**3GPP TSG-RAN WG1 Meeting #107-e R1-2112458**

**e-Meeting, November 11th – 19th, 2021**

**Agenda Item: 8.5.4**

**Source: Moderator (Huawei)**

**Title: Summary #2 of [107-e-NR-ePos-04] latency improvements**

**Document for: Discussion and decision**

# Introduction

In RAN1#107-e, the following papers provided input on latency improvements for DL and DL+UL methods.

1. R1-2110853 Enhancements to positioning latency improvements Huawei, HiSilicon
2. R1-2110959 Discussion on latency reduction for NR positioning ZTE
3. R1-2111016 Remaining issues on latency enhancement for NR positioning vivo
4. R1-2111259 Remaining issues on latency reduction for NR positioning CATT
5. R1-2111292 Enhancements on Latency Reduction in NR Positioning OPPO
6. R1-2111367 Views on PHY Latency Reductions Nokia, Nokia Shanghai Bell
7. R1-2111400 Remaining issues on latency improvements for NR positioning Sony
8. R1-2111435 Discussion on latency improvement for positioning China Telecom
9. R1-2111498 Remaining Open Aspects of NR Positioning Latency Reduction Intel Corporation
10. R1-2111575 Latency improvements for both DL and DL+UL positioning method Xiaomi
11. R1-2111611 Discussion on latency improvement for positioning CMCC
12. R1-2111741 Discussion on latency improvements for both DL and DL+UL positioning methods Samsung
13. R1-2111800 Latency improvements for both DL and DL+UL positioning methods InterDigital, Inc.
14. R1-2111877 Views on Rel-17 positioning latency reduction Apple
15. R1-2111976 Discussion on latency improvements for NR positioning LG Electronics
16. R1-2112073 Physical latency improvement aspects MediaTek Inc.
17. R1-2112111 Discussion on latency improvements for both DL and DL+UL positioning methods NTT DOCOMO, INC.
18. R1-2112220 Remaining issues on Latency Improvements for Positioning Qualcomm Incorporated
19. R1-2112325 Remaining issues on Positioning Latency Reduction Lenovo, Motorola Mobility
20. R1-2112342 Latency improvements for both DL and DL+UL positioning methods Ericsson
21. R1-2112411 Draft LS on lower Rx beam sweeping factor for latency improvement Moderator (Huawei)

This paper provides the moderator summary of solutions to improve positioning latency for DL and DL+UL methods, subject to the following email discussion.

[107-e-NR-ePos-04] Email discussion/approval on latency improvements for both DL and DL+UL positioning methods with checkpoints for agreements on November 15 and 19 – Su (Huawei)

# Measurement gap enhancements

## General information

The following agreements were made in RAN1#106bis-e on this issue.

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| Agreement:  Support the following options (in the agreement made in RAN1#106-e) for a new mechanism of MG activation request for the purpose of positioning.   * Option 2: by UE (via UCI or UL MAC CE)   + Select only one of UCI and UL MAC CE in RAN1#106bis-e * Option 1: by LMF (via an NRPPa message)   + Note: This is transparent to the UE   Conclusion:  Potential enhancements to latency reduction with respect to MG sharing with other RRM procedures is up to RAN4 to decide.  Agreement:  Support using UL MAC CE for MG activation request by UE (Option 2) for the purpose of positioning.  Agreement:  Support the following option (from the agreement made in RAN1#106-e) for a new MG activation procedure to be performed by the gNB for the purpose of positioning.   * Option 2: DL MAC CE * FFS: Deactivation process   Agreement:  With regards to MG activation by DL MAC CE, further study   * DL MAC CE payload * The necessity of pre-configuration of MGs in higher layers. |

## Preconfiguration of MG

The following sources provided their views on preconfiguration of MG

|  |  |
| --- | --- |
| **Company** | **Proposals** |
| Huawei, HiSilicon [1] | **Proposal 3:** Support preconfiguration of up to 8 MGs in RRC and DL MAC CE to provide the bitmap of the activation/deactivation status of each MG.   * The preconfigured MGs are by default deactivated. * From RAN1 perspective, at most a single preconfigured MG among all preconfigured MGs can be activated for the purpose of PRS measurement at any given time. * Send an LS to RAN2 and RAN4. |
| vivo [3] | **Proposal 1**   * The pre-configured MG should be transmitted to UE by RRC signaling, and include the following information.   + The common configuration parameters (e.g. MGRP, MGL, etc.)   + Initial status of pre-configured MG: activated, deactivated   + The pre-configured ID can be supported for indicating one of multiple pre-configured MG, or indicating a positioning MG   **Proposal 6:**   * Before MG or pre-configured MG configuration, the time/frequency characteristics (i.e., periodicity/offset and/or frequency layer information) of PRS should be transmitted to gNB in advance. |
| OPPO [5] | Proposal 2: Support configuring a list of MG configurations in RRC and the UE can use MAC CE to request one of them. |
| Nokia, NSB [6] | **Proposal 2**: RAN1 to discuss if pre-configured MG is supported or not. |
| SONY [7] | **Proposal 1:** gNB provides the configuration of supported MG(s) for positioning latency improvements to UE / LMF. The configuration is provided in higher layers signalling. |
| CTC [8] | **Proposal 2-1:** Rel-17 should support the pre-configuration of MG via RRC signaling.  **Proposal 2-2:** The details of RRC signalling of pre-configuration should left up to RAN2, while the reuse of configuration can be a start point, e.g. MGL, MGRP, MG offset. |
| Intel [9] | **Proposal 1:**   * + To reduce latency of NR positioning with MGs for DL PRS processing define the following enhancements:     - Support pre-configuration of the multiple MG patterns for the DL PRS processing using RRC or LPP signaling       * Signaling details are left up to RAN2     - Support DL MAC CE signaling only to activate the pre-configured MGs for DL PRS processing by UE       * Signaling details are left up to RAN2     - Inform RAN2 on the RAN1 discussion and agreement |
| Xiaomi [10] | **Proposal 4:** Prefer pre-configuration of MG. |
| IDC [13] | **Proposal 2:** If pre-configured measurement gaps are available at the UE, the UE sends a MG request via MAC-CE. Otherwise the UE sends the MG request via RRC. |
| LGE [15] | **Proposal 4:**   * RAN1 should support the pre-configuration of MGs in terms of latency reduction   **Proposal 5:**   * RAN1 should support followings if the pre-configuration of multiple MGs is supported   + Introducing MG index(or ID) to distinguish configured Multiple MGs easily   + Providing UE with information regarding association between pre-configuration of MGs and MG indices (or MG IDs)   + MG index (or MG ID) needs to be included in the both MG activation request (UE-initiated) and MG activation (gNB-initiated). |
| DCM [17] | **Proposal 1:**   * MG activation procedure based on combination of RRC and MAC-CE should be considered   + A MG configuration list including multiple MG configurations is configured via RRC signaling   + MAC CE is used to activate/deactivate one MG configuration in the configuration list |
| Lenovo, Moto Mobility [19] | **Proposal 4:** Support multiple pre-configured measurement gaps for latency reduction together with applicable assistance information from the LMF. |

**FL comments**

The preconfiguration of MGs are supported by majority of companies (12), while one company suggested to carry everything from RRC into DL MAC CE.

There were questions how gNB could determine the proper MG patterns in the preconfiguration, and there was a proposal on the preconditions on the signaling between LMF and gNB to enable so.

There were also a few proposals mentioning that preconfiguration of MGs should be provided by LMF. However, based on the understanding from the FL, this may involve RAN2 to check the feasibility.

### Round 1

Based on the summary from the contributions, the FL has the following proposal, and questions.

**Proposal 2.1.1-1 (revised)**

* Preconfiguration of MG(s) in RRC is supported from RAN1 perspective.

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| vivo | Yes |  |
| Nokia/NSB | Yes | We don’t see how this feature is useful without it |
| Qualcomm |  | To Nokia: Why you don’t see being useful without it? If a MAC-CE can include the RRC config of the DL-MAC-CE, what do we initially benefit from having multiple preconfigured?  Either way, for the sake of progress we can go with the majority on this, assuming that for UL-MAC-CE request, a UE will be able to request any MG needed, and not within the ones are preconfigured. |
| CATT | Yes |  |
| ZTE | Yes | We thin the MG request from LMF may help gNB to preconfigure the MGs. |
| OPPO | Yes |  |
| Xiaomi | Yes | Based on preconfiguration of MGs via RRC, UE can request one of them by UL MAC CE and gNB can activate one by DL MAC CE. |
| Huawei, HiSilicon | Yes |  |
| CMCC | Yes | We share the understandings with QC that, if no MG pre-configurations are provided, or the UE thinks that none of the pre-configurations is suitable, then UE can just request what it wants via UL MAC-CE. |
| Intel | Yes |  |
| NTT DOCOMO | Yes |  |
| Ericson | Yes |  |
| Lenovo,Motorola Mobility | Yes |  |
| CTC | Yes |  |
| Sony | Yes |  |
| LGE | Yes |  |
| Apple | Yes |  |
| InterDigital | Yes |  |

**Question 2.1.1-2 (closed)**

* Do companies see the need to send an LS to RAN2 and RAN3 if Proposal 2.1.1-1 is agreed?

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Nokia/NSB |  | Okay with LS |
| CATT |  | This may be related to the Question 2.1.1-3. If RAN1 wants RAN2/RAN3 to work on the details, then it is obvious that RAN1 needs to inform RAN2/RAN3. |
| OPPO |  | A LS is needed if it is agreed. |
| Xiaomi |  | Fine with LS |
| CMCC | Yes |  |
| Intel | Yes |  |
| Ericsson |  | Ok with LS |
| Lenovo,Motorola Mobility | Yes |  |
| ChinaTelecom | Yes |  |
| Sony | Yes |  |
| LGE | Yes |  |
| Apple |  | OK to send LS |
| InterDigital | Yes |  |

**Question 2.1.1-3 (closed)**

* Do companies think RAN1 should discuss how gNB determines the preconfiguration of MG(s) or leave it to RAN2 and/or RAN3 if Proposal 2.1.1-1 is agreed?

|  |  |
| --- | --- |
| **Company** | **Comments** |
| vivo | We are okay to determine the preconfiguration of MG(s) by gNB and discuss in RAN1 |
| Nokia/NSB | We are okay for RAN1 to assume there will be preconfigured MG with an assocaiated ID and then let RAN2/3 work on details. |
| CATT | Share the simiar view as Nokia. |
| ZTE | Agree with Nokia. |
| **Samsung** | **We wonder RAN2/3 will still need the input from RAN1 on which configuration parameter to be put in the messege, so why not just decided in RAN1.** |
| OPPO | It can be up to RAN2 design |
| Xiaomi | Leave it to RAN2 |
| Huawei, HiSilicon | Suggest to handle in RAN2/RAN3. |
| CMCC | We prefer to leave details to RAN2. |
| Intel | Leave the details up to RAN2 |
| NTT DOCOMO | It may be better to leave the discussion to RAN2. |
| Ericsson | The details can be discussed by RAN2 and/or RAN3. |
| Lenovo,Motorola Mobility | Better suited for a RAN2 discussion |
| ChinaTelecom | Share the similar view as Nokia |
| Sony | Agree with Nokia. |
| LGE | We are on the same page with Nokia. RAN1 can discuss the configuration of MGs and related information such as IDs and associations. |
| InterDigital | We agree with Nokia |

**Question 2.1.1-4 (closed)**

* Do companies think preconfiguration of MG(s) could also be provided by LPP?

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| vivo | No |  |
| Qualcomm | No |  |
| ZTE | No |  |
| OPPO | No |  |
| Xiaomi | No |  |
| Huawei, HiSilicon | No |  |
| CMCC | No |  |
| Ericsson | No |  |
| Lenovo,Motorola Mobility | No |  |
| ChinaTelecom | No |  |
| Sony | No |  |
| LGE | No |  |
| Apple | No |  |

**FL comments**

With the comments received, the FL has the following proposals update.

**Proposal 2.1.1-1a**

* Preconfiguration of MG(s) in RRC is supported from RAN1 perspective.
  + Each MG in the preconfiguration is associated with MG-ID
  + Send an LS to RAN2 and RAN3

**Proposal 2.1.1-5 (continued)**

* Include in the LS the following content
  + RAN1 understands it is up to RAN2 and/or RAN3 to decide how gNB determines the preconfiguration of MG(s).

### Agreement after the GTW

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| --- |
| **Agreement**  Preconfiguration of MG(s) in RRC is supported from RAN1 perspective.   * + Each MG in the preconfiguration is associated with an ID   + The information in the UL MAC CE for MG activation request by the UE can be one ID associated with the preconfiguration of the MG   + Send an LS to RAN2 and RAN3 |

### Round 2

The following proposals are discussed for Round 2.

**Proposal 2.1.2-1 (closed)**

* Include in the LS the following content
  + RAN1 understands it is up to RAN2 and/or RAN3 to decide how gNB determines the preconfiguration of MG(s).

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| OPPO | Yes |  |
| Samsung | Yes |  |
| Xiaomi | Yes |  |
| ZTE | Yes |  |
| Lenovo,Motorola Mobility | Yes |  |
| Nokia/NSB | okay |  |
| CATT | Yes |  |
| QC | OK |  |
| Ericsson | Yes |  |
| Huawei, HiSilicon | Yes |  |
| China Telecom | Yes |  |
| NTT DOCOMO | Yes |  |
| SONY | Yes |  |

### Agreement as per email announcement

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| **Conclusion**  ●    Include in the LS the following content:  ○    RAN1 understands it is up to RAN2 and/or RAN3 to decide how gNB determines the preconfiguration of MG(s). |

## MG activation request by UE

The following sources provided their views on UL MAC CE based MG activation request by the UE.

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| --- | --- |
| **Company** | **Proposals** |
| Huawei, HiSilicon [1] | **Proposal 1:** Support inclusion of the following information in the NRPPa message and UL MAC CE for MG activation request.   * PRS point A * PRS measurement periodicity and offset * PRS measurement length   **Proposal 2:** Introduce a new parameter in RRC to enable/disable the MG activation request using UL MAC CE. |
| vivo [3] | **Proposal 2:**   * With pre-configured MG, MG request only includes the activation/deactivation indication |
| OPPO [5] | Proposal 2: Support configuring a list of MG configurations in RRC and the UE can use MAC CE to request one of them. |
| CTC [8] | **Proposal 1:** Rel-17 should support a new mechanism of MG request by UE via UCI or UL MAC CE at least for UE-based positioning methods. |
| IDC [13] | **Proposal 2:** If pre-configured measurement gaps are available at the UE, the UE sends a MG request via MAC-CE. Otherwise the UE sends the MG request via RRC.  **Proposal 3:** Support using UL MAC CE for MG deactivation request by UE for the purpose of positioning. |
| Apple [14] | **Proposal 2**: DL (UL) MAC-CE contains indication of which MG-ID is activated (demanded) |
| LGE [15] | **Proposal 5:**   * RAN1 should support followings if the pre-configuration of multiple MGs is supported   + Introducing MG index(or ID) to distinguish configured Multiple MGs easily   + Providing UE with information regarding association between pre-configuration of MGs and MG indices (or MG IDs)   + MG index (or MG ID) needs to be included in the both MG activation request (UE-initiated) and MG activation (gNB-initiated). |
| Qualcomm [18] | **Proposal 1:** Support request of MG(s) with an UL MAC-CE from the UE which copies NR-PRS-MeasurementInfoList-r16 elements, i.e., includes the following elements in the UL MAC-CE.   * dl-PRS-PointA-r16 * nr-MeasPRS-RepetitionAndOffset * nr-MeasPRS-length-r16 |

**FL comments**

It appears that there are two solutions.

* Solution 1: The UL MAC CE indicates the MG ID associated with the preconfiguration.
  + Supported by (6): vivo, OPPO, CTC, IDC, Apple, LGE
* Solution 2: The UL MAC CE provides the information carried in RRC LocationMeasurementIndication.
  + Supported by (2): Huawei/HiSilicon, Qualcomm

### Round 1

Based on the summary from the contributions, the FL has the following proposal and questions.

**Proposal 2.2.1-1 (closed)**

* Select between the following two alternatives on the information in the UL MAC CE for MG activation request by the UE.
  + Alt.1 MG ID associated with the preconfiguation of MGs
  + Alt.2 Information carried in the RRC LocationMeasurementIndication, i.e.
    - dl-PRS-PointA
    - nr-MeasPRS-RepetitionAndOffset
    - nr-MeasPRS-length

|  |  |  |
| --- | --- | --- |
| **Company** | **Alt** | **Comments** |
| vivo | Alt.1 | Firstly, if the preconfiguation of MGs is provided, why provides the information carried in RRC LocationMeasurementIndication in MAC CE?  In addition, we would like to note the agenda is about latency reduction, and if the preconfiguation of MGs is provided after MG request, we don’t know how to reduce latency |
| Nokia/NSB | Alt 1. | Payload size should be considered. |
| Qualcomm | Alt. 2 | A UE should be able to request any MG it requires. We could accept having an UL-MAC-CE which has 1 one bit flag to pick between the MG-IDs, if the UE has received pre-configuration, or ask for a new MG using UL-MACCE |
| CATT |  | Alt. 1 if preconfiguation of MGs is supported. Otherwise, we are fine to Alt.2. |
| ZTE | Alt.1 |  |
| OPPO |  | That would depends on the result of proposal 2.1.1-1. If it is agreed, then Alt.1 natually. Otherwise, Alt2. |
| Xiaomi |  | If preconfiguraion of MGs is supported, prefer Alt 1 to reduce signaling overhead. |
| Huawei, HiSilicon | Either | We are OK with Alt.1 if preconfiguration of MGs is supported. |
| CMCC |  | Question: Can both alternatives be supported?  As we commented on Proposal 2.1.1-1, even if preconfiguration of MG is supported, we should not preclude the case that the UE finds no preconfiguration is suitable and then use Alt. 2 to inform the gNB what it really wants. |
| Ericsson | Alt 1. | We agree to introduce a MG ID per preconfigured MG. Then, the UE can request one of the preconfigured MGs via the UL MAC CE.  Given that we are nearing the end of Rel-17 normative work, keeping the workload in mind, we suggest to downselect one and not agree both options. |
| Lenovo,Motorola Mobility | Alt. 1 | Support IDs be included in the UL MAC CE activation request |
| ChinaTelecom | Alt1 | Support Alt1 if preconfiguration is supported. |
| Sony | Alt 1 | Support Alt1 considering its lower payload compared with Alt2 |
| LGE | Alt.1 | We think Alt.1 is more preferable when preconfiguration is provided through RRC. |
| Apple | Alt1 |  |
| InterDigital | Alt 1 |  |

**Question 2.2.1-2 (closed)**

* Should UL MAC CE be used for MG deactivation request?
* Alternate question: Should UE use UL MAC CE to request the deactivation of the MG that has been already activated by a previous DL MAC CE?

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| vivo | Yes |  |
| Nokia/NSB |  | We should first discuss if there is a need for UL MG deactivation request. It is not clear from prior agreements we have agree to add this feature. |
| Qualcomm |  | Unclear. It’s a “request”. A UE would send a separate request if it wants a different MG.  FL: My understanding based on contribution from the proponent is that this could be similar to RRC LocationMeasurementIndication indicating that PRS measurement has stopped. |
| CATT |  | It seems no need to have MG deactivation request unless periodical preconfigured MG is supported.  FL: My understanding based on the contribution from the proponent is that when UE no longer needs to measure the PRS, UE sends the MG deactivation request using UL MAC CE to the gNB to request deactivation of the MG. |
| FL |  | FL intention here is discuss UE request to the gNB to deactivate the MG that is already activated by the DL MAC CE. I added alternate question to it. |
| ZTE |  | OK. Leave the details to RAN2. |
| OPPO | NO | We do not think a MG deactivation request is needed. |
| Xiaomi |  | It can be supported by associating a MG ID with a pattern of non-MG by RRC. |
| Huawei, HiSilicon | Yes | It actually depends on whether activated MG can be deactivated by a timer/counter.  Our preference is use a DL MAC CE to explicitly deactivate the MG, so that there should be need for the UE to request activation when UE is done with the PRS measurement. |
| CMCC |  | We share similar views with Nokia that, we can wait for the discussion on whether DL MAC-CE deactivation is needed or not. If companies think the deactivation can be implicitly indicated, then this UE requests deactivation seems not needed as well. |
| Ericsson |  | Agree with Nokia. Deactivation details including the need can be discussed in RAN2. |
| Lenovo,Motorola Mobility | Needs further discussion | Somehow related to the conditions of using the pre-configured MG , this could be under the scope of RAN2. |
| ChinaTelecom |  | We support the UE use UL MAC CE only if the MG deactivation request is needed. |
| Sony |  | We share similar view as Nokia’s. We should first discuss whether MG deactivation is supported or not. |
| LGE | Yes | Considering the multiple MGs can be activated by MG activation, MG deactivation is needed because there is the case that some activated MGs can be deactivated in accordance with deactivation |
| Apple | No | The benefir/necessariation is not clear to us |
| InterDigital | Yes | For consistent operation, the UE should send a rquest to deactivate the requested MG. |

**FL comment**

Based on the comments receive so far, the FL proposes to discuss proposal 2.2.1-1 directly in the GTW.

### Round 2 (closed)

Given the fact that there is concern on supporting UL MAC CE based MG deactivation or supporting the whole feature of MG deactivation request at all. The suggestion from FL lead is we stop discussing this issue in this meeting.

RAN2 could also look into this issue and decied whether the existing RRC-based location measurement indication for the purpose of PRS measurement stop is sufficient to cover the MG deactivation request.

## MG activation request by LMF

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| **Company** | **Proposals** |
| Huawei, HiSilicon [1] | **Proposal 1:** Support inclusion of the following information in the NRPPa message and UL MAC CE for MG activation request.   * PRS point A * PRS measurement periodicity and offset * PRS measurement length |
| ZTE [2] | **Proposal 1:** For a new mechanism of MG activation request by LMF (via an NRPPa message), support at least one of the following options,   * Option 1: The MG activation request message includes the same information as the RRC signaling LocationMeasurementInfo defined in Rel-16 for DL PRS measurement * Option 2: The MG activation request message indicates a specific MG pattern, where the MG pattern at least include, * MGL: the measurement gap length of the measurement gap * MGRP: measurement gap repetition period of the measurement gap * Gap offset: the gap offset of the measurement gap pattern indicated by MGL and MGRP * MGTA: the measurement gap timing advance |
| vivo [3] | **Proposal 3:**   * The MG request including the activated/deactivated indication by the LMF can be transmitted in the NRPPa Request location information (via a UE-associated NRPPa message).   **Proposal 16:**   * Support a new requesting NRPPa signaling from LMF to gNB for gNB to determine the use of MG or PRS processing window, and the detailed configuration of the corresponding MG or PRS processing window that includes   + The time/frequency characteristics (i.e., periodicity/offset information, and frequency layer information) of PRS”   + The location request information (i.e., positioning requirement, latency, Bandwidth that needed to meet accuracy requirement) |

**FL comments**

For MG activation request by the LMF, there is limited input. The views from proponents are quite diverse.

### Round 1

Based on the summary from the contributions, the FL has the following questions.

**Question 2.3.1-1 (closed)**

* Do companies think RAN1 should discuss the MG activation request by LMF or leave the detailed analysis to RAN3?

