3GPP TSG-RAN WG1 Meeting #100-e draft R1-200NNNN

Online, February 24th – March 6th, 2020

Agenda Item: 7.2.8.2

Source: Moderator (Ericsson)

Title: Feature lead summary for UL Reference Signals for NR Positioning

Document for: Discussion

# 1 Introduction

This document contains the feature lead summary of critical issues related to maintenance of UL Reference Signals for NR Positioning. The purpose of the document and the accompanying email discussion thread is to support the preparation phase of the emeeting and identify the critical issues to treat in the upcoming email discussion/approval phase (4/20-4/30).

By the end of Friday 4/17, once all critical issues have been identified and the group agrees the topics to be discussed over email a revised feature lead summary will be submitted.

# 2 UL Reference Signals maintenance issues and priority

The issues discussed in the submitted contributions (listed in reference [1-11]) have been grouped in

* High priority issues (i.e. issues leading to broken specifications)
* Editorial issues (e.g. typos, parameter names that are misaligned)
* Low priority issues (non critical enhancements)

The proposed High priority issues and editorial issues are grouped as follow

Email discussion A:

1 Simultaneous SRS transmission in a single symbol

2 Number of SRS for positioning resources per slot

3 Intra-band collision between PosSRS and MimoSRS

4 Collision between PUSCH and aperiodic SRS

Email discussion B:

5 PHR for SRS positioning configuration

6 power control mechanism

email discussion C:

7 parameter level of a reference signal of spatialRelationInfo

8 MAC CE spatial relation update:

9 Spatial relationship fallback

Issues with low priority or deemed editorial will not be treated during the email discussion. The editorial issues should be discussed at the CR alignment stage. The issues that are listed in low priority may be reopen at a later WG meeting and a low priority should not be interpreted as meaning not relevant, resolved or not significant.

