3GPP TSG RAN WG1 #114-bis draft\_R1-2310430

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

Agenda Item: 8.3.5

Source: Ericsson

Title: Feature Lead summary #2 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:

|  |
| --- |
| * 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]. |

# 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.

|  |  |
| --- | --- |
| **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 procedures  The 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** |
| ZTE | We are OK to extend the feature to non-Redcap UEs |
| Qualcomm | OK |
| vivo | The modification is out of scope of WID, we prefer the previous version.   * 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. |
| Nokia/NSB | We also think it is out of scope of WID. |
| Futurewei | Ok |
| Samsung | No, same view as nokia and vivo. |
| DOCOMO | Same view with vivo and Nokia. |
| Ericsson | Support |
| CATT | We prefer the original version. The change is out of the scope of WID. |
| Huawei, HiSilicon | Support.  At least we should discuss the applicability of features related to RedCap UEs to non-RedCap UEs before putting restriction on the UE capability signaling and network configuration. |

## 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]

|  |  |
| --- | --- |
| TP 2.2-1 |  |
| Reason for change | In RAN1 previous meeting, the following agreement on PRS Rx hopping had been achieved.   |  | | --- | | Agreement  PRS 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 38.214  5.1.6.5 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:**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | OK |
| Qualcomm | OK |
| Spreadtrum | OK |
| vivo | OK |
| Nokia/NSB | We are okay. |
| Futurewei | Ok |
| Samsung | ok |
| DOCOMO | OK |
| SONY | OK |
| LGE | OK |
| Ericsson | OK |
| CATT | OK |
| Huawei, HiSilicon | OK |
| FL | Moved for online endorsement, see section 8 |

## 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:

|  |
| --- |
| Agreement  For 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.  Agreement  SRS 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   Agreement  For 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  |  | | --- | | 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. |

|  |  |
| --- | --- |
| 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 38.214  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 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>   |  | | --- | | 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:**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | We prefer TP in [7] since it also clarifies the start PRB location of the remaining frequency hops. Based on that, we don’t need any TP for TS 38.211 anymore. |
| Spreadtrum | We are fine with TP in [4]. |
| vivo | We slightly prefer to capture the related parameter in TS 38.211. So, maybe we can postpone the discussion after the CR in TS 38.211 is specified. |
| Nokia/NSB | We prefer TP provided by [6], if this needs to be implemented in RAN1 spec. |
| Futurewei | No strong preference but conditions for wraparound seem missing |
| LGE | We don’t have strong preference but for „the starting PRB of the first frequency hop“, it should be changed as „the starting PRB of the first hop“ as TP in [6] based on the agreement in last RAN1#113 meeting. |
| Ericsson | We prefer the TP in [4] or [6], and the description of the starting PRB for all hops can be captured in 211 once the FH equation and hopping parameters are agreed. |
| CATT | We slightly prefer the TP in [4] |
| Huawei, HiSilicon | No strong preference on any of it. The enumerating of parameters seems trivial. What is more important is the capture how the starting RBs for the succeeding freuqency hops are determined considering the wrapped staircase.  Regarding the comments from LGE, we think that the existing 214 needs improvement to avoid the ambiguity. The first frequency hop should be the freuqency hop transmitted firstly, instead of the frequency hopping corresponding to the lowest frequency. |

## 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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| --- |
| Agreement  For 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 |

|  |  |
| --- | --- |
| 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:**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | This is not sufficient. For example, a SRS hop with 4 symbols, but the first 2 and the remaining 2 symbols are in different slots. This case should be avoided. We prefer the wording as follows  When the reduced capability UE is configured to perform transmit frequency hopping, the UE does not expect to be configured for any one hop across slot boundaries |
| vivo | Since it is part of TP 2.3-1, we share the same view as TP 2.3-1. We slightly prefer to capture the related descriptions together with hop parameters in TS38.211. |
| Nokia/NSB | Prefer the wording from ZTE. |
| LGE | We prefer the proposed TP.  We think that ZTE’s example case can be forbidden with the proposed TP. If the SRS hop with 4 symbols where the first 2 and the remaining 2 symbols are in different slots, then *startingsymbol* of the SRS hop would be 11 so the hop exceeds a slot duration. |
| Ericsson | Same view as LGE. The TP captures the wanted behavior from the UE. |
| Huawei, HiSilicon | We are fine in general to capture that in the spec. However the TP is not so accurate. The starting symbol in the agreement refers to any hop, but whether the starting symbol of a succeeding hops is directly indicated in a higher layer parameter is not clear yet. |

## 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:**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | We prefer not to capture this error case which can be avoided by network implementation. |
| Qualcomm | We are OK to capture this. |
| vivo | OK |
| Nokia/NSB | We don’t see the necessity to capture this. |
| Futurewei | This proposal is related to Proposal 5.1-1 in 5.1.2, which can be discussed jointly to determine what slot offset values are feasible. |
| LGE | OK. |
| Ericsson | It seems needed to capture this sort of restriction. The slot offset values will have a range of possible values , but only some of these values will be applicable based on the UE capability. |
| CATT | OK with the TP. |

## 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:**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | We don’t have strong view. The current spec is actually equivalent to the current TP. |
| Qualcomm | We don’t think the TP is needed. |
| Nokia/NSB | The UE is expected to receive DL signals/channels within the window, so we are not sure if the double clarification is necessary in the spec. We would like to understand the motivation first. |
| InterDigital | We support the TP. This is to clarify the agreement made in RAN1#114. |
| LGE | We don’t think this clarification is needed. Since agreement for UL time window is already saying that the UE is expected to receive DL signal/channel, it seems double clarfication as Nokia’s comment. |
| Ericsson | The TP clarifies the behaviour for TDD. We think it would be helpful. |
| CATT | It seems that the TP is not needed. |
| Huawei, HiSilicon | Not necessary. |

