**3GPP TSG RAN WG1 #106-e R1-210nnnn**

**e-Meeting, August 16th – 27th, 2021**

**Source: Moderator (CATT)**

**Title: Summary on email discussion [106-e-NR-Pos-04] for optional content in nr-DL-PRS-ReferenceInfo**

**Agenda item: 7.2.8**

**Document for:** **Discussion and Decision**

Introduction

This contribution summarizes the discussions and outcomes of email discussion [106-e-NR-Pos-04] triggered by the following Chair’s decision:

[106-e-NR-Pos-04] Email discussion/approval on optional content in nr-DL-PRS-ReferenceInfo (Aspect #4) until August 20 – Xiaotao (CATT)

Discussion

Optional content in *nr-DL-PRS-ReferenceInfo*

**Background**

In draft CR for TS 38.214(R1-2106994) , it is proposed that for DL RSTD, when network indicates a reference, a DL PRS resource set ID should be revised to be optional. Further, in addition to different PRS Resources, UE may also use a single different DL PRS Resource to determine the reference.

During the discussion in preparation phase in RAN1#106-e, the consensus was achieved that updating the scope of the issue to potential revision in the following sentence “*This reference provided by nr-DL-PRS-ReferenceInfo may include a dl-PRS-ID, and optionally a DL PRS resource set ID, a single DL PRS resource ID or a list of DL PRS resource IDs [17, TS 37.355]*.” to align it with signaling in TS 37.355.

Firstly, let’s review the RAN1 agreements related to this email discussion. In RAN1#96bis meeting [2], the reference determinations for RSTD measurements have been agreed as follows:

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| Agreement:   * The network can indicate one or more of the following for the UE to use to determine a reference (reference time based on the DL PRS Resource ID(s)) for DL RSTD measurements.   + A DL PRS Resource ID   + A subset of DL PRS Resource IDs from a single DL PRS Resource set   + A DL PRS Resource set   Agreement:   * The UE may use different DL PRS Resource ID(s) (with the condition that the multiple DL PRS Resource IDs belong to a single DL PRS Resource set) or a different DL PRS Resource set for determining the reference for the RSTD measurement, and if it chooses to do so, it should report the DL PRS Resource ID(s) and/or the information on the DL PRS Resource set used to determine the reference |

According to the above agreements, when network indicates a reference, it may optionally select a DL PRS Resource ID, a subset of DL PRS Resource IDs or a DL PRS Resource set. None of the three items is mandatory.

Moreover, as shown in the following descriptions in TS37.355 (section 6.4.3) [3], the *dl-PRS-ID* is mandatory, but DL PRS Resource ID and DL PRS resource set ID is optional, which match the above RAN1 agreements.

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| 6.4.3 Common NR Positioning Information Elements [TS 37.355]– *DL-PRS-ID-Info* The IE *DL-PRS-ID-Info* provides the IDs of the reference TRPs' DL-PRS Resources.  -- ASN1START  DL-PRS-ID-Info-r16 ::= SEQUENCE {  dl-PRS-ID-r16 INTEGER (0..255),  nr-DL-PRS-ResourceID-List-r16 SEQUENCE (SIZE (1..nrMaxResourceIDs-r16)) OF  NR-DL-PRS-ResourceID-r16  OPTIONAL, -- Need ON  nr-DL-PRS-ResourceSetID-r16 NR-DL-PRS-ResourceSetID-r16  OPTIONAL -- Need ON  }  -- ASN1STOP  < Uncorrelated parts are omitted > |

However, in section 5.1.6.5 of TS 38.214, we can see everything is optional (including *dl-PRS-ID*, DL PRS resource set ID and DL PRS resource ID), since the word “may” is used marked in YELLOW colour in the following paragraph in section 5.1.6.5.

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| 5.1.6.5 PRS reception procedure [TS 38.214]  < Uncorrelated parts are omitted >  The UE may be indicated by the network that DL PRS resource(s) can be used as the reference for the DL RSTD, DL PRS-RSRP, and UE Rx-Tx time difference measurements in a higher layer parameter *nr-DL-PRS-ReferenceInfo*. The reference indicated by the network to the UE can also be used by the UE to determine how to apply higher layer parameters *nr-DL-PRS-ExpectedRSTD* and *nr-DL-PRS-ExpectedRSTD-Uncerainty*. The UE expects the reference to be indicated whenever it is expected to receive the DL PRS. This reference provided by *nr-DL-PRS-ReferenceInfo* may include a *dl-PRS-ID*, a DL PRS resource set ID, and optionally a single DL PRS resource ID or a list of DL PRS resource IDs [17, TS 37.355]. The UE may use different DL PRS resources or a different DL PRS resource set to determine the reference for the RSTD measurement as long as the condition that the DL PRS resources used belong to a single DL PRS resource set is met. If the UE chooses to use a different reference than indicated by the network, then it is expected to report the *dl-PRS-ID*, the DL PRS resource ID(s) or the DL PRS resource set ID used to determine the reference.  < Uncorrelated parts are omitted > |

Therefore, at least dl-PRS-ID can be observed to be mandatory in TS 37.355, but it is optional in TS 38.214.

