**3GPP TSG RAN WG1 Meeting #102-E R1-200ZZZZ**

**e-Meeting, August 17th – 28th, 2020**

**Source: Moderator (Intel Corporation)**

**Title: Summary of Email Discussion [102-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 [102-e-NR-Pos-01] and its outcome. The open aspects for discussion were agreed by RAN WG1 during preparation phase based on review of submitted contributions [1]-[19] as documented in [20].

1. Discussion on Remaining DL PRS Open Aspects

## Aspect #0: DL PRS and SSB Collisions

### Description

In [[1], vivo], it was noticed that the time frequency location of SSB is not only determined by *ssb-PositionsInBurst*. The UE is provided with SSB assistance data when PRS is configured with QCL relation. Therefore, when the UE is configured with QCL relation with SSB, it can also obtain the time frequency location of the SSB which has QCL relation with the PRS. Therefore, it can be concluded that the related description in TS 38.211 is not comprehensive.

The following TP was proposed for the TS 38.211 to address this aspect:

|  |
| --- |
| < Unchanged parts are omitted >  - the symbol is not used by any SS/PBCH block used by a serving cell for downlink PRS transmitted from the same serving cell or any SS/PBCH block from a non-serving cell indicated by the higher-layer parameter *ssb-PositionsInBurst-r16* or indicated by *dl-PRS-QCL-Info-r16* for downlink PRS transmitted from the same non-serving cell;  < Unchanged parts are omitted > |

**Feature Lead Response**

It is recommended to include this aspect into one of the e-mail discussions and clarify aspect of DL PRS and SSB collisions. It needs to be concluded whether proposed change is needed and/or complete.

### Collection of Views on Original Proposal

Please comment in table below whether you agree with raised issue and text proposal as well as provide any proposal that you may have.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Huawei/HiSilicon | We fail to see the relationship between PRS-QCL and SSB-puncturing-PRS, since QCL resource SSB may not be overlapping with PRS at all.  The proposed option 1 in [1] should be fine to resolve the issue when *ssb-PositionsInBurst-r16* is not provided, as the field itself is optional.  **Option 1**   |  | | --- | | < Unchanged parts are omitted >  - the symbol is not used by any SS/PBCH block used by a serving cell for downlink PRS transmitted from the same serving cell or any SS/PBCH block from a non-serving cell whose time frequency location is provided to the UE ~~indicated by the higher-layer parameter~~ *~~ssb-PositionsInBurst-r16~~* for downlink PRS transmitted from the same non-serving cell;  < Unchanged parts are omitted > | |
| vivo | Response to Huawei’s comment on the relationship between PRS-QCL and SSB-puncturing-PRS.  To clarify, in our contribution, we didn’t say QCL resource SSB always has to be overlapping with PRS. Rather, we said the SSB assistance data can be provided for PRS-QCL or when DL-PRS is punctured by SSB, which is based on the note we made w.r.t. SSB assistance data in RAN1#99   * Note: The SSB assistance data can be provided at least when DL-PRS-QCL-Info for a DL-PRS Resource of a TRP indicates ‘QCL Type-D’ or ‘QCL Type C’, or when DL-PRS is punctured by SSB.   When *dl-PRS-QCL-Info-r16* is provided to the UE, the time frequency location of SSB is known.  Our proposal “or indicated by *dl-PRS-QCL-Info-r16”* is meant to use an aligned style as the relevant text exists in 38.211.  We’re okay to take option 1 in our contribution [1] if companies prefer no explicit higher layer parameter IE names at all. |
| Nokia/NSB | We are okay with Option 1 from vivo/ Huawei above. |

## Aspect #1: Prioritization of Assistance Data

### Description

The following views were expressed with respect to prioritization of DL PRS resources in assistance signalling:

* With regards to the prioritization of the assistance data, support the prioritization of the frequency layers and the resources within set according to their ordering. [[17], Qualcomm]
* Confirm that when the UE is configured with DL PRS configurations exceeding the UE capability, the 4 frequency layers are sorted according to priority and the 64 resources of the set per TRP per frequency layer are sorted according to priority. [[18], Ericsson]
* Adopt the following TP [[13], LGE]

|  |
| --- |
| 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 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. The 64 resources of the set per TRP per frequency layer are sorted according to priority. |

* [[12], CMCC]
  + When a UE is configured in the assistance data of a positioning method with a number of PRS resources beyond its capability, it is up to UE implementation for the selection of frequency layers.
  + When a UE is configured in the assistance data of a positioning method with a number of PRS resources beyond its capability, the 64 resources of the set per TRP per frequency layer are sorted according to priority.
* [[4], CATT]
  + The 4 frequency layers are sorted according to priority
  + The 64 resources of the set per TRP per frequency layer are sorted according to priority
* [[7], Huawei]
  + The 4 frequency layers are sorted according to priority
  + The 64 resources of the set per TRP per frequency layer are sorted according to priority
  + Endorse the following TP to clause 5.1.6.5 of TS 38.214.

|  |
| --- |
| ===================== Unchanged parts omitted ======================  If UE reports DL PRS resource capability for a positioning method in higher layer parameters *NR-DL-PRS-ResourcesCapability-r16*, and if UE is provided by the higher layers to receive PRS, UE is only expected to measure the DL PRS resources selected according to the following steps:  *-* Step.1 Select the first *maxNrOfPosLayer-r16* positioning frequency layers;  *-* Step.2 Select the first *maxNrOfTRP-AcrossFreqs-r16* positioning nodes in the order of positioning frequency layers within the selected *maxNrOfPosLayer-r16* positioning frequency layers;  *-* Step.3 Select the first *maxNrOfDL-PRS-ResourceSetPerTrpPerFrequencyLayer-r16* DL PRS resource sets within each positioning node on each positioning frequency layer from the selected *maxNrOfTRP-AcrossFreqs-r16* positioning nodes;  *-* Step.4 Select the first *maxNrOfDL-PRS-ResourcesPerResourceSet-r16* DL PRS resources within each DL PRS resource sets from the selected DL PRS resource sets;  *-* Step.5 Select the first *maxNrOfDL-PRS-ResourcesPerPositioningFrequencylayer-r16* DL PRS resources in the order of positioning node, DL PRS resource set, and DL PRS resource within each selected positioning frequency layer;  *-* Step.6 Select the first *maxNrOfDL-PRS-ResourcesAcrossAllFL-TRP-ResourceSet-r16* DL PRS resources in the order of positioning frequency layer, positioning node, DL PRS resource set, and DL PRS resource across all positioning frequency layers within each FR.  UE expects that the reference indicated by *nr-DL-PRS-ReferenceInfo-r16* is selected.  ===================== Unchanged parts omitted ====================== |

* Do not support prioritization of DL PRS resources in assistance data. [[16], Nokia]
* The following views are expressed in [[2], vivo]
  + Positioning frequency layers in NR are not sorted according to priority
  + LMF recommends some PRS resources in high priority to measure while the actual PRS resources to be measured is still decided by the UE.
  + 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:
    - The resources of the set are divided into M measurement groups. The priority of measurement groups of a PRS reource set are sorted according to the priority order of PRS resource set first, then by the order of TRP, at last followed by the next measurement group of the same PRS resource set.
  + The sorted PRS resource priority is assumed only within the measurement gap window on the UE side.

