters and values?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Fraunhofer | No | We prefer that the NW provides different indices for the parameter and value combination. The NW can still provide different parameter values for a given parameter under different indices. Furthermore, under an index, PRS from multiple TRPs could be grouped together so that they can be requested together. As an example, when a UE makes a demand of BW of 50 MHz and periodicity of 20 ms, it could request that it is transmitted from a group of TRPs bundled with its serving / camped cell. We agree with Rapporteur’s comment that the configuration pointed by the index could be flexibly changed by the network.  |
| CATT | Yes for that UE request is within the allowed parameters and values | UE request of explicit indications is more flexible compared with pre-configured DL-PRS ID only. However, the UE request must be within the available DL-PRS configurations pre-configured by NW, so as to reduce the latency and improve the efficiency of on-demand PRS. |
| vivo | Yes | So far, we have agreed to 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. On top of this, including some explicit parameters in the on-demand PRS configuration request may increase the flexibility of on-demand PRS. The explicit parameters can be a list of value range to ensure the request is still within the NW capability. In this case, we shall further discuss how to design the on-demand PRS configuration from LMF to UE. From our understanding, the identifier and explicit parameter can be incorporated. In detail, the identifier is per PRS configuration and the value range is per parameter in PRS configuration. For PRS configuration associated with one identifier, some parameters can be explicit values, the other parameters can be value ranges. The UE shall request the on-demand PRS with an identifier. For each parameter with a value range in the PRS configuration corresponding to the requested identifier, the UE can explicitly indicate the requested value which is within the value range. For example:configuration 1 can be:  dl-PRS-onDemandID = 1 dl-PRS-Periodicity Range = (8, 32, 64, 160) in slots dl-PRS-ResourceBandwidth = 20 MHzconfiguration 2 can be:  dl-PRS-onDemandID = 2 dl-PRS-Periodicity = 32 slots dl-PRS-ResourceBandwidth Range = (40, 50, 80, 100) in MHzThe UE can request: dl-PRS-onDemandID = 1 dl-PRS-Periodicity = 8 slotsor dl-PRS-onDemandID = 2 dl-PRS-ResourceBandwidth = 40MHzIn conclusion, the combination of identifier and explicit parameter is beneficial for flexibility and overhead reduction of on-demand PRS signaling. |
| Apple  | no | We should stick to our agreement that a UE may request an on-demand PRS configuration by signalling an identifier.Adding the possibility to request specific parameters adds complexitiy both to the UE and the network. Furthermore, if we are to allow for a UE to signal both an on-demand PRS configuration identifier and some specific parameters, that would be the worst possible outcome (in terms of complexitiy), which would also render the agreed functionality of sending an identifier irrelevant.  |
| Qualcomm | Yes | Explicit indication as in the RAN1 agreements/parameter list.This can be existing LPP parameter as in the RAN1 parameter list. Indexing is only needed for the pre-defined DL-PRS configurations, not for the explicit parameter list. |
| Intel | Yes | We agree with CATT that in general, the UE request for explicit indication of DL PRS parameters can be more flexible. In our view, at least the number of DL PRS frequency layers and the start/end time of DL PRS transmission can be explicitly indicated by the UE |
| Nokia | No | Requests are only via reference to an index. Restricting the ODPRS request to refer to one or more indices that refers to a structure of parameters allows the NW and UE to have a common view of allowed combination of parameters and eases the NW to handle requests from different UEs. More than one index allows prioritization of the request from UE. Restricting the ODPRS request to only indices allows predefining the sets of parameters and mapping it to different QoS or radio conditions.In the description from rapporteur, an example is shown where the Index is associated to a parameter or a set of parameters where the parameters are from the RAN1 agreed list of parameters. An alternative way is to reuse the current PRS assistance data structure as is (exact IE from 37.355 can be discussed) that is referred to by an index. |
| ZTE | Yes | RAN1 has already confirmed that UE can request flexible parameters. If UE can only request IDs, this RAN1 decision will be hard to achieve. Also, restricting UE to only request indexes from available PRS configuration is rather inflexible. So we support both requesting config ID that NW has already packed up, and requesting explicit parameters that RAN1 provided(within the range of current spec allowed values). |
| OPPO | No | We think the following agreement on how to request on-demand PRS is sufficient.*The network can signal predefined PRS configurations to the UE and the UE can select one to request.*Explicit indication for on-demand PRS may bring extra signaling overhead between UE and LMF. And as PRS configuration is not a UE-specific configuration, it would be quite complex if UE request a on-demand PRS with explicit parameters.  |
| Xiaomi | Yes | The explicit indication for on-demand PRS request is more flexible, and it can provide some information for LMF to determine proper pre-defined on-demand PRS configuration.  |
| Lenovo, Motorola Mobility | Yes | RAN1 agreements confirm that the different on-demand PRS parameters agreed can be explicitly signalled. An index is only needed for providing a set of per-defined on-demand PRS parameters. We also share the view that explicit indication allows for more flexibility of the on-demand PRS feature, which was one of the main benefits of on-demand PRS.  |
| InterDigital | Yes | We share similar understanding with QC and ZTE, that for flexibility the UE can send explicit indication for requesting explicit parameters from the list of parameters agreed by RAN1. This is in addition to the ID of the PRS configuration as previously agreed by RAN2, which the UE can send when requesting for an on-demand PRS configuration.  |
| Huawei, Hisilicon | Yes | For UE-initiated on-demand PRS request, we think both options can be supported:Option 1: A complete set of PRS configurations (already agreed)Option 2: Individual PRS configuration parameters which are within the scope of the assistance data.Since Option 1 only works for the case when the predefined PRS configuration exactly meets the UE’s expectation. However, there are some exceptional cases:Case 1: Only a part of parameters in some predefined PRS configurations can meet the UE’s expectation;Case 2: None of the parameters within the predefined PRS configurations can meet the UE’s expectation.To deal with these cases and meet the needs of UE as much as possible, we think the UE should be able to request individual PRS configuration parameters |
| Ericsson | Yes |  |
|  |  |  |
|  |  |  |

