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: Output of email discussion 100b-e-NR-Pos-03] on UL SRS for positioning and UL RTOA reference time

Document for: Discussion

# 1 Introduction

This document summarizes the output of the email discussion thread [100b-e-NR-Pos-03] help during RAN1#100b-e. the scope of the email discussion was discussed in a preceding email discussion captured in R1-2002715 and focused on UL SRS for positioning. Additionally, a discussion from agenda item 7.2.8.3 regarding UL RTOA reference time was added during the consolidation of email discussion threads. The email discussion scope was confirmed by chairman’s decision available in the chairman’s notes:

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| [100b-e-NR-Pos-03] Email discussion/approval on the following issues by 4/23; if necessary, followed by endorsing the corresponding TPs by 4/28 – Florent (Ericsson)* UL SRS for positioning
	+ Simultaneous SRS transmission in a single symbol
	+ Intra-band collision between PosSRS and MimoSRS
	+ PHR for SRS positioning configuration
* UL RTOA reference time
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# 2 UL SRS for positioning

## 2.1 Simultaneous SRS transmission in a single symbol

The issue was discussed in R1-2001559, with the following proposal and TP:

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|  ***Proposal 1: 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}.******Proposal 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 ====================== |

Companies are encouraged to provide their comments below:

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| Company | Comment |
| Huawei/HiSilicon | Support.In response to Nokia’s comment: Proposal 1 can be updated to the following. Would that be better? I guess the TP is more aligned with the updated proposal.***Introduce a new UE capability for the number of SRS resources for positioning on a symbol for intra-band CA, where the SRS resources are on different CCs. The candidate number at least includes {1, 2}.***In response to QC and vivo on why we only consider intra-band CA case, we think in general UE supports simultaneous transmission of UL on different CCs for inter-band CA, except for the following cases: SRS with PUCCH/PUSCH, and SRS with PRACH, which was captured as UE capability in Rel-15 by *parallelTxSRS-PUCCH-PUSCH* and *parallelTxPRACH-SRS-PUCCH-PUSCH*, and the behaviour is captured in 6.2.1 of TS 38.214. It is our understanding that not allowing simultaneous transmission of SRS for MIMO on different CCs for inter-band CA is not specified. We prefer to keep the same for SRS for positioning.In response to Futurewei on the numbers, our understanding is the total number of SRS resources across CCs in a band on a symbol.In response to QC on the same *resourceType*, we consider intra-band CA very similar to single CC, and in the discussion of handling priorities in RAN1#100e, we agreed that handling of different priorities in the current spec were also applicable to positioning SRS. As the current does not mention any restrictions on single carrier or CA, we think that priority-based dropping is also applicable for intra-band CA.In case a SRS resource with *resourceType* set as 'aperiodic' is triggered on the OFDM symbol(s) configured with periodic/semi-persistent SRS transmission, the UE shall transmit the aperiodic SRS resource and only the periodic/semi-persistent SRS symbol(s) overlapping within the symbol(s) are dropped, while the periodic/semi-persistent SRS symbol(s) that are not overlapped with the aperiodic SRS resource are transmitted. In case a SRS resource with *resourceType* set as 'semi-persistent' is triggered on the OFDM symbol(s) configured with periodic SRS transmission, the UE shall transmit the semi-persistent SRS resource and only the periodic SRS symbol(s) overlapping within the symbol(s) are dropped, while the periodic SRS symbol(s) that are not overlapped with the semi-persistent SRS resource are transmitted. |
| Nokia/NSB | On proposal 1: We think we should be more specific that this is for different CCs and that it is across SRS resource sets for positioning. Is that the correct understanding? If so we support. In response to HW’s update:We support the updated proposal wording.  |
| Qualcomm | We have preference to introduce simultaneous SRS transmission for positioning for both intra-band and inter-band CA as follows:***Introduce a new UE capability for the number of simultaneous transmission of SRS resources for positioning on a symbol for intra-band CA, where the SRS resources are on different CCs. The candidate number at least includes {1, 2}.******Introduce a new UE capability for the number of simultaneous transmission of SRS resources for positioning on a symbol for inter-band CA, where the SRS resources are on different CCs. The candidate number at least includes {1, 2}.***On the detailed TP: 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].why is the constraint “same resourceType ” needed?* If the 2 SRS for positioning are in different CCs, why cannot be transmitted simultaneously and have different timing behaviour?
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| vivo | We also support to introduce simultaneous SRS transmission for positioning for both intra-band and inter-band CA. We don’t understand why it has to be limited to intra-band CA case as in proposal 1.On the detailed TP in proposal 2, we’d like to echo the question of Qualcomm, why the constraint of “same resourceType” is needed. |
| Futurewei | On Proposal 1, a question on revised wording from QC “.. ***where the SRS resources are on different CCs. The candidate number at least includes {1, 2}.***Does that candidate {1,2} apply per CC? |
| CATT | No strong opinion. SRS is transmitted in a single port. We don’t see the usage for UE to simultaneously transmit multiple SRS resources for positioning on the same symbol. |
| ZTE | No strong view. We don’t see the technical motivation to support this.  |
| CMCC | We believe it may have potential use cases and performance optimization for adopting this proposal, and from the perspective of spec completeness, we are ok with the TP. |
| mtk | We can support the first two paragraphs of the proposal regarding single carrier operation.For CA case, we would like to ask is there any potential use case? |
| Intel | We are open to drop support of CA case for SRS for positioning in Rel.16. We do see some limitations here like potential power sharing, spatial filter considerations across CCs, etc. If companies have strong preference to support in in R16 then, it seems we need to analyze both cases intra and inter-band CA and make conclusion for each of the raised aspects. |
| LG | We support of introducing the UE capability on simultaneous transmission of SRS resources for positioning on the same symbol for both intra-band CA and inter-band CA. In our understanding, we do not need to prevent UEs which are capable of simultaneously transmitting SRS for different CCs from doing it. |
| Ericsson | The CA aspects was never discussed during the work item, so it is difficult to judge the potentail benefits. |
| Sony | We are fine with the first two paragraph. However, Positioning with CA has not been discussed in Rel.16.  |

