3GPP TSG RAN WG1 #114-bis R1-23NNNNNNN

Xiamen, China, October 9th – 13th, 2023

Agenda Item: 8.3.5

Source: Ericsson

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

Document for: Discussion, Decision

# Introduction

This document summarizes the proposals received as part of Agenda Item 8.3.5 for RAN1#114bis for the Rel-18 work item on expanded and improved NR positioning [1]. The objectives relevant for this agenda item are as follow:

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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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# Text Proposals

Several contribution provided text proposals related to previous agreement already captured in specifications. For these proposal it is possible to discuss directly the TPs.

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| --- | --- | --- |
| Source | Proposal | FL Summary |
| [1] | P8+P9 | 214 captures the FH features for SRS Tx hopping and PRS Rx hopping but limits it to redcap UEs. The TP proposes to remove this limitation. It is also proposed to introduce a sub-clause for PRS rx hopping. |
| [4] | P1 | Since Rx hopping is supported in all RRC modes, MGs are not always needed.  |
|  | P2 | Addition of the missing parameters for SRS Tx hopping in 214.  |
| [17] | P9 | Confirms that MGs for Rx hopping are only for connected mode |
| [18] | P2-2 | Captures the condition that the minimum time difference between the starting symbol of two consecutive hops must be larger than the sum of the switching time and the hop duration.  |
| [14] | P2-2 | Captures the condition that the minimum time difference between the starting symbol of two consecutive hops must be larger than the sum of the switching time and the hop duration.  |
| [11] | P2-2 | Captures the condition that the minimum time difference between the starting symbol of two consecutive hops must be larger than the sum of the switching time and the hop duration.  |

## Applicability of SRS and PRS hopping to non-redcap UEs

### Background

In [1] proposal 8 and 9, the following TP is proposed, to remove the limit of support for Rx hopping to redcap UEs.

FL comment: TP seems reasonable, considering the new feature is already conditioned to a UE capability, it could be signaled by other UEs than RedCap UEs.

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| **TP 2.1-1** |
| reason for change:  | Current specification limits the PRS Rx hopping features to redcap UEs. |
| summary of change:  | remove references to redcap UEs in clause 5.1.6.5. introduce new sub-clause for PRS frequency hopping procedures. |
| Consequences if not approved:  | PRS Rx hopping is limited to redcap UEs. |
| ---------------------------- Start of Text Proposal for TS 38.214 -----------------------------< Unchanged parts are omitted >5.1.6.5 PRS reception procedure< Unchanged parts are omitted >For a UE configured with DL PRS Processing Window(s), when the UE receives an activation/deactivation command, as described in clause 6.1.3.42 of [10, TS 38.321], for a DL PRS processing window activation, and when the UE would transmit a PUCCH with HARQ-ACK information in slot n corresponding to the PDSCH carrying the command, the corresponding actions in [10, TS 38.321] and the UE assumptions shall be applied starting from the first slot that is after slot where ** is the SCS configuration for the PUCCH. The UE is not expected to be indicated with more than 4 activated DL PRS processing windows across all active DL BWPs and is not expected to be indicated with the activated DL PRS processing windows that overlap in time.5.1.6.5.x PRS frequency hopping proceduresThe UE may be configured to measure and report, subject to UE capability, via [higher layer parameter] 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 bandwidth that may be greater than the maximum UE channel bandwidth, within a configured measurement gap. The UE performing receiver frequency hopping may be configured to report via [*higher layer parameter*] one measurement associated with one received frequency hop or one measurement based on multiple hops of the DL PRS. In RRC\_CONNECTED mode, the 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. < Unchanged parts are omitted >--------------------------------------- End of Text Proposal ---------------------------------- |

### Round 1

Companies are encouraged to comment on the proposed TP in the table below

**TP 2.1-1:**

|  |  |
| --- | --- |
| **Company** | **Comment** |
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## Correction for reception of PRS with Rx hopping in RRC\_INACTIVE and RRC\_IDLE

### Background

In [4] Proposal 1, it is noted that the specification limits DL PRS measurements with Rx hopping to the case with measurement gaps. However, for the case of RRC INACTIVE and RRC\_IDLE, gaps are not needed.

In a related proposal, in[17] Proposal 9, it is proposed to remove the brackets around the text “[In RRC\_CONNECTED mode].

FL comment: The TP below is a merge between the TP proposed in [4] and [17]

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| TP 2.2-1 |  |
| Reason for change | In RAN1 previous meeting, the following agreement on PRS Rx hopping had been achieved.

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| AgreementPRS Rx frequency hopping for RRC\_INACTIVE state and for RRC\_IDLE state is supported for a RedCap UE. |

In RRC\_INACTIVE state and RRC\_IDLE state, there is no gap configuration. For PRS Rx frequency hopping for RRC\_INACTIVE state and for RRC\_IDLE state, UE does not need to use measurement gap for PRS reception. |
| Summary of change | Section 5.1.6.5 in 38.214: Clarify for PRS Rx frequency hopping in RRC\_INACTIVE state and RRC\_IDLE state, UE does not need to use measurement gap for PRS reception. |
| Consequences if not approved | UE behavior on PRS Rx frequency hopping in RRC\_INACTIVE state and RRC\_IDLE state is not clear.  |
| Text proposal | TS 38.2145.1.6.5 PRS reception procedure\*\*\*\*\*\*\*\*\*\*\*\*\*\* Unchanged parts omitted\*\*\*\*\*\*\*\*\*\*\*\*\*\*The reduced capability UE may be configured to measure and report, subject to UE capability, via [higher layer parameter] 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 bandwidth that may be greater than the maximum reduced capability UE bandwidth. The reduced capability UE performing receiver frequency hopping may be configured to report via [*higher layer parameter*] one measurement associated with one received frequency hop or one measurement based on multiple 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.\*\*\*\*\*\*\*\*\*\*\*\*\*\* Unchanged parts omitted\*\*\*\*\*\*\*\*\*\*\*\*\*\* |

### Round 1

Companies are encouraged to comment on the proposed TP in the table below

**TP 2**.**2-1:**

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| **Company** | **Comment** |
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## Correction for the configuration of the SRS for positioning with Tx Hopping

### Background

In [4] Proposal 2 and [6] proposal 4 and [7] proposal 1, it is proposed to captured the remaining agreed parameters of SRS with frequency hopping, based on the following RAN1#114 agreement:

|  |
| --- |
| AgreementFor SRS Tx hopping, the configuration includes:* a hop bandwidth common to all hops
	+ FFS: possible values
* a single overlap value can be configured for all hops for the SRS resource
	+ FFS: possible values
* The starting slot offset and starting symbol for the SRS resource with tx hopping (first hop)
	+ FFS: possible values
* the starting slot offset and symbol for each of the hops following the first hop,
	+ Note Up to ran2 to design signaling of the starting position for each hop, i.e. how the SRS resource configuration signaling indicates the starting slot offset and starting symbol for the hops following the first hop
	+ FFS: possible values
* The number of consecutive symbols in a hop common to all hops
	+ FFS: possible values
* The number of hops
	+ FFS: possible values
* UE does not expect to be configured for any hops across slot boundaries, i.e.the starting position + duration of a hop cannot exceed a slot duration
* FFS: whether/how special handling for the last hop overlap
 |

FL comment: this TP is similar to one of the comment made during the editor’s email discussion. At the time, the editor’s view was that not all parameters needed to be in 214:

|  |  |  |  |
| --- | --- | --- | --- |
| Ericsson | For Redcap positioning: the parameters for SRS tx hopping could be added, based on the following agreements. AgreementSRS for positioning with Tx hopping can be configured outside of the active UL BWP* The configuration may include SCS, CP size and bandwidth (position and size), which can use a SCS, CP size and bandwidth different from the UL active BWP

AgreementFor SRS Tx hopping, the configuration includes:* a hop bandwidth common to all hops
	+ FFS: possible values
* a single overlap value can be configured for all hops for the SRS resource
	+ FFS: possible values
* The starting slot offset and starting symbol for the SRS resource with tx hopping (first hop)
	+ FFS: possible values
* the starting slot offset and symbol for each of the hops following the first hop,
	+ Note Up to ran2 to design signaling of the starting position for each hop, i.e. how the SRS resource configuration signaling indicates the starting slot offset and starting symbol for the hops following the first hop
	+ FFS: possible values
* The number of consecutive symbols in a hop common to all hops
	+ FFS: possible values
* The number of hops
	+ FFS: possible values
* UE does not expect to be configured for any hops across slot boundaries, i.e.the starting position + duration of a hop cannot exceed a slot duration
* FFS: whether/how special handling for the last hop overlap

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| The reduced capability UE may be configured via [*higher layer parameter*], subject to UE capability, to perform transmit frequency hopping separate from the UL BWP configuration and outside of the UL 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 provided with the following parameters:* The starting slot offset and starting symbol for each hop in [higher layer parameter].starting PRB of the first frequency hop in [higher layer parameter]
* The number of symbols in each hops in [higher layer parameter].
* The hop bandwidth in [higher layer parameter]
* The overlap between hops, if present, in [higher layer parameter]

The number of hops in [higher layer parameter].The UE is not expected to be configured with a SRS with transmit hopping such that [higher param for number of symbols in each hop] + [parameter for starting symbol in the slot for each hop] exceeds  |

 | #1: Not sure if 214 really needs to capture all configuration parameters. |

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| TP 2.3-1 |  |
| Reason for change | All SRS frequency hopping related configuration parameters need to be captured in 6.2.1.4 in 38.214.  |
| Summary of change | Section 6.2.1.4 in 38.214: Clarify SRS frequency hopping related configuration parameters. |
| Consequences if not approved | SRS frequency hopping configuration is not clear in 38.214. |
| Text proposal from[4] | TS 38.2146.2.1.4 UE sounding procedure for positioning purposes\*\*\*\*\*\*\*\*\*\*\*\*\*\* Unchanged parts omitted\*\*\*\*\*\*\*\*\*\*\*\*\*\*The reduced capability UE may be configured via [*higher layer parameter*], 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 provided with the following parameters:.- The starting PRB of the first frequency hop in [higher layer parameter]- The starting slot offset and starting symbol for each hop in [higher layer parameter]- The number of symbols in each hops in [higher layer parameter]- The hop bandwidth in [higher layer parameter]- The overlap between hops, if present, in [higher layer parameter]- The number of hops in [higher layer parameter].\*\*\*\*\*\*\*\*\*\*\*\*\*\* Unchanged parts omitted\*\*\*\*\*\*\*\*\*\*\*\*\*\* |
| Text proposal from [6] | The reduced capability UE may be configured via [*higher layer parameter*], 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 ~~via [higher layer parameter] with the starting PRB of the first frequency hop~~.- the starting PRB of the first hop via [higher layer parameter],- the hop bandwidth via [higher layer parameter],- the number of overlap PRBs between hops via [higher layer parameter],- the starting slot offset and starting symbol of each hop via [higher layer parameter],- the number of consecutive symbols in each hop via [higher layer parameter],- the number of hops via [higher layer parameter]. |
| Text proposal in [7] | <Unrelated part omitted>

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| The reduced capability UE may be configured via [*higher layer parameter*], 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 via [higher layer parameter] with the following parameters for each positioning SRS resource:- the number of hops- a hop bandwidth common to all hops- a single overlap value can be configured for all hops for the SRS resource- the number of consecutive symbols in a hop common to all hops- start symbol and slot offset for each hop- starting PRB of the first frequency hop.where the starting PRB of frequency hop m+1 is equal to the end of PRB of frequency hop m - the single overlap value. And the UE does not expect to be configured for any one hop across slot boundaries. |

<Unrelated part omitted> |

### Round 1

Companies are encouraged to comment on the proposed TPs and comment if there is a preference between the TP in [4][6][7] in the table below

**TP 2**.**3-1:**

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| --- | --- |
| **Company** | **Comment** |
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## Corrections on SRS Tx hopping configuration

### Background

In [13] it is observed that the conditions on hops not being across slot boundaries is not captured in RAN1 specifications.