## 2.1 Issues with high priority

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| Issue # | Description | Tdoc | Email discussion thread |
| 1 | Simultaneous SRS transmission in a single symbol  Introduce a new UE capability for the number of SRS resources for positioning on a symbol for intra-band CA. The candidate number at least includes {1, 2}.  Endorse the following TP for clause 6.2.1.4 of TS 38.214.  ==== Unchanged parts omitted =====  For single carrier operations, the UE does not expect to be configured on overlapping symbols with more than one SRS resources configured by the higher layer parameter *SRS-PosResource* with *resourceType* of the SRS resources as ‘periodic’.  For single carrier operations, the UE does not expect to be triggered to transmit SRS on overlapping symbols with more than one SRS resources configured by the higher layer parameter *SRS-Pos-Resource* with *resourceType* of the SRS resources as ‘semi-persistent’ or ‘aperiodic’.  For intra-band CA operations, a UE can simultaneously transmit more than one SRS resources configured by *SRS-PosResource* with same *resourceType* on different CCs, subject to UE’s capability provided by [XX].  ==== Unchanged parts omitted ========== | R1-2001559 (proposal 1,2) | A |
| 2 | Number of SRS for positioning resources per slot  ***Proposal 3: Introduce a new UE capability for the number of SRS resources for positioning across all SRS resource sets per slot in a BWP.*** | R1-2001559 (proposal 3) | A |
| 3 | Intra-band collision between PosSRS and MimoSRS  ***Proposal 4: Endorse the following TP for clause 6.2.1 of TS 38.214.***  ====== Unchanged parts omitted === ======  For single carrier and intra-band CA operations, the UE does not expect to be configured on overlapping symbols with a SRS resource configured by the higher layer parameter *SRS-PosResource* and a SRS resource configured by the higher layer parameter *SRS-Resource* with *resourceType* of both SRS resources as ‘periodic’.  For single carrier and intra-band CA operations, the UE does not expect to be triggered to transmit SRS on overlapping symbols with a SRS resource configured by the higher layer parameter *SRS-Pos-Resource* and a SRS resource configured by the higher layer parameter *SRS-Resource* with *resourceType* of both SRS resources as ‘semi-persistent’ or ‘aperiodic’.  ====== == Unchanged parts omitted ====== ======  Text Proposal #1 to the TS 38.214 Section 6.2.1  Editorial: Align specification to the common wording “…UE is not expected to be…”  Technical: Statement “For single carrier operations,” is a bit ambiguous given that it may be interpreted as 1) scenario when one carrier is configured. Our understanding is that the intention was to say on the same carrier.  **Proposal 3: Adopt Text Proposal #1 to the TS38.214 in the next revision of the TS 38.214**  **Start of Text Proposal #1 to the TS 38.214 -----**  6.2.1 UE sounding procedure  <omitted text>  For operations in the same carrier, the UE is not expected to be configured on overlapping symbols with a SRS resource configured by the higher layer parameter *srs-PosResource-r16* and a SRS resource configured by the higher layer parameter SRS-Resource with *resourceType* of both SRS resources as ‘periodic’.  For operations in the same carrier, the UE is not expected to be triggered to transmit SRS on overlapping symbols with a SRS resource configured by the higher layer parameter *srs-PosResource-r16* and a SRS resource configured by the higher layer parameter SRS-Resource with *resourceType* of both SRS resources as ‘semi-persistent’ or ‘aperiodic’.  <omitted text>  **End of Text Proposal #1 to the TS 38.214 -----------------------------** | R1-2001559 (proposal 4)  R1-2002286 (proposal 3) | A |
| 4 | Collision between PUSCH and aperiodic SRS  Proposal 1: 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.  Proposal 2: Adopt the following text proposal for collision handling between SRS-Pos and PUSCH in 38.214: | R1-2002096 (prop 1,2) | A |
| 5 | PHR for SRS positioning configuration  Proposal 1: Clarify whether UE can report type 3 PHR based on SRS for positioning or not.  Proposal 2: UE type 3 PHR report can be based on SRS for positioning.  Proposal 3: Adopt the following text proposal into TS 38.213 for Type 3 PHR. | R1-2001686  (prop 1,2,3) | B |
| 6 | power control mechanism  Proposal 2: UE should identify the weakest link quality and transmit based on the weakest link quality as long as it is lower than the maximum allowed transmit power per carrier to ensure successful reception of SRS by the non-serving cells. The following TP should be captured in TS 38.213. | R1-2002145 (prop 2) | B |
| 7 | parameter level of a reference signal of spatialRelationInfo  Proposal 4: Change ‘DL-PRS-ResourceId’ to ‘[dl-PRS]’.  Proposal 5: Adopt the following text proposal into TS 38.214 for a reference ’[dl-PRS]’. | R1-2001686  (prop 4,5) | C |
| 8 | MAC CE spatial relation update:  Proposal 6: Support to update spatial relation for semi-persistent and aperiodic SRS for positioning by MAC CE.  Proposal 7: Adopt the following text proposal into TS 38.214 for updating spatial relation. | R1-2001686  (prop 6,7) | C |
| 9 | Spatial relationship fallback  Proposal 1: The spatial relation information fallback mechanism should be defined for the UL SRS for positioning.  Proposal 2: For the UL SRS for positioning that transmitted towards the neighboring cell, the DL RS that can be detected with the highest RSRP from the same neighboring cell should be used as the fallback spatialRelationInfo RS.  Proposal 3: For the UL SRS for positioning that transmitted towards the serving cell, the RS that obtaining MIB from the serving cell should be used as the fallback spatialRelationInfo RS. | R1-2002217 (prop 1,2,3) | C |

## 2.2 Editorial issues

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| Issue # | Description | Tdoc | Email discussion thread |
| 10 | Spatial relation info configuration for positioning SRS  Proposal 1: Adopt the text changes in appendix | R1-2001601 (prop 1) | to be treated during CR phase |
| 11 | Editorial issues regarding the name oft he SRS for positioning in RAN1 specifications:  Proposal 1: Use SRS-ResourceSet and SRS-PosResourceSet-r16 to differentiate the traditional SRS and SRS for positioning  Proposal 2: Align the following RRC parameters in TS 38.213 with those in TS 38.331  SRS-Positioning-Config -> SRS-PosResourceSet-r16  SRS-ResourceSetId -> srs-PosResourceSetId-r16  SRS-ResourceSet -> SRS-PosResourceSet-r16  pathlossReferenceRS -> pathlossReferenceRS-Pos-r16 | R1-2001732 (prop 1 and 2) | to be treated during CR phase |
| 12 | Triggering of aperiodic SRS:  Proposal 1: All DCI formats in Rel-15 which support aperiodic SRS triggering should support Rel-16 aperiodic SRS for NR positioning purpose.    Propose 2: Update Table 7.3.1.1.2-24 in TS38.212 to specify specific SRS resource set fields as shown in the text proposal in Section 3. | R1- 2002038 (proposal 1,2) | to be treated during CR phase |
| 13 | * **Change all occurrences of the “**[*SRS-for-positioning*]**” to the agreed by RAN2 WG higher layer parameter called “***SRS-PosResource-r16***” in the TS 38.211 Section 6.4.1.4**    * **Adopt Text Proposal #1 to the TS38.211 in the next revision of the TS 38.212**    * **Adopt Text Proposal #1 to the TS38.214 in the next revision of the TS 38.214** | R1-2002286 (proposal 1,2) |  |

