**3GPP TSG-RAN WG1 Meeting #118** **R1- 24NNNN**

Maastricht, Netherlands, August 19th – August 24th, 2024

Agenda Item: 8.1

Source: Moderator (Ericsson)

Title: Feature Lead summary #1 for Maintenance of Positioning for RedCap UEs

Document for: Discussion, Decision

# Introduction

This document summarizes the draft CRs received in RAN1#118 during the maintenance of NR positioning.

For Redcap positioning maintenance, the following draft CRs have been identified. The draft CRs identified as alignment CR candidates are treated by the general alignement CR discussion for positioning maintenance.

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| --- | --- | --- |
| **Tdoc#** | **Title and proposal** | **Comments** |
|  R1-2406019 | Corrections to TS 38.214 on SRS for positioning with frequency hopping Intel Corporation |  See moderator CR C/D |
| R1-2406170  | Draft CR on higher-layer parameter for for SRS transmission with frequency hopping in TS 38.213 vivo | Treated in alignment CR |
| R1-2406171  | Draft CR on higher-layer parameter for SRS frequency hopping in TS 38.211 vivo | Treated in alignment CR |
| R1-2406165 | Draft CR on bandwidth part considering SRS frequency hopping for positioning vivo |  See moderator draft CR A |
| R1-2406956 | Corrections on positioning in TS 38.214 ZTE Corporation, Sanechips | See moderator CR B |
| R1-2406351  | Correction on SRS frequency hopping for positioning CATT |  Same topic as x7170See moderator CR C |
| R1-2407170 | Draft CR for correction to SRS for positioning with tx hopping in 38.214 Ericsson | Same topic as x6351See moderator CR C |
| R1-2406953  | Draft CR for collision handling of positioning SRS with Tx hopping in TDD system ZTE Corporation, Sanechips | See moderator CR D |
| R1-2406954 | Draft CR for staircase pattern for SRS Tx hopping in TS 38.211 ZTE Corporation, Sanechips |  See moderator CR E |
| R1-2407099 | Correction on SRS frequency hopping for positioning Nokia | See moderator CR F |
| R1-2407169 | Draft CR for correction to SRS for positioning with tx hopping in 38.211 Ericsson | See moderator CR G |
| R1-2407172 | Draft CR for correction to SRS for positioning with tx hopping in 38.213 Ericsson | Treated in alignment CR |

# Maintenance for Redcap Positioning

## Bandwidth part for SRS frequency hopping for positioning

### Background

In x6165 it is proposed to clarify that the SRS with Tx hopping may be transmitted outside of an active bandwidth part. Currently 38.211 states that the UE shall not transmit SRS outside of an active bandwidth part.

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| **Tdoc#** | **Title and proposal** |
| x6165  | A UE can be configured with up to four bandwidth parts in the uplink with a single uplink bandwidth part being active at a given time. If a UE is configured with a supplementary uplink, the UE can in addition be configured with up to four bandwidth parts in the supplementary uplink with a single supplementary uplink bandwidth part being active at a given time. The UE shall not transmit PUSCH or PUCCH outside an active bandwidth part. For an active cell, the UE (except for reduced capability UE configured with SRS frequency hopping for positioning as described in clause 6.2.1.4.1 of [6, TS 38.214]) shall not transmit SRS outside an active bandwidth part. |

###  First round

From the FL perspective, the specification text may need even further changes, considering that the SRS for positioning is also transmitted in inactive mode and outside the UL active BWP as stated in 38.214. since the BWP behaviour of the SRS for positioning is already captured in 38.214, it may be sufficient to clarify the statement in 38.211 to limit it to the SRS for mimo and exclude SRS for positioning. Hence it is propose in the moderator CR to instead add “configured by *SRS-Resource”*  to the paragraph.

