**3GPP TSG RAN WG1 #109-e R1-220XXXX**

e-Meeting, May 9th – 20th, 2022

Source: moderator (vivo)

Title: Feature lead summary on [109-e-NR-CRs-06] Maintenance on SRS carrier switching

Agenda Item: 7.1

Document for: Discussion and Decision

1. Introduction

Following agreements reached in RAN1#106-e.

**Agreement**

For a target CC, when multiple aperiodic SRS resource sets for carrier switching are triggered by the same DCI and all the SRS resource sets will be transmitted according to the dropping rule, regarding UE behaviour on switching back to the source CC after transmitting one SRS resource set, further discuss the following alternatives:

* Alt 1) The behavior depends on the UE implementation
* Alt 2) UE stays in the target CC in the period between the SRS resource sets.
* Alt 3) If the time period between the SRS resource sets is smaller than the total required RF switching time to the source CC and back to the target CC and a higher priority UL transmission and/or DL reception is not scheduled on the source CC in the time period between the two SRS resources sets, the UE stays in the target CC in the period between the SRS resource sets; otherwise, the UE switches back to the source CC after transmitting each SRS resource set.
* Alt 4) UE switches back to source CC between the SRS resource sets

**Agreement**

For a target CC, In the case that multiple SRS resource sets are triggered by the same DCI, regarding the applicable timeline(s), further discuss the following alternatives:

* Alt 1) Individual timeline is applied to each triggered SRS resource set
	+ “Individual timeline” means that for each SRS resource set, the deadline to consider DCI triggering the SRS resource set or other uplink signals is applied and decision is made independently amongst the SRS resource sets.
* Alt 2) The same timeline is applied to all the triggered SRS resource sets
	+ “Same timeline” means that the deadline to consider DCI triggering the SRS resource sets or other uplink signals is applied considering the multiple SRS resource sets as a whole so that a single decision on collision handling is made for these SRS resource sets.

Following agreement reached in RAN1#107-e.

**Conclusion**

Regarding SRS carrier switching priority rules:

* For Rel-16, it is concluded that no modification in specifications should be made to clarify the current UE behaviour or to introduce a new UE behaviour regarding SRS carrier switching priority rules.
* For releases later than Rel-16, it is concluded to consider introducing a new UE capability for indicating simultaneous transmission while switching, and/or clarify the UE behaviour in the case of intra-band CA.
	+ Note: If introduced, the new UE capability should always assume no simultaneous transmission while SRS carrier switching for the bands in the band combinations that are signalled to not support simultaneous transmission within *BandCombinationList-UplinkTxSwitch*.

**Agreement**

When multiple SRS resource sets for carrier switching are triggered by the same DCI, individual timeline is applied to each triggered SRS resource set (Alt 1 in RAN1 106-e agreement).

* FFS: whether spec change is needed

Following agreement reached in RAN1#108-e.

**Agreement**

For SRS carrier switching in Rel-17,

* Introduce prioritization rules for carriers that are in the same band as the source CC for intra-band CA
* Introduce prioritization rules for carriers that are in a different band as the source CC for inter-band CA
	+ Introduce a new capability

**Agreement**

For Rel-17, when the UE supports half duplex TDD CA and SRS carrier switching simultaneously, the UE first applies SRS prioritization rules, next applies collision directional rules.

**Working Assumption**

A new UE capability is defined as below,

1. For each “source-target” pair (as indicated by *srs-SwitchingTimesListNR*), the UE can indicate which other bands in the band combination are affected by the SRS switch. If this new indication is missing, the UE defaults to Rel-15 behavior.
2. If the UE indicates the new list of bands, the dropping rules / timelines apply to the bands indicated by the list (requires update in RAN1 specs).

Note: the new UE capability has no impact on the legacy capability *txSwitchImpactToRx* and *txSwitchWithAnotherBand*

Based on the contributions listed in reference section, proposals for discussion/conclusion/agreement are provided in section 2.

1. Discussion
	1. Switching back to source CC

Proposal 2-1 : Support alt3. (from RAN1#106-e)

* If the time period between the SRS resource sets is smaller than the total required RF switching time to the source CC and back to the target CC and a higher priority UL transmission and/or DL reception is not scheduled on the source CC in the time period between the two SRS resources sets, the UE stays in the target CC in the period between the SRS resource sets; otherwise, the UE switches back to the source CC after transmitting each SRS resource set.

