**3GPP TSG RAN WG1 #104bis-e R1-210zzzz**

**e-Meeting, April 12th – 20th, 2021**

**Source: Moderator (Intel Corporation)**

**Title: Summary of Email Discussion [104b-e-NR-Pos-01] on NR Positioning Maintenance**

**Agenda item: 7.2.8**

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

# Introduction

In this contribution, we provide summary of the RAN WG1 e-mail discussion [104b-e-NR-Pos-01] on remaining maintenance issues for NR positioning.

Based on review of contributions [1]-[6], the following aspects were agreed for [104b-e-NR-Pos-01] discussion during preparation phase captured in R1-2103793 (Summary of Remaining Opens for Rel.16 NR Positioning Maintenance):

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| [104b-e-NR-Pos-01] Email discussion/approval on the following until Apr-16 – Alexey (Intel)   * Aspect #1: Cell determination for DL PRS reception * Aspect #2: DL PRS measurement w/ different numerology * Aspect #7: Editorial corrections (for official endorsement) |

In this contribution, we continue discussion on above aspects as part of the RAN WG1 e-mail discussion - [104b-e-NR-Pos-01].

# Remaining Opens

In this section, we summarize submitted TPs / draft CRs for identified open aspects on NR positioning maintenance based on review of contributions [1] - [6].

## Aspect #1: Cell determination for DL PRS reception procedure

In [1], it is noticed that the current DL-PRS reception procedure requires UE to be able to identify the cell from which the DL-PRS is transmitted, for the purpose of

* DL-PRS punctured by the SSB
* SRS transmission power control and spatial relation with respect to DL-PRS

However, the current specification is not clear how the cell from which the DL-PRS is transmitted is determined by the UE. The following aspects require clarification:

* Aspect #1: PRS cell ID includes PCI and CGI, and for SSB of the non-serving cell, only PCI is provided. Whether PCI ambiguity across multiple frequency layers should be considered needs clarification.
* Aspect #2: PRS cell ID is optional. UE behaviour when PRS cell ID is not provided needs clarification.

To address mentioned above aspects, it is proposed to clarify the following behaviour for determining the PRS cell:

1. The PRS is transmitted not from any cell if neither PCI nor CGI is provided; the PRS is transmitted from a serving cell if at least PCI or CGI is provided and if PCI, CGI and ARFCN associated with the PRS, if provided, is the same as the information related to a serving cell; the PRS is transmitted from a non-serving cell otherwise
2. The PRS and the SSB are transmitted from the same serving cell if the serving cell from which the PRS is transmitted is the cell that is defined by the SSB; the PRS and the SSB are transmitted from the same non-serving cell if the PCI and the band of the PRS, if provided, is the same as the PCI of the SSB; the PRS and SSB are not transmitted from the same cell otherwise

The following text proposal was provided in draft CR [1]:

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| 5.1.6.5 PRS reception procedure ========================= Unchanged parts =========================  The UE expects that it will be configured with *dl-PRS-ID* each of which is defined such that it is associated with multiple DL PRS resource sets from the same cell. The UE expects that one of these *dl-PRS-ID* along with a *nr-DL-PRS-ResourceSetID* and a *nr-DL-PRS-ResourceID-r16* can be used to uniquely identify a DL PRS resource.  The UE may be configured by the network with *nr-PhysCellID*, *nr-CellGlobalID*, and *nr-ARFCN* [17, TS 37.355] associated with a *dl-PRS-ID*.  - If neither *nr-PhysCellID* nor *nr-CellGlobalID* is provided, the UE may assume that the PRS is not associated with any cell;  - If *nr-PhysCellID* or *nr-CellGlobalID* is provided, and if *nr-PhysCellID*, *nr-CellGlobalID* and *nr-ARFCN* associated with the *dl-PRS-ID*, if provided, are the same as the physical cell ID, cell global ID, and ARFCN of a serving cell, respectively, the UE may assume that the PRS is transmitted from the serving cell;  - Otherwise, the UE may assume that the PRS is transmitted from a non-serving cell.  For the purpose of identifying whether PRS and SS/PBCH block are transmitted from the same cell  - If the UE assumes that PRS is transmitted from a serving cell, and if the serving cell is the same as the serving cell defined by the SS/PBCH block, the UE may assume that the PRS and the SS/PBCH block are trasnmitted from the same serving cell;  - If the UE assumes that PRS is transmitted from a non-serving cell of a band, and if *nr-PhysCellID* is provided, and is the same as physical cell ID of the SS/PBCH block from a non-serving cell of the same band, the UE may assume that the PRS and the SS/PBCH block are transmitted from the same non-serving cell;  - Otherwise, the UE may assume that the PRS and the SS/PBCH block are not transmitted from the same cell.  A DL PRS resource set is configured by *NR-DL-PRS-ResourceSet*, consists of one or more DL PRS resources and it is defined by: |