## 3.2 Request beyond NW Indication

Based upon the discussion during last meeting, some of the companies view that UE should not request on-Demand PRS assistance data if NW has not indicated the support of On-Demand PRS. Further, their view is that the UE request should be limited to the parameters that NW provides saying these can be changed dynamically and further may provide the range (min, max) within which the UE request should be bounded to. For example; the maximum value that the NW indicates for supporting on-Demand PRS (for example if NW indicates, NW can support DL-PRS BW enumerated {n5, n10, n20, n50}; i.e UE should not request BW larger than n50. But, from RAN1 perspective, it is still an FFS: “FFS values for requested on-demand DL PRS parameters”. It may be possible that UE request any value in the value range that RAN1 specifies.

In some cases (or in some deployment), it may be beneficial to know what kind of PRS UE prefers. If there is large variation between what UE requests and what NW supports; NW (Operators) can take measures to improve the situation. For example, UE demands 64 resources per resource set per TRPs whereas NW says it can only transmit 8 resources per resource set per TRP

There are few Options here; for example; UE can request any PRS characteristics (From RAN1 list) and sends value of its preference (value range decided by RAN1) or RAN2 decides on the content. The Options are listed below

1. Ask/Wait for RAN1 input to see the value range and whether UE can send any value in the range
2. RAN2 decide that UE can request only the parameters that NW indicates and their value range is within the value range that NW supports.
3. RAN2 decides that UE can request any parameters from the RAN1 agreed parameter list based upon the values that are already in the range from Rel-16 specifications; example UE can be configured up to 4 frequency layers, 256 DL PRS IDs (TRPs), BW Integer (1 to 64) etc. Hence, the request range is based upon already existing range.