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| Company | views | comments |
| ZTE | Agree | This proposal is very important to implement this feature. As this is targeting for Rel-17, we support the optimal solution, i.e. Alt.3.  |
| Qualcomm | Do not agree (at least for R15/16) | This goes against the principle of SRS CS, where the UE always goes back to the source. We are open to optimizing for the case where the two SRS resource sets are nearby (i.e., defining new behavior with new UE capability), but this cannot be a clarification on Rel-15/16. |
| Apple | Do not agree | We share similar view as Qualcomm, unless we don’t see this as a critical issue, but over optimization, given that current spec specifies UE behavior and it is not broken. If majority want to specify a new behavior, it shall be considered for R17 and beyond, with a new UE capability.  |
| Samsung | Agree | For Rel-17, more efficient scheduling can be done with Alt. 3.  |
| Intel | Agree | We think the UE behavior in the interval between two SRS resoruce sets is missing in the spec and Alt 3 is the proper way to address the issue.Our preference is for Rel-15/Rel-16. But if majority companies agree to have this for Rel-17 with UE capability, we can live with it. |

* 1. UE capability

Based on proposals in the tdoc, majority of companies support confirming WA from RAN1#108-e.

Proposal 2-2: confirm the following working assumption

**Working Assumption**

A new UE capability is defined as below,

1. For each “source-target” pair (as indicated by *srs-SwitchingTimesListNR*), the UE can indicate which other bands in the band combination are affected by the SRS switch. If this new indication is missing, the UE defaults to Rel-15 behavior.
2. If the UE indicates the new list of bands, the dropping rules / timelines apply to the bands indicated by the list (requires update in RAN1 specs).

Note: the new UE capability has no impact on the legacy capability *txSwitchImpactToRx* and *txSwitchWithAnotherBand*

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| Company | comments |
| ZTE | Agree |
| QC | Agree |
| Apple  | Agree |
| Samsung | Agree |
| Intel | Agree |

* 1. TP on UL/DL directional collision and priority

In RAN1#108-e, it was agreed that when the UE supports half duplex TDD CA and SRS carrier switching simultaneously, the UE first applies SRS prioritization rules, next applies collision directional rules. Based on this agreement following TP is proposed

Proposal 2-4: agree following TP for 38.214

**6.2.1.3** UE sounding procedure between component carriers

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<omitted text>

In case of inter-band carrier aggregation, a UE can simultaneously transmit SRS and PUCCH/PUSCH across component carriers in different bands subject to the UE's capability.

In case of inter-band carrier aggregation, a UE can simultaneously transmit PRACH and SRS across component carriers in different bands subject to UE's capability.

If the UE is not configured for PUSCH/PUCCH transmission for at least one serving cell configured with slot formats comprised of DL and UL symbols, and if the UE is not capable of simultaneous reception and transmission on serving cell *c1*and serving cell *c2*, and if a UE

- is configured with multiple serving cells and is provided with *directionalCollisionHandling-r16* = 'enabled' for a set of serving cell(s) among the configured multiple serving cells including serving cell *c1*and *c2*, and

- indicates support of *half-DuplexTDD-CA-SameSCS-r16* capability, and

- is not configured to monitor PDCCH for detection of DCI format 2\_0 on any of the multiple serving cells,

the UE shall apply first the prioritization/dropping rules described above for sounding procedure between component carriers and then apply the procedures for directional collision handling in clause 11.1 of [6, TS 38.213].

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| Company | Comments |
| ZTE | This rule should be applied between c1 and any carrier of s(c2) as similar as section 2.4. Hence, above c2 should be replaced by s(c2).  |
| Apple | Agree in principle although current TP is not quite clear which on which carriers the rules are applied (az ZTE says, it should be c1 and any carrier of s(c2)). |
| Sasmung | Agree with ZTE’s comment. If the related spec (c2 🡪any carrier of S(c2)) would be updated as proposal 2-4, this TP should reflect the modification. |
| Intel | Fine with the TP in principle |

* 1. Text Proposal on prioritization rule

Based on agreement on prioritization rule in RAN1#108-e, there are several companies proposed corresponding text proposals with slightly different wording, following TP is proposed as starting point for discussion.

Proposal 2-4: agree on following TP for 38.214 section 6.2.1.3

**6.2.1.3 UE sounding procedure between component carriers**

For a carrier of a serving cell *c1* with slot formats comprised of DL and UL symbols, not configured for PUSCH/PUCCH transmission, denote as the corresponding carrier of a serving cell whose UL transmissions are temporarily suspended as signalled by higher layer parameter *srs-SwitchFromServCellIndex* and *srs-SwitchFromCarrier*. Define the set as the set of carriers of serving cells that each carrier meets one of the following conditions:

-               is in the same band as *,* or is an inter-band CA with and is indicated through the capability signalling *ImpactedBands-SRS-CS-v17* to be affected by the SRS switch from to .

-     is in the same TAG as .

Where .

----- unchanged part omitted-----

For an SRS transmission starting in symbol of carrier and a conflicting transmission in any carrier within the set starting in symbol, the UE shall apply the prioritization / dropping rules in the remainder of this clause taking into account:

-       DCI(s) for which the time interval between the last symbol of PDCCH and is at leastsymbols and an additional time duration ,  and the time interval between the last symbol of PDCCH and is at least symbols*;* and

-       semi-persistent CSI reports or SRS considered active at least symbols and an additional time duration before , and considered active at least symbols before .

Where , and the time interval unit of OFDM symbol is counted based on the smaller subcarrier spacing across any carrier within the set , and their corresponding scheduling cells.