### Round #1

Companies are invited to provide comments on TP clarifying cell determination for DL PRS reception procedure

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| Company Name | Comments |
| vivo | [1] stated the reason to have this TP is that the current DL-PRS reception procedure requires UE to be able to identify the cell from which the DL-PRS is transmitted, for the purpose of  • DL-PRS punctured by the SSB  • SRS transmission power control and spatial relation with respect to DL-PRS  However, we think that UE need to identify which cell DL-PRS is from only for the purpose of DL-PRS punctured by the SSB, but not for the purpose of DL-PRS as the reference for SRS power control and spatial relation.  As in TS38.331  SRS-SpatialRelationInfoPos-r16 ::= CHOICE {  servingRS-r16 SEQUENCE {  servingCellId ServCellIndex OPTIONAL, -- Need S  referenceSignal-r16 CHOICE {  ssb-IndexServing-r16 SSB-Index,  csi-RS-IndexServing-r16 NZP-CSI-RS-ResourceId,  srs-SpatialRelation-r16 SEQUENCE {  resourceSelection-r16 CHOICE {  srs-ResourceId-r16 SRS-ResourceId,  srs-PosResourceId-r16 SRS-PosResourceId-r16  },  uplinkBWP-r16 BWP-Id  }  }  },  ssb-Ncell-r16 SSB-InfoNcell-r16,  dl-PRS-r16 DL-PRS-Info-r16  }  pathlossReferenceRS-Pos-r16 CHOICE {  ssb-IndexServing-r16 SSB-Index,  ssb-Ncell-r16 SSB-InfoNcell-r16,  dl-PRS-r16 DL-PRS-Info-r16  }  DL-PRS-Info-r16 ::= SEQUENCE {  dl-PRS-ID-r16 INTEGER (0..255),  dl-PRS-ResourceSetId-r16 INTEGER (0..7),  dl-PRS-ResourceId-r16 INTEGER (0..63) OPTIONAL -- Need S  }  Once TRP ID is known, no need for UE to determine the cell of which DL-PRS is from for the purpose of SRS pathloss reference and power control.  So we suggested the following revised wording.  For the purpose of identifying whether PRS and SS/PBCH block are transmitted from the same cell  - If *nr-PhysCellID* or *nr-CellGlobalID* is provided, and if *nr-PhysCellID*, *nr-CellGlobalID* and *nr-ARFCN* associated with the *dl-PRS-ID*, if provided, are the same as the physical cell ID, cell global ID, and ARFCN of a serving cell, respectively, the UE may assume that the PRS is transmitted from the serving cell. If the serving cell is the same as the serving cell defined by the SS/PBCH block, the UE may assume that the PRS and the SS/PBCH block are transmitted from the same serving cell;  - Otherwise, the UE may assume that the PRS is transmitted from a non-serving cell of a band. If *nr-PhysCellID* is provided, and is the same as physical cell ID of the SS/PBCH block from a non-serving cell of the same band, the UE may assume that the PRS and the SS/PBCH block are transmitted from the same non-serving cell. |
| ZTE | We prefer vivo’s revision. UE doesn’t need to identify by itself whether DL PRS is from serving cell or non-serving cell, because it’s configured by network. |
| OPPO | vivo’s vision seems better. |
| Huawei/HiSilicon | Reply to vivo/ZTE/OPPO:  We have the following UE features that have serving/non-serving cell differentiation with respect to PRS.   | ***olpc-SRS-Pos-r16***  Indicates whether the UE supports OLPC for SRS for positioning. The capability signalling comprises the following parameters.  - *olpc-SRS-PosBasedOnPRS-Serving-r16* indicates whether the UE supports OLPC for SRS for positioning based on PRS from the serving cell in the same band. The UE can include this field only if the UE supports *NR-DL-PRS-ProcessingCapability-r16* defined in TS 37.355 [22], and *srs-PosResources-r16*. Otherwise, the UE does not include this field;  …  - *olpc-SRS-PosBasedOnPRS-Neigh-r16* indicates whether the UE supports OLPC for SRS for positioning based on PRS from the neighbouring cell in the same band. The UE can include this field only if the UE supports *olpc-SRS-PosBasedOnPRS-Serving-r16*. Otherwise, the UE does not include this field;  … | Band | | --- | --- | | ***spatialRelationsSRS-Pos-r16***  Indicates whether the UE supports spatial relations for SRS for positioning. It is only applicable for FR2. The capability signalling comprises the following parameters.  …  …  - *spatialRelation-SRS-PosBasedOnPRS-Serving-r16* indicates whether the UE supports spatial relation for SRS for positioning based on PRS from the serving cell in the same band. The UE can include this field only if the UE supports any of DL PRS Resources for DL AoD, DL PRS Resources for DL-TDOA or DL PRS Resources for Multi-RTT defined in TS37.355 [22], or *srs-PosResources-r16*. Otherwise, the UE does not include this field;  …  …  - *spatialRelation-SRS-PosBasedOnPRS-Neigh-r16* indicates whether the UE supports spatial relation for SRS for positioning based on PRS from the neighbouring cell in the same band. The UE can include this field only if the UE supports *spatialRelation-SRS-PosBasedOnPRS-Serving-r16*. Otherwise, the UE does not include this field; | Band | | |