## 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:

|  |  |
| --- | --- |
| **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** |
| Qualcomm | We are OK with the TP, even though, we don’t think it is enough. An explicit formula is needed to be captured in 38.211 related to what ‘staircase” and “wrapped staircase” pattern mean. |
| vivo | The wrapped staircase pattern will be captured in TS 38.211 as part of SRS FH mapping description, which is not essential to be captured in TS 38.214. |
| Nokia/NSB | We don’t support. Even if we mention the staircase pattern in the spec, we still need clarification on this pattern. We would suggest this is addressed based on configurations. |
| Futurewei | Share the same view that staircase and wrapped staircase should captured. However, the TP is incomplete. For wrapped staricase, UE should know which hop wraparound occurs. For staircase and wrapped staircase, overlapping bandwidth needs to be taken into account. We propose the following in our contribution:  „The starting PRB of the current hop is determined from the starting PRB of the previous hop and adding the difference between the hopping bandwidth value and the overlapping bandwidth value. If any PRB of the current hop exceeds the highest PRB of the entire frequency hopping bandwidth, the starting PRB of the current hop is the difference between the starting PRB of the first hop, and the product of the number of remaining hops (including the current hop) and the difference between the hopping bandwidth value and the overlapping bandwidth .“ |
| LGE | Same view with vivo‘s |
| Ericsson | Prefer to capture the pattern and wraparound together in 211. |
| CATT | Support the TP, since it is based on the agreement and it is missed in the spec. We think two TPs are needed for this agreement, one TP is for 38.214 and another one is for 38.211. We prefer to agree this TP for 38.214 and then discuss another TP for 38.211(i.e., the TP related to what ‘staircase” and “wrapped staircase” pattern mean ). |
| Huawei, HiSilicon | Agree with Qualcomm that the “staircase” and “wrapped staircase” pattern should be clarified. |

## 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 :

|  |  |
| --- | --- |
| **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:**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | Not necessary. ‘scheduled’ seems more like a dynamic resource allocation, but we have configured grant UL transmission. |
| Qualcomm | Not necessary |
| Nokia/NSB | We are not supportive of this. |
| InterDigital | We support the TP. In TS 38.214, we do see „scheduled“ placed in uplink channels, such as below. „For operation on the same carrier, if an SRS configured by the higher parameter SRS-PosResource collides with a scheduled PUSCH, the SRS is dropped in the symbols where the collision occurs.“ |
| LGE | Do not support. |
| Ericsson | Not necessary |
| CATT | It seems that this TP is not needed. |
| Huawei, HiSilicon | Not necessary. |

# 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:

|  |  |
| --- | --- |
| **Company** | **Proposal** |
| [3] | **Proposal 1:** 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 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.**   |  | | --- | | --------------------------<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** |
| ZTE | OK |
| Qualcomm | We do not support this enhancement. We believe that reporting of hop information is not necessary. We believe that a single bit, whether it is a single-hop or a multi-hop measurement (related to Section 3.2.2) is enough. |
| vivo | At least for DL frequency hopping, it is up to UE implementation to perform Rx frequency hopping and no related information about hop, so only reporting the indicator of ‘single’ or ‘multi-hop’ measurement is enough, and the detailed hop indication (which hop, how many hops) and hop indicator request from LMF are no needed. |
| Nokia/NSB | Support. We think the LMF needs this information to select measurements to be used to run the estimation algorithm. |
| Futurewei | Such reporting is not needed and not clear what the use cases are. |
| InterDigital | Support. |
| DOCOMO | We think the detailed hop indication is not necessary. If the hop indication is reported, simple 1 bit indicator which reports single or multiple hop measurement may be enough in terms of the overhead. |
| SONY | Support |
| LGE | Do not support. We don’t think there is need for reporitng the indication hop information. |
| NEC | Support. |
| Ericsson | Support |
| CATT | In our view, only an indicator is needed to indicate the measurement based on multiple hops or based on single hop. |
| Huawei, HiSilicon | Not useful except for RedCap CPP. |

## [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** |
| ZTE | Support |
| Qualcomm | We support this proposal. |
| Spreadtrum | Support |
| vivo | OK |
| Nokia/NSB | We are generally okay, but we don’t think conditions for reporting single or multiple are necessary at least for the gNB. We would suggest removing the note. |
| Futurewei | The proposal seems Ok. |
| InterDigital | We support the proposal. |
| DOCOMO | OK |
| SONY | Support |
| LGE | We are okay with proposal **except second bullet.**  We don’t find technical reason for supporting this indication. And we think the reporting either a single/multi hop measurmentit can be worked as it is for now, so we would like to postpone this issue after other critical issue is closed. |
| NEC | Support in general. Similar as the previous proposal, we think it should support that LMF can require the reported measurement based on a single hop or multiple hops. |
| CATT | Support the proposal. |
| Huawei, HiSilicon | OK. |
| Ericsson | Support. Regarding the 1 or multiple hop reporting indication, RAN2 could decide on whether the same report is used and an indicator notify whether the report is for single or multi hop, or if different reports IEs are used. |
| FL | We can discuss at the offline if it is agreeable. |

## [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** |
| Nokia/NSB | Support. The UE may be able to perform DL PRS measurement based on relatively narrow band from DL PRS frequency hopping while gNB performing wideband UL SRS measurement from the SRS frequency hopping. To guarantee the accuracy, it is necessary to add some restriction so that the DL/UL BW from DL/UL frequency hopping could be the same. |
|  |  |