## 2.2 Intra-band collision between PosSRS and MimoSRS

The issue was discussed in R1-2001559, andR1- 2002286 with the following proposals and TPs:

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| R1-2001559 |
| ***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 ====================== |

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| R1-2002286 |
| **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 -----------------------------------------------------------------------------------------------**1.
* **Adopt Text Proposal #1 to the TS38.214 in the next revision of the TS 38.214**
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The two proposals differ in that R1-2001559 proposes to extend the specification text to includes intra-band CA, while R1- 2002286 is only providing text clarification. Companies are encouraged to provide their comments in the table below

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| Company | Comment |
| Huawei/HiSilicon | Support the TP that proposed to extend the specification text to include intra-band CA.In response to QC: We consider MIMO SRS will have more antenna ports than positioning SRS, and it can have antenna switching usage. The transmission characteristics would be totally different.For intra-band CA, normally the signal from different CCs uses from the same RF, and we may face power ramping between symbols for a RF chain, where the EVM will not be guaranteed.. |
| OPPO | Support the 2nd TP |
| Nokia/NSB | Support the 1st TP.  |
| Qualcomm | We prefer the 2nd TP. As we note in our reply above for 2 SRS in different CCs. Proponents of 1st TP, can it be clarified why SRS for POS and SRS for MIMO cannot be configured on the same symbols in different CCs?  |
| vivo | We prefer the 2nd TP. |
| Futurewei | OK with either TP |
| CATT | We support to merge the two TPs. |
| ZTE | Support the 2nd TP.  |
| CMCC | Support the 2nd TP. |
| mtk | We kind of prefer the 2nd TP |
| Intel | Support the 2nd TP. As for the 1st TP, it can be merged in the 2nd TP if issue 2.1 is resolved. |
| LG | Support the 2nd TP. The transmission of SRS for POS and SRS on the same symbol is feasible depending on UE hardware, so we need the related UE capability. For example, even for intra-band CA, some UEs could use different RF chain for the case of non-contiguous CA. |
| Sony | Support the 2nd TP.  |

## 2.3 PHR for SRS positioning configuration

The issue was discussed in R1-2001686 with the following proposals and TPs.

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| ***Proposal 1: Clarify whether UE can report*** ***type 3 PHR based on SRS for positioning or not.***For Option 1, if UE type 3 PHR can only be based on SRS configured by *SRS-Config*, the text proposal is as below:

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| *TS 38.213-g10*7.7.3 Type 3 PH report< Unchanged parts are omitted >If a UE determines that a Type 3 power headroom report for an activated serving cell is based on an actual SRS transmission then, for SRS transmission occasion  on active UL BWP  of carrier  of serving cell  and if the UE is not configured for PUSCH transmissions on carrier  of serving cell , and the SRS is configured by *SRS-Config,* the UE computes a Type 3 power headroom report as  [dB]where , , , ,  and  are defined in Clause 7.3.1 with corresponding values obtained from *SRS-ResourceSet*.If the UE determines that a Type 3 power headroom report for an activated serving cell is based on a reference SRS transmission then, for SRS transmission occasion  on UL BWP  of carrier  of serving cell , and if the UE is not configured for PUSCH transmissions on UL BWP  of carrier  of serving cell , and the reference SRS is configured by *SRS-Config，*the UE computes a Type 3 power headroom report as   [dB]where  is a SRS resource set corresponding to *SRS-ResourceSetId = 0* for UL BWP  and , ,  and  are defined in Clause 7.3.1 with corresponding values obtained from *SRS-ResourceSetId = 0* for UL BWP .  is computed assuming MPR=0 dB, A-MPR=0 dB, P-MPR=0 dB and TC =0 dB. MPR, A-MPR, P-MPR and TC are defined in [8-1, TS 38.101-1], [8-2, TS38.101-2] and [8-3, TS 38.101-3]. If a UE is configured with two UL carriers for a serving cell and the UE determines a Type 3 power headroom report for the serving cell based on a reference SRS transmission, the UE computes a Type 3 power headroom report for the serving cell assuming a reference SRS transmission on the UL carrier provided by *pucch-Config*. If *pucch-Config* is not provided to the UE for any of the two UL carriers, the UE computes a Type 3 power headroom report for the serving cell assuming a reference SRS transmission on the non-supplementary UL carrier.< Unchanged parts are omitted > |

For Option 2, if UE type 3 PHR report can be based on SRS configured by *SRS-Resource* or *SRS for positioning*, the text proposal is as below:

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| *TS 38.213-g10*7.7.3 Type 3 PH report< Unchanged parts are omitted >If a UE determines that a Type 3 power headroom report for an activated serving cell is based on an actual SRS transmission then, for SRS transmission occasion  on active UL BWP  of carrier  of serving cell  and if the UE is not configured for PUSCH transmissions on carrier  of serving cell , and the SRS is configured by *SRS-Config,* the UE computes a Type 3 power headroom report as  [dB]where , , , ,  and  are defined in Clause 7.3.1 with corresponding values obtained from *SRS-ResourceSet*.If the UE determines that a Type 3 power headroom report for an activated serving cell is based on a reference SRS transmission then, for SRS transmission occasion  on UL BWP  of carrier  of serving cell , and if the UE is not configured for PUSCH transmissions on UL BWP  of carrier  of serving cell , and the reference SRS is configured by *SRS-Config，*the UE computes a Type 3 power headroom report as   [dB]where  is a SRS resource set corresponding to *SRS-ResourceSetId = 0* for UL BWP  and , ,  and  are defined in Clause 7.3.1 with corresponding values obtained from *SRS-ResourceSetId = 0* for UL BWP .  is computed assuming MPR=0 dB, A-MPR=0 dB, P-MPR=0 dB and TC =0 dB. MPR, A-MPR, P-MPR and TC are defined in [8-1, TS 38.101-1], [8-2, TS38.101-2] and [8-3, TS 38.101-3]. If a UE determines that a Type 3 power headroom report for an activated serving cell is based on an actual SRS transmission then, for SRS transmission occasion  on active UL BWP  of carrier  of serving cell  and if the UE is not configured for PUSCH transmissions on carrier  of serving cell , and the SRS is configured by *SRS-Positioning-Config，*the UE computes a Type 3 power headroom report as  [dB]where , , , , and  are defined in Clause 7.3.1 with corresponding values obtained from [*SRS-PosResourceSet*].If the UE determines that a Type 3 power headroom report for an activated serving cell is based on a reference SRS transmission then, for SRS transmission occasion  on UL BWP  of carrier  of serving cell , and if the UE is not configured for PUSCH transmissions on UL BWP  of carrier  of serving cell , and the reference SRS is configured by *SRS-Positioning-Config，*the UE computes a Type 3 power headroom report as   [dB]where  is a SRS resource set corresponding to [*SRS-PosResourceSetId*] *= 0* for UL BWP  and ,  and  are defined in Clause 7.3.1 with corresponding values obtained from [*SRS-PosResourceSetId*] *= 0* for UL BWP .  is computed assuming MPR=0 dB, A-MPR=0 dB, P-MPR=0 dB and TC =0 dB. MPR, A-MPR, P-MPR and TC are defined in [8-1, TS 38.101-1], [8-2, TS38.101-2] and [8-3, TS 38.101-3]. If a UE is configured with two UL carriers for a serving cell and the UE determines a Type 3 power headroom report for the serving cell based on a reference SRS transmission, the UE computes a Type 3 power headroom report for the serving cell assuming a reference SRS transmission on the UL carrier provided by *pucch-Config*. If *pucch-Config* is not provided to the UE for any of the two UL carriers, the UE computes a Type 3 power headroom report for the serving cell assuming a reference SRS transmission on the non-supplementary UL carrier.< Unchanged parts are omitted > |

***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.***

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| *TS 38.213-g10*7.7.3 Type 3 PH report< Unchanged parts are omitted >If a UE determines that a Type 3 power headroom report for an activated serving cell is based on an actual SRS transmission then, for SRS transmission occasion  on active UL BWP  of carrier  of serving cell  and if the UE is not configured for PUSCH transmissions on carrier  of serving cell , and the SRS is configured by *SRS-Config,* the UE computes a Type 3 power headroom report as  [dB]where , , , ,  and  are defined in Clause 7.3.1 with corresponding values obtained from *SRS-ResourceSet*.If the UE determines that a Type 3 power headroom report for an activated serving cell is based on a reference SRS transmission then, for SRS transmission occasion  on UL BWP  of carrier  of serving cell , and if the UE is not configured for PUSCH transmissions on UL BWP  of carrier  of serving cell , and the reference SRS is configured by *SRS-Config，*the UE computes a Type 3 power headroom report as   [dB]where  is a SRS resource set corresponding to *SRS-ResourceSetId = 0* for UL BWP  and , ,  and  are defined in Clause 7.3.1 with corresponding values obtained from *SRS-ResourceSetId = 0* for UL BWP .  is computed assuming MPR=0 dB, A-MPR=0 dB, P-MPR=0 dB and TC =0 dB. MPR, A-MPR, P-MPR and TC are defined in [8-1, TS 38.101-1], [8-2, TS38.101-2] and [8-3, TS 38.101-3]. If a UE determines that a Type 3 power headroom report for an activated serving cell is based on an actual SRS transmission then, for SRS transmission occasion  on active UL BWP  of carrier  of serving cell  and if the UE is not configured for PUSCH transmissions on carrier  of serving cell , and the SRS is configured by *SRS-Positioning-Config，*the UE computes a Type 3 power headroom report as  [dB]where , , , , and  are defined in Clause 7.3.1 with corresponding values obtained from [*SRS-PosResourceSet*].If the UE determines that a Type 3 power headroom report for an activated serving cell is based on a reference SRS transmission then, for SRS transmission occasion  on UL BWP  of carrier  of serving cell , and if the UE is not configured for PUSCH transmissions on UL BWP  of carrier  of serving cell , and the reference SRS is configured by *SRS-Positioning-Config，*the UE computes a Type 3 power headroom report as   [dB]where  is a SRS resource set corresponding to [*SRS-PosResourceSetId*] *= 0* for UL BWP  and ,  and  are defined in Clause 7.3.1 with corresponding values obtained from [*SRS-PosResourceSetId*] *= 0* for UL BWP .  is computed assuming MPR=0 dB, A-MPR=0 dB, P-MPR=0 dB and TC =0 dB. MPR, A-MPR, P-MPR and TC are defined in [8-1, TS 38.101-1], [8-2, TS38.101-2] and [8-3, TS 38.101-3]. If a UE is configured with two UL carriers for a serving cell and the UE determines a Type 3 power headroom report for the serving cell based on a reference SRS transmission, the UE computes a Type 3 power headroom report for the serving cell assuming a reference SRS transmission on the UL carrier provided by *pucch-Config*. If *pucch-Config* is not provided to the UE for any of the two UL carriers, the UE computes a Type 3 power headroom report for the serving cell assuming a reference SRS transmission on the non-supplementary UL carrier.< Unchanged parts are omitted > |

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Note that R1-2001686 presents two TP options and proposes to endorse option 2. However this email discussion is not limited to these options and companies are encouraged to provide their own TP options (if any).