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| --- | --- |
| **Company** | **Comments** |
| vivo | At least, the parameter is used to determine MG activation or PRS Process window configuration by gNB is needed |
| Nokia/NSB | Can be left to RAN3. |
| Qualcomm | Up to RAN3 |
| CATT | Up to RAN3 |
| ZTE | We cannot leave all the details to RAN3, at least we should discuss which parameters can be included in the request. |
| OPPO | Leave to RAN3 |
| Xiaomi | Up to RAN3 |
| Huawei, HiSilicon | Prefer to leave to RAN3. |
| CMCC | Prefer to leave it up to RAN3. |
| Intel | Up to RAN3 |
| Ericsson | No. This should be left to RAN3. |
| Lenovo,Motorola Mobility | RAN3 scope |
| ChinaTelecom | Leave to RAN3 |
| Sony | Up to RAN3 |
| LGE | Leave it to RAN3. |

**Question 2.3.1-2 (closed)**

* For the companies thinking that RAN1 should discuss the MG activation request by LMF, which parameter do you think should be included in the NRPPa message?

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| --- | --- |
| **Company** | **Comments** |
| vivo | 1. PRS parameter: periodicity/offset information, and frequency layer information, length  2. The location request information (i.e., positioning requirement, latency, Bandwidth that needed to meet accuracy requirement) is used to determine to activate MG or configure PRS Process window |
| ZTE | At least one of the following option,   * Option 1: The MG activation request message includes the same information as the RRC signaling LocationMeasurementInfo defined in Rel-16 for DL PRS measurement * Option 2: The MG activation request message indicates a specific MG pattern, where the MG pattern at least include, * MGL: the measurement gap length of the measurement gap * MGRP: measurement gap repetition period of the measurement gap * Gap offset: the gap offset of the measurement gap pattern indicated by MGL and MGRP * MGTA: the measurement gap timing advance   FFS: Whether UE should proved MG related capabilities to LMF. |
|  |  |

**FL comments:**

Based on the comments received, the FL has the following proposal.

**Proposal 2.3.1-1 (continued)**

* For the MG activation request by the LMF, it is up to RAN3 to design the necessary information to be transferred in the NRPPa message.
* Include it in the LS to RAN2 and RAN3.

### Round 2

Let’s continue the discussion on the proposal based on the comment received in the previous round.

**Proposal 2.3.2-1 (clsoed)**

* For the MG activation request to the gNB by the LMF, it is up to RAN3 to design the necessary information to be transferred in the NRPPa message.
* Include it in the LS to RAN2 and RAN3.

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| OPPO | Yes | The signalling design shall be up to RAN3 |
| Xiaomi | Yes |  |
| ZTE | Yes | Although we think some guidance from RAN1 would be helpful. |
| Intel | OK |  |
| Lenovo,Motorola Mobility | Yes | RAN1 has found MG activation request to gNB beneficial for latency reduction with signalling details left up to RAN3 |
| Nokia/NSB | Yes |  |
| CATT | Yes |  |
| Qualcomm | OK |  |
| Ericsson | ok | the current formulation is ok. We don’t agree with the comment from Lenovo/Motorola Mobility that ‘RAN1 has found MG activation request to gNB beneficial for latency reduction’. Based on company inputs to Question 2.3.1 in Round 1, we should just leave this issue to RAN3. |
| Huawei, HiSilicon | Yes |  |
| China Telecom | Yes |  |
| NTT DOCOMO | Yes |  |
| SONY | Yes | We should provide the background / justification. We could use the the suggested wording from Lenovo / Motorola. Alternatively, we could say: RAN1 has identified MG activation request to gNB can be used for latency reduction. |

### Agreement as per email announcement

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| --- |
| **Conclusion**  For the MG activation request to the gNB by the LMF, it is up to RAN3 to design the necessary information to be transferred in the NRPPa message.   * Include it in the LS to RAN2 and RAN3. |

## DL MAC CE for MG activation and deactivation

The following sourced provided their views on DL MAC CE for MG activation and the corresponding deactivation process.

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| --- | --- |
| **Company** | **Proposals** |
| Huawei, HiSilicon [1] | **Proposal 3:** Support preconfiguration of up to 8 MGs in RRC and DL MAC CE to provide the bitmap of the activation/deactivation status of each MG.   * The preconfigured MGs are by default deactivated. * From RAN1 perspective, at most a single preconfigured MG among all preconfigured MGs can be activated for the purpose of PRS measurement at any given time. * Send an LS to RAN2 and RAN4. |
| Vivo [3] | **Proposal 5:**   * With preconfigured MG, the MG activation via MAC CE only includes activation and deactivation indications.   + FFS pre-configured MG indication for indicating one of multiple pre-configured MG and/or indicating a positioning MG |
| CATT [4] | **Proposal 4:** It is not necessary to introduce a deactivation process. |
| OPPO [5] | Proposal 3: In MG activation MAC CE, the gNB indicates:   * One MG configuration to be activated * Indicate a number of repetitions.   Proposal 4: The activated MG configuration is deactivated automatically when the indicated number of repetitions is finished. |
| SONY [7] | **Proposal 2:** DL MAC CE payload contains the triggering/activation of MG(s) for positioning measurement, including the index of the selected measurement gap configuration. |
| Intel [9] | **Proposal 1:**   * + To reduce latency of NR positioning with MGs for DL PRS processing define the following enhancements:     - Support pre-configuration of the multiple MG patterns for the DL PRS processing using RRC or LPP signaling       * Signaling details are left up to RAN2     - Support DL MAC CE signaling only to activate the pre-configured MGs for DL PRS processing by UE       * Signaling details are left up to RAN2     - Inform RAN2 on the RAN1 discussion and agreement |
| CMCC [11] | **Proposal 1:** Support one or both of the following options for the MG deactivation process;   * Option 1: DL MAC-CE * Option 2: A MG validation timer |
| IDC [13] | **Proposal 4:** Support using DL MAC CE for MG deactivation by gNB for the purpose of positioning. |
| Apple [14] | **Proposal 2**: DL (UL) MAC-CE contains indication of which MG-ID is activated (demanded)  **Proposal 4**: Associate each new MG configuration with a life cycle after which the MG will be deactivated automatically with no further signaling/indication from gNB is required. |
| LGE [15] | **Proposal 3:**   * For the deactivation of MG, RAN1 should select one option:   + Option #1: Introducing the additional signaling for activation and the signaling is transmitted after activation of MG. For the ignaling, downselect among following two alternatives.     - Alt. 1: DCI     - Alt. 2: MAC-CE   + Option #2: MG is autonomously deactivated after specific time (e.g. inactivity timer) from reference time (e.g. activation time of MG) and the information regarding inactivity timer can be transmitted through one or more following alternatives     - Alt.1 :System information     - Alt.2: RRC signaling     - Alt.3: MAC-CE (for activation of MG)   **Proposal 5:**   * RAN1 should support followings if the pre-configuration of multiple MGs is supported   + Introducing MG index(or ID) to distinguish configured Multiple MGs easily   + Providing UE with information regarding association between pre-configuration of MGs and MG indices (or MG IDs)   + MG index (or MG ID) needs to be included in the both MG activation request (UE-initiated) and MG activation (gNB-initiated).   **Proposal 6:**   * RAN1 should consider that MAC-CE for MG activation includes the information about measurement report. |
| DCM [17] | **Proposal 1:**   * MG activation procedure based on combination of RRC and MAC-CE should be considered   + A MG configuration list including multiple MG configurations is configured via RRC signaling   + MAC CE is used to activate/deactivate one MG configuration in the configuration list |
| Qualcomm [18] | **Proposal 2:** Support a new DL MAC CE to activate a MG for Positioning which includes the following elements from the GapConfig message from 38.331:   * gapOffset, * measuremeng gap length (mgl) including the values from mgl-16, * measurement gap periodicity (mgrp), * measurement gap timing advance (mgta), * refServCellIndicator, refFR2ServCellAsyncCA * per-FR1/per-FR2/per-UE flag. |

**FL comments**

For MG activation DL MAC CE, there are two solutions.

* Solution 1: The DL MAC CE indicates the MG ID associated with the preconfiguration.
  + Supported by (10): vivo, CATT, OPPO, SONY, Intel, CMCC, IDC, Apple, LGE, DCM
* Solution 2: The DL MAC CE indicates the bitmap of MGs associated with the preconfiguration
  + Supported by: Huawei/HiSilicon
* Solution 3: The DL MAC CE provides the information carried in the RRC GapConfig IE.
  + Supported by: Qualcomm

For MG deactivation process, there were two alternatives

* Alt.1: Based on explicit DL MAC CE for deactivation
  + Supported by (7): Huawei/HiSilicon, vivo, [CATT], CMCC, IDC, [LGE], DCM
* Alt.2: Timer/counter based (e.g. the MG activation MAC CE indicates the timer/counter and the MG is deactivated when the timer/counter expires)
  + Supported by (4): OPPO, CMCC, Apple, [LGE]

### Round 1

Based on the summary from the contributions, the FL has the following proposal and questions.

**Proposal 2.4.1-1**

* Select between the following alternatives on the information in the DL MAC CE for MG activation by the gNB.
  + Alt.1 MG ID associated with the preconfiguation of MGs
  + Alt.2 MG bitmap associated with the preconfiguration of MGs
  + Alt.3 Information carried in the RRC GapConfig IE, i.e.
    - gapOffset,
    - measuremeng gap length (mgl) including the values from mgl-16,
    - measurement gap periodicity (mgrp),
    - measurement gap timing advance (mgta),
    - refServCellIndicator, refFR2ServCellAsyncCA
    - per-FR1/per-FR2/per-UE flag.

|  |  |  |
| --- | --- | --- |
| **Company** | **Alt** | **Comments** |
| vivo |  | Alt 2 or Alt 1 |
| Nokia/NSB | 1 | Alt 2 is our second preference but we prefer Alt 1 |
| Qualcomm | Alt. 3 | First preference is Alt. 3, otherwise we can go with Alt. 1 |
| CATT |  | Alt.2 if activate/deactivate multiple MGs simultaneously is supported. Otherwise, Alt.1 |
| ZTE | Alt.1 |  |
| OPPO |  | It is the MAC CE design, that should be up to RAN2 design. |
| Xiaomi |  | Alt 1 or Alt 2 |
| Huawei, HiSilicon | Alt.2, but | Can accept Alt.1.  The understanding from our side using bitmap is that network may use a single DL MAC CE to activate one and deactivate another, and can be future proof for later release if multiple MGs can be activated at the same time, e.g. per FR MG for positioning. |
| CMCC |  | We support Alt. 1 and also Alt. 3. Same question: can we support more than one alternative? |
| Intel | Alt 1 |  |
| NTT DOCOMO |  | We prefer either Alt.1 or Alt.2. |
| Ericsson | Alt 1 | We think alt1 is enough from the RAN1 perspective. RAN2 can decide how to map the MG ID to a MAC CE.  Given that we are nearing the end of normative work for Rel-17, keeping in mind the workload, we prefer not to agree multiple Alts in this proposal. |
| Lenovo,Motorola Mobility | Alt. 1 | Also support that the MG parameters (e.g. MGRP, MGL) should be associated each of each of the preconfigured MGs |
| ChinaTelecom | Alt 1 |  |
| Sony | Alt 1 |  |
| LGE | Alt 1 |  |
| InterDigital | Alt. 1 or Alt. 2 |  |

**Proposal 2.4.1-2 (revised)**

* Select between the following alternatives on how the activated MG is deactivated.
  + Alt.1 By an explicit DL MAC CE for deactivation
  + Alt.2 By a timer/counter included in the MG activation DL MAC CE

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| **Company** | **Alt** | **Comments** |
| vivo |  | Alt 1, one bit to indicate deactivation MAC CE or activation MAC CE |
| Nokia/NSB |  | We think both options could be considered. |
| Qualcomm | Alt. 1 |  |
| CATT | Alt. 1 | Alt.1 seems simpler. |
| ZTE |  | Leave it to RAN2. RAN1 only needs to agree the MG can be deactivated by DL MAC CE |
| OPPO |  | We also think both Alt.1 and Alt.2 can be considered. They support different functions and have different use cases. |
| Xiaomi |  | Both can be considered. |
| Huawei, HiSilicon | Alt. 1 | Alt. 2 relies on knowing how long PRS measurement will last, which may not be easily determined beforehand.  It may also impact the timeline when there re-transmission of the PDSCH carrying the DL MAC CE. |
| CMCC |  | Our first preference is Alt. 1, and we are also open to support Alt. 2 since we think that it can be applicable for some particular cases and DL PRS patterns. |
| Intel | Alt 1 |  |
| NTT DOCOMO | Alt.1 | Our 1st preference is Alt.1. Moreover, Alt.2 can be considered. |
| Ericsson | Comments | This should be discussed in RAN2. RAN1 does not usually make agreements related to timers/counters. Also, whether the same MAC CE or a separate MAC CE is needed for deactivation is up to RAN2. We see no need to discuss this in RAN1. |
| Lenovo,Motorola Mobility |  | Share Ericsson’s view that it should be discussed in RAN2. |
| Sony |  | We have similar view as in section 2.2. We prefer to first discuss whether we support deactivation or not. |
| LGE |  | We think both options can be considered. |
| InterDigital | Alt. 1 or Alt. 2 |  |

**FL comments**

Based on the comments receive so far, the FL proposes to discuss proposal 2.4.1-1 directly in the GTW.

For proposal 2.4.1-2, Alt.1 seems to be supported for most companies, while for Alt.2 some companies have concerns on how the timer/counter value can be know in advance, and some companies believe that it is up to RAN2 to make related design on timer/counters. The Flhas the following proposal update.

**Proposal 2.4.1-2a**

* From RAN1 perspective, at least the following is supported for deactivating the activated MG
  + By an explicit DL MAC CE for MG deactivation
  + It is up to RAN2 to decide whether deactivation can be performed by a timer/counter included in the DL MAC CE for MG activation

### Round 2

Let’s continue the discussion on the following proposal based on the progress on MG preconfiguration and MG activation request.

**Proposal 2.4.2-1 (closed)**

* The DL MAC CE for MG activation indicates the ID associated with the preconfigured MG.

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| OPPO | Yes | MAC CE indicatin one ID is sufficient |
| Xiaomi | Yes |  |
| ZTE | Yes |  |
| vivo | Yes |  |
| Intel | Yes |  |
| Lenovo,Motorola Mobility | Yes |  |
| Nokia/NSB | Yes |  |
| CATT | Yes |  |
| Qualcomm | Yes |  |
| Ericsson | Ok |  |
| Huawei, HiSilicon | Yes. |  |
| China Telecom | Yes |  |
| NTT DOCOMO | Yes |  |
| SONY | Yes |  |

### Agreement as per email announcement

|  |
| --- |
| **Agreement**  The DL MAC CE for MG activation indicates the ID associated with the preconfigured MG. |

### Proposal 2.4.2-2

* From RAN1 perspective, at least the following is supported for deactivating the activated MG
  + By an explicit DL MAC CE for MG deactivation
  + It is up to RAN2 to decide whether deactivation can be performed by a timer/counter included in the DL MAC CE for MG activation

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| OPPO |  | The current wording has obvious bias to Alt1. Alt1 is listed as one option and but Alt2 is listed as “up to RAN2”.  We are suggest to either (1) support both options or (2) leave it up to RAN2 to choose one of Alt1 or Alt2.  **Version #1:**   * From RAN1 perspective, both of the following are supported for deactivating the activated MG   + Option 1: By an explicit DL MAC CE for MG deactivation   + Option2: deactivation can be performed by a timer/counter included in the DL MAC CE for MG activation   **Version #2:**   * From RAN1 perspective, at least one of the following is supported for deactivating the activated MG and it is up to RAN2 to decide:   + Option 1: By an explicit DL MAC CE for MG deactivation   + Option 2: ~~It is up to RAN2 to~~ ~~decide whether~~ deactivation can be performed by a timer/counter included in the DL MAC CE for MG activation |
| Xiaomi |  | We are fine with the proposal and we support both options. |
| ZTE |  | Leave it to RAN2. RAN1 only needs to agree the MG can be deactivated by DL MAC CE |
| vivo | Yes | We think the first subbullet (explicit DL MAC CE for MG deactivation)should be supported at least.  MAC CE deactivation MG is suitable for all deactivation scenarios and is more flexible than timer/counter based echanism. For example, when the location request is stopped, the MG can be deactivated through the MAC CE; when the UE switches to the BWP matching the PRS, the MG can be deactivated through the MAC CE, but it is difficult to deactivate via timer/counter based echanism in these scenarios. |
| Intel | OK |  |
| Lenovo,Motorola Mobility | See comments | Prefer to leave deactivation criteria of both sub-bullets up to RAN2 |
| Nokia/NSB |  | Similar view as ZTE. |
| CATT | Yes |  |
| Qualcomm | OK |  |
| Ericsson | Comments | We have some concern with this proposal.  As we commented in the previous round, whether the same MAC CE or a separate MAC CE is needed for deactivation is up to RAN2. We see no need to discuss this in RAN1.  Given the large number of open issues for 8.5.4 and we are down to the last meeting of ePos normative work for RAN1, we suggest to prioritize the issues that are essential to be closed out from RAN1 perspective, rather than discussing issues that are in RAN2’s domain. |
| Huawei, HiSilicon | Yes |  |
| China Telecom |  | We share the similar view as ZTE |
| InterDigital | Yes | It may be hlepful for RAN2 to see potential solutions from RAN1 perspetive. |
| NTT DOCOMO | Yes | We are also fine to leave the discussion to RAN2. |

## Handling on duplicated MG activation request from UE and LMF

The following source provided their views on handling on duplicated MG activation request from UE and LMF.

|  |  |
| --- | --- |
| **Company** | **Proposals** |
| vivo [3] | **Proposal 4:**   * To select one of the following options for avoiding duplicated MG request from both LMF and UE   + The LMF indicate whether the LMF request MG by NRPPa when LMF send the LPP RequestLocationInformation message to the UE.   + Guarantee the MG activation is not later than the time when the location request is received   **Proposal 7:**   * UE is not expected to perform the measurement outside MG if MG is requested or configured. |
| IDC [13] | **Proposal 1:** If LMF makes a request for a measurement gap, to avoid the duplicate request from the UE, the LMF indicates to UE that MG config is not needed. |

**FL comments**

There is limited input on this issue. To the understanding of the FL, this issue may not be so essential for this meeting, and it can even be better discussed by RAN2/RAN3/RAN4.

### Round 1

Based on the summary from the contributions, the FL has the following question.

**Question 2.5.1-1 (closed)**

* Do companies think RAN1 should discuss the solution to avoid “duplicated” request from LMF and UE on the MG activation request.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| vivo | Yes |  |
| Nokia/NSB | No | gNB has full control if it receives two requests. We don’t see the issue. |
| Qualcomm | No | There is nothing to do. gNB will handle it. |
| ZTE | No | Up to gNB implementation. |
| OPPO | No | gNB implementation can resolve it. |
| Xiaomi | No | Up to gNB implementation |
| Huawei, HiSilicon | No |  |
| Intel | No |  |
| Ericsson | No | We don’t see the need to discuss this issue in RAN1. |
| Lenovo,Motorola Mobility | No |  |
| SONY | No |  |
| LGE | No |  |
| InterDigital | Yes |  |

**FL comments**

It appears that most companies prefer to leave it to gNB. Let’s close this section for this meeting. Any further enhancement beyond what gNB implementation can handle could be discussed during the maintanence phase.

## Others

The FL added comments to the following proposals, considering that they may not be so essential and proposed only by a single source.

|  |  |
| --- | --- |
| **Company** | **Proposals** |
| ZTE [2] | **Proposal 2**: Support UE to report UE capability information related to MG (e.g. supportedGapPattern) to LMF.  FL: This could be discussed on the basis that LMF configures the MG to the UE. |
| Intel [9] | **Proposal 2:**   * + Optimize the Rel.16 MG patterns (e.g., period, length, type) for NR DL PRS processing by UE to facilitate the flexible MG pre-configuration and send LS to RAN4 with a recommendation to define new MG patterns for positioning   FL: Suggest to let RAN4 handle this. |
| Lenovo, Moto Mobility [19] | **Proposal 6:** Introduce additional T values for UE (N,T) processing capabilities (e.g. 1, 2 or 4ms) within a MG.  FL: As discussed in the previous meeting, this can be directly discussed in the UE feature. |

# PRS measurement outside MG

## General information

The following agreements were made in RAN1#106bis-e on this issue.

|  |
| --- |
| Agreement:  For PRS measurement outside MG, support the following Alt. 2 in the working assumption made in RAN1#106-e with the following update of the PRS cell condition.   * Alt. 2: Applicable to all PRS (serving and/or non-serving cell) under conditions to PRS of non-serving cell.   + The conditions at least include that the Rx timing difference between PRS from the non-serving cell and that from the serving cell is within a threshold     - The UE is not expected to determine whether the above condition is satisfied by performing measurements and instead can be determined using assistance data       * FFS: Rx timing difference between PRS from the non-serving cell and that from the serving cell is determined by the expected RSTD and expected RSTD uncertainty.   + Further discuss the necessity on the following additional conditions     - When the PRS is higher priority than other channels/signals, for capability 1A and 1B, the PRS from the non-serving cell have to be inside the PRS prioritization window.     - When the PRS is higher priority than other channels/signals, for capability 2, the PRS from the non-serving cell have to be in the same symbols as the PRS of the serving cell since the serving cell does not know the symbol position of neighbour cell PRS.   Agreement:   * With regards to UE determining the PRS priority with other DL signal/channels within the PRS processing window for PRS measurement outside MG, support the priority indicated by gNB.   + FFS: What are the other DL signals/channels * With regards to the PRS processing window for PRS measurement outside MG, at least support the window indicated by gNB. |

## Condition of the non-serving cell

The following sources provided their views on the condition to receive the non-serving cell, especially on the Rx time difference determination and the threshold to compare against.

|  |  |
| --- | --- |
| **Company** | **Proposals** |
| Huawei, HiSilicon [1] | **Proposal 4:** UE may assume that the PRS from the serving cell and non-serving cell are synchronized if the PRS processing window is indicated by the gNB.   * Note: The threshold of Rx timing difference between PRS from the non-serving cell and that from the serving cell is CP length of the active DL BWP of the serving cell on the PRS frequency. * Send an LS to RAN4 informing that   + RAN1 understands that UE performance requirement for PRS measurement outside MG may only target the synchronization condition. |
| ZTE [2] | **Proposal 5**: Support UE to receive DL PRS from both serving cell and non-serving cell, where Rx timing difference between DL PRS from the non-serving cell and that from the serving cell determined by expected RSTD and expected RSTD uncertainty should be smaller than a threshold (e.g the cyclic prefix length determined by the serving cell). |
| vivo [3] | **Proposal 13:**   * In the RAN1 perspective, the minimum threshold of Rx timing difference can be the length of CP for the synchronization case. * RAN4 should specify the minimum threshold of Rx timing difference.   **Proposal 14:**   * Subject to UE capability, if the UE implementation is to do sliding correlation in the time domain, and PRS prioritization over all other DL signals/channels in all symbols inside the window, all the PRS within the PRS processing window from the serving cell and/or the non-serving cell(s) can be measured in the PRS process window. * The maximum threshold of Rx timing difference can be the length of the PRS processing window. |
| CATT [4] | **Proposal 1:** Support Rx timing difference between PRS from the non-serving cell and that from the serving cell is determined by the expected RSTD and expected RSTD uncertainty. |
| OPPO [5] | **Proposal 5:** In PRS assistance data, the LMF explicitly indicate to the UE whether the PRS resource of one TRP can be measured outside MG. |
| Nokia, NSB [6] | **Proposal 7**: The PRS from non-serving cells must be within the PRS prioritization window for the UE to measure it outside a MG. |
| Ericsson [20] | **Proposal 2** When a UE with capabilities 1A or 1B is configured to measure PRS outside measurement gaps, a non-serving cell PRS is required to be inside the PRS prioritization window if the PRS is higher priority than other DL signals/channels.  **Proposal 3** When a UE with capabilities 2 is configured to measure PRS outside measurement gaps, a non-serving cell PRS is required to be in the same symbols as a serving cell PRS inside the PRS prioritization window if the PRS is higher priority than other DL signals/channels. |
| LGE [15] | **Proposal 1:**   * Support using the expected RSTD and expected RSTD uncertainty in PRS processing window to determine Rx timing difference between PRS from the non-serving cell and that from the serving cell. |
| MTK [16] | **Proposal 2-1**: The expectRSTD and expectRSTD-uncertainty are applicable to measurement outside the gaps |
| Qualcomm [18] | **Proposal 4:** For the purpose of determining the condition for MG-less PRS processing between PRS from the non-serving cell and that from the serving cell, the UE shall use the expected RSTD and expected RSTD uncertainty configured in the assistance data.  **Proposal 5:** Within an active BWP of a serving cell, for the MG-less PRS processing feature, the UE is not expected to process the DL PRS of a non-serving cell which has Rx timing difference from the DL PRS of the serving cell that is larger than 50% of the OFDM symbol duration of the active BWP. |

**FL comments**

On determination of the Rx timing difference between PRS from the serving cell and non-serving cell, majority of companies support to use expected RSTD and expected RSTD uncertainty. One company thinks that UE may simply assume they are synchronized and requests RAN4 to only consider the synchronization condition for the corresponding requirements, while another company thinks LMF could explicitly indicates the PRS resources of TRPs that can be received outside MG.