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| AgreementFor SRS Tx hopping, the configuration includes:* a hop bandwidth common to all hops
	+ FFS: possible values
* a single overlap value can be configured for all hops for the SRS resource
	+ FFS: possible values
* The starting slot offset and starting symbol for the SRS resource with tx hopping (first hop)
	+ FFS: possible values
* the starting slot offset and symbol for each of the hops following the first hop,
	+ Note Up to ran2 to design signaling of the starting position for each hop, i.e. how the SRS resource configuration signaling indicates the starting slot offset and starting symbol for the hops following the first hop
	+ FFS: possible values
* The number of consecutive symbols in a hop common to all hops
	+ FFS: possible values
* The number of hops
	+ FFS: possible values
* UE does not expect to be configured for any hops across slot boundaries, i.e.the starting position + duration of a hop cannot exceed a slot duration
* FFS: whether/how special handling for the last hop overlap
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| TP 2.4-1 |  |
| Reason for change | For SRS with Tx hopping, the each hop must be contained within a slot. The UE does not expect to be configured for any hops across slot boundaries, i.e.the starting position + duration of a hop cannot exceed a slot duration. |
| Summary of change | captures the following text from RAN1#114 agreement:* UE does not expect to be configured for any hops across slot boundaries, i.e.the starting position + duration of a hop cannot exceed a slot duration
 |
| Consequences if not approved | The configuration of the starting position and hop duration for SRS with tx hopping is not clear.  |
| Text proposal | TS 38.214 --------------------------<Start of text proposal for TS 38.214>--------------------------6.2.1.4              UE sounding procedure for positioning purposes-------------------------- Text omitted --------------------------The reduced capability UE may be configured via [*higher layer parameter*], 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 via [higher layer parameter] with the starting PRB of the first frequency hop. When the reduced capability UE is configured to perform transmit frequency hopping, it does not expect to be configured with [*StartingSymbol*] and [*Length*] a hop that exceeds a slot duration.--------------------------<End of text proposal for TS 38.214>-------------------------- |

### Round 1

Companies are encouraged to comment on the proposed TP in the table below

**TP 2.4-1:**

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| **Company** | **Comment** |
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## Configuration of the starting position for the hops following the first hop

### Background

In [18] proposal 2-2, the following TP is proposed, to capture that the delay between the starting positions of the SRS hops in time is such that it spans at least the duration of the hops plus the retuning time.

FL comment: this was never formally agreed but seems to be rather obvious. Hopefully we can directly agree on the TP.

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| **TP 2.5-1** |
| reason for change:  | The current specification does not limit the combination of hop duration, starting position conguration to be compatible with the required retuning time between hop |
| summary of change:  | New text added to capture that the time between hops must exceed the hop duration plus retuning time.  |
| Consequences if not approved:  | Some invalid configuration of the starting position and hop duration for SRS with FH is still possible according to the specs.  |
| ---------------------------- Start of Text Proposal for TS 38.214 -----------------------------===================== Unchanged parts omitted ======================The reduced capability UE may be configured via [*higher layer parameter*], 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 via [higher layer parameter] with the starting PRB of the first frequency hop. The reduced capability UE is not expected to be configured that the time difference between the starting symbol position of any two adjacent frequency hops is less than the summation of the common number of SRS symbols for a frequency hop and the reported RF switch time.===================== Unchanged parts omitted ======================Text Proposal ---------------------------------- |

### Round 1

Companies are encouraged to comment on the proposed TP below

**TP 2.5-1:**

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| **Company** | **Comment** |
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## Dropping of scheduled UL signals in UTW

### Background

In [14] it is proposed to capture in the specification that only the scheduled UL signals are dropped when colliding with the SRS for positioning in UTW, in accordance with the agreement struck last meeting.

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| **TP 2.6-1** |
| reason for change:  | **Clarify the UE behavior during downlink slots when downlink slots overlap with the UL time window.**  |
| summary of change:  | **description of the UE behavior during downlink slots within the UL time window.**  |
| Consequences if not approved:  | **loss of downlink signals or channels due to failure for the UE to receive downlink signals or channels during the UL time window.** |
| --------------------------<Start of text proposal for TS 38.214>--------------------------6.2.1.4 UE sounding procedure for positioning purposes< Unchanged parts are omitted >The reduced capability UE may be configured, via [higher layer parameter], 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. When the UL time window overlaps with downlink slots, the UE is expected to receive downlink signals or channels in the downlink slots.< Unchanged parts are omitted >--------------------------<End of text proposal for TS 38.214>--------------------------End of text proposal for TS 38.214>-------------------------- |

### Round 1

Companies are encouraged to comment on the proposed TP below

**TP 2.6-1:**

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| --- | --- |
| **Company** | **Comment** |
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## correction for the SRS Tx hopping pattern description

### Background

in [11] it is propose to clarify that the UE transmit hopping follows a staircase pattern:

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| **TP 2.7-1** |
| reason for change:  | The following agreement about the hopping configuration needs to be captured in the specification.**Agreement**For the SRS Tx hopping pattern configuration support at least the staircase pattern, including a wrapped staircase pattern.Support configuring the starting PRB of the first hop  |
| summary of change:  | In clause 6.2.1.4, add UL SRS Tx hopping pattern configuration. |
| Consequences if not approved:  | Specification is not align with RAN1’s agreement and incomplete. |
| Text proposal | ----------------------------------------- Start of text proposal to TS 38.214 v18.0.0-------------------------------------------6.2.1.4 UE sounding procedure for positioning purposes**<<< UNCHANGED PARTS OMITTED >>>**The reduced capability UE may be configured via [*higher layer parameter*], 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 as a staircase pattern, including a wrapped staircase pattern, 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 via [higher layer parameter] with the starting PRB of the first frequency hop.**<<< UNCHANGED PARTS OMITTED >>>**----------------------------------------- End of text proposal to TS 38.214 v18.0.0------------------------------------------- |

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### Round 1

Companies are encouraged to comment on the proposed TP below

**TP 2.7-1:**

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| **Company** | **Comment** |
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## correction for the SRS Tx hopping pattern description

### Background

in [14] it is propose to clarify that scheduled signals and channels are subject to the dropping rules :

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| --- |
| **TP 2.8-1** |
| reason for change:  | clarify the situations for the UE to drop UL channels. |
| summary of change:  | New text to indicate only scheduled channels within the UL time window is to be dropped. |
| Consequences if not approved:  | **the UE cannot complete Tx frequency hopping.** |
|  --------------------------<Start of text proposal for TS 38.214>--------------------------6.2.1.4 UE sounding procedure for positioning purposes< Unchanged parts are omitted >The reduced capability UE may be configured, via [higher layer parameter], subject to UE capability, with an UL time window where the UE is not expected to transmit other scheduled signals/ channels and is only expected to transmit the SRS for positioning using frequency hopping. < Unchanged parts are omitted >--------------------------<End of text proposal for TS 38.214>-------------------------- |

### Round 1

Companies are encouraged to comment on the proposed TP below

**TP 2.8-1:**

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| **Company** | **Comment** |
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# Measurement reporting

The proposals on measurement reporting revolve around the following issues:

* hop indication for multi hop reporting
* use of single-hop or multi-hop reporting
* number of hops included in a measurement request
* special case for multi-RTT measurements

## [MEDIUM] Hop indication

### Summary of contributions

For multi-hop and single hop reporting, several contributions discuss the use of hop indicators.

- in [3] it is proposed that the hop indication is subject to a request from the LMF to the gNB (for UL measurements)

- in [5][11][19], it is proposed to indicate which of single- or multi-hop is being reported

- in [3][7][13][14][15][20] it is proposed to report which hops or how many are used for the measurement

 -in [9][17][19], this is not supported

Company views are summarized in the table below:

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| --- | --- |
| **Company** | **Proposal** |
| [3] |  **Proposal 1:** RAN1 supports the following text proposal on Clause 5.1.6.5 of TS 38.214.

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| --- |
| <omitted text>The reduced capability UE may be configured to measure and report, subject to UE capability, via [higher layer parameter] 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 bandwidth that may be greater than the maximum reduced capability UE bandwidth, within a configured measurement gap. The reduced capability UE performing receiver frequency hopping may be configured to report via [*higher layer parameter*] one measurement associated with one received frequency hop or one measurement based on multiple hops of the DL PRS. In the measurement report via [*higher layer parameter*], the reduced capability UE may include the number of consecutive hops of the DL PRS used for the measurement. [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. <omitted text> |

**Proposal 14**: LMF may requests the gNB to indicate which received hop(s) are associated with a reported positioning measurement.  |
| [5] | **Proposal 1:** • An indication in measurement report may be needed to distinguish measurements based on multiple hops or one hop. |
| [7] | **Proposal 4:** For UL Tx hopping, support TRP to report how many and which hops are used for the measurement report.**Proposal 5:** For DL Rx hopping, support UE to report how many hops are used for the measurement report. |
| [9] | **Proposal 4**: For UL SRS-pos Tx hopping, * Reporting the indication of how many received hops or which received hops where used in the measurement report from gNB is not supported.
* Reporting both of the measurement based on multiple hops or the measurement based on single hop together from gNB is not supported.
 |
| [11] | Proposal 2: An indicator is needed to indicate the measurement based on multiple hops or based on single hop.**Proposal 3:** Adopt the TP #1 regarding measurement report in clause 5.1.6.5 of TS 38.214[3]. ----------------------------------------- Start of text proposal to TS 38.214 v18.0.0-------------------------------------------5.1.6.5 UE sounding procedure for positioning purposes**<<< UNCHANGED PARTS OMITTED >>>**The reduced capability UE may be configured to measure and report, subject to UE capability, via [higher layer parameter] 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 bandwidth that may be greater than the maximum reduced capability UE bandwidth, within a configured measurement gap. The reduced capability UE performing receiver frequency hopping may be configured to report via [higher layer parameter] one measurement associated with one received frequency hop or one measurement based on multiple hops of the DL PRS. The reduce capability UE is expected to use an indicator to indicate the measurement based on one received frequency hop or based on multiple 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.**<<< UNCHANGED PARTS OMITTED >>>**----------------------------------------- End of text proposal to TS 38.214 v18.0.0------------------------------------------- |
| [13] | Proposal 1: For DL Rx hopping or UL Tx hopping, NO need to include the following contents in a measurement report:• Indication of which hop is used for a single-hop measurement;• Indication of which hops are used for multiple-hop measurement. |
| [14] | Proposal 4: Adopt the following TP to support the UE to include the identity of received hop(s) in the measurement report. The reason for the change is to enable inclusion of an identity of a Rx hop in the measurement report. **The summary of change is introduction of association of an identify of a Rx hop in the measurement report. The consequence if not approved is degradation of positioning accuracy for RedCap UE positioning.**

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| --------------------------<Start of text proposal for TS 38.214>--------------------------5.1.6.5 PRS reception procedure< Unchanged parts are omitted >The reduced capability UE may be configured to measure and report, subject to UE capability, via [higher layer parameter] 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 bandwidth that may be greater than the maximum reduced capability UE bandwidth, within a configured measurement gap. The reduced capability UE performing receiver frequency hopping may be configured to report via [*higher layer parameter*] one measurement associated with one received frequency hop associated with an index or one measurement based on multiple 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. < Unchanged parts are omitted >--------------------------<End of text proposal for TS 38.214>-------------------------- |

 |
| [15] | **Proposal 3:**• A single measurement can be fed back in the case that some of the hops are not combined in the measurement. • To assist in the measurement, an indication of which received hops were used in the measurement report can be sent.**Proposal 4:** • For the measurement per hop, this can (a) be configured to be reported always with the single measurement, (b) be reported in a fall-back mode (e.g. if there is a failure in the single measurement), or (c) be reported by itself based on an explicit measurement request. • To assist in the measurement, an indication of which received hops were measured and sent can be reported. |
| [17] | **Proposal 8:*** For DL Rx hopping and UL Tx hopping, hop indication should not be supported.
 |
| [19] | **Proposal 4:** Do not support an additional indication of how many received hops / which received hops where used in the measurement report.• Note: A UE may, up to UE implementation, to use the quality metric and the ReportingGranularityfactor to inform the LMF that a more accurate measurement is being reported. |
| [20] | **Proposal 24** For TRP measurements on a single hop, the TRP provides in the measurement report the hop index corresponding to the measured hop in the SRS resource Frequency hopping pattern.**Proposal 25** For UE measurements on a single hop, the UE provides in the measurement report the starting PRB and number of PRB corresponding to the measured portion of the DL PRS bandwidth in the reported single hop. |

### First round

Based on the proposals received there is no consensus to support reporting the number of hops, or which hops were used in the measurement by the UE or gNB. Moreover, reporting of the number of hops is not really critical to the functionality of the feature, and we should focus on critical issues.