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| Company | Comment |
| Huawei/HiSilicon | Our understanding is that Type 3 PHR based on MIMO SRS is only applicable when UE capability supports parallel SRS and PUSCH transmission in inter-band CA, that is, the UE capability parallelTxSRS-PUCCH-PUSCH is equal to “Supported”. To our understanding, we do not have any agreement clarifying that parallelTxSRS-PUCCH-PUSCH also includes parallel transmission of SRS for positioning and PUSCH. As such, we suggest to first have an independent discussion on this issue in the next meeting and if companies agreed that parallelTxSRS-PUCCH-PUSCH UE capability also applies to SRS for positioning, then we can work on the TP for supporting Type 3 PHR based on SRS for positioning. Besides this issue, since Type 3 PHR has not been discussed before, we suggest to exercise some caution before hastily agreeing to use the same values as in MIMO SRS for calculation.  Please also note that the TP needs some modification since both SRS-PosResourceSet and SRS-ResourceSet are configured by SRS-Config. SRS-Positioning-Config IE is not included in 38.331. In response to vivo, our understanding is that when we decide to call SRS for positioning (UL PRS) as SRS, we consider the majority of features from SRS is applicable to SRS for positioning. In particular, when spec uses generic term SRS, rather than SRS configured by *SRS-Resource* or *SRS-ResourceSet*, we expect the same behaviour for SRS for positioning by default unless problems are identified.It is our understanding that the SRS in *parellelTxSRS-PUCCH-PUSCH* and *parellelTxPRACH-SRS-PUCCH-PUSCH* should be considered to extend to include SRS for positioning as well, if no concerns are raised.Supporting PHR for SRS for positioning will actually define two PHRs for SRS, one for MIMO SRS and one for positioning SRS. Currently we do not know whether it will also have MAC spec impact, and also considering limited use case of it, we suggest to either conclude that it is not supported in Rel-16 and revisit it in Rel-17, or postpone to the next meeting.[v13] Regarding Type 3 PHR, we suggest to make a conclusion that Type 3 PHR based on SRS for positioning is not supported in Rel-16. This is required to stabilize the spec and change “SRS” to “SRS configured by *SRS-Resource*” in 7.7.3 of 38.213 |
| OPPO | Since only open loop power control is supported for SRS for positioning, the PHR reporting based on it is not useful. Thus, the Type 3 PHR based on SRS for positioning should not be supported in Rel-16.The TP for option 1 is not aligned with TS 38.331 v16.0.0, where both SRS for MIMO and SRS for positioning are configured in SRS-Config. These two types of SRS should be differentiated by *SRS-Resource* and *SRS-PosResource-r16* now.SRS-Config ::= SEQUENCE { srs-ResourceSetToReleaseList SEQUENCE (SIZE(1..maxNrofSRS-ResourceSets)) OF SRS-ResourceSetId OPTIONAL, -- Need N srs-ResourceSetToAddModList SEQUENCE (SIZE(1..maxNrofSRS-ResourceSets)) OF SRS-ResourceSet OPTIONAL, -- Need N srs-ResourceToReleaseList SEQUENCE (SIZE(1..maxNrofSRS-Resources)) OF SRS-ResourceId OPTIONAL, -- Need N srs-ResourceToAddModList SEQUENCE (SIZE(1..maxNrofSRS-Resources)) OF SRS-Resource OPTIONAL, -- Need N tpc-Accumulation ENUMERATED {disabled} OPTIONAL, -- Need S ..., [[ srs-RequestForDCI-Format1-2-r16 INTEGER (1..2) OPTIONAL, -- Need S srs-RequestForDCI-Format0-2-r16 INTEGER (1..2) OPTIONAL, -- Need S srs-ResourceSetToAddModListForDCI-Format0-2-r16 SEQUENCE (SIZE(1..maxNrofSRS-ResourceSets)) OF SRS-ResourceSet OPTIONAL, -- Need N srs-ResourceSetToReleaseListForDCI-Format0-2-r16 SEQUENCE (SIZE(1..maxNrofSRS-ResourceSets)) OF SRS-ResourceSetId OPTIONAL,-- Need N srs-PosResourceSetToReleaseList-r16 SEQUENCE (SIZE(1..maxNrofSRS-PosResourceSets-r16)) OF SRS-PosResourceSetId-r16 OPTIONAL, -- Need N srs-PosResourceSetToAddModList-r16 SEQUENCE (SIZE(1..maxNrofSRS-PosResourceSets-r16)) OF SRS-PosResourceSet-r16 OPTIONAL,-- Need N srs-PosResourceToReleaseList-r16 SEQUENCE (SIZE(1..maxNrofSRS-PosResources-r16)) OF SRS-PosResourceId-r16 OPTIONAL,-- Need N srs-PosResourceToAddModList-r16 SEQUENCE (SIZE(1..maxNrofSRS-PosResources-r16)) OF SRS-PosResource-r16 OPTIONAL -- Need N ]]}One possible TP is to add one sentence (highlighted part) in Section 7.7.3 that all the SRS resource for type 3 PH report is configured by *SRS-Resource*7.7.3 Type 3 PH reportIf a UE determines that a Type 3 power headroom report for an activated serving cell is based on an actual SRS transmission then, for SRS transmission occasion  on active UL BWP  of carrier  of serving cell  and if the UE is not configured for PUSCH transmissions on carrier  of serving cell , the UE computes a Type 3 power headroom report as  [dB]where , , , ,  and  are defined in Clause 7.3.1.If the UE determines that a Type 3 power headroom report for an activated serving cell is based on a reference SRS transmission then, for SRS transmission occasion  on UL BWP  of carrier  of serving cell , and if the UE is not configured for PUSCH transmissions on UL BWP  of carrier  of serving cell , the UE computes a Type 3 power headroom report as   [dB]where  is a SRS resource set corresponding to *SRS-ResourceSetId = 0* for UL BWP  and , ,  and  are defined in Clause 7.3.1 with corresponding values obtained from *SRS-ResourceSetId = 0* for UL BWP .  is computed assuming MPR=0 dB, A-MPR=0 dB, P-MPR=0 dB and TC =0 dB. MPR, A-MPR, P-MPR and TC are defined in [8-1, TS 38.101-1], [8-2, TS38.101-2] and [8-3, TS 38.101-3]. If a UE is configured with two UL carriers for a serving cell and the UE determines a Type 3 power headroom report for the serving cell based on a reference SRS transmission, the UE computes a Type 3 power headroom report for the serving cell assuming a reference SRS transmission on the UL carrier provided by *pucch-Config*. If *pucch-Config* is not provided to the UE for any of the two UL carriers, the UE computes a Type 3 power headroom report for the serving cell assuming a reference SRS transmission on the non-supplementary UL carrier.The corresponding SRS resource(s) for a Type 3 power headroom report is configured by *SRS-Resource.*  |
| Qualcomm | We have a preference to finalize issues and we don’t consider this additional feature to be really necessary for the operation, so we are OK to limit the Type- 3 PHR for SRS configured by SRS-Resource |
| vivo | In response to Huawei/HiSilicon, to our understanding, we also do not have any agreement saying that parallel transmission of SRS for positioning and PUSCH on different carriers is excluded. In response to OPPO’s comment “Since only open loop power control is supported for SRS for positioning, the PHR reporting based on it is not useful. Thus, the Type 3 PHR based on SRS for positioning should not be supported in Rel-16.”. Please note that type 3 PHR is for a UE operate with multiple carriers where PHR calculation is based on SRS transmission on a carrier without scheduled PUSCH. So the benefit of type 3 PHR report is that it can be used by the serving cell for other carrier(s), not necessarily for SRS for positioning transmission itself. Comparing to type 3 PHR based on SRS-Resource only, we believe type 3 PHR based on SRS for positioning will be more accurate given all those pathloss reference configuration.  |
| CATT | For the above TPs related to UE type 3 PHR report, we can understand that UE type 3 PHR report based on SRS for positioning can facilitate more accurate PHR reporting. We are generally support extending current UE type 3 PHR report to SRS-Pos but we need carefully check the potential issues before agree the above TPs.  |
| ZTE | Agree with OPPO and QC. We don’t see the strong benefit for type 3 PHR report based on positioning SRS. |
| CMCC | We share similar views with CATT and vivo that by supporting Type 3 PHR based on SRS for POS, potential benefits may be obtained since the gNB is able to allocate resources for the SRS for POS in a more precise way. However, we also think that the use cases/scenarios of supporting this PHR are limited, and some further issues such as real/virtual PHR design are identified and should be discussed. Therefore, we prefer to not support this feature during the CR stage, and postpone the discussion in Rel-17. |
| mtk | Consider to discuss this in Rel-17 |
| Intel | We believe it is not a maintenance proposal rather than new feature. We also agreed on neighbor cell pathlosses for NR Positioning. This new feature may also need to cover this aspect. In our view, system can work w/o type-3 PHR support. These optimizations can be considered in the next release if it is justified. |
| LG | We think that there might be some potential benefits by supporting type 3 PHR report for SRS for positioning, but it seems an optimization issue which could be discussed in next release with more clarification of necessity and benefit. |
| Nokia/NSB | We agree with Intel’s view that this would need full consideration and is something new. So we think this should be postponed to Rel-17 and is not critical to solve. We don’t support any TP at this time. |
| Sony | We have a similar view as Intel. This is a matter of optimization and it can be discussed in the next release. |