On the threshold to compare against, some companies mentioned CP length, and a company mentioned 50% of the OFDM symbol duration. The understanding from the FL is that this may be properly handled by RAN4.

### Round 1

Based on the summary from the contributions, the FL has the following proposals.

**Proposal 3.1.1-1 (revised)**

* The Rx timing difference between the PRS from the non-serving cell and that from the serving cell is determined by expected RSTD and expected RSTD uncertainty in the assistance data.
* Send an LS to RAN4 to consider the following thresholds which is used to be compared against with the Rx timing difference to determine whether the PRS from the non-serving cell satisfy the condition of PRS measurement outside MG.
  + Option 1: CP length
  + Option 2: 50% of the OFDM symbol
  + Other options can be considered by RAN4

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| **Company** | **Yes/No** | **Comments** |
| vivo |  | We suggest adding option 3: the length of PRS processing window for the UE is to do sliding correlation in the time domain for positioning. |
| Nokia/NSB | Yes | This should be decided by RAN4 so listing options and sending an LS is reasonable. |
| Qualcomm | Yes | We don’t see how the suggestion option 3 from vivo would work. PRS processing window will be many many OFDM symbols. Saying that the Rx timing difference is as large as the PRS processing window, doesn’t put any constraint. |
| CATT | Yes | We may want to make it clear that it is up to RAN4 to decide thresholds |
| ZTE | Yes |  |
| Samsung |  | One question, if the determination is based on the “expected RSTD and expected RSTD uncertainty in the assistance data” which are provided by LMF/gNB; why not gNB directly only configure/indicate these PRS can/should be measured? Why need UE to further decide on this? Unless it’s other option to ask UE to decide the “threhold”, otherwise, it seems such request for UE behavior is not strongly motivated. |
| OPPO |  | The condition shall be decided by RAN4, instead of RAN1. So the LS should be that RAN4 is requested to study the feasible thresholds for that.  Suggest the following changes for the 2nd bullet:   * Send an LS to request RAN4 to ~~consider~~ study and determine the ~~following~~ thresholds which is used to be compared against with the Rx timing difference to determine whether the PRS from the non-serving cell satisfy the condition of PRS measurement outside MG.   + Examples for the thresholds: ~~Option 1:~~ CP length, ~~Option 2:~~ or 50% of the OFDM symbol   + Other options can be considered by RAN4 |
| MTK | Yes only for 1st bullet, | The expectedRSTD-uncertainty already defines the threshold for search. Don't quite understand the need of 2nd bullet and we don't think it is not needed |
| Xiaomi | Yes | And prefer OPPO’s revision on the 2nd bullet since it should be dertermined by RAN4. |
| Huawei, HiSilicon | Yes, but | Our preference is UE performance requirement should only target sync case, so there is no harm if UE assume they are sync, because otherwise no requirement is specified. |
| CMCC | Yes |  |
| vivo 2 |  | To QC  Whether applies this condition (condition of the non-serving cell) to UE is up to UE capability, for UEs which support sliding correlation in the time domain, we don’t see the need to apply this condition. Option 3 proposed works for the case UE supports sliding correlation, that is, a sufficiently large threshold is equivalent to that the UE can ignore this condition.  For Rel 16 positioning, the expected RSTD can be +-0.5ms, it is larger than OFDM and UE can measure the window. If the company is concerned about the length of PRS processing window, the maximum value can be the maximum value of expected RSTD, that is 1 ms.  In addition, if the value is determined by RAN4, there is no harm to add a candidate value  option 3: 1ms |
| Ericsson |  | This can be decided by RAN4. We are ok to send an LS to RAN4. |
| LGE |  | We have similar view with Samsung. If Expected RSTD and uncertainty is used for it, we think the additional discussion seems not necessary. |

**FL comments**

With the comment received so far, the FL has the following proposal update.

**Proposal 3.1.1-1a**

* The Rx timing difference between the PRS from the non-serving cell and that from the serving cell is determined by expected RSTD and expected RSTD uncertainty in the assistance data.
* Send an LS to request RAN4 study and determine the threshold, which is used to be compared against with the Rx timing difference to determine whether the PRS from the non-serving cell satisfy the condition of PRS measurement outside MG.
  + Examples for the thresholds: CP length, 50% of the OFDM symbol, 3ms
  + Other options can be considered by RAN4

### Round 2

Let’s continue to discuss the following proposal.

**Proposal 3.1.2-1 (revised)**

* The Rx timing difference between the PRS from the non-serving cell and that from the serving cell is determined by expected RSTD and expected RSTD uncertainty in the assistance data.
* Send an LS to request RAN4 study and determine the threshold, which is used to be compared against with the Rx timing difference to determine whether the PRS from the non-serving cell satisfy the condition of PRS measurement outside MG.
  + Examples for the threshold: CP length, 50% of the OFDM symbol, 1ms
  + Other options can be considered by RAN4

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| OPPO | Yes with wording change | * + Other options also can be considered by RAN4 |
| Samsung |  | Our question is not answered for first bullet.  Whether such rx timing difference will be used for gNB/LMF to determine which PRS to be configured to UE, such that, UE did not have make the comparision.  FL: Sorry for not replying the comments timely. My understanding is that any assistance data could be applied to unicast and broadcast. The suggestion from Samsung seems to only imply to unicast only.  From the assistance data perspective, I guess every UE wishes to know more about PRS transmission,despite some of them does not have performance requirement since they are considered out of sync from the serving cell. Personally, I think assistance data trimming is a solution, but adding more assistance data does not make the PRS measurement requirement more strigent. |
| Xiaomi | Yes |  |
| ZTE | Yes | To Samsung,  We cannot preclude that UE can still request MG for PRS measurement. When the PRS measurement is inside the MG, we don’t need the threshold for rx timing difference. |
| vivo |  | We would like to ask whether the 3ms in “Examples for the threshold” is because of our suggestion. If it is, the 3ms may need to change to 1ms since the value range of the expected RSTD is +/- 500 us Based on the Rel 16 agreement.  Agreement:  The expected RSTD value is a single value defined as the RSTD the UE is expected to measure (at the UE location).   * The value range of the expected RSTD is +/- 500 us. * The value range for the uncertainty of the expected RSTD is   + When any of the resources used for the DL positioning measurement are in FR1: +/- 32 us   + When all of the resources used for the DL positioning measurement are in FR2: +/- 8 us   FL: This should be 1ms per request from vivo. I misread the comments |
| Nokia/NSB | Yes with comments | In principle this is fine for us. We have a suggestion for the main bullet to make it more clear.  For the purpose of UE determining conditions for measuring the PRS outside of a MG, the expected Rx timing difference between the PRS from the non-serving cell and that from the serving cell is determined by expected RSTD and expected RSTD uncertainty in the assistance data |
| CATT |  | A question: from the proposal, it seems we are expecting RAN4 to define one fixed thread for all UEs in all scenarios (intra-/inter-PFL DL PRSs, FR1, FR2) , or it is up to RAN4 to decide. |
| Qualcomm | Yes with comments | OK with the change from Nokia.  To CATT: Our understanding is that it is up to RAN4 to decide. |
| Ericsson |  | Ok to send LS. Agree with suggested revision from Nokia/NSB. |
| Huawei, HiSilicon | Yes | OK with Nokia’s revision. |
| China Telecom | Yes | OK with the revised version from Nokia. |

The proposal is updated according to the suggestion received.

### Proposal 3.1.2-1a (High priority)

* For the purpose of UE determining conditions for measuring the PRS outside of a MG, the expected Rx timing difference between the PRS from the non-serving cell and that from the serving cell is determined by expected RSTD and expected RSTD uncertainty in the assistance data.
* Send an LS to request RAN4 study and determine the threshold, which is used to be compared against with the Rx timing difference to determine whether the PRS from the non-serving cell satisfy the condition of PRS measurement outside MG.
  + Examples for the threshold: CP length, 50% of the OFDM symbol, 1ms
  + Other options can also be considered by RAN4

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Samsung |  | **From email**  Thx FL and ZTE for the reply in the summary on our previous question on this proposal. Maybe we should be more specific, we agree that the PRS configuration, and general information in assistance data contains all possible cells are fine, and some of them could be used for MG not PRS processing window. Our intention was that such comparison is better to not require additional UE burden, if UE needs a round of filtering out the which PRS can use, which is not friendly for latency reduction. Instead, UE could follow gNB/LMF indication of the qualified cell(s), for simplicity and fix size for MAC CE, we could say, for example, at most [4] cell id could be indicated and included in DL MAC CE activation for PRS processing window. and UE just follow whatever indicated in the activation MAC CE and used that for measurement.  FL: I guess what samsung is proposing to allow network to explicit indicate the PRS that can be measured outside MG so that UE is not required to determine whether the sync condition is met.  Samsung2: Yes. |
| Nokia/NSB | Yes | If the UE or LMF is able to determine if the conditions are met depends on RAN4’s decision for the threshold. If the threshold is somehow UE specific then we would need to agree that this number is signaled to the network. If the threshold is just a fixed value (e.g., 1 ms) then we agree the LMF could indicate to the UE if the condition is met. We still prefer to allow the UE to determine it as it may have additional information that the LMF may not have. |
| CATT | Yes |  |
| ZTE | Yes |  |
| Samsung 2 |  | To Nokia, could you be more specific, how is that “ the threshold is somehow UE specific “? Thank you. |
| **Ericsson** | **Comments** | **After some further thought, if the network knows the expected RSTD and the expected RSTD uncertaintly, it makes some sense that the network only indicates the PRS that can be measured outside the MG as proposed by Samsung.**  **However, that would mean the network would have to update the PRS that can be measured outside the MG for example when the UE moves and the serving cell for the UE changes. Does it need frequent updates as opposed to sending the expected RSTD and expected RSTD uncertainty in assistance data?** |
| Nokia/NSB\_2 |  | To SS, the threshold value has not been defined yet. At one point in the discussion at last meeting some companies were mentioning that this may be a UE specific value. As we have not yet agreed how this threshold will look to us it makes sense to still allow the UE to determine if the condition is met. In addition, for periodic measurements the UE may have a past value of the expected RSTD which is much better than the LMF’s configured version. So is the LMF expected to update the assistance data every time? We don’t think that is a good way forward.  Ericsson also raises a good point on mobility that is related to the above. |
| CMCC |  | By further considering comments from Samsung, we tend to agree that would be a feasible solution. Our question is about the whole procedure of PRS processing window configuration/activation and whether the condition can be applied, which is also related to the discussion on Proposal 3.2.2-1a.  By reading the updated Proposal 3.2.2-1a, our understanding is that a joint indication of MG and PRS request will be used by LMF, and then the gNB would make the final decision on which one is used. Let’s say, the LMF informs the gNB that a UE should monitor PRS A, B, and C with associated information, then the gNB figures out that all these DL PRSs are within the UE’s current active DL BWP, and a PRS processing window can be used and activates it for the UE. In such a case, the UE has to first check whether these PRS satisfies the conditions when the PRS arrives, and if not, the UE will then informs the NW and requests a MG for further measurements? Is that the correct procedure? If so, it seems that the latency benefits may be marginal? However, considering SS’s solution, the NW can better determine which would be the most appropriate thing to be activated, MG or processing window.  In addition, regarding the problem raised by Ericsson, we agree that it would be an issue considering the UE mobility; however, considering the typical IIoT scenraios we are focusing on in Rel-17, it seems that a typical deployment within an indoor factory, the potential location range of UE is limited (e.g., a CP length of 30kHz SCS covers about 700m), and therefore, the updates caused by UE mobility seems not that frequent, no? |
| **vivo** |  | **We tend to the views of CMCC and SS are reasonable for the latency reduction.**  **Maybe we can add a bullet for LMF request PRS processing window case**   * **For the purpose of gNBdetermining conditions for measuring the PRS outside of a MG, if gNB activate a PRS processing window for a UE, the PRS of non-serving cell within the window can be regarded as satisfying the conditions** |

## PRS processing window indication

The following source provided their views on PRS processing window indication/configuration.

|  |  |
| --- | --- |
| **Company** | **Proposals** |
| Huawei, HiSilicon [1] | **Proposal 5:** Support LMF-based PRS processing window request, where the full PRS configuration is provided to the serving cell.   * This can be in the same NRPPa message used for MG activation request.   **Proposal 6:** Support LMF to recommend the expected PRS measurement latency to the gNB to facilitate gNB setting the priority of PRS against other signals and channels.  **Proposal 7:** Support preconfiguration of a PRS processing windows in RRC per BWP and DL MAC CE to provide the bitmap of the activation/deactivation status of each PRS processing window.   * The preconfigured PRS processing windows are by default deactivated. * From RAN1 perspective, multiple preconfigured PRS processing windows can be activated for the purpose of PRS measurement. * Send an LS to RAN2. |
| ZTE [2] | **Proposal 4**: Support the following general procedure to indicate the PRS processing window and PRS priority as shown below,   * Step 1: UE should provide its capabilities related to the PRS processing window and PRS priority to both LMF and serving gNB. * Step 2: LMF should send a request to serving gNB. The request may include the response time, recommended PRS processing window (e.g. offset, the length and repetition period of the PRS processing window), the types of to PRS processing window (Cap.1A, Cap.1B or Cap.2) and the DL PRS configuration that is expected to be measured in the PRS processing window. * Step 3: Serving gNB send a response to LMF. The response may include the PRS processing window (e.g. offset, the length and repetition period of the PRS processing window) and PRS priority determined by serving gNB. * Step 4: LMF provide the PRS processing window (e.g. offset, the length and repetition period of the PRS processing window) and PRS priority to UE (e.g. in a location information request message). |
| vivo [3] | **Proposal 9:**   * PRS processing window can be described by the following parameters   + Starting slot and symbol of PRS processing window   + Periodicity of PRS processing window   + Duration of PRS processing window   + PRS processing window type, e.g. Pre UE or Per Band, or Per CC window.   + Frequency related to PRS processing window, e.g. Point A of PRS within PRS processing window   **Proposal 16:**   * Support a new requesting NRPPa signaling from LMF to gNB for gNB to determine the use of MG or PRS processing window, and the detailed configuration of the corresponding MG or PRS processing window that includes   + The time/frequency characteristics (i.e., periodicity/offset information, and frequency layer information) of PRS”   + The location request information (i.e., positioning requirement, latency, Bandwidth that needed to meet accuracy requirement) |
| OPPO [5] | **Proposal 7:** When LMF requests positioning measurement results, the LMF indicates a configuration of PPW and the configuration of PPW includes the following parameters:   * The periodicity and slot offset of PPW * The length of time window * The number of occurrences of PPW. |
| SONY [7] | **Proposal 6:** UE can provide assistance information (UAI) indicating serving gNB that the UE is feasible to perform positioning outside the measurement gap. Subsequently, serving gNB can provide the response whether the UE is allowed to perform positioning measurement (e.g., when it is needed). Hence, there is no additional latency. |
| Samsung [12] | **Proposal 4:** LMF or NG-RAN configures the parameters of a UEPRS processing window. |
| IDC [13] | **Proposal 5:** The prioritization window is configured only when the priority level of PRS from the serving cell is high |
| Qualcomm [18] | **Proposal 6:** Support a new DL-MAC-CE to activate a PRS processing window with the following details:   * + PRS processing window starting time: SFN and slot offset   + Length: In slot level granularity at a chosen SCS with the following values supported:   + {1,2,4,5,8,10,16,20,32,40,60,64,80,100,128,160} slots   + Periodicity: Reuse the already supported PRS periodicities   + Type: {Type-1A, Type-1B, Type-2}   + PRS priority indication flag   **Proposal 7:** Support LMF suggesting to serving gNB a PRS processing window with the following signaling details:   * + PRS processing window starting time: SFN and slot offset   + Length: In slot level granularity at a chosen SCS with the following values supported:   + {1,2,4,5,8,10,16,20,32,40,60,64,80,100,128,160} slots   + Periodicity: Reuse the already supported PRS periodicities   + Type: {Type-1A, Type-1B, Type-2}   + For Type-1B and Type-2 type, set of Band IDs which may be affected by the PRS processing window   + PRS priority indication flag * Note: It is up to the serving gNB whether it will activate such a PRS processing window to the UE |
| Lenovo, Moto Mobility [19] | **Proposal 1:** Support the configuration of the PRS processing prioritization window via LPP with at least the start time and length of the window configuration parameters. |

**FL comments**

This area is quite diverged.

For PRS processing window request

* A few sources (Huawei/HiSilicon [1], ZTE [2], vivo [3], Qualcomm [18]) mentioned that it can be done by LMF, while one source (SONY [7]) mentioned that it can be done by UE.

For PRS processing window indication

* Some sources (ZTE [2], OPPO [5], Samsung [12], LenMM [19]) propose that it can indicated by LMF to the UE. However, to understanding of the FL, we already agreed that it should be indicated by the gNB.

For PRS processing window parameters, the following are mentioned by various sources

* Starting slot (vivo [3], OPPO [5], Qualcomm [18])
* Starting symbol (vivo [3])
* Periodicity (vivo [3], OPPO [5], Qualcomm [18])
* Duration/length (vivo [3], OPPO [5], Qualcomm [18])
* Processing type (vivo [3] , Qualcomm [18])
* Frequency information (vivo [3])
* Number of occurrence (OPPO [5])

On PRS processing window activation

* One source (Huawei/HiSilicon [1]) mentioned that it can be RRC preconfiguration and activated by a DL MAC CE
* One source (Qualcomm [18]) mentioned that it can be directed activated by a DL MAC CE.

### Round 1

Based on the summary from the contributions, the FL has the following question.

**Question 3.2.1-1 (closed)**

* Q1: Do companies support LMF-based PRS processing window request or UE-based PRS processing window request?
* Q2: What is your view on handling the discussion in RAN1?
  + (Note this may be similar to Question 2.3.1-1/2 on MG activation request by LMF)

|  |  |
| --- | --- |
| **Company** | **Comments** |
| vivo | We suggest using one signaling to request MG or PRS processing window. And okay with UE/LMF-based request. |
| Nokia/NSB | Q1: LMF based. If UE sends a request then it is unclear there is latency gains in MG-less.  Q2: Likely could be handled by RAN3 but some additional details may be discussed in RAN1 as PRS processing window is not known in RAN3 the way MG is. |
| Qualcomm | Q1: We have already agreed that it will be from the serving gNB. So, this really means that the flow LMF -> serving gNB -> UE has been agreed. I  We are supportive of having UE->serving gNB request, as we do for MG-based PRS processing.  Q2: We need to discuss it in RAN1 |
| CATT | Q1: LMF based  Q2: RAN1 may need to, at least, provide the parameters that need to be included in the LMF-based PRS processing window request.Q2: We need to discuss it in RAN1 |
| ZTE | Q1: LMF based to reduce latency  Q2: We need to discuss which parameters need to be included in the request. |
| MTK | Q1: If LMF request, why not LMF just request MG? which would be more intuitive and easier to solve the problem.  We don’t think LMF should request processing window.  Basically when LMF send measurement gap request to gNB, gNB could decide to use measurement gap, or processing window  For the earlier agreed MG request by LMF, the most important information is PRS configuration of other TRPs and which UE will be under location request. And then it is up to gNB to decide going for MG or PPW  Q2: NO PPW request. Information such as PRS configuration of other TRPs and which UE will be under location request have been included in MG request |
| Xiaomi | Q1: LMF based.  Q2: prefer RAN1 to discuss the parameters in the processing window request. |
| Huawei, HiSilicon | Q1: We prefer to only have LMF-based. However, if the UE-based UL MAC CE to request MG can be reused for this purpose, OK with UE-based also.  Q2: For LMF based, we suggest to leave it to RAN3, similar to MG activation request by LMF. |
| CMCC | Q1: We can support both requests. |
| Ericsson | Q1: in our understanding, the processing window should be requested to the serving gNB by the ~~UE~~ LMF.  Q2: RAN1 can discuss the type of information needed for the gNB to establish the window. We can then send an LS to ran2 to decide how to convey the information. |
| Lenovo,Motorola Mobility | Q1: Both can be supported and feasible in our view.  Q2: Under RAN1 scope |
| ChinaTelecom | Q1:We prefer the LMF based.  Q2: prefer RAN2 to discuss the parameters. |
| Sony | Q1: We support both options. We consider it’s efficient and beneficial for UE to report processing window request together with MG request via UL MAC CE.  Q2: prefer to discuss it in RAN1. |
| LGE | Q1: LMF based  Q2: The related parameters for configuration can be considered in terms of RAN1’s perspective. |

**Question 3.2.1-2 (closed)**

* Do companies think it necessary to support PRS processing window indicated by the LMF given that RAN1#106b already agreed gNB-based indication?

|  |  |
| --- | --- |
| **Company** | **Comments** |
| vivo | No  There are two alternative solutions as follows  Alt 1: LMF recommend PRS processing window to gNB  Alt 2: LMF provides PRS information (similar to Information carried in the RRC LocationMeasurementIndication ) to gNB to determine the PRS processing window |
| Nokia/NSB | No. |
| Qualcomm | No |
| CATT | No |
| ZTE | No. |
| OPPO | No |
| MTK | no |
| Xiaomi | No |
| Huawei, HiSilicon | No. |
| CMCC | No |
| Ericsson | No |
| Lenovo,Motorola Mobility | No |
| ChinaTelecom | No |
| SONY | No |
| LGE | No |