**Proposal 3.1-1:**

**For measurements based on DL PRS with Rx frequency hopping or UL SRS with Tx hopping:**

* **the UE/gNB can additionally report**
	+ **Indication of which hop(s) were used to produce the DL positioning measurement for UE reported DL positioning measurements**
	+ **Indication of which hop(s) were used to produce the UL positioning measurement for gNB reported UL positioning measurements.**
* **The LMF can request the UE /gNB to include the hop indicators in the measurement report.**

Companies are encouraged to comment on the proposal in the table below:

**Proposal 2.2.1-1:**

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

## [HIGH] Per hop or multi-hop measurement reporting

### Summary of contributions

For the reporting of single- or multi-hop measurements, we still have an unresolved issue of the reporting of the measurements together, or using the single-hop measurement as fallback if the wideband measurement fails. From the proposal, we can see the following:

* Reporting of both the wideband (multi-hop) and narrowband (single-hop) measurement
	+ Supported by [1][15]
	+ Not supported in [6][11][12][16][19][20]
* Reporting of the single or the multi-hop measurement is up to the UE/gNB [13][16]
* Reporting of the single hop measurement if the multi-hop measurement is not possible [14][15][20]

Company views are summarized in the table below:

|  |  |
| --- | --- |
| **Company** | **Proposal** |
| [1] | **Proposal 6:** For measurement reporting for DL Rx hopping or UL Tx hopping, support the following* Report both a wideband measurement and a measurement for a specific hop together if supported by UE/gNB
* A UE capability should be introduced to support UE to report one measurement associated with one received frequency hop and one measurement based on multiple hops of the DL PRS together.
 |
| [6] | Proposal 1• For DL PRS or UL SRS for positioning with frequency hopping, positioning measurements based on single hop and multiple hops are separately reported. • An indication of “single-hop” and “multiple-hop” can be included in the measurement report. |
| [11] | **Proposal 1:** When the measurement based on multiple hops is reported, measurement based on single hop should not be reported. When the measurement based on multiple hops fails, the measurement based on one received hop can be reported as a fallback. |
| [13] | **Proposal 2**: DL and UL measurements associated with one received hop are reported separately from the measurement based on multiple hops.• Note: Up to UE/gNB to report the single hop measurement instead of the multiple-hop measurement. |
| [14] | **Proposal 3:** Adopt the following TP to support the UE to report either one measurement associated with one received frequency hop if not all hops in a pattern are received or one measurement based on all hops of the DL PRS if all hops in a pattern are received. The reason for the change is to enable reporting based on received conditions. **The summary of change is introduction of conditions for different types of measurement reporting for Rx hopping. The consequence if not approved is that the UE may send a measurement report that cannot be used for positioning purpose.**

|  |
| --- |
| --------------------------<Start of text proposal for TS 38.214>--------------------------5.1.6.5 PRS reception procedure< Unchanged parts are omitted >The reduced capability UE may be configured to measure and report, subject to UE capability, via [higher layer parameter] 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 bandwidth that may be greater than the maximum reduced capability UE bandwidth, within a configured measurement gap. The reduced capability UE performing receiver frequency hopping may be configured to report via [*higher layer parameter*] one measurement associated with one received frequency hop if not all hops are received or one measurement based on multiple hops of the DL PRS if all hops are received. [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. < Unchanged parts are omitted >--------------------------<End of text proposal for TS 38.214>-------------------------- |

 |
| [15] | **Proposal 3:**• A single measurement can be fed back in the case that some of the hops are not combined in the measurement. • To assist in the measurement, an indication of which received hops were used in the measurement report can be sent.**Proposal 4:** • For the measurement per hop, this can (a) be configured to be reported always with the single measurement, (b) be reported in a fall-back mode (e.g. if there is a failure in the single measurement), or (c) be reported by itself based on an explicit measurement request. • To assist in the measurement, an indication of which received hops were measured and sent can be reported. |
| [16] | **Proposal 5:** For DL Rx hopping, support RedCap UE to report either one of the following measurements per measurement report, based on the UE frequency stitching capability. 1) One single measurement based on receiving multiple hops, 2) per-hop measurement. **Proposal 6:** Do not support a RedCap UE to support both one single measurement based on receiving multiple hops and per-hop measurement. |
| [19] | **Proposal 5:** For DL Rx hopping,* A UE may report either a measurement based on receiving multiple hops, or the measurement based on single hop.
	+ Introduce a signaling that indicated whether a “measurement based on receiving multiple hops” or “measurement based on single hop” is being reported
* Up to RAN4 to define any conditions on when the measurements are reported, what/if accuracy requirements are needed to be specified if there collisions or hops are being dropped.
 |
| [20] | **Proposal 22** Do not support reporting both single-hop and wideband measurements.**Proposal 23** The UE/TRP can optionally report a single hop measurement when the main (wideband) measurement cannot be computed.  |

### round 1

* Reporting of both the wideband (multi-hop) and narrowband (single-hop) measurement
	+ Supported by [1][15]
	+ Not supported in [6][11][12][16][19][20]
* Reporting of the single or the multi-hop measurement is up to the UE/gNB [13][16]
* Reporting of the single hop measurement if the multi-hop measurement is not possible [14][15][20]

Based on the received proposals, it does not seem possible to go forward with the reporting of both multihop and single-hop measurements. There are still some proposals supporting the reporting of single-hop if multi-hop is not possible and for indicating the measurement type between multi-hop and single hop. One possible way forward is to support reporting either of multi- or single-hop and leave to RAN4 to decide the conditions for which each report is applicable. Regarding the use of an indicator to say whether the report is for single or multi-hop, we can leave it to RAN2, since the report structure could use different IEs for single and multi-hops.

**Proposal 3.2-1:**

**For measurements based on DL PRS with Rx frequency hopping or UL SRS with Tx hopping:**

* **the UE/gNB can report either a single-hop or multi-hop measurement**
* **the measurement report indicates which of a single-hop or multihop measurement is being reported**
	+ **details of the reporting up to RAN2.**
* **Note: conditions for reporting single or multiple hops is up to RAN4.**

Companies are encouraged to comment on the proposal in the table below:

**Proposal 3.2-1:**

|  |  |
| --- | --- |
| **Company** | **Comment** |
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## [LOW] Reporting for Multi-RTT with Rx/Tx hopping

### Summary of contributions

In [3] a text proposal is put forward to add a condition that for Multi-RTT the UE should prioritize measurement across the same amount of hops in the DL that it is transmitting in the UL.

From the FL perspective, this seem to be an implementation issue, but we should first check what is the common view on the issue.

|  |  |
| --- | --- |
| **Company** | **Proposal** |
| [3] | **Proposal 2:** RAN1 supports the following text proposal on Clause 5.1.6.5 of TS 38.214.

|  |
| --- |
| <omitted text>The reduced capability UE may be configured to measure and report, subject to UE capability, via [higher layer parameter] 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 bandwidth that may be greater than the maximum reduced capability UE bandwidth, within a configured measurement gap. The reduced capability UE performing receiver frequency hopping may be configured to report via [*higher layer parameter*] one measurement associated with one received frequency hop or one measurement based on multiple 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. If the reduced capability UE has transmitted an SRS for positioning across *N* frequency hops to measure the UE Rx-Tx time difference, the UE should prioritize to measure at least *N* frequency hops of a DL PRS for the UE Rx-Tx time difference measurement.<omitted text> |

  |

### Round 1

Since this is a new issue, we should first capture some comments on the proposed TP to see whether to move forward.

**Issue 3.3:**

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

## [LOW] Number of hop in measurement request

### Summary of contributions

|  |  |
| --- | --- |
| **Company** | **Proposal** |
| [3] | **Proposal 4:** RAN1 supports a mechanism for LMF to indicate to gNB and RedCap UE to transmit and/or measure PRS/SRS frequency hops, where*M* is the maximum supported number of hops. If no indication to the transmission given, the maximum *M* hops are transmitted. If no indication to the measurement given, the maximum *M* hops are measured.  |

### Round 1

Since this is a new issue, we should first capture some comments on the proposal to see whether to move forward. However, this proposal seem to be not critical. Hence it is considered low priority.

**Proposal 3.4: Support a mechanism for LMF to indicate to gNB and RedCap UE to transmit and/or measure PRS/SRS frequency hops, where *M* is the maximum supported number of hops. If no indication to the transmission given, the maximum *M* hops are transmitted. If no indication to the measurement given, the maximum *M* hops are measured.**

**Proposal 3.4:**

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

# DL-PRS Frequency Hopping

## [HIGH] DL PRS RX hopping assistance data

### Summary of contributions

 In [7] [14] [19], the signaling of LMF requests to the UE to perform Rx frequency hopping is discussed.

Company views are summarized in the table below:

|  |  |
| --- | --- |
| **Company** | **Proposal** |
| [7] | ***Proposal 6:*** *For PRS reception with hopping, the following parameters in location information request should be introduced* * *Number of hops*
* *Bandwidth of each hop or total bandwidth of all hops*
* *The number of PRS occasions for a hopping cycle*
	+ *This may trigger UE to do intra-slot Rx frequency hopping*
 |
| [14] | Proposal 9: Support configurable number of Rx hops for DL PRS with Rx frequency hopping.  |
| [19] | Proposal 1: Support an LMF to include an explicit request in the Location Request Signaling for a device to perform and report measurements according to DL PRS Rx frequency hopping.Proposal 2: In the explicit request from the LMF, the following information can also be included: * Requested number of hops
* Requested Overlap size
* Requested total bandwidth across all hops
 |

### First round

From the proposal, one common point is the need for a specific parameter for rx hopping in the location request from the LMF. Companies should also provide their views on what parameters should be included.

**Proposal 4.1-1: for DL PRS Rx hopping, support the LMF to include an explicit request for DL PRS rx hopping measurements and reporting in the location request signaling.**

* **The location information request can also optionally include**
	+ **Number of hop**
	+ **Hop bandwidth**
	+ **Total bandwidth of all hops**
	+ **The maximum number of consecutive PRS occasions to perform Rx hopping**

Companies are encouraged to comment on the proposal in the table below:

**Proposal 4.1-1**

|  |  |
| --- | --- |
| **Company** | **comment** |
|  |  |
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## [HIGH] Further details on DL PRS hopping with overlap

### Summary of contributions

In [19] it is proposed to capture that RAN1 assumes no additional UE requirements shall be specified when Rx hopping is in use (with or without overlaps).

|  |  |
| --- | --- |
| **Company** | **Proposal** |
| [19] |  Proposal 1: For DL-PRS Rx frequency hopping, support performing Rx hopping with overlapping tones and non-overlapping tones.RAN1 assumes that no additional UE requirements shall be specified for the case of Rx hopping with non-overlapping tones; e.g., a UE is not responsible for keeping phase continuity across the hops in either case of overlapping or non-overlapping hops. |

### Round 1

The issue is whether we should have a similar agreement with a similar note as for UL SRS Tx hopping. Please comment on the proposal below.

