3GPP TSG-RAN WG1 #117 R1- 24NNNN

Fukuoka city, Fukuoka, Japan, May 20th – May 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#117 during the maintenance of

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| * Specify support of positioning for UEs with Reduced Capabilities (RedCap UEs)
	+ Specify support of Frequency Hopping (FH) beyond maximum RedCap UE bandwidth for reception of DL PRS and transmission of UL SRS for positioning [RAN1, RAN2].
		- NOTE: The complexity of the corresponding capabilities for RedCap UEs should be addressed for the introduction of appropriate capabilities for RedCap UEs.
	+ Specify RRM requirements for positioning including RRM measurements and procedures for RedCap UEs for both with and without frequency hopping [RAN4].
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# Maintenance for Redcap Positioning

## Summary of received draft CRs

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| --- | --- | --- |
| **Tdoc#** | **Title and proposal** | **Comments** |
| [2] x3970 | Correction on collision handling of positioning SRS with frequency hopping in TDD systems | Unresolved issue from previous meeting, to be discussed. |
| [3] x3971 | Corrections on positioning SRS with frequency hopping | parameter alignments for 214. Can be handled together with x5289 and x4155 |
| [5] x4155 | Draft CR on SRS frequency hopping for positioning | We can discuss the part on aperiodic SRS separately. The rest of the proposed changes are similar to x3971 and x5289, so we can work on a common CR for that.  |
| [6] x4993 | Draft CR for collision handling of positioning SRS with Tx hopping in TDD system | Similar issue treated in 4993, should be dicsussed together. |
| [8] x4995 | Draft CR for RedCap UE frequency hopping  | Similar issues as in 4155, for parameter names and slot offset definition. Can be handled with x5289 and x4155, respectively. |
| [9] x5288 | Draft CR for correction to SRS for positioning with tx hopping in 38.211 | Correct to parameter names and on the parameter applicable to the hop counter. |
| [10] x5289 | Draft CR for correction to SRS for positioning with tx hopping in 38.214 | can be discussed together with x4155, x3971,x4995 |
| [11] x5315 | Correction to 38.211 on the transmission counter | Correction to the description of the Hop counter in 211, can be discussed together with x5288. |

## Hop counter in 38.211

### Background

In x5288, x5315 it is proposed to clarify the use of the hop counter in the hopping equation in 38.211:

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| **Tdoc#** | **Title and proposal** |
| x5288 | - $n\_{SRS}^{TxHopping}=0,1,…,N\_{hops}^{SRS}-1$is the hop transmission counter in the time domain, which corresponds to the order of the higher-layer parameter *SlotOffsetForRemainingHopsList*. |
| x5315 |  $n\_{SRS}^{TxHopping}=0,1,…,N\_{hops}^{SRS}-1$ 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*. |

###  First round

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** |
| vivo | OK |
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## Starting slot offset description in 214

### Background

In x4155 and x4995, it is proposed to clarify the parameters for starting slot offset, which are differently named for periodic/semi-persistent and aperiodic SRS.

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| **Tdoc#** | **Title and proposal** |
| x4155 | 6.2.1.4.1 SRS frequency hopping for positioning<omitted text> 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 each hop in *slotOffset* for aperiodic SRS or *periodicityAndOffset* for periodic or semi-persistent SRS, and starting symbol for each hop in *startingPosition*- 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*. <omitted text>  |
| x4995 | 6.2.1.4.1 SRS frequency hopping for positioning<omitted text>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 *SRS-PeriodicityAndOffset*, starting slot offset for each hop following the first hop in *slotOffset* 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*. <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** |
| vivo | x4155 based on the agreementAgreementFor the values of the starting slot offset for each of the hops following the first hop in time:* Alt1: the value range can be {0,1,2…, nrof slot in periodicity -1} in slots for the slot offset.
* The value range slot offset for each hop applies to both the periodic and semi-persistent SRS.
* The periodicity in PeriodicityandOffset configured for each hop for a SRS resource with Tx hopping must be the same.
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## Parameter names for 38.211

### Background

The following CR changes have been proposed:

