**3GPP TSG RAN WG1 #105e R1-210zzzz**

**e-Meeting, May 10th – 27th, 2021**

**Source: Moderator (Intel Corporation)**

**Title: Summary of the e-mail discussion [105-e-NR-Pos-01] on Rel.16 NR positioning maintenance**

**Agenda item: 7.2.8**

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

# Introduction

In this contribution, we provide summary of the e-mail discussion [105-e-NR-Pos-01] on remaining opens identified for Rel.16 NR positioning framework based on submitted contributions to RAN1#105e meeting and approved for discussion during preparation phase:

[105-e-NR-Pos-01] Email discussion/approval on the following until May 25 – Alexey (Intel)

* Aspect #1: DL PRS processing priority
* Aspect #2: DL PRS numerology
* Aspect #3: Clarification on UE Rx-Tx time difference measurements

# Discussion on Remaining Opens

In this section, we summarize submitted TPs / draft CRs for relevant open aspects on NR positioning maintenance based on review of contributions [1]-[7].

## Aspect #1: DL PRS processing priority

In [1], it is stated that UE behaviour on the PRS processing according to priority is not clear. The following clarifications are proposed

Clarify the priority sorting is based on the appearance in the list (the first entry in the list has the highest priority) or is based on the ID numbering

Clarify that the priority is only based on the assistance data indicated by *NR-DL-PRS-ProvideAssistanceData*, instead of *NR-SelectedDL-PRS-IndexList*

Discuss ambiguity for UE supporting two PRS resource sets per TRP per frequency layer, and network supporting two PRS resource sets per frequency layer. It is suggested not to pursue it in Rel-16.

Clarify motivation of defining priority i.e. applicable when the PRS resources provided in the assistance data exceeds UE reported capability

The following TP was provided to clarify DL PRS processing priority order by UE:

|  |
| --- |
| 5.1.6.5 PRS reception procedure========================= Unchanged parts =========================Within a positioning frequency layer, the DL PRS resources are sorted in the decreasing order of priority for measurement to be performed by the UE, with the reference indicated by nr-DL-PRS-ReferenceInfo being the highest priority for measurement, and the following priority is assumed:- The first entry of the list provided by nr-DL-PRS-AssistanceDataPerFreq has the highest priority among the list, excluding the reference indicated by nr-DL-PRS-ReferenceInfo when applicable;- The first entry of the list provided by nr-DL-PRS-ResourceSetList has the highest priority among the list.The UE is only required to perform the measurement on the prioritized DL PRS resources within the capability indicated by the higher layer parameter NR-DL-PRS-ResourcesCapability.========================= Unchanged parts ========================= |

The relevant agreement is provided below for convenience

|  |
| --- |
| Agreement:When a UE is configured in the assistance data of a positioning method with a number of PRS resources beyond its capability (FG 13-2,13-3,13-4 for AoD, TDOA, MRTT respectively), the UE assumes the DL-PRS Resources in the assistance data are sorted in a decreasing order of measurement priority. Specifically, according to the current RAN2 structure of the assistance data, the following priority is assumed:* + FFS: the 4 frequency layers are sorted according to priority,
	+ The 64 TRPs per frequency layer are sorted according to priority,
	+ The 2 sets per TRP of the frequency layer are sorted according to priority,
	+ FFS: The 64 resources of the set per TRP per frequency layer are sorted according to priority.

The reference indicated by nr-DL-PRS-ReferenceInfo-r16 for each frequency layer has the highest priority at least for DL-TDOA |

**FL response:**

The decreasing priority order is mentioned in the main bullet. Irrespective of UE capability the list is constructed based on priority of reporting. Other aspects seem worthwhile to clarify in specification.