 **Proposal 4.2-1: For DL-PRS Rx frequency hopping, support performing Rx hopping with overlapping tones and non-overlapping tones.**

* **RAN1 assumes that no additional UE requirements shall be specified for the case of Rx hopping with non-overlapping tones, e.g., a UE is not responsible for keeping phase continuity across the hops in either case of overlapping or non-overlapping hops.**

|  |  |
| --- | --- |
| **Company** | **comment** |
|  |  |
|  |  |

# UL SRS Tx Hopping

## [HIGH] UL SRS Tx hopping configuration

### Background

In [6], it is proposed to use a reference symbol from which the starting symbol of the first hop is defined.

In [6] it is proposed to define the starting symbol for hop n a symbol offset to preceding hop n-1. In [3] the offset is relative to the first hop starting position.

In [8] it is proposed to limit the starting point of the first hop to maximize the possibility to multiplex UEs.

* From the FL perspective, it is up to the network choice of implementation, following the available bandwidth.

In [9] a pattern index is proposed to indicated the wrapped staircase pattern.

* FL comment: In the previous meeting, we agreed that each hop have a starting position that was configurable. Hence the need for such patterns are unclear.

 Below is a summary of the listed parameter values in the received proposal

|  |  |  |  |
| --- | --- | --- | --- |
| parameter | Proposed IE | range | FL comment |
| Starting PRB for the first frequency hop | Frequencydomainshift can be reused | 0-267PRB[5][20][19]Also Use a hop index fort he different starting hops[19] |  |
| Hop bandwidth | New parameter, if not fixed | 48 RBs [1]Fixed 20MHz in FR1[2] at least 20MHz in[17]Fixed 100MHz in FR2[2] at least 100Mhz in [17]4 to 132 PRBs [5][11]Depends on SCS for [19][24,51,66,106,132]PRBs | In [11] maximum bandwidth is proposed to be 20MHz in FR1 and 100MHz in FR2. |
| Number of symbols in a hop | Re-use legacy IE[2][19] | 1,2,4,8,10,12,14 in [2]1,2,4,6 in [3]1,2,4,8,12 in [5][19][20][1,2,4] in [11]At least 1,2,3 in [17] | The number of symbol should be able to cover the comb-staggered pattern. |
| overlap | New IE | 1,2,3,4RBs[1][20]1 PRB only [2][1,2,4] in [3][11][19]1 to 8 in [5] |  |
| Number of hops | New IE | 5,6 [2]1,2,4,6 [3]2,…,6[1][5][20][2,3,4,5,8,10] for [19] |  |
|  |  |  |  |
| Starting symbol from hops after first frequency hop  | New IE | Same as for the first hop[5][19]Relative to first hop [20] |  |
|  |  |  |  |
| Periodicity and offset, Starting symbol and offset for the first hop | Re-use legacy | Same as legacy[5][7]2,6,12 for symbol index in [17] |   |

*Configuration of the SRS resource with Tx hopping:*

|  |  |
| --- | --- |
| **Company** | **Proposal** |
| [1] | ***Proposal 1: For the pos-SRS configuration to achieve a staircase pattern, at least the values for the following agreed parameters are needed:**** ***Frequency domain related parameters (common to all hops for the SRS resource)***
	+ ***Hop bandwidth (C\_SRS can be reused) based on the number of RBs allowed for the existing SRS BW configuration according to Table 6.4.1.4.3-1***
		- ***48 RBs for 30kHz with 20MHz***
	+ ***Overlap value: 1, 2, 4 PRB(s).***
* ***Time domain related parameters***
	+ ***Number of consecutive symbols in a hop (nrofSymbols can be reused): 1, 2, 4 symbol(s)***
	+ ***Number of hops: 2, 3, 4, 5, 6***
 |
| [2] | **Proposal 1: For SRS Tx hopping, a hopping bandwidth common to all hops should include (as a baseline):*** **FR1 20 MHz and FR2 100 MHz**

**Proposal 2: For SRS Tx hopping, a single overlap value can be *configured* for all hops for the SRS resource should include (as a baseline) = 1 PRB:*** **the actual overlap is = 1 PRB for all but one hop, one hop in the hopping cycle may have an actual overlapping bandwidth exceeding the configured value.**

**Proposal 3: For SRS Tx hopping, the number of hops for FR1 and FR2 should include (as a baseline):*** **{5, 6} hops.**

**Proposal 4: For SRS Tx hopping, the number of consecutive symbols in a hop common to all hops:*** **adopt the legacy SRS configuration: .**

**Proposal 6: For SRS Tx hopping, define the first hop starting symbol as symbol offset from a reference symbol:****• a potential reference symbol can be a symbol before hopping to the first hop.****Proposal 7:** **For SRS Tx hopping, define the next hop first symbol as symbol offset from the current hop.** |
| [3] | **Proposal 12:** Support the following configuration parameter values for an SRS resource for frequency hopping:* a single overlap value between hops for all hops for the SRS resource
	+ {1, 2, 4} RBs
* The periodicity and slot offset
	+ Reuse the existing periodicity and slot offset
		- Note: the slot offset determines the time-domain location of the first hop
* The starting slot offset and starting symbol for the SRS resource with tx hopping (first hop)
	+ Support indication of starting symbol location of the first hop and the slot offset is determined from the periodicity and slot offset
* the starting slot offset and symbol for each of the hops following the first hop,
	+ time-domain offset relative to the first hop.
* The number of consecutive symbols in a hop common to all hops
	+ {1, 2, 4, 6, FFS}
* The number of hops
	+ {1, 2, 4, 6}
 |
| [5] | ***Proposal 2**** ***Clarify that ‘the first hop’ for starting PRB configuration in previous agreement is ‘the first frequency hop’.***
* ***Update the previous agreement as the following.***

|  |
| --- |
| **Agreement(RAN1#113)**For the SRS Tx hopping pattern configuration support at least the staircase pattern, including a wrapped staircase pattern.* Support configuring the starting PRB of the first frequency hop
* FFS: details of signalling of PRB overlap across consecutive hops and bandwidth of each hop
 |

***Proposal 3**** ***The subband index of the first hop (first time hop) should be configured for SRS for positioning frequency hopping.***

***Proposal 4**** ***For SRS for positioning frequency hopping captured in TS38.211, support per-hop basis framework, e.g., per-hop basis sequence generation, per-hop basis sequence mapping to physical resources.***

***Proposal 5**** ***For the possible values of SRS for positioning frequency hopping configuration, support the following***
* ***Hop bandwidth: {4,8,12,16…, 128, 132}RBs***
* ***Overlap bandwidth: {1,2,..8}RBs***
* ***The starting slot offset and starting symbol for the SRS resource with tx hopping***
* ***Starting slot offset: {0,1,2…, -1} in slot***
* ***Starting symbol: {0,1,2,…13} in symbol***
* ***The starting slot offset and symbol for each of the hops following the first hop***
* ***Starting slot offset: {0,1,2…, -1} in slot.***
* ***Starting symbol: {0,1,2,…13} in symbol***
* ***The number of consecutive symbols in a hop: {1,2,4,8,12}***
* ***The number of hops: {2,3,4…6}***
* ***The starting PRB of the first frequency hop: {0..267} in RB***
 |
| [8] | ***Proposal 3: For frequency hopping of PRS or SRS, support size of overlapped bandwidth between two adjacent hops being decided by channel quality.******Proposal 7: Support limit the start point of the first hop, to ensure at least one hop is aligned with the boundary of hopping band, and maximize the number of UEs multiplexed within a same time and frequency resource.*** |
| [9] | ***Proposal 1: The bandwidth of each hop, hopping pattern index and number of hops are used for determining wrapped staircase pattern for SRS-pos resource.**** ***Hopping pattern index is used to indicate the relative frequency position of the first hop***

***Proposal 2: Adopt following TP for 38.211:*** **Text proposal** |
| [11] | **Proposal 4: The minimum configurable bandwidth for one hop is 4PRB, and the maximum configurable bandwidth is 20MHz in FR1 and 100MHz in FR2.****Proposal 5: The single overlap value can be configured as {0,1,2,4} PRB.****Proposal 6: The number of consecutive symbols in a hop can be configured as {1,2,4}.****Proposal 7: The starting position in the time domain given by where the offset counts symbols backwards from the end of the slot.****Proposal 8: The number of hops depends on UE capability, and the specific value is determined by the serving gNB.** |
| [14] | **Proposal 1: The amount of overlapped bandwidth is associated with gap between two consecutive frequency hops for UL frequency hopping and Rx frequency hopping** |
| [16] | **Proposal 1: On the SRS Tx hopping, the duration of each hop is configured from one or more SRS resources.** |
| [17] | **Proposal 1:*** **At least 20 MHz for FR1 and 100 MHz for FR2 should be supported as maximum hop bandwidths common to all hops of each FR.**

**Proposal 2:*** **Candidate values for a hop bandwidth may need to have enough granularities to support necessary flexibility of the total bandwidth size.**

**Proposal 3:*** **At least 0 and 1 PRB should be supported as overlap size.**

**Proposal 4:*** **At least 2, 6, 12 for a starting symbol may be supported.**

**Proposal 5:*** **At least from 1 to 3 consecutive symbols can be supported. If the number of hops less than 6 is supported, more symbol length can be supported.**

**Proposal 6:*** **In order to support the same total bandwidth as normal UE, at least 4, 5, 6 hops should be supported.**
 |
| [19] | **Proposal 8: For SRS Tx hopping, the configuration includes:**

|  |  |
| --- | --- |
| **Parameter** | **Values** |
| a hop bandwidth common to all hops | For 15 KHz: * {4,8,12,16,20,24,28,32,36,40,48,52,56,60,64,72,76,80,88,96,104} PRBs

For 30 KHz: * {4,8,12,16,20,24,28,32,36,40,48} PRBs

For 60 KHz: * {4,8,12,16,20,24} PRBs for FR1
* {4,8,12,16,20,24,28,32,36,40,48,52,56,60,64,72,76,80,88,96,104,112,120,128,132} PRBs for FR2

For 120 KHz: * {4,8,12,16,20,24,28,32,36,40,48,52,56,60,64} PRBs
 |
| a single overlap value can be configured for all hops for the SRS resource | {1,[2,4]} PRBs |
| The starting slot offset and starting symbol for the SRS resource with tx hopping (first hop) | Same with legacy SRS-PosResource for periodic, semi-persistent, aperiodic resources |
| the starting slot offset and symbol for each of the hops following the first hop | Same with legacy SRS-PosResource for periodic, semi-persistent, aperiodic resources |
| The number of consecutive symbols in a hop common to all hops | Same with legacy *nrofSymbols* of SRS-PosResource (i.e., 1,2,4,8,12 symbols) |
| The number of hops in the staircase or wrapped staircare pattern | New IE with values: ={2,3,4,5,8,10} |
| Starting PRB of the first hop domain starting position | Same with legacy *freqDomainShift* IE *(0..268)* with a reference point determined same with legacy |
| Hop index of the first hop in the staircase or wrapped staircare pattern | New IE with values {1,2, maxNumberHops}* The hops are indexed in ascending sequence according to increasing frequency index.
* The hop index of the i-th hop ( is given by

FL note: the proposal included a figure removed for clarity in the summary |

 |
|  |  |
| [20] | **Proposal 9 For the configuration of the hop bandwidth, select between:****i. The hop bandwidth reuses the parameter c\_srs, with values within the range of the redcap UE bandwidth capability****ii. The hop bandwidth re-uses the parameter c\_srs but is limited to the values {7, 12, 17, 25, 33} which corresponds to {24, 48, 64, 104, 132}.** **iii. The hop bandwidth is configured by a new parameter with possible values {24, 51, 66, 106, 132} in unit of RB.****Proposal 10 The value range of common overlap size is (0..4) in unit of RB.****Proposal 12 For the configuration of the starting position of each hop,****• For the first hop, the IE startposition can be reused.** **• For the remaining hops, slot offset and start position in the slot should be configured in a new IE for each hop.** **Proposal 13 Reuse the parameter nrofSymbols for the indication of the number of symbol of each hop, and the value range is same as legacy, i.e. {1, 2, 4, 8, 12}.****Proposal 14 The value range of the number of hops is {2, 3, 4, 5, 6}.****Proposal 15 Introduce frequency offset#1 relative to Tx hopping point A (i.e. the lowest subcarrier of the SRS allocation) to adjust the starting PRB of the first SRS hop, the value range of frequency offset#1 is (0 … [268]) and the unit is PRB.****i. Legacy parameter freqDomainShift can be reused.** **Proposal 16 Whether the starting hop is in the active BWP or not is up to network configuration.****Proposal 17 SRS configuration for tx hopping can re-use the SRS configuration resource from legacy, with the following additional parameters:****• Number of hops****• Overlap** **• Tx hopping point A.****• Starting point for each hop except for first hop** |

### Round 1

For this proposal, we can start the discussion based on the majority view for each of the parameter. A proposal for a candidate IE to be potentially re-used is also added for each IE where it is possible. When a new IE is required, it is also mentioned.