## [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** |
| ZTE | For DL, we are OK.  For UL, we don’t think the proposal is needed, SRS transmission should follow gNB configuration. |
| Qualcomm | At least with regards to the UE-side aspect of this proposal, this looks to us like a proposal related to “Location Request” enhancement (section 4.1). We prefer to treat 4.1-1 first and at a minimum have the LMF to request the UE to do “DL PRS frequency hopping”, and if there is consensus discuss more information with regards to what an LMF can request from the UE. |
| Nokia/NSB | We are supportive. |
| InterDigital | We have a similiar view as Qualcomm. |
| NEC | Not support the “**If no indication to the measurement given, the maximum *M* hops are measured.**” Because the receiver may not receive all the hops due to collision and something else. |
| Ericsson | Do not support. This is not critical to the functionality for redcap positioning |
| Huawei, HiSilicon | Similar view as QC.  For indication to gNB on SRS transmission, we think that the BW in the SRS characteristics should be OK. How many hops are there really depends on the UE switching capability and radio availablity.  For indication to UE on PRS reception, at least an indication whether or not Rx hopping is requested should be the baseline. |

# 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** |
| ZTE | Support |
| Qualcomm | We definitely consider essential the main sentence. A UE needs to receive a request from an LMF whether it is expected to do hopping or not. We are supportive to discuss what specific hopping properties an LMF can request, but we still think that at a minimum a simple “DL PRS frequency hopping location request” is needed. |
| Spreadtrum | Support |
| vivo | Not support especially for the sub-bullet. The UE can determine how to perform Rx frequency hopping based on the configured PRS bandwidth, required accuracy, its own capabilities and RAN4 requirement. |
| Nokia/NSB | Support. On top of this, we think that UE needs to request LMF to provide a necessary hop duration. The UE has to satisfy the minimum RSRP requirement and knows how many symbols/repetition it needs. |
| InterDigital | We support the proposal. |
| Samsung | We share the view as vivo, for this specific number and bw,  does LMF know which hops the UE can correctly measure?  In which use case that, the LMF wants UE to measure shorter BW than it is configured with? |
| DOCOMO | OK |
| SONY | Generally support. If the „Number of hop“ and „Hop bandwidth“ are provided. Do we still need „Total bandwidth of all hops“? |
| LGE | We shrae similar view with QC |
| NEC | Support. |
| CATT | OK |
| Huawei, HiSilicon | We would prefer to see a single bit of requesting hopping measurement. Other detailed information needs to be confirmed by RAN4 performance discussion. |
| Ericsson | OK with the main proposal. For the other items, we think these are maybe nice to have but not essential. |

## [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** |
| ZTE | What is the spec impact? Is it for LMF request signaling? |
| Qualcomm | We support the proposal. This can have spec impact in UE capabilities, and also in RAN4 discussions which are looking to determine the general framework on how frequency hopping should be done. |
| Nokia/NSB | The issues related to requirement need to be handled by RAN4. We don’t think a consensus on this proposal is necessary. |
| Futurewei | We are Ok to leave phase discontinuity to the UE implementation but it is necessary to agree on this in RAN1? |
| InterDigital | We support the proposal. |
| DOCOMO | Support |
| LGE | We are not sure about the spec impact on this proposal.  Question to Qualcomm: Could you elaborate more why the UE capability on overlapping will be required? As far as I concern, whether to use overlapped PRBs is up to UE implementation and NW does not need to know about it. |
| NEC | Support. |
| Ericsson | OK with the principle of the proposal but we agree with nokia that it may not be a show stopper for RAN4 if we do not capture it in RAN1. |
| CATT | If this proposal has the spec impact in UE capabilities, we can live with it. |
| Huawei, HiSilicon | OK. This should be a conclusion. |
| FL | Let’s try to capture a conclusion. |