Based on provided inputs many companies would like to resolve the following FFS points left from the last meeting:

* FFS: the 4 frequency layers are sorted according to priority
* FFS: the 64 resources of the set per TRP per frequency layer are sorted according to priority

**Feature Lead Response**

Discuss and resolve the following FFS points:

* FFS: the 4 frequency layers are sorted according to priority
* FFS: the 64 resources of the set per TRP per frequency layer are sorted according to priority

### Collection of Views on Original Proposal

Please comment in table below on how you want to resolve the following FFS aspects in the agreement from the previous meeting:

* FFS: the 4 frequency layers are sorted according to priority
* FFS: the 64 resources of the set per TRP per frequency layer are sorted according to priority

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Huawei/HiSilicon | We think there should be priority for positioning frequency layers; leaving it entirely up to UE implementation will cause misalignment between LMF and UE on which DL PRS resource will be processed for a UE that supports e.g. single positioning frequency layer, if assistance data contains more than one. |
| vivo | We didn’t see many explanations/motivations discussed in the contributions from the proponents of prioritize frequency layers in the assistance data. One argument was raised that in last meeting that LTE support it. However, as we discussed in our contribution [2], the definition of positioning frequency layer in NR is not the same as in LTE where a positioning frequency layer in NR consists of sets with the same value for ‘*DL-PRS-SubcarrierSpacing*’, *‘DL-PRS-PointA’,’ DL-PRS-StartPRB’,’ DL-PRS-ResourceBandwidth’ and ‘DL-PRS-CombSizeN’.* Previously, in LTE, two resource sets with the same centre frequency but different bandwidth can have the same priority given they are of the same frequency layer. However, supporting priority order of frequency layer in NR is not achieving the same as in LTE per se. Given priority of TRPs and resource sets per TRP are already agreed, we don’t think prioritize frequency layers in the assistance data is necessary.  Regarding the example mentioned in Huawei’s comment, our understanding of this over-capability provision of assistance data may be mostly for broadcast. As we discussed in [2], in this case, leaving to UE implementation actually allows UE to choose which frequency layer to process, for instance, to obtain better accuracy performance.  On the support of priority order of PRS resources in a set, we have a similar concern on the restriction to UE processing order. Given NR PRS resource is likely associated with beam, restrict a UE to always process all resources in a set before the next set is not efficient at all. We see some benefit if the network can recommend a small subset for processing though. In general, we propose that LMF recommends some PRS resources in high priority to measure while the actual PRS resources to be measured is still decided by the UE.  Last point, regardless whether priority order for frequency layer and/or resources in a set is support or not, we think another agreement is need related to measurement gap. As we discussed in [2], the sorted PRS resource priority is assumed only within the measurement gap window on the UE side. |
| Nokia/NSB | As we discuss in our contribution [16] beam sweeping of the DL PRS is new compare with the PRS in LTE. Let’s consider the broadcast assistance data case: the LMF then needs to prioritize the assistance data for all UEs within the cell which seems difficult if not impossible to do so in a way that is suitable for all UEs positioning performance at one time. Different UEs will have different PRS resources which they should prioritize if they have a capability lower than the broadcast assistance data. It was proposed that the LMF could do the prioritization in the spatial domain (e.g., putting broad beams first) but we think this may be sub-optimal. For example, if the UE is far from the transmitting TRP then it may need to measure the narrow beams in order to have overcome the high pathloss but if the prioritization is only the broad beams this UE will suffer some performance loss (it may also depend on the RX beams the UE is using). We think more discussion and clarity is needed if PRS resources are to be sorted by priority. |

## Aspect #2: DL PRS Processing Capability

### Description

* The following TP#1 was proposed in [[7], Huawei] to clarify UE DL PRS processing capability in clause 5.1.6.5 of TS 38.214.

