3GPP TSG-RAN WG2 Meeting #118-e ***R2-2206256***

Electronic Meeting, May 9 – 20, 2022

**Agenda item:** 6.11.2.1

**Source:** Qualcomm Incorporated

**Title:** [AT118-e][635][POS] Cross-group alignment for PPW (Qualcomm)

**Document for:**  Discussion

# 1. Introduction

This document summarizes the following email discussion:

* [AT118-e][635][POS] Cross-group alignment for PPW (Qualcomm)

Scope: Check P11 from R2-2206147 and determine whether to align the PPW/MG procedures.

Intended outcome: Report to Wednesday CB session in R2-2206256

Deadline: Tuesday 2022-05-17 1800 UTC

##### References:

[1] R2-2206340, "Summary of AI 6.11.2.1 on latency", ZTE, Sanechips.

[2] R2-2205764, "Issues with PRS Processing Window Procedures", Qualcomm Incorporated.

# 2. Background

RAN1 made the following agreement:

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| Subject to UE capability, support PRS measurement outside the MG, within a PRS processing window, and UE measurement inside the active DL BWP with PRS having the same numerology as the active DL BWP.   * Inside the PRS processing window, subject to the UE determining that DL PRS to be higher priority, support the following UE capabilities:   + Capability 1: PRS prioritization over all other DL signals/channels in all symbols inside the window.     - Cap. 1A: The DL signals/channels from all DL CCs (per UE) are affected.     - Cap. 1B: Only the DL signals/channels from a certain band/CC are affected.       * FFS: band or CC   + Capability 2: PRS prioritization over other DL signals/channels only in the PRS symbols inside the window   + A UE shall be able to declare a PRS processing capability outside MG.     - FFS: Details of capability signalling (e.g., per UE or per band, etc.) |

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| PRS processing window request to the gNB by the LMF is supported from RAN1 perspective.   * + It is up to RAN3 to design the necessary information to be transferred in the NRPPa message.   + Note: It is up to gNB to determine the usage of measurement gap or PRS processing window   + Include it in the LS to RAN2 and RAN3.   For PRS processing window configuration and indication, at least the following mechanism is supported   * + RRC (pre-)configuration for PRS processing window configuration and DL MAC CE activation for PRS processing window, respectively.   Include it in the LS to RAN2 and request RAN2 to decide whether DL MAC CE is feasible for this indication. |

RAN1 requested RAN2 in the LS [R2-2200089](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_116bis-e/Docs/R2-2200089.zip):

"RAN1 respectfully requests RAN2 to take above agreements into account in their future work and decide whether DL MAC CE is feasible for indicating the activation of the PRS processing window."

This LS was noted at RAN2#116bis-e and no reply LS was sent.

Accordingly, RAN2 defined the RRC pre-configuration and DL MAC CE activation and deactivation of PPW.

The PRS Processing Window Parameter are specified in TS 38.331 in IE *DL-PPW-PreConfig* and includes the following parameter:

- *dl-PPW-ID-r17*: The ID defining the pre-configured PPW.

- *dl-PPW-Periodicity-and-StartSlot-r17*: Defining the starting slot and the periodicity of the PPW (defined similar to the DL-PRS slot offset and periodicity).

- *length-r17*: Defining the PPW length in slots

- *type-r17*: Defining one of the 3 PPW types as specified in TS 38.214.

- *priority-r17*: Defining the priority between PDCCH/PDSCH/CSI-RS and DL-PRS as specified in TS38.214.

Further:

- The PRS processing window is configured per DL BWP.

- The maximum number of preconfigured PRS processing window per DL BWP is 4 (i.e., 4×4 in total).

- The maximum number of PRS processing windows that can be activated/deactivated by a DL MAC CE is 1.

- The maximum number of activated PRS processing windows per DL BWP is 1.

- The maximum number of activated PRS processing windows across all active DL BWPs is 4.

- Inside each single instance of a PRS processing window, a single PFL can be measured. This is applicable to all Types of MG-less PRS processing.

RAN2 defined the following Stage 2 procedure, which is essentially the same as for MGs, but without the possibility for a target device to request a particular pre-configured PPW to be activated (i.e., when starting measurements in a PFL) and be deactivated (i.e., when measurements are completed).

