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

Online, February 24th – March 6th, 2020

Agenda Item: 7.2.8.2

Source: Moderator (Ericsson)

Title: TPs and remaining open issues from email discussion [100b-e-NR-Pos-03] on UL SRS for positioning and UL RTOA reference time

Document for: Discussion

# 1 Introduction

This document summarize the discussion regarding the remaining text proposals and open issues from email discussion [100b-e-NR-Pos-03] on UL SRS for positioning and UL RTOA reference time.

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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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The following issues are discussed:

* Simultaneous SRS transmission in a single symbol
	+ FFS: Capability for simultaneous SRS transmission across bands for inter-band CA
	+ Continue discussion on capability for intra-band/inter-band CA, including potential TP to 38.214 to reflect the new capability.
* Intra-band collision between PosSRS and MimoSRS
	+ discuss a potential merge from TP1 until the TP deadline (28/4)
* PHR for SRSpos
	+ TP to reflect the conclusion in 38.213. Use the option 1 TP from R1-2001686 as a starting point.
	+ Note: Option 1 is UE report type 3 PHR only based on SRS configured by *SRS-Resource / ResourceSet.*
* UL RTOA reference time
	+ continue discussing the scope of the TP (e.g. remove bracket only, or include the reference time details proposed in the TP).

# 2 TPs and open issues

## 2.1 Simultaneous SRS transmission in a single symbol

The simultaneous transmission of multiple SRS resources in a symbol was discussed during the email discussion and it was agreed to introduce a capability for transmission of multiple SRS resources in a symbol in intra band CA. the remaining issue is whether to introduce another capability for inter-band CA. Since there is little time for concluding the discussion, we suggest to prioritize getting to an agreement on whether to have a new capability, and treat the details of the capability (e.g.value for number of resources signaled in the capability) as an item in the UE feature discussion or, if companies want to discuss it in this discussion, as a second priority.

During the email discussion, Huawei proposed not to specify the support for inter band CA, as the current specification can be interpreted as already supporting it. Several companies (Vivo, Intel, LG, CATT, Qualcomm) support adding a capability for inter band CA. The options are as follow:

1. For the number of SRS resources for positioning on a symbol for inter-band CA, where the SRS resources are on different CCs
	* + - Option 1: Introduce a new UE capability for the number of simultaneous transmissions of SRS resources for positioning on a symbol for inter-band CA, where the SRS resources are on different CCs.
			- Option 2: do not define a new capability for the number of SRS resources for positioning on a symbol in inter band CA

 The current draft TP for simultaneous transmission of SRS on different CCs is not yet endorsed, and so far focuses on intra-band CA. There is a discussion regarding whether the text should be restricted to simultaneous transmission of SRS resources with the same *resourceType* configuration.

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

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 give their comment on whether to endorse the TP as it is, or provide a suggested rewording, which may or may not include inter band CA based on the preferred option.

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| company | comment |
| Qualcomm | Option 1. For the intra-band CA, we don’t see the need of resourceType-based restriction, so the TP can just be: For intra-band and inter-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] and [YY] respectively.  |
| vivo | We support Option 1 to define a new UE capability for simultaneous transmission of SRS for positioning for inter-band CA. We also prefer the above revised TP from Qualcomm for intra-band CA case.  |
| Huawei/HiSilicon | We are OK with QC’s TP by removing the resourceType restriction for different CCs. With regard to Option 1, it seems like we moved one step forward from support of simultaneous transmissions of SRS resources for positioning for inter-band CA to number of simultaneous transmission of SRS resource for positioning for inter-band CA.Also to echo vivo’s comments, we think option 3 should also be considered?Also when it comes to inter-band CA, we prefer not to use “on a symbol”, as numerologies will be different for different band.* Option 1: Introduce a new UE capability for the number of simultaneous transmissions of SRS resources for positioning ~~on a symbol~~ for inter-band CA, where the SRS resources are on different CCs.
* Option 2: do not define a new capability for ~~the number~~simultaneous transmission of SRS resources for positioning ~~on a symbol~~ in inter band CA
* Option 3: Introduce a new UE capability for support of simultaneous transmission of SRS resources for positioning for inter-band CA, where the SRS resources are on different CCs

To us, we are OK with Option 1 and Option 3. |
| OPPO | We prefer Option 1 |
| CATT | We support Option1.Qualcomm’s updated TP is fine for us. |
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### Summary

There is a consensus to use option 1, with a rewording to remove mention of symbols as the numerology between CC may differ (wording from huawei’s comment):

* + - * Option 1: Introduce a new UE capability for the number of simultaneous transmissions of SRS resources for positioning ~~on a symbol~~ for inter-band CA, where the SRS resources are on different CCs.