# UL SRS Tx Hopping

## [closed] 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:**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | We are basically fine. For the first bullet, we prefer Alt2 to reuse the existing configuration parameters.  For aperiodic SRS, slot offset for each hop is also needed. |
| Qualcomm | For the hop bandwidth, we have a proposal different thatn Alt. 2 which we repeat below. In short, we don’t consider all hop sizes multiple of 4 PRBs, but rather, those that are already supported as SRS BW in legacy SRS (m\_SRS). For example, 100 PRBs, etc.   |  |  | | --- | --- | | a hop bandwidth common to all hops | For 15 KHz:   * {4,8,12,16,20,24,28,32,36,40,44,48,52,56,60,64,72,76,80,88,96,104} PRBs   For 30 KHz:   * {4,8,12,16,20,24,28,32,36,40, 44,48} PRBs   For 60 KHz:   * {4,8,12,16,20,24} PRBs for FR1 * {4,8,12,16,20,24,28,32,36,40, 44,48,52,56,60,64,72,76,80,88,96,104,112,120,128,132} PRBs for FR2   For 120 KHz:   * {4,8,12,16,20,24,28,32,36,40, 44,48,52,56,60,64} PRBs |   In short, we want to proposal an Alt. 3:   * Alt. 3: Support as possible hop BW values the values that are supported already for m\_SRS in legacy SRS such that the maximum bandwidth is: 104 PRBs, 48 PRBs, 132 PRBs, 64 PRbs, for 15,30,60,120 KHz respectively. |
| vivo | For **the hop bandwidth common to all hops,**  **Alt 2 is preferred**, since it is possible that hop bandwidth can be configured smaller than 20MHz or 100MHz. In addition, the parameter C\_SRS can also be reused with the value of (0..33) indicating the bandwidth of (4..132)PRB. Therefore, Alt 2 can be modified as the following.   * + **Alt2: the bandwidth is configurable between 4 to 132 RBs with granularity of 4 PRBs.**      - **Note: Configuration re-uses the IE ~~In case case a new parameter is configured~~.**   Other configuration parameters values are OK to us. |
| Nokia/NSB | Support Alt 2 of the first bullet and inclusion of AP SRS frequency hopping. For the number of hops, we don’t think a single hop is necessary to configure the SRS frequency hopping. |
| Futurewei | Support Alt 1. However, we do not see any contradiction between the two alternatives. Therefore, it is possible to extend Alt 1 to include Alt 2, which seems similar to Alt 3 by Qualcomm. |
| DOCOMO | For the flexibility, we prefer Alt. 2 or 3 by Qualcomm. |
| LGE | We are okay with proposal **except last bullet.**  We don’t agree to include value 1 for the number of hops. If the number of hops value is 1, then it means the resource doesn’t perform Tx hopping and it could be configured as existing SRS-pos resource supported by current spec.  Supprot **alt 2** in first bullet for the flexiblitiy. We even agreed to configure start position of each hop for flexibiltiy, then there is no need to restrict the hop BW.  Answer for the FL’s comments:  If we understand correctly, configurable starting positions of each hop is for time-domain. Our intentention of configuring a pattern index is that by indicating the relative frequncy hop index we can determine a fixed wrapped staircase hopping. Unless we define additional parameter for wrapped staircase pattern, we can’t determine a fixed pattern with parameters agreeded in last meeting.  FL response: thanks for the clarification. Then I suggest we revisit the use of a pattern index once we have agreed on the frequency boundaries of the tx-hopping (see discussion in 5.5) |
| NEC | We don’t support the overlap size and stating slot/symbol indication for the hop except the first one.  For overlap size, zero should be included or at least being a default value if no configuration.  For starting slot/symbol indication, indicate offset is more reasonable by considering all the hops are configured within a SRS resource. |
| CATT | For the first bullet: the hop bandwidth common to all hops, we prefer Alt 2 because this alternative improve the flexibility of configuration of hop bandwidth for the UL SRS. |
| Huawei, HiSilicon | For the hop bandwidth, we share similar understanding as QC to reuse the existing C-SRS.  For the starting slot offset and symbol for each of the hops following the first hop, we prefer to have a time offset relative to a previous hop. However, haven’t we agreed that it is up to RAN2?  For the number of hops, we think 1 hop may not be necessary. |
| FL | Thanks for all the received comments, below is an updated proposal for the offline. I went with the majority support for the different options.  I also added a clarification that the value zero overlap is used if the overlap IE is not present.  I also removed the value 1 for the number of hops.  For the starting position for hops following the first hop, i added two options, based on the comment from NEC  **Proposal 5.1-2**  **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~~**     - **~~Supported by: FW~~**   + **~~Alt2: the bandwidth is configurable between 4 to 132 RBs with granularity of 4 PRBs.~~**      - **~~Note: In this case a new parameter is configured.~~**     - **~~Supported by: ZTE ,Vivo (c\_srs up to value 33 (132PRBs of bandwidth) can be reused), Nokia, DCM,~~**   + **Alt. 3: Support as possible hop BW values the values that are supported already for m\_SRS in legacy SRS such that the maximum bandwidth is: 104 PRBs, 48 PRBs, 132 PRBs, 64 PRbs, for 15,30,60,120 KHz respectively.**      - **Supported by: QC, (FW),DCM** * **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**   + **Note: if the parameter is absent, overlap is zero** * **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 values for the starting slot offset and symbol offsets are**     - **alt1: relative to slot 0/symbol0 (absolute position)**     - **alt2: relative to the starting position of the first hop (relative position)** * **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** |
|  |  |

### Conclusion for RAN1#114b

The following was agreed during Tuesday session:

|  |
| --- |
| **Agreement**  For SRS Tx hopping, the configuration parameters values are:   * For the hop bandwidth common to all hops   + Configuration re-uses C\_SRS   + The values of C\_SRS in legacy SRS for positioning such that the maximum bandwidth is: 104 PRBs, 48 PRBs, 132 PRBs, 64 PRBs, for 15,30,60,120 KHz respectively when B\_SRS equal 0. * For the starting RB of the first hop in time domain:   + Configuration re-uses the IE freqDomainShift   + The range is {0,268} RBs * For the single overlap common to all hops for the SRS resource   + The value can be 0,1,2,4 RBs   + Note: This is a new IE * For the starting slot offset and starting symbol for the SRS resource with tx hopping (first hop in time)   + 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   + Starting 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 in time,   + FFS: 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 2,3,4,5,6   + This is a new IE |

## [closed] 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]

|  |  |
| --- | --- |
| **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 Tx 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:**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | OK |
| vivo | OK |
| Nokia/NSB | We have a clarification question. What is the meaning of the SRS with “T” hopping? |
| Futurewei | Not support |
| InterDigital | Support |
| Samsung | Support. |
| LGE | OK |
| NEC | Not support. If the bandwidth location and size is dedicated configured for SRS with frequency hopping. The configuration of overlap size, number of hops and the hop bandwidth may not match better with each other. |
| Ericsson | We can compromize and accept the proposal. |
| CATT | OK |
| Huawei, HiSilicon | Same comment as Nokia. |
| FL | Thanks for the comments and apologies fort he typo, it should have said “Tx hopping”.  If time allows, it would be good to conclude on this issue in the first offline. |
| FL | Based on the agreed proposal for 5.5, I don’t this this proposal is needed anymore. We can close this discussion. |



## 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.

|  |  |
| --- | --- |
| **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. |
|  |  |