# 3 UL RTOA reference time

This discussion started in agenda item 7.2.8.3, documented in R1-2002716. The proposals originated from R1-2001560 and are listed below.

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| ***Proposal 1: RAN1 continues to discuss the topic of gNB measurement and reaches agreements in RAN1#100b at least on the following issues and sends an LS to RAN3 to notify RAN3 regarding the reached agreements:***1. ***UL RTOA definition***
2. ***Search window configuration for gNB to receive SRS.***
 |
| ***Proposal 2: Introduce the following new parameter to the higher layer parameter list.***

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR\_pos-Core | NR UL Measurement Report Configuration | 　 | 　 | FFS in RAN3 WG | SFN Initialization time | SFN initialization time | New | 　 | The nominal beginning time of SFN 0 for SRS | Same as SFN initialization time in LPPaBIT STRING (64) | 　 | 　 | NRPPa 38.455 | 　 | Time in seconds relative to 00:00:00 on 1 January 1900 (calculated as continuous time without leap seconds and traceable to a common time reference) where binary encoding of the integer part is in the first 32 bits and binary encoding of the fraction part in the last 32 bits. The fraction part is expressed with a granularity of 1 /2\*\*32 second. |

 |
| ***Proposal 3: The RTOA reference time is defined as T0+tSRS***, ***where**** ***T0 is the nominal beginning time of SFN 0 provided by LMF.***
* ***tSRS is the nominal time offset of the beginning of the subframe that contains the target SRS relative to the nominal beginning time of SFN 0.***
 |
| ***Proposal 4: Adopt the following TP to TS 38.215.***===================== Unchanged parts omitted ======================**2 References**===================== Unchanged parts omitted ======================[xx] 3GPP TS 38.455: "NG-RAN; NR Positioning Protocol A (NRPPa)"===================== Unchanged parts omitted ======================**5.2.2 UL Relative Time of Arrival (TUL-RTOA)**