|  |
| --- |
| ===================== Unchanged parts omitted ======================  For the case when measurement gap is configured, the UE DL PRS processing capability is defined in [TS 38.306 Clause 4.2.7.2]. For the purpose of DL PRS processing capability, the duration *K* *ms* of DL PRS symbols within any *P* *ms* window, is calculated by  *-* Type 1 duration calculation with UE symbol level buffering capability  *-* Type 2 duration calculation with UE slot level buffering capability  *- S* is the set of slots based on the numerology of PRS of a serving cell within the *P* msec window in the positioning frequency layer that contains potential DL PRS resources considering the actual *nr-DL-PRS-ExpectedRSTD*, *nr-DL-PRS-ExpectedRSTD-Uncertainty* provided for each pair of DL PRS Resource Sets.  *-* For Type 1, is the smallest interval in *ms* within slot corresponding to an integer number of OFDM symbols based on the numerology of PRS of a serving cell that covers the union of the potential PRS symbols and determines the PRS symbol occupancy within slot , where the interval considers the actual *nr-DL-PRS-ExpectedRSTD*, *nr-DL-PRS-ExpectedRSTD-Uncertainty* provided for each pair of DL PRS resource sets (target and reference).  - For Type 2, is the numerology of PRS, and is the cardinality of the set .  ===================== Unchanged parts omitted ====================== |

* The following TP#2 was proposed in [[7], Huawei] to clarify UE capability in terms of DL PRS processing in clause 5.1.6.5 of TS 38.214.

|  |
| --- |
| ===================== Unchanged parts omitted ======================  For the purpose of the DL PRS processing capability, if UE reports DL PRS processing capability (N, T), for any time window, the UE should be capable to process all DL PRS resources within , if  *-* , 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].  ===================== Unchanged parts omitted ====================== |

**Feature Lead Response**

1. Regarding TP#1, it seems useful clarification and recommended to be agreed.
2. Regarding TP#2, it is recommended to follow RAN2 preference and capture it in LPP.

### Collection of Views on Original Proposal

Please provide your feedback on the TP#1 and TP#2.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Huawei/HiSilicon | Agree with TP#1.  For TP#2, the reason that we proposed it is that RAN2 dismissed the RAN1 LS last meeting. |
| vivo | OK with TP#1.  For TP#2, agree with FL to follow RAN2 preference and capture it in LPP. |
| Nokia/NSB | Okay with TP#1 but suggest to use DL PRS in the changed parts to align with rest of spec rather than simply PRS.  For TP#2 agree with FL and vivo. LS Action was clear that RAN1 was leaving the decision to RAN2. |

## Aspect #3: Additional Path Report

### Description

* In [[2], vivo], it is proposed to
  + Capture UE capability of additional path report for NR DL-TDOA positioning and NR Multi-RTT positioning in TS 38.214.
  + Corresponding TP is provided below

|  |
| --- |
| *TS 38.214*  *5.1.6.5 PRS reception procedures*  < Unchanged parts are omitted >  The UE may be configured to measure and report, subject to UE capability, up to 4 UE Rx-Tx time difference measurements 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.  The UE may be configured to measure and report, subject to UE capability, up to 2 additional detected path timing values relative to the path timing in association to each TOA measurement used to determine each RSTD measurement or RX-TX time difference measurement. The UE may also be configured to report quality metrics corresponding to each additional detected path.  < Unchanged parts are omitted > |

**Feature Lead Response**

1. Regarding capability, the feature was introduced by RAN WG2 and thus it is up to RAN WG2 to define such capability.
2. Regarding text proposal, it seems RAN WG1 needs to incorporate it in TS 38.214. Proposed TP can be used as a starting point for discussion.

### Collection of Views on Original Proposal

Please provide your feedback regarding the following

* A) Need to discuss and define UE capability by RAN1
* B) Whether TP for additional path is needed/agreeable or any modifications are needed?

