**3GPP TSG RAN WG1 #108-e R1-220xxxx**

**e-Meeting, February 21th – March 3rd, 2022**

Source: moderator (vivo)

Title: Feature lead summary on [108-e-NR-CRs-04] Issue#5 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

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.

|  |  |  |
| --- | --- | --- |
| Company | views | comments |
| Apple | Do NOT support | Look at future is not desired as a UE behavior. We support Alt4 which in our view needs no (to minimal) spec change. |
| Qualcomm | Do not support | In our understanding, the current spec has the UE tuning back to the source CC always. The case where two SRS are scheduled without enough retuning time would be an error case. We would be open to optimizing this case as a TEI. |
| Intel | Support | We don’t think Alt 4 is specified in current spec. The UE behavior between SRS resoruce sets is not clear in current spec.  With Alt 4, the latter SRS resoruce set will never be transmitted when the interval between SRS sets is smaller than the required RF switching time.  Therefore, we support Alt 3. |
| MTK | Only Support to discuss in R17 or later releases | To our understanding, the current spec always has the UE switching back to the source CC. Therefore, the proposal is like a further enhancement and can be discussed in R17 or later releases. |
| vivo |  | We are fine with the proposal for Rel-17, can live without it as well. |
| CATT | Do not support | We think force UE switches back to the source CC after transmitting each SRS resource set when the time period between the SRS resource sets is larger than or euqals to the total required RF switching time to the source CC is not reasonable. |
| Moderator | Based on comments above seems there is no consensus on the proposal, however few companies proposed to discuss it for Rel-17 or as TEI. As TEI would be Rel-18, it is not appropriate to discuss/conclude here. For those who expressed "Do not support", can you accept this proposal for Rel-17 ? | |
| Qualcomm | We do not see the urgency of optimizing this case. We would be open to discussing in R18 (or if there is strong demand for R17) | |
| Futurewei | As we commented below in the first round, we think this is the UE behavior per the current spec. However, as the group cannot reach a common understanding, it will be beneficial to clarify the spec. As the time for R17 TEI has passed, it has to be for R18. | |
| Intel | As Qualcomm indicated that two SRS are scheduled without enough retuning time would be an error case, why the error case can’t be fixed for Rel-16?  Also, we think it’s important to clarify the current spec since we don’t have common understanding.  For progress, is it acceptable if Alt 3 is used as UE optional by having a new UE capability? If UE doesn’t support Alt 3, then Alt 4 is used. | |
| Samsung | We can support proposal 2-1 or Intel’s version. | |

Conclusion for Rel-16:

* 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:
  + 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.

|  |  |  |
| --- | --- | --- |
| Company | views | comments |
| ZTE | Agree | Is this the same as Proposal 2-1 ? |
| Futurewei | Agree | We are ok to have this as conclusion of Rel-16 UE behavior |
| Apple | Do NOT support | Look at future is not desired as a UE behavior. We support Alt4 which in our view needs no (to minimal) spec change. |
| Samsung | Agree | This seems more efficient behavior |
| Qualcomm | Do not support | Unclear why this is a separate proposal – same input as above. |
| Intel | Support as agreement | We support Alt 3. But it should be agreement instead of conclusion.  Clearly companies have different view on whether Alt3 or Alt 4 is specified by the current spec.  We prefer to make the spec clearer. |
| Ericsson | Do not support | We are OK with Alt4 if that helps progress. |
| MTK | Not understand the intention | Is this the same as Proposal 2-1 ? |
| vivo |  | We are fine with the proposal for Rel-16, can live without it as well. |
| CATT |  | We are also confuesed on its relationship to Proposal 2-1. |
| Moderator | Sorry for confusion with proposal 2-1 above, original intention was to make agreement on proposal 2-1 or make conclusion for Rel-16. Seems there is no consensus on conclusion for Rel-16. | |
|  |  | |

* 1. Prioritization rule

Proposal 2-2: agree on prioritization rule for SRS carrier switching, following 2 options are proposed for consideration, if option 1 is agreed then corresponding TP is to be further discussed.