A draft moderator CR is provided in R1-24XXXX\_A. Companies are encouraged to provide their view on the draft CR below:

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| --- | --- |
| **Company** | **Comment** |
| Qualcomm | OK |
| Huawei, HiSilicon | Such change is not needed. 211 should be kept in general. Alternatively, can have a simpler change in the end of the sentence as ‘unless stated otherwise’ and merged in to 211 combo CR from Debdeep.  |
| CATT | OK. HW’s suggestion is also fine to us. |
| ZTE | OK with HW’s suggestion. |
| vivo | Support the CR, and at least we need to indicate the misalignment case or limit it to the cases which can be aligned the wording. Otherwise the misalignment between 38.211 and 38.214 will be existed.In addition, we would like to note 211 also has same indication for CSI-RS

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| --- |
| A UE can be configured with up to four bandwidth parts in the downlink with a single downlink bandwidth part being active at a given time. The UE is not expected to receive PDSCH, PDCCH, or CSI-RS (except for RRM) outside an active bandwidth part. |

 |
| Nokia | OK |

## Slot offset configuration for SRS with tx hopping in TS 38.214

###  Background

In x6956 it is proposed to correct the description of the slot offset configuration with tx hopping is configured:

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| **Tdoc#** | **Title and proposal** |
| x6956 |  The reduced capability UE may be configured via *SRS-PosTx-Hopping*, subject to UE capability, to perform transmit frequency hopping separate from the UL BWP configuration and outside of the UL BWP, where the UE may be configured with subcarrier spacing, CP and bandwidth that are different from the UL active BWP. The reduced capability UE transmit frequency hopping is configured within one SRS resource for positioning, that may be configured with a bandwidth larger than the maximum bandwidth of the reduced capability UE, in RRC\_CONNECTED or RRC\_INACTIVE mode. The reduced capability UE transmit frequency hopping, may be configured with overlapping or non-overlapping frequency hops in the frequency domain. When the reduced capability UE is configured to perform transmit frequency hopping:- it expects to be configured with the following parameters:- starting PRB of the first hop in time domain in *freqDomainShift*- starting slot offset for the first hop in *resourceType* wherein *SRS-PeriodicityAndOffset* for periodic and semi-persistent SRS and *slotOffset* for aperiodic SRS, starting slot offset for each hop following the first hop in *SlotOffsetForRemainingHops*, and starting symbol for each hop in *startPosition*- number of symbols in each hop in *nrofSymbols*- hop bandwidth in *c-SRS*- number of overlapping resource block(s) between hops, if present, in *overlapValue*- number of hops in *numberOfHops*.- it does not expect to be configured with the sum of *startPosition* and *nrofSymbol*s for a hop that exceeds a slot duration.- it expects to be configured with the same periodicity of each hop of an SRS resource with the transmit frequency hopping.<omitted text>  |

###  First round

A draft moderator CR is provided in R1-24XXXX\_B. Companies are encouraged to provide their view on the draft CR below:

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| --- | --- |
| **Company** | **Comment** |
| Huawei, HiSilicon | This one has been reflected in 214 combo CR so can be discussed there.  |
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## Definition of “Cycle” for SRS with tx hopping in 38.214

### Background

In x6165 , x6019 and x7170 it is proposed to either remove the brackets on “cycle” or clarify the wording in the paragraph describing the case of overlapping srs with tx hopping transmission with a configured UL tx window.

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| **Tdoc#** | **Title and proposal** |
| x6351  |  The reduced capability UE may be configured, via srs-PosUplinkTransmissionWindowConfig, subject to UE capability, with an UL time window where the UE is not expected to transmit other signals/channels and is only expected to transmit the SRS for positioning using frequency hopping. The UE is not expected to be configured with one cycle of the transmit frequency hopping, including the switching time from/to active BWP required ahead of the first hop and after the last hop, that is partially overlapped with the time window. |
| X7170 | The reduced capability UE may be configured, via *srs-PosUplinkTransmissionWindowConfig*, subject to UE capability, with an UL time window where the UE is not expected to transmit other signals/channels and is only expected to transmit the SRS for positioning using frequency hopping. The UE is not expected to be configured to transmit a SRS resource with positioning with transmit frequency hopping, including the switching time from/to active BWP required ahead of the first hop and after the last hop, that is partially overlapped with the time window.  |
| x6019 | The reduced capability UE may be configured, via *srs-PosUplinkTransmissionWindowConfig*, subject to UE capability, with an UL time window where the UE is not expected to transmit other signals/channels and is only expected to transmit the SRS for positioning using frequency hopping. The UE is not expected to be configured with one cycle of the transmit frequency hopping, including the switching time from/to active BWP required ahead of the first hop and after the last hop, that is partially overlapped with the time window.  |