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Huawei/HiSilicon | For A), it is discussed in 7.2.11.  For B), we are fine to capture the additional path reporting or leave it entirely up to RAN2. For the TP if it is needed, we suggest to go with the following:  The UE may be configured to measure and report, subject to UE capability, the timing and the quality metrics of up to 2 additional detected paths associated with each RSTD or UE Rx – Tx time difference. The timing of each additional path is reported relative to the TOA values represented by *nr-RSTD-r16* or *nr-UE-RxTxTimeDiff-r16*.  The difference is that for a TRP, UE may be configured to report up to 4 RSTD/UE-RxTxTimeDiff values, and for each RSTD/UE-RxTxTimeDiff, UE may report up to 2 additional paths, namely up to 12 TOAs (4x3) for a TRP.  In addition, it was agreed in RAN2 that the additional path timing for RSTD is reported relative to a single reference, i.e. *nr-RSTD-r16*, i.e. the remaining 11 TOAs is relative to the main RSTD represented by *nr-RSTD-r16*. It is also proposed in RAN2 to adopt a uniform structure for UE-RxTxTimeDiff. |
| vivo | We’re fine to only discuss B) here.  On the wording changes proposed by Huawei, we’re okay for the explained reason. Though we think the last sentence in our original proposal is still needed as below for 38.214.  The UE may be configured to measure and report, subject to UE capability, the timing and the quality metrics of up to 2 additional detected paths associated with each RSTD or UE Rx – Tx time difference. The timing of each additional path is reported relative to the TOA values represented by *nr-RSTD-r16* or *nr-UE-RxTxTimeDiff-r16*. The UE may also be configured to report quality metrics corresponding to each additional detected path. |
| Nokia/NSB | For A) we agree with Huawei that this should be discussed in 7.2.11.  For B) We are okay with the proposed text above by vivo. However, this assume that this is agreed to be a UE capability so it may be better to put that part in brackets for now. |

## Aspect #4: PRS Reception Procedure and SRS Spatial Relation for Multi-Panel UE

### Description

* The following inconsistency is noticed in [[2], vivo]
  + In intra-band and inter-band CA operations, different spatial relations in the same OFDM symbol for SRS is allowed and up to UE capability.
    - if the panel of UE is more than one, it can support the simultaneous transmission of SRS resources with different spatial relations. And it is better to take the different spatial relations when one SRS resources in the FR1 and another in the FR2
  + In order to correct above proposal, it is recommended to adopt the following text proposal into TS 38.214 for the spatial relation for SRS.

|  |
| --- |
| *TS 38.214*  *5.1.6.5 PRS reception procedure*  < Unchanged parts are omitted >  In the same carrier, the UE is not expected to transmit multiple SRS resources with different spatial relations in the same OFDM symbol.  < Unchanged parts are omitted > |

**Feature Lead Response**

It seems RAN1 needs to discuss this aspect and make some additional agreement/conclusion.

### Collection of Views on Original Proposal

Please provide your views on the raised aspect and whether/how to address it (e.g. whether proposed correction is agreeable?).

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Huawei/HiSilicon | OK. |
| vivo | Support. |
|  |  |

## Aspect #6: Clarification on PRS Reception Procedure

### Description

* In [[9], OPPO], the following TP is proposed to clarify PRS reception procedure

|  |
| --- |
| 5.1.6.5 PRS reception procedure  \*\*\* Unchanged text is omitted \*\*\*  For the DL RSTD, DL PRS-RSRP, and UE Rx-Tx time difference measurements the UE can report an associated higher layer parameter *nr-TimeStamp-r16*. The *nr-TimeStamp-r16* can include the SFN and the slot number for a subcarrier spacing. These values correspond to the reference which is provided by *nr-DL-PRS-ReferenceInfo-r16*.  The UE is expected to measure the DL PRS resource outside the active DL BWP or with a numerology different from the numerology of the active DL BWP if the measurement is made during a configured measurement gap. When the UE is expected to measure the DL PRS resource outside the active DL BWP or with a numerology different from the numerology of the active DL BWP, it may request a measurement gap in higher layer parameter *measGapConfig*.  \*\*\* Unchanged text is omitted \*\*\* |

**Feature Lead Response**

Proposed revision seems to be consistent with current agreements and can be accepted for the sake of clarity of specification.