**Question 3.2.1-3 (closed)**

* What is your view on the following parameters to indicate the PRS processing window from gNB to the UE?
  1. Starting slot
  2. Starting symbol
  3. Periodicity
  4. Duration/length
  5. Processing type
  6. Frequency information
  7. Number of occurrence

|  |  |
| --- | --- |
| **Company** | **Comments** |
| vivo | First 6  In addition to First 6, we think reference serving cell indicator may be needed to indicate which serving cell the time parameters of PRS processing window refer to, which is similar to the mechanism for MG.  refServCellIndicator ENUMERATED {pCell, pSCell, mcg-FR2}  refServCellIndicator  Indicates the serving cell whose SFN and subframe are used for gap calculation for this gap pattern. Value pCell corresponds to the Pcell, pSCell corresponds to the PSCell, and mcg-FR2 corresponds to a serving cell on FR2 frequency in MCG. |
| Nokia/NSB | We have a question for clarification: What information would be in processing type? In addition, the number of occurrences may not strictly be needed. |
| Qualcomm | This proposal may need a clarification. Is this the indication from LMF to the gNB, or from gNB to the UE?  FL: Let’s focus on gNB to the UE. For UE 🡪 gNB or LMF 🡪 gNB as the request, let’s see if RAN1 agreed UE based request, and if RAN1 agreed to let RAN3 handle LMF based request first.  To Nokia: The UE reports its MG-less capability & Type to the LMF. The LMF should send a request to the serving gNB, and that request should include what capability the UE has; so that the servig gNB can make scheduling decisions. If the Type-1 is per-UE then the processing window will affect all DL CCs (across LTE,NR), but if it is Type-2, then the window will affect a single band, etc.  If we are talking about the signaling from gNB -> UE, the “Processing type” is needed if the UE supports multiple Processing types. This way, the UE/gNB would agree on which symbols/bands are affected/prioritized/deprioritized.  It is a bit unclear what “frequency information” corresponds to. From our understanding:   * If it is Type-1A, then ALL DL CCs, in LTE/NR are affected, so frequency information is not really needed * For Type-1B/2, then we agree that frequency information isneeded, on which bands are affected.   So we suggest to change this bullet to:   * + Frequency information for Type-1B/2. For Type-1A, according to the WA, the PRS processing window applies to all all DL CCs in LTE/NR (“per UE”). |
| CATT | We assume 1, 3, 4 are at least needed.  For “2. Starting symbol”, assuming it is by default to tbe the 1st DL PRS symbol of the starting slot for processing type 2 and the 1st symbol of the slot for processing types 1A/1B.  For “5. Processing type”, we assume it can be optional for the UE supports multiple processing types. |
| ZTE | Before we discuss this proposal, we should discuss first whether the PPW determined by gNB should be indicated to UE directly or send to LMF( then configure the PPW to UE via LPP).  We think the later one(i.e. LMF indicates PPW to UE) have some benefits for LMF to control the time budget. For example, LMF can configure a proper response time based on the PPW from gNB and get the measurement report as soon as possible. |
| OPPO | 1,3,4 and 7 are needed.  For “2. Starting symbol”: that is not needed. The processing window can be in unit of slots,  For ‘5. Processing type’: the definition is not clear.  For “6. Frequency information”: the definition is not clear too. |
| MTK | The parameters should be similar to MG. So 1, 3, 4, 7 are at least supported  For processing type, is it the priority rule? If so, it is supported |
| Xiaomi | We support 1,3,4 at least.  We think 2 is not needed, and share same views as OPPO that the processing window can be in unit of slots.  For 5,6,7, more clarification is needed on the definition before we discuss the necessity. |
| Huawei, HiSilicon | OK with 1, 3, 4, 6.  No need for symbol.  For 5, it depends on whether to allow multiple capabilities reporting (1A/1B/2). If we only allow single capability reporting from the UE, there is no such need; otherwise, the indication is needed.  For 7, it may not be possible to predict the number of occurrences prior to actually taking the measurement. |
| Ericsson | At least 1, 3, and 4 are needed.  Regarding 5, we agree that 5 is not needed if the UE only supports one or two of the capabilities 1A/1B/2. But a general question to the group on this. Is it really necessary to couple the processing type to the PRS processing window indication? Can’t the processing type be configured to the UE outside of the PRS processing window indication? |
| Lenovo,Motorola Mobility | Support 1, 3 and 4 which are at least needed. For 5 it depends on the support of Cap 1A/1B/2 UEs, but this should be known well in advance. |
| ChinaTelecom | Support 1,3 and 4 at least.  For 2: not needed  For 5,6,7: need further clarifications. |
| LGE | Supportive of 1, 3, 4, 6 and option 2/7 are not necessary. Regarding 5, further discussion is needed. |

**Question 3.2.1-4 (closed)**

* What is your view on the PRS processing window configuration/activation?
  + Alt.1: Configured in RRC-only
  + Alt.2: Activated by DL MAC CE directly without RRC (pre-)configuration
  + Alt.3: RRC (pre-)configuration and activated by DL MAC CE
  + Alt.4: Configured in LPP-only
  + Alt.5: Others (please indicate the solution in the table)

|  |  |  |
| --- | --- | --- |
| **Company** | **Alt** | **Comments** |
| vivo | Alt.3 |  |
| Qualcomm | Alt. 2 | 2nd preference Alt. 3. |
| CATT | Alt.3 |  |
| ZTE | Alt.4 | We think Alt.4 have some benefits for LMF to control the time budget. For example, LMF can configure a proper response time based on the PPW from gNB and get the measurement report as soon as possible. |
| OPPO | Alt3 is prefered |  |
| MTK | Alt. 3 |  |
| Xiaomi | Alt 2 or Alt 3 |  |
| Huawei, HiSilicon | Alt. 3 |  |
| CMCC | Alt. 3 | Similar as DL MAC-CE activate/deactive MG, do we need PRS processing window deactivation process? |
| Ericsson | Alt 1 or Alt 3 | In case of Alt 3, we should let RAN2 decide whether DL MAC CE is feasible for this indication. |
| Lenovo,Motorola Mobility | Alt . 3 |  |
| LGE | Alt.3 is preferred. |  |

**FL comments**

With the comment received so far, the FL has the following proposal.

**Proposal 3.2.1-5 (continued)**

* 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.
  + Include it in the LS to RAN2 and RAN3.

**Proposal 3.2.1-6 (continued)**

* Decide in RAN1#107-e if PRS processing window request to the gNB by the UE is supported.

**Proposal 3.2.1-7 (continued)**

* At least the following parameters for the PRS processing window are supported.
  + Starting slot
  + Periodicity
  + Duration/length
* Other parameters to be concluded in RAN1#107-e.

**Proposal 3.2.1-8 (continued)**

* For PRS processing window configuration and indication, at least the following mechanism is supported
  + RRC (pre-)configuration and DL MAC CE activation
* Include it in the LS to RAN2 and request RAN2 to decide whether DL MAC CE is feasible.

### Round 2

Let’s continue discussing the following proposals.

**Proposal 3.2.2-1 (revised)**

* 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.
  + Include it in the LS to RAN2 and RAN3.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| OPPO | Yes |  |
| Xiaomi | Yes |  |
| ZTE | Yes |  |
| vivo | Yes |  |
| Lenovo,Motorola Mobility | Yes |  |
| Nokia/NSB | Yes |  |
| CATT | Yes |  |
| Qualcomm | No | We need further progress on what are the parameters, before sending an LS to RAN2/RAN3.  FL: My understanding is that for LMF-basd MG activation request, everyone seems to be OK with RAN3 to determine the NRPPa signaling. Could QC be OK with this proposal that RAN3 could jointly consider the MG activation request and PRS processing window request in NRPPa? Is there any special attention that is required for processing window? |
| Ericsson | Yes |  |
| China Telecom | Yes |  |
| MTK | No | It seems to us that it is gNB to determine using MG or PPW. What LMF could provide to gNB is the general information such as the neighbor PRS configuration, and which UE under location request. These informations are general to use MG or PPW.  The title of “PPS request” may be confusing. Maybe we could put together with earlier agreement for “MG activation request”, saying that  “PPW and/or MG request” to the gNB by LMF is supported from RAN1 perspective   * Note: it is up to gNB to determine the usage of PPW and/or MG |
| ZTE |  | To Qualcomm,  We’re fine to consolidate some parameters for consideration by RAN2/RAN3 for both PRS processing window request and MG activation request. Given the situation in Proposal 2.3.2-1, we cannot get the consensus on which possible parameters can be included in the request. We can accept this proposal as a compromise.  To MTK,  We think the argument is the same for MG activation request, LMF is the control of positioning service, so it’s better for LMF to suggest some parameters which can meet the latency/accuracy requirement. |
| Ericsson | Yes |  |

**FL comments**

With the comments received, let’s see if the following update is acceptable.

### Proposal 3.2.2-1a (Input requested, High priority)

* PRS processing window request (in addition MG activation 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 measuremeng gap or PRS processing window
  + Include it in the LS to RAN2 and RAN3.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| FL |  | My understanding of the logic of the change also taking into account the comments from Qualcomm is that actually a single request by the LMF can serve as either MG or PRS processing window, so that when RAN3 design the NRPPa signaling, they could consider the two functionality jointly. |
| Nokia/NSB | Yes |  |
| Samsung |  | Does it mean gNB can configure MG even if LMF request PPW? |
| Huawei, HiSilicon | Yes | To SS: I think it is not precluded, but that is transparent to the UE. It also depends on whether the NRPPa signaling explicitly indicates the purpose of for MG activation or PRS processing window, which is subject to RAN3 consideration. |
| CMCC | Yes |  |
| ZTE | Yes | We don’t need to mention MG activation request as it has been agreed. For us, LMF may indicate whether MG or PRS processing window is expected. |
| China Telecom | Yes |  |
| Xiaomi | Yes |  |

### Proposal 3.2.2-2

* PRS processing window request to the gNB by the UE is supported.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| OPPO | Yes |  |
| ZTE | No | We don’t see the latency benefit. |
| Vivo | Yes |  |
| Lenovo,Motorola Mobility | Ok |  |
| Nokia/NSB | Maybe | Could the proponents explain why the UE would request something different than the LMF if the LMF also sends a request to the gNB? Or is this UE request in response to the “original” configured PRS processing window which the UE determines is not sufficient? If yes, how would the UE determine it is not sufficient? |
| CATT |  | Similar comment as Nokia. |
| Qualcomm | Yes | To Nokia: The UE very easily determines that a window is not enough: Periodicity is not enough, PRS processing window configured in the wrong band (for Type-1B/2), or the UE wants to sample a different PFL now. Note that when an AD is sent to the UE, or a location request, there is no association on which PFL should be measured. In NR Rel-16 the understanding is that the UE will send a separate RRC MG request when a new PFL is needed to be measured.  Especially for UE-based positioning, it is really up to the UE which PRS to measure, which PFL, etc, and the LMF is just one entity providing recommendatiosn to the gNB. The other entity should be the UE. |
| Ericsson | No | After some futher offline discussion, we tend to agree with ZTE’s view. |
| Huawei, HiSilicon | Yes | We think the UL MAC-CE used to request activation of the MG can be considered. |
| China Telecom | OK | We share the similar view as Nokia, and QC’s comments maybe a good explainment. However, we are also curious about the reason why there is no latency benefit as ZTE and Ericsson said. |
| InterDigital | Yes |  |
| ZTE |  | To China Telecom,  We think the general procedures would be ,  LMF send the request for serving gNB to configure PRS processing window according to the positioning latency/accuracy requirement. Then, gNB indicates the PRS processing window to UE. We don’t see the need for the request from UE.  If we agree that the request can be sent from UE to gNB, we think UE should receive the PRS configuration and location request from LMF firstly before the request. However, LMF can send the PRS configuration and PPW request (to gNB) at the same time, which saves a lot of latency because gNB doesn’t need to wait for the request from UE for the determination of PPW.  In addition, why we agreed UE can send request via UL MAC CE is to replace the RRC based MG request in Rel-16. For PPW, we don’t see the need to introduce UL MAC CE. |
| Nokia/NSB |  | Thanks QC for the reply. While it seems a bit of a corner case we can live with UE request as long as LMF request is seen as the baseline. |
| China Telecom2 | Yes | To ZTE,  Thanks for your patient explaintation. However, our former understanding of this proposal it to support the PPW request intial by UE, the procedure you described is something like part of PPW request form LMF to gNB. If the motivation of this proposal is what we understood, we are OK with the proposal, otherwise, we think what you said is exactly right. |

**Proposal 3.2.2-3 (revised)**

* At least the following parameters for PRS processing window are supported.
  + Starting slot
  + Periodicity
  + Duration/length
* Other parameters to be concluded in RAN1#107-e.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments (reasons why other parameters are needed)** |
| OPPO | Yes |  |
| Samsung | Yes |  |
| Xiaomi | Yes |  |
| ZTE | Yes |  |
| vivo | Yes, with comments | We are OK to introduce starting slot, but which serving cell and SCS the ‘starting slot’ is referred to is still not clear. If ‘starting slot’ is supported, the related serving cell and SCS should also be clarified. |
| Lenovo,Motorola Mobility | Yes |  |
| CATT | Yes |  |
| Qualcomm | No | The “frequency domain/Processing Type” parameters need to be included:   * In Type-1A, the processing window applies to all DL CCs (LTE/NR) * In Type-1B/2 the PRS processing applies to certain band/CC   How would the system work without this? Do all companies above assume that only Type-1A is supported in the spec? When the UE gets a configuration of a PRS processing window, for which band/CC it applies to?  To E// comment:   * *Regarding 5, we agree that 5 is not needed if the UE only supports one or two of the capabilities 1A/1B/2. But a general question to the group on this. Is it really necessary to couple the processing type to the PRS processing window indication? Can’t the processing type be configured to the UE outside of the PRS processing window indication?*   Even if the “processing type” is configured to the UE outside the PRS processing window, it doesn’t mean that it is not part of the PRS processing window. It is part of the Processing window and needs to be included.  We also agree with vivo on the “starting slot” definition. |
| Ericsson | Yes |  |
| Huawei, HiSilicon | Yes |  |
| China Telecom | Yes |  |
|  |  |  |

**FL comments**

The proposal is revised to reflect the comments received.

### Proposal 3.2.2-3a (High priority)

* At least the following parameters for PRS processing window are supported.
  + Starting slot
  + Periodicity
  + Duration/length
* Strive to conclude the following parameter in RAN1#107-e. (Postpone to maintenance phase if not)
  + Cell and SCS information associated with the slot
  + Processing type (associated with the corresponding UE capability 1A/1B/2)

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments:**  1. Cell and SCS information associated with the slot  2. Necessity of indicaing processing type |
| InterDigital | Yes |  |
| vivo | Yes | We are okay to include new parameters |
| ZTE | Yes | We think the second bullet should be processing type |
| CATT |  | Why cell and SCS information are needed? Should the TRP and SCS of DL PRS be incuded in PRS assistance data? |
| Vivo2 |  | To CATT  For us, it is used to explain which serving cell and SCS the ‘starting slot’ time is relative to since multiple serving cells can be configured |
| Ericsson | Ok |  |
| Nokia/NSB | Ok |  |
| Huawei, HiSilicon | Yes | We are to add the additional two parameters with the following clarification.  For the processing type, we would like to ensure that it should not have any impact on the discussion on UE capability, i.e. whether UE is able to report more than one from the set {1A, 1B, 2} is separately discussed.  If in Rel-17, we eventually have single capability reported by the UE, this indication is just for the purpose of confirmation from network. |
| China Telecom | Yes | We are also OK for more parameters. |
| Xiaomi | Ok |  |

**Proposal 3.2.2-4 (revised)**

* For PRS processing window configuration and indication, at least the following mechanism is supported
  + RRC (pre-)configuration and DL MAC CE activation
* Include it in the LS to RAN2 and request RAN2 to decide whether DL MAC CE is feasible for this indication.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| OPPO | Ok |  |
| Samsung | Ok with clarification | The “RRC (pre-)configuration” is for “PRS processing window configuration”;  The “DL MAC CE activation” is for “indication”. It is not allowed to have cross function, right, e.g., “DL MAC CE activation” to have “PRS processing window configuration”.   * 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 indication, respectively. |
| Xiaomi |  | Prefer Samsung’s version |
| ZTE | OK for progress |  |
| vivo | Yes |  |
| Lenovo,Motorola Mobility | Yes |  |
| CATT | Yes | Prefer Samsung’s version with a further change: “for PRS processing window ~~indication~~, respectively.” |
| Qualcomm | OK |  |
| Ericsson | Yes | Ok with Samsung’s revision. But what is the intention of ‘at least’ in the main bullet? Do we need more than one solution? If not, then we suggest to delete ‘at least’ from the main bullet. |
| Huawei, HiSilicon | Yes |  |
| China Telecom | Yes |  |

**FL comments**

The proposal is updated based on the comments received.

### Proposal 3.2.2-4a (High priority)

* 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.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Apple |  | **From email**  Are we talking about single PRS window configuration (or it could be multiple configurations)?  FL: My understanding is that this can be further discussed by RAN2 or during maintenance by RAN1 if necessary. Currently it is not precluded either way.  I think the window should at least be configured on a CC (maybe per BWP) to cover the PRS outside MG on the CC/BWP. Then it should appear that there maybe multiple PRS processing window configurations per UE, since UE may have multiple CCs. As for the numbers on each CC, whether single window or multiple windows are configured is still open based on my understanding. |
| vivo | Yes |  |
| CATT | Yes |  |
| Ericsson | OK |  |
| Nokia/NSB | Ok |  |
| Huawei, HiSilicon | Yes |  |
| ZTE | Yes |  |
| China Telecom | Yes |  |
| Xiaomi | Yes |  |

## PRS measurement priority indication and determination

The following sources provided their views on priority indication and determination.

|  |  |
| --- | --- |
| **Company** | **Proposals** |
| Huawei, HiSilicon [1] | **Proposal 8:** A single priority indicator for PRS is included in the DL MAC CE to activate the PRS processing window.   * Note: the priority applies to the PRS on frequencies that satisfies the condition of PRS measurement outside MG.   **Proposal 9:** For the specially handling of SSB, both CD-SSB and SSB in SMTC should be prioritized over PRS within the PRS processing window.  **Proposal 10:** Support binary indicator to select either from the following two priority states.   * PRS is higher priority than PDCCH, PDSCH, and CSI-RS. * PRS is lower priority than PDCCH, PDSCH, and CSI-RS.   **Proposal 11:** For UE supporting PRS prioritization processing capability 1 (1A/1B), if the PRS has lower priority than data, UE is not expected to receive PRS within an occasion of the PRS processing window, if the occasion overlaps with PDCCH monitoring, or PDSCH/CSI-RS reception on the same or different CC (capability 1A), or on the same CC (capability 1B).  **Proposal 12:** For UE supporting PRS prioritization processing capability 2, PRS is always assumed to be higher priority than data within the PRS processing window on the target CC. |
| vivo [3] | **Proposal 10:**   * The priority indication of PRS can be included in the configuration of PRS processing window since it used to indicate the PRS priority with other DL signal/channels within the PRS processing window   **Proposal 11:**   * For capability 1 UE, if PRS configured by high priority collides with other DL signals/channels, the other DL signals/channels are dropped within a PRS processing window. * For capability 1 UE, if PRS configured by low priority collides with other DL signals/channels, the PRS is dropped within a PRS processing window.   **Proposal 12:**   * For capability 2 UE, if PRS configured by low priority collides with low priority other DL signals/channels, the DL signals/channels are dropped in the collide symbols. * For capability 2 UE, if PRS configured by low priority collides with high priority other DL signals/channels, the PRS is dropped in the collide symbols. * For capability 2 UE, if PRS configured by high priority collides with low priority other DL signals/channels, the DL signals/channels are dropped in the collide symbols. * For capability 2 UE, if PRS configured by high priority collides with high priority other DL signals/channels, the PRS is dropped in the collide symbols. |
| CATT [4] | **Proposal 2:** Support the DL PRS has higher priority than other DL signal/channels (e.g. PDCCH, PDSCH, CSI-RS, PT-RS, and non cell-defined SSB, etc.) within the PRS processing window for PRS measurement outside MG indicated by gNB .  **Proposal 3:** All DL signals/channels (PDCCH, PDSCH, CSI-RS, PT-RS, and non cell-defined SSB) except for cell-defined SSB can have lower priority than DL-PRS, and cell-defined SSB has the highest priority. |
| OPPO [5] | **Proposal 6:** For processing PRS outside MG:   * The gNB can indicate the priority of PRS vs the PDSCH/PUSCH/PUCCH and UCI associated with high priority index. * The gNB can indicate the priority of PRS vs the PDCCH in Type-3 CSS set in SpCell and USS. * The gNB can indicate the priority of PRS vs serving cell SSB. * The gNB can indicate that PRS resource has higher priority than PDCCH/PDSCH/PUSCH/PUCCH not associated with high priority, CSI-RS and SRS. |
| Nokia, NSB [6] | **Proposal 6**: The gNB can indicate the PRS is either lowest priority or high priority. Namely the priority order in decreasing order is SSB, other system information, high priority PRS, all other DL signals/channels, low priority PRS. |
| Xiaomi [10] | **Proposal 1:** With regards to the priority states to be indicated between PRS (serving and/or non-serving cell) and other DL signals/channels from serving cell, at least support the case with two priority states   * PRS is higher priority than any other DL signals/channels excluding SSB * PRS is lower priority than any other DL signals/channels   **Proposal 2:** Prefer no special handling for priority related to PDSCH/PDCCH carrying URLLC data/control.  **Proposal 3:** Discuss whether to support MAC CE or DCI for priority state indication to consider PDSCH/PDCCH carrying URLLC data/control. |
| CMCC [11] | **Proposal 2:** Support special handling for priority related to PDSCH/PDCCH carrying URLLC data/control and high priority LPP signalling.  **Proposal 3:** Support introducing physical layer priority to identify high priority DL signals/channels. |
| Samsung [12] | **Proposal 5:** Priority between PRS and SSB is indicated by gNB and PRS has higher priority than other non-SSB DL signals  **Proposal 6:** Indication of priority between PRS and SSB includes   * PRS has higher priority than SSB; * PRS has lower priority than SSB; * PRS has equal priority as SSB. |
| IDC [13] | **Proposal 5:** The prioritization window is configured only when the priority level of PRS from the serving cell is high  **Proposal 6:** When the priority level of PRS is high, the UE should not expect to receive other channels/signals, except SSB, during the prioritization window for Capability 1 and over PRS symbols for Capability 2. |
| Apple [14] | **Proposal 1**: If PRS is indicated to be high priority,   * UE is not expected to receive other configured DL signals and channels, except SSB * UE does not expect to be dynamically scheduled a DL signal/channel within the PRS processing window |
| LGE [15] | **Proposal 2:**   * Regarding priority in the processing time window, except for SSB, RAN1 should support that gNB can informs/indicates priority rules between PRS and other DL signals/channels (CSI-RS, PDCCH, PDSCH). |
| DCM [17] | **Proposal 2:**   * Rel-17 should support the following two priority states for DL-PRS measurement without MG   + PRS is higher priority than any other DL signals/channels excluding SSB   + PRS is lower priority than any other DL signals/channels including SSB |
| Qualcomm [18] | **Proposal 7:** Support LMF suggesting to serving gNB a PRS processing window with the following signaling details:   * + PRS processing window starting time: SFN and slot offset   + Length: In slot level granularity at a chosen SCS with the following values supported:   + {1,2,4,5,8,10,16,20,32,40,60,64,80,100,128,160} slots   + Periodicity: Reuse the already supported PRS periodicities   + Type: {Type-1A, Type-1B, Type-2}   + For Type-1B and Type-2 type, set of Band IDs which may be affected by the PRS processing window   + PRS priority indication flag * Note: It is up to the serving gNB whether it will activate such a PRS processing window to the UE   **Proposal 8:** Support the following priority options in the processing window:   * PRS is higher priority than any other DL signal/channel * PRS is higher priority than any other DL signal/channel except URLLC channels.   1. In this contenxt, URLLC channel corresponds a dynamically scheduled PDSCH whose PUCCH resource for carrying ACK/NAK is marked as high-priority. * PRS is lower priority than all other DL signals/channels   **Proposal 14:** For a PRS processing window starting in symbol of carrier and a conflicting transmission in carrier starting in symbol, the UE shall apply the prioritization / dropping between the PRS and the conflict transmission taking into account:   * DCI(s) for which the time interval between the last symbol of PDCCH and is at leastsymbols, and the time interval between the last symbol of PDCCH and is at least symbols,   wherein the time interval unit of OFDM symbol is counted based on the smaller subcarrier spacing across and their corresponding scheduling cells  **Proposal 15:** For a PRS processing window starting in symbol of carrier and a conflicting transmission in carrier starting in symbol, the UE shall apply the prioritization / dropping between the PRS and the conflict transmission taking into account:   * DL channels & signals considered active at least before and at least symbols before ,   wherein the time interval unit of OFDM symbol is counted based on the smaller subcarrier spacing across and their corresponding scheduling cells. |
| Lenovo, Moto Mobility [19] | **Proposal 2:** Consider both high and low priority PRS processing behaviors with respect to other DL signals/channels. |
| Ericsson [20] | **Proposal 4** For the UE to determine whether DL PRS shall be prioritized or not, the priority of at least the following channels/signals relative to DL PRS can be indicated by the gNB to the UE:  Dynamic scheduled traffic/reference signals (e.g., PDCCH, dynamically scheduled PDSCH, aperiodic CSI-RS including aperiodic TRS)  (ii) Periodic/semi persistent signals and channels (e.g., SPS PDSCH, semi-persistent CSI-RS, periodic CSI-RS including periodic TRS) |

**FL comments**

This area is quite diverged.