The following prioritization rules shall be applied in case of collision between a transmission of SRS over carrier and transmission of a physical signal/channel over a carrier of a serving cell in set

-     ~~For a carrier of a serving cell with slot formats comprised of DL and UL symbols, not configured for PUSCH/PUCCH transmission,~~ the UE shall not transmit SRS whenever SRS transmission (including any interruption due to uplink or downlink RF retuning time [11, TS 38.133] as defined by higher layer parameters *switchingTimeUL* and *switchingTimeDL* of *SRS-SwitchingTimeNR)* on the carrier of the serving cell and PUSCH/PUCCH transmission carrying HARQ-ACK/positive SR/RI/CRI/SSBRI and/or PRACH on a carrier of a serving cell in set happen to overlap in the same symbol and that can result in uplink transmissions beyond the UE’s indicated uplink carrier aggregation capability included in [13, TS 38.306].

-     ~~For a carrier of a serving cell with slot formats comprised of DL and UL symbols, not configured for PUSCH/PUCCH transmission,~~ the UE shall not transmit a periodic/semi-persistent SRS whenever periodic/semi-persistent SRS transmission (including any interruption due to uplink or downlink RF retuning time [11, TS 38.133] as defined by higher layer parameters *switchingTimeUL* and *switchingTimeDL* of *SRS-SwitchingTimeNR)* on the carrier of the serving cell and PUSCH transmission carrying aperiodic CSI on a carrier of a serving cell in set happen to overlap in the same symbol and that can result in uplink transmissions beyond the UE’s indicated uplink carrier aggregation capability included in [13, TS 38.306].

-     ~~For a carrier of a serving cell with slot formats comprised of DL and UL symbols, not configured for PUSCH/PUCCH transmission,~~ the UE shall drop PUCCH/PUSCH transmission carrying periodic/semi-persistent CSI comprising only CQI/PMI/L1-RSRP/L1-SINR, and/or SRS transmission on a carrier of a serving cell in set ~~another serving cell~~ configured for PUSCH/PUCCH transmission whenever the transmission and SRS transmission (including any interruption due to uplink or downlink RF retuning time [11, TS 38.133] as defined by higher layer parameters *switchingTimeUL* and *switchingTimeDL* of *SRS-SwitchingTimeNR)* on the carrier of the serving cell happen to overlap in the same symbol and that can result in uplink transmissions beyond the UE’s indicated uplink carrier aggregation capability included in [13, TS 38.306].

-     ~~For a carrier of a serving cell with slot formats comprised of DL and UL symbols, not configured for PUSCH/PUCCH transmission,~~ the UE shall drop PUSCH transmission carrying aperiodic CSI comprising only CQI/PMI/L1-RSRP/L1-SINR on a carrier of a serving cell in the setwhenever the transmission and aperiodic SRS transmission (including any interruption due to uplink or downlink RF retuning time [11, TS 38.133]) as defined by higher layer parameters *switchingTimeUL* and *switchingTimeDL* of *SRS-SwitchingTimeNR)* on the carrier of the serving cell happen to overlap in the same symbol and that can result in uplink transmissions beyond the UE’s indicated uplink carrier aggregation capability included in [13, TS 38.306].

----- unchanged part omitted-----

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| Company | comments |
| ZTE | Support in principle. Suggested wording:denote ~~as~~  as the corresponding carrier of a serving cell is an carrier of inter-band CA with and |
| QC | We would like to remove the following sentence, which is not needed anymore :  can result in uplink transmissions beyond the UE’s indicated uplink carrier aggregation capability included in [13, TS 38.306]” |
| Apple | Agree with modification by QC |
| Samsung | Support the updates from ZTE and QC.  |
| Intel | Fine in principle with the update from ZTE.Don’t agree with QC to remove the sentence. |

* 1. Timeline

One company proposed following proposals on timeline for aperiodic SRS transmission triggering or scheduled with high priority UL transmission, followings are proposed for discussion, and agreement if there is consensus.

Proposal 2-5: discuss whether following proposals are needed,

* For the case that aperiodic SRS transmission on the target cell has higher priority than overlapping UL transmissions on the impacted UL carriers:
* UE does not expect that the gap between the last symbol of DCI indicating A-SRS on target CC and the first symbol of the earliest low priority UL transmission overlapping with A-SRS transmission, to be less than , with
* For the case that UE is scheduled by a DCI, or a set of DCIs, to transmit a high priority UL transmission on a serving cell overlapping with a low priority SRS transmission on a carrier without configured PUSCH/PUCCH, and simultaneous transmission is beyond UE’s capability:
* UE does not expect the gap between the first symbol of the earliest low priority SRS transmission on the target cell and a last symbol of the last DCI among all DCIs indicating high priority transmissions on another carriers within the set of UL carriers on which SRS CS prioritization rules are applied, overlapping with SRS transmission on target, to be less than , with

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| Company | views | comments |
| ZTE | Disagree | TP in section 2.4 has solved the timeline issue.  |
| QC | Disagree | Except if something is missing, the TP in 2.4 seems to be enough. |
| Samsung | Disagree | We can share the similar view with ZTE and QC. |
| Intel | Disagree | Same view as ZTE and QC. |

1. Reference:

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| R1-2203499 | Maintenance on SRS carrier switching | vivo |
| 1. Support Alt 3 and no specification change is needed.
2. It is better to make a conclusion to avoid ambiguities on UE implementation for carrier switching if Alt 3 is supported.
3. Confirm the working assumption on the new capability definition.
4. Adopt following TP to section 6.4.1.3 of TS 38.214.