**Question 2: Companies are invited to provide input on which of the above Options they prefer on whether UE can request preferred PRS configurations that go beyond what the network indicated?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Fraunhofer | None | We prefer that the UE provides measurements on certain Rel. 16 DL-PRS, and this information can be used by LMF to trigger on-demand PRS from the network. |
| CATT | Option b | We think that UE can only request the on-demand PRS parameters that NW indicates and their value range is within the value range that NW supports. There is a left issue that RAN2 does not decide the content of the available DL-PRS that NW pre-configured to UE. From our perspective, the available DL-PRS can be designed as a parent set of the parameters that UE can on-demand. |
| vivo | Option b | We think RAN2 can decide this issue from signaling perspective. Option b can avoid meaningless message exchange between TRP, LMF and UE when the NW does not support on-demand PRS. |
| Apple | None | As we explained above, we should stick to our agreement according to which the UE should only signal an identifier of an on-demand PRS configuration.  |
| Qualcomm | Option c | No need for RAN2 to decide, since we have the RAN1 agreements and parameter. We also cannot see the difference compared to any other assistance data request. E.g., the NW also does not provide a list of GNSSs supported, supported assistance parameter, signals, frequencies, etc. for which a UE can request GNSS assistance data. |
| Intel | Option b | We share the same view as vivo |
| Nokia | See comment | The problem is not well defined, and the question is not very clear. If the question is whether the UE can explicitly indicate a PRS parameter in the ODPRS request, then it depends on conclusion to Question 1. If the question is what value range is allowed for the different ODPRS parameters, then it depends on the specific parameter and whether this is an existing parameter, or a new parameter introduced that can be used in the ODPRS request. For existing ODPRS parameters e.g., bandwidth, periodicity, resource repetition factor, comb size etc. the already defined value range in Rel-16 specification applies. |
| ZTE | Prefer c | After last meeting, several companies think UE can only request PRS that within NW’s provision, some companies think there should be no restriction on this. For the sake of progress, we think a compromised solution can be as following:* when UE requests IDs, UE can only request on-demand PRS based on prior reception of on-demand PRS configuration. Then there is no dis-satisfy scenario, since on-demand PRS configuration is the PRSs that LMF wants UE to choose from.
* when UE requests explicit parameters, UE can request any values that current spec supports. In this case if NW can not satisfy UE’s request, NW can send UE a error message.
 |
| OPPO | Option b with comments | We think RAN2 can decide on this issue, while we prefer that UE can only request the preconfigured PRS configiuration by sending the **configuration index** among the pre-configured PRS configurations. |
| Xiaomi | Option c | UE can indicate the real requirements on PRS configuration by option c, and LMF can use the request from UE to decide more suitable PRS configuration. |
| Lenovo, Motorola Mobility | Option c | The value range already supported since Rel-16 should be sufficient for each of the supported on-demand PRS parameters provided by RAN1. |
| InterDigital | Option c | Our understanding is the UE can request any parameters from the list agreed by RAN1 |
| Huawei, HiSilicon | Option b | We think the UE can only request PRS configuration/parameters within the scope of the assistance data provided by the network. And RAN1 has reached some agreements on the parameter list. We think RAN2 can discuss the relevant signalling process considering the limited time left. |
| Ericsson | Option b |  |
|  |  |  |
|  |  |  |

## 3.3 Pre-requisite for On-demand PRS Request

MO-LR is service request that the UE can send to initiate location service request. It can embed LPP messages in such LCS message. The LPP message may contain request for Assistance data. For example; the UE may request AD for A-GNSS positioning method using this mechanism. In Rel-16 though, as part of periodic AD request for GNSS RTK; a control parameter was introduced; i.e the NW provides the capability whether it supports periodic AD transfer or not. UE will know if it can request periodic RTK AD based upon NW indication. In the same analogy one may consider that on-Demand PRS is advance feature build upon already existing DL-PRS request where a control parameter (capability) or what NW supports in terms of on-Demand PRS should be indicated beforehand.

Using MO-LR for the very first time with all the needed DL-PRS characteristics and also RRM Measurements will help to reduce latency if NW happens to select DL-PRS based Positioning method or supports such DL-PRS configurations. There is certainly benefit, but of-course there are questions as well as should it be designed in this way. Should it be part of control parameter or capability exchange before triggering on-Demand PRS?

Another aspect is that UE may append RRM measurements as part of also regular DL-PRS AD request. This would be useful also to trigger on-Demand PRS request.

One final remark is that in order to send the UE preferred DL-PRS attributes for On-Demand Request an explicit indication would be needed; as it would be the 1st message.