| Apple | Question for clarification: If neither *nr-PhysCellID* nor *nr-CellGlobalID* is provided, the UE may assume that the PRS is not associated with any cell; that means UE is not expected to receive PRS? Also, the above sub-bullet seems to be out of the main bullet (The UE may be configured by the network…) |
| CATT | We slightly prefer HW’s original TP.  About vivo’s revised TP, according to HW’s reply above, since there are UE features that have serving/non-serving cell differentiation for DL-PRS, therefore, UE need to identify the cell from which the DL-PRS is transmitted (serving cell or non-serving cell). |
| Ericsson | Support |
| Qualcomm | Thanks for the CR. A few suggestions:   * We don’t see the need to clarify that PRS-only transmission points (or as it is called in the above text as “no cell”). For the purpose of PRS/SSb collision of the OLPC and Spatial, there are just two entities: serving and non-serving. What ever is not serving, should be classified as non-serving.   + **Proposal 1:** Remove this sentence: If neither *nr-PhysCellID* nor *nr-CellGlobalID* is provided, the UE may assume that the PRS is not associated with any cell; * In the 2nd subbullet:   If *nr-PhysCellID* or *nr-CellGlobalID* is provided, and if *nr-PhysCellID*, *nr-CellGlobalID* and *nr-ARFCN* associated with the *dl-PRS-ID*, if provided, are the same as the physical cell ID, cell global ID, and ARFCN of a serving cell, respectively  It appears as if CGI is mandatory for a UE to be able to determine that the PRS comes from a serving cell, and we assume that this is not the intention. Our functional understanding is that the UE can use the (PCI, ARFCN) OR the CGI in addition, to determine whether the PRS is coming from the cell. So we suggest the following for the 2nd subbulet:  ***Proposal 2:*** *If nr-PhysCellID and nr-ARFCN is provided, or if nr-CellGlobalID is also provided, for the dl-PRS-ID, and are the same as the corresponding information of a serving cell, the UE may assume that the PRS is transmitted from the serving cell;*   * *In the 4th subbulet, in this sentence:* as the serving cell defined by the SS/PBCH block   Is the intention to only consider Cell Defining SSBs (CD-SSB)? To be more specific, imagine a serving cell with 2 sync rasters, that includes one CD-SSB and a non cell defining SSB. Does this sentence mean that the UE will not assume there is conflict between the non-cell-defining SSBs of the serving cell? The intention of the previous agreement was that all SSBs have priority over PRS when there is a Time/frequency collision.  **Question 1:** Or is the word “defined by”, could be a bit more generic like “associated with”?   * In the 5th subbulet, it is unclear why the word “of a band” is suggested, rather than talk about “ARFCN”. In high-layer, the UE gets for each SSB the PCI and ARFCN value, and it should just compare them with the corresponding values of the PRS. We make the following proposal for the 5th subbulet:   **Proposal 3:** If the UE assumes that PRS is transmitted from a non-serving cell, and if nr-PhysCellID and ARFCN are provided, and are the same as the corresponding information of the SS/PBCH block, the UE may assume that the PRS and the SS/PBCH block are transmitted from the same non-serving cell; |
| vivo2 | Response to Huawei’s comment.  The logic from Huawei seems implying the UE feature/capability where UE supports OLPC and/or spatial relation for SRS for positioning based on PRS from the serving or neighbouring cell in the same band means UE need to identify serving/non-serving cell of DL-PRS during DL-PRS reception and SRS for positioning transmission procedure.  However, that’s not our understanding. As we commented before, UE only need to follow dl-PRS-r16 as in the assistance data without differentiate serving/non-serving cell for DL-PRS as reference of OLPC/spatial relation for SRS for positioning.  If the understanding of Huawei is that serving/non-serving cell differentiation for DL-PRS is a prerequisite for UE feature/capability reporting of olpc-SRS-Pos-r16 and/or spatialRelationsSRS-Pos-r16, we think that’d have been better discussed during UE feature e..g, whether to introduce any separate capability. To us, having the first paragraph as in the proposed TP may mislead that UE always performs DL-PRS serving/non-serving cell differentiation in DL-PRS reception procedure. |