The editorial issues 10 to 13 are minor and it is proposed to handle them during the CR alignment phase.

## 2.3 Issue with low priority

This issues below are either enhancements of topics for discussions in other email discussion (e.g. UE feature email discussion), and are therefore down-prioritized.

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| Issue # | Description | Tdoc | note |
| 14 | Cyclic shift allocation for the SRS for positioning  **Proposa**l: The issues and possible enhancements of Cyclic Shift allocation should be studied and evaluated in RAN4 with reference to the minimum performance requirement that RAN4 would define.  Proposal 3: Symbol-specific cyclic shifts for SRS-Pos should be supported in order to keep phase continuities when a staggered SRS-Pos pattern is de-staggered for the SRS-Pos detection at the receiver.  Proposal 4: Adopt the following changes to Section 6.4.1.4.3 in TS 38.211:  ***Proposal 1: For Rel-16 support at least:***  ***a phase correction for the staggered SRS***  ***maintain the cyclic shift step size of Rel-15***  ***Proposal 2: Extend the range of the cyclic shift by applying Option 2.***  Proposal 3: Endorse the text proposal in Annex for inclusion in TS 38.211.  [Proposal 1 The cyclic shift of the UL SRS with staggered pattern can be configured 1) per symbol, according to REL-15 behaviour or 2) per SRS resource, across all symbol in the SRS resource, according to equation 1 above](#_Toc37449652)  [Proposal 2 Text proposal 1 is endorsed in TS 38.211](#_Toc37449653) | R1-2002047  R1-2002096(prop 3 and 4)  R1-2002199 (proposal 1,2,3)  R1-2002621 (prop 1,2) | Noncritical enhancements |
| 15 | SRS-Pos coordination among multiple gNBs  Proposal 5: Support SRS-Pos resource coordination to achieve orthogonal SRS-Pos resource assignment and/or SRS-Pos interference cancellation. | R1-2002096 (prop 5) | Noncritical enhancements |
| 16 | Proposa1 1: The values for the maximum number of supported SRS resource sets for positioning include {1, 16} only. | R1-2002145 (prop 1) | Can be addressed in capability discussion’ |
| 17 | SRS priority indication in DCI  [Proposal 3 The aperiodic SRS priority follows the priority bit in DCI, if configured. Otherwise, the aperiodic SRS is considered to be low priority.](#_Toc37449654) | R1-2002621  (Proposal 3) | Noncritical enhancements |