Option1:

For Rel-17, define joint prioritization rules for carriers that are in the same band as the source CC, taking as baseline the CR in R1-2103759.

Option2:

TP proposal below

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

6.2.1.3 UE sounding procedure between component carriers

For a carrier of a serving cell *d* 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 and are both configured with *uplinkTxSwitching-r16*.

- is in the same TAG as .

Where .

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

For an SRS transmission starting in symbol of carrier and a conflicting transmission in carrier starting in symbol, where , 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 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 set 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 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-----

|  |  |
| --- | --- |
| Company | comments |
| ZTE | Agree in principle. If the new UE capability for inter-band CA case is supported, the spec should be updated together. |
| Futurewei | Comparing options 1 and 2, the main difference is about whether same SCS is a condition and whether *uplinkTxSwitching-r16* is considered. To our understanding, same SCS is no longer needed for NR as difference SCS can be configured even with a single carrier for different BWP. About *uplinkTxSwitching-r16,* we are ok to include it as condition when the UE supports uplink TX switching. Overall, we agree with option 2. |
| Apple | Is this (Opt1 and/or Opt2) proposed for R16 ? If so we do NOT support and it is against the conclusion in 107-e (no need to open up the old discussion). If this is as part of R17, we only support together with new capability signaling for inter-band, and by removing *uplinkTxSwitching-r16* (which will be replaced with new R17 capability indication parameter, e.g. what is explained in Qualcomm’s contribution, R1-2202112, Sec. 5) |
| Samsung | Agree in principle. We can share similar view as ZTE. |
| Qualcomm | Agree with Apple. Probably we need to solve this issue in a holistic way in Rel-17 (note that this discussion has been ongoing for 1 year already !) :   1. Introduce the above change for intra-band CA (no need for capability) 2. Add new capability for inter-band CA   We would suggest to treat these two cases together. From previous discussions it seems clear that this may be the only way forward. |
| Intel | This should be dicsussed for Rel-17. |
| Ericsson | Agree with Apple that we should not revert the conclusion in 107-e. |
| MTK | Same view as Apple/QC |
| vivo | Agree in principle for Rel-17 |
| CATT | Support in principle. We are open to discuss whether the priority rule is also applied to inter-band CCs. |
| Moderator | According to agreement in RAN1#107-e, the prioritization rule is only considered for Rel-17. From the comments above it seems agreeable to introduce prioritization rule in Rel-17 for. Following is proposed for second round discussion :  Proposal 2.2 : For 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 the same band as the source CC for inter-band CA   + Introduce a new capability (details to be discussed in section 2.4) |
| Qualcomm | In our understanding, the new capability is of carriers that are in a « different band », so it would be as follows :   * 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 (details to be discussed in section 2.4) |
| Apple2 | Support QC’s version |
| Futurewei | We are ok to introduce a new capability and related UE behavior and Qualcomm’s wording can be a starting point. However, time for R17 TEI has passed therefore it has to be for R18. If the group really sees the need to do it for R17, we need to ask for RAN1 chair’s guidance ASAP. |
| Samsung | We are fine with QC ‘s latest version in principle. For the clarification, we suggest to modify the first bullet as follow (we don’t need to introduce prioritization rules for intra-band CA) :   * Introduce the above change for carriers that are in the same band as the source CC for intra-band CA (no need for capability) |
| Huawei | We are fine with QC’s version and prefer to be discussed in Rel-17. |
| MTK2 | We are fine with QC’s version and prefer to discuss in Rel-17 CR or Rel-18 TEI. |

* 1. UL/DL directional collision and priority

Proposal 2-3:

* Discuss ambiguity of application order between directional collision handling and priority check for SRS carrier switching.
  + Consider application order of transmission or reception from the UE side in timeline.