The text proposal updated in QC’s comment seem to also be agreeable:

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

1. For intra-band and inter-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] and [YY] respectively.

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

Proposal for offline consensus #1:

* **A new UE capability is introduced for the number of simultaneous transmissions of SRS resources for positioning for inter-band CA, where the SRS resources are on different CCs.**
* **The following text is added to 38.214**

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

1. For intra-band and inter-band CA operations, a UE can simultaneously transmit more than one SRS resources configured by *SRS-PosResource* on different CCs, subject to UE’s capability provided by [XX] and [YY] respectively.

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

## 2.2 Intra-band collision between PosSRS and MimoSRS

The following TP (TP#2 in the email discussion) was agreed:

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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 -----------------------------------------------------------------------------------------------**  |

Several companies proposed to merge the other TP (TP#1) in the discussion to the agreed to. TP#1 is as follow:

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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 ====================== |

 CATT proposed a merge version in the comments to the email discussion:

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| **------------------------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 ------------------------------------** |

Companies are encouraged to provide their view on merging TP#1 to TP#2, as well as proposals for the merged TP

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| Company | Comment |
| Qualcomm | We don’t agree with the new TP. For intra-band CA, we don’t see the problem of having 2 SRS in different CCs independent of whether these 2 resources are one for positioning and for MIMO.  |
| vivo | We do not agree with the reason to have TP#1. We support to have TP#2 only. |
| Huawei/HiSilicon | We are now OK with lifting the restriction for intra-band CA collision after further internal check, which means no additional TP on top of the agreed TP proposed by Intel is needed. |
| CATT | We support the merge of TP#2 and TP#1. In our point of view, for intra-band CA case, suppose two CCs, inter-feature SRS-Pos + SRS-MIMO on overlapping symbols is different with intra-feature SRS-Pos + SRS-Pos, as SRS-MIMO may take up large proportion of Tx power on overlapping symbols, therefore will affect the transmission power of SRS-Pos, or vice versa. However, SRS-Pos + SRS-Pos can avoid such thing by intra-feature coordination.Anyway, we are also fine to only agree TP#2 if most of companies don’t support TP#1, and left TP#1 for next meeting discussion. |

### Summary

Most companies agreed to keep only the agreed TP without merging the proposed TP#1. CATT agrees to only agree to TP2 this meeting and proposed to bring back TP1 next meeting.

Proposal for offline consensus #2:

* Conclusion: No update to the previously agreed TP for Intra-band collision between PosSRS and MimoSRS is needed for this meeting.

## 2.3 PHR for SRSpos

 During the email discussion it was concluded that for release 16, type3 PHR based on SRS for positioning is not supported. In R1-2001686 a text proposal was given to capture the conclusion.

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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 > |

Companies are encouraged to provide their view on the TP and possible edits.

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| Company | Comment |
| Qualcomm | It looks OK |
| Nokia/NSB | Wouldn’t it be more clear to just say that the SRS is configured with SRS-ResourceSet or something similar? As written the first change does not exclude positioning SRS.  |
| vivo | I guess Nokia’s comment is coming from *SRS-Config*, where in TS 38.331 v16.0.0, both SRS for MIMO and SRS for positioning are configured in *SRS-Config*. To address that, the TP should be updated to the following by replacing *SRS-Config* into *SRS-Resource*.

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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-Resource,* 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-Resource，*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 > |

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| Huawei/HiSilicon | OK with vivo’s revision.I adjust the table width in the comment provided by vivo. |
| OPPO | Support vivo’s revision |
| CATT | We share the same view with Nokia/NSB and vivo. As both SRS-MIMO and SRS-Pos are configured by *SRS-Config* IE in TS 38.331, we cannot only use “configured by *SRS-Config*” to distinguish them. Therefore, we updated the TP as follows, and make the change in the first place which SRS appears in this section.

