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

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

**Source: Intel Corporation, CATT, Ericsson, Qualcomm**

**Title: Summary of Remaining Issues for NR Positioning**

**Agenda item: 7.2.8**

**Document for: Discussion and Decision**

1. Introduction

In this contribution, we provide overview of open aspects raised by companies in contributions [1]-[19] submitted for Rel.16 NR Positioning Maintenance AI. In addition, we provide feature lead responses and recommendations to organize three e-mail discussions and their scope.

1. List of Opens Related to DL PRS and L1 Procedures

## Aspect #1: Prioritization of Assistance Data

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**

Include this aspect into one of the e-mail discussions 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

## Aspect #2: DL PRS Processing Capability

* 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 included into the scope of one of the e-mail discussions.
2. Regarding TP#2, it is recommended to follow RAN2 preference and capture it in LPP.

## Aspect #3: Additional Path Report

* 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.

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

* 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.

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| *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.

## Aspect #5: Relocation of Frequency Layer Parameters

* A positioning frequency layer is a collection of DL PRS resource sets across one or more TRPs which have the same SCS and CP type, center frequency, point-A, comb size, bandwidth and start PRB. However, *dl-PRS-CombSizeN-r16*, *dl-PRS-ResourceBandwidth-r16*, *dl-PRS-StartPRB-r16* are put under DL PRS resource set definition.
* In [[3], ZTE], the following TP is proposed:

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| ====================TS 38.214 clause 5.1.6.5 unchanged parts omitted=======================  A positioning frequency layer consists of one or more DL PRS resource sets and it is defined by Clause 6.4.2.1 [17, TS 37.355]:  ==========================unchanged parts omitted==================================  *- dl-PRS-PointA-r16* defines the absolute frequency of the reference resource block. Its lowest subcarrier is also known as Point A. All DL PRS resources belonging to the same DL PRS resource set have common Point A and all DL PRS resources sets belonging to the same DL PRS positioning frequency layer have a common Point A.  *- dl-PRS-CombSizeN-r16* defines the comb size of a DL PRS resource where the allowable values are given in Clause 7.4.1.7.1 of [TS38.211]. All DL PRS resource sets belonging to the same positioning frequency layer have the same value of *dl-PRS-CombSizeN-r16*.  *- dl-PRS-ResourceBandwidth-r16* defines the number of resource blocks configured for DL PRS transmission. The parameter has a granularity of 4 PRBs with a minimum of 24 PRBs and a maximum of 272 PRBs. All DL PRS resources sets within a positioning frequency layer have the same value of *dl-PRS-ResourceBandwidth-r16*.  *- dl-PRS-StartPRB-r16* defines the starting PRB index of the DL PRS resource with respect to reference Point A, where reference Point A is given by the higher-layer parameter *dl-PRS-PointA-r16*. The starting PRB index has a granularity of one PRB with a minimum value of 0 and a maximum value of 2176 PRBs. All DL PRS resource sets belonging to the same positioning frequency layer have the same value of *dl-PRS-StartPRB-r16*.  ==========================unchanged parts omitted==================================  A DL PRS resource set consists of one or more DL PRS resources and it is defined by Clause 6.4.2.1 [TS 37.355]:  ==========================unchanged parts omitted==================================  *- nr-DL-PRS-SFN0-Offset-r16* defines the time offset of the SFN0 slot 0 for the transmitting cell with respect to SFN0 slot 0 of reference cell.  ==========================unchanged parts omitted================================== |

**Feature Lead Response**

Proposed revision seems to be editorial correction. Can be discussed by the group, if it is really needed.

## Aspect #6: Clarification on PRS Reception Procedure

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

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| 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.

## Aspect #7: Alignment of Parameter Names

* 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.

## Aspect #8: Side Conditions for Accurate Pathloss Measurements

* The work in [[5], CATT] suggests the following:
  + Adopt whether the side conditions for SS-RSRP (for SSB), CSI-RSRP (for CSI-RS resource) and DL PRS-RSRP (for DL-PRS resource) which had been defined or will be defined in TS 38.133 are met as the criterion of pathloss measurement failure.

**Feature Lead Response**

RAN4 clarified side conditions in reply LS to RAN1. So formally technical debate is completed. RAN1 can update specification later once RAN4 completes the work if it is necessary.

## Aspect #9: QCL Type-C for DL PRS

* SSB(s) from physical serving/neighbour cell(s) can be configured as a QCL source for both QCL type-C and type-D, while PRS resource is possible only for QCL type-D configuration but support of QCL type-C is necessary to support QCL type-D, so we have a TP for minor change [[14], LGE]

**Feature Lead Response**

The topic was discussed multiple times without outcome. It is worthwhile to check if concerns still hold but it is not considered as an essential correction at this stage.