For the value of the starting slot, it is clarified that this apply to periodic SRS transmission. Semi-persistent is added in bracket, in case it is also agreed this meeting.

**Proposal 5.1-1**

**For SRS Tx hopping, the configuration parameters values are:**

* **For the hop bandwidth common to all hops**
	+ **Alt1: the bandwidth is fixed to the nearest number of RBs for 20MHz in FR1 and 100MHz in FR2, for each of the supported SCS.**
		- **Note: In this case no parameter is needed for hop bandwidth**
	+ **Alt2: the bandwidth is configurable between 4 to 132 RBs with granularity of 4 PRBs.**
		- **Note: In case case a new parameter is configured.**
* **For the starting RB of the first hop:**
	+ **The range is {0,268} RBs**
	+ **Configuration re-uses the IE freqDomainShift**
* **For the single overlap common to all hops for the SRS resource**
	+ **The value can be 1,2,4 RBs**
	+ **Note: This is a new IE**
* **For the starting slot offset and starting symbol for the SRS resource with tx hopping (first hop)**
	+ **The value range is {0,1,2…, nrof slot in periodicity} in slots for the slot offset**
		- **Note: this is for the periodic [and semi-persistent] SRS**
	+ **Starting symbol: {0,1,2,…13} in symbol**
	+ **Starting slot reuses the SRS-PeriodicityAndOffset IE**
	+ **Startying symbol reuses the starting position *startPosition* in the IE resourceMapping**
* **the starting slot offset and symbol for each of the hops following the first hop,**
	+ **The value range is {0,1,2…, nrof slot in periodicity} in slots for the slot offset**
		- **Note: this is for the periodic [and semi-persistent] SRS**
	+ **Starting symbol: {0,1,2,…13} in symbol**
	+ **this is a new IE**
* **The number of consecutive symbols in a hop common to all hops**
	+ **Values are 1,2,4,8 and 12 symbols**
	+ **Configuration re-uses the IE *nrofsymbols* in *resourcemapping***
* **The number of hops**
	+ **Values are 1,2,3,4,5,6**
	+ **This is a new IE**

Companies are encouraged to comment on the proposal in the table below:

**Proposal 5.1-1:**

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| **Company** | **Comment** |
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## Handling of the last hop

### Background

The handling of the last hop was left FFS in RAN1#114. In the contribution, there is basically a split between not treating the last hop as a special case and allowing the last hop to have either a different overlap or a different bandwidth:

* No special handling:[1] [5] [10] [14] [15]
* Special overlap value for the last hop in frequency [2] [8] [20]

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| **Company** | **Proposal** |
| [1] | ***Proposal 3: No need for special handling of the last hop in time assumption. Each SRS will have its lower frequency bound to re-start the first hop in frequency and continue the mapping of the following hops using the configured overlap RB.**** ***Note: The last hop in time and the first hop in time, which are adjacent in frequency, may not have the same overlapping RBs as other adjacent hops in frequency.***
 |
| [2] | **Proposal 5: For SRS Tx hopping, special handling for the last hop overlap is needed, and*** **the actual amount of overlapping in the last hop (or any hop) can exceed the configured overlapping value .**

**Proposal 9: For staircase (including wrapped staircase) SRS Tx frequency-hopping patterns, capture the following text proposal (highlighted in red and underline) in the specification for the case of no special handling:** **Text proposal** |
| [5] | ***Proposal 6:*** ***• No need to introduce special handling for the last hop overlap.*** |
| [8] | ***Proposal 4: Support apply special overlap size for the last hop or the hop across boundary of configured bandwidth for hopping SRS in a cycle, to align the hops with the configured bandwidth for hopping SRS.*** ***Proposal 5: For the hop across the boundary of configured bandwidth:******Alt-1: Shift it by the bandwidth outside of the boundary for the hop if it’s without wrapping******Alt-2: Shift it by the difference between the total bandwidth and the bandwidth outside of the boundary for the hop if it’s with wrapping.******Proposal 6: For the hop(s) after the last hop across the boundary of configured bandwidth:******Alt-1: Shift each of them by same shifting value as the one for the last hop across the boundary.******Alt-2: Shift each of them except the last one by same shifting value as the one for the last hop across the boundary, and shift the last hop by a value can keep the overlap size between the last hop and first hop same as the configured one.*** |
| [10] | ***Proposal****:* ***No special handling of the last hop overlap.*** |
| [14] | **Proposal 2: Regarding “FFS: whether/how special handling for the last hop overlap”, the UE is expected to be configured with the bandwidth within which all hops in the pattern are contained, i.e., no special handling for the last hop overlap is needed.** |
| [15] | ***Proposal 5: There should be no special handling for the last overlap. The UE does not expect parameters of the hop bandwidth, overlap value and number of hops to be different for all hops.*** |
| [20] | **Proposal 11 Overlap size and bandwidth of the top hop of the wide bandwidth are configured by network via****• Alt. 1: Common overlap size and common hop bandwidth for the top hop, when virtual bandwidth is equal or larger the sum of the stitched bandwidth for all hops** **• Alt. 2: Common hop bandwidth for the top hop, with a larger overlap for the top hop when virtual bandwidth is less than the sum of the stitched bandwidth for all hops if a common overlap value was also used for the top hop*** **The top hop overlap can be derived from the size of the virtual bandwidth part and the hop bandwidth**
 |

### Round 1

We can start the discussion with the majority opinion. From the FL perspective, the feature would be nice to have but is not a critical functionality. Hence at this stage we should not dedicated too much time to it.

 **Proposal 5.2-1: (for conclusion): For the SRS with T hopping, there is no special handling of the overlap.**

Companies are encouraged to comment on the proposal in the table below:

**Proposal 5.2-1:**

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| **Company** | **Comment** |
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## UL time window (option 1)

### Summary of proposals

For the uplink time window, the we already agreed that the UL time window could be configured to be periodic. In this meeting, contributions have provide further details for the configuration of the UL time widow.

* In [3][19] values for the window duration are proposed. In [11][19] it is proposed to have the save values for the parameters of the periodic UTW than for the same paramters in the SRS for positioning.
* In [4][11] it is proposed to add aperiodic support for UTW, with either DCI or MAC CE support.
* In [5] it is proposed that if UTW is configured, SRS for positioning shall not be transmitted outside UTW.
* In [8] the UTW period is proposed to be the same as the one configured (if any) for MG.

For the behaviour of the UL Time window with respect to downlink, [4] proposes that when a DL measurement gap is configured so that UTW overlaps with the MG, the UTW becomes invalid. I[14] it is proposed that within a UTW, the DL signal slots are received (text proposal).

For the behaviour of the UTW within the UE, [9][14] proposes that within a window, if no SRS with Tx hopping is colliding with other UL or DL transmission, the UL or DL transmission can be transmitted/received.

Additionally, the open issue of the UE behaviour outside the window was discussed

* In [3][7][9][19][20] it is proposed to remove the bracket in the previous agreement, and thus clarify that the UE behaviour for collision outside of UTW is to follow option 2, i.e. collision rules.
* In [17] it Is proposed to clarify that a single UTW is configured. In [19] it is proposed that the window is configured as part of the BWP configuration. In [4] it is proposed to attach the window to either a SRS resource or a SRS resource set

In [20] it is proposed not to support UE originated UTW requests.

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| **Company** | **Proposal** |
| [3] | **Proposal 9:** For the agreement on the UL time window and the priority for UL SRS frequency hopping, support removing the square bracket of option 2. That is, RAN1 update the previous agreement as follow:**Proposal 11:** RAN1 supports {1, 2, 4, 6} slots for the configuration of the window length. |
| [4] | **Proposal 7:** For aperiodic SRS transmission, the following two schemes to determine the UL time window can be considered.* Configure the length of the uplink transmission window through high-level parameters, and DCI indicates the starting position of the uplink transmission window.
* UE determines the starting position and length of the uplink time window based on the SRS resource time position in the SRS resource set triggered by DCI.

***Proposal 5: Per SRS resource or per SRS resource set configuration of the UL time window parameter should be supported.******Proposal 6: UL time window activation/deactivation mechanisms (e.g., though DCI or MAC CE) should be supported.******Proposal 8: UL time window validity criteria should be defined in specification.******Proposal 9: When the UL time window overlaps with the measurement gap, the UL time window becomes invalid.*** |
| [5] | Proposal 7: • The UE is not expected to perform SRS for positioning frequency hopping outside UL time window if the UL time window is configured.• Regarding collision between SRS for positioning frequency hopping and other signals/channels, Option 2 cannot apply outside UL time window. |
| [6] | **Proposal 5*** For collision handling of positioning SRS with frequency hopping, for Option 1 (UL time window)
* For TDD, when SSB symbols including the switching period collide with one of the hops for positioning SRS transmission, the SRS on the hop is dropped.
 |
| [7] | ***Proposal 3:*** *For one SRS transmission occasion, if the UL time window is configured and the SRS occasion is in the window, then option 1 is applied. Otherwise, the collision rule is applied (i.e., Option 2).* |
| [8] | ***Proposal 8: Support same period configuration for DL measurement gap and UL time window for positioning, and the applied period can be the indicated one or two times of the indicated one when both DL measurement gap and UL time window are configured or activated.*** |
| [9] | ***Proposal 5: Within the UTW, UE can transmit other uplink transmission if and only if it does not collide with SRS-pos with frequency hopping configured.******Proposal 6: Adopt following TP for 38.214:******Text proposal******Proposal 7: When SRS-pos resource configured across the boundary of UTW, collision handling rule is applied for hops outside the UTW.*** |
| [11] | **Proposal 10: The following parameters of UL time window should be supported:*** **Starting SFN**
* **Periodicity**
	+ **Values for starting SFN and periodicity can be the same as SRS configuration.**
* **Starting slot and starting symbol**
	+ **The values for starting slot and starting symbol can be smaller than SRS configuration, e.g., {0..7} slot and {0..13} symbol.**
* **Duration/length, e.g., {1..160} slot.**

