**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:

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| < 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.

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| --- | --- |
| **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. |
| OPPO | We sympathize the motivation of the proposed TP. When a SSB is configured as QCL source for a DL PRS, the location of SSB is provided to the UE.  Regarding which TP shall be adopted, the Option1 is preferred. |
| CATT | Our preference is to keep the original text. Our understanding from the original text is that:   * For downlink PRS transmitted from the same serving cell, the symbol is not used by any SS/PBCH block used by a serving cell. * For downlink PRS transmitted from the non-serving cell, the symbol is not used by any SS/PBCH block used by the same non-serving cell, which is indicated by the higher-layer parameter *ssb-PositionsInBurst-r16 of the* same non-serving cell.   If we take Option 1, then the information “indicated by the higher-layer parameter ssb-PositionsInBurst-r16 of the same non-serving cell” is lost.  If we add “or indicated by *dl-PRS-QCL-Info-r16”,* then the meaning of the requirement becomes unclear, since SS/PBCH block transmission is not indicated by dl-PRS-QCL-Info-r16. |
| vivo2 | Response to CATT  As we discussed in [1] in details, there’s an identified problem of original text in 38.211. “indicated by the higher-layer parameter ssb-PositionsInBurst-r16 of the same non-serving cell” in 38.211 is actually not consistent with what described in 38.214 “If the time frequency location of the SS/PBCH block transmissions from non-serving cells are provided to the UE then the UE also assumes that the DL PRS from a non-serving cell is not mapped to any symbol that contains the SS/PBCH block of the same non-serving cell.” and cause problem when *ssb-PositionsInBurst-r16* is not provided since it’s optional. |
| ZTE | From our view, all SSBs used for positioning will be configured in *NR-SSB-Config-r16,* regardless of the SSB is configured in *ssb-PositionsInBurst-r16* or *dl-PRS-QCL-Info-r16*. So we think following TP will be clear enough,  < 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~~ NR-SSB-Config-r16* for downlink PRS transmitted from the same non-serving cell;  < Unchanged parts are omitted > |
| vivo3 | In response to ZTE’s comment.  The following *NR-SSB-Config-r16* IE is from 37.355 where *ssb-PositionsInBurst-r16* is a sub IE. When the optional *ssb-PositionsInBurst-r16* is not presented, does *NR-SSB-Config-r16* indicate the time frequency location of SSB? Replacing *ssb-PositionsInBurst-r16* with *NR-SSB-Config-r16* as proposed by ZTE does not resolve the issue here. *– NR-SSB-Config* The IE *NR-SSB-Config* defines SSB configuration.  -- ASN1START  NR-SSB-Config-r16 ::= SEQUENCE {  nr-PhysCellID-r16 NR-PhysCellID-r16,  nr-ARFCN-r16 ARFCN-ValueNR-r15,  ss-PBCH-BlockPower-r16 INTEGER (-60..50),  halfFrameIndex-r16 INTEGER (0..1),  ssb-periodicity-r16 ENUMERATED { ms5, ms10, ms20, ms40, ms80, ms160, ...},  ssb-PositionsInBurst-r16 CHOICE {  shortBitmap-r16 BIT STRING (SIZE (4)),  mediumBitmap-r16 BIT STRING (SIZE (8)),  longBitmap-r16 BIT STRING (SIZE (64))  } OPTIONAL, --Need OR  ssb-SubcarrierSpacing-r16 ENUMERATED {kHz15, kHz30, kHz60, kHz120, kHz240, ...},  sfn-SSB-Offset-r16 INTEGER (0..15),  ...  }  -- ASN1STOP   | *NR-SSB-Config* field descriptions | | --- | | ***ssb-PositionsInBurst***  Indicates the time domain positions of the transmitted SS-blocks in a half frame with SS/PBCH blocks as defined in TS 38.213 [39], clause 4.1. The first/ leftmost bit corresponds to SS/PBCH block index 0, the second bit corresponds to SS/PBCH block index 1, and so on. Value 0 in the bitmap indicates that the corresponding SS/PBCH block is not transmitted while value 1 indicates that the corresponding SS/PBCH block is transmitted. | | ***ss-PBCH-BlockPower***  Average EPRE of the resources elements that carry secondary synchronization signals in dBm that the NW used for SSB transmission, see TS 38.213 [13], clause 7. | | ***ssb-periodicity***  The SSB periodicity in ms for the rate matching purpose. If the field is absent, the UE applies the value ms5. (see TS 38.213 [39], clause 4.1). | | ***ssb-SubcarrierSpacing***  Subcarrier spacing of SSB. Only the values 15 kHz or 30 kHz (FR1), and 120 kHz or 240 kHz (FR2) are applicable. | | ***ssb-Index***  For a DL-PRS Resource, SSB index indicated for QCL Type D and QCL Type C is same. | |
| LG | In our understanding, location server would not configure a PRS resource overlapped with a SSB which is QCL source of the PRS resource. If we need some modification, we prefer option 1 above. |
| ZTE2 | From our understanding, if *ssb-PositionsInBurst-r16* is not configured, which means UE is expected to measure all SSBs within this cell, and SS/PBCH blocks in a half frame are indexed in an ascending order in time. Overall, *ssb-PositionsInBurst-r16* configures a common pool for measurement.  If my understanding is wrong, please correct me. |
| SS | We have the same understanding as LG and thus prefer option 1. |
| Qualcomm | We can go with either Option 1 or the more explicit proposal from vivo. |
| MTK | Option 1 is preferred.  We feel that somehow *dl-PRS-QCL-Info-r16* should be aligned with *ssb-PositionsInBurst-r16* |