# 3 Companies comments

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| Issue # / Email Discussion | Company | Comment |
| Email Discussion B | Huawei | **Issue 4:** Not a priority in our view. Whether or how to support AP-SRS for positioning is being discussed in RAN2 where, currently, slight majority of companies have deemed it infeasible (please see R2-2003068 for summary of discussions). As such, we believe it is better to discuss any possible enhancements regarding AP-SRS for positioning in Rel-17 if RAN2 supports AP-SRS for positioning.  **Issue 5:** Not a priority in our view. We do not see PHR discussion based on SRS for positioning to be essential in Rel-16 maintenance phase. Also, we believe that PHR based on SRS for positioning is not required as SRS for positioning does not support closed loop power control. The only thing that may need to be clarified in the current specification is that Type 3 PHR is based on SRS configured by SRS-Resource.  **Issue 6:** Not a priority in our view. SRS for positioning Tx power based on weakest link has been proposed in Rel-16 meetings and was not agreed. We do not see the need to re-open the issue. |
| Email Discussion C | Huawei | **Issue 7:** Not a priority in our view. We do not see any ambiguity to keep the current ‘DL-PRS-ResourceId’.  **Issue 8:** Not a priority in our view. This is just an enhancement. Moreover, whether or how to support AP-SRS for positioning is being discussed in RAN2 where, currently, slight majority of companies have deemed it infeasible (please see R2-2003068 for summary of discussions). As such, we believe it is better to discuss any possible enhancements regarding AP-SRS for positioning in Rel-17 if RAN2 supports AP-SRS for positioning. |
| Email Discussion for UL SRS for positioning | Qualcomm | Our understanding is that there will be up 4 email threads for the whole NR Positioning (so up to 1 email thread per sub-agenda). Therefore there needs to be some pretty heavy de-prioritization and brave down-scoping across all sub-agendas.  Based on the above, we propose to have in this one email discussion the following issues (with highest priority the first between the 2):   * Simultaneous SRS transmission in single symbol considering both SRS for positioning and SRS for communication (that is, #1 & #3 from ED A) * PHR for SRS for positioning (#5 ED B)   We consider all the remaining as not needed. Some comments for these:   * The Number of SRS resources per slot can be part of UE capability discussion. It is a well understood capability without really clarifications needed in the main session, so it should be fine to leave it for the UE features. * PUSCH and AP-SRS is optimization and not a correction. Can be revisited in Rel-17 * Spatial Relation Fallback is optimization and not a correction. Can be revisited in Rel-17 * Power control mechanism was discussed already and there was an agreement. No further discussion needed in rel-16. |
| Email discussion A | Samsung | We think issue 2 and 7 are not critical. |
| Email discussion B | Samsung | We support to discuss the power control issue. PHP discussion is also part of power control and it is odd to prioritize PHP but leave the link selection unaddressed. In addition, it is not re-opening any new discussion but more of a clarification. UE needs to know which link to use to determine its Tx power. |
| Email discussion C | Samsung | Issue 7 seems not crirical. |
| E-mail discussion A | Intel Corporation | Issue #2 / A  Propose to discuss in UE capability discussion – at least need to avoid duplication (not critical for this thread)  Issue #4 / A  Motivation of proposal #1 is unclear. In general, issue can be avoided by gNB implementation. Not sure if SRS for positioning should be always higher priority than PUSCH. How about URLLC scenarios. Do not consider this issue as critical for R16.  Issues # 1/A, #3/A: discussion is needed |
| E-mail discussion B | Intel Corporation | Issue #5/B: discussion is needed  Issue #6 / B  Motivation is unclear. Propose to not discuss new UE behavior for SRS for positioning power control. |
| E-mail discussion C | Intel Corporation | Issue #7 /C  It is better to make all corrections based on one document. The tdoc providing corrections to align with RAN2 specification was submitted in R1-2002287. There may be a duplication, if we treat similar issues across different AIs.  Issue #8C – Looks as an optimization. Not critical.  Issue #9C – We do not see the need for fallback mechanism in case of spatial relation. It can be left up to UE implementation in R16. |
| Email discussion B | OPPO | Issue #5: Only open loop power control is used for SRS for positioning. Thus PHR based on SRS for positioning are not useful. We agree with Huawei that “The only thing that may need to be clarified in the current specification is that Type 3 PHR is based on SRS configured by SRS-Resource.” |
| Email discussion C | OPPO | Issue #7: It is an editorial change. The RRC IE is copied here for reference.  SRS-SpatialRelationInfoPos-r16 ::= SEQUENCE {  servingCellId-r16 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  },  ssbNcell-r16 SSB-InfoNcell-r16,  dl-PRS-r16 DL-PRS-Info-r16  }  }  Issue#8: Regarding A-SRS for positioning, RAN1 and RAN2 should be kept on the same page. |
| Email discussion A | CATT | According to Chairman’s guidance, it seems that up to one email thread can be expected in each sub agenda for NR Positioning. In our point of view, the issues #1, #3, #4 can be included into the email thread for SRS-Pos sub agenda.  Issue #2: It had better to move the issue on new UE capability for the number of SRS resources for positioning per slot to the UE features agenda. Let us discuss this issue in that agenda.  Issue #4: Although RAN2 has not yet decided whether to support AP-SRS, however, since RAN1 has agreed that AP-SRS needs to be supported, the issue on collision rules between AP-SRS-Pos and PUSCH still needs to be solved.  Table 1: Collision rules between SRS-Pos and PUCCH/PUSCH in current spec   |  |  |  |  | | --- | --- | --- | --- | | PUCCH/PUSCH  SRS-Pos | PUCCH carrying semi-persistent/periodic CSI report(s) or semi-persistent/periodic L1-RSRP report(s) only, or only L1-SINR report(s) | PUCCH carrying HARQ-ACK, link recovery request and/or SR | PUSCH | | Semi-persistent and Periodic SRS-Pos | Drop SRS-Pos | Drop SRS-Pos | Drop SRS-Pos | | Aperiodic SRS-Pos | **Drop PUCCH** | Drop SRS-Pos | **Drop SRS-Pos** |   From the above collision rules between SRS-Pos and PUCCH/PUSCH in current spec marked as BLUE color in Table 1, it can be observed that PUCCH and PUSCH have different behavior when aperiodic SRS-Pos collides with PUSCH and PUCCH carrying semi-persistent/periodic CSI report(s) or semi-persistent/periodic L1-RSRP report(s) only, or only L1-SINR report(s). As the aperiodic SRS has a higher transmission priority than semi-persistent/periodic CSI report(s), and considering that aperiodic SRS-Pos will be received by multiple TRPs involved in positioning, aperiodic SRS-Pos should has a higher transmission priority than PUSCH, and the aperiodic SRS should transmitted in the overlapped symbols when it collides with PUSCH. Therefore, we suggest the following rule of collision handling between SRS-Pos and PUSCH:  Proposal: PUSCH shall not be transmitted when aperiodic SRS configured by the higher layer parameter [SRS-for-positioning] is triggered to be transmitted to overlap in the same symbol with PUSCH. |

