3GPP TSG-RAN WG2 Meeting #112-e***R2-20xxxxx***

Electronic, November 2 – 13, 2020

**Agenda item:** 6.6.3

**Source:** Qualcomm Incorporated

**Title:** Summary of Email discussion [AT112-e][605][POS] LPP proposals

**Document for:**  Discussion and Decision

# 1. Introduction

This document summarizes the following email discussion.

* [AT112-e][605][POS] LPP proposals (Qualcomm)

Scope: Discuss and resolve the remaining proposals from R2-2010975: P1-P5, P7, P8.

Intended outcome: Agreeable CR in R2-2010865

Deadline: Tuesday 2020-11-10 1200 UTC

Please provide your comments before Friday 2020-11-06 (EOB in your time zone). This allows all agreeable TPs/CRs to be merged into a single CR in R2-2010865 and also have some time to review the merged CR.

# 2. DL-PRS ID Reuse on Different Frequency Layers

Contribution [1] discusses the issue of DL-PRS-ID assignment on different positioning frequency layers, which is related to the discussion and agreement from RAN2#111-e to add an *associated-dl-PRS-ID* field to the IE *NR-TRP-LocationInfo* (similar to the IE *NR-DL-PRS-BeamInfo*).

The question discussed in [1] is whether a particular DL-PRS ID can be reused for different positioning frequency layers or not.

The discussion in [1] came to the following conclusion/proposal:

"*dl-PRS-ID can be reused across frequency layers*"

Rapporteur's Comments:

- A positioning frequency layer is essentially a collection of DL-PRS Resource Sets which have the same subcarrier spacing and CP, same DL-PRS point A, start PRB, bandwidth, and same comb-size.

- Therefore, there could be multiple positioning frequency layer on a single physical TRP. One example may be a "narrow band" DL-PRS positioning frequency layer and a more "wide band" DL-PRS positioning frequency layer (similar to the multiple PRS configurations introduced for LTE eMTC).

- If the DL-PRS for multiple positioning frequency layer are transmitted from the same physical antenna reference points, they should use the same DL-PRS ID (since the same TRP with the same antenna locations).

- Therefore, the proposal in [1] should be common understanding.

- However, the assignment of DL-PRS IDs to TRPs should be a deployment issue/choice.

**Question 1-1: Do you agree that a DL-PRS ID can be reused across Positioning Frequency Layers?**

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| Intel | Yes |  |
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**Question 1-2: Do you think any specification changes are required to support/clarify your answer for Question 1-1?**

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| Company | Yes/No | Comments |
| Intel | No | If anything is needed, we can just capture RAN2 understanding in chairman Notes. |
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A text proposal for a clarification is provided in [3]. An additional field description for the *dl-prs-id* in IE *NR-DL-PRS-AssistanceData* is proposed as follows:

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| *NR-DL-PRS-AssistanceData* field descriptions |
| --- |
| […] |
| ***dl-PRS-ID***  This field is used along with a DL-PRS Resource Set ID and a DL-PRS Resource ID to uniquely identify a DL-PRS Resource, and is associated with a single TRP across positioning frequency layers. |
| […] |

================================== END TP ===========================================

**Question 1-3: If your answer to Question 1-1 and 1-2 was "Yes", do you agree with the above text proposal?**

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# 3. UE Capabilities

## 3.1 Band Combination fallback

Some DL-PRS Resource Capabilities are defined per band combination (IE *DL-PRS-ResourcesBandCombination*). Contribution [5] suggests that these capabilities do not need to be provided for all possible/supported band combinations, but only for the super-set. For RRC capabilities, this is referred to as "Fallback band combination" in TS 38.306:

***Fallback band combination****: A band combination that would result from another band combination by releasing at least one SCell or uplink configuration of SCell, or SCG. An intra-band non-contiguous band combination is not considered to be a fallback band combination of an intra-band contiguous band combination.*

For example, if the UE provides the capabilities for band combinations A+B+C, the network may assume the capability is also supported for any subset combination, e.g., A+B, B+C, A+C, A, B, C.

Contribution [5] has the following proposal:

*Clarify the following reporting behaviour for DL-PRS-ResourcesBandCombination that Band combination fallback is allowed.*

*- UE capability signaling on a superset BC applies to any subset BC thereof.*

*- UE shall not report the capability for the subset BC if the capability is the same as the superset BC.*

*- Note: For FR1/FR2 mixed operation, the capability applies to the subset BC within each FR.*

*- Note: If the capability on a subset BC is different from that on the superset BC, UE may report the subset BC individually.*

Rapporteur's Comments:

- The above proposal seems not a "clarification", but a new feature not yet considered for LPP.