###  First round

Let’s check the views on the two candidate CRs. The moderator CR C is based on x6351. Companies are encouraged to provide their view on the draft CR below:

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| **Company** | **Comment** |
| Qualcomm | The word “one cycle” is still not a good option. We need some discussion to understand what was really the intention of the “cycle”. If the intention was to say that all the hops need to be within a single time window, the x7170 proposal doesn’t say that. Something like the following could say that more clearly:The UE is expected to be configured with a SRS resource for positioning with transmit frequency hopping which has all the hops, including the switching time from/to active BWP required ahead of the first hop and after the last hop, fully overlapped with a single instance of a time window. If the intention was to say that a hop should not partially overlap with a time window, then indeed x7170 appears to be enough, however, this allows the hops to straddle across time window instances.  |
| Huawei, HiSilicon | Suggested as: The UE does not expect to be configured with a SRS resource for positioning with transmit frequency hopping with the time duration from the fist hop till the last hop, including the switching time from/to active BWP required ahead of the first hop and after the last hop, fully overlapped with a single instance of a time window.  |
| CATT | In our view, the configured SRS resource for positioning should be *within* the single instance of a time window, but does not have to fully overlapping *with* it. Suggested change:The UE is - expected to be configured with a SRS resource for positioning with transmit frequency hopping with the time duration from the fist hop till the last hop, including the switching time from/to active BWP required ahead of the first hop and after the last hop, fully overlapped within a single instance of a time window |
| Samsung  | I thought the agreement (note) is to ensure there is no partial overlap, meaning the window will contains full SRS hops, but what QC and HW suggested that “UE does not expect such time span of a full hop cycle to fully overlap with time window”, which is contradict to the original agreement. Suggested as (red change based on HW’s version): The UE does not expect to be configured with a SRS resource for positioning with transmitting frequency hopping with the time duration from the first hop till the last hop, including the switching time from/to active BWP required ahead of the first hop and after the last hop, partially overlapped with ~~a single instance of~~ a time window.  |
| Nokia | We hope this issue could be resolved in this meeting. We have the following suggestion.The UE is expected to be configured with a SRS resource for positioning with transmit frequency hopping within a time duration which includes all the hops, including the switching time from/to active BWP required ahead of the first hop and after the last hop, fully overlapped with a single instance of a time window.  |

## collision handling of positioning SRS with Tx hopping in TDD

###  Background

In x6953 it is proposed to add text to capture the SRS behaviour when colliding with downlink transmission in TDD. This issue was previously discussed and most commenting companies opposed the change and prefer to treat the collision as an error case. In x6019 the issue is similar, but the solution is to instead point to relevant clauses.

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| **Tdoc#** | **Title and proposal** |
| x6953  |  If the SRS symbol(s), including the switching time to and from the active bandwidth part, of the transmit frequency hopping collides with PUSCH or PUCCH, and if the UE determines the SRS to be dropped, the colliding SRS symbol(s) are dropped. In unpaired spectrum, if the SRS symbol(s), including the switching time to and from the active bandwidth part, of the transmit frequency hopping collides with DL signals or channels, and if the UE determines the SRS to be dropped, the colliding SRS symbol(s) are dropped. |
| x6019 | When the reduced capability UE is configured by the higher layer parameter *SRS-PosTx-Hopping*, including a switching time to and from the active bandwidth part, the UE shall use the same priority rules as defined in Clause 6.2.1 and Clause 7.5, 8.1, 11.1, 11.2A and 17.2 in [6, TS38.213]. |

###  First round

From the FL perspective, the proposal in x6019 seems simpler and avoids repeating the rules on collision. A draft moderator CR is provided in R1-24XXXX\_D. Companies are encouraged to provide their view on the draft CR below:

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| --- | --- |
| **Company** | **Comment** |
| Qualcomm | Would a merged version of the above proposal be useful? Something like: the following with X,Y,Z to be populated accordingly:If the SRS symbol(s), including the switching time to and from the active bandwidth part, of the transmit frequency hopping collides with PUSCH or PUCCH, and if the UE determines the SRS to be dropped according to the priority rules defined in Clause X and Y, the colliding SRS symbol(s) are dropped. In unpaired spectrum, if the SRS symbol(s), including the switching time to and from the active bandwidth part, of the transmit frequency hopping collides with DL signals or channels, and if the UE determines the SRS to be dropped according to the priority rules defined in Clause Z and W, the colliding SRS symbol(s) are dropped. |
| Huawei, HiSilicon | For the addition of ‘in unpaired spectrum…..’, when the DL can be actually used for switching or retuning as allowed as legacy, does it mean UE behavior will change to drop the collided SRS symbol instedad? |
| ZTE | Support in general.OK with either version from Intel or Qualcomm. |
| vivo | We prefer not discuss those CR, and don’t think we can consider all the cases |

## Staircase pattern for SRS Tx hopping in TS 38.211

###  Background

In x6954 it is proposed to clarify in 38.211 that since only the wrapped staircase pattern may be configured, the list of slot offsets must be sequentially in ascending order, i.e. *SlotOffsetForRemainingHops* in *slotOffsetForRemainingHopsList* are in ascending order.

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| **Tdoc#** | **Title and proposal** |
| x6954  |  - $n\_{SRS}^{TxHopping}=0,1,…,N\_{hops}^{SRS}-1$ is the hop transmission counter in the time domain, where $n\_{SRS}^{TxHopping}=1,2,…,N\_{hops}^{SRS}-1 $ corresponds to the order of the higher-layer parameter *SlotOffsetForRemainingHops* in *slotOffsetForRemainingHopsList*, wherein the UE expects to be configured with hops in an ascending order sequentially in time domain. |

###  First round

A draft moderator CR is provided in R1-24XXXX\_E. Companies are encouraged to provide their view on the draft CR below:

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| --- | --- |
| **Company** | **Comment** |
| Qualcomm | Support |
| Futurewei | Ok.  |
| CATT | OK |
| Samsung  | May not needed“$n\_{SRS}^{TxHopping}=0,1,…,N\_{hops}^{SRS}-1$” which is already ascending order sequentially |
| ZTE | SupportTo samsung, we agree that $n\_{SRS}^{TxHopping}=0,1,…,N\_{hops}^{SRS}-1$ is already ascending order sequentially. However, the transmission counter $n\_{SRS}^{TxHopping}$ for SRS Tx hopping corresponds to the order of higher layer parameter for hops. However, there is no such restriction in either RAN1’s spec or RAN2’s spec, and the (wrapped) staircase pattern can not be guaranteed. |
| Vivo | Same view as Samsung, otherwise why $n\_{SRS}^{TxHopping}$ is called hop transmission counter in the time domain |
| Nokia | OK |

##  Sequence generation for SRS Tx hopping in TS 38.211

###  Background

 In x7099, it is proposed to change the text on sequence generation for SRS with tx hopping in 38.211. the current specification states that each hop is generated separately. The concern in x7099 is that the overall transmitted SRS is not a ZC sequence anymore.

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| **Tdoc#** | **Title and proposal** |
| x7099  |  The sounding reference signal sequence for an SRS resource shall be generated according to $r^{(p\_{i})}\left(n,l'\right)=w\_{TDM}^{(p\_{i})}\left(l'\right)r\_{u,v}^{(α\_{i},δ)}\left(n\right)$ $0\leq n\leq M\_{sc,b}^{SRS}-1$ $l'\in \left\{0,1,…,N\_{symb}^{SRS}-1\right\}$where $M\_{sc,b}^{SRS}$ is given by clause 6.4.1.4.3, $r\_{u,v}^{\left(α,δ\right)}(n)$ is given by clause 5.2.2 with $δ=log\_{2}\left(K\_{TC}\right)$ and the transmission comb number $K\_{TC}\in \left\{2,4,8\right\}$ is contained in the higher-layer parameter *transmissionComb*. The quantity $l'\in \left\{0,1,…,N\_{symb}^{SRS}-1\right\}$ is the OFDM symbol number within the SRS resource.**<Unchanged parts are omitted>** |