# 4 Conclusions

The following email discussions are proposed for the Official email discussion/approval phase (4/20-4/30):

The proposed High priority issues and editorial issues are grouped as follow

**Email discussion A:** SRS collision handling and number of resources:

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| Issue # | Description | Tdoc |
| 1 | Simultaneous SRS transmission in a single symbol | R1-2001559 (proposal 1,2) |
| 2 | Number of SRS for positioning resources per slot | R1-2001559 (proposal 3) |
| 3 | Intra-band collision between PosSRS and MimoSRS | R1-2001559 (proposal 4)  R1-2002286 (proposal 3) |
| 4 | Collision between PUSCH and aperiodic SRS | R1-2002096 (prop 1,2) |

**Email discussion B:** SRS power control issues:

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| Issue # | Description | Tdoc |
| 5 | PHR for SRS positioning configuration | R1-2001686  (prop 1,2,3) |
| 6 | power control mechanism | R1-2002145 (prop 2) |

**Email discussion C:** SRS spatial relation info issues:

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| Issue # | Description | Tdoc |
| 7 | parameter level of a reference signal of spatialRelationInfo | R1-2001686  (prop 4,5) |
| 8 | MAC CE spatial relation update: | R1-2001686  (prop 6,7) |
| 9 | Spatial relationship fallback | R1-2002217 (prop 1,2,3) |

# 5 References

1. [R1-2001559](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_100b\Docs\R1-2001559.zip) Maintenance of SRS for NR positioning Huawei, HiSilicon
2. [R1-2001601](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_100b\Docs\R1-2001601.zip) Maintenance of UL reference signals for NR positioning ZTE
3. [R1-2001686](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_100b\Docs\R1-2001686.zip) Discussion on remaining issues on UL RS for NR positioning vivo
4. [R1-2001732](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_100b\Docs\R1-2001732.zip) Remaining Issues on UL Positioning Reference Signal OPPO
5. [R1-2002038](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_100b\Docs\R1-2002038.zip) Maintenance on UL reference signals for NR Positioning Nokia, Nokia Shanghai Bell
6. [R1-2002047](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_100b\Docs\R1-2002047.zip) Remaining details on UL Reference Signals Futurewei
7. [R1-2002096](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_100b\Docs\R1-2002096.zip) Remaining issues on UL SRS for NR Positioning CATT
8. [R1-2002145](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_100b\Docs\R1-2002145.zip) UL Reference Signals for NR Positioning Samsung
9. [R1-2002199](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_100b\Docs\R1-2002199.zip) Discussion on staggered SRS for NR Positioning Fraunhofer IIS, Fraunhofer HHI
10. [R1-2002286](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_100b\Docs\R1-2002286.zip) Corrections to UL reference signals for NR positioning Intel Corporation
11. [R1-2002621](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_100b\Docs\R1-2002621.zip) Maintenance of rel16 UL reference signals for NR positioning Ericsson