On special handling of SSB

* Huawei/HiSilicon [1] considered CD-SSB and SSB in SMTC always has higher priority than PRS
* CATT [4] considered CD-SSB always has higher priority than PRS, while non-CD SSB can have higher or lower priority than PRS subject to priority indication.
* OPPO [5] considered no specially handling of SSB, but proposed to have a dedicated priority indication for SSB.
* Nokia [6] considered SSB/OSI always has higher priority than PRS.
* Xiaomi [10], Apple [14], LGE [15], and DCM [17] considered SSB always has higher priority than PRS.
* Samsung [12] prefers to only design priority indication between PRS and SSB, and they also proposed to have “equal priority” between PRS and SSB.

On the priority states between PRS and another DL signals/channels

* Huawei/HiSilicon [1], vivo [3] (capability 1), [CATT [4]], Nokia [6], Xiaomi[10], LGE [15], and DCM [16] proposed to have 2 states
  + State 1: PRS > data
  + State 2: data > PRS
* CMCC [11], and Qualcomm [18] proposed to have 3 states
  + State 1: PRS > (URLLC, others)
  + State 2: URLLC > PRS > others
  + State 3: (URLLC, others) > PRS
  + The URLLC channel corresponds a dynamically scheduled PDSCH whose PUCCH resource for carrying ACK/NAK is marked as high-priority. (Qualcomm [18])
* vivo [3] explained the handling of dropping between PRS being high/low priority with data being high/low priority for capability 2, but to the understanding of the FL, there is no difference between high priority PRS and low priority PRS.

|  |  |  |
| --- | --- | --- |
|  | L PRS | H PRS |
| L data | Drop data | Drop data |
| H data | Drop PRS | Drop PRS |

* OPPO [5] proposed to have separate priority indication for PRS vs. high priority data, PRS vs. type-3 CSS and USS, PRS vs. other signaling/channel not associated with high priority, respectively. OPPO also included UL signals/channels in the discussion.
* Ericsson [20] proposed to have separate priority indication for PRS vs. dynamical scheduled traffic/signals, and PRS vs. periodic/semi-persistent signals/channels.

On the priority indication signaling

* Huawei/HiSilicon [1] proposed to use DL MAC CE
* vivo [3] proposed to be included the PRS processing window configuration
* Xiaomi [10] proposed to discuss the MAC CE or DCI based priority state indication.
* Qualcomm [18] proposed to use DL MAC CE

In addition,

* Huawei/HiSilicon [1] proposed to drop the entire PRS processing window for capability 1 if the window collides with DL signals/channels and do not define low priority for capability 2.
* IDC [13] proposed that PRS processing window should not be provided if the PRS is low priority.
* Qualcomm [18] proposed the timeline to determine the collision between PRS and other signals/channels.

### Round 1

Based on the summary from the contributions, the FL has the following proposal and questions.

**Proposal 3.3.1-1 (continued)**

* At least CD-SSB of the serving cell is always higher priority than PRS
  + Send an LS to RAN4 to consult on other SSBs, including non-CD SSBs, and SSB detected in SMTC.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| I |  | In general, the priority should be dependent on the PRS processing window periodicity and length, and /or measurement request.  Even in MG, the CSSF is also dependent on PRS periodicity(e.g PRS periodicity>160ms, CSSF is 1), so we prefer to add a priority indication for SSB too since gNB knows the PRS process window and SSB configuration |
| Nokia/NSB |  | Okay with the main bullet. We think RAN1 can define a more detailed/complete priority and then send an LS to RAN4. E.g., SSB>high priority PRS>other DL signals/channels>low priority PRS. |
| Qualcomm |  | Up to RAN4 to decide. |
| CATT | Yes |  |
| ZTE | Yes |  |
| Samsung | No | We share views with vivo. In addition, even for the CD-SSB, UE is not require to always decode it. So yes, CD-SSB has most significant impact to the system, but it doesn’t mean that in PRS processing window, such PRS cannot be higher or equal priority as SSB. gNB could indicate such information to UE as well. And we don’t think this should be decided RAN4, it’s a RAN1 issue. |
| OPPO |  | We prefer to make it configurable. The system can indicate which one of the CD-SSB or PRS has higher priority. |
| MTK | Yes |  |
| Xiaomi | Yes |  |
| Huawei, HiSilicon | Yes |  |
| CMCC | Yes |  |
| NTT DOCOMO | Yes |  |
| Ericsson |  | Given the short amount of time left on the release, we think it is better to simplify the problem and have all SSBs with higher priority than PRS. |
| Lenovo,Motorola Mobility | Yes |  |
| LGE | Yes |  |
| InterDigital | Yes |  |
| China Telecom | Yes |  |

**Proposal 3.3.1-2 (continued)**

* Select between the following alternatives on priority states to be indicated to the UE
  + Alt.1 Two priority states are defined
    - State 1: PRS is higher priority than all PDCCH/PDSCH/CSI-RS
    - State 2: PRS is lower priority than all PDCCH/PDSCH/CSI-RS
  + Alt. 2 Three priority states are defined
    - State 1: PRS is higher priority than all PDCCH/PDSCH/CSI-RS
    - State 2: PRS is lower priority than URLLC PDSCH and higher priority than other PDCCH/PDSCH/CSI-RS
      * Note: The URLLC channel corresponds a dynamically scheduled PDSCH whose PUCCH resource for carrying ACK/NAK is marked as high-priority.
    - State 3: PRS is lower priority than all PDCCH/PDSCH/CSI-RS
  + Note: SSB is a separate issue.

|  |  |  |
| --- | --- | --- |
| **Company** | **Alt** | **Comments** |
| vivo |  | Whether state 3 is needed？ Is it any different from state 2 “PRS is lower priority than URLLC PDSCH and higher priority than PDCCH/PDSCH/CSI-RS”  Why does PDCCH/PDSCH/CSI-RS in state 2 has priority indication, while state 1 and state 3 haven’t |
| Nokia/NSB |  | Okay with Alt 2 in principle. |
| Qualcomm | Alt. 2 |  |
| CATT |  | For Alt.2, should the state 1 be: “PRS is higher priority than URLLC PDSCH/ PDCCH/PDSCH/CSI-RS?  FL: updated to make it clear. |
| ZTE | Alt.1 | This is our last meeting in RAN1. We think a simple solution will be easy to conclude this one. |
| Samsung | No | Since this is in the PRS processing window which is targeting for latency reduction, PRS should be given with higher priority in general. If it is still arguable that whether such PRS can have lower priority with other DL signals, there is no point to configure such window.  We suggest to add Alt3,  Alt 3: PRS is always higher priority than PDCCH/PDSCH/CSI-RS |
| OPPO | Alt.2 | For Alt.2 the state 2 shall be updated to:  PRS is lower priority than URLLC PDSCH and PDCCH and higher priority than other ~~PDCCH/~~PDSCH/CSI-RS  The reason is the URLLC PDSCH is indicated by DCI. If the UE miss the PDCCH, the UE would never know there is a URLLC PDSCH. |
| MTK | Alt. 3 of SS | Similar view as SS |
| Xiaomi | Alt 1 | More discussion is needed if we consider URLLC specially. It is not clear on how to identify PDCCH/PDSCH for URLLC. |
| Huawei, HiSilicon | Alt. 1 |  |
| CMCC | Alt. 2 |  |
| Ericsson | Alt 2 | Alt 2 is more flexitible to handle URLLC use cases also. We agree with the update suggested by OPPO to Alt 2 which ensures that the UE can prirotize PDCCH in order to receive URLLC PDSCH. We also think more discussion regarding PDCCH priority is needed. Since PDCCH is transmitted in a ndica common to many Ues, PRS priority will impact even non-positioning Ues. |
| Lenovo,Motorola Mobility | Alt.1 is preferred | Alt. 1 is simpler, however we also agree Alt. 2 enables an extra priority state to be distinguished for URLLC services. |
| LGE | Alt.1 |  |
| InterDigital | Alt. 1 | Since the priority is decided by the gNB, for simplicity, high/low is sufficient. |
| China Telecom | Alt. 2 | However if there is not enough time to confirm the details of alt.2 , we can also agree Alt.1 since. |

**Question 3.3.1-3 (closed)**

* Do companies think it is necessary to have separate priority indication for different PDCCH/PDSCH as the following exemplary options?
  + Option 1
    - One priority indicator for PRS vs. PDSCH associated with high priority index
    - One priority indicator for PRS vs. PDCCH in type-3 CSS of SpCell and USS
    - One priority indicator for PRS vs. other DL signaling/channel not associated with high priority
  + Option 2
    - One priority indicator for PRS vs. dynamical scheduled traffic/signals
    - One priority indicator for PRS vs. periodic/semi-persistent signals/channels

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| vivo | No |  |
| Nokia/NSB |  | Not needed in our view. |
| Qualcomm | No |  |
| CATT | No |  |
| ZTE | No |  |
| Samusng | NO |  |
| OPPO |  | PDSCH associated with high priority index is just the URLLC PDSCH. So Option 1 is already covered by Alt2 in Proposal 3.3.1-2.  For Option 2: we do not think it is needed. |
| Xiaomi | No |  |
| Huawei, HiSilicon | No |  |
| Ericsson | Yes, Option 2 |  |
| LGE | No |  |
| InterDigital | No |  |

**Question 3.3.1-4 (closed)**

* Do companies think it is necessary to discuss the priority between PRS and UL signals/channels?

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Nokia/NSB |  | If UE is schedule for UL signals/channels it should likely be higher priority as it would be neighbor cell PRS which will be interfered with by UL signals |
| CATT |  | It is unclear why there is a need to discuss it, assume the UE reception of the DL PRS and UE transmission of UL signals/channels are in different time slots. |
| ZTE |  | We don’t seed the need. |
| Samsung | No really | From legacy behavior, pasted from 213  “For operation on a single carrier in unpaired spectrum, if a UE is configured by higher layers to receive a PDCCH, or a PDSCH, or a CSI-RS, or a DL PRS in a set of symbols of a slot, the UE receives the PDCCH, the PDSCH, the CSI-RS, or the DL PRS if the UE does not detect a DCI format that indicates to the UE to transmit a PUSCH, a PUCCH, a PRACH, or a SRS in at least one symbol of the set of symbols of the slot; otherwise, the UE does not receive the PDCCH, or the PDSCH, or the CSI-RS, or the DL PRS in the set of symbols of the slot.  …  If a UE is configured by higher layers to receive a DL PRS in a set of symbols of a slot and the UE detects a DCI format 2\_0 with a slot format value other than 255 that indicates a slot format with a subset of symbols from the set of symbols as uplink, or the UE detects a DCI format indicating to the UE to transmit PUSCH, PUCCH, SRS, or PRACH in at least one symbol in the set of the symbols, the UE cancels the DL PRS reception in the set of symbols of the slot.”  The PRS reception could be cancelled if it’s overlapped with DCI triggered UL transmission, and it can be done if it’s overlapped with non-DCI triggered UL. |
| OPPO |  | If it is assumed that DL PRS and UL transmission are in different time slots, then we need to make a clear conclusion to avoid misunderstanding.  Otherwise, the UE could meet the case where DL PRS conflict with UL transmission.  **Proposed conclusion: The UE does not expect that the receiption of DL PRS and transmission UL signal/channels happen in a same time slot.** |
| MTK |  | No |
| Xiaomi |  | Does it mean the PRS is transmitted in the UL slot/symbol configured by SFI from serving cell? According to the information provided by Samsung, it can be solved by existed spec. |
| Huawei, HiSilicon | No |  |
| CMCC | No |  |
| Ericsson |  | Agree with the conclusion proposed by OPPO. But may be we should clarify here that we are talking about DL PRS reception without MG. See suggested change below:  **Proposed conclusion: The UE does not expect that the receiption of DL PRS without measurement gap and transmission UL signal/channels happen in a same time slot.** |
| LGE | No |  |

**Question 3.3.1-5 (closed)**

* What is your preference on the following alternatives on the message to carry the priority indication to the UE?
  + Alt.1 The priority is indicated in RRC
  + Alt.2 The priority is indicated in DL MAC CE
  + Alt.3 The priority is indicated in DCI.

|  |  |  |
| --- | --- | --- |
| **Company** | **Alt** | **Comments** |
| I | Alt 2 |  |
| Qualcomm | Alt. 2 | Use the MAC-CE that activates a specific PRS processing window. |
| CATT | Alt. 2 or Alt. 3 |  |
| OPPO | Alt.1 |  |
| Xiaomi | Alt 2 or Alt 3 | Use MAC CE or DCI to align with the scheduling of URLLC. |
| Huawei, HiSilicon | Alt.2 |  |
| CMCC | Alt. 2 |  |
| Ericsson | Alt 1 |  |
| Lenovo,Motorola Mobility | Alt. 2 | Alt. 2 is a cleaner solution. |
| InterDigital | Alt. 1 | Alt. 2 is acceptable as well. |

**Question 3.3.1-6 (closed)**

* What is your view on the collision detection timeline as proposed by [18]?

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | Support |
| Huawei, HiSilicon | Why do we need the timeline here since UE knows when the PRS processing window starts and the priority of PRS in advance. |
| Ericsson | We have similar question as HW. |
| Qualcomm | To HW/Ericsson: Even if the UE knows where the PRS processing window is, the PDCCH that carries a colliding channel should not be received “too close in time to the start of the PRS window”. If it is too close, the UE would have already assumed that there is no collision, so it will not have time to follow the prioritization. In other words, a UE makes decision whether to process PRS or drop PRS just a little time before N\_c1 shown below. If, at that time, there has been a PDCCH that might signal a collision with the processing window, the UE would not be able to take it into account.    In other words, a UE makes a decision to drop or not just before the start of the PRS window, and it will only take into account the channels that have been triggered/activated “well in advance”. Any command/PDCCH/MACCE coming too late, and triggering a channel colloding with the window, will not be taken into account. This is common principle to all similar dropping rules.  That’s the same with SP traffic shown below. |

**FL comments**

Based on the comments received so far, the FL suggests to discuss proposal 3.3.1-2 directly in the GTW and has the following proposal for conclusion.

**Proposal 3.3.1-7 (continued)**

* The UE does not expect that the receiption of DL PRS without measurement gap and transmission UL signal/channels happen in a same time slot.

### Round 2

With regards to special handling of SSB, it seems most companies supportive of the proposal. There were proposals to treat all SSB the same, while some companies prefer to let RAN4 handle this. I think it is reasonable to simply the design to use generic term of SSB without differenting CD-SSB, Non-CD-SSB and SSB in SMTC.

For the priority state, there is almost equal split on the both alternatives. Some companies suggest to modify Alt.2 to accommondate PDCCH monitoring, so that PDCCH is treated the same priority as URLLC traffic given the understanding that UE may have no idea on URLLC PDSCH unless PDCCH decoding the successful. There was also proposal to consider single priority, i.e. PRS always has higher priority. However this may result in reverting the previous agreement on introducing priority in the first place. The FL understands the needs from three parties, but we need to finish the feature in time.

For the priority indication, most source prefer to have DL MAC CE, while two company prefer to have RRC.

### Proposal 3.3.2-1

* For PRS measurement outside MG within the PRS processing window, UE may assume SSB measurement always has higher priority than PRS.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| OPPO | No | The issue with the proposal  Assuming NSC SSB measurement always has higher priority than PRS is not correct. The SC SSB and NSC SSB provide fundamentally different function to the UE. For a UE, measuring SC SSB is essential for the serving cell connection. But measuring NSC SSB is purely for the purpose of positioning.  For the progress, we can design by the following way: for the serving cell SSB: we can decide that SSB always has higher priority than PRS but for non-serving cell SSB: the priority vs PRS can be ndicated by the system.   * For PRS measurement outside MG within the PRS processing window,   + UE may assume serving cell SSB measurement always has higher priority than PRS.   + The priority of PRS vs non-serving cell SSB measurement is indicated by the system |
| Samusng | No | As we commented, even with CD-SSB, such SSB is not always necessarily for UE to receive. It’s reasonable to indicate the SSB priority with PRS. |
| Xiaomi |  | We also think that the non-serving cell SSB should be exculed and it can be configured by gNB. |
| ZTE | No | It’s enough to support CD-SSB of the serving cell is always higher priority than PRS. For non CD-SSB should be have lower priority than DL PRS. |
| vivo |  | We slightly prefer to up to gNB indication to decide priority since gNB knows the PRS process window and SSB configuration. |
| Lenovo,Motorola Mobility |  | Prefer RAN4’s input on the treatment of non-serving cell SSBs, although we share the view that prioiritzation of CD-SSB may be different from non-serving cell SSB. |
| Nokia/NSB | Yes |  |
| CATT |  | Our preference is to separate CD-SSB and non CD-SSB. But, we are okay to accept the proposal for the progress. |
| Qualcomm | No | Up to RAN4 to decide |
| Huawei, HiSilicon |  | We think that RAN4 is already discussing it. Perhaps bettler leave to measurement related priority to RAN4. |
| InterDigital |  | It is ok to set the priority level fixed. However if the priority level of SSB for non-serving cell changes dynamically, it may require coordination between gNBs and LMF, creating overhead. |
| SONY | Yes | SSB is an essential signal in NR. Positioning procedure should not affect the overall operation. Down-prioritizing SSB may affect the general NR measurements (which often required for communications (e.g. control / data transmissions)). |
| Ericsson | Yes |  |

### Proposal 3.3.2-2 (High priority)

* The following options are supported subject to UE capability for priority handling of PRS when PRS measurement is outside MG.
  + Option 1: UE may indicates support of two priority states.
    - State 1: PRS is higher priority than all PDCCH/PDSCH/CSI-RS
    - State 2: PRS is lower priority than all PDCCH/PDSCH/CSI-RS
  + Option 2: UE may indicate support of three priority states
    - State 1: PRS is higher priority than all PDCCH/PDSCH/CSI-RS
    - State 2: PRS is lower priority than PDCCH and URLLC PDSCH and higher priority than other PDSCH/CSI-RS
      * Note: The URLLC channel corresponds a dynamically scheduled PDSCH whose PUCCH resource for carrying ACK/NAK is marked as high-priority.
    - State 3: PRS is lower priority than all PDCCH/PDSCH/CSI-RS
  + Option 3: UE may indicate support of single priority state
    - State 1: PRS is higher priority than all PDCCH/PDSCH/CSI-RS
* Note: SSB is a separate issue.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| OPPO | Option 2 | We support Option 2 |
| Samsung | Option 3 | This is for Latency reduction, if PRS could be lower than other PDSCH/PDCCH, there is no need to indicate/activate the PRS processing window. Regarding the comment from FL,  “However this may result in reverting the previous agreement on introducing priority in the first place.”  We did not agree. Clearly, that agreement will have FFS on what the other DL signals could be. Our understanding is SSB is the other DL signal to be signaled with priority. But PDSCH/PDCCH is not! |
| Xiaomi | Option 1 | For Option 3, does it mean that if there is no such indication, the default priority of PRS is lower than all PDCCH/PDSCH/CSI-RS? If yes, we are also fine with Option 3. |
| ZTE | Option 3 |  |
| vivo | Option 2 |  |
| Lenovo,Motorola Mobility | Option 2 |  |
| Nokia/NSB | Option 2 | Also okay with option 1. No need to have multiple UE capabilities on this part. Only one option should be supported. |
| CATT | Option 2 | We are also fine to take Option 1. |
| Qualcomm | Option 2 | OK with Option 1 also |
| Ericsson | Option 2 | @Samung: We agree with the feature lead that Option 3 means reverting the previous agreement on introducing priority in the first place.  The discussion which led to the agreement made in RAN1#106e can be found in [**R1-2108583**](http://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_106-e/Docs/R1-2108583.zip). You can see the FL summary for the related proposal states the following which clearly mention network control over prioritization of PRS/data. So we don’t think this is only about prioritization of SSB.  “  *The change based on my observation is to emphasize network control over the prioritization of PRS/data, in addition to the UE processing capability. I hope everyone has the same understanding on the intention here.*   * *UE has limited processing capability, and is able to dedicate all its resources for the low latency PRS processing with potential impact to data.* * *Network understands the UE capability, but can still control UE to operate on either high PRS priority mode or high data priority mode.*   ” |
| Huawei, HiSilicon | Option 1 |  |
| China Teelcom | Option 2 |  |
| InterDigital | Option 1 | Prefers Option 1 due to its simplicity but ok with option 2 as well |
| Apple | See questions | The proposal is not clear to me. Do we want to down select or all options will be supported? Let’s say option 1 is included, then what is UE behavior for state 2, for example for Cap 1A? Recall that WA in 106 says PRS within processing window is higher priority. How UE is indicated whether it should perform based on State 1 or State 2?  FL: The current formatting is support ALL three options subject to UE capability. UE may indicate whether it support 1 state, 2 states or 3 states associated with capability 1A, 1B. or 2 processing.  The working assumption has the condition that if UE determines that PRS is higher priority, but there is also another note to allow for PRS being low priority. |
| NTT DOCOMO | Option 2 | We are also fine with Option 1 |
| SONY | Option 2 |  |
| ZTE |  | One question for clarification,  The priority is only for Capability 2 or for all types of capabilities?  FL: I think it is applicable to all types, as mentioned in the following Note in the WA.   * Note: When the UE determines higher priority for other DL signals/channels over the PRS measurement/processing, the UE is not expected to measure/process DL PRS which is applicable to all of the above capability options.   For Capability 1, we have made the following WA, which means the PPW is quite similar to MG, i.e. all other other DL signals/channels should be deprioritized. Therefore, we don’t need to discuss priority indication for capability 1.   * + 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   For Capability 2, the priority may be indicated per symbol level. For us, Option 1 or Option 3 is enough. Serving gNB can still schedule URLLC channel in some symbols that don’t contain PRS.  FL: I have a different view though. The working assumption for Capability 1 on PRS prioritization over all DL signals/channels is conditioned on UE determining that PRS is higher priority. But the Note above (in the WA) also deals with the case when PRS is lower priority |
| ZTE2 |  | To FL  Thanks for the further explanation. According to your understanding, UE can still measure some DL PRS symbols that don’t overlap with other channels if the DL PRS has lower priority than other channels.  We don’t need to support ALL options. We can support one of Option 1 and Option 3. |
| Samsung | questions | We have similar concern with Apple and ZTE’s question.  The original purpose of introducing PRS processing window was to allow PRS a higher priority over other DL signals/channels to reduce latency especially when the UE can only handle a single DL signal/channel. In other word, if UE is capable to handle processing PRS and other DL signals/channels simultaneously, there will be no issue at all. Thus, Priority indication is needed only if the UE can handle a single DL signal/channel. So our understanding, the UE capability should also be whether UE can handle one or multiple DL at the same time.  With this understanding of introducing PRS processing window, the default priority of PRS should be highest inside the window. However, given the agreement the priority should be indicated by gNB, we just need to indicate the priority of PRS with the highest priority DL signal/channel, i.e. SSB, and for the others, should be kept as lower priority comparing to PRS. Otherwise, what’s the point to introducing such window.  In addition, we suggest to downselect the 3 options other than accept all.  To E///, thx for the reply, but we think the data is not only data, besides, in last meeting, there was proposal to indicate the SSB priority to PRS from FL, which was only concerned from us. So given the situation, we don’t think we should limit to “data” only. |
| Ericsson | Option 2 | Supporting all three options is an overkill. We suggest to downselect one option. From our perspective, Option 3 is very restrictive and we cannot support Option 3. For us, option 3 mimics how PRS are measured inside the measurement gap based framework. Among Options 1 and 2, we can accept whichever (among Options 1 and 2) has the most support for the sake of progress. |
| FL |  | I think based on the input, the simpliest way is support all three options in the spec, and UE may indicate which option it supports associated with 1A/1B/2 capability reporting.  For example, UE supporting capability 1A may also indicate that it supports Option 3 meaning that it support only high priority PRS with capability 1A, while UE supporting capability 1B may indicate that it supports Option 2. Network will consider the UE capability, and leverage the benefit of MG and PRS processing window and make a proper decision.  To SS, we think anything related to SSB cannot be converged by this meeting, and some companies suggest to leave it to RAN4 to consider. I am not sure whether insisting priority indication for SSB can help progress here. |
| CMCC | Option 2 | Thanks for the further discussion.  Similar view as Ericsson, our preference is to support only one option and we prefer Option 2. For making progress, we can live with FL’s recommendation to support all.  In our understanding, at the early stage of the WI, many companies proposed to enhance DL PRS measurement without MG, as MG-based PRS measurement in R16 has some characteristics that introduce large positioning latency, incl. MG pattern mismatch with that of PRS, MG request and activation signaling, and additionally, it also has a side effect of totally data interruption, which we believe should be further considered in case of IIoT scenarios with high priority URLLC traffic. During the discusson on PRS measurement wo MG, some companies argued that MG ensures a faster process of both PRS and data; otherwise, a UE has to perform both which may cause higher latency when compared to operate one task at a time. Then, the PRS processing window was introduced, but with different features with MG that, up to UE capability, symbol/CC/band level restrictions of scheduling is possible, and it leaves a room for scheduling flexibility and UE determines PRS has lower priority than other DL signals/channels, which is dynamically scheduled. In this sense, I’m confused about the difference between Option 3 and MG-based measurement. However, as I said, we can live with it for progress. |
| Ericsson |  | Regarding FL’s compromised proposal to support all three options, we have one clarification question:  Are each of the options tied to a particular UE capability among UE cap 1A/1B/2? or is the proposal that for each UE cap 1A/1B/2, the UE can additionally indicate which option it supports? |