### [high] 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:**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | OK |
| Qualcomm | **OK** |
| vivo | We have concerns about the first sub-bullet. In our view, UTW is configured per BWP, while **the periodicity and starting slot offset** are configured per SRS resource. It is up to Network to configure suitable UTW parameters instead of limiting UTW to have the same range as the periodicity and starting slot offset parameters for the SRS for positioning. |
| Nokia/NSB | OK |
| LGE | OK with proposal. |
| CATT | Support the proposal in principle, but for the last bullet, why the duration of the window in slot is only {1,2,4,6} slots, we prefer to have more options for the duration of the window, e.g., up to 20 or more slots. |
| FL | Let’s check that proposal at the next available offline. |

### [high] 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** |
| ZTE | Alt.1 without the wording of ‘virtual’ |
| Qualcomm | Alt. 1 without the “virtual”. Is the intention of “virtual” to mean that BWP that has the SRS frequency hopping configured? |
| Spreadtrum | We prefer Alt 2 and Alt 3. |
| vivo | Alt 1 |
| Nokia/NSB | Prefer Alt2 or Alt 3 |
| InterDigital | We would also like to get more clarification of „virtual“ in Alt. 1. i.e., what it means in terms of configuration. |
| LGE | Prefer Alt2 and Alt 3. |
| CATT | We prefer Alt.1 |
| Huawei, HiSilicon | We prefer Alt.1. |
| Ericsson | Alt1 |
| FL | Regarding the wording “virtual” BWP in Alt1, this is a placeholder word for the carrier configuration housing the SRS with tx hopping. My understanding is that SRS config with tx hopping is configured outside the active BWP, and that the configuration is not a real BWP. |

### Collision with DL signals and channel within UTW

#### Round 1

For the UTW definition, we had the following agreement:

|  |
| --- |
| **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** |
| ZTE | The proposal is not needed from our side. Within the gap, UE basically does not transmit any UL signals except PRACH. |
| Qualcomm | MG has priority according to RAN4 specifications, we don’t think that an explicitly agreement/conclusion is needed |
| Spreadtrum | We think we should clarify the behavior of the UE within the UTW for the DL slots. During the measurement gap, UE can only perform RRM measurements and cannot perform other data transmission and reception operations. When the UL time window overlaps with the measurement gap, the measurement gap becomes invalid. In this case, there is significant impact on the requirements for RRM measurement in RAN4. |
| Nokia/NSB | We don’t think it is necessary. |
| InterDigital | We would need more time for discussion on this topic, i.e., whether the UL time window should be invalid or not when it collides with MG. |
| LGE | We don’t think it is necessary. |
| CATT | Not needed. |
| Huawei, HiSilicon | In general, we think that MG should have higher priority than UTW. |
| Ericsson | We think the MG definition is clear for this issue. MGs have priority. |
| FL | Hopefully the behaviour is clear enough and no agreement is needed. If not, we could capture a conclusion.  To spreadtrum, IDG, are you ok with the understanding from other companies? |

### 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:**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | OK |
| Spreadtrum | Support |
| vivo | We prefer not transmit other signal based on the current agreement |
| InterDigital | Support |
| LGE | Support  Considering the very harmful impact on data transmission of UTW with highest priority, this should be covered. |
| NEC | Support. |
| CATT | Support |
| Huawei, HiSilicon | It is not clear why network would configure the UTW without SRS in it. Is it about SP-SRS not activated? |
| Ericsson | Same view as Huawei. Maybe it is useful if the UTW is configured outside of SRS config. In that case one could turn off and on the SRS resources without having to deconfigure the UTW in between. But that is kind of a corner case. |
| FL | We could try the proposal offline considering the support. |

### 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** |
| ZTE | OK |
| vivo | We have concern about the case if Option 2 is allowed outside UL time window, the priorities of SRS hops inside and outside the UTW will be different. Is it necessary for this case to exist? |
| Nokia/NSB | Support |
| Samsung | We should first see what’s the new collision from option2 in 5.4.1. |
| LGE | OK |
| NEC | Support. |
| CATT | OK |
| Huawei, HiSilicon | We do not support this. |
| FL | It seems there are at least two companies not supporting it. Then it is better to remove the [or outside] option. |

#### Round 2

It seems there are at least two companies not supporting it. Then it is better to remove the [or outside] option.

**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 5.4-2:**

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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 BWP  2) 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.