**<Unchanged parts are omitted>**6.2.1.3 UE sounding procedure between component carriersFor a carrier of a serving cell *d* with slot formats comprised of DL and UL symbols, not configured for PUSCH/PUCCH transmission, denote as *s*0(*d*) the corresponding carrier of a serving cell whose UL transmissions are temporarily suspended as signalled by higher layer parameter *srs-SwitchFromServCellIndex* and *srs-SwitchFromCarrier*. Define the set *S*(*d*)*=* {*s*0(*d*)… *s*N-1(*d*)} as the set of carriers of serving cells that meet all the following conditions:- {*s*0(*d*)… *s*N-1(*d*)} are in the same band as *s*0(*d*).- {*s*0(*d*)… *s*N-1(*d*)} have the same SCS as *s*0(d).- {*s*0(*d*)… *s*N-1(*d*)} are in the same TAG as *s*0(d).The following prioritization rules shall be applied in case of collision between a transmission of SRS over carrier *d* and transmission of a physical signal/channel over a carrier of a serving cell in set *S(d)*:- the UE shall not transmit SRS whenever SRS transmission (including any interruption due to uplink or downlink RF retuning time [11, TS 38.133] as defined by higher layer parameters *switchingTimeUL* and *switchingTimeDL* of *SRS-SwitchingTimeNR)* on the carrier of the serving cell *d* and PUSCH/PUCCH transmission carrying HARQ-ACK/positive SR/RI/CRI/SSBRI and/or PRACH on a carrier of a serving cell in set *S(d)* happen to overlap in the same symbol.- the UE shall not transmit a periodic/semi-persistent SRS whenever periodic/semi-persistent SRS transmission (including any interruption due to uplink or downlink RF retuning time [11, TS 38.133] as defined by higher layer parameters *switchingTimeUL* and *switchingTimeDL* of *SRS-SwitchingTimeNR)* on the carrier of the serving cell *d* and PUSCH transmission carrying aperiodic CSI on a carrier of a serving cell in set *S(d)* happen to overlap in the same symbol. - the UE shall drop PUCCH/PUSCH transmission carrying periodic CSI comprising only CQI/PMI/L1-RSRP/L1-SINR, and/or SRS transmission on a carrier of a serving cell in set *S(d)*  configured for PUSCH/PUCCH transmission whenever the transmission and SRS transmission (including any interruption due to uplink or downlink RF retuning time [11, TS 38.133] as defined by higher layer parameters *switchingTimeUL* and *switchingTimeDL* of *SRS-SwitchingTimeNR)* on the carrier of the serving cell *d* happen to overlap in the same symbol. - the UE shall drop PUSCH transmission carrying aperiodic CSI comprising only CQI/PMI/L1-RSRP/L1-SINR on a carrier of a serving cell in set *S(d)* whenever the transmission and aperiodic SRS transmission (including any interruption due to uplink or downlink RF retuning time [11, TS 38.133]) as defined by higher layer parameters *switchingTimeUL* and *switchingTimeDL* of *SRS-SwitchingTimeNR)* on the carrier of the serving cell *d* happen to overlap in the same symbol.**<Unchanged parts are omitted>** |
| R1-2203618 | Discussion on SRS carrier switching | ZTE |
| ***Proposal 1:*** *Confirm the working assumption made in RAN1#108-e meeting for Rel-17 UE capability****Proposal 2:*** *Make the following as a conclusion or agreement for Rel-17.** *For a target CC, when multiple aperiodic SRS resource sets for carrier switching are triggered by the same DCI and all the SRS resource sets will be transmitted according to the dropping rule, regarding UE behavior on switching back to the source CC after transmitting one SRS resource set:*
	+ *If the time period between the SRS resource sets is smaller than the total required RF switching time to the source CC and back to the target CC and a higher priority UL transmission and/or DL reception is not scheduled on the source CC in the time period between the two SRS resources sets, the UE stays in the target CC in the period between the SRS resource sets; otherwise, the UE switches back to the source CC after transmitting each SRS resource set.*