## Aspect #10: Correction on QCL and RS Type

* The work in [[3], ZTE] proposes TP
  + Send an LS to RAN2 to clarify rs-Type-r16 is not used in RAN1, and adopt the following TP for 38.214 (please refer to [3])

**Feature Lead Response**

Nothing seems to be broken considering RAN1 specification and RAN2 signaling together. Proposal does not seem to be an essential correction at this stage.

## Aspect #11: Number of symbols in DL PRS Resource

* The following change is proposed in [[2], vivo]
  + Choose an option for the alignment of the parent IE of ‘dl-PRS-NumSymbols-r16’
    - Option 1: Modify RAN2 Parent IE of ‘dl-PRS-NumSymbols-r16’ as DL-PRS-Resource and send LS to RAN2
    - Option 2: Align the Parent IE as RAN2 and modify the RAN1 specification.

**Feature Lead Response**

Seems no action is needed. The definition of RRC parameter at DL PRS Resource Set level means same value is applicable to each DL PRS Resource of the DL PRS Resource Set.

## Aspect #12: Expected RSTD Clarification of Definition

* The following TP proposed in [[3], ZTE] to have a clear definition of expectedRSTD:

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| ======================TS 38.214 clause 5.1.6.5 unchanged parts omitted==================  The UE expects to be configured with higher layer parameter *nr-DL-PRS-expectedRSTD-r16*, which defines the time difference between the received DL subframe timing the UE is expected to receive DL PRS and the received DL subframe timing the UE is expected to receive DL PRS provided by *nr-DL-PRS-ReferenceInfo-r16*, and *DL-PRS-expectedRSTD-uncertainty-r16*, which defines a search window around the *nr-DL-PRS-expectedRSTD-r16*.  =============================unchanged parts omitted============================== |

**Feature Lead Response**

Proposed revision does not seem to be essential correction at this stage.

## Aspect #13: DL PRS Processing and Measurement Gap

* Motivated by the RAN1 agreement below

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| **Agreement:**   * UE is not expected to process DL PRS without configuration of measurement gap in Rel-16 * RAN1 assumes that no RAN4 requirements are to be defined for the case w/o configured measurement gap in Release 16 * Inform RAN4 about this agreement |

**t**he following TP for 38.214 was proposed in [[3], ZTE].

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| ===================TS 38.214 clause 5.1.6.5 unchanged parts omitted=======================  The UE is expected to measure the DL PRS resource only if the measurement is made during a configured measurement gap. When the UE is expected to measure the DL PRS resource it may request a measurement gap in higher layer parameter *measGapConfig*.  ==============================unchanged parts omitted============================== |

**Feature Lead Response**

The proposed revision seems to be inconsistent since UE can perform measurements of DL PRS in active DL BWP, but it is not standardized and there will be no requirements defined for such case. Therefore, current text seems to be correct and reflects previous agreements.

1. List of Opens Related to UL SRS for Positioning and Procedures

## Aspect #14: SRS Configuration

* Include the carrier information and active BWP information in the SRS configuration. [[8] Huawei]

**Feature Lead Response**

It seems this information is indeed missing and needs to be added. Recommended to discuss this aspect in one of the e-mail threads.

## Aspect #15: AP- SRS Support

* This aspect is raised in [[8], Huawei]. In order to support the neighbouring TRP to receive AP-SRS, a specific slot number with potential SFN should be included in the MEASUREMENT REQUEST, so that the neighbouring TRPs know in which slot to receive the AP SRS.
* It is recommend by proponent to adopt the SFN and slot number of the AP-SRS to be transmitted in NRPPa.
  + aperiodicSRS-ResourceTriggerList
  + slotOffset

**Feature Lead Response**

Given reply LS from RAN WG3, this aspect deserves more RAN WG1 discussion on AP-SRS support especially by neighbor cells. Some conclusion needs to be made in Rel.16.

## Aspect #16: MAC CE for SP/AP SRS Spatial Relation Indication

* Rel.16 MIMO agenda has introduced a new MAC CE to update the spatial relation info of SP/AP SRS. But there is no conclusion on whether the above agreement can be applicable to positioning SRS. In addition, the MAC CE defined in clause 6.1.3.26 of TS 38.321 doesn’t support to update spatial relation info of SP/AP positioning SRS.
* The following TP is proposed in [[3], ZTE] for clause 6.2.1 of the TS 38.214