**Question 3: Companies are invited to provide input on whether capability exchange procedure be needed (i.e NW should provide beforehand whether on demand PRS is supported and on what DL-PRS attributes can be changed before UE makes an explicit request)?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Fraunhofer | No | From our perspective, the UE can request AD for on-demand PRS as a part of request assistance data.  |
| CATT | No | No additional signaling is needed, because we already agreed that NW provide the available DL-PRS configurations to UE, which can be used as the pre-requisite for on-demand PRS request. |
| vivo | No | The network can proactively provide the on-demand configuration via broadcasted posSIB or dedicated LPP message. Only after receiving the on-demand configuration, the UE can request the on-demand PRS. NW doesn't have to provide beforehand whether on-demand PRS is supported with an extra indication or capability exchange procedure. |
| Apple | No | Agree with the arguments from CATT and vivo above. |
| Qualcomm | No | In principle, it would be desired to have a LMF Capability Exchange procedure defined as well. However, this is not specific or related to DL-PRS assistance data requests. |
| Intel | No | Agree that no additional signaling is required to enable on-demand PRS procedure. |
| Nokia | See comment | There are multiple aspects discussed but the question is very vague. The discussion part mentions the following aspects: signaling of NW capability for support of ODPRS, UE providing measurements as part of ODPRS request, either in a request assistance data message or in MO-LR message. Then the question itself seems to bring up again whether explicit parameters can be requested or only an index can be included in the request (i.e., the part about what DL-PRS attributes can be changed by the UE).In general, we agree that some signaling to indicate NW support for on-demand PRS feature and whether NW currently allows on-demand PRS request if it indeed supports on-demand PRS feature, is useful. Also, if only an index to predefined PRS configuration is allowed to be included in the request, then there is no need for NW to tell explicitly which DL-PRS attributes can be changed. |
| ZTE | No | When available PRS configuration is provided in advance, it means NW has the capability for on-demand PRS; When UE request on-demand PRS without available PRS configuration, if NW can not support on-deman PRS, an error message can be returned. So no additional capability transfer is needed. |
| OPPO | No  | Agree with CATT. UE will only request on-demand PRS based on the PRS configurations provided by NW. |
| Xiaomi | No | The pre-defined on-demand PRS configuration provided by network can be used as an indication, with the indication, the UE can send on-demand PRS request.  |
| Lenovo, Motorola Mobility | See comments | According to our understanding, RAN1 is has been discussing UE-initiated on-demand PRS as a potential capability to be exchanged with the network. This may require further discussion pending RAN1 progress on the UE feature list. |
| InterDigital | No | Similar to others, we do not see much gain for supporting additional signalling for indicating NW capability for on-demand |
| Huawei, HiSilicon | No | Agree with vivo. We think the assistance data for on-demand DL-PRS configurations provided by the network can be considered as an implicit indication of the support of on-demand PRS. |
| Ericsson | See comments | We agree that explicit indication is not needed. |
|  |  |  |

**Question 4: A follow up question is whether provision for UE to request DL-PRS AD (legacy Rel-16) along with appending RRM measurements be supported. Benefit is that it can save latency and it can still trigger On-Demand PRS transmission?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Fraunhofer | Yes | The measurements (as we also mentioned in Q2) could help LMF to trigger the relevant on-demand PRS (for example: finer beams for AoD methods) based on outcome of the measurement of wider beams (e.g. SSBs. The measurement on DL-PRS appended on DL-PRS AD could be used by LMF to make on-demand PRS to the NG-RAN node (for example, bandwidth, QCL, periodicity etc). |
| CATT | No | LMF may request UE to provide the existing POS or RRM measurement results to NW, assisting the LMF initiated on-demand PRS. But there is no specification impact and no need to append within the on-demand PRS request from UE, because current LPP procedure already supports it. |
| vivo | No | UE can request DL-PRS AD and send RRM measurements at the same time as the LPP transactions within a session may occur in parallel. Therefore, no need to piggyback the RRM measurement in the requestAD message. |
| Apple | No | The benefit is not clear |
| Qualcomm |  | Not clear what is proposed here. If "RRM measurements" mean "NR-ECID measurements", then this is anyhow supported. A LPP Request Assistance Data can always be provided together with Provide Capabilities and/or Provide Location Information. |
| Intel | No | Agree with Qualcomm that it is not clear what additional enhancement is being proposed. The LPP request AD can be provided already and it is not clear if anything else is additionally needed. |
| Nokia | Yes | UE can append measurements when requesting assistance data for on-demand PRS, which would help network determining more suitable PRS configurations for the UE, and proactive signaling would save from latency. |
| ZTE | No  | Agree with QC and vivo |
| OPPO | No  |  |
| Xiaomi | No |  |
| Lenovo, Motorola Mobility | Yes | Currently, the NR-ECID measurements may/may not be available at the LMF when the UE requests on-demand PRS. It would be beneficial to assist the LMF in providing the optimal PRS parameters to the UE based on the appended RRM (NR-ECID) measurements.  |
| InterDigital | No | The network already has RRM measurements so a need for the UE to send RRM measurements is not clear. Latency benefit by attaching RRM measurements is not clear either. If measurements are helpful for the network to determine PRS configuration, PRS-based measurements already provided by the UE should be as informative as RRM measurements.  |
| Huawei, HiSilicon | No | We don’t see any necessity or benefit to couple the request of DL-PRS AD (legacy Rel-16) and the report of RRM measurements together, since the former is agreed and the latter is already supported. |
| Ericsson | Yes | Agree with Nokia |
|  |  |  |