**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** |
| ZTE | Alt 1-1.  For priority of the SRS, outside the active BWP, we support Alt 2-1.  Within the active BWP, the legacy priority rule can be completely reused.  For collision with DL, we think the existing rules defined in 38.213 can be reused. |
| Qualcomm | **Alt. 1-2**  **Alt. 2-1**  **For Question 3: the existing rules in 38.23 should be enough; no further specification changes are needed.** |
| Spreadtrum | We prefer Alt. 1-2 and Alt. 2-1 |
| vivo | OK with the first sub-bullet.  **When the SRS with TX hopping resource collides with PUSCH or PUCCH (down select), and SRS with Tx hopping is dropped:**  **Alt 1-3 is supported.**  From the perspective of frequency hopping performance, dropping part of hops/symbols may lead phase discontinuity between hops, the performance gain of frequency hopping will be largerly reduced. The remaining unaffected hops/symbols seems to be no need to transmit.  From the perspective of low UE complexity and capability of the RedCap UE, it may not accept frequently switching from frequency hopping transmission to active BWP for other signals/channels reception/transmission, and then switching back to frequency hopping transmission again.  So, Alt 1-1/1-2 may bring higher UE complexity and require higher UE capability without potential performance gain, however, **Alt 1-3** is more complexity/power friendly and more consistent with UE capability for RedCap UE.  **For priority of the SRS with Tx hopping compared to PUSCH/PUCCH transmission:**  Alt 2-1 is supported.  **For collision with downlink transmission:**  Alt 3-2 is supported.  The priority of SRS in Rel-16/17 can be reused, so the SRS for Tx hopping can be treated as low priority compared to PUSCH, PUCCH and DL transmission. |
| Nokia/NSB | We prefer Alt 1-1, Alt 2-3, and Alt 3-1. |
| InterDigital | Alt 1-3 : At the receiver side, hop measurements make sense only when all hops are received.  Alt. 2-1  Alt. 3-1 |
| Samsung | For first bullet, the collision is counted based on the transmission, rather than the resource. For example, where UE really needs to transmit the UL signals.  Alt.1-2  Atl.2-2  Alt.3-2. |
| DOCOMO | Alt. 1-3: A whole wide band measuremement is necessary to achieve a good performance. Thus, if a part of hop is dropped, all hops should be dropped.  Alt. 2-1: Considering the maintenance phase, legacy behavior is preferred.  Alt. 3-1 |
| LGE | Since we support the legacy collision rule except symbol-level dropping due to the UE complexity, we support  Alt. 1-2  Alt. 2-1  Alt. 3-2 |
| NEC | For the second sub-bullet, we think dynamic dropping among different granularities is more flexible. If only one option is to be selected to decrease the complexity, we prefer Alt1-2.  For the fourth bullet, we prefer Alt 3-1. |
| CATT | We prefer the following alternatives:  Alt. 1-2  Alt. 2-3  Alt. 3-1 |
| Huawei, HiSilicon | Alt. 1-2  Alt. 2-1 with the switching time before and after each hop should be considered, which should be cpatured in 38.214. |
| Ericsson | Alt 1-1  Alt 2-1  Agree that existing rules for DL can be re-used. |
| FL | From the comments, we can drop the part about DL collision (alt 3.x) and priority (alt2.x), since there is a majority supporting not adding these features. for alt1-x at least alt1-3 seems to have less support. We can down-scope the proposal as below:  **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~~** |

### Round 2

For the second round, I think we can focus on choosing between alt1-1 and alt-1-2. For the other alternative, hopefully we can focus on alt.2-1. Based on the received comment alt3-x are removed.

**Proposal 5.4-2**

**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**
* **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)**

**Proposal 5.4-2:**

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

## [HIGH] configuration of 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.

|  |  |
| --- | --- |
| **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:**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | No need. We have agreed the lowest PRB for the first frequency hop. The higher bound can be implied by this, the overlapping PRBs, and the number of hops. |
| vivo | Based on the endorsed CR as the following, it seems no needed to additional consider lower frequency bound of hops.  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.  To address the problems of wrap around staircase pattern, in addition to configure lower/higher boundary, some companies ([5][9][19]) also propose to configure hop index(or subband index, or hopping pattern index) of the first hop. In our view, it is an easier way than configuring lower/higher boundary.  Therefore, we suggest a new proposal as the following.  **For wrapped staircase SRS Tx frequency-hopping patterns, support configuring [hop index (or subband index, or hopping pattern index)] of the first hop.** |
| Nokia/NSB | Alt 1. Based on the current agreement, Alt2 shouldn’t be considered. |
| Futurewei | All alternatives are fine |
| Samsung | Agree ZTE. |
| LGE | Since we agree to configure starting PRB of 1st hop, the wrapped staircase pattern can be implicitly fixed by only configuring lower or higher frequency bound with other frequency domain parameters (i.e. the hop BW, the number of hops, and overlap size). So we don’t think Alt 3 is needed.  Moreover**, similiar with vivo’s comments**, we would like to propose more efficient/easier way to determine the wrapped staircase pattern by configuring the relative frequency hop index. It does need only granularity of bits indicating hop index.  So we suggest to **replace Alt 3** as following:  **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.~~** * **Alt3: [frequency hop index (or subband index, or hopping pattern index)] of first time hop is configured by higher layer signaling**   We prefer **alt 3.** |
| NEC | We prefer Alt3. |
| Ericsson | We think alt1 is necessary because Tx hopping operates outside of the active BWP. Therefore, we need a lower frequency reference, otherwise the exisiting configuration parameters for the starting PRB cannot be used. To NEC, LGE, is the intention that the frequency index of the first hop is configured in absolute frequency values within SRS config?  Additionally, we think that if there is no upper limit, then a wrapping pattern is needed. |
|  |  |
| CATT | It seems that such configuration by higher layer signaling is not needed. |
| Huawei, HiSilicon | Reply to ZTE, we think that the first hop (which is the first hop in time) is not the lowest frequency hop, so the hopping boundary is needed for wrappped staircase. |
| FL | Let’s further discuss offline how to finalize this part of the design. We can use the proposal from LGE as a start, but I think we do need first a reference frequency to place the staircase pattern, and then probably another agreement is needed to capture the different wrapped staircase patterns .  From my side, it would be good to understand what companies views are to implement the wrapping depending on how the boundaries of the frequency hopping are configured. I agree with vivo that indexing the hops might be a simple approach as proposed by the cited 3 contributions.  **Proposal 5.5a-2 : 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.~~** * **Alt3: [frequency hop index (or subband index, or hopping pattern index)] of first time hop is configured by higher layer signaling** |
|  |  |
|  |  |

### Round 2

The following agreement was struck on the Tuesday session:

|  |
| --- |
| Working assumption  For the SRS for positioning with Tx hopping wrapping pattern, the starting frequency for each symbol of the wrapped staircase pattern is configured by:  a new offset nFH is added to the the exisiting equation for the starting frequency , where  Where:  - is the frequency hop index of the initial hop.  - FFS whether this is signaled as a new parameter.  - is the SRS hop transmission counter in time domain  - is the configured number of hops  - is the configured hop bandwidth, in number of RBs  - is the configured common overlap between two hops, in number of RB(s).  In the definition of the starting PRB of the SRS , the starting PRB is configured as:   * In k0, nshift is replaced by *startingPRBfirsthop* - n0\*( –)\* |