- LPP has no strict message size limitation, therefore, introduction of such feature may not necessarily be needed.

- The "Fallback band combination" definition for RRC capabilities seems not directly applicable to DL-PRS resource capabilities.

- There may be some loss in flexibility; e.g., if a UE supports A+B, but not B, etc.

**Question 2-1: Do you agree that "band combination fallback" is introduced in LPP Provide Capabilities?**

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| Company | Yes/No | Comments |
| Intel | Not for now | Agree Rapporteur’s comments. This is a new feature instead of clarification since it will impact both UE and LMF. Therefore it should not be considered as R16 clarification. |
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A text proposal is provided in [5]. An additional field description for the *dl-PRS-ResourcesBandCombinationList* in IE *NR-DL-PRS-ResourcesCapability* is proposed as follows:

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| *NR-DL-PRS-ResourcesCapability* field descriptions |
| --- |
| ***maxNrOfDL-PRS-ResourceSetPerTrpPerFrequencyLayer***  Indicates the maximum number of DL-PRS Resource Sets per TRP per frequency layer supported by UE. |
| ***maxNrOfTRP-AcrossFreqs***  Indicates the maximum number of TRPs across all positioning frequency layers. |
| ***maxNrOfPosLayer***  Indicates the maximum number of supported positioning layer. |
| ***dl-PRS-ResourcesBandCombinationList***  Indicates the capabilities of DL-PRS resources on the supported band combinations. The capability reported on a superset band combination is also applicable to any of its subset band combinations. UE does not signal the capability for a subset band combination that has the same capability as its reported superset band combination.  For FR1-FR2 mixed operation, the capability on subset band combination is only applicable the bands in the respective frequency range. |
| ***maxNrOfDL-PRS-ResourcesPerResourceSet***  Indicates the maximum number of DL-PRS Resources per DL-PRS Resource Set. Value 16, 32, 64 are only applicable to FR2 bands. Value 1 is not applicable for DL-AoD. |
| ***maxNrOfDL-PRS-ResourcesPerPositioningFrequencylayer***  Indicates the maximum number of DL-PRS resources per TRP across all frequency layers. Value 6 is only applicable to FR1 bands. |
| ***maxNrOfDL-PRS-ResourcesAcrossAllFL-TRP-ResourceSet***  Indicates the maximum number of DL-PRS Resources supported by UE across all frequency layers, TRPs and DL-PRS Resource Sets.  fr1-Only: This is applicable for FR1 only band combinations;  fr2-Only: This is applicable for FR2 only band combinations;  fr1-FR2Mix: This is applicable for band combinations containing FR1 and FR2 bands. fr1 means for FR1 in FR1/FR2 mixed operation, and fr2 means for FR2 in FR1/FR2 mixed operation. |

================================== END TP ===========================================

**Question 2-2: If your answer to Question 2-1 was "Yes", do you agree with the above text proposal?**

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## 3.2 Common DL-PRS Capabilities

The *NR-DL-PRS-ProcessingCapability* and *NR-DL-PRS-QCL-ProcessingCapability* are common DL-PRS capabilities (in agreement with RAN1 capability list). The IE can be included in the LPP Provide Capabilities message for each applicable method (i.e., each message for each method is self-contained). However, in case of capabilities for multiple methods are provided, the common capability applies across methods.

Contribution [5] has the following proposal:

*UE includes the capabilities with NR-DL-PRS-ProcessingCapability and NR-DL-PRS-QCL-ProcessingCapability in only one of the IEs NR-DL-TDOA-ProvideCapabilities, NR-DL-AoD-ProvideCapabilities, and NR-Multi-RTT-ProvideCapabilities, when capabilities of multiple positioning methods are provided.*

Rapporteur's Comments:

- This seems in agreement with RAN1 capabilities spreadsheet, and analogous to the IE *NR-DL-PRS-ProvideAssistanceData.*

**Question 3-1: Do you agree that the UE includes the capabilities with *NR-DL-PRS-ProcessingCapability* and *NR-DL-PRS-QCL-ProcessingCapability* in only one of the IEs *NR-DL-TDOA-ProvideCapabilities*, *NR-DL-AoD-ProvideCapabilities*, and *NR-Multi-RTT-ProvideCapabilities*, when capabilities of multiple positioning methods are provided.?**