***Proposal 3:*** *Adopt the text proposal in section 2 for Rel-17 38.214*6.2.1.3 UE sounding procedure between component carriersA UE can be configured with SRS resource(s) on a carrier *c1* with slot formats comprised of DL and UL symbols and not configured for PUSCH/PUCCH transmission. For carrier *c1*, the UE is configured with higher layer parameter *srs-SwitchFromServCellIndex* and *srs-SwitchFromCarrier* the switching from carrier *cs*  which is configured for PUSCH/PUCCH transmission. Define a set *C* as the set of carriers that meet one of the following two conditions:- carriers in the set *C* are in the same band and in the same TAG as *cs* - carriers indicated by UE capability signaling for each {*c1, cs*} pair included in [13, TS 38.306]. Denote *c2* is any one carrier in the set *S*.When SRS transmission on carrier *c1* is performed according to the prioritization/dropping rules in this subclause, during SRS transmission on carrier *c1* (including any interruption due to uplink or downlink RF retuning time [11, TS 38.133] as defined by higher layer parameters *switchingTimeUL* and *switchingTimeDL* of *SRS-SwitchingTimeNR*), the UE temporarily suspends the uplink transmission on carrier *c2*.For an SRS resource set transmission starting in symbol of carrier and a conflicting transmission in carrier starting in symbol, the UE shall apply the prioritization / dropping rules in the remainder of this clause taking into account:- DCI(s) for which the time interval between the last symbol of PDCCH and is at leastsymbols and an additional time duration , and the time interval between the last symbol of PDCCH and is at least symbols*;* and- semi-persistent CSI reports or SRS considered active at least symbols and an additional time duration before , and considered active at least symbols before .where , and the time interval unit of OFDM symbol is counted based on the smaller subcarrier spacing across and their corresponding scheduling cells.The UE shall not transmit SRS whenever SRS transmission (including any interruption due to uplink or downlink RF retuning time [11, TS 38.133] as defined by higher layer parameters *switchingTimeUL* and *switchingTimeDL* of *SRS-SwitchingTimeNR)* on the carrier *c1* and PUSCH/PUCCH transmission on the carrier *c2* carrying HARQ-ACK/positive SR/RI/CRI/SSBRI and/or PRACH happen to overlap in the same symbol.The UE shall not transmit a periodic/semi-persistent SRS whenever periodic/semi-persistent SRS transmission (including any interruption due to uplink or downlink RF retuning time [11, TS 38.133] as defined by higher layer parameters *switchingTimeUL* and *switchingTimeDL* of *SRS-SwitchingTimeNR)* on the carrier *c1* and PUSCH transmission on the carrier *c2* carrying aperiodic CSI happen to overlap in the same symbol. The UE shall drop PUCCH/PUSCH transmission carrying periodic/semi-persistent CSI comprising only CQI/PMI/L1-RSRP/L1-SINR, and/or SRS transmission on the carrier *c2*configured for PUSCH/PUCCH transmission whenever the transmission and SRS transmission (including any interruption due to uplink or downlink RF retuning time [11, TS 38.133] as defined by higher layer parameters *switchingTimeUL* and *switchingTimeDL* of *SRS-SwitchingTimeNR)* on the carrier *c1* happen to overlap in the same symbol. The UE shall drop PUSCH transmission the carrier *c2* carrying aperiodic CSI comprising only CQI/PMI/L1-RSRP/L1-SINR whenever the transmission and aperiodic SRS transmission (including any interruption due to uplink or downlink RF retuning time [11, TS 38.133]) as defined by higher layer parameters *switchingTimeUL* and *switchingTimeDL* of *SRS-SwitchingTimeNR)* on the carrier *c1* happen to overlap in the same symbol.**<Unchanged parts are omitted>**  |
| R1-2203850 | Clarification on SRS carrier switching  | Samsung |
| 6.2.1.3 UE sounding procedure between component carriersA UE can be configured with SRS resource(s) on a carrier *c1* with slot formats comprised of DL and UL symbols and not configured for PUSCH/PUCCH transmission. For carrier *c1*, the UE is configured with higher layer parameter *srs-SwitchFromServCellIndex* and *srs-SwitchFromCarrier* the switching from carrier *c2* which is configured for PUSCH/PUCCH transmission. During SRS transmission on carrier *c1* (including any interruption due to uplink or downlink RF retuning time [11, TS 38.133] as defined by higher layer parameters *switchingTimeUL* and *switchingTimeDL* of *SRS-SwitchingTimeNR*), the UE temporarily suspends the uplink transmission on carrier *c2*.<omitted text>In case of inter-band carrier aggregation, a UE can simultaneously transmit SRS and PUCCH/PUSCH across component carriers in different bands subject to the UE's capability.In case of inter-band carrier aggregation, a UE can simultaneously transmit PRACH and SRS across component carriers in different bands subject to UE's capability.If the UE is not configured for PUSCH/PUCCH transmission for at least one serving cell configured with slot formats comprised of DL and UL symbols, and if the UE is not capable of simultaneous reception and transmission on serving cell *c1*and serving cell *c2*, and if a UE - is configured with multiple serving cells and is provided with *directionalCollisionHandling-r16* = 'enabled' for a set of serving cell(s) among the configured multiple serving cells including serving cell *c1*and *c2*, and- indicates support of *half-DuplexTDD-CA-SameSCS-r16* capability, and - is not configured to monitor PDCCH for detection of DCI format 2\_0 on any of the multiple serving cells, the UE shall apply first the prioritization/dropping rules described above for sounding procedure between component carriers and then apply the procedures for directional collision handling in clause 11.1 of [6, TS 38.213].<omitted text> |
| R1-2204761 | Discussion on SRS carrier switching  | Intel Corporation |
| **Proposal 1:**When multiple aperiodic SRS resource sets for carrier switching are triggered by the same DCI, support Alt. 3 regarding UE behavior between two SRS resource sets. |
| R1-2204932 | Discussion on SRS carrier switching  | Huawei, HiSilicon |
| Proposal 1: The potential RF sharing and the impact by SRS carrier switching should be considered in the new capability design for SRS carrier switching. |
| R1-2204972 | Discussion on SRS carrier switching  | Qualcomm Incorporated |
| **Proposal 1: Confirm the following working assumption for Rel-17:****A new UE capability is defined as below,** 1. **For each “source-target” pair (as indicated by *srs-SwitchingTimesListNR*), the UE can indicate which other bands in the band combination are affected by the SRS switch. If this new indication is missing, the UE defaults to Rel-15 behavior.**
2. **If the UE indicates the new list of bands, the dropping rules / timelines apply to the bands indicated by the list (requires update in RAN1 specs).**