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| **Tdoc#** | **Title and proposal** |
| x5288 | 6.4.1.4 Sounding reference signal6.4.1.4.1 SRS resource<--------------------------unchanged text ommited------------------------------>- $N\_{hop}$, the number of hops for SRS Tx hopping for an SRS resource configured by *SRS-PosResource* given by the higher layer parameter *numberOfHops* if configured, otherwise $N\_{hop}=1$.<--------------------------unchanged text ommited------------------------------>6.4.1.4.2 Sequence generationThe sounding reference signal sequence for an SRS resource, or if *numberOfHops* for *SRS-PosResource* is provided, for a given hop within an SRS resource, shall be generated according to $r^{(p\_{i})}\left(n,l'\right)=w\_{TDM}^{(p\_{i})}\left(l'\right)r\_{u,v}^{(α\_{i},δ)}\left(n\right)$ $0\leq n\leq M\_{sc,b}^{SRS}-1$ $l'\in \left\{0,1,…,N\_{symb}^{SRS}-1\right\}$<--------------------------unchanged text ommited------------------------------>6.4.1.4.3 Mapping to physical resourcesThroughout this clause, when the higher layer parameter *numberOfHops* is provided for *SRS-PosResource*, the sounding reference signal sequence definitions applies to a given hop.<--------------------------unchanged text ommited------------------------------> if the higher-layer parameter *EnableStartRBHopping* is configured, otherwise $k\_{hop}=0$.- $m\_{overlap}^{hop}\in \left\{0,1,2,4\right\}$ is given by the higher-layer parameter *overlapValue*.- $n\_{SRS}^{TxHopping}=0,1,…,N\_{hops}^{SRS}-1$is the hop transmission counter in the time domain, which corresponds to the order of the higher-layer parameter *SlotOffsetForRemainingHopsList*.- $n\_{init}^{hop}=\left⌊{n\_{shift}}/{\left(m\_{SRS,0}-m\_{overlap}^{hop}\right)}\right⌋$ is the initial hop index.<--------------------------unchanged text ommited------------------------------>If *numberOfHops* is configured:- The reference point for $k\_{0}^{(p\_{i})}=0$ is the lowest subcarrier of the configured bandwidth for SRS with Tx hopping configured by the parameter bwp in *SRS-PosTx-Hopping*. <--------------------------unchanged text ommited------------------------------> |
| x5315 | - $m\_{overlap}^{hop}\in \left\{0,1,2,4\right\}$ is given by the higher-layer parameter *overlapValue* in *TxHoppingConfig*. |

###  First round

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

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| **Company** | **Comment** |
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## Collision handling of positioning SRS with frequency hopping in TDD systems

### Background

The following CR changes have been proposed:

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| **Tdoc#** | **Title and proposal** |
| x3970 | 6.2.1.4.1 SRS frequency hopping for positioning**<Unchanged parts are omitted>**In RRC\_CONNECTED mode, for a transmission of a hop for an SRS resource for positioning with frequency hopping starting in symbol $N\_{c\_{1}}$ and a colliding PUSCH or PUCCH transmission$ $starting in symbol $N\_{S} $, the UE shall apply the dropping rules taking into account:- DCI(s) for which the time interval between the last symbol of PDCCH and the SRS symbol $N\_{c\_{1}}$is at least $N\_{2}$ symbols and additional time duration $T\_{SRS\_{h}}$, where $T\_{SRS\_{h}}$ is the switching time to/from the active BWP.- DCI(s) for which the time interval between the last symbol of PDCCH and the colliding PUSCH/PUCCH symbol $N\_{S} $is at least $N\_{2}$ symbols, where calculation of $N\_{2}$ is based on the smallest SCS between the SCS configured for positioning SRS with the frequency hopping, the SCS of the PUSCH/PUCCH, and the SCS of the PDCCH.- semi-persistent CSI reports or SRS considered active at least $N\_{2}$ symbols and an additional time duration $T\_{SRS\_{h}}$ before $N\_{c\_{1}}$, and considered active at least $N\_{2}$ symbols before $N\_{S}$.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 other DL signals or channels, and if the UE determines the SRS to be dropped, the colliding SRS symbol(s) are dropped.When the reduced capability UE is configured by the higher layer parameter *txFHRedCapSrs-PosResource*, 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.**<Unchanged parts are omitted>** |
| x4993 | 6.2.1.4.1 SRS frequency hopping for positioning<omitted text>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. |

###  First round

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** |
| vivo | The modification will introduce new problem, e,g., how determine the priority rule between DL and SRS, based on our understanding, there are no priority rule between DL and SRS in RRC\_Connected state in 6.2.1. |
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## Parameter names for 38.214

###  Background

The following CR changes have been proposed:

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| **Tdoc#** | **Title and proposal** |
| x4155 | 6.2.1.4.1 SRS frequency hopping for positioningThe 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 each hop in *slotOffset* and starting symbol for each hop in *startingPositioning*- 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 *startingPosition* and *nrofSymbols*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.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. For aperiodic positioning SRS with Tx frequency hopping, the minimal time interval between the last symbol of the PDCCH triggering the aperiodic SRS transmission and the first symbol of SRS resource is *N2* symbols and an additional time duration corresponding to the switching time from the active uplink BWP.The reduced capability UE is expected to switch back to the active BWP if the time between two consecutive hops exceeds twice the switching time from/to the active BWP.In RRC\_CONNECTED mode, for a transmission of a hop for an SRS resource for positioning with frequency hopping starting in symbol $N\_{c\_{1}}$ and a colliding PUSCH or PUCCH transmission$ $starting in symbol $N\_{S} $, the UE shall apply the dropping rules taking into account:- DCI(s) for which the time interval between the last symbol of PDCCH and the SRS symbol $N\_{c\_{1}}$is at least $N\_{2}$ symbols and additional time duration $T\_{SRS\_{h}}$, where $T\_{SRS\_{h}}$ is the switching time to/from the active BWP.- DCI(s) for which the time interval between the last symbol of PDCCH and the colliding PUSCH/PUCCH symbol $N\_{S} $is at least $N\_{2}$ symbols, where calculation of $N\_{2}$ is based on the smallest SCS between the SCS configured for positioning SRS with the frequency hopping, the SCS of the PUSCH/PUCCH, and the SCS of the PDCCH.- semi-persistent CSI reports or SRS considered active at least $N\_{2}$ symbols and an additional time duration $T\_{SRS\_{h}}$ before $N\_{c\_{1}}$, and considered active at least $N\_{2}$ symbols before $N\_{S}$.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.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.For operation in the same carrier, the reduced capability UE is not expected to be configured on overlapping symbols with an SRS resource of the transmit frequency hopping configured by the higher layer parameter *SRS-PosTx-Hopping* including the switching time to or from the active bandwidth part and an SRS resource with *resourceType* of both SRS resources as 'periodic'.For operation in the same carrier, the reduced capability UE is not expected to be activated or triggered to transmit SRS on overlapping symbols with a SRS resource of the transmit frequency hopping configured by the higher layer parameter *SRS-PosTx-Hopping* including the switching time to or from the active bandwidth part and a SRS resource with *resourceType* of both SRS resources as 'semi-persistent' or 'aperiodic'.<omitted text> |
| x5289 | 6.4.1.4.1 SRS frequency hopping for positioningThe 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 each hop in *slotOffset* 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 [*StartingSymbol*] and [*Length*] 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.The reduced capability UE may be configured, via*SRS-PosTx-Hopping* , 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. For aperiodic positioning SRS with Tx frequency hopping, the minimal time interval between the last symbol of the PDCCH triggering the aperiodic SRS transmission and the first symbol of SRS resource is *N2* symbols and an additional time duration corresponding to the switching time from the active uplink BWP.The reduced capability UE is expected to switch back to the active BWP if the time between two consecutive hops exceeds twice the switching time from/to the active BWP.In RRC\_CONNECTED mode, for a transmission of a hop for an SRS resource for positioning with frequency hopping starting in symbol $N\_{c\_{1}}$ and a colliding PUSCH or PUCCH transmission$ $starting in symbol $N\_{S} $, the UE shall apply the dropping rules taking into account:- DCI(s) for which the time interval between the last symbol of PDCCH and the SRS symbol $N\_{c\_{1}}$is at least $N\_{2}$ symbols and additional time duration $T\_{SRS\_{h}}$, where $T\_{SRS\_{h}}$ is the switching time to/from the active BWP.- DCI(s) for which the time interval between the last symbol of PDCCH and the colliding PUSCH/PUCCH symbol $N\_{S} $is at least $N\_{2}$ symbols, where calculation of $N\_{2}$ is based on the smallest SCS between the SCS configured for positioning SRS with the frequency hopping, the SCS of the PUSCH/PUCCH, and the SCS of the PDCCH.- semi-persistent CSI reports or SRS considered active at least $N\_{2}$ symbols and an additional time duration $T\_{SRS\_{h}}$ before $N\_{c\_{1}}$, and considered active at least $N\_{2}$ symbols before $N\_{S}$.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.When the reduced capability UE is configured by the higher layer parameter *txFHRedCapSrs-PosResource*, 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.For operation in the same carrier, the reduced capability UE is not expected to be configured on overlapping symbols with an SRS resource of the transmit frequency hopping configured by the higher layer parameter [*to\_be\_defined*] including the switching time to or from the active bandwidth part and an SRS resource with *resourceType* of both SRS resources as 'periodic'.For operation in the same carrier, the reduced capability UE is not expected to be activated or triggered to transmit SRS on overlapping symbols with a SRS resource of the transmit frequency hopping configured by the higher layer parameter *SRS-PosTx-Hopping* including the switching time to or from the active bandwidth part and a SRS resource with *resourceType* of both SRS resources as 'semi-persistent' or 'aperiodic'. |