### Round #1

Companies are invited to express their views and suggestions in table below:

|  |  |
| --- | --- |
| Company Name | Comments |
| Huawei, HiSilicon | The track of the changes is missing.Based on our understanding in the preparation email and the reason of change in the draftCR, we suggest to break the discussion into the following 4 questions.* Q1: Should the priority be defined based on the ID number (i.e. dl-PRS-ID or dl-PRS-ResourceSetID) or the appearance in the list.
* Q2: If the priority is defined based on the appearance in the list, should the list be the list provided by the higher layer parameter *nr-DL-PRS-AssistanceDataPerFreq*/*nr-DL-PRS-ResourceSetList* or the list provided by the higher layer parameter *nr-SelectedDL-PRS-IndexListPerFreq-r16*/*nr-DL-SelectedPRS-ResourceSetIndex*?
* Q3: Do we need to specify what UE should process according to the priority and UE capability?
* Q4: Do we need to specify the priority for the cases of multiple PRS resource sets and multiple TRPs.

 |
| Nokia, NSB | We are not sure that the CR is needed. The order of the priority is already given by the first line of the spec so what do we gain in the sub-bullets? The final line about within the UE capability seems to be somewhat obvious to us and we don’t feel it is needed. The LMF should always assume this.  |
| Qualcomm | Q1: appearance in the list (similar to LTE)Q2: SelectedPRS as was agreed already based on our understanding of the agreement “When a UE is configured in the assistance data of a positioning method”Q3: No need to add this item in 38.214Q4: The UE prioritizes all sets of TRP0 before going to TRP1 (aka the blue line).  |
| vivo | We share similar understanding as Nokia and don’t think this CR is needed.  |
| Huawei, HiSilicon | Q1: appearance in the list, as commented by Qualcomm.Q2: We prefer assistance data, but are also fine with the selected resource.Q3: We think it should be captured here. The reason is that * If the UE capability supports processing all resources, there is no such need to define the priority at all, because UE will measure all the PRS.
* The priority is the logic sequence, it should have nothing to do with whether UE receive some resource earlier than other resource; instead it should be used to determine which resource to process given limited UE capability.
* We do not have such description as in LTE OTDOA (from TS 37.355), and there is no way to enforce the UE to follows the priority rule.

|  |
| --- |
| The prioritization of the cells in the list is left to server implementation. The target device should provide the available measurements in the same order as provided by the server. |

Q4: We are fine if the common understanding is the blue line.Reply to Nokia and vivo, do you think that there is ambiguity which list (red or green) should be used to determine the priority?NR-DL-TDOA-ProvideAssistanceData-r16 ::= SEQUENCE { nr-DL-PRS-AssistanceData-r16 NR-DL-PRS-AssistanceData-r16 OPTIONAL, -- Need ON nr-SelectedDL-PRS-IndexList-r16 NR-SelectedDL-PRS-IndexList-r16 OPTIONAL, -- Need ON nr-PositionCalculationAssistance-r16 NR-PositionCalculationAssistance-r16 OPTIONAL, -- Cond UEB nr-DL-TDOA-Error-r16 NR-DL-TDOA-Error-r16 OPTIONAL, -- Need ON ...} |
| OPPO | Same understanding as Nokia and vivo, this CR is not neededThe text in 38.214 already clearly specifies the priority rule on PRS. * Chaing those two bullet is not needed. Because the first sentence before those two bullets explain how to sort them clearly
* The added last sentence on UE capability does not provide any new information too. That is part of UE capability specification.
 |
| Apple | Same view as Nokia, vivo etc, CR is not needed |
| ZTE | We share similar view as Qualcomm. Regarding DL PRS is based on the nr-DL-PRS-AssistanceData or nr-SelectedDL-PRS-IndexList, our understanding is that nr-SelectedDL-PRS-IndexList is optional to be provided. So, DL PRS is according to nr-SelectedDL-PRS-IndexList first if this IE is provided to UE. Otherwise, DL PRS is according to nr-DL-PRS-AssistanceData . |
| CATT | In our view, the common understanding of DL-PRS priority should be the blue line, i.e., UE will firstly measure the 2 DL-PRS resource sets in one TRP, then measure another TRP. |
| Lenovo, Motorola Mobility | On Q1, it would be beneficial to clarify that this priority is based on the appearance within the list. For Q2 the issue could be perhaps already solved based on the appearance order of *nr-DL-PRS-AssistanceData* and/or *nr-SelectedDL-PRS-IndexList*. On Q3, this could be under scope of the Rel-17 discussion. For Q4: “2 sets per TRP of the frequency layer are sorted according to priority” , our understanding is that this already assumes that the resource sets within a TRP are prioritized first before moving to the next TRP (the blue line). |