***Issue 1: dl-PRS-ID is mandatory in TS 37.355, but it is optional in TS 38.214.***

In addition, UE is allowed to use a single different DL PRS Resource to determine the reference, according the second RAN1 agreement above. This option is missed in the specification, as only ‘different DL PRS resources’ is mentioned in section 5.1.6.5 of TS 38.214.

***Issue 2: The following option is missed in the specification TS 38.214.***

* ***UE is allowed to use a single different DL PRS Resource to determine the reference.***

**Proposed change**

The following text proposal is prepared to address raised above issues:

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| 5.1.6.5 PRS reception procedure < Unchanged parts are omitted > The UE may be indicated by the network that DL PRS resource(s) can be used as the reference for the DL RSTD, DL PRS-RSRP, and UE Rx-Tx time difference measurements in a higher layer parameter *nr-DL-PRS-ReferenceInfo*. The reference indicated by the network to the UE can also be used by the UE to determine how to apply higher layer parameters *nr-DL-PRS-ExpectedRSTD* and *nr-DL-PRS-ExpectedRSTD-Uncerainty*. The UE expects the reference to be indicated whenever it is expected to receive the DL PRS. This reference provided by *nr-DL-PRS-ReferenceInfo* include a *dl-PRS-ID*, and optionally a DL PRS resource set ID, a single DL PRS resource ID or a list of DL PRS resource IDs [17, TS 37.355]. The UE may use different DL PRS resource(s) or a different DL PRS resource set to determine the reference for the RSTD measurement as long as the condition that the DL PRS resources used belong to a single DL PRS resource set is met. If the UE chooses to use a different reference than indicated by the network, then it is expected to report the *dl-PRS-ID*, the DL PRS resource ID(s) or the DL PRS resource set ID used to determine the reference. < Unchanged parts are omitted > |

Discussion Round #1

Companies are invited to provide views on the text proposal above:

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| Company Name | Comments |
| OPPO | According to the RAN1 agreement and description in 37.355, the following cases can be supported:   1. Only dl-PRS-ID is provided 2. dl-PRS-ID and PRS resource set ID are provided 3. dl-PRS-ID, PRS resource set ID and one or more PRS resource IDs are provided.   However, the wording in proposed TP seems to suggest that only 1) and 3) are supported. Here is another alternative for TP:  The UE may be indicated by the network that DL PRS resource(s) can be used as the reference for the DL RSTD, DL PRS-RSRP, and UE Rx-Tx time difference measurements in a higher layer parameter *nr-DL-PRS-ReferenceInfo*. The reference indicated by the network to the UE can also be used by the UE to determine how to apply higher layer parameters *nr-DL-PRS-ExpectedRSTD* and *nr-DL-PRS-ExpectedRSTD-Uncerainty*. The UE expects the reference to be indicated whenever it is expected to receive the DL PRS. This reference provided by *nr-DL-PRS-ReferenceInfo* includes a *dl-PRS-ID*, and may include a DL PRS resource set ID, a single DL PRS resource ID or a list of DL PRS resource IDs [17, TS 37.355]. The UE may use different DL PRS resource(s) or a different DL PRS resource set to determine the reference for the RSTD measurement as long as the condition that the DL PRS resources used belong to a single DL PRS resource set is met. If the UE chooses to use a different reference than indicated by the network, then it is expected to report the *dl-PRS-ID*, the DL PRS resource ID(s) or the DL PRS resource set ID used to determine the reference. |
| Huawei, HiSilicon | Based on the discussion during the preparation phase, we tend to agree with Qualcomm on the need to DL-PRS resource set ID to be used whenever a resource ID or a list of resource set IDs are used. Omission of the resource set ID even if the AD only provides a single resource set is an over optimization.  Getting back to the current specification in TS 37.355, our understanding is that the AD reference could either take the form as agreed by RAN1 (single set, or single resource, or a list of resources), or the form as introduced by RAN1 (the whole TRP).  In that sense, we think the OPPO proposed by OPPO is aligned with the current LPP, and we are OK to take that. |
| vivo | First of all, we don’t see any issue of current wording in the specification.  We don’t think the purpose of RAN1 specification is to make it clear wherever a particular IE in high layer specification is mandatory or optional to begin with. That is up to high layer specification. Given TS37.355 is cited here, we don’t see any confusion.  We prefer not to change anything if it’s not broken. Our understanding is that “Only essential corrections” but not optimizations are allowed for AI 7.2. |
| Nokia/NSB | As commented during the preparation phase we view this TP as breaking the spec rather than fixing it. If the UE does not report the resource set ID then reporting the resource ID alone is useless at the LMF as that ID is not unique.  CATT also commented that we could specify some fallback behavior for the case that there is only a single resource set that the UE could be referring too. So, the TP seems to create a problem rather than solve it.  The spec is clear in our view and we should not focus on non-critical issues at this stage. |
| Qualcomm | As commented earlier, having a fallback behavior for the case of single-set, is an unnecessary signaling optimization, which, even though it is not wrong, it gives the wrong message that such optimizations are needed/useful in this stage.  Glad to see that technically it seems that views are aligned (OPPO provided the options above, and didn’t seem that companies have concerns with that).  We are OK with the current spec, or with the OPPO’s proposal; which is not wrong, just a bit unnecessary; if majority wants OPPO’s proposal, we will live with it, otherwise our vote goes to not change it. |
| Intel | We prefer to keep current spec. Our understanding is that both dl-PRS-Id and DL PRS resource set ID are expected to be provided since those anyway needed to uniquely identify resource.  If above IDs are not provided for reference determination, there is also no issue since UE can autonomously determine it and report. Therefore, we do not see critical issue.  The potential correction that can be acceptable is:  “This reference provided by *nr-DL-PRS-ReferenceInfo* includes a *dl-PRS-ID*, a DL PRS resource set ID and optionally a single DL PRS resource ID or a list of DL PRS resource IDs” |
| ZTE | Although we thin it’s non-essential, we can live with OPPO’s version aligned with RAN2 signaling design. |
| CATT1 | We are fine with either original proposed CR or OPPO’s version.  For vivo’s comments, we want to clarify that there are two issues in current TS 38.214 as follows:   * Issue 1: dl-PRS-ID is mandatory in TS 37.355, but it is optional in TS 38.214. * Issue 2: The following option is missed in the specification TS 38.214.   + UE is allowed to use a single different DL PRS Resource to determine the reference.   Therefore, we prefer to fix the above issues to avoid the confusion on parameter configuration.  For Nokia’s comments, we think Nokia’s concern is that the DL PRS resource ID should not be configured without DL PRS resource set ID.  In fact, in the proposed CR or OPPO’s updated CR, dl-PRS-ID is changed to be mandatory in order to align with TS 37.355, but don’t touch the case of single resource set configuration where only DL PRS resource ID without DL PRS resource set ID. Therefore, we think Nokia’s concern can be addressed.  For Intel’s comments, if we see the descriptions in TS 37.355, only dl-PRS-ID is mandatory, but DL PRS resource set ID and DL PRS resource ID are optional, therefore, it looks like OPPO’s version is better. |
| Ericsson | Do not support. If a change is to be done, Intel’s proposal is closer to the LPP specification. However the RAN1 specification is not broken in the existing state. |
| CATT2 | For Ericsson’s comments, in our point of view, matching of RAN1 and RAN2's pacification is essential. We are also fine with Intel’s proposal.  Then, It seems we can have two options to fix the issues:  a) Option 1: Take OPPO’s proposal.  b) Option 2: Take Intel’s proposal, but then we may need to send an LS to RAN2 to make the corresponding changes in LPP.  We would like to check the opinions of the companies. |
| vivo2 | Response to CATT  We don’t share your view on the “issues” in current TS 38.214. The word “may” was used in many places in specification. However, we don’t infer a particular IE defined in high layer specification is optional by the word “may”. Readers are expected to refer to TS 37.355 for that information. With that, why fix if no problem to begin with?  We have strong prefer to not change anything. |
| Apple | Do not support. Current text is more clear. |
| CATT3 | For vivo2’s comments, in our point of view, matching of RAN1 and RAN2's pacification is essential. The word “may” is not properly used here, since dl-PRS-ID is mandatory. Thus, it needs to be fixed.  In addition, we proposed another issue 2 as follows,  Issue 2: The following option is missed in the specification TS 38.214.   * UE is allowed to use a single different DL PRS Resource to determine the reference.   We prefer both the two issues to be fixed in the TP to make the TS 38.214 to align with TS37.355 and avoid any potential ambiguity.  For Apple’s comments, we would like to clarify that current texts in TS 38.214 have two issues:   * Issue 1: dl-PRS-ID is mandatory in TS 37.355, but it is optional in TS 38.214. * Issue 2: The following option is missed in the specification TS 38.214. * UE is allowed to use a single different DL PRS Resource to determine the reference.   Therefore, we proposed a TP to fix the above two issues. |

Discussion Round #2

**Intermediate Summary**

During the round#1 email discussion, 7 companies are OK with the updated TP based on OPPO’s proposal or Intel’s proposal. And 3 companies prefer to not change anything.

