**3GPP TSG RAN WG1 Meeting #102-E R1-20zzzzz**

**E-meeting, October 26th – November 13th, 2020**

**Source: Moderator (Intel Corporation)**

**Title: Outcome of RAN WG1 E-mail Discussion [103-e-NR-Pos-01]**

**Agenda item: 7.2.8**

**Document for: Discussion and Decision**

1. Introduction

In this contribution, we provide summary of the RAN WG1 e-mail discussion [103-e-NR-Pos-01]. This e-mail discussion is organized to resolve remaining open aspects identified in the submitted contributions [1]-[4] for NR Positioning Maintenance agenda item as reported in [5]:

* [103-e-NR-Pos-01] Email discussion/approval on DL PRS on aspects 2, 3, 13 (to capture RAN1 agreement only), 14, 16, in the FL summary until 10/29 with potential CRs by 11/4– Alexey (Intel)

1. List of Remaining Opens on NR Positioning

## Aspect #2: On DL PRS periodicity and DL PRS processing capability

In [Huawei, [1]], it is discussed how to select considering the RAN4 definition of DL PRS report delay which is dependent on UE reported capability and the calculated . The following is proposed:

is selected to be the maximum PRS periodicity among the DL PRS resource sets in a positioning frequency layer.

* Capture it in RAN4 spec or in RAN1 spec
* In case it is required to be captured in the RAN4 spec, send an LS to RAN4.
* In case it is required to be captured in the RAN1 spec, agree the draft CR in R1-2008789, where the following reasons for change are provided:
  + The P-msec window selection is undefined in the specification, which results in ambiguity of K-msec PRS duration calculation, as a different P corresponds to a different K. It will further result in ambiguity in calculation of the PRS measurement latency requirement defined in TS 38.133. The selection of P-msec is non-trivial as PRS resource (sets) on a positioning frequency layer can have various periodicities, and it should be clarified which periodicity should be used for the selection of P.
  + The specification number referenced for PRS processing capability is not correct, as LPP capabilities are not captured in TS 38.306, but in TS 37.355.

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| 5.1.6.5 PRS reception procedure ============================== Unchanged parts ==============================  For the case when measurement gap is configured, the UE DL PRS processing capability is defined in [TS37.355]. For the purpose of DL PRS processing capability, the duration *K* *ms* of DL PRS symbols within any *P* *ms* window corresponding to the maximum PRS periodicity in a positioning frequency layer, is calculated by  *-* Type 1 duration calculation with UE symbol level buffering capability  *-* Type 2 duration calculation with UE slot level buffering capability  ============================== Unchanged parts ============================== |

## Aspect #2 – Discussion Round #1

Companies are invited to provide views on the text proposal above to address discussion aspect #2:

|  |  |
| --- | --- |
| Company Name | Comments |
| Huawei/HiSilicon | Support the TP. |
| LG | We understand the motivation of this proposal, but we have a comment based on our understanding about the example described in contribution [1]. In the given example of PRS periodicity set (160 msec, 320 msec) with UE capability (N,T)=(6,160), the UE can select P=160ms and then its corresponding latency is 1.28 msec under the current spec(no restriction to select P ms). However, if the UE has to select the P ms window corresponding to the maximum periodicity, the UE should select P=320 and its corresponding latency is changed to 2.56 msec. We understand that the selection P affects to the latency value, but it seems that selection of the P ms window corresponding to the maximum periodicity is not always better, so we also need to consider that the UE can select P ms window properly by implementations. We are open to discuss more about the problems if we leave up to UE to select P. |
| Nokia/NSB | Okay. |
| Futurewei | Support |
| CATT | If I understand the proposal correct, the *P* *ms* window now is no longer **any** window, but specifically corresponds to the maximum PRS periodicity in a positioning frequency layer. If that is the case, we may what to say:  “within the *P* *ms* window corresponding to the maximum PRS periodicity in a positioning frequency layer,” |
| vivo | 1. During Rel-16 UE PRS processing capability discussion, it’s explained that (N, T) pair reported by UE as capability does not depend on PRS configuration. We don’t understand why now the TP proposed here requires that P is corresponding to the maximum PRS periodicity in a positioning frequency layer which is part of PRS configuration. 2. Is the intention of this TP to limit UE implementation? On the reason of current specification may result in ambiguity in calculation of the PRS measurement latency requirement, it’s not clear to us why RAN4 cannot make assumptions when derive latency requirement. |
| Qualcomm | Generally supportive, but to be fair, we need to admin that it is somehow RAN4 related (e.g. in QC’s RAN4 paper R4-2016507 this meeting, we also added a similar Proposal; Proposal 2). We are also OK with the clarification from CATT. |
| Huawei/HiSilicon2 | To LGE, we do not recommend that it should be up to UE implementation. Because in that case, network will expect the worst case scenario when it comes to positioning latency, which I understand resulting in RAN4 spec being broken.  To CATT, our view is that “any” still applies, since the window starting position can be anywhere, and if we make the window size the same as the maximum periodicity, the starting position does not matter so much anymore, and thus we are fine with the clarification from CATT.  To vivo, the reported (N,T) is not dependent on PRS configuration, but here we are addressing (K,P) that is based on actual PRS configuration. RAN4 already associated them in the positioning latency calculation.  Regarding RAN4 working area, to vivo and QC, our understanding is that RAN4 is still fully-occupied. Capturing this grey area in either RAN1 spec or RAN4 spec would help resolve the issue anyway, but we prefer to resolve this in RAN1. |
| ZTE | To clarify the ambiguity, we are generally fine with the proposal. Another suggestion in my mind is, can P be defined as “ **the** **least common multiple of the periodicities in the positioning frequency layer”** ? Then the problem in aspect #3 will also be addressed. |
| OPPO | We are fine with the TP. |
| LG2 | We understand the clarification is needed to avoid worst case assumption by network, and OK to address this issue in either RAN1 or RAN4. We are fine with the modified proposal from CATT. |
| Apple | Support TP with the note added by CATT. |