Based on discussion it seems there is a common understanding on the following:

* Priority is defined based on appearance in the list provided by the higher layer parameter nr-SelectedDL-PRS-IndexListPerFreq-r16/nr-DL-SelectedPRS-ResourceSetIndex
* For DL PRS processing, UE prioritizes resource set within TRP before going to another TRP

### Round #2

**Conclusion 1-2**

* No need to adopt TP for Aspect #1 due to common understanding

|  |  |
| --- | --- |
| Company Name | Comments |
| Nokia/NSB | Support conclusion.  |
|  |  |
| Huawei, HiSilicon | We have concern to leave the text as is.It is not clear from the text that the priority is based on the selected list.It is also not clear from the text how the priority is defined if the selected list is not provided.Based on the common understanding, we suggest the following revised TP.5.1.6.5 PRS reception procedure===================== Unchanged parts =====================Within a positioning frequency layer, the DL PRS resources are sorted in the decreasing order of priority for measurement to be performed by the UE, with the reference indicated by *nr-DL-PRS-ReferenceInfo* being the highest priority for measurement, and the following priority is assumed:- Up to 64 *NR-SelectedDL-PRS-IndexPerTRP* of the frequency layer are sorted according to priority if *nr-SelectedDL-PRS-IndexListPerFreq* is provided, or up to 64 *NR-DL-PRS-AssistanceDataPerTRP* of the frequency layer are sorted according to priority otherwise;- Up to 2 *DL-SelectedPRS-ResourceSetIndex* per *dl-PRS-ID* of the frequency layer are sorted according to priority if *dl-SelectedPRS-ResourceSetIndexList* is provided, or up to 2 *NR-DL-PRS-ResourceSet* per *dl-PRS-ID* of the frequency layer are sorted according to priority otherwise.===================== Unchanged parts ===================== |
| ZTE | We think Huawei’s revision makes sense. As we commented before, at least the ambiguity issue should be solved. |
| OPPO | Support the proposed Conclusion 1-2. |
| FL | Please continue providing your comments considering revised TP from Huawei (see above) that aims to clarify discussed understanding in spec.Given that discussion deadline is approaching let me ask you to provide response on whether revised TP from Huawei is agreeable? |

## Aspect #2: DL PRS numerology

In [2], it is proposed to clarify that 240kHz SCS is not applicable for DL PRS configuration according to RAN1 agreement below:

|  |
| --- |
| Agreement:The following periodicity values of DL PRS resource allocation are supported depending on SCS         {4, 5, 8, 10, 16, 20, 32, 40, 64, 80, 160, 320, 640, 1280, 2560, 5120, 10240} slots, µ = 0, 1, 2, 3 for SCS 15, 30, 60 and 120kHz respectively |

The following TP was provided to address it:

|  |
| --- |
| 5.1.6.5 PRS reception procedure*-----------------------------------------------------* unrelated part omitted *------------------------------------------------*The UE assumes that the following parameters for each DL PRS resource(s) are configured via higher layer parameters *NR-DL-PRS-PositioningFrequencyLayer, NR-DL-PRS-ResourceSet* and *NR-DL-PRS-Resource*.A positioning frequency layer is configured by *NR-DL-PRS-PositioningFrequencyLayer,* consists of one or more DL PRS resource sets and it is defined by:*- dl-PRS-SubcarrierSpacing* defines the subcarrier spacing for the DL PRS resource. All DL PRS resources and DL PRS resource sets in the same DL PRS positioning frequency layer have the same value of *dl-PRS-SubcarrierSpacing*. The supported values of *dl-PRS-SubcarrierSpacing* are given in Table 4.2-1 of [4, TS38.211], excluding the value of 240kHz. *-----------------------------------------------------* unrelated part omitted *------------------------------------------------* |

**FL response:**

It is proposed to discuss/clarify this aspect. In general, the supported set of subcarrier spacing for DL PRS can be directly understood from the *dl-PRS-SubcarrierSpacing.* According to the TS 37.355this field specifies the subcarrier spacing of the DL-PRS Resource. 15, 30, 60 kHz for FR1; 60, 120 kHz for FR2.