|  |  |
| --- | --- |
| Company | comments |
| ZTE | We are open to discuss this new feature in Rel-17, i.e. support half duplex TDD CA and SRS carrier switching. If supported, we think directional collision handling should always be done first. |
| Futurewei | Agree with ZTE. This can be discussed for Rel-17 or later release. |
| Apple | We are open to further discuss this. In our view, similar to URLLC multiplexing vs cancellation issue, here first it should be determined which UL grants may survive. So, first apply SRS prioritization rules, next apply collision directional rules. |
| Samsung | Support proposal 2-3.  Our preference is to solve this ambiguity in Rel-16.  We think the ambiguity can be simply resolved by considering the order of transmission or reception from UE side. However, we can accept with other rule to solve this ambiguity. |
| Qualcomm | Our preference would be to follow the same approach as in URLLC (first prioritization & dropping, then directional collision) |
| Intel | We are open on this issue. Prefer to discuss it for Rel-17. |
| MTK | Agree with ZTE. This can be discussed for Rel-17 or later release. |
| Vivo | We are open for discussion, specific rule can be discussed further. |
| CATT | Open for discussion. |
| Moderator | From the comments above, it seems everyone agrees to further discuss for Rel-17, hence following is proposed for second round of discussion.  Updated Proposal 2.3 : for Rel-17, when the UE supports half duplex TDD CA and SRS carrier switching simultaneously, the first applies SRS prioritization rules, next applies collision directional rules. |
| Futurewei | More discussion is needed to reach a solution. Also guidance is needed from RAN1 chair if we want to do this in R17. |
| Samsung | We can accept Updated proposal 2.3 because the ambiguity can be resolved in manner of URLLC. |
| Huawei | We prefer to be discussed in Rel-17 or later release. |
| MTK | We are fine to specify this in R17 CR or R18 TEI. |

* 1. UE capability

Proposed conclusion :

* RAN1 concludes that current ASN.1 does not include a capability to indicate “beyond UE’s indicated uplink CA capability”
  + Based on current specification, UEs not supporting simultaneous transmission in the target band and a third band (other than source and target bands) are allowed to drop transmissions in the third band (per RAN4 requirements)

|  |  |  |
| --- | --- | --- |
| Company | views | comments |
| ZTE | Agree |  |
| Futurewei | Not agree | We do not see such a conclusion is needed. |
| Samsung | Agree | Based on this conclusion, we can make progress to clarify “beyond UE’s indicated uplink CA capability”. |
| Qualcomm | Agree | There may be no need to agree to this conclusion, but this is the current spec. |
| Intel | Don’t agree | The conclusion may not be needed. |
| Ericsson | Agree |  |
| MTK | Agree | We think this reflects the current spec |
| CATT | Don’t agree | As we said in previous meetings, in our opinion, at least *parallelTxMsgA-SRS-PUCCH-PUSCH-r16*, *parallelTxSRS-PUCCH-PUSCH, parallelTxPRACH-SRS-PUCCH-PUSCH, and simulTX-SRS-AntSwitchingInterBandUL-CA-r16* in *CAParametersNR* indicate whether UE can simultaneously transmit SRS in a carrier with a UL signal in another carrier together. |
| Moderator | From the comments above, there is no consensus on proposed conclusion. | |

Proposal 2-4: Introduce a new UE capability, if agreed, down selection between option 1 and 2.

Option1 :

* Introduce a new Rel-17 UE FG to indicate if UL transmission in one band within a BandCombination impacts UL transmission in another band within the BandCombination for SRS carrier switching.

Option2:

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).