The moderator would like to clarify that there are two issues in current TS 38.214 as follows:

* Issue-1: *dl-PRS-ID* is mandatory in TS 37.355, but it is optional in TS 38.214.
* Issue-2: The following option is missed in the specification TS 38.214.
  + UE is allowed to use a single different DL PRS Resource to determine the reference.

In our point of view, matching of RAN1 and RAN2's pacification is essential. The word “may” is not properly used here, since *dl-PRS-ID* is mandatory. Thus, it needs to be fixed. Therefore, we prefer both the two issues to be solved in the TP to make the TS 38.214 to align with TS37.355 and avoid any potential ambiguity.

For the 7 companies who are OK to change the specifications, 4 companies support Option1 below, 2 companies support Option2 below, and 1 company support either Option1 or Option2.

* Option1: the revised TP1 based on OPPO’s proposal.

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| The UE may be indicated by the network that DL PRS resource(s) can be used as the reference for the DL RSTD, DL PRS-RSRP, and UE Rx-Tx time difference measurements in a higher layer parameter *nr-DL-PRS-ReferenceInfo*. The reference indicated by the network to the UE can also be used by the UE to determine how to apply higher layer parameters *nr-DL-PRS-ExpectedRSTD* and *nr-DL-PRS-ExpectedRSTD-Uncerainty*. The UE expects the reference to be indicated whenever it is expected to receive the DL PRS. This reference provided by *nr-DL-PRS-ReferenceInfo* includes a *dl-PRS-ID*, and may include a DL PRS resource set ID, a single DL PRS resource ID or a list of DL PRS resource IDs [17, TS 37.355]. The UE may use different DL PRS resource(s) or a different DL PRS resource set to determine the reference for the RSTD measurement as long as the condition that the DL PRS resources used belong to a single DL PRS resource set is met. If the UE chooses to use a different reference than indicated by the network, then it is expected to report the *dl-PRS-ID*, the DL PRS resource ID(s) or the DL PRS resource set ID used to determine the reference. |

* Option2: the revised TP2 based on Intel’s proposal.

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| The UE may be indicated by the network that DL PRS resource(s) can be used as the reference for the DL RSTD, DL PRS-RSRP, and UE Rx-Tx time difference measurements in a higher layer parameter *nr-DL-PRS-ReferenceInfo*. The reference indicated by the network to the UE can also be used by the UE to determine how to apply higher layer parameters *nr-DL-PRS-ExpectedRSTD* and *nr-DL-PRS-ExpectedRSTD-Uncerainty*. The UE expects the reference to be indicated whenever it is expected to receive the DL PRS. This reference provided by *nr-DL-PRS-ReferenceInfo* includes a *dl-PRS-ID*, a DL PRS resource set ID, and optionally a single DL PRS resource ID or a list of DL PRS resource IDs [17, TS 37.355]. The UE may use different DL PRS resource(s) or a different DL PRS resource set to determine the reference for the RSTD measurement as long as the condition that the DL PRS resources used belong to a single DL PRS resource set is met. If the UE chooses to use a different reference than indicated by the network, then it is expected to report the *dl-PRS-ID*, the DL PRS resource ID(s) or the DL PRS resource set ID used to determine the reference. |

Given that 5 companies are OK with Option1 and 3 companies are OK with Option2, let’s see if the 3 companies can live with Option1. Then, the moderator has the following Proposal 1 for offline consensus. Companies are encouraged to provide comments on whether the proposal below is agreeable.

In addition, the moderator would like to point out that Option1 can support the following three cases (as OPPO’s comments), which match the previous RAN1 agreement and description in TS 37.355:

1. Only *dl-PRS-ID* is provided
2. *dl-PRS-ID* and PRS resource set ID are provided
3. *dl-PRS-ID*, PRS resource set ID and one or more PRS resource IDs are provided.