## Aspect #2 – Discussion Round #2

Based on discussion and clarifications provided above it seems group can converge on the following proposal accommodating minor revision proposed by CATT:

**Feature Lead Proposal #1**

* **Agree on the revised text proposal #1 below:**

**Text proposal #1**

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| 5.1.6.5 PRS reception procedure ============================== Unchanged parts ==============================  For the case when measurement gap is configured, the UE DL PRS processing capability is defined in [TS37.355]. For the purpose of DL PRS processing capability, the duration *K* *ms* of DL PRS symbols within ~~any~~ *P* *ms* window corresponding to the maximum PRS periodicity in a positioning frequency layer, is calculated by  *-* Type 1 duration calculation with UE symbol level buffering capability  *-* Type 2 duration calculation with UE slot level buffering capability  ============================== Unchanged parts ============================== |

Companies are invited to provide further views/comments if any

|  |  |
| --- | --- |
| Company Name | Comments |
| Huawei/HiSilicon | Support. |
| QC | Support |
| OPPO | Support |
| LG | Support |
| Apple | Support |
| ZTE | Support |
| Nokia/NSB | Support |

## Aspect #3: On handling DL PRS periodicity which is not LCM

In [Huawei,[1]], it is also proposed that “UE is not expected to handle the case that the maximum PRS periodicity in a positioning frequency layer is not the least common multiple of the periodicities in the positioning frequency layer”.

## Aspect #3 – Discussion Round #1

Companies are invited to provide views on proposal below to address discussion aspect #3:

**Proposal:**

**UE is not expected to handle the case that the maximum PRS periodicity in a positioning frequency layer is not the least common multiple of the periodicities in the positioning frequency layer.**

