3GPP TSG-RAN WG1 Meeting #102e draft R1-20xxxxx

e-meeting August-17th -28th 2020

Agenda Item: 7.2.8

Source: Moderator (Ericsson)

Title: Feature lead summary for maintenance of UL SRS and L1 procedures for NR positioning

Document for: Discussion

# 1 Introduction

This document is based on the feature lead summary for NR positioning maintenance AI 7.2.8[1], and tracks the progress of the discussion for aspects 14-18 and 22 as stated in the chair notes:

[102-e-NR-Pos-02] Email discussion/approval on UL SRS and L1 procedures focusing on aspects 14-18 and 22 in the FL summary until 8/21; if necessary, endorse remaining TPs by 8/27 – Florent (Ericsson)

The following aspects are treated:

* Aspect #14: SRS Configuration
* Aspect #15: AP- SRS Support
* Aspect #16: MAC CE for SP/AP SRS Spatial Relation Indication
* Aspect #17: UE Sounding Procedure - Alignment of Parameter Names
* Aspect #18: Prioritization for Transmission Power Reduction
* Aspect #22: Priority of SRS for Positioning

# 2 Discussion

## 2.1 Aspect #14: SRS Configuration

In [[9] Huawei], it is proposed to add BWP and carrier information to NRPPa. It is also proposed to reflect potential agreements in an LS to RAN3.

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| ***Proposal 2: Include the carrier information and active BWP information in the SRS configuration.**** ***Carrier information includes one or more UL carriers, each containing***
	+ ***PCI***
	+ ***SFN Initialization time***
	+ ***PointA position***
	+ ***Usable RBs for each subcarrier spacing (Resource grid)***
* ***Active BWP information, containing***
	+ ***BWP location and bandwidth***
	+ ***Subcarrier spacing***
	+ ***CP type***
	+ ***Tx DC location***
	+ ***7.5kHz shift***
 |

Feature lead proposal 1: the following information is added to the SRS configuration IEs sent by the gNB to the LMF:

Carrier information includes one or more UL carriers, each containing

- PCI

- SFN Initialization time

- PointA position

- Usable RBs for each subcarrier spacing (Resource grid)

Active BWP information, containing

- BWP location and bandwidth

- Subcarrier spacing

- CP type

- Tx DC location

- 7.5kHz shift

Companies are encouraged to provide their feedback on the feature lead proposal in the comment section below.

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| Company | Comment |
| Nokia/NSB | Shouldn’t the NRPPa information follow both RRC spec and the higher layer parameter LS that RAN1 sent to both RAN2/RAN3? Or is there additional information in the proposal that RAN3 needs to be informed of?  |

## 2.2 Aspect #15: AP- SRS Support

In [[9] Huawei], several issues pertaining to aperiodic SRS support are discussed:

Issue with triggering of aperiodic SRS, based on a DCI codepoint sent by the LMF:

 - whether the LMF can “order” the gnodeB to send the SRS triggered by the code point in the LMF message.

 - whether the gnodeB should trigger all SRS (including SRS mimo and SRS for positioning) associated with the DCI code point

Issue with the understanding of the transmission instant for neighbouring gnodeBs:

 - The serving gnodeB should send additional information regarding the delay between the DCI and the actual SRS transmission (slot offset) to the LMF for forwarding to measurement neighboring nodes.

The following is proposed:

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| ***Proposal 4: Send a reply LS to RAN3 on the problem of providing the following two parameters in NRPPa, and recommend to adopt the SFN and slot number of the AP-SRS to be transmitted instead.**** ***aperiodicSRS-ResourceTriggerList***
* ***slotOffset***
 |

Feature lead proposal 2: When using aperiodic SRS in positioning methods:

 - The LMF is informed of the aperiodic SRS configuration by:

 Option 1: the gNodeB transmitsa list of code points the LMF can choose from, and the LMF can, at the moment of transmission, request any of the code points to trigger SRS.

 Option 2: the LMF request aperiodic transmission (which may include a proposal for an appropriate code point) and the gNodeB responds by providing the code point used to the LMF. The code point may differ from the LMF recommendation

- the gNodeB should include slotOffset (including slot number and SFN) as part of the aperiodic SRS information sent to the LMF.

- Send a reply LS to RAN3 reflecting the agreement

Companies are encouraged to provide their feedback on the feature lead proposal in the comment section below.

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| Company | Comment |
| Nokia/NSB | Our understanding is that Option 2 is what was intended to be supported and that RAN3 was not deciding that LMF would have radio resource control. Positioning Activation Request should only be considered a recommendation.  |

## 2.3 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. Two companies propose to correct the issues via two similar text proposals:

* in [4] the following TP for clause 6.2.1 of the TS 38.214 specification propose to make the MAC CE update of the spatial relation only applicable to SRS resources belonging to an *SRS-ResourceSet* (i.e. a set configured for mimo)

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| **TP 2.3A**========================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 $n+3N\_{slot}^{subframe,µ}. $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============================== |

* in [8] the following TP for clause 6.2.1 of the TS 38.214 specification propose to make the MAC CE update of the spatial relation only applicable to SRS resources configured by *SRS-Resource* (i.e. a resource configured for mimo).

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| **TP 2.3B** ===================== 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 $n+3N\_{slot}^{subframe,µ}. $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 ========================= |

Companies are encouraged to provide their preference between TP2.3A, TP2.3B or other changes (if any) in the comment section below.

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| Company | Comment |
| vivo | Seems both TPs are addressing the same thing. We’re okay with the intention of either TP |

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

Two companies provided updates to the UE sounding procedure in 38.214 for the purpose of parameter alignment:

* in [[5], CATT] the TP (reproduced below as TP 2.4A) 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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| **TP 2.4A***------------------------------------------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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|  **TP 2.4B**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 \*\*\* |

Companies are encouraged to provide their preference between TP2.4A, TP2.4B or other changes (if any) in the comment section below.

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| Company | Comment |
| Nokia/NSB | Support TP2.4A. |
| vivo | support TP2.4A |

## 2.5 Aspect #18: Prioritization for Transmission Power Reduction

* In [[13], LGE] a TP (reproduced below as TP2.5A) is proposed for section 7.5 Prioritizations for transmission power reductions`

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| **TP2.5A***---- 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 ----* |

Companies are encouraged to provide their feedback on TP2.5A in the comment section below.

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| Company | Comment |
| Nokia/NSB | Support.  |
| vivo | Not support. In our opinion, the power allocation issues when SRS for positioning is transmitted simultaneously with other signal is bigger than the solution of this proposed TP. For instance, should periodic SRS (for MIMO) always take priority over aperiodic SRS for positioning? There’re many contributions for Rel-17 positioning SI discussing some priority among signals including power allocation. We think this issue in section 2.5 should be left to Rel-17 for a complete discussion.  |

## 2.6 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:

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| **TP2.6A***---------------------------------------------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 ------------------------------------------------------------* |

Companies are encouraged to provide their feedback on TP2.6A in the comment section below.

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| Company | Comment |
| Nokia/NSB | We consider this an enhancement at this stage and suggest proponents to bring it to Rel-17 for discussion.  |
| vivo | We had a similar proposal in previous RAN1 meeting. We support this in principle. However, as we mentioned in section 2.5, we think this whole priority issue should be discussed in details in Rel-17. |

# Conclusion

TBD

# References

1. R1-2006996, Feature lead summary for NR positioning maintenance AI 7.2.8, Moderator (Intel), Ericsson, CATT, Qualcomm
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