## 3.4 Network Control Mechanisms

From the previous summary discussion of on-Demand PRS [R2-2111256], the below proposal was marked for further discussion.

*Proposal 4: Network control of UE-initiated on-demand PRS is supported. The following options are to be downselected:*

* *Option A: UE can only request on-demand PRS based on prior reception of on-demand PRS configuration sets.*
* *Option B: Configuration of a prohibit timer*
* *Option C: Reattempt timer*
* *Option D: Stop message indication from the LMF*
* *Note: If error indication in Proposal 3 is supported, Option D is not required.*

For completeness the Proposal 3 is also listed below [R2-2111256]

* *Error indication is supported for a partial or completely unfulfilled on-demand PRS request.*

Generally, for any spontaneous UE request a prohibit timer is considered beneficial. From the above Options, it appears Option C and D may also be able to prohibit the UE from sending the request. It is unclear from Option A though as how it will stop UE from sending the several request even if it is based upon only allowed list. It is not guaranteed that NW will accept the request. Hence, UE may be encouraged to send the request again. From NW side, it is possible to also send an abort message if UE happens to send several requests, this may be considered similar as stop or error indication.

It is suggested that companies evaluate if such prohibit functionality is needed and if so which of the Options are preferred.

• Option A: UE can only request on-demand PRS based on prior reception of on-demand PRS configuration