### Proposal 3.3.2-3

* The UE does not expect that the receiption of DL PRS without measurement gap and transmission UL signal/channels happen in a same time slot.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| OPPO | Yes |  |
| Samsung |  | Question:  This proposal seems more restrict than current what we have, i.e., even in the same slot, this DL reception and UL tx is not allowed. Could FL clarify the reason?  FL: I do not think this should be a useful conclusion per se, at least not the most essential one. However, I would like to hear more views on this proposal drafted on the fly during the first round. |
| Xiaomi |  | It is more reasonbale to restrict it in the same time symbol. |
| ZTE | No | We think the current texts in TS 38.213 quoted by Samsung in last round are enough. |
| Vivo |  | The same time slot is one slot?  If it is, we are fine with the conclusion |
| CATT |  | We are support the conclusion.The wording “without measurement gap” may be removed, assuming we do not expect a UE to measure DL PRS and transmit UL signal/channels at same time slot with MG. |
| Qualcomm | No | We should be able to get PRS and UL symbols on the same slot. Agree with ZTE/SS reference. |
| Ericsson | Some further questions | We have a few clarification questions after some offline discussion.  We recall when we were discussing PRS prioritization windows, some companies suggested that the UE may be able to transmit in UL within the PRS prioritization window while receiving PRS. This aspect was suggested as one difference between PRS prioritization windows and measurement gaps. Now, what happens in the case the UE is FDD full-duplex? For FDD full duplex UEs, there is no issue with the reception of DL PRS without measurement gap and transmission of UL signals/channels in the same slot right? |
| Huawei, HiSilicon | No |  |

**Proposal 3.3.2-4 (revised)**

* The priority of PRS (for two priority states and three priority states subject to another proposal) is indicated in DL MAC CE.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| OPPO | No | Why does RRC not work? So the priority need to be changed dynamically? |
| Xiaomi | Yes |  |
| ZTE | No | If we agree the Option 3 in Proposal 3.3.2-2, we don’t see the need to have a dedicated DL MAC CE for priority indication. If UE receives the PRS processing window, the priority is naturally applied. |
| vivo | Yes | In our view, gNB can judge the priority based on the current scheduling state, so we prefer the priority of PRS is indicated in DL MAC CE |
| Qualcomm | Comments | We prefer to just be included in the single MAC-CE that activates the PRS processing window. The above proposal may appear as if a new MAC-CE will be used, which is not needed. |
| Ericsson | No | Given that PRS is periodic, we think RRC configuration should be sufficient. We don’t see a scenario where the priority of the PRS needs to be dynamically changed. |
| Huawei, HiSilicon | Yes | We think the baseline should be the same MAC CE that activates the PRS processing window, but this can be decided by RAN2. |
| China Telecom | No | RRC is enough. |

**FL comments**

The proposal is updated according to the comments received.

### Proposal 3.3.2-4a (High priority)

* The priority of PRS (for two priority states and three priority states subject to another proposal) is indicated in RRC.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| InterDigital | Yes |  |
| NTT DOCOMO | Yes |  |
| vivo |  | We can compromise for the progress |
| ZTE | Not for now | We should wait the progress in Proposal 3.3.2-12. If we agree the Option 3 in Proposal 3.3.2-2, we don’t see the need to have a dedicated RRC signaling for priority indication. If UE receives the PRS processing window, the priority is naturally applied.  FL: My understanding is that receiving PRS processing window may not be corresponding to the high priority PRS |
| Nokia/NSB |  | Okay. We are also okay with QC’s suggestion that a single MAC CE actives the PPW and indicates the priority. |
| CATT | Yes |  |
| Ericsson | Yes |  |
| Huawei, HiSilicon | Yes | We believe RAN2 may look into it if DL MAC CE activation following the RRC configuration is beneficial. |
| Xiaomi |  | We can accept it for progress |

### Proposal 3.3.2-5

* Companies are encouraged to analyse whether and how to define the collision detection timeline especially for a colliding channel (scheduled by PDCCH) that is very close to the start of the PRS processing window.
* Details can be found in R1-2112220.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| ZTE |  | Low priority for this meeting. We can further check if it’s necessary in maintenance phase. We should focus on some essential issues. |
|  |  |  |
|  |  |  |

## Working assumption

The following sources provided their view on the working assumption for MG-less PRS measurements.

|  |  |
| --- | --- |
| **Company** | **Proposals** |
| Nokia, NSB [6] | **Proposal 3**: Confirm the prior working assumption on MG-less PRS reception. |
| SONY [7] | **Proposal 3:** Confirm the working assumption: Subject to UE capability on 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. |
| Qualcomm [18] | **Proposal 3:** For Type-1B, and Type-2 MG-less PRS processing, a UE should be able to signal whether the MG-less PRS processing in one band, impacts the downlink receiving in another band. This can be a per band in a per band-pair combination reporting.  **Proposal 13:** A UE should be able to report multiple of the Type-1A, Type-1B, Type-2 MG-less PRS processing capabilities, each one associated with a different PRS processing capability, to the LMF. |
| Ericsson [20] | **Proposal 1** Confirm the working assumption made in RAN1#106-e to support DL measurements based on DL PRS without the UE having to request measurement gaps. |

**FL comments**

Three sources proposed to confirm the working assumption, and one source proposed to finalize capability 1B by settling the band/CC.

### Round 1

Based on the summary from the contributions, the FL has the following proposal and questions.

### Proposal 3.4.1-1 (High priority)

* Select between band and CC for capability 1B as per working assumption made in RAN1#106-e.
  + Alt.1 band
  + Alt.2 CC

|  |
| --- |
| Working assumption:  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.) |

|  |  |  |
| --- | --- | --- |
| **Company** | **Alt** | **Comments** |
| vivo | Alt 1 |  |
| Qualcomm | Alt. 1 |  |
| CATT | Alt. 2 | Given that Cap. 1A is for all DL CCs, it makes sense for Cap. 1B is limited the impact to a particular CC. |
| ZTE | Alt. 2 |  |
| OPPO | Alt.1 |  |
| Xiaomi | Alt 1 |  |
| Huawei, HiSilicon | Alt.2 | Alt.1 would imply the same rule for capability 1B and capability 2 for intra-band CA configuration. We do not think it is beneficial. |
| Ericsson | Alt 2 |  |
| Lenovo,Motorola Mobility | Alt. 1 |  |
| ZTE |  | Shall we also need to discuss whether the Capability 2 is per band or per CC?  FL: My suggestion is this issue perhaps should be better contribution driven in the next time. Not sure we can have time to resolve it this time. |
| Nokia/NSB | Alt 2 |  |
| ZTE2 |  | To FL  Anyway, it ‘s a remaining issue that we need to resolve. We prefer to discuss together with this proposal. |
| FL |  | May I understand the logic of supporting Alt.1 or Alt.2 better? I appears that we are in the deadlock, which may not be easily resolved without proper reasoning.  Is it per band because for FR2 with Rx beamforming resulting the scheduling restriction?  Would everyone be fine if we agree per band is for FR2 while per CC is for FR1? |
| ZTE3 |  | We agree per CC for FR2 may lead to restrictions across carriers in the same band. So FL’s suggestion may be a way forward. |

### Question 3.4.1-2 (more input requested)

* Do companies support the extension on the impacted band/CC beyond the (single) certain band/CC for capability 1B and 2?
  + E.g. as proposed by [18], for Type-1B, and Type-2 MG-less PRS processing, a UE should be able to signal whether the MG-less PRS processing in one band, impacts the downlink receiving in another band.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Qualcomm | Yes | The WA says “certain”, it doesn’t say which one. As we pointed out in our paper, PRS in one band could be affected by Positioning in another band. Especially in FR2.  FL: The working assumption reads   * + - Cap. 1B: Only the DL signals/channels from a certain band/CC are affected.       * FFS: band or CC   Since we are talking about PRS inside the active DL BWP of a CC, I guess that CC/band containing the DL BWP should at least be impacted. Given the word “only” in the working assumption, I seriously do not think another CC/band is possible. |
| Qualcomm2 |  | To FL: We agree that at least the CC/band should be affected, but this does NOT mean it is the only band!. Take for example FR2, where single beam is used for all bands. Then, processing PRS in one band, (aka using a specific beam), will impact the DL reception in the remaining FR2 bands. Can you technically argue that this is not true?  FL: Are you preferring to capabitliy 2? |
| Qualcomm3 |  | To FL: Not sure I understand the previous question. Could you please clarify it further?  FL: I guess for capability 1B, it clearly reads “**Only** the DL signals/channels from a certain band/CC are affected”, given that PRS is aready in a BWP of a CC in a band, this CC/band should be the only CC/band that is impacted, which means that other CC/band is precluded.  For capability 2, there WA only mentions symbol level dropping, so I guess it is still open that capability 2 can have multiple bands/CC affected on the same symbol.  The above is the reason that I made the previous question. |
| Apple | See comments | In our understanding, the WA for 1B already includes all bands/CCs that will be impacted by PRS reception on a given active BWP (indeed once such capability is defined, UE will indicate simultaneous PRS reception (or processing for 2) on target BWP and other bands/CCs is supported (everything not indicated will indicate simultaneous reception is beyond UE capability). |
| ZTE |  | We acknowledge that there might be some restrictions we need to consider aside from the active BWP measuring the DL PRS. We prefer to treat this as low priority at this meeting. We should focus on some essential issues. |
| Ericsson |  | Similar to ZTE view, we can defer to next meeting. |

Based on the comments received so far, the FL proposes to discuss Proposal 3.4.1-1 directly in the GTW.

Please continue the discussion on proposal 3.4.1-1.

## Conditions for MG-less measurement not satisfied

The following source provided their view on conditions for MG-less measurement not being satisfied.

|  |  |
| --- | --- |
| **Company** | **Proposals** |
| Huawei, HiSilicon [1] | **Proposal 13:** Support UE to request MG configuration or MG activation by the existing means if the MG-less PRS measurement condition is not satisfied.   * Note: It is already Rel-16 behaviour that UE may request MG configuration if the current MG is not sufficient for PRS measurement. |
| ZTE [2] | **Proposal 6:** UE performs PRS measurement following the measurement period defined in Rel-16 when the conditions for PRS processing window are not met. |
| Vivo [3] | **Proposal 8:**   * When MG is not configured, subject to UE capability, whether to request MG or perform PRS outside MG is decided by UE itself   + if the overlapping bandwidth of active BWP and PRS can satisfy the performance requirement, UE measurement can be inside the active BWP. Otherwise, the UE can request MG(s) or BWP switching. |
| Nokia, NSB [6] | **Proposal 4**: Specify a fallback method for the UE to switch from MG-less to MG-based if the UE drops enough PRS.  **Proposal 5**: A UE should be able to measure the PRS both outside and inside of a MG where applicable. Note: Any changes to RAN4 requirements can be discussed directly by RAN4. |
| SONY [7] | **Proposal 4:** Define UE behaviour when positioning measurement (outside measurement gap) cannot be satisfied due to interruption event.  **Proposal 5:** Support a UE to provide positioning measurement report based on the partial reception of PRS resource(s) in case there is an interruption (e.g. BWP switching) during positioning measurement time window. |
| Lenovo, Moto Mobility [19] | **Proposal 3:** Support partial reporting for PRS within a prioritization window and measurement dropping for PRS deemed outside the prioritization window. |

**FL comments**

There is limited input on this issue. To the understanding of the FL, this issue may not be so essential for this meeting, and it can even be better discussed by RAN2 and RAN4.

### Round 1

Based on the summary from the contributions, the FL has the following question.

**Question 3.5.1-1 (closed)**

* Do companies think RAN1 should discuss the issues on conditions of MG-less measurement not satisfied?

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| vivo | Yes |  |
| Nokia/NSB | Yes | In our view, if the conditions are not satisfied, the UE needs to switch over to MG-based mode. Otherwise latency may suffer due to dropped PRS. |
| Qualcomm | No |  |
| CATT | Yes |  |
| ZTE | Yes |  |
| Xiaomi | Yes |  |
| Huawei, HiSilicon | Yes, but | We feel time may not be sufficient for this issue. |
| Ericsson |  | Agree with HW. We may be limited by time to discuss and agree on these conditions. |
| Lenovo,Motorola Mobility | Yes | Some UE behavioral conditions should be discussed on MG-less measurement. |
| Sony | Yes | This is one important aspects as the consequence of performing positioning measurement outside meas gap. |
| LGE |  | We prefer to deal with the issue as low priority. |
| InterDigital | Yes | Same view as Nokia. |

### Round 2

There is some request to discuss this issue. Let’s see if we can make some progress on this.

**The FL has the following proposal based on submission.**

**Proposal 3.5.2-1 (revised)**

* Decide whether each of the following options should be supported if the conditions of PRS measurement outside MG cannot be met.
  + Option 1: UE may fallback to MG-based PRS measurement.
  + Option 2: UE may measure the PRS on overlapping BW with the curret active DL BWP if the performance requirement can be met
  + Option 3: UE may measure PRS from both inside MG and outside MG (within the PRS processing window)
  + Option 4: If an onging PRS measurement outside MG is interrupted, e.g. due to BWP switch, UE may report the partial measurement.

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| **Company** | **Options** | **Comments** |
| OPPO | Option 1 | We supports Option 1, which does not need extra spec support.  The issue of Option 2: it is not doable since the condition is not met.  The issue of Option 3: How can the UE measure out side MG if the condition is not met?  The issue of Option 4: When the condition is not met, there does not exist any ongoing PRS measurement outside MG. |
| Xiaomi | Option 1 |  |
| ZTE | Option 1 or Option 3 | We think the discussion point here is whether UE should follow the measurement period defined in Rel-16 for a location information report. For both Option 1 and Option 3, UE should follow the the measurement period defined in Rel-16 for measurement gap based measurement. |
| Vivo |  | * + Option 2 seems to conflict with the main bullet, it is about the performance requirement can be met   + Causality is unclear for option 3, that is, why Option 3 can address the main bullet problem,   + Option 4 only is not clear to us, what the relationship between ‘the condition’ in the mainbullet and ‘an onging PRS measurement outside MG is interrupted’?   We support removing the last 3 bullets, and adding the following bullet   * + Option X:UE may stop performing PRS measurement outside MG |
| Lenovo,Motorola Mobility | Option 4 | Prefer Option 4, assuming that PRS measurements, which are not dropped are still reported, when transitioning from MG-less to MG or when MG-less PRS measurements are interrupted. |
| Nokia/NSB | Option 1 and Option 3 | We think option 1 and option 3 are both valid in some scenarios. For example, the UE may feel that the conditions are met for some PRS but not others. In that case the UE may measure PRS both inside and outside the MG. So option 3 makes sense to support.   We feel that option 1 should be supported for the case that the conditions are not met and also for the case that the UE drops the PRS. It seems clear that the PRS will not always be the highest priority signal. So it can happen that the UE drops the PRS multiple times and leads to much higher latency. In this case there should be a fallback option for the UE to switch to the MG mode. |
| CATT | Option 1 |  |
| Qualcomm | Comment | Option 1 will be supported without any additional specification support; a UE can always send a request for MG-based PRS, and there is no need to specify when/why it will send such requests. |
| Ericsson |  | Agree with comments from Nokia. We think it is important to take into account the case that the conditions may not be met for some PRSs (e.g., for some non-serving cell PRS) while the conditions can be met for other PRSs (e.g., serving cell PRSs and some other non-serving cell PRSs). The proposal should take into account how this case would be handled.  We also feel that this issue may not be the most urgent issue to solve in this meeting. Such fallback operation may be discussed once the conditions for PRS measurement are agreed. |
| Sony | Option 1 and 4 | Option 1 can be used and agree with Qualcomm. However, Option 1 does not improve the latency at all. Option 4 can be beneficial to improve the latency. |

**FL comments**

With comments received, it seems like

* Most companies tend to the agree that Option 1 is anyway available.
* Some companies prefer to deal with handling of time domain characteristics being not met (synchronization)
* Some companies prefer to deal with handling of frequency domain characteristics being not met (bandwidth)

Given this is also not considered as urgent to be resolved for this meeting, the FL has the following proposal for further study during the maintanence phase. This proposal is for information only, and not intended for being captured in the Notes.

### Proposal 3.5.2-1a

* Study and identify during the maintainence phase whether and how to specify the UE behaviour targeting the following conditions for which the MG-less measurement are not met.
  + Time domain conditions (e.g. Rx time difference) for some PRS not met
  + Frequency domain conditions (e.g. bandwidth of PRS in relation with an active DL BWP) not met

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| **Company** | **Options** | **Comments** |
| ZTE | OK for study | We prefer to add another subbullet,   * + UE can still do PRS measurement inside MG |
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## Others

The FL added comments to the following proposals, considering that they may not be so essential and proposed only by a single source.

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| Qualcomm [18] | **Proposal 9:** Leave it up to UE implementation whether to do simultaneous processing of PRS within an MG and outside an MG. Any measurement period requirements can be defined assuming one type of PRS processing or the other.  **Proposal 11:** 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.  **Proposal 12:** Simultaneously processing of multiple PRS processing windows on different CCs/Bands is not supported for the MG-less PRS processing feature.  FL: My understanding is that proposal 11 and proposal 12 are already implied in the UE capability (N, T) signaling for the MG-less PRS measurement. |

# Other open issues

## PRS processing capability enhancements

The following sources provided their views on PRS processing capability enhancements.

|  |  |
| --- | --- |
| **Company** | **Proposals** |
| Huawei, HiSilicon [1] | **Proposal 14:** MG or PRS processing window should not be extended to cover the processing period, and no additional enhancement with respect to Rel-16 measurement period optimization is considered in RAN1. |
| ZTE [2] | **Proposal 8**: For the PRS processing capability in a PRS processing window, at least consider one of the following types,   * Type 1 PRS processing capability: UE has to report its capability with at least of the combination {R, P}, * A PRS processing window (with duration L) is divided into a PRS buffering window (with duration L-(T-N)) and a PRS computation window (with duration T-N). The PRS computation window starts right after the end of the PRS buffering window. * UE shall take (T-N) ms of time to process up to N ms of symbols containing PRS resources received by UE in the PRS buffering window * UE is not expected to be configured a PRS processing window with duration smaller than T-N. * Type 2 PRS processing capability: UE has to report its capability of PRS computation time (Tcompute) * A time span (Tspan) is calculated from an end of the latest DL PRS resource in the PRS processing window that is used for a location information report to the end of the PRS processing window * The value of Tspan is not expected to be smaller than the PRS computation time (Tcompute). |
| Vivo [3] | **Proposal 15:**   * The processing optimization of the PRS processing window is not supported (e.g. no corresponding enhancement for splitting MG into two windows) |
| CATT [4] | **Proposal 5:** For UE PRS processing capabilities on latency reduction, Alt.3 can be supported.   * + Alt. 3 UE has to report its capability of PRS computation time (Tcompute)     - A time span (Tspan) is calculated from an end of the latest DL PRS resource in the PRS processing window that is used for a location information report to the end of the PRS processing window     - The value of Tspan is not expected to be smaller than the PRS computation time (Tcompute) . |
| Intel [9] | **Proposal 3:**   * For UE DL PRS processing capability support alternative 1 discussed at the previous meeting:   + During the first part of the window with duration of ~~at least~~ L-(T-N) msec, up to N msec of PRS symbols are expected to be buffered, where L is the duration of the PRS processing window   + The UE is expected to be capable of reporting measurements derived on the PRS measured in the first window after T-N msec from the end of first part of the PRS processing window   + UE is not expected to be configured a PRS processing window with duration smaller than T (i.e., L>T) |
| MTK [16] | **Proposal 3-1**: The processing window T ms contains the N ms mainly for the DL-PRS buffering. The remaining (T-N) ms are mainly used for computation in order to produce measurement report  **Proposal 3-2**: After T ms, UE is able to report the measurement based on a single instance within N ms  **Proposal 3-3**: UE doesn’t need to additional report the DL-PRS computation time |
| Qualcomm [18] | **Proposal 10:** With regards to the processing window for MG-less Processing support the following (Alt. 1 in the previous discussion):   * During the first part of the window with duration of at least L-T msec, up to N msec of PRS symbols are expected to be buffered, where L is the duration of the PRS processing window, and (N,T) is the reported capability for MG-less PRS processing. * The UE is expected to be capable of reporting measurements derived on the PRS measured in the first window after T msec from the end of first part of the PRS processing window |

**FL comments**

It appears that there are three alternatives to be considered for this topic.

* Alt.1: Supported by [ZTE], Qualcomm, Intel
  + During the first part of the window with duration of [at least] L-(T-N) or (L-T) msec, up to N msec of PRS symbols are expected to be buffered, where L is the duration of the PRS processing window, and (N,T) is the reported capability for MG-less PRS processing.
  + The UE is expected to be capable of reporting measurements derived on the PRS measured in the first window after T msec from the end of first part of the PRS processing window
  + UE is not expected to be configured a PRS processing window with duration smaller than T (i.e., L>(T-N) or L>T
* Alt.2: Supported by ZTE, CATT
  + UE has to report its capability of PRS computation time (Tcompute)
  + A time span (Tspan) is calculated from an end of the latest DL PRS resource in the PRS processing window that is used for a location information report to the end of the PRS processing window
  + The value of Tspan is not expected to be smaller than the PRS computation time (Tcompute).
* Alt.3: Supported by Huawei/HiSilicon, vivo, MTK
  + No enhancement to PRS processing capability is defined

### Round 1

Based on the summary from the contributions, the FL has the following question.