|  |  |
| --- | --- |
| Company Name | Comments |
| Huawei/HiSilicon | We noticed that the current PRS periodicities have two series, one with 4\*2^N msec and the other with 5\*2^N msec  Mixing of the two series will cause problem on counting the PRS durations, and we suggest to add this restriction. |
| LG | OK. |
| CATT | From the discussion in [1], the issue is that “it will be extremely difficult to analyse the PRS measurement latency if the maximum PRS periodicity is not the least common multiple (LCM) of the periodicities in a positioning frequency layers.” If that is the same, a simpler solution may be for RAN4 not defining the corresponding latency requirement for the scenario. If we say “UE is not expected to handle the case”, then it means UE is not expected to provide any DL positioning measurements, which may not be desirable since the UE can obvious processing one or both DL PRS sets. |
| vivo | We have difficulty in understanding the motivation for this proposal. It is stated in [1] that it will be difficult to analyze the PRS measurement latency if the maximum PRS periodicity is not the least common multiple (LCM) of the periodicities in a positioning frequency layers. Maybe as CATT mentioned above, RAN4 can do some other way?  Clarification question on the wording of this proposal. Take this example, two sets with periodicity 4 and 10ms on a frequency layer. When it says “**UE is not expected to handle the case”,** does it mean such PRS configuration is not allowed or UE is expected to only process one, or some other UE behaviour? |
| Huawei/HiSilicon2 | To CATT/vivo, the current RAN4 requirement also applies to the case that UE processing e.g. 4ms and 10ms simultaneously, in which case the window is assumed to be 10ms, and the PRS duration in 10ms window is calculated and compared against UE reported capability, as the equation is quite generic. According to our understanding, RAN4 were not aware of the complicated PRS periodicity structure introduced by RAN1.  Our proposal is saying that UE Rx behaviour upon reception of e.g. mixed 4ms and 10ms periodicities is not specified, which leaves entirely up to UE implementation. |
| Apple | Still clarification is needed, on why the case of PRS periodicity is not LCM of Ps in PFL cannot be handled by RAN4, e.g. as CATT mentioned? Or maybe better to define this case as an error case (instead of “is not expected” use “does not expect”) |

## Aspect #3 – Discussion Round #2

Based on discussion it seems the following alternatives are on the table and need to be decided by RAN WG1:

**Feature Lead Proposal #2**

* **Regarding whether / how to address the case that the maximum PRS periodicity in a positioning frequency layer is not the least common multiple of the periodicities in the positioning frequency layer select one of the following alternatives:**
  + **Alt.1 Continue discussion in RAN WG4**
  + **Alt.2 Make RAN WG1 conclusion that it is an error case and send LS to RAN WG4**
  + **Alt.3 Capture in the TS 38.214:**
    - **UE is not expected to handle the case that the maximum PRS periodicity in a positioning frequency layer is not the least common multiple of the periodicities in the positioning frequency layer**
    - **Send LS to RAN WG4**
  + **Alt.4 Leave it up to UE implementation how to handle such case**
* Companies are invited to provide further views/comments

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| --- | --- |
| Company Name | Comments |
| Huawei/HiSilicon | We do not think Alt.4 is something that can be the understanding without any spec impact.  We are fine with Alt.1, Alt.2, and Alt.3. We are also fine with Apple’s proposal by change “UE is not expected to” to “UE does not expect to”. |
| QC | Alt.1 |
| OPPO | Open to Alt.1/2/3 |
| LG | We slightly prefer Alt.1 |
| Apple | Alt.1/2 |
| ZTE | Alt.1 |
| Nokia/NSB | Alt. 1 |

## Aspect #13: DL PRS Processing Priority

The following TPs was provided in [LGE, [3]] aiming to reflect RAN1 agreements on DL PRS processing order.

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| --- |
| **5.1.6.5 PRS reception procedure**  *---- Unchanged parts omitted ----*  When a UE is configured with a number of PRS resources beyond its capability, 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-r16* being the highest priority for measurement, and the following priority is assumed.   1. The 64 TRPs per frequency layer are sorted according to priority, 2. The 2 sets per TRP of the frequency layer are sorted according to priority, |

## Aspect #13 – Discussion Round #1

Text proposal above for the TS 38.214 aims to reflect the following RAN WG1 agreements

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| 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:  1. FFS: the 4 frequency layers are sorted according to priority, 2. The 64 TRPs per frequency layer are sorted according to priority, 3. The 2 sets per TRP of the frequency layer are sorted according to priority, 4. 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 |

Companies are invited to provide views on the text proposal above to address discussion aspect #13:

|  |  |
| --- | --- |
| Company Name | Comments |
| Huawei/HiSilicon | Just want to clarify that by agreeing to the existing partial agreement, we are actually saying that the priority of frequency layers and PRS resources is up to UE implementation, and to ensure that there is no ambiguity and can be common understanding between UE and LMF of such cases, the number of positioning frequency layers and resources should not exceed UE capability. |
| LG | Support. We have spent a lot of time to discuss whether or not to support the FFS points, but could not reach a consensus. we are not sure that we can reach a consensus in this meeting, so we propose to finalize this issue by capturing the current agreement to the spec. |
| Nokia/NSB | Support. Reflects the agreement. |
| CATT | Support. |
| vivo | OK |
| Qualcomm | OK |
| ZTE | OK |
| OPPO | Support |
| Apple | Support |