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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 and the actual SRS is configured by *SRS-Resource* 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 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 and the reference SRS is configured by *SRS-Resource* 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 and the reference SRS is configured by *SRS-Resource*, 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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### Summary

Companies support the version revised by Vivo in its comment. In the FL’s view, the CATT version is the same as Vivo’s version in terms of content with the addition of covering the case of the 2 UL carrier case. Since most companies agree to Vivo’s proposal I suggest to edit the update from CATT regarding the 2 UL case into the Vivo TP. The following offline consensus is proposed:

Proposal for offline consensus #3:

The following text is endorsed for inclusion in 38.213:

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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-Resource,* 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-Resource，*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 and the reference SRS is configured by *SRS-Resource*, 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 > |

## 2.4 UL RTOA reference time

 During the email discussion it was agree to introduce the higher layer parameter for the nominal beginning time of SFN 0 (provided by LMF) and to define The RTOA reference time 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

A text proposal was being discussed to capture the agreement in 38.215.

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| ===================== 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 view on the TP and possible edits.

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| Company | Comment |
| Qualcomm | No need to be written in 38.215, we can just remove the brackets and then RAN3 will handle it from there. |
| Nokia/NSB | At this time we only support removing the brackets of the first paragraph and leaving the rest pending RAN3 input or to be resolved at next meeting.  |
| vivo | Same preference as Qualcomm and Nokia. |
| Huawei/HiSilicon | We cannot agree with removing the brackets only in the first paragraph.Look at the following statement. What is the configurable reference time in your mind? The UL Relative Time of Arrival (TUL-RTOA) is the beginning of subframe *i* containing SRS received in positioning node *j*, relative to the configurable reference time.In the agreement that we made, do you expect to capture the equation in RAN3 specification? To us, RAN3 is only going to capture the higher layer signaling, with potential field description on the signaling itself, e.g. SFN initialization time. However how to use that signaling to associate with a PHYSICAL LAYER measurement falls in RAN1 expertise, e.g. the offset . It is OK for us to let RAN3 check whether the definition is feasible from their perspective, but the final spec to capture how to get the RTOA reference time from the higher layer signaling should be in RAN1 based on our understanding. Otherwise I am confused with the WG work split and even the WI description.We are OK to add questionnaire in the LS to consult RAN3 regarding where to capture how to get the RTOA reference time from the higher layer signaling, e.g. in RAN1 or RAN3, but we cannot assume RAN3 will automatically do something that is outside their scope at least based our understanding. In case RAN3 think they do not intend to include it in their spec, RAN1 should do it.In summary, our suggestion is either the following Alt. 1 (first preference) and Alt. 2 (second preference)* Alt. 1 Endorse the TP.
* Alt. 2 Do not change anything to TS 38.215 and send an additional question in the LS to RAN3 regarding RAN1 or RAN3 to capture how to get the RTOA reference time from the higher layer signaling.
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| CATT | As the following descriptions in RED color had been agreed to be included into the LS to RAN3 and let RAN3 to further discuss this issue, we think Alt.2 proposed by Huawei is fine for us. We don’t need change the specs at current stage, and the brackets still keep and wait for the response from RAN3, and then we can decide whether/how to modify the definition of UL-RTOA.===================================================[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.]=================================================== |
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### Summary

3 companies (QC, nokia, vivo) support removing the brackets from 38.215 definition

2 companies (CATT, HW second preference) want to keep the brackets and send an LS to RAN3 including where to put the definition of the UL RTOA reference time (ran1 or ran3 specs)

1 company want to update the 215 spec (HW, first preference).

One way forward would be to remove the bracket and ask where to put the definition in the LS to RAN3. From the LS discussion, it looks like this could be agreeable.

Proposal for offline consensus #4:

The following text is endorsed for 38.215 (brackets are removed from the first paragraph):

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| ===================== 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 configurable reference time. 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 ====================== |

# 3 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