**Proposal 2: Endorse the TP in Section 3 for TS 38.214 (Rel-17).****<Unchanged parts are omitted>**6.2.1.3 UE sounding procedure between component carriersFor a carrier of a serving cell *d* with slot formats comprised of DL and UL symbols, not configured for PUSCH/PUCCH transmission, denote as *s*0(*d*) the corresponding carrier of a serving cell whose UL transmissions are temporarily suspended as signalled by higher layer parameter *srs-SwitchFromServCellIndex* and *srs-SwitchFromCarrier*. Define the set *S*(*d*)*=* {*s*0(*d*)… *s*N-1(*d*)} as the set of carriers of serving cells that meet any of the following conditions:- *s*i(*d*) is in the same band as *s*0(*d*) and *s*i(*d*) is in the same TAG as *s*0(d).- Higher layer parameter *srs-switchingInterruptionToOtherBand* indicates that a switch from *d* to *s*0(*d*) creates an interruption on *s*i(*d*).where.A UE can be configured with SRS resource(s) on a carrier *d* with slot formats comprised of DL and UL symbols and not configured for PUSCH/PUCCH transmission. For carrier *d*, the UE is configured with higher layer parameter *srs-SwitchFromServCellIndex* and *srs-SwitchFromCarrier* the switching from carrier *s*0(*d*) which is configured for PUSCH/PUCCH transmission. During SRS transmission on carrier *d*(including any interruption due to uplink or downlink RF retuning time [11, TS 38.133] as defined by higher layer parameters *switchingTimeUL* and *switchingTimeDL* of *SRS-SwitchingTimeNR*), the UE temporarily suspends the uplink transmission on carrier *S*(*d*).For an SRS transmission starting in symbol of carrier and a conflicting transmission in carrier *s*i(*d*) starting in symbol, where , the UE shall apply the prioritization / dropping rules in the remainder of this subclause taking into account:* DCI(s) for which the time interval between the last symbol of PDCCH and is at leastsymbols and an additional time duration , and the time interval between the last symbol of PDCCH and is at least symbols*;* and
* semi-persistent CSI reports or SRS considered active at least symbols and an additional time duration before , and considered active at least symbols before .