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| ==========================unchanged parts omitted==================================  when a UE receives an spatial relation update command, as described in clause 6.1.3.26 of [10, TS 38.321], for an SRS resource configured by *SRS-ResourceSet*, and when the HARQ-ACK corresponding to the PDSCH carrying the update command is transmitted in slot n, the corresponding actions in [10, TS 38.321] and the UE assumptions on updating spatial relation for the SRS resource shall be applied for SRS transmission starting from the first slot that is after slot The update command contains spatial relation assumptions provided by a list of references to reference signal IDs, one per element of the updated SRS resource set. Each ID in the list refers to a reference SS/PBCH block, NZP CSI-RS resource configured on serving cell indicated by *Resource Serving Cell ID* field in the update command if present, same serving cell as the SRS resource set otherwise, or SRS resource configured on serving cell and uplink bandwidth part indicated by Resource *Serving Cell ID* field and *Resource BWP ID* field in the update command if present, same serving cell and bandwidth part as the SRS resource set otherwise. When the UE is configured with the higher layer parameter *usage* in *SRS-ResourceSet* set to 'antennaSwitching', the UE shall not expect to be configured with different spatial relations for SRS resources in the same SRS resource set.  ==========================unchanged parts omitted================================== |

* The following TP is proposed in [[7], Huawei] for clause 6.2.1 in 38.214:

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| ===================== Unchanged parts omitted =========================  For a UE configured with one or more SRS resource configuration(s), and when the higher layer parameter *resourceType* in *SRS-Resource* or *SRS-PosResource-r16* is set to 'aperiodic':  ===================== Unchanged parts omitted =========================  - when a UE receives an spatial relation update command, as described in clause 6.1.3.26 of [10, TS 38.321], for an SRS resource configured with the higher layer parameter *SRS-Resource*, and when the HARQ-ACK corresponding to the PDSCH carrying the update command is transmitted in slot n, the corresponding actions in [10, TS 38.321] and the UE assumptions on updating spatial relation for the SRS resource shall be applied for SRS transmission starting from the first slot that is after slot The update command contains spatial relation assumptions provided by a list of references to reference signal IDs, one per element of the updated SRS resource set. Each ID in the list refers to a reference SS/PBCH block, NZP CSI-RS resource configured on serving cell indicated by *Resource Serving Cell ID* field in the update command if present, same serving cell as the SRS resource set otherwise, or SRS resource configured on serving cell and uplink bandwidth part indicated by Resource *Serving Cell ID* field and *Resource BWP ID* field in the update command if present, same serving cell and bandwidth part as the SRS resource set otherwise. When the UE is configured with the higher layer parameter *usage* in *SRS-ResourceSet* set to 'antennaSwitching', the UE shall not expect to be configured with different spatial relations for SRS resources in the same SRS resource set.  ===================== Unchanged parts omitted ========================= |

**Feature Lead Response**

It seems some RAN WG1 discussion/decision is needed to implement this change.

## Aspect #17: UE Sounding Procedure - Alignment of Parameter Names

[[5], CATT]

* The TP below aims to align parameter names with RAN2 WG. Another issue in the above descriptions in section 6.2.1 is the ambiguity on the applicability of the higher layer parameter *cyclicShift-n8-r16* and *combOffset-n8-r16*. For the higher layer parameter *cyclicShift-n8-r16*, in fact, only two higher layer parameters *cyclicShift-n2* and *cyclicShift-n4* are applicable for the configuration of the cyclic shiftsof *SRS-MIMO.* The higher layer parameter *cyclicShift-n8-r16* is only applicable for SRS-Pos but not applicable for SRS-MIMO. However, the descriptions in the current section 6.2.1 in 38.214 mix these parameters together, which maybe cause some ambiguity on the applicability of the higher layer parameter *cyclicShift-n8-r16*. For the higher layer parameter *combOffset-n8-r16*, there is the similar issue.