### Collection of Views on Original Proposal

Please express your views on proposed correction/clarification.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Huawei/HiSilicon | We prefer the following change.  The UE is expected to measure the DL PRS resource outside the active DL BWP or with a numerology different from the numerology of the active DL BWP if the measurement is made during a configured measurement gap. |
| Nokia/NSB | This TP was discussed at previous meetings and not agreed. We think the current text is correct and that this change is not needed. Do not support the TP. |
|  |  |

## Aspect #7: Alignment of Parameter Names

### Description

* In [[5],vivo] the following change was proposed to align TS 38.214 clause 5.1.6.5 PRS reception procedure with RAN2 spec
  + To align with RAN2, change the parameter name ‘nr-DL-PRS-RstdMeasurementInfoRequest-r16’ and ‘DL-PRS-UE-Rx-Tx-MeasurementInfo’ to ‘NR-DL-TDOA-SignalMeasurementInformation’ and ‘NR-Multi-RTT-SignalMeasurementInformation’ respectively.
* In [[10], OPPO] the following changes are proposed:
  + Change in TS 38.211 the higher layer parameter names
    - *dl-PRS-SequenceId-r16* to *dl-PRS-SequenceID-r16*
  + Change in TS 38.211 and TS 38.214 the higher layer parameter names
    - *dl-PRS-ReOffset-r16* to *dl-PRS-CombSizeN-and-ReOffset-r16*
    - *mutingOption1-r16* and *mutingOption2-r16* to *dl-PRS-MutingOption1-r16* and *dl-PRS-MutingOption2-r16* respectively
    - *dl-PRS-MutingPatternList-r16 to dl-PRS-MutingOption1-r16* and *dl-PRS-MutingOption2-r16*

**Feature Lead Response**

Recommend implementing proposed changes. In general, it can be done later when editors prepare revision of specification and ask for feedback.

### Collection of Views on Original Proposal

Please express your views on proposed corrections.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Huawei/HiSilicon | Agree with the Feature Lead Response. |
| vivo | Our preference is actually agree these changes in positioning sessions. Having the agreed changes would be easy for the editors for reference and to incorporate into specifications. |
|  |  |

1. References
2. R1-2005357, Remaining issues on DL RS for NR positioning vivo
3. R1-2005358, Remaining issues on physical layer procedure for NR positioning vivo
4. R1-2005452, Maintenance of NR positioning ZTE
5. R1-2005681, Remaining issues on DL PRS and measurements for NR Positioning CATT
6. R1-2005682, Remaining issues on UL SRS and UL procedures for NR Positioning CATT
7. R1-2005780, Discussion on QCL for PRS ZTE
8. R1-2005795, NR positioning corrections Huawei, HiSilicon
9. R1-2005806, RAN1 inputs to RAN3 on SRS support Huawei, HiSilicon
10. R1-2005978, Remaining Issues on measurements and procedure for NR Positioning OPPO
11. R1-2005979, Remaining Issues on RS for Positioning OPPO
12. R1-2006120, On remaining issues for Rel.16 positioning Samsung
13. R1-2006199, Remaining issues on DL PRS processing order CMCC
14. R1-2006372, Discussion on remaining issues on simultaneous SRS transmission and PRS processing priority for NR positioning LG Electronics
15. R1-2006373, Discussion on remaining issues on QCL and spatial relation information for NR positioning LG Electronics
16. R1-2006425, Maintenance on measurements for NR positioning Nokia, Nokia Shanghai Bell
17. R1-2006426, Priority of Assistance Data Nokia, Nokia Shanghai Bell
18. R1-2006784, Maintenance on DL Reference Signals for NR Positioning Qualcomm Incorporated
19. R1-2006911, Maintenance of rel16 reference signals for NR positioning Ericsson
20. R1-2006912, Maintenance of rel16 Physical-layer procedures to support UE - gNB measurements Ericsson
21. R1-2006996, Feature lead summary for NR positioning maintenance AI 7.2.8, Moderator (Intel Corporation), Ericsson, CATT, Qualcomm