* Option B: Configuration of a prohibit timer

• Option C: Reattempt timer

• Option D: Stop or Error or Abort message indication from the LMF

• Option E: None

**Question 5: Companies are invited to provide input on which option is best suited here?**

|  |  |  |
| --- | --- | --- |
| Company | Agree with Proposal Yes/No | Comments |
| Fraunhofer | Agree, Option A | UE can only request on-demand PRS based on prior reception of on-demand PRS configuration. |
| CATT | Agree, Option A&B/C | From device perspective, the option A is the combination of Q3, i.e., the pre-requisite for on-demand PRS request and Q2, i.e., whether UE can request preferred PRS configurations that go beyond what the network indicated. And we agree that only UEs that have been provided the available DL-PRS configurations can initiate the on-demand PRS request, and the contents of the on-demand PRS request must be within the available DL-PRS provided by NW.From multi-UEs management perspective, we support B or C because NW should restrict too frequent on-demand PRS request from UEs by configuring the prohibit timer or reattempt timer. The timer can be configured to the UE when the available on-demand PRS is sent to UE. |
| vivo | Agree, Option A&B/C with clarification | The NW may reject the on-demand PRS request as the radio resource is temporarily not available, e.g., RAN overload. To avoid massive signaling, the UE shall not request another PRS configuration despite whether the previous request is accepted or not. Therefore, Option C shall be clarified that the reattempt timer can be included in the response no matter the NW accepts or rejects the on-demand PRS request. If so, we think either Prohibit timer or reattempt timer can work and the only difference is the Prohibit timer is in the configuration and the reattempt timer is in the response. |
| Apple | Option A | Option A is sufficient |
| Qualcomm | None (E) | None is needed for basic functionality. However, if there are concerns that a UE may send repeatedly requests, B/C can be considered. However, this concern – if any – would not be specific/restricted to DL-PRS assistance data requests. |
| Intel | Option A and maybe B/C | We think option A is anyway needed to ensure that the UE is able to select the corresponding PRS configuration set/identifier as part of the on-demand request. In addition, we do not think options B or C are essential, but we are fine to support if majority prefers to have it. We do not think D is needed. |
| Nokia | Option A | UE can only request index or indices of PRS configurations provided by the network beforehand for an on-demand PRS request. In order to make such requests from multiple UEs manageable, UEs are limited to requesting only the PRS configurations matching to their positioning QoS and/or radio conditions, indicated by the network. Yet, UEs should be able to request multiple indices with these criteria, in case one of them gets rejected by the network. |
| ZTE | None  | As we mentioned before,a compromised solution is that UE can request PRS config IDs based on prior reception of on-demand PRS configuration, and UE can also request explicit PRS parameters without the restriction of NW. So option A is not complete/accurate.If UE requests explicit parameters, UE can request any values that spec supports. In this case if NW can not satisfy UE’s request(send UE an error), whether UE will request again or UE will wait for a while depends on UE’s implementation. No need to define signalling interaction between LMF and UE. So option B C D is unnecessary. |
| OPPO | Option A,B/C | As mentioned in Q3, UE can only request on-demand PRS based on pre-configured PRS configurations provided by NWFor option B/C, we think both prohibit timer and reattempt timer aiming to avoid redundant and frequent on-demand PRS request, and such mechanism is needed.  |
| Xiaomi | Option A, D | For option A, if network provide on-demand PRS configuration, the UE can send on-demand PRS request. When the LMF can’t provide the on-demand PRS configuration requested by UE, the option D can be used. |
| Lenovo, Motorola Mobility | Option E - None | Option A is restricitive, while options C-D are optimizations of which the benefits are not clear.  |
| InterDigital | Option B/C | We do not think Option A prevents the UE from resending on-demand PRS given the condition of prior reception of on-demand PRS configuration. On the other hand, Option B and C can be useful in controlling how frequent the UE can send on-demand PRS. |
| Huawei, HiSIlicon |  | We would like to understand why the previous LPP spec does not put any restriction on when the UE can send the LPP message and there is no prohibit timer between successive LPP message tranmissions. Similar mechanism can be found in the RRC UE-initiated messages.If there is no problem for LPP to work without such mechanism, we prefer E that we don’t shift from the LPP style |
| Ericsson | E | Agree with Huawei |
|  |  |  |
|  |  |  |
|  |  |  |

## 3.5 posSI response to on-demand PRS request

During email discussion of stage2 [R2-2111375], the below proposal was discussed and has been currently been marked as an FFS. We try to conclude in this email discussion.

Proposal 2: For On-Demand PRS, to discuss whether posSI can be the response for On-Demand PRS request.

Similar to the functionally of on-Demand PRS, another feature “On-Demand SIB/PosSIB” request in dedicated mode has been specified in RRC in Rel-16. The behaviour described in RRC allows NW to deliver the requested SIB either via RRCReconfiguration Message or Broadcast. In fact, UE is expected to monitor the broadcast whereas NW may deliver via dedicated signalling. Rapporteur’s view is that to some extent, this behaviour should be applicable also for on-Demand PRS.

If NW is already providing the PRS configuration via poSIB and UE happens to request another configuration via LPP dedicated signaling, the NW should be allowed to send the content either via posSIB (by changing to new configuration) or via LPP.

We need to also note that there has previously below agreement as captured in the Note below. Thus, NW may simply abort the ongoing LPP procedure and/or send the configuration via posSI.

NOTE 1: It is up to Network (LMF) implementation on the steps to follow (accept/reject/ignore) on receiving UE-initiated On-Demand PRS request.

It was further mentioned that the NW may not know UE capability of posSI; however, as such there is no capability associated for broadcast. Yes, there is subscription associated with posSIBs and the posSIB may be encrypted; thus UEs with only valid subscription can avail that. The same though is also applicable for connected mode where LMF may check the UE’s subscription and deny the request if UE does not have valid subscription [Reference provided from SA2 spec in [Annex](#_6_Annex)]. Hence, as such there should be no reason to deny a NW implementation to send the response via broadcast.