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| *------------------------------------------Start of Text Proposal for 38.214--------------------------------------------------*  6.2.1 UE sounding procedure  *--------------------------------------------* Unchanged part omitted *--------------------------------------------------------*  The following SRS parameters are semi-statically configurable by higher layer parameter *SRS-Resource* or *SRS-PosResource-r16*.  - *srs-ResourceId* or *SRS-PosResourceId-r16* determines SRS resource configuration identity.  - Number of SRS ports as defined by the higher layer parameter *nrofSRS-Ports* and described in Clause 6.4.1.4 of [4, TS 38.211]. If not configured, *nrofSRS-Ports* is 1.  *-* Time domain behaviour of SRS resource configuration as indicated by the higher layer parameter *resourceType* or *resourceType-r16*, which may be periodic, semi-persistent, aperiodic SRS transmission as defined in Clause 6.4.1.4 of [4, TS 38.211].  - Slot level periodicity and slot level offset as defined by the higher layer parameters *periodicityAndOffset-p* or *periodicityAndOffset-sp* for an SRS resource of type periodic or semi-persistent, which configured by *SRS-Resource*, and *periodicityAndOffset-p*-*r16* or *periodicityAndOffset-sp-r16* for an SRS resource of type periodic or semi-persistent, which configured by *SRS-PosResource-r16*. The UE is not expected to be configured with SRS resources in the same SRS resource set *SRS-ResourceSet* or *SRS-PosResourceSet-r16* with different slot level periodicities. For an *SRS-ResourceSet* configured with higher layer parameter *resourceType* set to 'aperiodic', a slot level offset is defined by the higher layer parameter *slotOffset.* For an *SRS-PosResourceSet-r16* configured with higher layer parameter r*esourceType-r16* set to 'aperiodic', the slot level offset is defined by the higher layer parameter *slotOffset-r16* for each SRS resource.  - Number of OFDM symbols in the SRS resource, starting OFDM symbol of the SRS resource within a slot including repetition factor R as defined by the higher layer parameter *resourceMapping* or *resourceMapping*-*r16* and described in Clause 6.4.1.4 of [4, TS 38.211]. If *R* is not configured, then *R* is equal to the number of OFDM symbols in the SRS resource.  - SRS bandwidth and , as defined by the higher layer parameter *freqHopping* or *freqHopping*-*r16* and described in Clause 6.4.1.4 of [4, TS 38.211]. If not configured, then= 0.  - Frequency hopping bandwidth, , as defined by the higher layer parameter *freqHopping* or *freqHopping*-*r16* and described in Clause 6.4.1.4 of [4, TS 38.211]. If not configured, then = 0.  - Defining frequency domain position and configurable shift, as defined by the higher layer parameters *freqDomainPosition* and *freqDomainShift, or freqDomainPosition*-*r16* and *freqDomainShift*-*r16 respectively,* and described in Clause 6.4.1.4 of [4, TS 38.211]. If *freqDomainPosition* or *freqDomainPosition*-*r16* is not configured, *freqDomainPosition* or *freqDomainPosition*-*r16* is zero.  - Cyclic shift, as defined by the higher layer parameter *cyclicShift-n2* or *cyclicShift-n4* for transmission comb value 2 or 4 for an SRS configured by *SRS-Resource*, respectively, and defined by the higher layer parameter *cyclicShift-n2-r16*, *cyclicShift-n4-r16, or cyclicShift-n8-r16* for transmission comb value 2, 4 or 8 for an SRS configured by *SRS-PosResource-r16*, respectively, and described in Clause 6.4.1.4 of [4, TS 38.211].  - Transmission comb value as defined by the higher layer parameter *transmissionComb* or *transmissionComb-r16* described in Clause 6.4.1.4 of [4, TS 38.211].  - Transmission comb offset as defined by the higher layer parameter *combOffset-n2* or *combOffset-n4* for transmission comb value 2 or 4 for an SRS configured by *SRS-Resource*, respectively, and defined by the higher layer parameter *combOffset-n2-r16*, *combOffset-n4-r16*, or *combOffset-n8-r16* for transmission comb value 2, 4, or 8 for an SRS configured by *SRS-PosResource-r16*, respectively, and described in Clause 6.4.1.4 of [4, TS 38.211].  - SRS sequence ID as defined by the higher layer parameter *sequenceId* or *sequenceId-r16* in Clause 6.4.1.4 of [4].  - The configuration of the spatial relation between a reference RS and the target SRS, where the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos-r16*, if configured, contains the ID of the reference RS. The reference RS may be an SS/PBCH block, CSI-RS configured on serving cell indicated by higher layer parameter *servingCellId* if present, same serving cell as the target SRS otherwise, or an SRS configured on uplink BWP indicated by the higher layer parameter *uplinkBWP* or *uplinkBWP-r16* , and serving cell indicated by the higher layer parameter *servingCellId* if present, same serving cell as the target SRS otherwise. When an SRS is configured by the higher layer parameter *SRS-PosResourceSet-r16*, the reference RS may also be a DL PRS configured on a serving cell, an SS/PBCH block or a DL PRS of a non-serving cell indicated by a higher layer parameter.  *-------------------------------------------*Unchanged part omitted *---------------------------------------------------------*  *---------------------------------------------End of Text Proposal ----------------------------------------------------------* |

* In [[9], OPPO], it is proposed to align parameter names for UE sounding procedure Section 6.2.1 of TS 38.214
  + The following TP below is proposed:

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| --- |
| 6.2.1 UE sounding procedure \*\*\* Unchanged text is omitted \*\*\*  The following SRS parameters are semi-statically configurable by higher layer parameter *SRS-Resource* or *SRS-PosResource-r16*.  - *srs-ResourceId* or *srs-PosResourceId-r16* determines SRS resource configuration identity.  - Number of SRS ports as defined by the higher layer parameter *nrofSRS-Ports* and described in Clause 6.4.1.4 of [4, TS 38.211]. If not configured, *nrofSRS-Ports* is 1.  *-* Time domain behaviour of SRS resource configuration as indicated by the higher layer parameter *resourceType*, which may be periodic, semi-persistent, aperiodic SRS transmission as defined in Clause 6.4.1.4 of [4, TS 38.211].  - Slot level periodicity and slot level offset as defined by the higher layer parameters *periodicityAndOffset-p* or *periodicityAndOffset-sp* for an SRS resource of type periodic or semi-persistent. The UE is not expected to be configured with SRS resources in the same SRS resource set *SRS-ResourceSet* or *SRS-PosResourceSet-r16* with different slot level periodicities. For an *SRS-ResourceSet* configured with higher layer parameter *resourceType* set to 'aperiodic', a slot level offset is defined by the higher layer parameter *slotOffset.* For an *SRS-PosResourceSet-r16* with higher layer parameter r*esourceType-r16* set to 'aperiodic-r16', the slot level offset is defined by the higher layer parameter *slotOffset-r16* for each SRS resource.  - Number of OFDM symbols in the SRS resource, starting OFDM symbol of the SRS resource within a slot including repetition factor R as defined by the higher layer parameter *resourceMapping* and described in Clause 6.4.1.4 of [4, TS 38.211]. If *R* is not configured, then *R* is equal to the number of OFDM symbols in the SRS resource.  - SRS bandwidth and , as defined by the higher layer parameter *freqHopping* and described in Clause 6.4.1.4 of [4, TS 38.211]. If not configured, then= 0.  - Frequency hopping bandwidth, , as defined by the higher layer parameter *freqHopping* and described in Clause 6.4.1.4 of [4, TS 38.211]. If not configured, then = 0.  - Defining frequency domain position and configurable shift, as defined by the higher layer parameters *freqDomainPosition* and *freqDomainShift, respectively,* and described in Clause 6.4.1.4 of [4, TS 38.211]. If *freqDomainPosition* is not configured, *freqDomainPosition* is zero.  - Cyclic shift, as defined by the higher layer parameter *cyclicShift-n2*, *cyclicShift-n4, or cyclicShift-n8* for transmission comb value 2, 4 and 8, respectively, and described in Clause 6.4.1.4 of [4, TS 38.211].  - Transmission comb value as defined by the higher layer parameter *transmissionComb* or *transmissionComb-r16* described in Clause 6.4.1.4 of [4, TS 38.211].  - Transmission comb offset as defined by the higher layer parameter *combOffset-n2*, *combOffset-n4*, or *combOffset-n8* for transmission comb value 2, 4, or 8 respectively, and described in Clause 6.4.1.4 of [4, TS 38.211].  - SRS sequence ID as defined by the higher layer parameter *sequenceId* or *sequenceId* -r16 in Clause 6.4.1.4 of [4].  - The configuration of the spatial relation between a reference RS and the target SRS, where the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos-r16*, if configured, contains the ID of the reference RS. The reference RS may be an SS/PBCH block, CSI-RS configured on serving cell indicated by higher layer parameter *servingCellId* if present, same serving cell as the target SRS otherwise, or an SRS configured on uplink BWP indicated by the higher layer parameter *uplinkBWP*, and serving cell indicated by the higher layer parameter *servingCellId* if present, same serving cell as the target SRS otherwise. When SRS is configured by the higher layer parameter *SRS-PosResourceSet-r16* the reference RS may also be a DL PRS configured on a serving cell, an SS/PBCH block or a DL PRS of a non-serving cell indicated by a higher layer parameter.  \*\*\* Unchanged text is omitted \*\*\*  - if the UE is configured with the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos-r16* containing the ID of a reference 'ssb-Index', 'ssb-IndexServing-r16', or 'ssb-IndexNcell-r16' the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference SS/PBCH block, if the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos-r16* contains the ID of a reference 'csi-RS-Index' or 'csi-RS-IndexServing-r16', the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference periodic CSI-RS or of the reference semi-persistent CSI-RS, if the higher layer parameter *spatialRelationInfo* or *spatialRelationInfoPos-r16* contains the ID of a reference 'srs' or 'srs-SpatialRelation-r16', the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the transmission of the reference periodic SRS or of the reference semi-persistent SRS. When the SRS is configured by the higher layer parameter *SRS-PosResourceSet-r16* and if the higher layer parameter *spatialRelationInfoPos-r16* contains the ID of a reference 'dl-PRS-ResourceId-r16', the UE shall transmit the target SRS resource with the same spatial domain transmission filter used for the reception of the reference DL PRS.  \*\*\* Unchanged text is omitted \*\*\* |