**Proposal 11: DL MAC CE can be used to activate/deactivate the window.** |
| **[14]** | **Proposal 6:** Adopt the following TP to enable the UE is to receive downlink signals or channels during the UL time window when the UL time window overlaps with downlink slots. The reason for the change is to clarify the UE behavior during downlink slots when downlink slots overlap with the UL time window. **The summary of change description of the UE behavior during downlink slots within the UL time window. The consequence if not approved is loss of downlink signals or channels due to failure for the UE to receive downlink signals or channels during the UL time window.****Text proposal****Proposal 8:** Clarify whether UL signals or channels can be transmitted during the UL time window if SRS for positioning is not scheduled to be transmitted during the UL time window. |
| [15] | ***Proposal 7: It is necessary to discuss if the window spans a single hop or spans the entire hop sequence.*** * ***If the UL time window spans the entire hop sequence and no additional collision rules are defined then, at least for SRS measurement, there is no need to discuss the per-hop or single measurement issue.***
 |
| [17] | **Proposal 7:*** **Regarding the higher layer parameter for UL time window, the FFS point can be removed (i.e., a single UL time window can be provided to a UE).**
 |
| [19] | Proposal 9: For to the UL time window for SRS frequency hopping, * With regards to the configuration of the window:
	+ is part of a BWP configuration
	+ it includes a periodicity in slots and the offset of the starting slot with respect to SFN #0 slot #0 of the serving cell where the UL time window is configured with the same values as those in *SRS-PeriodicityAndOffset* IE,
	+ The duration within a slot is equal to the nrofSymbols IE of the SRS-PosREsource (i.e., 1,2,4,8,12 symbols)
	+ The start positioning is equal to the start startPosition IE of the SRS-PosREsource (0-13 symbols)
	+ A length in consecutive slots which includes at least {1,2,3,4,5} slots
* With regards to the brackets “[or outside]” remove the text, i.e. Option 2 applies without UL time window configuration.
 |
| [20] | Proposal 6 UE originated UL time window request is not supported.Proposal 7 Option 2 applies when option 1 is not configured, or outside of the UTW when option 1 is configured. |
|  |  |

### Parameter values for UL time window

#### Round 1

Based on the proposal in [3][19] and [11] we propose to start the discussion on parameters value with the following:

**Proposal 5.3.2-1 With regards to the configuration of the UTW:**

* **the window parameters for periodicity and starting slot offset have the same range as the periodicity and starting slot offset parameters for the SRS for positioning in the IE**

 ***PeriodicityAndOffset***

* **the duration of the window in slot is {1,2,4,6} slots**

**Proposal 5.3.2-1:**

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| **Company** | **Comment** |
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### Configuration level for UTW

#### Round 1

Based on the received proposal, we need to choose where to place the UTW configuration. additionally, the number of UTW in case it is configured within the BWP (or virtual BWP, where SRS tx hopping is configured), we should clarify how many UTW can be configured. This is a separate proposal that we can discuss if alt1 is chosen.

**Proposal 5.3.3-1 With regards to the configuration of the UTW:**

* + **Alt1 UTW is part of a (virtual) BWP configuration**
	+ **Alt2 UTW is part of an SRS resource definition and only applies to this resource**
	+ **Alt3 UTW is part of an SRS resource set definition and applies to all resource of the resource set**

**Proposal 5.3.3-1:**

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| **Company** | **Comment** |
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### Collision with DL signals and channel within UTW

#### Round 1

For the UTW definition, we had the following agreement:

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| **Agreement**For RedCap UEs positioning transmitting the UL SRS with frequency hopping, regarding the collisions between other UL and DL signals/channels and the UL SRS with frequency hopping, support both of the following options * Option 1: UL time window where the UE is not expected to []transmit other signals/channels and is only expected to transmit FH SRS for positioning.
	+ FFS details of an UL time window
	+ Note: it implies that UE drops the transmission of other signals/channels and transmits SRS for positioning
* Option 2: new collision rules between the UL SRS with frequency hopping and other UL and DL signals/channels/. Option 2 can apply without [or outside] UL time window (i.e. option 1)
	+ FFS: details on the collision rules
* Note: it is understood that option 2 is a component of the feature for UL SRS Tx hopping (FG 41-5-2), and option 1 is a separate feature group.
 |

Based on the received proposal, we should clarify the behavior of the UE within the UTW for the DL slots. From the FL perspective, it seems clear that the agreement is limited to transmission from the UE. hence the UTW should not apply to DL signals. However, it may be good to clarify the case of UTW periods overlapping with MGs.

**Proposal 5.3.4-1: When the UL time window overlaps with the measurement gap, the UL time window becomes invalid.**

**Proposal 5.3.4-1:**

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| **Company** | **Comment** |
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### UE behaviour in UTW with no SRS transmission

#### Round 1

It may be good to clarify as proposed in [14] what happens if no SRS is to be transmitted within the UTW. One option is to allow UL transmission of other signals and channels. Another is to treat the UTW as a measurement gap and suspend all UL transmission beside SRS.

**Proposal 5.3.5-1: Within a UTW, if no SRS is to be transmitted, other UL channels can be transmitted.**

**Proposal 5.3.5-1:**

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| **Company** | **Comment** |
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### UE behaviour outside UTW

#### Round 1

When the UTW is configured, we should clarify what happens outside the UTW. From the FL perspective, the window does not preclude the UE to transmit SRS outside the UTW. Therefore, normal collision rules should apply outside the window. This is also the general view of the received proposals.

**Proposal 5.3.6-1: the agreement below is updated by removing the bracket on “on outside”**

**Agreement**

For RedCap UEs positioning transmitting the UL SRS with frequency hopping, regarding the collisions between other UL and DL signals/channels and the UL SRS with frequency hopping, support both of the following options

* Option 1: UL time window where the UE is not expected to []transmit other signals/channels and is only expected to transmit FH SRS for positioning.
	+ FFS details of an UL time window
	+ Note: it implies that UE drops the transmission of other signals/channels and transmits SRS for positioning
* Option 2: new collision rules between the UL SRS with frequency hopping and other UL and DL signals/channels/. Option 2 can apply without ~~[~~or outside~~]~~ UL time window (i.e. option 1)
	+ FFS: details on the collision rules
* Note: it is understood that option 2 is a component of the feature for UL SRS Tx hopping (FG 41-5-2), and option 1 is a separate feature group.

**Proposal 5.3.6-1:**

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| **Company** | **Comment** |
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## [HIGH] Additional Collision rules (option 2)

### Background

The following is proposed for the collision rules of the SRS with Tx hopping

* Re-use the exisiting rules for the SRS for the SRS for positioning, but include the switching time in the definition of the colliding SRS symbols [1][6][9][19][20]
	+ FL note: in the current specification, only colliding symbols of the SRS for positioning resource are drop.
* In[7] it is proposed to use existing rules for RRC\_CONNECTED for the symbols in hops that are within the active BWP, and for RRC\_INACTIVE elsewhere.
* In [4] it is proposed to consider the whole SRS resource for the as high priority, including retuning time prior to and after Tx hopping.
* In [14] it is proposed to have the priority of the SRS with Tx hopping to be configurable.
* In [5] it is instead proposed to drop the whole SRS resource when a collision happens.
* In [9] it is propose to drop only the colliding hop.
* In[15] two options for per hop or per resource collision handling is proposed.
* In [13] specific rules for configured grants type 1 and 2 are mentioned.
	+ FL note: in legacy, the SRS dropping rules for PUSCH apply to all PUSCH irrespective of the type of transmission.
* For the collisions with DL signals, [15] proposes to either configure a priority between the SRS with Tx hopping and DL signals, or re-use rules from CA in previous releases

For RRC INACTIVE, [3] proposes to configure whether to give high priority or low priority to the SRS with Tx hopping.

In[16] it is propose to postpone transmission when collision occur.

Additionally, some proposal mention conditions for returning to the UL active BWP. From the FL perspective, the UE should always return to the active BWP if the collision rules have established that the transmission in the active BWP (wich includes the retuning time) has higher priority than the SRS transmission. Thus no special rules are needed if the collision rules are clear.

* In [8] it is proposed to consider the total transmission time for an active BWP transmission between hops, including retuning time. If the start of the transmission including the time needed to retune is such that the total transmission does not interfere with any hop, the UE is allowed to switch back to the BWP. In [19] a note similar to the proposal in [8] is included.
	+ FL note: from the FL perspective, this case does not constitutes a collision, hence this is legacy behaviour.
* In [9] the BWP retuning time is added to the definition of the other potentially colliding channels

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| **Company** | **Proposal** |
| [1] | **Proposal 4: Clarify that the collision rule between the UL SRS with frequency hopping and other UL channels (PUSCH, PUCCH, SRS) are applicable but the switching time before and after each hop should be considered.****Proposal 5: Endorse the following TP to clause 6.2.1.4 of TS 38.214.****Text proposal** |
| [3] | **Proposal 10:** For the RedCap UE in RRC\_INACTIVE mode, the UE may be configured with a priority indicator to determine whether to drop the other channels and/or reference signals. |
| [4] | **Proposal 3:** Scheduling restriction rules before ad after SRS hopping pattern should be supported.**Proposal 4:** During SRS hoping transmission, UE is not expected to receive/transmit other signals/channels and is only expecting to transmit FH SRS for positioning.**Proposal 10:** For Option 2, the new collision rule should be defined as follow:* If there are N non-affected SRS hops in once SRS transmission, UE needs to transmit SRS using the N non-affected SRS hops, where N is not less than M, otherwise, all hops are dropped. M is configured by the network or predefined.
 |
| [5] | **Proposal 8:** • For Option 2: new collision rules between the UL SRS with frequency hopping and other UL and DL signals/channels, support UE dropping all the SRS hops when collision happens.**Proposal 9:** • For UE dropping all the SRS hops, the descriptions of case1~5 should be adopted into the specification.Text proposals |
| [6] | **Proposal 6*** For collision handling of positioning SRS with frequency hopping, for Option 2 (new collision rules)
* Switching period associated with transmission of positioning SRS with frequency hopping has same priority as the corresponding positioning SRS.
 |
| [7] | **Proposal 2:** For RedCap UEs positioning transmitting the UL SRS with frequency hopping, regarding the collisions between other UL and DL signals/channels and the UL SRS with frequency hopping, * If the SRS hop is within the active BWP, the existing dropping rule for RRC\_CONNECTED state is reused.
* If the SRS hop is outside the active BWP, Rel-17 defined rule for SRS outside initial BWP in RRC\_INACTIVE state is reused, i.e. SRS has low priority.
 |
| [8] | **Proposal 9:** To handle the collision between gap and UL channel/signals, support UE switches back to the activate BWP only when both the two conditions meets:1) The time between hop and the UL channel/signals exceed the retuning time to the active BWP2) The time between the UL channel/signals and hop exceed the retuning time from the active BWP |
| [9] | **Proposal 8:** For collision handling of UL SRS-pos with FH, hop level dropping is supported**Proposal 9:** for the collision handling rule, switching time required ahead of the first hop and after the last hop described in reply LS is also applied ahead and after the other signals/channels.**Proposal 10:** Adopt following TP for TS 38.214:Text proposal |
| [13] | **Proposal 4:** For RedCap UEs positioning transmitting the UL SRS with frequency hopping, support to define additional collision rules between the UL SRS with frequency hopping and other UL and DL signals/channels:* If SRS resources for Tx frequency hopping collides with a Type 1 configured grant of UL/DL channels/signals, UE drops SRS resources for Tx frequency hopping;
* If a DCI scheduling a dynamic grant or Type 2 configured grant of UL/DL channels/signals arrives before T ahead of the first symbol of SRS resources for Tx frequency hopping, and collides with SRS resources for Tx frequency hopping, UE drops SRS resources for Tx frequency hopping; otherwise, UE drops the schedule UL/DL channels/signals;
	+ - T is a preparation time for transmission of SRS resources for Tx frequency hopping and switching time.
 |
| [14] | **Proposal 9:** Adopt the following text proposal on collision rules between UL channel/signal transmission and gap between SRS for positioning hops. The reason of the change is include the agreement. The summary of the change is to introduce configuration of a priority level for SRS for positioning and collision occasions. The consequence if not approved is that the UE cannot complete Tx frequency hopping. |
| [15] | ***Proposal 6: An UL Hopping SRS instance collides with DL/UL signal/channel if any portion of the other DL/UL signal/channel overlaps with the time interval starting X symbols before the transmission and ending Y symbols after the transmission. Note that X and Y may be different for UL and DL signals and channels.*** ***Proposal 8: On the collision rules, the transmission of UL-FH-SRS depends on relative priority of colliding signals and channel. The UE behavior can be one of the following:**** ***Option 1: per hop collision: UL-SRS transmitted or dropped if collision occurs on a specific hop***
* ***Option 2: per total bandwidth collision: All UL-FH-SRS are dropped if collision occurs on any of the hops***