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| 7.8.2 Pre-configured PRS processing window procedures Figure 7.8.2-1 shows the general positioning procedure for Pre-configured PRS processing window.    Figure 7.8.2-1: Pre-configured PRS processing window configuration procedure  0. LMF obtains the TRP information required for positioning services from the gNBs.  1. The LMF provides the PRS information of the neighbour TRPs to the serving gNB and requests the serving gNBs to pre-configure PRS processing window configuration(s) via NRPPa MEASUREMENT PRECONFIGURATION REQUIRED message.  2. Based on the assistance information from the LMF and the UE capability, the serving gNB provides pre-configured PRS processing window configuration(s) with associated ID(s) to the UE by sending RRC Reconfiguration message specified in TS 38.331 [14].  3. The UE sends RRC Reconfiguration complete message to the gNB to confirm the reception of pre-configured PRS processing window configuration.  4. The gNB sends the confirmation message to the LMF to indicate the success of the pre-configuration via NRPPa MEASUREMENT PRECONFIGURATION CONFIRM message.  5. The LMF sends the NRPPa MEASUREMENT ACTIVATION message to request the gNB to (de)activate the preconfigured PRS processing window.  6. Based on the request from the LMF in step 5, the gNB sends DL MAC CE PPW Activation/Deactivation Command containing an ID to activate the associated PRS processing window. |

However, the above procedure can not be supported with the current RAN3 specification as observed in [2] . In particular:

(a) A LMF can currently not request the serving gNB of the target UE to pre-configure PRS processing window configuration(s) via NRPPa MEASUREMENT PRECONFIGURATION REQUIRED message (Step 1 of the Stage 2 procedure). (The same is the case for MGs).

(b) The currently specified "assistance information" provided by the LMF to the serving gNB of the target device in a NRPPa MEASUREMENT PRECONFIGURATION REQUIRED message does not enable the serving gNB to properly preconfigure PRS processing windows in the target device. A serving gNB would need to know (at least) the detailed DL-PRS processing capabilities of the UE outside measurement gaps (FG 27-3-3; not known at gNB).

(c) A LMF does currently not know whether a serving gNB has preconfigured a target device with measurement gaps or PRS processing windows.

(d) There is currently no NRPPa message defined which allows an LMF to activate preconfigured PRS processing windows. (Step 5 of the Stage 2 procedure).

The above items concern RAN3 NRPPa procedures (probably except for (b)) and are also discussed in RAN3.

However, from RAN2 perspective, contribution [2] observes the following issues:

- Assuming the NRPPa issues get fixed, a LMF can activate a pre-configured PPW (and also MG) at the beginning of a location session (e.g., when sending LPP assistance data or location request to the target device).

- However, if during an ongoing location measurement in the target device, the UE requires a different PPW (e.g., to measure a different PFL), there is no mechanism to deactivate a PPW and request activation of a different pre-configured PPW (e.g., in a different BWP).

- The above is the same issue as with MGs. I.e., a single gap configuration is usually not suitable for measurements on different PFLs, since a UE can measure one PFL at a time (same as Rel-15 RRC location measurement indication with start/stop mechanism).

- This is essentially the benefit of pre-configuration; i.e., multiple PPW/MG configurations are provided to the target device in advance and one of them is activated when needed. However, an LMF can activate a particular PPW/MG only at the beginning of a location session but does not know when a UE requires a different PPW/MG to be activated during a session.

- Therefore, UL MG activation/deactivation requests are supported for MGs (via UL MAC CE), but not for PPW. The reason for this is unknown to the moderator/source company [2], since the PPW and MG features are essentially the same from a procedure point of view.

Therefore, [2] proposed to unify the MG and PPW procedures, and a summary proposal for discussion was formulated in [1]:

Proposal 11: Support to adopt the same procedure for pre-configured PPW and pre-configured MG. The RAN2 changes including:

- Introduce a new UL MAC CE for PPW activation/deactivation request;

- Add UE capabilities for UL/DL MAC-CE based PPW activation.

The RAN3 changes including:

- Include the UE DL-PRS processing capability outside measurement gaps in the NRPPa  
 MEASUREMENT PRECONFIGURATION REQUIRED message.

- Include information on what has been preconfigured in the target device (MGs and/or PPW) in the  
 NRPPa MEASUREMENT PRECONFIGURATION CONFIRM message.

- Enable the NRPPa MEASUREMENT ACTIVATION message to activate/deactivate  
 preconfigured PRS processing windows.

If agreed, adopt TPs of 38.305, 38.321, 38.331, 37.355 in R2-2205764 as baseline. Send LS to RAN1 and RAN3 for confirmation.

A unified procedure merging sections 7.7 and 7.8 of Stage 2 into a single procedure was proposed in [2]:

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| 7.7 Procedures for Pre-configured Measurement Gap and PRS Processing Window7.7.1 General The procedure is used by the network to provide measurement gap or PRS processing window for NR DL-PRS measurements. The gNB may activate/deactivate the pre-configurated measurement gap or PRS processing window upon receiving the request from a UE or LMF. 7.7.2 Pre-configured Measurement Gap and PRS Processing Window procedures Figure 7.7.2-1 shows the general procedure for Pre-configured Measurement Gap and PRS Processing Window.  Figure 7.7.2-1: Pre-configured measurement gap and PRS processing window configuration procedure  0. The LMF obtains the DL-PRS information required for preconfiguration of measurement gaps or PRS processing windows from the gNBs.  1. The LMF provides the DL-PRS information of the TRPs together with UE capability information to the serving gNB and requests the serving gNBs to pre-configure measurement gap or PRS processing window via NRPPa MEASUREMENT PRECONFIGURATION REQUIRED message.  NOTE 1: It is up to the serving gNB of the target device to determine the usage of measurement gap or PRS processing window.  2. Based on the assistance information from the LMF and the UE capability, the serving gNB provides pre-configured measurement gap or PRS processing window configuration(s) with associated ID(s) to the UE by sending RRC Reconfiguration message specified in TS 38.331 [14].  3. The UE sends RRC Reconfiguration complete message to the gNB to confirm the reception of pre-configured measurement gap configuration.  4. The gNB sends the confirmation message to the LMF to indicate the success of the pre-configuration via NRPPa MEASUREMENT PRECONFIGURATION CONFIRM message. The message includes an indication on whether measurement gaps or PRS processing windows have been preconfigured in the target device.  5a. If the UE requires measurement gaps or PRS processing windows for performing the requested location measurements, the UE sends an UL MAC CE Positioning Measurement Gap or PRS Processing Window Activation Request to the gNB and indicates the requested measurement gap or PRS processing window configuration based on the ID configured in step 1.  5b. The LMF may send the NRPPa MEASUREMENT ACTIVATION message to request for measurement gap or PRS processing window activation.  6. Based on the request from the UE in step 5a or the request from the LMF in step 5b, the gNB may send DL MAC CE Positioning Measurement Gap Activation containing an ID to activate the associated measurement gap or PRS processing window.  NOTE 2: If the target device requires more than one measurement gap or PRS processing window configuration for performing the requested DL-PRS measurements (e.g., in the case of measurements for multiple Positioning Frequency Layer are performed), Steps 5a and 6 may be repeated.  7a. When the location measurements have been completed and measurement gap or PRS processing window are not needed any longer, the UE sends an UL MAC CE Positioning Measurement Gap or PRS Processing Window Deactivation Request to the gNB and indicates the measurement gap or PRS processing window configuration based on the ID provided in step 6 to be deactivated.  7b. When the location measurements have been completed, the LMF may send the NRPPa MEASUREMENT ACTIVATION message to the serving gNB to request measurement gap or PRS processing window deactivation. |

As mentioned in Proposal 11 [1], the RAN2 impacts are the specification of a new PPW Activation/Deactivation Request MAC CE (analogous to the MG Activation/Deactivation Request MAC CE) together with corresponding RRC capabilities.

# 3. Discussion

**Question 1:** Assuming NRPPa will be corrected to support the Stage 2 procedure as currently specified in clause 7.8.2 of TS 38.305 (copied at the beginning of section 2 above) , do you think an LMF initiated activation of PPW is sufficient for the feature to work proper?