**Feature Lead Response**

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

## Aspect #18: Prioritization for Transmission Power Reduction

* The following TP [[13], LGE] is proposed for section 7.5 Prioritizations for transmission power reductions`

|  |
| --- |
| *---- Unchanged parts omitted ----*  The total UE transmit power in a symbol of a slot is defined as the sum of the linear values of UE transmit powers for PUSCH, PUCCH, PRACH, and SRS in the symbol of the slot.  *---- Unchanged parts omitted ----*  - SRS transmission, with aperiodic SRS having higher priority than semi-persistent and/or periodic SRS, or PRACH transmission on a serving cell other than the PCell  - SRS transmission, with SRS resource configured by *SRS-Resource* having higher priority than SRS resource configured by *SRS-PosResource-r16*  *---- Unchanged parts omitted ----* |

**Feature Lead Response**

Seems RAN WG1 discussion is needed to conclude on prioritizations for transmission power reductions for SRS for positioning.

## Aspect #19: Fall-back Spatial Relation Information

* TP on Section 6.2.1.4 of TS 38.214. [[14], LGE].
  + “If the UE determines that the UE is not able to accurately measure a DL PRS or a SS/PBCH block configured on a non-serving cell, configured as a source of spatial relation information spatialRelationInfoPos*-r16* of a SRS resource configured by *SRS-PosResource-r16*, the UE can use the physical cell ID corresponding to the non-serving cell to determine a spatial domain transmission filter for transmission of the SRS resource.”

**Feature Lead Response**

This aspect was discussed last time w/o conclusion. There are no additional supporters this time and thus it seems to be the case that there is no consensus to define it at least in Rel.16.

## Aspect #20: R15 SRS Support

* Whether to support MIMO SRS for positioning? Two alternatives are proposed in [Huawei, [8]]
  + Alt. 1 Agree in RAN1 that MIMO SRS can also be used for UE/gNB Rx – Tx time difference measurement.
  + Alt. 2 Send an LS to RAN3 to inform that whether positioning SRS is desired by the LMF should be included in the NRPPa message POSITIONING INFORMATION REQUEST.

**Feature Lead Response**

The aspect whether to support MIMO SRS for positioning was discussed during WI phase with no consensus in a group. It does not seem to be a proper item for maintenance phase.

## Aspect #21: Power Split Across Antenna Ports

* In [[5], CATT], it is proposed to adopt the following text proposal (TP-C) for linear value of SRS Power split by UE in section 7.3 of 38.213:

|  |
| --- |
| *-----------------------------------------------Start of Text Proposal for 38.213----------------------------------------------*  **7.3 Sounding reference signals**  For SRS configured by the higher parameter *SRS-Resource*,a UE splits a linear value  of the transmit power  on active UL BWP  of carrier  of serving cell  equally across the configured antenna ports for SRS.  *-----------------------------------------------------* Unchanged part omitted *------------------------------------------------ --------------------------------------------------------End of Text Proposal --------------------------------------------------* |

**Feature Lead Response**

Considering single antenna port for SRS for positioning it seems there is no issue with current specification text even w/o correction. It does not seem to be urgent/essential to address.

## Aspect #22: Priority of SRS for Positioning

* In [[5]], CATT] it is proposed to have higher priority for Aperiodic SRS-Pos than for PUSCH. In particular, the following proposals were made:
  + Aperiodic SRS-Pos should have a higher transmission priority than PUSCH, and PUSCH should be dropped in the overlapped symbols when colliding with aperiodic SRS-Pos.
  + Adopt the following text proposal (TP-D) for collision handling between SRS-Pos and PUSCH in section 6.2.1 of 38.214:

|  |
| --- |
| *---------------------------------------------Start of Text Proposal for 38.211--------------------------------------------*  **6.2.1 UE sounding procedure**  *-----------------------------------------------* Unchanged part omitted *---------------------------------------------------*  For PUCCH and SRS on the same carrier, a UE shall not transmit SRS when semi-persistent and periodic SRS are configured in the same symbol(s) with PUCCH carrying only CSI report(s), or only L1-RSRP report(s), or only L1-SINR report(s). A UE shall not transmit SRS when semi-persistent or periodic SRS is configured or aperiodic SRS is triggered to be transmitted in the same symbol(s) with PUCCH carrying HARQ-ACK, link recovery request (as defined in clause 9.2.4 of [6, 38.213]) and/or SR. In the case that SRS is not transmitted due to overlap with PUCCH, only the SRS symbol(s) that overlap with PUCCH symbol(s) are dropped. PUCCH shall not be transmitted when aperiodic SRS is triggered to be transmitted to overlap in the same symbol with PUCCH carrying semi-persistent/periodic CSI report(s) or semi-persistent/periodic L1-RSRP report(s) only, or only L1-SINR report(s).  For PUSCH and SRS on the same carrier, PUSCH shall not be transmitted when aperiodic SRS configured by the higher layer parameter *srs-PosResource-r16* is triggered to be transmitted to overlap in the same symbol with PUSCH.  *------------------------------------------* Unchanged part omitted *---=----------------------------------------------------*  *-------------------------------------------End of Text Proposal ------------------------------------------------------------* |

**Feature Lead Response**

Considering RAN3 reply LS on signalling for AP-SRS support, it seems this aspect may need to be reviewed again to have common understanding.