## 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]

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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 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.

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| ===================== 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

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| **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. |
| OPPO | We fail to see the motivation and benefit for sorting the frequency layers or DL PRS resources in set according some configured priority. That shall be left for UE implementation.  Actually, we can see foresee some problem if the DL PRS resources in a set are sorted according to some priority. In FR2 system, multiple DL PRS resources in a set are used to support beam sweeping operation. Different UEs would have different ‘best’ beam direction. System configuring some DL PRS, i.e., some Tx beam directions with high priority but other DL PRS with low priority would cause wrong UE behavior. Does the UE have to first use the DL PRS resource configured with higher priority even though that DL PRS resource’s Tx beam does not align with the UE? |
| CATT | We assume it would be better for LMF to sort the priority of the frequency layers according to its own knowledge. The order from LMF is simply an suggestion to the UE. It is then up to the UE to decide whether to follow the priority order for the processing the DL PRS, similar to RSTD reference information from LMF to the UE. |
| ZTE | 1. We think the defined prioritization is only applicable to broadcast PRS, since network can ensure PRS configuration is within UE’s capability when the assistance is provided in a UE specific manner. 2. Remove the prioritization for frequency layers. LMF may not have prior information of best frequency layer for UE to receive. 3. Remove the prioritization for resources within a set. The case that PRS configuration is beyond UE’s capability will normally happen in broadcast PRS, so it’s hard to say which resource should be prioritized since the PRS is cell-specific configured. |
| CMCC | For the FFS on the 4 frequency layers, we prefer NO prioritization in processing order. When multiple frequency layers are configured to a UE, it can up to its own implementation to select a particular frequency layer that fits its active DL BWP operation.  For the FFS on the 64 resources, we prefer to HAVE prioritization in processing order, which helps a UE with limited capability requires high positioning accuracy. |
| Qualcomm | Agree in both prioritizations: Between PFLs and resources within set.  If the PFL-based prioritization is not aggregable, at least the PRS resources within a set would be needed.  To @ZTE argument: Even in cell specific PRS you can say which is important. Network can use hierarchical codebooks: the first few beams may be broader than the rest. If network uses equal-width beam, then it wouldn’t hurt if there is prioritization or not. |
| MTK | We support layer prioritization |

## 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.

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| ===================== 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.

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| ===================== 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.

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| **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. |
| OPPO | Ok with TP#1 with slight change:  - For Type 2,  ~~is the numerology of PRS, and~~ is the cardinality of the set .  “The u is the numerology of PRS” is already mentioned twice and thus no need to specify it again.  TP#2: agree with FL’s proposal. |
| CATT | Okay with TP#1 and the suggestion from Nokia.  For TP#2, it may be better to let RAN2 to handle |
| ZTE | 1. Agree with OPPO and Nokia on TP#1. 2. Agree with feature lead response. |
| LG | OK with TP#1 with small change suggested from Nokia and OPPO  For TP#2, we agree with FL’s suggestion |
| SS | TP#1 is OK.  TP#2 should follow FL’s suggestion. |
| Qualcomm | OK with TP#1. Leave TP#2 to Ran2 |
| Huawei/HiSilicon2 | Updated TP#1, by taking comments from Nokia into consideration.  Regarding the comments by Oppo, I guess the sentence is for the purpose of explaining mu, and we suggest to keep it.  Reason of change:  The current PRS duration calculation uses slots and OFDM symbols without specifying the corresponding subcarrier spacing.  ===================== 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 the DL 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 the DL 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 the DL PRS, and is the cardinality of the set .  ===================== Unchanged parts omitted ====================== |
| MTK | We are okay for FL’s response |

## 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

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| *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?