## Aspect #2: DL PRS measurement w/ different numerology

In [2], it is noticed that only during measurement gap, the UE can measure DL-PRS outside the active DL BWP or a DL PRS with a numerology different from the one of the active DL BWP. It is a common understanding that the UE can request MG if the UE is expected to measure DL-PRS with different SCS. But the current specification 38.214 does not clarify that a UE can request measurement gap when the UE is expected to measure DL-PRS with different numerology.

To address discussed above point, the following text proposal is provided in [2].

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| 5.1.6.5 PRS reception procedure  <Unchanged parts are omitted>  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 via higher layer parameter *NR-PRS-MeasurementInfoList* [12, TS 38.331].  <Unchanged parts are omitted> |

### Round #1

Companies are invited to provide comments on TP clarifying UE behavior for the case when DL PRS numerology is different from the numerology of the active DL BWP

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| Company Name | Comments |
| Huawei/HiSilicon | We prefer the following change to align with TS 38.305:  When the UE is expected to measure the DL PRS resource while measurement gaps are either not configured or not sufficient, it may request a measurement gap via higher layer parameter *NR-PRS-MeasurementInfoList* [12, TS 38.331]. |
| Nokia/NSB | We don’t support the change and don’t feel this issue should have even been treated. We would have expressed concerns given time (not in the original FL proposal aspects) for inclusion of this topic which has been proposed at multiple meetings. No change is needed. |
| vivo | No need. |
| ZTE | Our first preference is the change is not needed. If other companies think it might be good to clarify this, we can accept it. |
| OPPO | From our perspective, we need make a conclusion on the following questions to align the understanding:  Question: Can UE request measurement gap if the UE is requested to measured PRS with different numerology?  Because from the current specification, it is ambiguous. |
| Apple | Not needed, and somehow problematic as in our understanding UE is not expected to perform PRS measurements out of the MG, even if DL PRS resource has the same numerology as current active DL BWP. |
| CATT | We don't think the TP is particularly necessary, but if majority companies think this issue should be solved, we can also accept it, but with the modifications marked with YELLOW background as follows,   |  | | --- | | 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 outside the measurement gap, it may request a measurement gap via higher layer parameter *NR-PRS-MeasurementInfoList* [12, TS 38.331]. | |
| Ericsson | We don’t see the update as critical. Additionally, we agree with Apple that all measurements in release 16 are performed within a MG. |

Based on discussion, one company proposed modification to the proposal and 6 companies expressed views that the change is either not needed/critical/necessary. It seems there is no consensus to adopt TP.

### Round #2

Proposed conclusion:

* No consensus to adopt TP.

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## Aspect #7: Editorial Corrections

In this section, we capture TPs with the proposed editorial changes provided in [5] and [6] respectively.

**Text proposal A:**

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| TS38.214-g50  5.1.6.5 PRS reception procedure  < Unchanged parts are omitted >  A DL PRS resource is defined by:  *- nr-DL-PRS-ResourceID* determines the DL PRS resource configuration identity. All DL PRS resource IDs are locally defined within a DL PRS resource set.  *- dl-PRS-SequenceID* is used to initialize cinit value used in pseudo random generator as described in Clause 7.4.1.7.2 of [4, TS 38.211] for generation of DL PRS sequence for a given DL PRS resource.  …  If the UE is configured with *DL-PRS-QCL-Info* and the QCL relation is between two DL PRS resources, then the UE assumes those DL PRS resources are associated with the same *dl-PRS-ID*. If *DL-PRS-QCL-Info* is configured to the UE with *qcl-Type* set to 'type-D' with a source ~~DL-PRS-Resource~~ DL PRS resource then the *nr-DL-PRS-ResourceSetId* and the *nr-DL-PRS-ResourceId* of the source DL PRS resource are expected to be indicated to the UE.  …  < Unchanged parts are omitted > |