## Aspect #23: UE Sounding Procedure and Spatial Relation Info

* In [[9], OPPO], it is proposed to delete the following wording on UE spatial relation behaviour in TP for TS 38.214:
  + Motivation: wording is redundant and can be left up to UE implementation

|  |
| --- |
| 6.2.1.4 UE sounding procedure for positioning purposes When the SRS is configured by the higher layer parameter *SRS-PosResource-r16* and if the higher layer parameter *spatialRelationInfoPos-r16* is configured*,* it contains the ID of the configuration fields of a reference RS according to Clause 6.3.2 of [TS 38.331]. The reference RS can be an SRS configured by the higher layer parameter *SRS-Resource* or *SRS-PosResource-r16*, CSI-RS, SS/PBCH block, or a DL PRS configured on a serving cell or a SS/PBCH block or a DL PRS configured on a non-serving cell.  The UE is not expected to transmit multiple SRS resources with different spatial relations in the same OFDM symbol. |

**Feature Lead Response**

The proposed TP does not seem to be an essential correction

1. List of Opens Related to Measurements

## Aspect #24: Timing Quality

* In [[10], OPPO], the following change is proposed to align with RAN2 parameter name.

|  |
| --- |
| **In TS 38.214 Section 5.1.6.5**  *<omitted text>*  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~~ timingQualityValue-r16* which provides the best estimate of the uncertainty of the measurement  *- ~~timingMeasQualityResolution-r16~~ timingQualityResolution-r16* which specifies the resolution levels used in the*~~timingMeasQualityValue-r16~~ timingQualityValue-r16* field.  The UE expects to be configured with higher layer parameter *nr-DL-PRS-expectedRSTD-r16*, which defines the time difference with respect to the received DL subframe timing the UE is expected to receive DL PRS, and *DL-PRS-expectedRSTD-uncertainty-r16*, which defines a search window around the *nr-DL-PRS-expectedRSTD-r16*.  *<omitted text>* |

**Feature Lead Response**

From feature lead perspective, the change should be made by RAN2 since quality relates to measurement. It is recommended to discuss in RAN1 and decide whether to ask RAN2 to revert change or update RAN1 spec.

## Aspect #25: RTOA Definition

* The following TP was proposed for UL-RTOA definition (TS 38.215) in [Huawei, [7]]

|  |  |  |
| --- | --- | --- |
| **5.2.2 UL Relative Time of Arrival (TUL-RTOA)**   |  |  | | --- | --- | | **Definition** | The UL Relative Time of Arrival (TUL-RTOA) is the beginning of subframe *i* containing SRS received in positioning node *j*, relative to the RTOA Reference Time.  The UL RTOA reference time is defined as , where  - is the nominal beginning time of SFN 0 provided by SFN Initialization Time [15, TS 38.455]  - , where and are the system frame number and the subframe number of the SRS, respectively.  Multiple SRS resources can be used to determine the beginning of one subframe containing SRS received at a positioning node.  The reference point for TUL-RTOA shall be:  - for type 1-C base station TS 38.104 [9]: the Rx antenna connector,  - for type 1-O or 2-O base station TS 38.104 [9]: the Rx antenna (i.e. the centre location of the radiating region of the Rx antenna),  - for type 1-H base station TS 38.104 [9]: the Rx Transceiver Array Boundary connector. | |

**Feature Lead Response**

Recommend discussion in RAN1. Definitions need to be provided either in RAN1 or RAN3 specs.

## Aspect #26: UE-RX-TX Time Difference

* In [Ericsson, [19]] it is proposed for NR Rel-16, limit UE Rx – Tx time difference only to PRS and SRS in the same band.

**Feature Lead Response**

Seems some discussion is needed to reach common understanding.

## Aspect #27: Positioning Node Terminology

* RAN1 either sends an LS to RAN3 informing them of the need to define positioning node, or defines a positioning node as described above in TS 38.215. [ [15], Nokia]
* Re//place the terminology ‘Positioning Node’ in TS 38.215 by ‘Transmission Point (TP)’ or ‘Reception Point (RP)’, or ‘Transmission and Reception Point (TRP)’ where applicable. [[4], CATT]

**Feature Lead Response**

Two companies insist on the need of change, while this issue was deprioritized last time. It seems companies have common understanding on how positioning node is defined. It is worthwhile to have small discussion if email discussion budget is reasonable.