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| **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 UL RTOA reference time.The UL RTOA reference time is defined as , where- is the nominal beginning time of SFN 0 provided by [yy] [xx, TS 38.455]- is the nominal time offset of the beginning of the subframe that contains the target SRS relative to the nominal beginning time of SFN0. Multiple SRS resources for positioning 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. |

===================== Unchanged parts omitted ====================== |

Companies are encouraged to provide their comments below:

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| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | Current definition in […] has the problem that SRS received in different subframes will have multiple ms offset for the UL RTOA measurement. Also it may imply that configurable reference time is configured per SRS resource, which has unnecessary overhead.In response to Nokia, we cannot simply remove the bracket, as it is problematic. As from the WID, it should be RAN1 to define the measurement, and RAN3 should do NRPPa signalling to support the measurement, based on the LS from RAN1, which has been the common practice as other higher layer parameters between RAN1 and RAN2.In response to QC, we think that TP is required since, in our understanding, UL RTOA reference time is a part of UL RTOA definition and it needs to be included in the definition of this measurement in RAN1 specification for the sake of completeness. Also, it is a practice that we have followed for other gNB measurements. For instance, the description of the reference direction is included in UL AoA definition and the description of reference point is included in the definitions of gNB Rx-TX time difference and UL RTOA in 38.215. We do not know how it can work without changing TS 38.215. The definition is still in brackets, and we cannot simply remove the brackets as in that way the UL RTOA for SRS in subframe #1 will be 1ms larger than the UL RTOA for SRS subframe#0.In response to vivo, definition of gNB measurement is a RAN1 centric objective in the WID, and the definition of gNB measurement is also in RAN1 spec. To us, we do not understanding in additional to capturing the RAN1 agreed parameters in NRPPa what else RAN3 need to do. For example, do you expect to define RIM-RS in RAN3?In response to CATT, we would like to clarify only as the SFN initialization time should be provided by higher layer signaling, and is calculated by gNB. Would that be easier if we change the TP to the following.The UL RTOA reference time is defined as , where- is the nominal beginning time of SFN 0 provided by [yy] [xx, TS 38.455]- , where and are the system frame number and the subframe number of the SRS.It would have been helpful if the LS were sent to RAN3 earlier, but as we are now in very late stage, and RAN3 is heavily burdened, it would be impractical to offload the RAN1-centric objective to RAN3. If we go with LTE way, the configured RTOA reference time would be resource-specific, which means that the configured RTOA reference time would be associated with a subframe, and in case 16 SRS resources are transmitted in different subframes (may be discontinuous), which subframe should be assumed by gNB upon receiving the RTOA reference time?In response to ZTE, it is RAN1 centric objective, and it is capture in RAN1 spec, how can it be defined by RAN3?=============== Update of the TP =================Regarding the TP, we can change the proposed one to the following, to clarify that is not part of the signaling.The UL Relative Time of Arrival (TUL-RTOA) is the beginning of subframe *i* containing SRS received in positioning node *j*, relative to the UL RTOA reference time.The UL RTOA reference time is defined as , where- is the nominal beginning time of SFN 0 provided by [yy] [xx, TS 38.455]- , where and are the system frame number and the subframe number of the SRS.[v13] Regarding this issue, we suggest to* Agree proposal 1
* Agree proposal 2 by adding a new parameter
* Agree proposal 3 with the following modification

***The RTOA reference time is defined as T0+tSRS***, ***where**** ***T0 is the nominal beginning time of SFN 0 provided by LMF.***
* ***, where and are the system frame number and the subframe number of the SRS***
* Agree the following TP, and send an LS to RAN3 about the above agreements and request on their opinion about the above definition of UL RTOA reference time

===================== Unchanged parts omitted ======================**2 References**===================== Unchanged parts omitted ======================[xx] 3GPP TS 38.455: "NG-RAN; NR Positioning Protocol A (NRPPa)"===================== Unchanged parts omitted ======================**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 UL RTOA reference time.[The UL RTOA reference time is defined as , where- is the nominal beginning time of SFN 0 provided by [yy] [xx, TS 38.455]- is the nominal time offset of the beginning of the subframe that contains the target SRS relative to the nominal beginning time of SFN0.] Multiple SRS resources for positioning 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. |

===================== Unchanged parts omitted ====================== |
| Nokia/NSB | As the proposed TP involves a higher layer parameter from RAN3 specs perhaps we should first agree to remove the brackets in the first line and agree that we need a parameter for the configurable reference time. Then we can send an LS to RAN3 to finalize as we understand this issue has also been submitted to RAN3. Updated:We are okay with agreeing the proposals and then sending an LS to RAN3 who we understand is working in parallel on this. We can support only a TP removing the brackets at this time as supported by QC.  |
| Qualcomm | We are OK with Proposal 1 (the aspect related to RTOA definition), the addition of the high layer parameter (Proposal 2) and the Proposal 3, together with sending the LS with these agreements. However, the TP is not needed, since this definition would not be needed to be added in 38.215. We can just remove the brackets as Nokia suggests. |
| vivo | OK with Proposal 1, 2 and 3 in principle. Regarding where to capture this, assuming an LS with these agreements is to be sent to RAN3. Our preference is still the same as in RAN1#100-e, let RAN3 capture/finalize this issue. |
| Futurewei | LS to RAN3 on Proposal 1, 2, and 3 are needed to ensure that RAN3 proceeds correctly with the signalling to support the measurements. Details to support to network level signalling may not necessarily needed to be captured in RAN1 specs.  |
| CATT | Our understanding is that RAN3 also has the responsibility to solve his issue of the definition of the UL RTOA reference time. An LS can be send to RAN3 to notify the issue.On the other hand, if this issue needs to be determined by RAN1, our view is that NR and LTE have the same definition for RTOA, e.g., the beginning of subframe i containing SRS relative to the configurable reference time, although LTE and NR use different ways to allocate the SRS resources. LTE UL RTOA Reference Time IE is defined in reference to the SFN initialization time with the valid range of a whole frame (TS 36.459) as follows.