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| Company | Yes/No | Comments |
| Intel | No | We agree the intention. But the problem is that so far NR-DL-PRS-ProcessingCapability and NR-DL-PRS-QCL-ProcessingCapability are mandatory under each positioning method. Therefore the suggested changes can only work if change mandatory to optional that is NBC change. |
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A text proposal is provided in [5]. An additional introduction text for the IE *NR-DL-PRS-ProcessingCapability* and IE *NR-DL-PRS-QCL-ProcessingCapability* is proposed as follows:

================================= BEGIN TP ===========================================

##### – *NR-DL-PRS-ProcessingCapability*

The IE *NR-DL-PRS-ProcessingCapability* defines the common downlink PRS Processing capability. This IE shall be present in only one of the IEs *NR-DL-TDOA-ProvideCapabilities*, *NR-DL-AoD-ProvideCapabilities*, and *NR-Multi-RTT-ProvideCapabilities*, for the cases when capabilities of multiple positioning methods are signalled.

-- ASN1START

[…]

##### *– NR-DL-PRS-QCL-ProcessingCapability*

The IE *NR-DL-PRS-QCL-ProcessingCapability* defines the common UE downlink PRS QCL Processing capability. The UE can include this IE only if the UE supports *NR-DL-PRS-ProcessingCapability*. Otherwise, the UE does not include this IE. This IE shall be present in only one of the IEs *NR-DL-TDOA-ProvideCapabilities*, *NR-DL-AoD-ProvideCapabilities*, and *NR-Multi-RTT-ProvideCapabilities*, for the cases when capabilities of multiple positioning methods are signalled.

-- ASN1START

[…]

================================== END TP ===========================================

**Question 3-2: If your answer to Question 3-1 was "Yes", do you agree with the above text proposal?**

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## 3.3 SRS Capability Update

Some capabilities in IE *NR-UL-SRS-Capability* are provided for the configured UL CA band combination only. Therefore, these UE capabilities may change during an LPP session depending on addition/modification of an SCell.

Contribution [5] points out that the specification is currently not clear whether the UE should provide updated SRS capabilities during an LPP session or not.

Contribution [5] has the following proposal:

*UE is not required to update its UL SRS capability in case of SCell activation/deactivation or addition/release/modification.*

Rapporteur's Comments:

- During an active Multi-RTT LPP session, it should in principle be possible to provide an unsolicited LPP Provide Capabilities message, if some "capabilities" change. However, the need for this is questionable, since NRPPa signalling would provide updated SRS configurations to the LMF (if needed) (as also discussed in [5]).

- For UL-only positioning, this may generally have more impact, since after the capability exchange procedure, the UE may not have an active LPP session any longer.

**Question 4-1: Do you agree that the UE is not required to update its UL SRS capability in case of SCell activation/deactivation or addition/release/modification?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Intel |  | Agree the gNB should send the updated SRS configuration to the LMF. But without knowing the UE updated capability, the LMF cannot recommend the updated SRS configuration to the gNB again.  However, agree Rapporteur’s comments on UL only positioning. |
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A text proposal is provided in [5]. An additional introduction text for the IE *NR-UL-SRS-Capability* is proposed as follows:

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##### *– NR-UL-SRS-Capability*

The IE *NR-UL-SRS-Capability* defines the UE uplink SRS capability. For the cases when UL CA configuration change results in the change of the capability, UE is not required to signal the updated value.

-- ASN1START

[…]

================================== END TP ===========================================

**Question 4-2: If your answer to Question 4-1 was "Yes", do you agree with the above text proposal?**

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## 3.4 Capturing UE DL PRS Processing Capability

At RAN2#110, an RAN1 LS was received on "Capturing UE DL PRS Processing Capability" in [R2-2006103](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_110-e/Docs/R2-2006103.zip) which provides a text proposal for TS 38.306 summarizing the UE DL PRS processing capabilities with the following action to RAN2:

"*RAN WG1 respectfully asks RAN WG2 to consider the agreed text proposal recommended from RAN WG1 perspective in the TS 38.306 and/or TS 37.355, which is left up to RAN WG2 decision*".