**Question 6: Do companies agree with rapporteurs above reasoning that posSI can be the response for On-Demand PRS request and it is up to NW implementation to select the delivery mode?**

|  |  |  |
| --- | --- | --- |
| Company | agree with above Yes/No | Comments |
| Fraunhofer | Yes | Informing the UE about the ongoing on-demand PRS via posSib could be reused by other UEs, if they have similar demands. They could make better reuse the existing transmissions (i.e. they could indicate that they need the same index). |
| CATT | No | UE initiated on-demand PRS request is via the LPP request assistance data message, which is a class 1 message according to current specification, i.e., a LPP response is necessary. Thus, from our perspective, NW must provide the LPP provide assistance data as response of the on-demand PRS request from UE.As for the posSI, it is natural that posSI will be updated accordingly when the DL-PRS configuration is changed. Just like the A-GNSS AD will be updated in posSI accordingly when it is changed. No need to specify the change of posSI because of the on-demand request. |
| vivo | No | RAN2 has agreed that on-demand PRS request is initiated via the existing LPP RequestAssistanceData message. In our view, the LPP RequestAssistanceData message is always followed by an LPP ProvideAssistanceData message as the response. Besides, responding to the on-demand PRS request via posSI may cause very frequent system information update and further cause the unnecessary consumption of UE power due to the reading of updated system information. |
| Apple | No | Agree with the argumenrs from CATT and vivo above. |
| Qualcomm | No | Agree with CATT and vivo above. (On-demand) posSI (i.e., RRC) and LPP signalling should not be mixed. |
| Intel | No | Same view as other companies above that we should not mix LPP procedure with posSI |
| Nokia | No | It is one thing to have broadcast signaling for the provisioning of predefined PRS configuration, but it is altogether different whether NW sends a posSI message in response to the request for on-demand PRS. The former should be OK while the later is not OK. Also, agree with CATT’s comments. |
| ZTE | No | Agree with other companies that LPP response is the one that corresponds to LPP request. |
| OPPO | No  | Agree with other companies. |
| Xiaomi | No |  |
| Lenovo, Motorola Mobility |  No  | Also share CATT’s view. |
| InterDigital |  No | Same view as other companies |
| Huawei, HiSIlicon | No | Same view as CATT |
| Ericsson | Yes | If NW is already providing the PRS configuration via poSIB and UE happens to request another configuration via LPP dedicated signaling, the NW should be allowed to send the content either via posSIB (by changing to new configuration) or via LPP.  |
|  |  |  |

##

# 5 Conclusion

Based on the discussion in the previous sections we propose the following:

# 6 Annex

TS 23.273 v17.2.0

4) The AMF invokes the Nlmf\_Location\_DetermineLocation service operation towards the LMF. The service operation includes an LCS Correlation identifier, the serving cell identity, the client type, an indication whether a location estimate, or location assistance data is requested, UE Positioning Capability if available, a list of MO-LR subscribed assistance data and any embedded LPP message(s) in the MO-LR Request. If the UE's location is requested, the service request may include an indication if UE supports LPP, the requested QoS and Supported GAD shapes. If location assistance data is requested, the embedded LPP message(s) will convey the requested types of location assistance data. If any of the procedures in clause 6.11.1 or 6.11.2 are used the service operation includes the AMF identity. Once an AMF has selected an LMF it must continue to use that LMF for the duration of the session.

# 7 Agreements

**RAN2-113bise**

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.

**RAN2-114e**

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.

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.

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

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.)

**RAN2-115e**

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.

**RAN2-116**

Agreements:

RAN2 to agree to support the UE originated request of on-demand PRS via MO-LR for autonomous self location.

RAN2 to agree that UE can send 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, and the MOLR-Type of this MO-LR Request message is “assistanceData”.

RAN2 to agree the following general stage 2 procedure as baseline for UE initiated on-demand PRS via MO-LR. [Figure 2 of R2-2109483, with the associated list of steps as given in section 5 of R2-2109483.] To be discussed in development of the running stage 2 CR (post-meeting) how much of this detail we need to capture in 38.305.

The UE may initiate an on-demand PRS request per positioning method including DL-TDoA, DL-AoD and Multi-RTT, via the existing LPP RequestAssistanceData message.

There is no need for introducing a new LPP message to carry the on-demand PRS request.

# 8 References

1. R2-2111256***,*** Summary on agenda item 8.11.4 on on-demand PRS, Lenovo, Motorola Mobility
2. R2-2109483, [Post115-e][606][POS] MO-LR for on-demand PRS (CATT)
3. R2-2111375, Report of offline discussion [AT116-e][623][POS] 38.305 CR for RAT-dependent positioning (Intel)