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| --- |
| UL RTOA Reference Time (TS 36.459).Time in seconds relative to 00:00:00 on 1 January 1900 (calculated as continuous time without leap seconds and traceable to a common time reference) where binary encoding of the integer part is in the first 32 bits and binary encoding of the fraction part in the last 32 bits. The fraction part is expressed with a granularity of 1 /2\*\*32 second. This IE is defined in reference to the SFN initialization time, TS 36.455 [4]. |

We think RAN3 can follow the same approach to define UL RTOA Reference Time for NR. Above the issue that when SRS are included multiple subframes and whether there is a need to indicate the different subframes for the UL RTOA measurement, we don’t think there is a need to do so. If SRS are transmitted in a sequence of the subframes, the RTOA can use any one of subframes that contain the SRS, there is no need to indicate the subframe offset, since it will not cause the ambiguity for UL RTOA measurement given that 1ms corresponding to 30km in distance. |
| ZTE | We are supportive of 1-3 proposals, but how to capture the definition can be decided by RAN3. |
| Intel | We suggest informing RAN3 that RAN1 has looked into the issue of the reference time for UL RTOA measurement and come up with the following approach and recommendation for consideration by RAN3 WG:The UL RTOA reference time is defined as , where- is the nominal beginning time of SFN 0 provided by [yy] [xx, TS 38.455]- , where and are the system frame number and the subframe number of the SRS.Then it will be up to RAN3 to accept it or modify it.We do not need to change measurement definition now, but we can add placeholder for the reference to RAN3 spec. |
| LG | We are fine with proposal 1, 2, and 3, and sending an LS to RAN3 to inform them of this issue which is needed to be addressed.  |
| Sony | We have similar view as Nokia (i.e NRPPa is RAN3 spec, We just need to send an LS to RAN3). |

# 4 Conclusions and offline consensus

## 4.1 Simultaneous SRS transmission in a single symbol

There is a discussion on whether to support CA for SRSpos. A few companies do not see the gain of supporting CA at this stage, but a majority of companies support the proposal. Qualcomm wants to extend the proposal to cover inter-band CA.

Given the number of potential open issues to be resolved in the proposed extension of the proposal (capabilities, support of Intra or inter CA or both, whether resource from the same set can be across CC), my suggestion would be to first agree or not to the current TP (support intra band CA for SRS pos in rel16), and if needed, take the remaining issue at the next meeting for the details so that each company can propose their analysis of the spec impact. I suppose the capability discussion could be taken in Hiroki’s session either in this meeting or the next one.

FL proposal:

Since the TP has a majority support, I would like to check for a possible compromise on supporting the TP and proposal 1, revised as per Huawei’s comment addressing nokia’s. If we don’t have consensus, the issue can be discussed at a later meeting.

**Proposal for offline consensus: endorse proposal 1 and 2 from R1-2001559 with revision ot proposal 1 based on huawei’s comment, as follow:**

 ***Introduce a new UE capability for the number of SRS resources for positioning on a symbol for intra-band CA, where the SRS resources are on different CCs. The candidate number at least includes {1, 2}.***

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| Company | Comment |
| Qualcomm | So, to understand HW’s comment:* Inter-band SRS + SRS for positioning on the same symbols is allowed and there is no need for separate capability.

“It is our understanding that not allowing simultaneous transmission of SRS for MIMO on different CCs for inter-band CA is not specified. We prefer to keep the same for SRS for positioning.”But for other companies, these features are not supported at all.From our side, we don’t suggest that inter-band is precluded, just that there a separate capability bit for it. So, we still have a preference, to have a capability for both inter-band and intra-band, rather than assuming “implicitly” that is supported.To some additional technical discussion: Is HW’s understanding that the priority rules defined in 38.214 are also applicable for inter-band CA, since again the spec in Rle-15 didn’t write “single carrier + intra-band”? Our understanding of Rel-15 spec is that the priority rules are defined “per CC”. Either way, not sure if this changes the proposal here. We still prefer to have separate capability bit for intra-band and inter-band.  |
| Huawei/HiSilicon | We do not have a strong objection to introduce the inter-band capability bits, but have the following clarification.* First it is not a single bit. It may be reported as number of resources on a symbol, in the granularity of per band combination. Maybe Qualcomm can clarify whether it is reported per UE, per BC, or even per FS?
* For collision rule between different time domain behaviour, I remember the agreement in Rel-15 says single CC, but the spec says generically. I guess it was discussed in MIMO, and we are not supposedly to affect the UE behaviour with respect to processing MIMO SRS.
* In general, we think UE should be able to transmit SRS simultaneously with one from FR1 band and another from FR2 band.
 |
| CATT | We support the proposal for offline consensus. |
| Sony | We think we need more discussion on this topic. The supporting tdoc R1-2001559 said: “*for intra-band CA, transmitting multiple SRS resources on a symbol should be allowed as long as UE capability supports it and the Tx beams are the same.*” It seems the aspect of “Tx beam are the same” has not been covered in the proposed text above. |

## 4.2 Intra-band collision between PosSRS and MimoSRS

The second TP has the majority support. Some support also to have a merge of the two TPs. Companies who propose to merge the two TPs are encouraged to propose a revision on the TP in the comments.