***Proposal 9: To set the relative priority of the UL-SRS compared with other DL and uplink signals**** ***Option 1: Can be configurable based on higher layer signaling e.g. set to a relative priority for all DL signals***
* ***Option 2: can be pre-determined e.g. similar to Carrier Aggregation in previous releases.***
 |
| [16] | Proposal 2: On the collision rule for option 2 where UL SRS with frequency hopping collides with the other DL/UL channels, support at least postponing a portion or entire hopping cycle. |
| [19] | **Proposal 10: With regards to the collisions between SRS for Positioning with frequency hopping and other channels,** * **the already specified collision rules between the UL SRS with frequency hopping and other UL channels (PUSCH, PUCCH, SRS) are applicable, by incorporating in the length of the occupied symbols from the SRS the retune time before and after each hop.**
* **Note: If the time between hop exceed the sum of the retuning time to and from the active BWP, the UE switches back to the active BWP and transmits the UL channel / signals.**
 |
| [20] | **Proposal 8 For the collision rules of UL SRS for positioning with Tx hopping,** **• the collision rules for SRS with Tx hopping re-use the collision rules for the SRS for positioning without tx hopping.****• for SRS symbols in a hop occurring outside the active BWP, the colliding symbols for PUSCH or PUCCH include retuning time to and from the active BWP.** |

### Round 1

It is proposed to discuss the following:

* Definition of the colliding resource, including retuning time
* Whether to drop a symbol, a hop, or a whole SRS resource when in collision
* Whether to introduce a priority indicator for the SRS with Tx hopping in RRC\_CONNECTED
* Whether to define rules for collision with downlink signals
	+ This could be avoiding if hopping is only allowed in UL slots.
* Whether to introduce additional priorities for RRC\_INACTIVE

Regarding an agreement for the conditions of PUSCH/PUCCH transmission in the active BWP between hop, we can see if it is needed once we have stable collision rules.

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**Proposal 5.4-1**

**For the collision rules of the SRS with Tx hopping (option2)**

* **A colliding PUSCH or PUCCH resource includes the retuning time required before or after the PUSCH/PUCCH resource to return to and from the active BWP**
* **When the SRS with TX hopping resource collides with PUSCH or PUCCH (down select), and SRS with Tx hopping is dropped:**
	+ **Alt 1-1: the colliding symbols are dropped**
	+ **Alt 1-2: the colliding hop is dropped**
	+ **Alt 1-3: the colliding SRS transmission is dropped, i.e. all hops in one occasion.**
* **For priority of the SRS with Tx hopping compared to PUSCH/PUCCH transmission:**
	+ **Alt 2-1: no priority is configured, the SRS for Tx hopping as low priority compared to PUSCH and PUCCH (legacy behavior)**
	+ **Alt 2-2: no priority is configured, the SRS for Tx hopping is always high priority compared to PUSCH or PUCCH**
	+ **Alt 2-3: a priority is configured to the SRS resource for Tx hopping**
* **For collision with downlink transmission:**
	+ **Alt 3-1 The SRS with Tx hopping is only allowed in UL slots**
	+ **Alt 3-2 The with Tx hopping has lower priority compared to DL transmission.**
	+ **Alt 3-3 the priority of the SRS with Tx hopping compared to DL transmission can be configured**

**Proposal 5.4-1:**

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| **Company** | **Comment** |
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## [HIGH] the hopping bandwidth for SRS with Tx hopping

### Background

In [1][2] and [20], it is proposed to configure the lower and higher limits of the hopping sequence. It is noted that this is necessary to allow the staircase pattern to wrap around.

In [1] and [20] only the lower limit of the hopping pattern is configured, and the higher limit is instead determined by other parameters.

In[2] the highest PRB of the FH bandwidth is configured.

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| **Company** | **Proposal** |
| [1] | Proposal 2: To define a wrapped staircase pattern, the following parameter for pos-SRS configuration are needed: ● The lower frequency bound of the Tx hopping pattern for the pos-SRS resource● Note: The UE shall be able to determine the upper frequency bound based on other parameters and correspondingly when to wrap a hop. |
| [2] |  Proposal 8: For wrapped staircase SRS Tx frequency-hopping patterns, support configuring the highest PRB of the entire frequency hopping bandwidth. |
| [20] | **Proposal 18** Introduce a Tx hopping point A referring to the lowest subcarrier across all hops for the SRS resource with Tx hopping**Proposal 1**9 Support the configuration of virtual wide bandwidth for SRS frequency hopping, and the value can be up to 100MHz in FR1 and 400MHz in FR2 and depends on network configuration. |

### Round 1

It is proposed to start the discussion by checking what is needed to complete the design:

**Proposal 5.5-1 : For the frequency domain boundaries of a SRS with TX hopping**

* **Alt1 only the lower frequency bound of the frequency hopping is configured by higher layer signaling.**
* **Alt2 only the higher frequency bound of the frequency hopping is configured by higher layer signaling.**
* **Alt3: lower and higher frequency bound of the frequency hopping are configured by higher layer signaling.**

Companies are encouraged to comment on the proposal in the table below:

**Proposal 5.5-1:**

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| **Company** | **Comment** |
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## [HIGH] Aperiodic / SP SRS with Tx hopping / on demand SRS rescheduling

### Background

We have not discussed the time domain behaviour of the SRS for positioning with FH yet. Several companies in [3,6,19] proposed to support all three behaviours already supported since release 16 for the SRS for positioning also when Tx hopping is used.

In [3], it is proposed to use a single DCI to trigger the aperiodic SRS with FH

* FL note: for the legacy SRS for positioning, the DCI will trigger the entire SRS for positioning resource set.

In [9], it is proposed to activate / deactivate FH by MAC-CE

* FL note: from the FL understanding this is a new feature separate from aperiodic SRS or semi-persistent. In this proposal the same resource can have or not have Tx hopping depending on the active status of the tx hopping.

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| Company | Proposal |
| [3] | **Proposal 13:** RAN1 supports single DCI triggering aperiodic SRS frequency hopping including RF switching. |
| [6] | **Proposal 3**• Semi-persistent and aperiodic SRS transmission are supported for SRS for positioning with Tx frequency hopping for RedCap UEs. |
| [9] | **Proposal 3:** For UL SRS-pos Tx hopping, * Support frequency hopping of SRS-pos to be activated/deactivated by MAC-CE.
* Support frequency hopping of SRS-pos to be triggered by DCI
 |
| [19] | **Proposal 7: The Time domain behaviour of an SRS resource for positioning with frequency hopping   is indicated by the higher layer parameter resourceType, which may be periodic, semi-persistent, aperiodic SRS transmission.*** **For aperiodic SRS, the slot-offset indicated by the *slotoffset corresponds* to the slot offset of the first hop**
 |

### Round 1

**Proposal 5.6-1 Tx hopping can be configured for SRS for positioning resources configured to be aperiodic, aperiodic or semi-persistent**

* + **The mechanism for aperiodic and semi-persistent SRS for positioning (DCI triggered and MAC-CE activation/deactivation, respectively) can be re-used**
	+ **For aperiodic SRS, the slot-offset indicated by the *slotoffset corresponds* to the slot offset of the first hop**

Companies are encouraged to comment on the proposal in the table below:

**Proposal 5.6-1:**

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| **Company** | **Comment** |
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## [MEDIUM] Power and TA consideration

### Background

In [20] power control over the Tx hopping is discussed.

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| Company | Proposal |
| [20] | **Proposal 21** UE uses same pathloss estimation for SRS transmission during one SRS frequency hopping duration if uplink power control is configured. |

### Round 1

**Proposal 5.7-1: UE uses same pathloss estimation for SRS transmission during one SRS frequency hopping duration if uplink power control is configured.**

Companies are encouraged to comment on the proposal in the table below:

**Proposal 5.7-1:**

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| **Company** | **Comment** |
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## [MEDIUM] LMF request for SRS FH parameters

### Background

In [19], it is proposed to enable the LMF to request the SRS FH characteristics.

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| Company | Proposal |
| [19] |  **Proposal 11:** An LMF should be able to request, using the “Requested SRS Transmission Characteristics IE”, that a “SRS frequency hopping” needs to be considered. **Proposal 12:** An LMF should be able to request, using the “Requested SRS Transmission Characteristics IE”, specific SRS frequency hopping parameters, including the number of symbols per hop, the amount of overlap between 2 consecutive hops, hopping bandwidth of each hop. |

### Round 1

We can check what is the support for this proposal. from the FL perspective, it could be handled by RAN3.

**Proposal 5.8-1: An LMF should be able to request, using the “Requested SRS Transmission Characteristics IE”, specific SRS frequency hopping parameters, including the number of symbols per hop, the amount of overlap between 2 consecutive hops, hopping bandwidth of each hop.**

Companies are encouraged to comment on the proposal in the table below:

**Proposal 5.8-1:**

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| **Company** | **Comment** |
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# UE features

### Summary of proposals

Several proposal releated to UE features were provided.

* In[3] it is proposed to introduce a capability for the number of symbols required for PRS rx hopping, as well has the maximum number of hops
	+ FL comment: this could be left to RAN4 requirements.
* In [8] it is proposed to report a capability for the phase error, to facilitate the overlap configuration
* In[1,19] the processing capability for the redcap UE was discussed
* In [18] the RF switching time is a reported UE capability
	+ FL comment: This can be part of the reception / processing capability for DL PRS with Rx hopping, and part of the SRS with tx hopping capability.

We propose to discuss the case of the processing capabilities, as well as the RF switching capability. It seems other topics can be left to RAN4.

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| Company | Proposal |
| [ 1] | Proposal 6: For measurement reporting for DL Rx hopping or UL Tx hopping, support the following* Report both a wideband measurement and a measurement for a specific hop together if supported by UE/gNB
* A UE capability should be introduced to support UE to report one measurement associated with one received frequency hop and one measurement based on multiple hops of the DL PRS together.

Proposal 7: For PRS processing capability, support RedCap UE to report two sets of PRS processing capabilities, including* A PRS processing capability (N, T) for non-FH based PRS reception as legacy
* A new PRS processing capability (N3, T3) for FH based PRS reception
	+ Introduce an overall bandwidth across hops as a component
	+ The value T3 corresponds to the processing time assuming the processing bandwidth corresponds to the reported overall bandwidth across hops.
	+ The value N3 corresponds to the maximum DL-PRS bandwidth provided in supportedBandwidthPRS
* Note: RAN4 to discuss the calculation of duration K
 |
| [ 3] | **Proposal 3:** RAN1 supports the following text proposal on Clause 5.1.6.5 of TS 38.214.