**Question 4.1.1-1 (closed)**

* Which alternative do companies prefer with regards to PRS processing capability enhancement?
  + Alt.1
    - During the first part of the window with duration of [at least] L-(T-N) or (L-T) msec, up to N msec of PRS symbols are expected to be buffered, where L is the duration of the PRS processing window, and (N,T) is the reported capability for MG-less PRS processing.
    - The UE is expected to be capable of reporting measurements derived on the PRS measured in the first window after T msec from the end of first part of the PRS processing window
    - UE is not expected to be configured a PRS processing window with duration smaller than T (i.e., L>(T-N) or L>T
  + Alt.2
    - UE has to report its capability of PRS computation time (Tcompute)
    - A time span (Tspan) is calculated from an end of the latest DL PRS resource in the PRS processing window that is used for a location information report to the end of the PRS processing window
    - The value of Tspan is not expected to be smaller than the PRS computation time (Tcompute).
  + Alt.3
    - No enhancement is defined

|  |  |  |
| --- | --- | --- |
| **Company** | **Alt** | **Comments** |
| vivo | Alt 3 |  |
| Qualcomm | Alt. 1 | To HW/vivo: If we go with Alt.3, the PRS resources can be in the end of the window. How would the UE be ready to report just after the window? Do you make the assumption that the UE would have more time after the window? How much time? |
| CATT | Alt. 2 |  |
| ZTE | Alt.1/Alt.2 or both | Depend on different kinds of UE implementations, we think both alternatives can work to reduce latency.  We suggest to make Alt.1 more clear (second subbullet is to align similar descriptions in Rel-16),   * + Alt.1     - During the first part of the window with duration of ~~[at least] L-(T-N) or~~ (L-T) msec, up to N msec of PRS symbols are expected to be buffered, where L is the duration of the PRS processing window, and (N,T) is the reported capability for MG-less PRS processing.     - The UE ~~is expected to be capable of reporting measurements derived on the PRS measured~~ can process the up to N msec of PRS symbols in the first window after T msec from the end of first part of the PRS processing window     - UE is not expected to be configured a PRS processing window with duration smaller than T (i.e., ~~L>(T-N) or~~ L>T |
| MTK | Alt. 3 |  |
| Huawei, HiSilicon | Alt.3 |  |
| Nokia/NSB | Alt 3 |  |
| Qualcomm2 |  | There is no response from the proponents of Alt. 3. What if the PRS appears in the end of the gap? How would the UE have time to finish the processing? |
| Huawei, HiSilicon2 |  | Reply QC2: We think that the gap/window duration should **only cover** the PRS duration, i.e. the gap and window is for buffering purpose only. The offline processing if needed after buffering should follow what we have in Rel-16.  It is up to UE to request longer MGL to extend the buffering region, but it should not be explicitly specified. |

**FL comments**

Based on the answer received

* Alt.1
  + Supported by: Qualcomm, ZTE
* Alt.2
  + Supported by: CATT, ZTE
* Alt.3
  + Supported by: vivo, MTK, Huawei/HiSilicon, Nokia/NSB

### Round 2

Based on the comments received, the FL has the following proposal.

### Proposal 4.1.2-1

* Do not persue either Alt.1 or Alt.2 for the PRS processing capability enhancement in Rel-17.
  + Alt.1
    - During the first part of the window with duration of [at least] L-(T-N) or (L-T) msec, up to N msec of PRS symbols are expected to be buffered, where L is the duration of the PRS processing window, and (N,T) is the reported capability for MG-less PRS processing.
    - The UE is expected to be capable of reporting measurements derived on the PRS measured in the first window after T msec from the end of first part of the PRS processing window
    - UE is not expected to be configured a PRS processing window with duration smaller than T (i.e., L>(T-N) or L>T
  + Alt.2
    - UE has to report its capability of PRS computation time (Tcompute)
    - A time span (Tspan) is calculated from an end of the latest DL PRS resource in the PRS processing window that is used for a location information report to the end of the PRS processing window
    - The value of Tspan is not expected to be smaller than the PRS computation time (Tcompute).

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| MTK |  | To QC for earlier question and let me use ZTE’s figures for illustration.  The current Rel-16 capability seems to support the below 3 cases. However in our view it is just due to the wording. Figure 2a is actually the right thing.  For {N,T}, the N should be in the front of a duration T. we give a different {N,T} for the case outside gap |
| ZTE | No | We think the PRS processing should be defined, which is different for MG based processing,   * The PRS is only be processed inside the active BWP * The measurement should be finished right after the PPW for latency reduction, i.e. the PRS symbols should be front-loaded.   It’s an essential issue to claim that the latency can be reduced over MG based approach. |
| Qualcomm | No | To HW: This is really a very essential issue. I thought it was clear in the WA what we were talking about:    It seems MTK supports Figure 2a, which is fine for us, but this is really Alt. 1. Why is MTK saying that Alt. 3 is enough. Alt.3 allows Figure 2c to happen. Our point is: We don’t need to change the PRS capability, **just ensure that for PRS without MG, Figure 2a is the correct thing to do. That is Alt. 1 and NOT Alt. 3. If you don’t like the wording in Alt. 1, please suggest one that ensures that Figure 2a is understood. Figure 2a says, that the PRS processing window is “T”, and the first “N” symbols have the PRS. Do you have a different understanding?**  If companies want to agree on a “figure” that’s fine for us.  For us it is obvious in the WA also. It was the debate of having 1A/1B vs 2: In 1A/1B, ALL symbols are dropped and NOT only those that collide with PRS. Why would we drop the symbols before the PRS? It is the only logical conclusion that we would be dropping the symbols AFTER the PRS symbols. We also use both words measure/process.  Working assumption:  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.) * Note: When the UE determines higher priority for other DL signals/channels over the PRS measurement/processing, the UE is not expected to measure/process DL PRS which is applicable to all of the above capability options. |
| ZTE2 |  | We fully agree with the comments from Qualcomm. |
| Huawei, HiSilicon |  | Reply to Qualcomm/ZTE: our interpretation on the working assumption is that for capability 1A and 1B:  Data allowed  L (PRS processing window length)  K (LPRS,i In RAN4)  Data not allowed  T  It means processing of PRS after L PRS processing window (or MG in Rel-16/Rel-17) is supported, which takes up to T msec if K<N.  Normally PRS processing window can extend a little bit (spill-over) beyond the slots/symbols containing the PRS, but extension of PRS processing window to T (as per UE PRS processing) is too much. We understand if T=1msec or 2msec or 4msec, it could be OK, but we do not expect that the window duration could last for more than 10 msec, e.g. 80msec. |
| vivo | Yes | Okay for FL proposal |
| Qualcomm |  | **From email**  I am confident you had read QC’s paper back then, and we, as QC, were heavily involved in the debate that led to the WA, and explanation related to that, so I am even more confident that we had the same understanding back then. We are talking about a window of time, after the PRS reception for the UE to finish the processing during which no DL symbols will be measured for cap 1A/1B (for cap-2 is what you show below).    So, lets agree on the common understanding, as we had back then, lets start adding down values for the time after the PRS gap that is needed for PRS processing. If your concern is that we want only large values, lets discuss that, instead of debating again the WA.    From our side, we are envisioning that 4 msec of time after the last PRS symbol is a good starting point for a discussion. |
| Samsung |  | **From email**  Thx for the discussion. I feel quite different understanding on the purpose of PRS processing window. Many hidden information which cannot be reflected by current agreement or working assumption.  Put aside the disucssion for T, L, N, according to the working assumption, and if the PRS processing window is as Su picture suggested, why on earth do we need to introduce the priority indication for PRS and data？  Even If PRS is to be indicated lower priority than other DL siganls, why does gNB need to activate the PRS processing window? because as the "priority" implied, the low priority signal is not allowed, or not expected to be received.  FL: From our side, we do not think priority is needed for capability 2, but it can be useful for capability 1A and 1B.  Let’s take capability 1A UE for example, UE will interrupt all communication links (cells for CA) for the purpose of PRS measurement if PRS is high priority. If PRS is low priority, and there is no collision between PRS processing window on a CC with ***other DL signals/channels on the other CC***, UE can still dedicate its all resources for PRS measurement, but in case there is collision, UE will drop the PRS.  So providing low priority for PRS means that PRS measurement could be prone to interruption from ***data on another CC*** for capability 1A, since UE is not able to dedicate all its resources for a low priority PRS. However, that could still be possible if there is no collision.  In principle, priority only matter when collision happens. Maybe that is not clear in the working assumption, and we do not mind to clarify it. |
| ZTE3 |  | To FL,  We have different views for your reply to Samsung.  We think the priority indication for Capability 1 is useless. Let me ask one question,  *If gNB indicates that PRS is lower priority than all PDCCH/PDSCH/CSI-RS for Capability 1A, can UE still measure some DL PRS symbols that don’t collide with other channels ?*  Our answer is NO. Otherwise, there is no difference between Capability 1A and Capability 2. Therefore, if UE cannot measure some DL PRS symbols that don’t collide with other channels, why do we need to have more than one priority states. For us, if PRS processing window is configured for Capability 1, DL PRS always has high priority over all other DL signals/channels in all symbols inside the window (as mentioned in WA). There is no need for additional priority indication.  The Capability 1A is defined per UE, which means all CCs would be impacted. We don’t need to consider the collision between different CCs.  We assume Capability 1B is defined per CC. There is also no need to have more than one priority states either. When we talk about collision or priority, we should first concentrate on the channels/signals within the same CC. From our understanding, once UE receives a PRS processing window associated with a CC, DL PRS always has high priority over all other DL signals/channels in all symbols of the CC. Regarding what is the impact on another CC if UE is configured with CA. We can discuss in next meeting.  For Capability 2, we acknowledge that different priority states may be helpful for network flexibility. However, i*f PRS is lower priority than PDCCH and URLLC PDSCH and higher priority than other PDSCH/CSI-RS, we doubt that if there is enough symbols for PRS reception. From our understanding, UE may be configured with a lot of search spaces for PDCCH detection ( for the scheduling of current CC or cross carrier scheduling), so a lot of symbols are reserved for PDCCH(since we have no way to determine which PDCCH is for URLLC before it has been decoded). Therefore, more than two priority states is not necessary. We can accept Option 1 for Capability 2.*  Let’s go back to this proposal. With the understanding above, we should be open to support either Alt.1 or Alt.2 for latency reduction, which can be at least applied for Capability 1.  FL: The understanding from my side is that for capability 1A with PRS being low priority, if there is any symbol on any CC within the PRS processing window that requires to receive PDCCH (even monitoring), PDSCH, or CSI-RS, the PRS measurement will be dropped (at least this sample of PRS in the window will not be counted). |
| Qualcomm |  | Thanks for the passionate discussion!   * In either capability (1A,1B,2), a gNB may want to say:   + I am activating you with a MAC-CE a low-priority PRS processing window,but if any other signal appears in the processing window, drop the PRS. At the time the gNB sends this sginaling, it may not know what will be scheduled in the future. It could, up to its implementation to decide to avoid scheduling other channels inside the PRS processing window, or it may consider that it needs these resources for other more important channels.   + On the other hand, if we only have the option of scheduling a high priority window, a new MAC-CE is needed to deactivate the PRS processing if the gNB decides that these resources are better used if other channel is received. * *If gNB indicates that PRS is lower priority than all PDCCH/PDSCH/CSI-RS for Capability 1A, can UE still measure some DL PRS symbols that don’t collide with other channels ?*   + Same undersntading with ZTE. We prefer to keep the solution simple and just say no.   Examples:   * + Imagine a high priority PRS window is 8 slot, and PRS symbols are the first 4 slots (i.e. 4 slots to finish the processing). 2 scenarios:     - Other channels appear on the same symbols as PRS -> The PRS is processed the other channels are dropped.     - Other channels appear in the 4 slots where the UE is doing the processing -> The PRS is processed and other channels are dropped.   + Imagine a low priority PRS window is 8 slot, and PRS symbols are the first 4 slots (i.e. 4 slots to finish the processing). 2 scenarios:     - Other channels appear on the same symbols PRS -> The PRS is dropped and the other channels are processed.     - Other channels appear in the 4 slots where the UE is doing the processing -> The PRS is dropped and other channels are processed. Since other channels appear during the processing window, the UE doesn’t have enough processing power to do both, and therefore stops the PRS processing and uses the resources to do the other-channel processing   In all the above, the UE should know well enough in advance whether a collision is bound to happen, otherwise the UE would not be able to take an action. This is related to the Question 3.3.1-6 / Proposal 3.3.2-5 (collision detection timeline), which unfortunately was closed for this meeting, even though it clearly needs to be revisited during the maintenance phase.  Overall, low-latency is about “front-loading PRS” and having some time to finish the processing. In either capability, a UE should be able to declare how much time it needs to finish the processing after the end of the last PRS symbols.  Even in HW’s reply, you acknowledge that:   * *extend a little bit (spill-over) beyond the slots/symbols containing the PRS, but extension of PRS processing window to T (as per UE PRS processing) is too much. We understand if T=1msec or 2msec or 4msec, it could be OK, but we do not expect that the window duration could last for more than 10 msec, e.g. 80msec.*   **So, we are talking about the same thing. How much is the “processing spillover” as you call it after the last PRS symbol? Similar discussions happened for low-latency PDSCH, CSIRS, etc. This is business as usual, and it was obvious for us when the WA was made**.  A formulation of that “spillover after the PRS” is really Alt.1/2 (very similar those 2). So we are repeating Alt. 1 with a figure.This figure just says 2 simple things:   * PRS should be front-loaded, so that the UE will have time to report at the end of the window * During a second part of the window, there is “spillover” and for the UE to be able to finish the processing, it will not process any other DL channel if it is determined that PRS is higher priority than those channels. * The values of N & T can be debated in UE capability if needed and they can be very different than those compared to the legacy (N,T). |
| Samsung |  | We kind of having different understanding on how this window works from FL, sorry to say.  For capability 1(1A,1B), actually more like case 1; the PRS is prioritized over the whole window, regardless whether there is collision during the whole window length, PRS is handled, other DL is not expected to be handled (subject to UE capability on simutalously processing multiple DL signals);  For capability 2, actually more like case 2, the PRS is prioritized over only overlapped symbols, so only during the collision happened, the PRS is prioritized; and other time in this window, as long as PRS and DL signals are not overlapped, both of them are expected to be handled.  So to us, in order to allow it work well, UE should first report whether he can handle PRS with other DL signals simutalnious or not; if yes, MG-based solution might be sufficient then the PPW based solution may be not necessary from latency reduction point of view. If no, UE can only handle one, then the discussion here is meangingful and the PPW is meaningful. |
| Huawei, HiSilicon |  | Reply SS:  The interpretation of SS’s explanation is purely on the basis that PRS can only be higher priority than other signals/channels, and providing the PRS processing window is only to limit the time region of PRS being higher priority.  Can SS also consider the request from some other companies when reaching the working assumption that PRS could be lower priority than other DL signals/channels (data in the context, not SSB)?  Can SS also understand the logic that providing PRS processing window could also serve the boundary for UE to measure the PRS, i.e. network does not expect UE to measure the PRS outside the PRS processing window?  Why should UE report the capability that it can handle PRS with DL signals simultaneously? What does “simultaneous” mean here? Of course UE can only handle on a symbol, or even within the window subject to capability 1A/1B/2. |

**FL comments**

With the comments received, I would like to raise the following question at least for the purpose of understanding each other on the working assumption and at least have a better starting point for the next meeting.

### Question 4.1.2-2 (input requested)

* Do you think PRS processing window should consist of buffering period and processing period, and thus the length should depend on the UE PRS processing capability (N, T)?
  + This is intended to address the capability enhancements proposed by ZTE, CATT, Intel, Qualcomm.

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Nokia/NSB |  | If the LMF is the one requesting the PRS processing window then isn’t this possible by LMF implementation already? Not clear why we need to write in the spec that they are related. |
| Qualcomm | Yes | To Nokia: The LMF needs to know what are the UE capaiblities in order to request the correct PRS processing window. The UE needs to know how its UE capabilities are interpreted so that it can commit to them!  Sorry again for another long reply, but i think that the situation requires it.  Our understanding is that this the only way of having a low latency feature. This is basic principles in PDSCH (DMRS is front-loaded), in CSIRS (low-latency is applicable to the low-complexity CSI processing with explicit and very tight timelines), etc, etc. This is what needs to be done for PRS.  One way or the other, a UE needs to inform the network how much time it requires after the last PRS symbol. During the debate of the WA, we clearly said that the reason to introduce cap. 1A/1B is to have the **UE to dedicate all its processing** (across NR/LTE in cap. 1A) so that it can report the **fastest possible back to the network**. Then, other companies wanted to have cap.2, where effectively such “spillover” time after the PRS does not exist. We argued that this cap.2 will result to significantly higher latencies, and we still believe that it is an expensive feature to implement because UEs would need additional hardware to keep the same PRS processing capabilities; unless the UE reports that it can do a a very small number of PRS resource per slot.  However, companies wanted to have such “tradeoff” between scheduling flexibility and latency for given PRS computation capabilities.  Then, the WA effectively allows: One UE to report increased latency by declaring cap.2, another UE to report decreased latency and support cap 1A/1B. Different use-cases may require different such tradeoffs, low-tier/mid/premiup UEs will make different decisions, etc, etc  We have also pointed out, to further increase the network flexibility, and make it more likely for this feature to be deployed, that a UE should be able to declare multiple such capabilities, so the “latency/scheduling-flexibility” is known to the network, and can decide accordingly based on the needs. E.g. A same UE says to network:   * I can finish 12 PRS resources per slot in 4msec if i have those 4msec free from anything else (e.g. cap1A), OR * i can finish those 12 resources in 40msec, if you want me to be able to do the remaing DL processing (cap 2). * It is the network decision what to configure to the UE.   Note that in all cases (1A/1B/2**), the PRS processing window can be defined the same way**: There is a time **after the last PRS symbol** that is needed to finish the processing and report the measurements. The difference is that in cap. 1A/1B, some other channels, during this “spillover” time, shall be dropped (If PRS is higher priority), whereas in cap.2, the other channels will be processed even during this “spillover” time. However, the PRS window still exists and is defined the same way. In short:   * + *Maximum N msec PRS is processed at the beginning of the PRS processing window*   + *The PRS processing window length is properly set to allow UE to finish all the processing based on the reported capability T*     - *As shown in the WA, during this period of time, for cap 1A/1B other DL channels shall be dropped, if PRS is signaled as higher priority, whereas for cap 2, the other DL channels are expected to be processed. The purpose of having a PRS processing window is for the UE to declare when the report is ready to be sent.*   Having said the above, from QC, side, and given the WA status, we do NOT want to preclude reasonable UE implementations, and we are being constructive into ensuring that it could have decent chances to be deployed:   * There can be UEs that really focus on getting the lowest latency for a given cost to address specific market needs. These UEs will tend to report cap. 1A. These UEs require some time after the last PRS symbol to finish the processing as fast as possible given the available hardware.   There can be UEs that focus on a more balanced approach, where they go for cap. 1B or 2, increase the time needed to report after the last PRS, but could do the processing simultaneously with other DL channels. These UEs still need to report a “spillover time”, because at the end of the day, these UEs still have timeline and the network needs to know when is the UE ready to report. We believe that these UEs, for a given PRS processing load, will report significantly higher “spillover time”, i.e, higher latency, but that’s fine; its part of the latency/flexibility tradeoff and depends on its UE’s goal/market/use-case. |
| Samsung |  | Based on our understanding on the PRS processing window. Anything related to PRS handling should be prioritized within this window. Thus it could include PRS buffer, processing; or potentially even positioning calculation and report. But I assume the later two might be aggressive, so at least first two should be included. Otherwise, if PRS processing is not in the window, and not be prioritized, then it means other DL signal reception or processing could interrupt the PRS processing, does is seem useful for latency reduction? |
| Huawei, HiSilicon | Probably no | To Nokia: I think the intention is align with LMF understanding with UE expectance.  For example, if UE implementation expects the PRS processing window to extend to buffering+processing, then when LMF requests the PRS processing window to the gNB, it should set a proper value.  However, as commented, we currently would only accept the PRS processing window to extend beyond PRS buffering window for the new T values introduced in Rel-17, i.e. 1ms, 2ms and 4ms. Larger T values will force network to configure a larger PRS processing window length, which is not efficient as configuring the measurement gap.  To SS, let’s consider PRS measurement within MG, the MG length is supposedly cover only the RF retuning time and PRS buffering time, but not the follow-up PRS offline processing time. This could be the same for any RRM measurement (SSB, CSI-RS). If the UE requires 20ms PRS processing time (T = 20ms), this would effectively mean that network cannot schedule UE for 20ms if PRS is higher priority and UE will never measure PRS if PRS is lower prioirity considering the typical CORESET/SS monitoring periodicity. |
| ZTE | Yes | We tend to agree the following statement from Qualcomm,  *Note that in all cases (1A/1B/2****), the PRS processing window can be defined the same way****: There is a time* ***after the last PRS symbol*** *that is needed to finish the processing and report the measurements. The difference is that in cap. 1A/1B, some other channels, during this “spillover” time, shall be dropped (If PRS is higher priority), whereas in cap.2, the other channels will be processed even during this “spillover” time. However, the PRS window still exists and is defined the same way.*  Anyway, we have to define the PRS computation time(i.e. the spillover time) for both Capability 1 and Capability 2. Capability 1A/1B UE puts its all computation resources to finish the PRS computation without the need to process other channels, which can achieve better latency reduction than Capability 2. In addition, we also think the PRS processing window should cover both measuring (or buffering) and processing (or computation) time, which is clearly noted in the WA.   * Note: When the UE determines higher priority for other DL signals/channels over the PRS measurement/processing, the UE is not expected to measure/process DL PRS which is applicable to all of the above capability options.   Only we ensure UE can only measure the front-loaded PRS, which precludes that the spillover time will be extended outside the PRS processing window. Therefore, the PRS processing should reserve enough time to process the PRS buffered in the first part of the PRS processing window.  We’re fine to support either Alt.1 or Alt.2 as they are typical UE implementations. |
| MTK |  | In our view, the processing window is T, and within a T period, UE could buffer N ms front-loaded DL-PRS symbols. The major computation time is T – N. The reason to say “major” here is because, for some UE implementation, UE could compute during buffering. For such UE, the T will be shorter.  For capability 1A 1B and 2, we expect T will be different. Basically 1A would have shorter T and cap 2 has longer T |
|  |  |  |

### Question 4.1.2-3 (input requested)

* Do you think UE may be expected to measure PRS outside MG if there is no PRS processing window or if the PRS is outside the PRS processing window?
  + This is intended to address the meaningfulness of PRS processing window raised by Samsung.