**question: should n0 be a new parameter?**

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

Let’s discuss whether the initial hop index is a required new parameter:

## [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.

|  |  |
| --- | --- |
| 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:**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | The last bullet is not aligned with the previous agreements. The slot offsets should be configured for each hop including for aperiodic SRS. |
| Spreadtrum | For aperiodic SRS transmission, how UE determines the starting position of UTW needs to be discussed. The following schemes can be considered.  - Scheme 1: Configure the length of the uplink transmission window through high-level parameters, and DCI indicates the starting position of the uplink transmission window.  - Scheme 2: UE sends aperiodic SRS using a periodically configured uplink time window.  - Scheme 3: 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. |
| vivo | OK with the main-bullet and first sub-bullet.  For the 2nd sub-bullet, more clarifications are needed. For example, for the remaining hops, whether to additionally configure ***slotoffset*** for each hop? In our view, we prefer reuse the same parameter as first hop other than offset relative to first hop. |
| Nokia/NSB | okay |
| InterDigital | A question for clarification. Do we expect that the upllink transmission window is also aperiodic/semi-persistent, corresponding to the characterstics of SRS for positioning? |
| SONY | We support except the last sub-bullet point. |
| LGE | Support  Considering the impact on data transmission of SRS for positioning with FH, we have to guarantee the scheduling flexibility of gNB.  Although we know that some companies worry about time limitation, we think we can reuse whole mechanism of aperiodic and semi-persistent SRS, same as that configuration of SRS-pos-FH would reuse existing parameter and mechanism.  And we kindly ask to correct typo in the proposal:  **Proposal 5.6-1 Tx hopping can be configured for SRS for positioning resources configured to be ~~a~~periodic, aperiodic or semi-persistent** |
| NEC | Support. |
| CATT | Support |
| Huawei, HiSilicon | We consider AP-SRS with frequency hopping low priority. At least we do not prefer to introduce one DCI triggering a AP SRS transmsision that spans more than 2 slots. |
| Ericsson | Support. We think it would be simpler for aperiodic SRS that all remaining hops are relative to the first hop. These hops position can be configured similar to the way they are configured for periodic.  We do not agree with further optimization of the UTW for aperiodic SRS. The network can ensure the SRS is received in UTW if needed. |

### Round 2

We can continue the discussion on this issue, the proposal is the same with the corrected typo. It would be good to capture more comments on the slot offset configuration for each hop.

**Proposal 5.6-2 Tx hopping can be configured for SRS for positioning resources configured to be periodic, 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 5.6-2:**

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

## [closed] Power and TA consideration

### Background

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

|  |  |
| --- | --- |
| 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. |

### [closed] 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:**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | The proposal is not needed from our view since only singe PL RS is configured anyway if we don’t do enhancement for RRC. |
| vivo | As SRS hops are configured within an SRS resource, it is natural for UE to use same pathloss estimation for SRS transmission during one SRS frequency hopping duration. Additional descriptions may not be needed. |
| Nokia/NSB | SRS frequency hopping is performed within an SRS resource. The associated path-loss RS is a single DL RS. The intention compared to the current system is unclear to us. |
| CATT | It seems that it is not needed. |
| FL | Let’s close this issue, it does not seem necessary. |
|  |  |

## [MEDIUM] LMF request for SRS FH parameters

### Background

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

|  |  |
| --- | --- |
| 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:**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Nokia/NSB | okay |
| Huawei, HiSilicon | We think the existing BW is sufficient. |

# 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.

|  |  |
| --- | --- |
| 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.   |  | | --- | | <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:**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Qualcomm | We dont think that it is enough to onyl report the a single parameter of the „overlal BW“. How many hops a UE can do, how much overlap it requires, would result to differnet UE behaviors and response times/measurement periods.  Also, there is a need for the legacy „Maximum number of PRS resources in a slot“.  So, in the above the following are needed:   * **Maximum 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** * **Max number of DL PRS resources that UE can process in a slot for a PFL**   Now, if for the „maximum PRS BW per hop“, the assumption is that it will be 20 Mhz for FR1 and 100 MHz for FR2, please note that a UE can already report a 5 MHz PRS processing even from NR rel-16. So, we should not make the assumption that the minimum BW will be 20 MHz. |
| vivo | OK |
|  |  |
|  |  |
|  |  |

## 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:**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| vivo | This may be duplicated with proposal 6.2-1 at least for sub-bullet 5. In addition, we have some concern on sub-bullet 1,2 since the length of MG is different and per hop bandwidth is same as non-hopping case. |
| Nokia/NSB | To FL: Providing the required number of symbols is critical in our understanding, which is not about the UE capability. RAN1 agreed to support the DL PRS frequency hopping within a DL PRS resource. It should be noted that the RedCap UE measures PRS RSRP from 1/N symbols per each hop for frequency hopping over N hops. The LMF doesn’t know the required hop duration per hop. The UE will perform RSRP measurement considering different number of symbols of the provided DL PRS resource, and the UE is able to know the necessary minimum hop duration for frequency hopping. The LMF needs this information. |
|  |  |
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| --- | --- |
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## 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:**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Qualcomm | We agree, but there are more capabilities for SRS Tx hopping that need to be added:   1. Maximum SRS BW per hop which is supported and reported by UE 2. Maximum number of SRS hop(s) per SRS resource which is supported and reported by UE 3. Amount of Frequency domain overlap(s) between hops which are supported and reported by UE 4. Max number of P/SP/AP SRS Resources and resource sets for positioning with Tx Frequency Hopping per CC and per CC & slot |
| Futurewei | Ok |
| Huawei, HiSilicon | This should be reflected in RAN4 UE feature list. |
|  |  |
|  |  |
|  |  |