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| <omitted text>The reduced capability UE may be configured to measure and report, subject to UE capability, via [higher layer parameter] 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 bandwidth that may be greater than the maximum reduced capability UE bandwidth, within a configured measurement gap. The reduced capability UE performing receiver frequency hopping may be configured to report via [*higher layer parameter*] one measurement associated with one received frequency hop or one measurement based on multiple 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. The UE may be requested to report required number of symbols per frequency hop of a DL PRS.<omitted text> |

**Proposal 5:** RAN1 supports that the UE provides the LMF with the maximum number of frequency hops that it can measure, to guarantee the measurement error less than a certain threshold considering UE mobility, for a given DL PRS resource configuration including repetitions.**Proposal 6:** RAN1 supports that the UE provides the LMF with the maximum number of frequency hops that it needs to measure to guarantee a certain level of the measurement accuracy for a given DL PRS resource configuration including repetitions. |
| [ 8] | **Proposal 1:** For frequency hopping of positioning RS, support UE reporting the capability related to the phase offset to facilitate the overlap size’s configuration.**Proposal 2:** For frequency hopping of positioning RS, support the minimum value of overlap size being zero, or support the presence of overlap size being determined by the capability related to phase offset between hops of RedCap UE. |
| [ 16] | **Proposal 3**: Support the UE capability to reflect the supported frequency hopping operation for NR RedCap UE. (i.e, by considering the RedCap UE constraints / limitations).**Proposal 4:** Support the RedCap UE’s processing time for Rx frequency hopping as part of the UE capability. |
| [18] | **Proposal 2-1**: The RF switch time of UE may also need to report to the NW |
| [19] | **Proposal 6:** For the main per-band FG on DL PRS Rx hopping, we propose the following components: * PRS BW per hop which is supported and reported by UE
* Maximum number of PRS hops of a PRS resource within a single MG instance
* Minimum amount of frequency domain overlap(s) between hops
* RF Rx retune time between consecutive hops
* Duration of DL PRS symbols N in units of ms a UE can process every T ms assuming maximum DL PRS bandwidth in MHz for each PFL
* Max number of DL PRS resources that UE can process in a slot for a PFL
 |

## Processing capability for DL PRS without rx hopping for redcap UEs.

### Round 1

We can check if the proposal in [1] is agreeable:

**Proposal 6.2-1: For PRS processing capability, support RedCap UE to report two sets of PRS processing capabilities, including**

* **A PRS processing capability (N, T) for non-FH based PRS reception as legacy**
* **A new PRS processing capability (N3, T3) for FH based PRS reception**
	+ **Introduce an overall bandwidth across hops as a component**
	+ **The value T3 corresponds to the processing time assuming the processing bandwidth corresponds to the reported overall bandwidth across hops.**
	+ **The value N3 corresponds to the maximum DL-PRS bandwidth provided in supportedBandwidthPRS**
* **Note: RAN4 to discuss the calculation of duration K**

Companies are encouraged to comment on the proposal in the table below:

**Proposal 6.2-1:**

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| **Company** | **Comment** |
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## Processing capability for DL PRS without rx hopping for redcap UEs.

### Round 1

We can check if the proposal in [19] is agreeable:

**Proposal 6.3-1 For the main per-band FG on DL PRS Rx hopping, we propose the following components:**

* **PRS BW per hop which is supported and reported by UE**
* **Maximum number of PRS hops of a PRS resource within a single MG instance**
* **Minimum amount of frequency domain overlap(s) between hops**
* **RF Rx retune time between consecutive hops**
* **Duration of DL PRS symbols N in units of ms a UE can process every T ms assuming maximum DL PRS bandwidth in MHz for each PFL**
* **Max number of DL PRS resources that UE can process in a slot for a PFL**

Companies are encouraged to comment on the proposal in the table below:

**Proposal 6.3-1:**

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| **Company** | **Comment** |
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| [19] |  |

## Capability for RF retuning time

### Round 1

We can check if the proposal in [18] is agreeable:

**Proposal 6.4-1 for UL SRS with Tx hopping the UE report its RF retuning time as a UE capability**

**Proposal 6.4-1:**

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| **Company** | **Comment** |
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# Other issues

The proposal below deal with issues that have been discussed without converging during the earlier meetings of the release. Since we are now in the maintenance phase for Rel-18, we should focus on fixing functional issues in the current design. Topics that did not converge yet and could be seen as optimizations, or not essential to the feature being functional should be down prioritized. Hence it is propose to downprioritize the proposal below.

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| Company | Proposal |
| [ 3] | **Proposal 7:** RAN1 supports the mechanism to improve the DL/UL positioning accuracy of RedCap UE frequency hopping positioning in the presence of the mobility by * Reading the Doppler shift values per hop per gNB, and then averaging them
* Calculating the speed of RedCap UE per gNB () using the Doppler shift together with the transmitted signal frequency
* Assuming the measured time of flight () per gNB to be the time for the distance correction per gNB
* Distance correction per gNB is

FL comment: mobility was never discussed during SI or WI phase. At this stage we should only treat items essential to enable the functionalities already agreed.**Proposal 15:** RAN1 supports UE to request an SRS sequence (a single ZC sequence) that satisfies a certain level of PAPR for every SRS transmission occasion of the SRS frequency hopping.FL comment: This is previously discussed optimization that did not get enough support. At this stage we should only treat items essential to enable the functionalities already agreed.**Proposal 16**: RAN1 should discuss how to perform phase alignment between frequency chunks in PRS frequency hopping/stitching including the impacts of a poor channel on the overlapping RB/REs. FL comment: how to use the overlap is an implementation issue. Regarding the impact of the channel on the overlapping Res, I assume RAN4 will set side conditions for the use of the overlap. **Proposal 17**: RAN1 should support phase alignment for Multi-RTT and determine if phase alignment is needed for both UL at the gNB and DL at the UE.FL comment: This is previously discussed optimization that did not get enough support. At this stage we should only treat items essential to enable the functionalities already agreed. |
| [6] | **Proposal 2*** For DL PRS with Rx frequency hopping for RedCap UEs, only MG-based measurement is supported.

FL comment: PPW configuration was discussed extensively during previous meetings and did not converge. At this stage we should only treat items essential to enable the functionalities already agreed. **Proposal 7*** For HD-FDD RedCap UE, collision handling between DL PRS and UL channels/signals within a configured PPW needs to be addressed at least for the case where DL PRS is configured without Rx frequency hopping.

FL comment:The following is captured in the latest version of 38.213:

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| If a HD-UE is configured by higher layers to receive a PDCCH, or PDSCH, or CSI-RS, or DL PRS in a set of symbols, the HD-UE receives the PDCCH, or PDSCH, or CSI-RS, or DL PRS if the HD-UE does not detect a DCI format that indicates to the HD-UE to transmit a PUSCH, or PUCCH, or PRACH, or SRS in at least one symbol of the set of symbols; otherwise, the HD-UE does not receive the PDCCH, or PDSCH, or CSI-RS, or DL PRS in the set of symbols. |

Hence from the FL perspective it seem the issue is covered.  |
| [8] | Proposal 10: For NR RedCap UEs, study the muting mechanism for frequency hopping sub-bands.Proposal 11: For NR RedCap UEs, separate muting options configured for each hop or repetition of PRS is slightly preferred due to the flexibility on resource allocation.FL comment: These two proposals are from previously discussed optimization that did not get enough support. At this stage we should only treat items essential to enable the functionalities already agreed. |
| [12] | 1. ***For RedCap UEs positioning, support the SRS frequency hopping across multiple BWPs within one SRS resource.***

FL comment: we have agreed not to use multiple BWP to do hopping. At this stage we should only treat items essential to enable the functionalities already agreed. |
| [13] | Proposal 3: For RedCap UEs, the PPW-based DL PRS measurement with Rx frequency hopping is NOT supported in Rel-18.FL comment: PPW configuration was discussed extensively during previous meetings and did not converge. At this stage we should only treat items essential to enable the functionalities already agreed. |
| [14] | Proposal 5: The UE can be configured with PRS processing window(s) to receive PRS via Rx hoppingFL comment: PPW configuration was discussed extensively during previous meetings and did not converge. At this stage we should only treat items essential to enable the functionalities already agreed. |
| [15] | Proposal 1: For DL PRS Rx Hopping, the UE hops within a DL PRS resource. The specification impact includes the following:* Frequency domain: no change
* Time domain: increase number of repetitions to enable mapping over BW. This may need an update to parameters like the L-PRS-ResourceRepetitionFactor, DL-PRS-ResourceTimeGap and the DL-PRS-Periodicity.

FL comment: This is previously discussed optimization that did not get enough support. At this stage we should only treat items essential to enable the functionalities already agreed.Proposal 2: Additional design details DL PRS Rx Hopping are as follows:* Repetition: Time domain repetition may have to account for multiple sets of hops across the bandwidth as a single repetition is over multiple hops.
* Muting: The muting pattern may either mute a single hop or may mute a hop set.

FL comment: This is previously discussed optimization that did not get enough support. At this stage we should only treat items essential to enable the functionalities already agreed. |
| [16] | Proposal 7: For DL Rx hopping operation, support configurable hopping pattern configured by LMF.Proposal 8: Support frequency hopping is configurable across multiple DL PRS resources or resource-sets for DL Rx hopping.FL comment: Rx hopping is patterns are up to the UE implementation as per previous agreement. At this stage we should only treat items essential to enable the functionalities already agreed. We can discuss whether the LMF request should include Rx hopping information.  |
| [20] | **Proposal 1** Support intra-slot hopping within a DL PRS resourcei. Intra-slot hopping within a DL PRS resource is a UE capabilityii. Send an LS to RAN4 informing of the decision.**Proposal 2** Support intra-slot (symbol) level repetitions, with a new intra-slot repetition factor and intra-slot resource time gap using symbol resolution. Potential values for resource time gap for intra-slot hopping includes 2, 4, 8 symbols. Potential values for intra-slot repetition include 1, 2, 3, 4.FL comment: intra slot hopping was not agreed and it is not essential to the Rx hopping functionality. **Proposal 3** PPW is not supported with DL PRS Rx hopping.FL comment: PPW configuration was discussed extensively during previous meetings and did not converge. At this stage we should only treat items essential to enable the functionalities already agreed.**Proposal 20** Support partially overlapped SRS frequency hopping in both SRS resources and positioning SRS resources.FL comment: This is previously discussed issue that did not get enough support. At this stage we should only treat items essential to enable the functionalities already agreed. |

# Online sessions

# Conclusion

#  References

1. R1-2308880, Maintenance of RedCap positioning, Huawei, HiSilicon
2. R1-2308943, On remaining open issues in RedCap UE positioning, FUTUREWEI
3. R1-2308958, Remaining issues on Positioning for RedCap UEs, Nokia, Nokia Shanghai Bell
4. R1-2308988, Remaining issues on positioning for RedCap UEs, Spreadtrum Communications
5. R1-2309077, Remaining issues on positioning for RedCap UEs, vivo
6. R1-2309200, Remaining issues on Positioning for RedCap Ues, Intel Coporation
7. R1-2309225, Maintenance on Positioning for RedCap UEs, ZTE
8. R1-2309289, Remaining issues of positioning for RedCap UEs, NEC
9. R1-2309328, Remaining issues on positioning support for RedCap UEs, LG Electronics
10. R1-2309378, Maintenance on Positioning for RedCap UEs, Samsung
11. R1-2309529, Maintenance on positioning for RedCap UEs, CATT
12. R1-2309578, Remaining issue of positioning for RedCap UEs, OPPO
13. R1-2309674, Maintenance on RedCap UE positioning, CMCC
14. R1-2309801, Remaining issues on positioning for RedCap UEs, InterDigital, Inc.
15. R1-2309836, On Positioning for RedCap UEs, Apple
16. R1-2309907, Remaining Issues on Positioning for RedCap UEs, Sony
17. R1-2310036, Remaining issues on positioning for RedCap UEs, NTT DOCOMO, INC.
18. R1-2310091, Maintenance for positioning for RedCap UE, MediaTek Korea Inc.
19. R1-2310144, Maintenance on Positioning for Reduced Capabilities UEs, Qualcomm Incorporated
20. R1-2310201, Remaining issues on Positioning for RedCap Ues, Ericsson