**Text proposal B:**

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| TS 38.214 v16.5.0  ---------- unchanged text omitted--------------- 6.2.1 UE sounding procedure ---------- unchanged text omitted---------------  The UE may be configured by the higher layer parameter *resourceMapping* in *SRS-Resource* with an SRS resource occupying  adjacent OFDM symbols within the last 6 symbols of the slot, or at any symbol location within the slot if *resourceMapping-r16* is provided subject to UE capability, where all antenna ports of the SRS resources are mapped to each symbol of the resource. When the SRS is configured with the higher layer parameter *SRS-PosResourceSet,* the UE may be configured by the higher layer parameter *resourceMapping-r16* in *SRS-PosResource* with an SRS resource occupying adjacent symbols anywhere within the slot.  ---------- unchanged text omitted--------------- |

### Round #1

Companies are invited to provide comments on corrections summarized in TP-A and TP-B above

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| Company Name | Comments |
|  | TP-A:  TP-B: |
| Huawei/HiSilicon | TP-A: Support  TP-B: Support |
| Nokia/NSB | TP-A: Okay.  TP-B: Not sure this is “editorial” as it changes the meaning of the sentence but we are okay with the TP. |
| vivo | TP-A: OK  TP-B: OK |
| ZTE | TP-A: Support  For TP-B: We prefer the following change because the higher layer parameter *resourceMapping-r16* in *SRS-PosResource* should be mandatory configured.  When the SRS is configured with the higher layer parameter *SRS-PosResourceSet,* the UE should be configured by the higher layer parameter *resourceMapping-r16* in *SRS-PosResource* with an SRS resource occupying adjacent symbols anywhere within the slot. |
| OPPO | Ok with both |
| Apple | Support both |
| CATT | TP-A: Support.  TP-B: We prefer the updated TP as follows, since the higher layer parameter *resourceMapping-r16* is mandatory in *SRS-PosResource*, as ZTE pointed out.   |  | | --- | | The UE may be configured by the higher layer parameter *resourceMapping* in *SRS-Resource* with an SRS resource occupying  adjacent OFDM symbols within the last 6 symbols of the slot, or at any symbol location within the slot if *resourceMapping-r16* is provided subject to UE capability, where all antenna ports of the SRS resources are mapped to each symbol of the resource. When the SRS is configured with the higher layer parameter *SRS-PosResourceSet,* the higher layer parameter *resourceMapping-r16* in *SRS-PosResource* indicates an SRS resource occupying adjacent symbols anywhere within the slot. | |
| Ericsson | TP-A: OK  TP-B: agree with the ZTE comment. Since it is a mandatory configuration, we propose to use “is” instead of “should be”. |

Based on discussion, it seems TP-A is agreeable. TP-B seems also agreeable with minor modification. The change from CATT seems aligned with the proposed corrections pointed out by ZTE and supported by Ericsson.

### Round #2

Proposal:

* Adopt TP-A
* Adopt TP-B with the change proposed by CATT

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| Company Name | Comments |
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# Conclusions

TBD

# References

1. [R1-2102347](file:///C:\\Users\\wanshic\\OneDrive%20-%20Qualcomm\\Documents\\Standards\\3GPP%20Standards\\Meeting%20Documents\\TSGR1_104b\\Docs\\R1-2102347.zip) Correction to the procedure to determine the cell of PRS Huawei, HiSilicon

1. [R1-2102375](file:///C:\\Users\\wanshic\\OneDrive%20-%20Qualcomm\\Documents\\Standards\\3GPP%20Standards\\Meeting%20Documents\\TSGR1_104b\\Docs\\R1-2102375.zip) Text Proposals on NR Positioning OPPO

1. [R1-2102597](file:///C:\\Users\\wanshic\\OneDrive%20-%20Qualcomm\\Documents\\Standards\\3GPP%20Standards\\Meeting%20Documents\\TSGR1_104b\\Docs\\R1-2102597.zip) Discussion and TP on remaining issues in NR positioning CATT

1. [R1-2102659](file:///C:\\Users\\wanshic\\OneDrive%20-%20Qualcomm\\Documents\\Standards\\3GPP%20Standards\\Meeting%20Documents\\TSGR1_104b\\Docs\\R1-2102659.zip) Maintenance of NR positioning support ZTE

1. [R1-2102948](file:///C:\\Users\\wanshic\\OneDrive%20-%20Qualcomm\\Documents\\Standards\\3GPP%20Standards\\Meeting%20Documents\\TSGR1_104b\\Docs\\R1-2102948.zip) Maintenance on Rel-16 NR positioning vivo
2. [R1-2103734](file:///C:/Users/wanshic/OneDrive%20-%20Qualcomm/Documents/Standards/3GPP%20Standards/Meeting%20Documents/TSGR1_104b/Docs/R1-2103734.zip) Maintenance on Rel-16 NR positioning Ericsson