where , and the time interval unit of OFDM symbol is counted based on the smaller subcarrier spacing across *d, s*i(*d*) and their corresponding scheduling cells.The following prioritization rules shall be applied in case of collision between a transmission of SRS over carrier *d* and transmission of a physical signal/channel over a carrier of a serving cell in set *S(d)*:- the UE shall not transmit SRS whenever SRS transmission (including any interruption due to uplink or downlink RF retuning time [11, TS 38.133] as defined by higher layer parameters *switchingTimeUL* and *switchingTimeDL* of *SRS-SwitchingTimeNR)* on the carrier of the serving cell *d* and PUSCH/PUCCH transmission carrying HARQ-ACK/positive SR/RI/CRI/SSBRI and/or PRACH on a carrier of a serving cell in set *S(d)* happen to overlap in the same symbol.- the UE shall not transmit a periodic/semi-persistent SRS whenever periodic/semi-persistent SRS transmission (including any interruption due to uplink or downlink RF retuning time [11, TS 38.133] as defined by higher layer parameters *switchingTimeUL* and *switchingTimeDL* of *SRS-SwitchingTimeNR)* on the carrier of the serving cell *d* and PUSCH transmission carrying aperiodic CSI on a carrier of a serving cell in set *S(d)* happen to overlap in the same symbol. - the UE shall drop PUCCH/PUSCH transmission carrying periodic CSI comprising only CQI/PMI/L1-RSRP/L1-SINR, and/or SRS transmission on a carrier of a serving cell in set *S(d)*  configured for PUSCH/PUCCH transmission whenever the transmission and SRS transmission (including any interruption due to uplink or downlink RF retuning time [11, TS 38.133] as defined by higher layer parameters *switchingTimeUL* and *switchingTimeDL* of *SRS-SwitchingTimeNR)* on the carrier of the serving cell *d* happen to overlap in the same symbol. - the UE shall drop PUSCH transmission carrying aperiodic CSI comprising only CQI/PMI/L1-RSRP/L1-SINR on a carrier of a serving cell in set *S(d)* whenever the transmission and aperiodic SRS transmission (including any interruption due to uplink or downlink RF retuning time [11, TS 38.133]) as defined by higher layer parameters *switchingTimeUL* and *switchingTimeDL* of *SRS-SwitchingTimeNR)* on the carrier of the serving cell *d* happen to overlap in the same symbol.For an aperiodic SRS triggered in DCI format 2\_3 and if the UE is configured with higher layer parameter *srs-TPC-PDCCH-Group* set to 'typeA', and given by *SRS-CarrierSwitching,* without PUSCH/PUCCH transmission, the order of the triggered SRS transmission on the serving cells follow the order of the serving cells in the indicated set of serving cells configured by higher layers, where the UE in each serving cell transmits the configured one or two SRS resource set(s) with higher layer parameter *usage* set to 'antennaSwitching' and higher layer parameter *resourceType* in *SRS-ResourceSet* set to 'aperiodic'. For an aperiodic SRS triggered in DCI format 2\_3 and if the UE is configured with higher layer parameter *srs-TPC-PDCCH-Group* set to 'typeB' without PUSCH/PUCCH transmission, the order of the triggered SRS transmission on the serving cells follow the order of the serving cells with aperiodic SRS triggered in the DCI, and the UE in each serving cell transmits the configured one or two SRS resource set(s) with higher layer parameter *usage* set to 'antennaSwitching' and higher layer parameter *resourceType* in *SRS-ResourceSet* set to 'aperiodic'.If the UE is not configured for PUSCH/PUCCH transmission on carrier *c1* with slot formats comprised of DL and UL symbols, and if the UE is not capable of simultaneous reception and transmission on carrier *c1*and serving cell *c2*, the UE is not expected to be configured or indicated with SRS resource(s) such that SRS transmission on carrier *c1* (including any interruption due to uplink or downlink RF retuning time [11, TS 38.133] as defined by higher layer parameters *switchingTimeUL* and *switchingTimeDL* of *SRS-SwitchingTimeNR*) would collide with the REs corresponding to the SS/PBCH blocks configured for the UE or the slots belonging to a control resource set indicated by *MIB* or *SIB1* on serving cell *c2*.For *n*-th (*n ≥* 1) aperiodic SRS transmission on a cell *c*, upon detection of a positive SRS request on a grant, the UE shall commence this SRS transmission on the configured symbol and slot provided- it is no earlier than the summation of- the maximum time duration between the two durations spanned by N OFDM symbols of the numerology of cell *c* and the cell carrying the grant respectively, and- the UL or DL RF retuning time [11, TS 38.133] as defined by higher layer parameters *switchingTimeUL* and *switchingTimeDL* of *SRS-SwitchingTimeNR,*- it does not collide with any previous SRS transmissions, or interruption due to UL or DL RF retuning time.otherwise, *n*-th SRS transmission is dropped, where N is the reported capability as the minimum time interval in unit of symbols, between the DCI triggering and aperiodic SRS transmission.In case of inter-band carrier aggregation, a UE can simultaneously transmit SRS and PUCCH/PUSCH across component carriers in different bands subject to the UE's capability.In case of inter-band carrier aggregation, a UE can simultaneously transmit PRACH and SRS across component carriers in different bands subject to UE's capability.**<Unchanged parts are omitted>** |
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| **Proposal 1**: Confirm the working assumption. **Proposal 2**: If SRS transmission on target carrier, including any interruption due to UL/DL RF retuning time, overlaps in time with UL transmissions on UL carriers for which the SRS CS prioritization rules are applied, SRS shall be dropped if there is any UL transmission among the set of carriers that is higher priority than SRS transmission on the target carrier. In this case, none of the UL transmissions among the set of carriers can be defined as low priority (as there is no longer a SRS CS transmission to begin with). **Proposal 3**: For the case that aperiodic SRS transmission on the target cell has higher priority than overlapping UL transmissions on the impacted UL carriers:* UE does not expect that the gap between the last symbol of DCI indicating A-SRS on target CC and the first symbol of the earliest low priority UL transmission overlapping with A-SRS transmission, to be less than , with