## Aspect #13 – Discussion Round #2

Based on discussion above it seems original proposal is agreeable:

**Feature Lead Proposal #3**

* **Agree on the text proposal #2 below:**

**Text Proposal #2**

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| **5.1.6.5 PRS reception procedure**  *---- Unchanged parts omitted ----*  When a UE is configured with a number of PRS resources beyond its capability, 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-r16* being the highest priority for measurement, and the following priority is assumed.   1. The 64 TRPs per frequency layer are sorted according to priority, 2. The 2 sets per TRP of the frequency layer are sorted according to priority, |

Companies are invited to provide further views/comments if any

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| --- | --- |
| Company Name | Comments |
| Huawei/HiSilicon | Still to us, the overall PRS to measure has no ambiguity only if there is single positioning frequency layer. Therefore we suggest the following modification to the TP.  **5.1.6.5 PRS reception procedure**  *---- Unchanged parts omitted ----*  When a UE is configured with a single position frequency layer and with a number of PRS resources beyond its capability, 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-r16* being the highest priority for measurement, and the following priority is assumed.   1. The 64 TRPs per frequency layer are sorted according to priority, 2. The 2 sets per TRP of the frequency layer are sorted according to priority, |
| QC | HW’s modification would mean that for UEs supporting multiple layers, there will be no sorting/priority at all. Is that better than the current agreement? |
| OPPO | Share the same feeling as QC. Not sure whether I understand Huawei’s intention correctly: If UE is configured with multiple positioning frequency layers, gNB should ensure the configuration is within UE capability. Otherwise, it is up to UE implementation. Is it a correct understanding of Huawei’s proposal? |
| Huawei/HiSilicon | To QC/OPPO  The concern from us is that if there is no priority among frequency layers, which means that which positioning frequency layer to measure is up to UE implementation, why would we still care the priority within the randomly selected frequency layers?  Even if we relax the applicability of two priorities (i.e. on TRPs within a positioning frequency layer and on PRS resource sets of a TRP of a PFL) to “configured with multiple positioning frequency layers within the UE capability”, we still have the following capabilities that sums up the resource capability across positioning frequency layer, e.g. number of TRPs across all positioning frequency layers, number of PRS resource across all positioning frequency layers, that remain ambiguous if priority among frequency layers is not included.  E.g UE supports two PFLs, and maximum 16 TRPs across PFLs, and LMF provides two PFL with the number of TRPs (12+12), is there any common understanding which TRPs UE will measure? Are companies willing to accept that at least the first 4 TRPs within each PFL will be processed, considering (4+12 or 12+4).  I think the understanding from OPPO is aligned with our intention. |
| LG | Support. We only have the agreements for priority on TRPs per frequency layer, so we think HW’s modified proposal is also reasonable. Either the TP or the modified TP is OK to us. |
| Apple | Support |
| ZTE | Huawei’s proposal seems more reasonable, since the agreed priorities are defined per frequency layer rather than across frequency layers. |

## Aspect #14: Reference Correction in the TS 38.211

In [Ericsson, [4]], it was identified that “In 38.211, the clause referenced for description of how a DL PRS resource is transmitted in incorrect. Change the incorrect reference to clause 5.1.6.4 in 38.214 to 5.1.6.5.”

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| 7.4.1.7.4 Mapping to slots in a downlink PRS resource set ---------------------------------------------Unchanged parts are omitted----------------------------------------------------  For a downlink PRS resource in a downlink PRS resource set configured, the UE shall assume the downlink PRS resource being transmitted as described in clause 5.1.6.5 of [6, TS 38.214].  ---------------------------------------------Unchanged parts are omitted---------------------------------------------------- |

## Aspect #14 – Discussion Round #1:

Companies are invited to provide views on TP above to address discussion aspect #14:

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| --- | --- |
| Company Name | Comments |
| Huawei/HiSilicon | Support. |
| LG | OK. |
| Nokia/NSB | Support |
| Futurewei | Support |
| CATT | Support |
| vivo | OK |
| Qualcomm | OK |
| ZTE | OK |
| OPPO | Support |
| Apple | Support |

## Aspect #14 – Discussion Round #2

Based on discussion above it seems original proposal is agreeable:

**Feature Lead Proposal #3**

* **Agree on the text proposal #3 below:**

**Text Proposal #3**

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| --- |
| 7.4.1.7.4 Mapping to slots in a downlink PRS resource set ---------------------------------------------Unchanged parts are omitted----------------------------------------------------  For a downlink PRS resource in a downlink PRS resource set configured, the UE shall assume the downlink PRS resource being transmitted as described in clause 5.1.6.5 of [6, TS 38.214].  ---------------------------------------------Unchanged parts are omitted---------------------------------------------------- |

Companies are invited to provide further views/comments if any

|  |  |
| --- | --- |
| Company Name | Comments |
| Huawei/HiSilicon | Support. |
| QC | OK |
| OPPO | OK |
| LG | Support |
| Apple | Support |
| ZTE | Support |
| Nokia/NSB | Support. |

## Aspect #16: RSTD Measurement on Multiple DL PRS Resources

In [OPPO, [2]], it is proposed to change the text when UE performs multiple measurements on DL PRS resources with the following reasoning:

“There was an agreement as below, which is not captured in the spec TS 38.214 correctly. The condition (highlighted by Yellow) is for the case of different DL PRS resource ID(s) in the agreement. However, the conditioned is misplaced for the case of a different DL PRS resource set.”

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| --- |
| 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 |

The following TP is provided to correct the existing text.

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| --- |
| **In TS 38.214 Section 5.1.6.5**  *<omitted text>*  The UE may be indicated by the network that a DL PRS resources 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-r16*. 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-r16* and *nr-DL-PRS-expectedRSTD-uncerainty-r16*. 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-r16* may include an *dl-PRS-ID-r16*, a DL PRS resource set ID, and optionally a single DL PRS resource ID or a list of DL PRS resource IDs. The UE may use different DL PRS resources measurement as long as the condition that the DL PRS resources used belong to a single DL PRS resource set is met 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-r16*, the DL PRS resource ID(s) or the DL PRS resource set ID used to determine the reference.  *<omitted text>* |

## Aspect #16 – Discussion Round #1:

Companies are invited to provide views on TP above to address discussion aspect #16:

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| --- | --- |
| Company Name | Comments |
| Huawei/HiSilicon | OK. |
| LG | OK. |
| Nokia/NSB | We don’t think this is strictly needed but okay if all other companies feel it is important to clarify. |
| Futurewei | The TP proposed is not very concise i.e. “as long as the condition…” It does not the sentence clearer. |
| CATT | In addition to the proposed changes, suggest making the following changes: “The UE may use different DL PRS resource(s) …” |
| vivo | We don’t think this TP is needed. Current specification is clear and no ambiguity. |
| Qualcomm | Not really needed |
| ZTE | Agree with CATT |
| OPPO | Support the TP. Also ok with CATT’s change. |
| LG2 | We are also fine with the modified proposal from CATT. |
| Apple | Do not support. Since using a separate DL-PRS resource set is supported anyway, it seems the current TP is more accurate. |

## Aspect #16 – Discussion Round #2:

Based on discussion it seems that

* 5 companies are OK with TP (minor modifications may be needed)
  + Huawei, LGE, CATT, ZTE, OPPO
* 4 companies seems do not see the strong need for TP
  + vivo, Futurewei, Qualcomm, Apple
* 1 company can accept if majority agrees
  + Nokia

Considering that group is divided in opinions and proposed TP aims to clarify the original intention of RAN WG1 agreement, it seems OK to give it one more try and ask proponents to provide more accurate and acceptable wording:

Companies are invited to come up with the clarification / wording that can be acceptable to all companies:

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| --- | --- |
| Company Name | Comments |
| QC | Not needed |
| OPPO | Although we prefer to change the spec to match the wording of previous agreement, we are open to keep the current spec wording by considering reasons raised by opponents. |
| Apple | No need, current spec text is ok |
| ZTE | Support the majority view. |
| Nokia/NSB | Since there are multiple companies also seeing no need for the change we do not support the TP. |
|  |  |

1. Outcome of E-Mail Discussion

TBD

1. References
2. R1-2007574 Rel-16 positioning corrections Huawei, HiSilicon
3. R1-2008215 Text Proposals on RS for Positioning OPPO
4. R1-2008414 Discussions on remaining issues on Rel-16 NR positioning LG Electronics
5. R1-2008760 Corrections to 38.211 for NR positioning Ericsson
6. R1-2009239 Feature Lead Summary for NR Positioning Maintenance AI 7.2.8, Moderator (Intel Corporation, CATT, Ericsson, Qualcomm)