The included TP is repeated below.

| Definitions for parameters | Per | M | FDD-TDD  DIFF | FR1-FR2  DIFF |
| --- | --- | --- | --- | --- |
| ***[maxDL-PRS-Bandwidth]***  Maximum DL PRS bandwidth in MHz, which is supported and reported by UE. Values reported for FR1 bands are selected from {5, 10, 20, 40, 50, 80, 100} MHz. Values reported in for FR2 bands are selected from {50, 100, 200, 400} MHz | Band | No | No | No |
| ***[bufferingTypeDL-PRS]***  UE indicates whether it supports Type-1 or Type-2 UE capability, where Type 1 – sub-slot/symbol level buffering of DL PRS and Type 2 – slot level buffering for DL PRS | Band | No | No | No |
| ***[maxNumDL-PRS-ResourcesPerSlot]***  Max number of DL PRS resources that UE can process in a slot. Values reported by the UE for FR1 bands are selected from: {1, 2, 4, [6], 8, 12, 16, [24], 32, [48], 64} for each SCS: 15kHz, 30kHz, 60kHz. Values reported by the UE for FR2 bands are selected from: {1, 2, 4, [6], 8, 12, 16, [24], 32, [48], 64} for each SCS: 60kHz, 120kHz | Band | No | No | No |

| ***[processingCapDL-PRS]***  The UE DL PRS processing capability defined as a duration of DL PRS symbols *N* in units of ms a UE can process every *T* ms assuming maximum DL PRS bandwidth in MHz, which is supported and reported by UE.   1. Values of *T*: {8, 16, 20, 30, 40, 80, 160, 320, 640, 1280} ms 2. Values of N: {0.125, 0.25, 0.5, 1, 2, 4, 8, 12, 16, 20, 25, 30, 35, 40, 45, 50} ms   Notes:   1. UE reports one combination of (N, T) values per band, where N is a duration of DL PRS symbols in ms processed every T ms for a given maximum bandwidth (B) in MHz supported by UE 2. UE is not expected to support DL PRS bandwidth that exceeds the reported DL PRS bandwidth value 3. UE DL PRS processing capability is defined for a single positioning frequency layer (i.e. for a UE supporting multiple positioning frequency layers, a UE is expected to process one frequency layer at a time)   Note: The above parameters are reported assuming a configured measurement gap and a maximum ratio of measurement gap length (MGL) / measurement gap repetition period (MGRP) of no more than X% [TS 38.133, clause TBD].  For the purpose of the DL PRS processing capability, if UE reports DL PRS processing capability (*N*, *T*), for any time window defined in TS 38. 214 Clause 5.6.5.1, the UE should be capable to process all DL PRS resources within , if  - where K is defined in the TS 38.214 Clause 5.6.5.1, and  - the number of resources in each slot does not exceed the UE capability provided by the higher layer parameter *maxNumDL-PRS-ResourcesPerSlot*, and  - the configured measurement gap and a maximum ratio of measurement gap length (MGL) / measurement gap repetition period (MGRP) is no more than *X*% [TS 38.133, clause TBD] | Band | No | No | No |
| --- | --- | --- | --- | --- |

As discussed in [5], it seems this text proposal hasn't been captured yet in neither TS 38.306 nor TS 37.355 .

Contribution [5] has the following proposal:

*Capture the content in LS R2-2006103 to LPP specification for PRS processing capability.*

Rapporteur's Comments:

- Is there a specific reason, why the RAN1 text proposal can't be captured in TS 38.306? The proposed TP in the RAN1 LS looks a bit misplaced for LPP.

**Question 5-1: Should the content of the RAN1 TP in** [**R2-2006103**](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_110-e/Docs/R2-2006103.zip) **and shown above be included in TS 38.306 and/or TS 37.355?**

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| Company | TS(s) | Comments |
| Intel | TS37.355 | The PRS capabilities are only captured in TS37.355. TS38.306 is used to capture the RRC capabilities, and therefore we did not capture the descriptions on PRS capabilities in TS38.306. TS37.355 is the suitable place instead of 38.306. |
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A text proposal is provided in [5]. The field description for *durationOfPRS-Processing* in IE *NR-DL-PRS-ProcessingCapability* is extended with the description from RAN1 above:

================================= BEGIN TP ===========================================

| *NR-DL-PRS-ProcessingCapability* field descriptions |
| --- |
| ***maxSupportedFreqLayers***  Indicates the maximum number of positioning frequency layers supported by UE. |
| ***supportedBandwidthPRS***  Indicates the maximum number of DL-PRS bandwidth in MHz, which is supported and reported by UE. |
| ***dl-PRS-BufferType***  IndicatesDL-PRS buffering capability. Value *type1* indicates sub-slot/symbol level buffering and value *type2* indicates slot level buffering. |
| ***durationOfPRS-Processing***  Indicates the duration of DL-PRS symbol in units of ms a UE can process every T ms assuming maximum DL-PRS bandwidth represented by *supportedBandwidthPRS*.  For the purpose of the DL PRS processing capability, if UE reports DL PRS processing capability (*N*, *T*), for any time window defined in TS 38.214 Clause 5.6.5.1, the UE should be capable to process all DL PRS resources within , if  - where K is defined in the TS 38.214 Clause 5.6.5.1, and  - the number of resources in each slot does not exceed the UE capability provided by the higher layer parameter *maxNumDL-PRS-ResourcesPerSlot*, and  - the configured measurement gap is supported by the UE. |
| ***maxNumOfDL-PRS-ResProcessedPerSlot***  Indicates the maximum number of DL-PRS resources that UE can process in a slot. SCS: 15 kHz, 30 kHz, 60 kHz are applicable for FR1 bands. SCS: 60 kHz, 120 kHz are applicable for FR2 bands. |
| ***simulLTE-NR-PRS***  Indicates whether the UE supports parallel processing of LTE PRS and NR PRS. |