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| **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. |
| OPPO | For B) It seems more reasonable for RAN2 to decide how to capture it. |
| CATT | For B), for the proposed TP from Huawei and vivo, wording “The timing of each additional path is reported relative to the TOA values represented by *nr-RSTD-r16* or nr-UE-RxTxTimeDiff-r16”, although we understand the intention to use the “TOA values”, *nr-RSTD-r16* or *nr-UE-RxTxTimeDiff-r16* do not represent TOA values.  Maybe we can re-use the wording in 37.355 to say: “The timing of each additional path is reported relative to the  *path timing used for determining* *nr-RSTD-r16* or nr*-UE-RxTxTimeDiff-r16*”.  ***nr-AdditionalPathList (37.355)***  This field specifies one or more additional detected path timing values for the TRP or resource, *relative to the path timing used for determining the nr-RSTD value.* |
| vivo2 | Response to OPPO’s comments.  RAN2 already specified additional path report. The discussed proposal here is to capture relevant text for 38.214. |
| Huawei/HiSilicon | In response to vivo1, our understanding is that there is no such explicit indication of requesting quality metrics, and thus it is not accurate to say “UE is configured to report”. We know that there is precedence in the spec saying the following, but at least for the newly added text, we should avoid using inaccurate terms.  The UE may be configured to report quality metrics corresponding to the DL RSTD and UE Rx-Tx time difference measurements which include the following fields:  *- timingMeasQualityValue-r16* which provides the best estimate of the uncertainty of the measurement  *- timingMeasQualityResolution-r16* which specifies the resolution levels used in the *timingMeasQualityValue-r16* field.  The quality part is already covered by the highlighted text in the TP  In response to CATT, we support the change.  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 path timing used for determining *nr-RSTD-r16* or *nr-UE-RxTxTimeDiff-r16*. |
| vivo3 | In response to Huawei’s above comment.  We’d like to refer to 37.355 and copied the relevant specification below. The quality report is for each additional path, not for DL-RSTD and UE RTT. *– NR-AdditionalPathList* The IE *NR-AdditionalPathList* is used by the target device to provide information about additional paths in association to the TOA measurements associated to NR positioning in the form of a relative time difference and a quality value. The additional path *nr-relativeTimeDifference* is the detected path timing relative to the detected path timing used for the TOA value, and each additional path can be associated with a quality value *nr-path-Quality.*  -- ASN1START  NR-AdditionalPathList-r16 ::= SEQUENCE (SIZE(1..2)) OF NR-AdditionalPath-r16  NR-AdditionalPath-r16 ::= SEQUENCE {  nr-relativeTimeDifference-r16 CHOICE {  k0-r16 INTEGER(0..16351),  k1-r16 INTEGER(0..8176),  k2-r16 INTEGER(0..4088),  k3-r16 INTEGER(0..2044),  k4-r16 INTEGER(0..1022),  k5-r16 INTEGER(0..511),  ...  },  nr-path-Quality-r16 NR-TimingQuality-r16 OPTIONAL,  ...  }  -- ASN1STOP   | *NR-AdditionalPathList*field descriptions | | --- | | ***nr-relativeTimeDifference***  This field specifies the additional detected path timing relative to the detected path timing of the reference resource. A positive value indicates that the particular path is later in time than the detected path of the reference; a negative value indicates that the particular path is earlier in time than the detected path of the reference. | | ***nr-path-Quality***  This field specifies the target device′s best estimate of the quality of the detected timing of the additional path. | |
| ZTE | For A) we agree with Huawei that this should be discussed in 7.2.11.  For B) Prefer Huawei’s version. |
| Huawei/HiSilicon3 | Reply to vivo3:  We are not saying the quality is for RSTD or UE Rx – Tx time difference. In the proposed TP, the quality is for each of the two additional path (TOA), where the two additional path should be associated with an RSTD or an Rx-Tx time difference (the primary path used for determining the RSTD and Rx-Tx time difference). We use the figure in our RAN2 paper to show the relation. Hopefully the following change is acceptable  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 that are associated with each RSTD or UE Rx – Tx time difference. The timing of each additional path is reported relative to the path timing used for determining *nr-RSTD-r16* or *nr-UE-RxTxTimeDiff-r16*. |
| vivo4 | Thanks Huawei’s further clarification and explanation. We’re okay with the changes in Huawei/HiSilicon3. |
| LG | For A), this should be discussed in UE capability discussion  For B), Support the last revision of the TP from Huawei. |
| Qualcomm | OK with latest revision from Huawei |
| MTK | Yes, RAN2 already discuss and we can just follow HW3 |