# 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.

|  |  |
| --- | --- |
| 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:   |  | | --- | | 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 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. |
| [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 resource  i. Intra-slot hopping within a DL PRS resource is a UE capability  ii. 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. |

# Offline sessions

## Tuesday session

### Proposal 5.1-2 (SRS parameter configuration)

**Offline consensus:Proposal 5.1-2**

**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~~**
    - **~~Supported by: FW~~**
  + **~~Alt2: the bandwidth is configurable between 4 to 132 RBs with granularity of 4 PRBs.~~** 
    - **~~Note: In this case a new parameter is configured.~~**
    - **~~Supported by: ZTE ,Vivo (c\_srs up to value 33 (132PRBs of bandwidth) can be reused), Nokia, DCM,~~**
  + **Alt. 3: Support as possible hop BW values the values that are supported already for c\_SRS in legacy SRS such that the maximum bandwidth is: 104 PRBs, 48 PRBs, 132 PRBs, 64 PRbs, for 15,30,60,120 KHz respectively.** 
    - **Supported by: QC, (FW),DCM**
* **For the starting RB of the first hop in time domain:**
  + **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 0,1,2,4 RBs**
  + **Note: This is a new IE**
  + **~~Note: if the parameter is absent, overlap is zero~~**
* **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 values for the starting slot offset and symbol offsets are**
    - **alt1: relative to slot 0/symbol0 (absolute position)**
    - **alt2: relative to the starting position of the first hop (relative position)**
* **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**

### Overlap for the last hop

Considering the received feedback, it does not seem possible to support a special case for the last hop overlap. This will mean that in order for the hopping to be feasible, the hopping pattern need to fit perfectly the hopping bandwidth.

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

### Boundaries of the virtual BWP and staircase pattern.

From the discussion, it seems we need to clarify further the proposal. from my understanding, the initial hop frequency domain configuration is relative to the lower part of the virtual BWP. What we miss is the first frequency of the virtual BWP. For the proponent of alt3 below, it seems that the configured parameter for the starting RB of the first hop is not really the starting frequency of the first hop in time, but instead the starting RB of the *lowest hop in frequency*.

Based on the gathered understanding, we need, in my view, an origin for the starting PRB position agreed last meeting, and also discuss the way the pattern is configured. We can take the proposals from vivo/qualcomm/LGE as a starting point.

Proposal: the following agreement is revised as follow:

**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 5.5a-2 : 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.~~**
* **Alt3: [frequency hop index (or subband index, or hopping pattern index)] of first time hop is configured by higher layer signaling**

Let’s try to finalize the hopping pattern using vivo’s description, which is similar to what qualcomm and LGE proposed.

**Proposal 5.5b-1 : for the configuration of the staircase pattern, an additional frequency offset depending on the hop index is added to the definition of the frequency-domain starting position :**

**is the frequency offset of each hop with respect to the start PRB of the first frequency hop, where**

* **is the subband index of the first hop (first time hop)**
* **is the hop index for each hop**
* **is the number of hops**
* **is bandwith of each hop in PRB**
* **is the overlapping bandwidth between hops in PRB**

## Wednesday discussion

### UTW proposals

**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 5.3.3-1 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 5.3.5-1: Within a UTW, if no SRS is to be transmitted, other UL channels can be transmitted.**

**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.

### Additional dropping rules (option 2) proposals

**Proposal 5.4-2**

**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**
* **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)**

### DL PRS proposals

Based on the received comments it seems that the most critical part is the main part of the proposal.

**Proposal 4.1-2: 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~~**

**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.**

### Measurement proposals

We can try discussing this proposal, with the second bullet still controversial from at least 1 comment.

**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.**

# Online sessions

## Tuesday session

**Offline consensus:**

**Proposal 5.1-2**

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

* **For the hop bandwidth common to all hops**
  + **Configuration re-uses c\_srs**
  + **The values of c\_SRS in legacy SRS for positioning such that the maximum bandwidth is: 104 PRBs, 48 PRBs, 132 PRBs, 64 PRbs, for 15,30,60,120 KHz respectively.**
* **For the starting RB of the first hop in time domain:**
  + **Configuration re-uses the IE freqDomainShift**
  + **The range is {0,268} RBs**
* **For the single overlap common to all hops for the SRS resource**
  + **The value can be 0,1,2,4 RBs**
  + **Note: This is a new IE**
* **For the starting slot offset and starting symbol for the SRS resource with tx hopping (first hop in time)**
  + **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**
  + **Starting 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 in time,** 
  + **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 2,3,4,5,6**
  + **This is a new IE**

Proposal

For the SRS for positioning with Tx hopping wrapping pattern, the starting frequency for each symbol of the wrapped staircase pattern is configured by:

Alt1:

a new offset nFH is added to the the exisiting equation for the starting frequency , where

Where:

- is a new parameter for the initial hop index

- is the hop counter

- is the configured number of hops

- is the configured hop bandwidth

- is the configured common overlap between two hops.

In the definition of the starting PRB of the SRS , the starting PRB is configured as:

* In k0, nshift is replaced by *startingPRBfirsthop* - n0\*( –)\*

Alt2:

The starting PRB for each hop is configured by:

* , when < last PRB of the configured SRS for tx hopping bandwidth, for all hops 0,1,…where is the hop number of the hop that breaks the condition above.
* , for all remaining hops
  + is the lowest PRB in the configured SRS for tx hopping bandwidth

-

TP for endorsement (reason for change, consequence, and summary of changes provided in a table together with the TP):

**Proposal:**

TP 2.2-1 in section 2.2.1 of R1-NNNNNN is endorsed for TS 38.214 clause 5.1.6.5

# 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