| x3971 | 6.2.1.4.1 SRS frequency hopping for positioningThe 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 each hop in *slotOffset* and starting symbol for each hop in *startingPositioning*- 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 *startingPosition* and *nrofSymbols*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.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. For aperiodic positioning SRS with Tx frequency hopping, the minimal time interval between the last symbol of the PDCCH triggering the aperiodic SRS transmission and the first symbol of SRS resource is *N2* symbols and an additional time duration corresponding to the switching time from the active uplink BWP.The reduced capability UE is expected to switch back to the active BWP if the time between two consecutive hops exceeds twice the switching time from/to the active BWP.In RRC\_CONNECTED mode, for a transmission of a hop for an SRS resource for positioning with frequency hopping starting in symbol $N\_{c\_{1}}$ and a colliding PUSCH or PUCCH transmission$ $starting in symbol $N\_{S} $, the UE shall apply the dropping rules taking into account:- DCI(s) for which the time interval between the last symbol of PDCCH and the SRS symbol $N\_{c\_{1}}$is at least $N\_{2}$ symbols and additional time duration $T\_{SRS\_{h}}$, where $T\_{SRS\_{h}}$ is the switching time to/from the active BWP.- DCI(s) for which the time interval between the last symbol of PDCCH and the colliding PUSCH/PUCCH symbol $N\_{S} $is at least $N\_{2}$ symbols, where calculation of $N\_{2}$ is based on the smallest SCS between the SCS configured for positioning SRS with the frequency hopping, the SCS of the PUSCH/PUCCH, and the SCS of the PDCCH.- semi-persistent CSI reports or SRS considered active at least $N\_{2}$ symbols and an additional time duration $T\_{SRS\_{h}}$ before $N\_{c\_{1}}$, and considered active at least $N\_{2}$ symbols before $N\_{S}$.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.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.For operation in the same carrier, the reduced capability UE is not expected to be configured on overlapping symbols with an SRS resource of the transmit frequency hopping configured by the higher layer parameter *SRS-PosTx-Hopping* including the switching time to or from the active bandwidth part and an SRS resource with *resourceType* of both SRS resources as 'periodic'.For operation in the same carrier, the reduced capability UE is not expected to be activated or triggered to transmit SRS on overlapping symbols with a SRS resource of the transmit frequency hopping configured by the higher layer parameter *SRS-PosTx-Hopping* including the switching time to or from the active bandwidth part and a SRS resource with *resourceType* of both SRS resources as 'semi-persistent' or 'aperiodic'. |
| x4995 | **5.1.6.5.1 PRS receiver frequency hopping**The reduced capability UE may be configured to measure and report, subject to UE capability, via  *nr-DL-PRS-RxHoppingRequest* the DL RSTD, DL PRS-RSRP, DL PRS-RSRPP, or UE Rx-Tx time difference using receiver frequency hopping for a DL PRS resource, with a requested bandwidth of all hops that may be greater than the maximum reduced capability UE bandwidth. The reduced capability UE performing receiver frequency hopping may report via *nr-ReportDL-PRS-MeasBasedOnSingleOrMultiHopR*x one measurement associated with one received frequency hop or one measurement based on multiple hops of the DL PRS. The reduced capability UE may report whether the measurement is associated with one received frequency hop or multiple frequency hops of the DL PRS. In RRC\_CONNECTED mode, the reduced capability UE is expected to use a single instance of a configured measurement gap to receive all hops of the DL PRS using receiver frequency hopping.6.2.1.4.1 SRS frequency hopping for positioningThe 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 *SRS-PeriodicityAndOffset*, starting slot offset for each hop following the first hop in *slotOffset* 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 *nrofSymbols* 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.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. For aperiodic positioning SRS with Tx frequency hopping, the minimal time interval between the last symbol of the PDCCH triggering the aperiodic SRS transmission and the first symbol of SRS resource is *N2* symbols and an additional time duration corresponding to the switching time from the active uplink BWP.The reduced capability UE is expected to switch back to the active BWP if the time between two consecutive hops exceeds twice the switching time from/to the active BWP.In RRC\_CONNECTED mode, for a transmission of a hop for an SRS resource for positioning with frequency hopping starting in symbol $N\_{c\_{1}}$ and a colliding PUSCH or PUCCH transmission$ $starting in symbol $N\_{S} $, the UE shall apply the dropping rules taking into account:- DCI(s) for which the time interval between the last symbol of PDCCH and the SRS symbol $N\_{c\_{1}}$is at least $N\_{2}$ symbols and additional time duration $T\_{SRS\_{h}}$, where $T\_{SRS\_{h}}$ is the switching time to/from the active BWP.- DCI(s) for which the time interval between the last symbol of PDCCH and the colliding PUSCH/PUCCH symbol $N\_{S} $is at least $N\_{2}$ symbols, where calculation of $N\_{2}$ is based on the smallest SCS between the SCS configured for positioning SRS with the frequency hopping, the SCS of the PUSCH/PUCCH, and the SCS of the PDCCH.- semi-persistent CSI reports or SRS considered active at least $N\_{2}$ symbols and an additional time duration $T\_{SRS\_{h}}$ before $N\_{c\_{1}}$, and considered active at least $N\_{2}$ symbols before $N\_{S}$.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.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.For operation in the same carrier, the reduced capability UE is not expected to be configured on overlapping symbols with an SRS resource of the transmit frequency hopping configured by the higher layer parameter *TxHoppingConfig* including the switching time to or from the active bandwidth part and an SRS resource with *resourceType* of both SRS resources as 'periodic'.For operation in the same carrier, the reduced capability UE is not expected to be activated or triggered to transmit SRS on overlapping symbols with a SRS resource of the transmit frequency hopping configured by the higher layer parameter *TxHoppingConfig* including the switching time to or from the active bandwidth part and a SRS resource with *resourceType* of both SRS resources as 'semi-persistent' or 'aperiodic'. |