FL proposal:

In order to make progress, and given the majority support for TP#2, could we have offline consensus on the TP#2, and continue the discussion with a potential merge of TP#1

**Proposal for offline consensus: endorse proposal 1 from R1-2002286**

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| Company | Comment |
| Qualcomm | Support |
| Huawei/HiSilicon | OK to have TP#2 first.But honestly, regarding TP#1, we do not see any objection, as both TPs are not mutually exclusive. Suggest to agree with TP#1 in principle and we can work out a merged TP next week. |
| CATT | We support FL proposal and propose the merging with TP#1 as follows,**------------------------Start of Text Proposal to the TS 38.214 ------------------------------------**6.2.1 UE sounding procedure<omitted text>For operations in the same carrier or intra-band CA case(when 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* are in different component carriers), 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 or intra-band CA case(when 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* are in different component carriers), 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 ---------------------------------------** |
| Sony | Support |

## 4.3 PHR for SRSpos

The majority of comments do not want to further discuss the issue in rel16. Most of those opposing the issue are open to discuss It during rel17.

FL proposal:

No offline consensus so far.

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| --- | --- |
| Company | Comment |
| Huawei/HiSilicon | We suggest to make a conclusion that Type 3 PHR based on SRS for positioning is not supported in Rel-16. This is required to stabilize the spec and change “SRS” to “SRS configured by SRS-Resource” in 7.7.3 of 38.213 and to make sure that we do not spend time on this issue next meeting. |
| CATT | We support that this issue can be discussed in Rel-17. |

## 4.4 UL RTOA reference time

There seem to be a consensus on agreeing to the proposals 1 2 and 3 and sending an LS to RAN3. The TP is however not reaching full consensus, at least for the measurement definition.

FL proposal:

**Proposal for offline consensus: proposal 1,2,3 are agreed. Send an LS to RAN3 reflecting the consensus.**

* Continue discussing the scope of the TP (remove bracket only, or include the reference time details proposed in the TP).

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| --- | --- |
| Company | Comment |
| Qualcomm | Can I suggest that proposal 1,2,3 are repeated again in the summary section for easier tracking of the proposals and agrements? For example, Proposal 1 still talks about “search window”, which was not discussed at all. ***Proposal 1: RAN1 continues to discuss the topic of gNB measurement and reaches agreements in RAN1#100b at least on the following issues and sends an LS to RAN3 to notify RAN3 regarding the reached agreements:***1. ***UL RTOA definition***
2. ***~~Search window configuration for gNB to receive SRS.~~***
 |
| Huawei/HiSilicon | Suggest to explicitly write the proposal for agreement. We removed proposal 1 as this is treated as an intermediate wayforwad and the content is also captured by another proposal.One question for clarification is that search window configuration for gNB to receive SRS is not pursued in RAN1 for future meetings, or RAN1 can still discuss it? If it is not pursued in RAN1, we should have a conclusion and also included it in the LS to RAN3.***Proposal: Introduce the following new parameter to the higher layer parameter list.***

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR\_pos-Core | NR UL Measurement Report Configuration | 　 | 　 | FFS in RAN3 WG | SFN Initialization time | SFN initialization time | New | 　 | The nominal beginning time of SFN 0 for SRS | Same as SFN initialization time in LPPaBIT STRING (64) | 　 | 　 | NRPPa 38.455 | 　 | Time in seconds relative to 00:00:00 on 1 January 1900 (calculated as continuous time without leap seconds and traceable to a common time reference) where binary encoding of the integer part is in the first 32 bits and binary encoding of the fraction part in the last 32 bits. The fraction part is expressed with a granularity of 1 /2\*\*32 second. |

***Proposal: The RTOA reference time is defined as T0+tSRS***, ***where**** ***T0 is the nominal beginning time of SFN 0 provided by LMF.***
* ***, where and are the system frame number and the subframe number of the SRS, respectively***

***Proposal: Continue discussing the scope of the TP (remove bracket only, or include the reference time details proposed in the TP)******Proposal: Send an LS to RAN3 reflecting the consensus***[v20] To CATT, are we supposed to conclude TP in this email or next week? If here we are going to discuss the TP, we can compromise to put the agreement RTOA reference definition in […], and then we can remove the current brackets. Simply removing the brackets does not solve the problem at all. |
| CATT | We support the proposal for offline consensus, but for proposal 1, we have the same view with Qualcomm and Huawei/Hisilicon, ***Search window configuration for gNB to receive SRS*** is not the part of agreement.An LS can be sent to RAN3 to inform the issue and RAN1’s recommend solutions. About the TP, we suggest to remove bracket only. And the following texts can be included into the contents of LS for RAN3’s information.The UL RTOA reference time is defined as , where- is the nominal beginning time of SFN 0 provided by [yy] [xx, TS 38.455]- , where and are the system frame number and the subframe number of the SRS. |
| Sony | Same view as Qualcomm. We need to send LS to RAN3 and also continue the discussion on search window configuration for gNB to receive SRS. |

#  5 References

1. R1-2002715 Feature lead summary for UL Reference Signals for NR Positioning, Moderator (Ericsson)
2. R1-2002716 FL Summary of Remaining issues on NR Positioning Measurements, Moderator (CATT)
3. [R1-2001559](file:///C%3A/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
4. R1-2001560 Maintenance of NR positioning measurements Huawei, HiSilicon
5. [R1-2001686](file:///C%3A/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
6. [R1-2002286](file:///C%3A/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