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| Company | Yes/No | Comments |
| Huawei, HiSIlicon | Yes | it is sufficient for PPW activation/deactivation and there is explicit R1 agreement that this is needed. This has to be fixed.  **Agreement**  PRS processing window request to the gNB by the LMF is supported from RAN1 perspective.   * + It is up to RAN3 to design the necessary information to be transferred in the NRPPa message.   + Note: It is up to gNB to determine the usage of measurement gap or PRS processing window   + Include it in the LS to RAN2 and RAN3. |
| Ericsson | Yes, but instead of activation it is just a request as specified in RAN1 agreement | RAN1 says  **PRS processing window request** to the gNB by the LMF  But not activation/deactivation trigger.  MG and PPW are fundamentally different. MG is only about PRS measurement where gNB has stopped data scheduling. However, PPW also involves data scheduling and hence to activate PPW involving data scheduling decision is solely by gNB. There is no need of external trigger from UE or LMF.  LMF simply needs to provide the positioning measurement configuration to gNB that it has configured (or intending to configure). Based upon this LMF request gNB can decide whether to configure PPW or MG. If PPW is configured; gNB can estimate how long will UE take to perform measurement based upon UE PPW capabilities and based upon input/request received from LMF on positioning measurement configuration.  Hence, there is no need for external activation/deactivation for PPW. A new MAC CE design is expensive and would be complicated as well to handle. We should also note that RAN1 did not agree to this and also generic MG improvement did not see the need of either DL or UL MACCE.  If companies want optimization; the only thing that could be needed is that UE can provide a notification to gNB that it has completed positioning measurements via RRC so gNB can release PPW. But gNB should be able to deduce also based upon UE PPW capabilities and what positioning measurements have been configured to this UE. |
| Apple | Yes | Agree to define MAC CE for PPW activation/deactivation request (with UE capability) |
| Xiaomi | Yes | RAN1 had already agreed that PRS processing window request to the gNB by the LMF is supported. But we think there is no need to provide the PPW capability of UE to gNB by LMF, if the capability is required at the gNB, it is a straightforward way that UE provides its PPW capability to the gNB directly. |
| Intel | Yes | It is clearly indicated in RAN1 LS that   * + Note: It is up to gNB to determine the usage of measurement gap or PRS processing window   Therefore the LMF only needs to provide the request with necessary assistance information. |
| ZTE | Yes | Agree with Ericsson that R1 only says LMF to request PPW, not activate PPW. |
| InterDigital | Yes | As per RAN1 agreement we think it is sufficient for the PRS processing window request to the gNB by the LMF. Also, as indicated by Ericsson, the decision related to prioritization between data channels and PRS during activation/deactivation of PPW is anyways up to gNB. Therefore, an additional request for the activation/deactivation of PPW from the UE is not needed. |
| CATT | Yes | On PRS pre-configuration, LMF to provide the PRS configuration assistance information to gNB is enough. The only thing needed is to add what has been configured i.e., MG, or PPW, within the NRPPa MEASUREMENT PRECONFIGURATION CONFIRM.  On PRS activation, we agree that RAN3 should extend the NRPPa activation message so as LMF can trigger the activation of PPW, and by doing this, gNB can decide when UE decide to make positioning measurement, anyway the positioning measurement of UE is triggered by LMF.  On PRS deactivation, we think deactivation message is needed, and as we know RAN3 is discussing to introduce a new deactivation message now. |
| vivo | Yes | In our understanding, the LMF has not enough information to decide whether to need to activate the pre-gap or PPW to perform the positioning measurement by the UE. Therefore, the LMF only provides the necessary assistance information to the gNB. Based on the assistance information from the LMF (e.g., measured PRS frequencies), the gNB determines whether or not to activate the pre-gap or PPW based on UE’s access capability.  Therefore, the “LMF initiated activation of PPW” actually is a procedure of providing the assistance information as same for “LMF initiated activation of pre-gap”. Even it is possible that the gNB does nothing if the gNB finds that the UE is capable to perform the measurement without any activation. |
| Nokia | Yes | We think RAN2 had captured the RAN1 agreements correctly. RAN3 issues that are identified (misalignment with stage 2 and RAN1 agreements) needs resolving in RAN3. As the solution was evaluated and agreed in RAN1, any additional functionality like UE request to activate/deactivate PPW needs to be discussed in RAN1. |

Summary:

- It seems all companies which replied think that an LMF initiated activation request of PPW is sufficient for the feature to work proper.

**Question 2:** Do you agree to align the MG and PPW procedures (e.g., as shown at the end of section 2 above)? The corresponding Stage 3 changes required are:  
Introduction of a PPW Activation/Deactivation Request MAC CE together with corresponding RRC capability (analogous to MG).

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| Company | Yes/No | Comments |
| Huawei, HiSilicon | No | R1 has already discussed but has not agreed on this. |
| Ericsson | No | Fundamentally PPW and MG are different. PPW is also about PDCCH/PDSCH data scheduling and not just PRS measurement. |
| Apple | No | Just adding MAC CE is sufficient to solve the issue |
| Xiaomi | No | PPW Activation/Deactivation Request MAC CE should not be introduced since RAN1 didn’t make agreements on this. |
| Intel | No | Same as others. |
| OPPO |  | We have sympathy on this issue. We know that PPW and MG is different, PPW must be determined by the gNB itself. But UE should be given opportunity to indicate to the network that the measurement on one particular PFL has been finished by currently configured PPW and would like to ask another one for potentially measurement on another PFL, which does not contradicted with the requirement that PPW should be determined by the gNB. |
| ZTE | No | That is big change at this stage for both RAN2 and RAN3. |
| InterDigital | No | Given the issues indicated by Ericsson and the complications due to scheduling/prioritization between PRS and PDCCH/PDSCH that can be decided only by gNB, we do not think a PPW activation/deactivation request MAC CE will bring any benefit, and hence, not needed. |
| CATT | No | Seems not necessary, and RAN1 did not ask RAN2 to do this as well. |
| vivo | No | Whether MAC CE can be used to activate/deactivate PPW should be up to RAN1. |
| Nokia | No | Question 2 needs to be raised in RAN1. |

Summary:

- It seems all companies which replied think that the MG and PPW procedures do not need to be aligned. In particular, no UL MAC-CE is needed for PPW Activation/Deactivation Request.

# 4. Summary

- It seems all companies which replied think that an LMF initiated activation request of PPW is sufficient for the feature to work proper.

- It seems all companies which replied think that the MG and PPW procedures do not need to be aligned. In particular, no UL MAC-CE is needed for PPW Activation/Deactivation Request.

- With regards to the scope of this email discussion (check P11 from R2-2206147 and determine whether to align the PPW/MG procedures), P11 is not agreeable.