###  First round

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

|  |  |
| --- | --- |
| **Company** | **Comment** |
| vivo | The merged CR by reporter can be considered since each TP may not perfect. |
|   |  |
|  |  |
|  |  |

# Additional proposals

## LS to RAN2 on configuration of SRS with tx hopping pattern

### Background

In [1], it is propose to send an LS to RAN2 on the way SRS hopping is intended to be configured with a wrapped staircase.

|  |  |
| --- | --- |
| Source | Proposal |
| [1] | ***Proposal 3: Send an LS to RAN2 indicating that in order to configure the positioning SRS frequency hopping with (wrapped) staircase patterns, the symbol/slot number of the first hop in time (resourceMapping and resourceType in SRS-PosResource) and the symbol/slot number of the remaining hops in time (slotOffsetForRemainingHopsList) should be in an ascending order sequentially in time domain.*** |

###  First round

We can start by collecting views on the proposal:

|  |  |
| --- | --- |
| **Company** | **Comment** |
|  |  |
|  |  |
|  |  |

# Offline Sessions

TBD

# Online sessions

TBD

# Conclusion

 TBD

#  References

1. R1-2403959 Remaining issues of Rel-18 positioning Huawei, HiSilicon
2. R1-2403970 Correction on collision handling of positioning SRS with frequency hopping in TDD systems Intel Corporation
3. R1-2403971 Corrections on positioning SRS with frequency hopping Intel Corporation
4. R1-2404052 Maintenance on Expanded and Improved NR Positioning Nokia
5. R1-2404155 Draft CR on SRS frequency hopping for positioning vivo
6. R1-2404993 Draft CR for collision handling of positioning SRS with Tx hopping in TDD system ZTE
7. R1-2404994 Discussion on collision handling of positioning SRS with Tx hopping in TDD system ZTE
8. R1-2404995 Draft CR for RedCap UE frequency hopping ZTE
9. R1-2405288 Draft CR for correction to SRS for positioning with tx hopping in 38.211 Ericsson
10. R1-2405289 Draft CR for correction to SRS for positioning with tx hopping in 38.214 Ericsson
11. R1-2405315 Correction to 38.211 on the transmission counter Huawei, HiSilicon