**Proposal 4**: For the case that UE is scheduled by a DCI, or a set of DCIs, to transmit a high priority UL transmission on a serving cell overlapping with a low priority SRS transmission on a carrier without configured PUSCH/PUCCH, and simultaneous transmission is beyond UE’s capability:* UE does not expect the gap between the first symbol of the earliest low priority SRS transmission on the target cell and a last symbol of the last DCI among all DCIs indicating high priority transmissions on another carriers within the set of UL carriers on which SRS CS prioritization rules are applied, overlapping with SRS transmission on target, to be less than , with

**Proposal 5**: Endorse the proposed TP for TS 38.214, 6.2.1.3.**[Start of TP, 38.214]**6.2.1.3 UE sounding procedure between component carriersFor a carrier of a serving cell *c1* with slot formats comprised of DL and UL symbols, not configured for PUSCH/PUCCH transmission, denote as the corresponding carrier of a serving cell whose UL transmissions are temporarily suspended as signalled by higher layer parameter *srs-SwitchFromServCellIndex* and *srs-SwitchFromCarrier*. Define the set as the set of carriers of serving cells that each carrier meets one of the following conditions:-               is in the same band as *,* or is an inter-band CA with and is indicated through the capability signalling *ImpactedBands-SRS-CS-v17* to be affected by the SRS switch from to .-     is in the same TAG as .Where .----- unchanged part omitted-----For an SRS transmission starting in symbol of carrier and a conflicting transmission in any carrier within the set starting in symbol, the UE shall apply the prioritization / dropping rules in the remainder of this clause taking into account:-       DCI(s) for which the time interval between the last symbol of PDCCH and is at leastsymbols and an additional time duration ,  and the time interval between the last symbol of PDCCH and is at least symbols*;* and-       semi-persistent CSI reports or SRS considered active at least symbols and an additional time duration before , and considered active at least symbols before .Where , and the time interval unit of OFDM symbol is counted based on the smaller subcarrier spacing across any carrier within the set , and their corresponding scheduling cells.The following prioritization rules shall be applied in case of collision between a transmission of SRS over carrier and transmission of a physical signal/channel over a carrier of a serving cell in set -     ~~For a carrier of a serving cell with slot formats comprised of DL and UL symbols, not configured for PUSCH/PUCCH transmission,~~ the UE shall not transmit SRS whenever SRS transmission (including any interruption due to uplink or downlink RF retuning time [11, TS 38.133] as defined by higher layer parameters *switchingTimeUL* and *switchingTimeDL* of *SRS-SwitchingTimeNR)* on the carrier of the serving cell and PUSCH/PUCCH transmission carrying HARQ-ACK/positive SR/RI/CRI/SSBRI and/or PRACH on a carrier of a serving cell in set happen to overlap in the same symbol and that can result in uplink transmissions beyond the UE’s indicated uplink carrier aggregation capability included in [13, TS 38.306].-     ~~For a carrier of a serving cell with slot formats comprised of DL and UL symbols, not configured for PUSCH/PUCCH transmission,~~ the UE shall not transmit a periodic/semi-persistent SRS whenever periodic/semi-persistent SRS transmission (including any interruption due to uplink or downlink RF retuning time [11, TS 38.133] as defined by higher layer parameters *switchingTimeUL* and *switchingTimeDL* of *SRS-SwitchingTimeNR)* on the carrier of the serving cell and PUSCH transmission carrying aperiodic CSI on a carrier of a serving cell in set happen to overlap in the same symbol and that can result in uplink transmissions beyond the UE’s indicated uplink carrier aggregation capability included in [13, TS 38.306].-     ~~For a carrier of a serving cell with slot formats comprised of DL and UL symbols, not configured for PUSCH/PUCCH transmission,~~ the UE shall drop PUCCH/PUSCH transmission carrying periodic/semi-persistent CSI comprising only CQI/PMI/L1-RSRP/L1-SINR, and/or SRS transmission on a carrier of a serving cell in set ~~another serving cell~~ configured for PUSCH/PUCCH transmission whenever the transmission and SRS transmission (including any interruption due to uplink or downlink RF retuning time [11, TS 38.133] as defined by higher layer parameters *switchingTimeUL* and *switchingTimeDL* of *SRS-SwitchingTimeNR)* on the carrier of the serving cell happen to overlap in the same symbol and that can result in uplink transmissions beyond the UE’s indicated uplink carrier aggregation capability included in [13, TS 38.306].-     ~~For a carrier of a serving cell with slot formats comprised of DL and UL symbols, not configured for PUSCH/PUCCH transmission,~~ the UE shall drop PUSCH transmission carrying aperiodic CSI comprising only CQI/PMI/L1-RSRP/L1-SINR on a carrier of a serving cell in the setwhenever the transmission and aperiodic SRS transmission (including any interruption due to uplink or downlink RF retuning time [11, TS 38.133]) as defined by higher layer parameters *switchingTimeUL* and *switchingTimeDL* of *SRS-SwitchingTimeNR)* on the carrier of the serving cell happen to overlap in the same symbol and that can result in uplink transmissions beyond the UE’s indicated uplink carrier aggregation capability included in [13, TS 38.306].[**text unchanged**…]**[End of TP, 38.214]** |