#### **Proposal for offline consensus:**

* **Adopt the following TP1 based on OPPO’s proposal (Option1).**

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| The UE may be indicated by the network that DL PRS resource(s) can be used as the reference for the DL RSTD, DL PRS-RSRP, and UE Rx-Tx time difference measurements in a higher layer parameter *nr-DL-PRS-ReferenceInfo*. The reference indicated by the network to the UE can also be used by the UE to determine how to apply higher layer parameters *nr-DL-PRS-ExpectedRSTD* and *nr-DL-PRS-ExpectedRSTD-Uncerainty*. The UE expects the reference to be indicated whenever it is expected to receive the DL PRS. This reference provided by *nr-DL-PRS-ReferenceInfo* includes a *dl-PRS-ID*, and may include a DL PRS resource set ID, a single DL PRS resource ID or a list of DL PRS resource IDs [17, TS 37.355]. The UE may use different DL PRS resource(s) or a different DL PRS resource set to determine the reference for the RSTD measurement as long as the condition that the DL PRS resources used belong to a single DL PRS resource set is met. If the UE chooses to use a different reference than indicated by the network, then it is expected to report the *dl-PRS-ID*, the DL PRS resource ID(s) or the DL PRS resource set ID used to determine the reference. |

Companies are invited to provide views on the proposal above:

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| Company Name | Comments |
| Huawei, HiSilicon | OK |
| ZTE | OK |
| Intel | It seems Option 1 supports the following scenarios   1. Only *dl-PRS-ID* is provided 2. *dl-PRS-ID* and PRS resource set ID are provided 3. *dl-PRS-ID*, PRS resource set ID and one or more PRS resource IDs are provided.   Option 2 supports the following scenarios   1. *dl-PRS-ID* and PRS resource set ID are provided 2. *dl-PRS-ID*, PRS resource set ID and one or more PRS resource IDs are provided.   In our understanding Option 2 is consistent with RAN1 agreement.  We are not clear on UE behavior for the case when only dl-PRS-ID is provided. Seems it implies that UE is expected to select resource set for given dl-PRS-Id?  We propose to go with Option 2 which is in our view consistent with RAN1 agreement. |
| Huawei, HiSilicon | Reply to Intel: I think providing dl-PRS-ID only is something developed by RAN2, where they think sometimes providing assistance data reference TRP is sufficient (similar to LTE), and this also applies to the case when a single PRS resource set is provided in the AD. |
| Nokia/NSB | Our view is still that there is nothing broken, and therefore we don’t support any CR as they are not essential. The spec is clear in our view. |
| CATT | Support.  For Intel’s comments, we share the same view with Huawei that the case of “Only *dl-PRS-ID* is provided” is related to RAN2, which specified in TS37.355. It seems that Option1 match TS37.355 well. About RAN1 previous agreement, we think both Option 1 and Option 2 can match it. Therefore, we prefer Option1.  For Nokia’s comments, In our point of view, matching of RAN1 and RAN2's pacification is essential. The word “may” is not properly used here, since dl-PRS-ID is mandatory. Thus, we prefer to fix this issue. |
| OPPO | We support the proposal. |
| CATT2 | Regarding to Intel’s question: “We are not clear on UE behavior for the case when only dl-PRS-ID is provided. Seems it implies that UE is expected to select resource set for given dl-PRS-Id?”, we want to say that UE has the freedom to select the resource set when only dl-PRS-ID is provided as the agreement below:  Agreement:  The UE may use different DL PRS Resource ID(s) (with the condition that the multiple DL PRS Resource IDs belong to a single DL PRS Resource set) or a different DL PRS Resource set for determining the reference for the RSTD measurement, and if it chooses to do so, it should report the DL PRS Resource ID(s) and/or the information on the DL PRS Resource set used to determine the reference.  Therefore, in our point of view, Option1 still can work for the case of only dl-PRS-ID is provided. |

Summary

During the Round#2 email discussion, according the input from companies, a brief summary is given as follows,

* Four companies support Option1,
* One company prefers Option2,
* One company prefers to not change anything.

According to the status, the moderator has the following proposal update:

#### **Proposal (update):**

* **The draft CR on optional content in nr-DL-PRS-ReferenceInfo is not pursued.**

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| Company Name | Comments |
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Conclusion

TBD

Reference

1. R1-2106994, “Draft CR on PRS reception procedure in NR positioning”, CATT.
2. 3GPP TSG RAN WG1 Meeting RAN1#96bis Chairman's Notes, May.2019.
3. TS 37.355, “LTE Positioning Protocol (LPP) (Release 16)”, V16.5.0 (2021-06).
4. TS 38.214, “NR; Physical layer procedures for data (Release 16)”, V16.6.0 (2021-06).