###  First round

A draft moderator CR is provided in R1-24XXXX\_F. Companies are encouraged to provide their view on the draft CR below:

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| --- | --- |
| **Company** | **Comment** |
| Qualcomm | Do not support. If our understanding is correct, this proposal says that a UE will generate a long sequence according to the large BW (summed BW of all the hops), and then transmit parts of that long sequence on different symbolsThis violates our understanding of the agreement and the feature overall. Our understanding is that the UE will be generating sequence according to the hop BW and we don’t introduce a “large sequence” that the UE transmits in “split manner”. We didn’t agree to generate new waveforms to transmit for SRS, and this proposal is actually doing that.  |
| Huawei, HiSilicon | Not support. Agree with QC. The PAPR should be lower if keeping the sequence generated per hop.  |
| ZTE | Do not support. |
| Nokia | Support. In our understanding, SRS resource-based sequence generation is aligned with what we have used since Rel-16 from the gNB perspective so that the gNB can see a single ZC sequence from an SRS resource. PAPR issue could be further discussed.  |

## Starting position for SRS Tx hopping in TS 38.211

###  Background

 In x7169 it is proposed to clarify which parameter configures the starting position for each hop:

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| **Tdoc#** | **Title and proposal** |
| x7169  |  - $l\_{0}$, the starting position in the time domain given by $l\_{0}=N\_{symb}^{slot}-1-l\_{offset}$ where the offset $l\_{offset}\in \left\{0,1,…,13\right\}$ counts symbols backwards from the end of the slot and is given by the field *startPosition* contained in the higher layer parameter *resourceMapping* and $l\_{offset}\geq N\_{symb}^{SRS}-1$. If $N\_{hop}>1$ $l\_{0}$ is the starting position of each hop in the time domain, determined by the field *startPosition* contained in the higher layer parameter *resourceMapping* for the first hop and contained in the higher layer parameter *SlotOffsetForRemainingHops* for each remaining SRS transmission hop. |

###  First round

A draft moderator CR is provided in R1-24XXXX\_G. Companies are encouraged to provide their view on the draft CR below:

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| --- | --- |
| **Company** | **Comment** |
| Huawei, HiSilicon | Not needed. The original spec is clear since the parameter *startPosition* applied to both the first hop and the remaining hops. |
| Samsung  | Agree with hw, the “If $N\_{hop}>1$ $l\_{0}$ is the starting position of each hop in the time domain, determined by the field *startPosition*”, already say it is for each hop |
|  |  |
|  |  |

# Offline Sessions

TBD

# Online sessions

TBD

# Conclusion

 TBD

#  References

1. R1-2406019 Corrections to TS 38.214 on SRS for positioning with frequency hopping Intel Corporation
2. R1-2406165 Draft CR on bandwidth part considering SRS frequency hopping for positioning vivo
3. R1-2406170 Draft CR on higher-layer parameter for for SRS transmission with frequency hopping in TS 38.213 vivo
4. R1-2406171 Draft CR on higher-layer parameter for SRS frequency hopping in TS 38.211 vivo
5. R1-2406351 Correction on SRS frequency hopping for positioning CATT
6. R1-2406953 Draft CR for collision handling of positioning SRS with Tx hopping in TDD system ZTE Corporation, Sanechips
7. R1-2406954 Draft CR for staircase pattern for SRS Tx hopping in TS 38.211 ZTE Corporation, Sanechips
8. R1-2406956 Corrections on positioning in TS 38.214 ZTE Corporation, Sanechips
9. R1-2407099 Correction on SRS frequency hopping for positioning Nokia
10. R1-2407169 Draft CR for correction to SRS for positioning with tx hopping in 38.211 Ericsson
11. R1-2407170 Draft CR for correction to SRS for positioning with tx hopping in 38.214 Ericsson
12. R1-2407172 Draft CR for correction to SRS for positioning with tx hopping in 38.213 Ericsson