### Round #1

Companies are invited to express their views and suggestions in table below:

|  |  |
| --- | --- |
| Company Name | Comments |
| Huawei, HiSilicon | We are fine with the TP with the track of changes. |
| Nokia, NSB | We are okay with the TP but don’t see it as critical.  |
| Qualcomm | We are okay with the TP but don’t see it as critical. |
| Vivo | Non-essential correction but okay with the TP. |
| OPPO | Not supported.TS 37.355 clearly specified the subcarrier spacings for DL-PRS, why do we repeat the specification? It only causes redundancy in specification. |
| CATT | We support the TP.To OPPO: In current specs, it says: *“The supported values of dl-PRS-SubcarrierSpacing are given in Table 4.2-1 of [4, TS38.211]”*However, referring to the corresponding Table 4.2-1 shown below, the supported SCS values include 15, 30, 60, 120 and 240kHz. According to the previous agreement, the SCS value of 240kHz is not supported for DL PRS. There is a misalignment between the description in TS 38.214 and the previous agreement.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 4.2 NumerologiesMultiple OFDM numerologies are supported as given by Table 4.2-1 where $μ$ and the cyclic prefix for a downlink or uplink bandwidth part are obtained from the higher-layer parameters *subcarrierSpacing* and *cyclicPrefix*, respectively. Table 4.2-1: Supported transmission numerologies.

|  |  |  |
| --- | --- | --- |
|  |  | Cyclic prefix |
| 0 | 15 | Normal |
| 1 | 30 | Normal |
| 2 | 60 | Normal, Extended |
| 3 | 120 | Normal |
| 4 | 240 | Normal |

 |

Therefore, in order to solve the above issue, this TP should be adopted. |
| Apple | Fine with the TP |
| ZTE | Fine with the TP. |
| Lenovo,Motorola Mobility | Support TP for added clarity that 240KHz is not supported SCS. |

Based on discussion, it seems companies are fine with TP although it is not seen as critical correction by various sources. To avoid potential confusion/ambiguity, it is proposed to adopt TP for Aspect 2.

### Round #2

**Proposal 2-2:**

* **Endorse TP for Aspect 2**

|  |  |
| --- | --- |
| Company Name | Comments |
| Nokia/NSB | OK.  |
| ZTE | OK. |
| OPPO | We still think it is not needed to change spec because 37.355 has specified clearly the SCS values supported for DL PRS. The positioning feature is not implemented only based on 214 or 211, but implemented based on all the related Specs.If the majority companies are ok with the TP to change the spec, we can be fine even through it is kind of redundant work. |
|  |  |

## Aspect #3: Clarification on UE Rx-Tx time difference measurements

In [3], two alternatives are proposed to clarify / complete the descriptions of UE Rx-Tx time difference measurements in clause 5.1.6.5 of TS 38.214.

***Alt.1:***

|  |
| --- |
| **5.1.6.5 PRS reception procedure**================================**Unchanged parts omitted**=============================The UE may be configured to measure and report, subject to UE capability, up to 4 DL RSTD measurements per pair of *dl-PRS-ID* with each measurement between a different pair of DL PRS resources or DL PRS resource sets within the DL PRS configured for those *dl-PRS-ID*. The up to 4 measurements being performed on the same pair of *dl-PRS-ID* and all DL RSTD measurements in the same report use a single reference timing. The UE may be configured to measure and report, subject to UE capability, up to 8 DL PRS-RSRP measurements on different DL PRS resources associated with the same *dl-PRS-ID*. When the UE reports DL PRS-RSRP measurements from one DL PRS resource set, the UE may indicate which DL PRS-RSRP measurements associated with the same higher layer parameter *nr-DL-PRS-RxBeamIndex* [17, TS 37.355] have been performed using the same spatial domain filter for reception if for each *nr-DL-PRS-RxBeamIndex* reported there are at least 2 DL PRS-RSRP measurements associated with it within the DL PRS resource set.The UE may be configured to measure and report, subject to UE capability, up to 4 UE Rx-Tx time difference measurements based on different DL PRS resources associated with the same *dl-PRS-ID* and the same positioning frequency layer, and corresponding to a single configured SRS resource or resource set for positioning. The UE may be configured to measure and report, subject to UE capability, UE Rx-Tx time difference measurements based on DL PRS resources or resource sets in different positioning frequency layers for SRS transmitted in a single carrier. ===============================**Unchanged parts omitted**============================= |