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| **Company** | **Yes/No** | **Comments** |
| Nokia/NSB | Yes |  |
| Qualcomm | Yes | The UE can always request MG-based PRS if no Processing window is sent out or if it is not enough, or if any of the other prerequises of this feature are not met. Since the UE has gotten a request from the LMF, it is required to report. If the UE sends requests to the gNB, and no PRS processing window is actvated (or the prerequisites of this features are not met for any reason), it has to attempt other ways of informing the gnB that it requires to do PRS processing. The gnB could still ignore the UE, and then the UE will just report back an error message to the LMF. |
| Samsung |  | We don’t quite get how this question could solve our puzzle on the meaningfulness of PRS processing window. Read QC’s reply, if MG-based PRS is also counted, of couse the answer to the question is yes. But, what is the point? And for these description for request but no approvel with gNB, how does it answer our puzzle or answer the raised question?  Our puzzle was that, the whole point of PRS processing window is about prioirizing the PRS over other DL signals, so that the PRS reception, PRS processing or even measurement report could be somehow prioritized, and the latency can be reduced. But we are struggling whether PRS within this window is still lower priority than data, it’s not then intended to reduce latency. If this is the case, we don’t even want to confirm the working assumption. |
| Huawei, HiSilicon | No | Our understanding is that for the PRS not in the MG nor in the window, network does not expect UE to measure the PRS.  Then to answer SS’s question: the window is like SMTC for SSB RRM, and UE is not required to measure the PRS within the window if there is no gap. This window sets the boundary of PRS that network expects UE to measure, which is meaning of PRS processing window in the first place. We disagree with the understanding of SS that “PRS processing window is about prioritizing the PRS measurement”.  Then in this window, additionally priority can be indicated to handle of collision between DL signals and PRS. |
| ZTE |  | This can be discussed together in Proposal 3.5.2-1a.  For us, UE can still request MG for PRS measurement if there is no PRS processing window configured. |
| MTK | NO | This question is quite interesting.  If PRS is not covered by PPW, UE surely wants PRS to be within MG.    If no MG and also no PPW, it seems to us that PRS measurement is “don't care” from NW point of view. Also don't expect UE to perform autonomous gap at least for UE assisted mode  In our view, to have proper MG for UE is not a big issue if LMF could indicate proper information to gNB so that gNB in the beginning of a UE under location request could allocate proper MG.  Another thing to be able to discuss is within MG, whether the MG could be long enough to allow UE to finish computation, which means, MGL = T |

### Question 4.1.2-4 (input requested)

* Do you think the MG-less PRS measurement can also be used for other scenarios that do not persue low latency feature?
  + This is a general question on compatability for the sake of better understanding of the FL.

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| **Company** | **Yes/No** | **Comments** |
| Nokia/NSB | Yes |  |
| Qualcomm | Yes | What does it mean “low latency” in the spec? We don’t think that something like that we appear in the spec. E..g, do you mean that only if NumberSamples =1 then we can have MG-less PRS processing? If yes, we are OK to not restrict it only to the NumberSamples=1, but if majority wants to do that, we could be more open.  What makes this feature low latency is exactly the fact that there is a “tight” timeline form the UE perspective, which doesn’t exist in NR Rel-16: PRS at the beginning of the Processing window, and the UE is expected to finish the processing at the end and be ready to report. In NR Rel-16, there is a “T\_Last” added, and the smallest is 80+msec as we identified in the study item. We need to have scenarios where the UE can report PRS measurements earlier than that. |
| Samsung | No but agree spec wont say that | As all features designed in 3GPP, it will be eventually up to gNB on how to really use them. Because a feature is designed with many functions, how does the functions could be appied in reality is dependent.  However, when we design a feature in the spec, it is clearly and surely targeting for some specific purpose, in there, it’s about latency reduction. So we design it for latency reduction, If one tells me this processing window could be used for other purpose, it’s fine and it’s a happy coincidence, but other purpose should not be the design target. |
| Huawei, HiSilicon | Yes | As Qualcomm commented earlier, if the PRS processing window request or MG activation request, LMF could indicate to the gNB whether the measurement is for low latency purpose. I believe some companies are also arguing that LMF could indicate the expected measurement reporting time to facilitate gNB to schedule UL. Anyway we may need some signaling in RAN3 to differentiate low latency MG-less measurement and regular MG-less measurement.  In addition, I think RAN4 is also discussing the related requirements for MG-less measurement, and we believe in RAN4 consideration, a unified solution on the measurement perioid requirement is preferred that reuses MG-based measurement in Rel-16, but if anything advanced is introduced, it should be differentiated in RAN4 requirement, then some signaling to triggering the corresponding requirement may be needed. |
| ZTE | Yes | Agree with Qualcomm.  Low latency is not a terminology that should be specified. The feature can be implemented once both UE and gNB/LMF support those functions. In the spec, at least we should strive to reduce latency as much as possible to make it useful in IIOT scenario. |
| MTK | No | Low latency is the main target. What else we can pursue?   * High accuracy? Remember that the current agreement is within active BWP. For a UE without receiving data for a period of time, the BWP could be reduced but the UE may still need to perform PRS measurement. As such high accuracy may not be achieved unless we consider to extend outside gap measurement to support PRS measurement BW larger than active BWP * System efficiency (overhead reduction)? Seems not so related * UE efficiency (power saving)? Also not so related   Another thing we want to mention is, looking at 37.355:  ***durationOfPRS-Processing***  Indicates the duration *N* of DL-PRS symbols in units of ms a UE can process every T ms assuming maximum DL-PRS bandwidth provided in *supportedBandwidthPRS* and comprises the following subfields  It seems to us that we were actually thinking about PRS being front loaded in Rel-16, and however the wording is not properly expressed so that it is interpreted that PRS could also be in the middle, or in the end of T.  So if the wording is changed as  ***durationOfPRS-Processing***  Indicates the duration *N* of **front-loaded** DL-PRS symbols in units of ms a UE can process every T ms assuming maximum DL-PRS bandwidth provided in *supportedBandwidthPRS* and comprises the following subfields  Then it is applicable for both within gap and without gap |

### Proposal 4.1.2-5 (input requested)

* Decide during the maintanence phase whether/how PRS processing capability enhancement is introduced targerting PRS processing within the PRS processing window for the purpose of latency reduction, including at least the following aspects
  + Maximum N msec PRS is processed at the beginning of the PRS processing window
  + The PRS processing window length is properly set to allow UE to finish all the processing based on the reported capability T

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| **Company** | **Yes/No** | **Comments** |
| Nokia/NSB |  | Okay to discuss during maintenance given the time constraints. |
| Qualcomm |  | Yes we agree with the above. From our side, we envision that the time needed to finish the processing can be as small 4 msec (T-N>=4 msec), and indeed it doesn’t make sense to have UEs reporting that they need 80 msec to finish the processing. We acknowledge that we cannot block the medium and communication for so long period of time.     * + Maximum N msec PRS is processed at the beginning of the PRS processing window   + The PRS processing window length is properly set to allow UE to finish all the processing based on the reported capability T   As shown in the WA, during this period of time, for cap 1A/1B other DL channels shall be dropped, if PRS is ignalled as higher priority, whereas for cap 2, the other DL channels are expected to be processed. The purpose of having a PRS processing window is for the UE to declare when the report is ready to be sent.  Please note that we are still talking about a WA, and downscoping of features can always happen in December if it is understood that major aspects have not been addressed. From our side, it is rather major that it may appear as if we don’t have a common undersntading how “low-latency MG-less PRS processing” would work.  Based on the above, we think that something stronger is needed in this phase.  ***Proposal***   * ***A PRS processing capability (N,T) for the MG-less PRS processing feature should at least be able to address the following aspects:***   + ***Maximum N msec PRS processed at the beginning of the PRS processing window***   + ***PRS processing window length properly set to allow UE to finish all the processing based on the reported capability T***   ***Finalize the details of this UE capability, including the supported values (N,T) during the maintenance phase.*** |
| Samsung |  | Maybe we miss-understood the highlighted wording, “***Maximum N msec PRS processed at the beginning of the PRS processing window***”  Isn’t the N ms the buffer time for receiving PRS, and T-N ms the processing time for the buffered PRS? |
| Huawei, HiSilicon | OK | To SS: I think “process” is used in with multiple meanings. Should “received” be a better choice? |
| ZTE | Yes | We prefer not to preclude Alt.2 at this time. We can revise Qualcomm’s proposal as following,  ***Proposal***   * ***A PRS processing capability ~~(N,T)~~ for the MG-less PRS processing feature should at least be able to address the following aspects:***   + ***Maximum N msec PRS received ~~processed~~ at the beginning of the PRS processing window or time span (Tspan) from the last PRS symbol to the end of the PRS processing window***   + ***PRS processing window length properly set to allow UE to finish all the processing based on the reported capability T or Tcompute***   + ***Finalize the details of this UE capability, including the supported values (N,T) or Tcompute during the maintenance phase.*** |
| MTK |  | Treat T as the processing window, and PRS is front loaded within T  The definition in 37.355 could be changed by adding front-loaded for both within gap and outside gap. And for outside gap, the PRS BW for processing is within active BWP. However, it seems okay to ASSUME active BWP covers max PRS BW  ***durationOfPRS-Processing***  Indicates the duration *N* of **front-loaded** DL-PRS symbols in units of ms a UE can process every T ms assuming maximum DL-PRS bandwidth provided in *supportedBandwidthPRS* and comprises the following subfields |

## Positioning SRS priority

The following sources provided their views on the priority of positioning SRS.

|  |  |
| --- | --- |
| **Company** | **Proposals** |
| Nokia, NSB [6] | **Proposal 8**: RAN1 should study and work on new priority rules of transmitting SRS for positioning with other UL signals/channels, in order to reduce positioning latency for UL and DL+UL positioning methods. |
| Intel [9] | **Proposal 4:**  No priority indication for SRS for positioning is introduced in Rel.17 |
| Xiaomi [10] | **Proposal 5:** No priority indication for SRS is introduced in Rel-17. |
| CMCC [11] | **Proposal 4:** Support the following collision rule:   * If a PUSCH transmission with low priority overlaps in time with the periodic/semi-persistent SRS for positioning, the UE does not transmit the periodic/semi-persistent SRS for positioning in the overlapping symbols. * If a PUSCH transmission with low priority overlaps in time with the aperiodic SRS for positioning with low priority, the UE does not transmit the aperiodic SRS for positioning in the overlapping symbols. * If a PUSCH transmission with low priority overlaps in time with the aperiodic SRS for positioning with high priority, the UE does not transmit the PUSCH in the overlapping symbols.   **Proposal 5:** Up to UE capability, support priority indication of positioning SRS with:   * + Alt.1 Explicit indication by gNB;   The type of indication is indicated by RRC, and for semi-persistent and aperiodic SRS, the activation MAC-CE and the triggering DCI should be able to overwrite the priority indicated by RRC. |
| Qualcomm [18] | **Proposal 16:** Subject to UE capability, support the UE receiving explicitly signaling for SRS for positioning being higher priority than the SRS for MIMO of the same time-domain behavior. |

**FL comments**

This issue has been discussed for a couple meetings, and cannot be concluded. There was also explicit proposal not to introduce this feature.

### Round 1

Based on the summary from the contributions, the FL has the following proposal.

### Proposal 4.2.1-1 for conclusion

* No priority indication for SRS for positioning is introduced in Rel.17.

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| **Company** | **Yes/No** | **Comments** |
| Xiaomi | Yes | we think SRS priority can be handled implicitly by gNB implementation and DCI format 2\_4. |
| Intel | Yes |  |
| LGE | Yes |  |
| ZTE | OK with the conclusion. |  |
| vivo |  | **From email**  We prefer not to endorse the conclusion since M-RTT latency also exceeds the requirement, it can be reduced by PPW with SRS’s priority indication. And even if there is no such conclusion, it does not mean that R17 should support the priority indication of SRS. |
| CATT | Yes |  |

## Measurement report scheduling enhancements

The following sources provided their views on the measurement report scheduling enhancements.

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| --- | --- |
| **Company** | **Proposals** |
| ZTE [2] | **Proposal 7**: In order to balance the positioning latency and accuracy, LMF can configure two response times in the location information request,   * UE is required to provide a first location information report before the first response time based on the measurements conducted in the PRS processing window. * UE is required to provide a second location information report before the second response time, where the second location information doesn’t necessarily require UE to provide measurements conducted in the PRS processing window.   **Proposal 9:** In order to reduce UE measurement time of a location information report, LMF should be allowed to select a subset of DL PRS from DL PRS configured in ProvideAssistanceData message for UE to measure and report the location information, where the subset of DL PRS can be indicated in RequestLocationInformation message.  **Proposal 10:** In order to get quick response of an early location information report, LMF should be able to configure an early location information report associated with DL PRS used to derive the early location information report.  **Proposal 11:** For the purpose of reporting new location measurements in time, Rel-17 should allow UE to report multiple early location information reports prior to a response time. |
| Nokia, NSB [6] | **Proposal 1:** UE could request the expected measurement report resource from the serving gNB via RRC signaling to minimize the positioning measurement report delay. |
| SONY [7] | **Proposal 7:** Support CG-PUSCH for positioning measurement reporting. |
| Samsung [12] | **Proposal 1:** Configured grant PUSCH type 1 and type 2 are used for positioning measurement report in order to reduce the latency.  **Proposal 2:** The DG PUSCH with high priority is considered for positioning measurement report in order to reduce the latency. |
| Apple [14] | **Proposal 5**: NW configures (as part of MG configuration or PRS processing window configuration) PUSCH resource for UE to report positioning measurements and/or location information   * The grant is specifically configured for positioning measurement report, e.g. Nx symbols after the end of last symbol of last DL-PRS resource, or after the end of MG on duration/PRS processing window * Nx is determined based on UE capability |
| Lenovo, Moto Mobility [19] | **Proposal 5:** Support assistance information between gNB and LMF for enabling lower latency UL CG-based measurement reports. RAN3 to be consulted for impacts. |

**FL comments**

For indication of PUSCH resource to carry the LPP measurement report, it has been discussed for a couple of meeting, and the suggestion from the opposing companies was to discuss it in RAN2 or RAN3 directly.

For CG-PUSCH and DG-PUSCH, it is not clear what the proposal itself entails, given that both CG-PUSCH and DG-PUSCH can be used to carry the LPP measurement report.

### Round 1

Based on the summary from the contributions, the FL has the following proposal.

### Proposal 4.3.1-1 (for conclusion)

* No enhancements on measurement report scheduling is introduced by RAN1 in Rel-17.

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| **Company** | **Yes/No** | **Comments** |
| ZTE | No | We think the following points can be very useful for latency reduction,   * Multiple response times configured in location request * PRS prioritization on a subset of DL PRS indicated in location request |
| LGE | No | If resources (UL-grant) for measurement report is accompanied by MAC-CE for MG activation, we believe that it reduces latency for SR and UL grant. So, RAN1 sholud consider the issue. |
| InterDigital |  | We should let RAN2 decide on this issue. |
| CATT |  | Okay to let RAN2 decide |

## Rx beam sweeping factor

The following agreements were made in RAN1#106bis-e on this issue.

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| --- |
| Agreement:  Introduce a new UE capability on lower Rx beam sweeping factor (<8) to reduce the PRS measurement latency for FR2 positioning frequency layers.   * Send an LS to RAN4 to confirm.   MCC post meeting: Due to late decision, there was no time to the LS content to RAN4; postponed to next meeting. |

The following sources provided their views on Rx beam sweeping factor.

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| **Company** | **Proposals** |
| ZTE [2] | **Proposal 3**: Subject to UE capability, support LMF to explicitly request UE to report the measurement based on Rx beam sweeping factor equals to 8 or less than 8(e.g. 4) for FR2 positioning frequency layers. |
| Moderator (Huawei) [21] | Draft LS to RAN4 per agreement in RAN1#106bis-e. |

### Round 1

Based on the summary from the contributions, the FL has the following questions.

**Question 4.4.1-1 (closed)**

* Q1: Do you think the draft LS submitted in [21] as per the agreement made in RAN1#106bis-e on reduced number of Rx beam can be approved individually?
* Q2: Do you think it necessary for the LMF to explicitly indicate the Rx beam sweeping factor to the UE?

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| **Company** | **Comments** |
| vivo | Q1: Yes, whether the requirement can be satisfied with the reduced number of Rx beams should be discussed in RAN4  Q2: Waiting for RAN4 reply |
| ZTE | Q1: Yes  Q1: OK to wait for RAN4’s reply |
| Huawei, HiSilicon | Q1: Yes  Q2: No. |
| LGE | Q1: Yest  Q2: waits for RAN1 reply. |
| Nokia/NSB | Q1: Yes  Q2: No. |
| CATT | Q1: Yes  Q2: No. |

### Round 2

The FL has the following proposal based on the comments received.

**Proposal 4.4.2-1 (closed)**

* The draft LS submitted in R1-2112411 is endorsed.

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| **Company** | **Yes/No** | **Comments** |
| ZTE | Yes |  |
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### Agreement as per email announcement

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| --- |
| To fill in |

# Others

The following proposals are considered not essential to the completion of the latency improvement work by RAN1.

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| **Company** | **Proposals** |
| vivo [3] | **Proposal 17:**   * Support on-demand PRS configured/requested in a PRS processing window.   **Proposal 18:**   * The request of the measurement via MAC-CE and NRPPa procedure should be supported. |
| CATT [4] | **Proposal 6:** AP-PRS and SP-PRS receptions triggered by serving gNB should be supported at least for single gNB positioning, in which a UE is informed to measure the DL PRS of the TRPs of the same gNB.  **Proposal 7:** Support reception of AP-PRS or SP-PRS triggered by DCI or MAC CE for multiple gNB positioning.  **Proposal 8:** Support reception of AP-PRS or SP-PRS triggered/configured by LMF through LPP message. |
| OPPO [5] | Proposal 1: The LMF shall request the same M-sample or 4-sample measurement for all the positioning methods to one UE. The UE shall expect the same M-sample or 4-sample measurement to be performed on all positioning methods configured to the UE. |
| Samsung [12] | **Proposal 3:**   * The LMF indicates whether the UE can use less than 4 samples. * The UE determines the number of samples to be used and indicates it to the LMF * Note: this applies for both UE-based positioning and UE-assisted positioning |
| Apple [14] | **Proposal 3**: NW provides assistance data to UE, based on which UE is configured with one or more MG configurations and A-PRS resources associated with each MG.   * Once MG is activated, the A-PRS associated with MG is consequently activated as well |
| Lenovo, Moto Mobility [19] | **Proposal 7:** Introduce a separate UE capability set of values PRS processing outside an MG. |

## Round 1

### Proposal 5-1

The suggestion from the FL is not to discuss those proposals.

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| **Company** | **Comments on the necessity of any specific proposal** |
| Samsung | For the M-sample issue, there are some scenarios (e.g. UE based positioning) where the LMF cannot decide whether to use reduced samples for measurement. For these case, it is better to let the UE determine the number of samples to be used rather than the network. The LMF should give an indication on whether current positioning request is marked as “low latency” or not. In addition, for the case of UE-based positioning, there is no other choice but to let the UE decide the number of samples.  Proposal:   * + The LMF indicates whether the UE can use M< 4 samples.   + The UE determines the number of samples M (M<4) and indicates it to the LMF   Note: this applies for both UE-based positioning and UE-assisted positioning  FL: there is no measurement period requirement for UE-based positioning in Rel-16. |
| Samsung2 | It is not clear to us why FL said that there was no measurement period requirement for UE-B in R16. Our understanding is that the M=4 sample requirement in 38.133 applies to both UE-A and UE-B positioning:  **38.133, clause 9.9.2.5:**  When physical layer receives last of *NR-TDOA-ProvideAssistanceData* message and *NR-TDOA-RequestLocationInformation* message from LMF via LPP [34]*,* the UE shall be able to measure multiple (up to the UE capability specified in Clause 9.9.2.3) DL RSTD measurements, defined in TS 38.215 [4], during the measurement period defined as:  Where ,  is the index of positioning frequency layer,    is the number of PRS RSTD samples and = 4.  We would like to check with the group if the existing agreement of M=1 or M =4 sample only applies to UE-A positioning? How about UE-B positioning? |
|  |  |

# Conclusion

## Proposals for Friday GTW of 1st week

**Proposal 2.1.1-1a**

* Preconfiguration of MG(s) in RRC is supported from RAN1 perspective.
  + Each MG in the preconfiguration is associated with MG-ID
  + Send an LS to RAN2 and RAN3

**Proposal 2.2.1-1**

* Select between the following two alternatives on the information in the UL MAC CE for MG activation request by the UE.
  + Alt.1 MG ID associated with the preconfiguation of MGs
  + Alt.2 Information carried in the RRC LocationMeasurementIndication, i.e.
    - dl-PRS-PointA
    - nr-MeasPRS-RepetitionAndOffset
    - nr-MeasPRS-length

**Proposal 3.2.1-5**

* 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.
  + Include it in the LS to RAN2 and RAN3.

**Proposal 3.3.1-2**

* Select between the following alternatives on priority states to be indicated to the UE
  + Alt.1 Two priority states are defined
    - State 1: PRS is higher priority than all PDCCH/PDSCH/CSI-RS
    - State 2: PRS is lower priority than all PDCCH/PDSCH/CSI-RS
  + Alt. 2 Three priority states are defined
    - State 1: PRS is higher priority than all PDCCH/PDSCH/CSI-RS
    - State 2: PRS is lower priority than URLLC PDSCH and higher priority than other PDCCH/PDSCH/CSI-RS
      * Note: The URLLC channel corresponds a dynamically scheduled PDSCH whose PUCCH resource for carrying ACK/NAK is marked as high-priority.
    - State 3: PRS is lower priority than all PDCCH/PDSCH/CSI-RS
  + Note: SSB is a separate issue.

**Proposal 3.4.1-1**

* Select between band and CC for capability 1B as per working assumption made in RAN1#106-e.
  + Alt.1 band
  + Alt.2 CC

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| Working assumption:  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.) |

## Proposals for Tuesday GTW of 2nd week

**Proposal 3.2.2-3a**

* At least the following parameters for PRS processing window are supported.
  + Starting slot
  + Periodicity
  + Duration/length
* Strive to conclude the following parameter in RAN1#107-e. (Postpone to maintenance phase if not)
  + Cell and SCS information associated with the slot
  + Processing type (associated with the corresponding UE capability 1A/1B/2)

**Proposal 3.3.2-2**

* The following options are supported subject to UE capability for priority handling of PRS when PRS measurement is outside MG.
  + Option 1: UE may indicates support of two priority states.
    - State 1: PRS is higher priority than all PDCCH/PDSCH/CSI-RS
    - State 2: PRS is lower priority than all PDCCH/PDSCH/CSI-RS
  + Option 2: UE may indicate support of three priority states
    - State 1: PRS is higher priority than all PDCCH/PDSCH/CSI-RS
    - State 2: PRS is lower priority than PDCCH and URLLC PDSCH and higher priority than other PDSCH/CSI-RS
      * Note: The URLLC channel corresponds a dynamically scheduled PDSCH whose PUCCH resource for carrying ACK/NAK is marked as high-priority.
    - State 3: PRS is lower priority than all PDCCH/PDSCH/CSI-RS
  + Option 3: UE may indicate support of single priority state
    - State 1: PRS is higher priority than all PDCCH/PDSCH/CSI-RS
* Note: SSB is a separate issue.

**Proposal 3.4.1-1**

* Select between band and CC for capability 1B as per working assumption made in RAN1#106-e.
  + Alt.1 band
  + Alt.2 CC

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| --- |
| Working assumption:  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.) |

If time allows

**Proposal 3.2.2-1**

* 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.
  + Include it in the LS to RAN2 and RAN3.

**Proposal 3.3.2-4a (High priority)**

* The priority of PRS (for two priority states and three priority states subject to another proposal) is indicated in RRC.

## Proposals for email endorsement

### Proposal 2.1.2-1

* Include in the LS the following content
  + RAN1 understands it is up to RAN2 and/or RAN3 to decide how gNB determines the preconfiguration of MG(s).

### Proposal 2.3.2-1

* For the MG activation request to the gNB by the LMF, it is up to RAN3 to design the necessary information to be transferred in the NRPPa message.
* Include it in the LS to RAN2 and RAN3.

### Proposal 2.4.2-1

* The DL MAC CE for MG activation indicates the ID associated with the preconfigured MG.

### Proposal 4.4.2-1

* The draft LS submitted in R1-2112411 is endorsed.

## Proposals for Thursday GTW