## 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. |
| OPPO | Not support.  Simultaneous Tx from multi-panel UE is not supported in rel16. This motivation of this TP introduces new function, which we should not do at the late stage of maintenance. |
| vivo2 | Response to OPPO’s comment.  Recall in the last RAN1 meeting, the following were agreed.   * For intra-band and inter-band CA operations, support the simultaneous transmission of SRS resource for positioning and SRS resource for MIMO. * For intra-band and inter-band CA operations, a UE can simultaneously transmit more than one SRS resource configured by SRS-PosResource-r16 and SRS-Resource on different CCs, subject to UE’s capability     With the above agreements, I’m not sure whether “Simultaneous Tx from multi-panel UE is not supported in rel16. ” holds as claimed by OPPO.  The motivation of this TP is not to introduce new function, rather to make it more clear about what we agreed in the last meeting. |
| OPPO2 | Response to vivo2’s comment:  I think the agreement that you referred to does not align with the proposed TP.   * The proposed TP intends to ask the UE to simultaneously use two or more different spatial filter for uplink transmission on one symbol. That is not supported in rel16. In rel16 eMIMO, simultaneous uplink transmission with multiple spatial relations was discussed but no progress. There is no UE capability for supporting simultaneous multiple spatial relation in one symbol. * The agreement that you refer to only states that the UE can transmit SRS simultaneously. But the agreement does not request the UE transmit the SRS **with different spatial filters** on one symbol.   I think the “**with different spatial relations**” in the Spec text is the key here. One possible TP change is removing the “with different spatial relations”:  In the same carrier, the UE is not expected to transmit multiple SRS resources ~~with different spatial relations~~ in the same OFDM symbol. |
| vivo3 | In response to OPPO2’s comment.  About UE capability, as clearly indicated by the agreement wording from last meeting “subject to UE’s capability”, there’s a proposal/discussion in 7.2.11 to add UE capability supporting simultaneous SRS transmission (corresponding to above agreement from last meeting) in one symbol to Rel-16.  On your comment of “**with different spatial filters”,** this is exactly the reason we brought up the proposed TP trying to clarify and make it clear about what is the intention of last meeting’s agreement. If a UE can only use the same spatial filter for simultaneous SRS transmission regardless multiple carriers/panels, we have doubts on the usefulness of this simultaneous SRS for intra- and inter-band CA operation. |
| LG | Support TP.  It is clear that the simultaneous transmission of two different SRS resources is up to UE capability. If the two different Tx panels are used, same spatial relation condition might be a constraint for implementations. |
| OPPO2 | Response to vivo3:  First of all, we are not against simultaneous transmission of two different SRS.  What we concern is the proposed TP not only specify simultaneous transmission of two different SRS in CA case but also **specify the UE to use different spatial filters simultaneously on the same symbol**.  Supporting multiple different spatial filters simultaneously is not supported in rel16. That was discussed in multi-beam operation agenda in rel16 eMIMO but not conclusion. The proposed TP would introduce this new UE function and new UE feature which are not supported in rel16.  If you intend the capture the previous agreement, I suggest to add a new sentence to capture the agreement without touching that sentence. |
| Qualcomm | Not support. As pointed out by OPPO, simultaneous Tx from multi-panel UE is not supported in rel16. UE cannot transmit simultaneously from 2 panels in Rel-16. The agreements that vivo is referring to assumes same spatial Relation, and that is why the text can stay as is. |
| MTK | We are okay for vivo |

## 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. |
| OPPO | We are ok with FL’s proposal |
| CATT | For Rel-16, we assume all DL PRS measurement is done only when the measurement gap is configured. Thus, the last sentence seems not needed in Rel-16. |
| ZTE | We have agreed that “UE is not expected to process DL PRS without configuration of measurement gap in Rel-16”, so all the following paragraph is a bit redundant.  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 it may request a measurement gap in higher layer parameter *measGapConfig*.  The above paragraph can be replaced by following texts,  The UE is expected to measure the DL PRS resource only if the measurement is made during a configured measurement gap. |
| LG | We do not see strong necessity to change the current spec description. |
| SS | OK with the TP |
| Qualcomm | Ok with the TP. We prefer to keep it, it is still a valid statement. |
| MTK | We are okay with the TP and also fine with HW’s version |

## 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. |
| OPPO | Agree with FL’s response |
| CATT | Agree with FL’s response |
| ZTE | Agree with FL’s response |
| LG | Agree with FL’s response |
| SS | Agree with FL’s response |
| Qualcomm | OK |

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
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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
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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