***Alt.2:***

|  |
| --- |
| **5.1.6.5 PRS reception procedure**===============================**Unchanged parts omitted**=============================The UE may be configured to measure and report, subject to UE capability, up to 4 DL RSTD measurements per pair of *dl-PRS-ID* with each measurement between a different pair of DL PRS resources or DL PRS resource sets within the DL PRS configured for those *dl-PRS-ID*. The up to 4 measurements being performed on the same pair of *dl-PRS-ID* and all DL RSTD measurements in the same report use a single reference timing. The UE may be configured to measure and report, subject to UE capability, up to 8 DL PRS-RSRP measurements on different DL PRS resources associated with the same *dl-PRS-ID*. When the UE reports DL PRS-RSRP measurements from one DL PRS resource set, the UE may indicate which DL PRS-RSRP measurements associated with the same higher layer parameter *nr-DL-PRS-RxBeamIndex* [17, TS 37.355] have been performed using the same spatial domain filter for reception if for each *nr-DL-PRS-RxBeamIndex* reported there are at least 2 DL PRS-RSRP measurements associated with it within the DL PRS resource set.The UE may be configured to measure and report, subject to UE capability, up to 4 UE Rx-Tx time difference measurements based on different DL PRS resources associated with the same *dl-PRS-ID* and the same positioning frequency layer, and corresponding to a single configured SRS resource or resource set for positioning. Each measurement corresponds to a single received DL PRS resource or resource set which can be in different positioning frequency layers. ===============================**Unchanged parts omitted**============================= |

**FL response:**

RAN1 to discuss proposed alternatives and decide

### Round #1

Companies are invited to express their views and suggestions in table below:

|  |  |
| --- | --- |
| Company Name | Comments |
| Huawei, HiSilicon | Prefer Alt.1 |
| Nokia, NSB | We don’t feel that any change is needed so we don’t support either Alt.  |
| Qualcomm | The changes are not essential |
| vivo | This has been brought up in last meeting already. We don’t think it’s necessary. |
| OPPO | This TP is not needed.It was discussed in last meeting. It seem the proposal TP just repeat what is specified in UE capability. |
| Apple | Not essential |
| ZTE | We have explained the reason is to make spec clearer and align with other positioning methods.1st preference for Alt.1 and 2nd preference for Alt.2. |
| CATT | We slightly prefer Alt.1 with small modifications as follows,

|  |
| --- |
| The UE may be configured to measure and report, subject to UE capability, up to 4 UE Rx-Tx time difference measurements based on different DL PRS resources associated with the same *dl-PRS-ID* and the same positioning frequency layer, which correspond to a single configured SRS resource or resource set for positioning. Each measurement corresponds to a single received DL PRS resource or resource set which can be in different positioning frequency layers.  |

 |
| Lenovo,Motorola Mobility | Support Alt. 1 |

Based on discussion 4 sources prefer to support Alt.1 and 5 sources do not see the TP as critical/essential and thus do not support proposed alternatives. It seems there is no consensus to adopt TP.

### Round #2

**Conclusion 3-2:**

* **No consensus to adopt TP for Aspect 3, since it is not seen as critical/essential correction**

|  |  |
| --- | --- |
| Company Name | Comments |
| Nokia/NSB | Support conclusion.  |
| ZTE | OK with the conclusion. But we want to emphasize that sometimes we should not be so negative to the changes that could make the spec clear and readable. |
| OPPO | Support the proposed conclusion 3-2. |
|  |  |

# Conclusions

TBD

# References

1. R1-2104276 Correction to PRS processing priority Huawei, HiSilicon
2. R1-2104483 Discussion and TP on remaining issues in NR positioning CATT
3. R1-2104584 Clarification on UE Rx-Tx time difference measurements ZTE
4. R1-2104738 Corrections on DL PRS resource configuration OPPO
5. R1-2105470 Maintenance on Rel-16 NR positioning vivo
6. R1-2105518 Draft CR on measurement gap description for positioning Nokia, Nokia Shanghai Bell
7. R1-2105907 Maintenance on Rel-16 NR positioning Ericsson