## Aspect #28: Reference Determination

* In [[10], OPPO] the following TP is provided to match the agreement below:

|  |
| --- |
| Agreement:  The UE may use different DL PRS Resource ID(s) (with the condition that the multiple DL PRS Resource IDs belong to a single DL PRS Resource set) or a different DL PRS Resource set for determining the reference for the RSTD measurement, and if it chooses to do so, it should report the DL PRS Resource ID(s) and/or the information on the DL PRS Resource set used to determine the reference |

|  |
| --- |
| **In TS 38.214 Section 5.1.6.5**  *<omitted text>*  The UE may be indicated by the network that a DL PRS resources can be used as the reference for the DL RSTD, DL PRS-RSRP, and UE Rx-Tx time difference measurements in a higher layer parameter *nr-DL-PRS-ReferenceInfo-r16*. The reference indicated by the network to the UE can also be used by the UE to determine how to apply higher layer parameters *nr-DL-PRS-expectedRSTD-r16* and *nr-DL-PRS-expectedRSTD-uncerainty-r16*. The UE expects the reference to be indicated whenever it is expected to receive the DL PRS. This reference provided by *nr-DL-PRS-ReferenceInfo-r16* may include an *dl-PRS-ID-r16*, a DL PRS resource set ID, and optionally a single DL PRS resource ID or a list of DL PRS resource IDs. The UE may use different DL PRS resources as long as the condition that the DL PRS resources used belong to a single DL PRS resource set is met or a different DL PRS resource set to determine the reference for the RSTD measurement ~~as long as the condition that the DL PRS resources used belong to a single DL PRS resource set is met~~. If the UE chooses to use a different reference than indicated by the network, then it is expected to report the *dl-PRS-ID-r16*, the DL PRS resource ID(s) or the DL PRS resource set ID used to determine the reference.  *<omitted text>* |

**Feature Lead Response**

Current text seems clear enough.

## Aspect #29: Change of Cell to dl-PRS-ID-r16

* In [[10], OPPO] it is proposed to correct TS 38.214 to change the cell to be dl-PRS-ID-r16 which represents a TRP. The following TP is provided:

|  |
| --- |
| **In TS 38.214 Section 5.1.6.5**  5.1.6.5 PRS reception procedure  *<omitted text>*  The UE may be configured to measure and report, subject to UE capability, up to 4 DL RSTD measurements per pair of ~~cells~~ *dl-PRS-ID-r16* with each measurement between a different pair of DL PRS resources or DL PRS resource sets within the DL PRS configured for those cells. The up to 4 measurements being performed on the same pair of ~~cells~~ *dl-PRS-ID-r16* and all DL RSTD measurements in the same report use a single reference timing.  The UE may be configured to measure and report, subject to UE capability, up to 8 DL PRS RSRP measurements on different DL PRS resources ~~from the same cell~~ associated with the same *dl-PRS-ID-r16*. When the UE reports DL PRS RSRP measurements from one DL PRS resource set, the UE may indicate which DL PRS RSRP measurements associated with the same higher layer parameter *nr-DL-PRS-RxBeamIndex* have been performed using the same spatial domain filter for reception if for each *nr-DL-PRS-RxBeamIndex* reported there are at least 2 DL PRS-RSRP measurements associated with it within the DL PRS resource set..  The UE may be configured to measure and report, subject to UE capability, up to 4 UE Rx-Tx time difference measurements 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.  If the UE is configured with *dl-PRS-QCL-Info-r16* and the QCL relation is between two DL PRS resources, then the UE assumes those DL PRS resources are ~~from the same cell~~ associated with the same *dl-PRS-ID-r16*. If *dl-PRS-QCL-Info-r16* is configured to the UE with 'QCL-Type-D' with a source DL-PRS-Resource then the *nr-DL-PRS-ResourceSetId-r16* and the *nr-DL-PRS-ResourceId-r16* of the source DL PRS resource are expected to be indicated to the UE.  UE is not expected to process DL PRS without configuration of measurement gap.  *<omitted text>* |

**Feature Lead Response**

Can be raised during editor revision of the spec.

1. Intermediate Conclusions

Based on review of submitted contributions and discussion among feature leads, it is recommended to organize three e-mail discussions with the following scope:

Email Discussion #1 – DL PRS and L1 Procedures

Scope: Aspect#1-#7

Led by Alexey (Intel)

Email Discussion #2 – UL SRS for positioning and L1 procedures

Scope: Aspect#14-#18, #22 (related to aspect #15)

led by Florent (Ericsson)

Email Discussion #3 – NR Positioning Measurements

Scope: Aspect#24-#27

led by Sven (Qualcomm)

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