================================== END TP ===========================================

**Question 5-2: If your answer to Question 5-1 was "TS 37.355", do you agree with the above text proposal?**

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| Intel | Yes |  |
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# 4. Change Requests

## 4.1 Correction on PRS configuration [3]

The reason for change in [R2-2010263](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_112-e/Docs/R2-2010263.zip) [3] is as follows:

The conditional presence tag of *NotSameAsRefServ* is used at multiple places without description.

The bit-length of *dl-prs-MutingBitRepetitionFactor* should be the same as *dl-PRS-ResourceRepetitionFactor.*

It is clarified that the *dl-PRS-ID* can be reused across positioning frequency layers to denote a TRP deployed on multiple positioning frequency layers.

The field description for *sfn-ssb-offset* does not specify the meaning of the signalled values.

The following changes are proposed:

1. Change the conditional presence tag of *NotSameAsRefServ* to Need ON, and delete the description for the conditional presence tag.

2. Clarify that *dl-prs-MutingBitRepetitionFactor* should be the same as *dl-PRS-ResourceRepetitionFactor.*

3. Clarify that the same *dl-PRS-ID* identifies a TRP across positioning frequency layers.

4. Clarify in the field description of *sfn-ssb-offset* what the value 0 stands for and value 1 stands for and so on. Clarify that the offset shall be within the configured SSB periodicity.

Rapporteur's Comments:

- At least the corrections #1 and #4 seem essential, since interoperability problems could occur otherwise.

- Clarifications for #2 seems useful.

- Change #3 depends on the conclusion of Question 1.

Please use the comments column in the Table below to provide any suggested changes to the CR or to add explanations if you disagree with the CR or any parts of it.

NOTE: Change #3 (clarify that the same *dl-PRS-ID* identifies a TRP across positioning frequency layers) depends on the conclusion of Question 1-3.

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| Company | Agree with CR  Yes/No | Comments |
| Intel | Yes for change 1/2/4 | #3 depends on question 1. |
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## 4.2 Correction on NR E-CID [4]

The reason for change in [R2-2010264](https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_112-e/Docs/R2-2010264.zip) [4] is as follows:

E-CID and NR E-CID are two positioning methods supported by LPP. However, the specification does not clearly distinguish the two methods at several places.

The field description for *NR-ECID-TargetDeviceErrorCauses* is missing.

The following changes are proposed:

1. Clarify on the difference between E-CID and NR E-CID.

2. Add the field description for IE *NR-ECID-TargetDeviceErrorCauses*.

Rapporteur's Comments:

- The corrections seem less essential, but probably useful.

- It is unclear why the field description for *cause* in IE *NR-ECID-TargetDeviceErrorCauses* includes "…if any of these measurements of the primary cell is not available.", which is different compared to the corresponding LTE error cause.

Please use the comments column in the Table below to provide any suggested changes to the CR or to add explanations if you disagree with the CR or any parts of it.

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| Company | Agree with CR  Yes/No | Comments |
| Intel | Yes | Same comment as Rapporteur on the field descriptions for cause. Rest changes looks ok. |
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# 5. Summary

TBD

# References

[1] R2-2009042, "Discussion on whether PRS ID can be reused on different frequency layers", vivo Mobile Communication Co.

[2] R2-2010093, "Clarification of quality and time stamp for RSTD measurements", Qualcomm Incorporated.

[3] R2-2010263, "Correction on PRS configuration", Huawei, HiSilicon.

[4] R2-2010264, "Correction on NR E-CID", Huawei, HiSilicon.

[5] R2-2010265, "LPP corrections on UE capability signaling", Huawei, HiSilicon.

[6] R2-2010975, "Summary of LPP corrections agenda item 6.6.3", Qualcomm Incorporated.