|  |  |  |
| --- | --- | --- |
| Company | views | comments |
| ZTE | Slightly prefer option 1 | Just one question for option 2, why the capability should be introduced per ‘source-target’ pair ? what kind of usecase is ? e.g. for a source-target pair c2-c1, c3 is impacted, but for source-target pair c4-c1, c3 is not impacted, why ? In our view, whether c3 is impacted only replies on c1 regardless of the sourcce carrier. |
| Futurewei | We prefer option 2 | Option 2 is clearer and more future-proof. |
| Apple | Prefer Option 2 | In our view, Option 2 is a more detailed version of Option 1. We are fine to begin with a signaling procedure proposed by Qualcomm in R1-2202112, Sec. 5. |
| Samsung | Option 1 |  |
| Qualcomm | Option 2 | To try to clarify the question raised by ZTE : the interruption of other carriers when switching is related to the amount of RF reconfiguration needed for this switch. For instance, if only an LO retuning is needed, there may be no interruption in other CCs, but if a more general reconfiguration of the RF is needed (e.g. change setpoints of PA) there may be interruption. Thus, we think it is cleaner to give enough flexibility to signal interruption with all possible switches. |
| Intel | Don’t agree | Why this new capability is needed ? Needs more clarification |
| Ericsson | Can consider either | For clarification, both option 1 and 2 are for Rel-17, right ? |
| MTK | Option 2 | We slightly prefer Option 2. We also want to check Option 2 should belong to Rel-17, right ? |
| vivo | We are fine to introduce a new capability | Exact description can be futher discussed |
| CATT |  | Open to discuss. Maybe we should have a conclusion on what Rel-15 behavior is first. |
| Moderator | From the comments above, except one company all others agree introducing a new UE capability, in my understanding the new UE capability related to proposal in section 2.2. With this understanding I would like to check with Intel whether you can accept introdcution of a new UE capability for Rel-17. | |
| Intel2 | It’s not clear to us to introduce such a new capability and we want to see a clear picture. In current capability, there are parameters, *txSwitchImpactToRx* and *txSwitchWithAnotherBand*, which indicates the impacted bands by SRS switching. If new capability is introduced, what’s the relationship with the legacy ones and how should the UE report? | |
| Qualcomm | To clarify, the “txSwitchImpactToRx” is related to **antenna** switching, not **carrier** switching. It just means that multiple bands go through the same physical switch to the antenna, so when you switch one band they impact other bands. The problem for carrier switching is different (it has nothing to do with physical switches but with RF reconfiguration). | |
| Futurewei | We are ok to introduce a new capability and related UE behavior and Qualcomm’s wording can be a starting point. However, time for R17 TEI has passed therefore it has to be for R18. If the group really sees the need to do it for R17, we need to ask for RAN1 chair’s guidance ASAP. | |
| Intel | Thanks Qualcomm for the response.  In our understanding, *txSwitchImpactToRx* and *txSwitchWithAnotherBand* can be used for SRS carrier switching. See below text from 38.306 and 38.331  *From 38.306:*  - *txSwitchImpactToRx* indicates the entry number of the first-listed band with UL (see NOTE) in the band combination that affects this DL, which is mandatory with capability signaling;  - *txSwitchWithAnotherBand* indicates the entry number of the first-listed band with UL (see NOTE) in the band combination that switches together with this UL, which is mandatory with capability signaling.  For *txSwitchImpactToRx* and *txSwitchWithAnotherBand*, value 1 means first entry, value 2 means second entry and so on. All DL and UL that switch together indicate the same entry number.  The entry number is the band entry number in a band combination. The UE is restricted not to include fallback band combinations for the purpose of indicating different SRS antenna switching capabilities.  NOTE: The first-listed band with UL includes a band associated with *FeatureSetUplinkId* set to 0 corresponding to the support of SRS-SwitchingTimeNR.  *From 38.331:*  ***srs-TxSwitch*** Indicates supported SRS antenna switch capability for the associated band. If the UE indicates support of *SRS-SwitchingTimeNR*, the UE is allowed to set this field for a band with associated *FeatureSetUplinkId* set to 0 for SRS carrier switching.  @Qualcomm, could you please give an example how UE should report the legacy *txSwitchImpactToRx* and *txSwitchWithAnotherBand* when we have the new capability?  Basically, we think the details should be further discussed. | |
| Qualcomm | To Intel:  When you say “they can be used” for SRS carrier switching, you may mean two things:   1. You can indicate whether the switch of antenna switching during SRS carrier switching is shared with other bands (yes, that is the yellow part in your reply). 2. The capability can be used to indicate whether RF retuning for a source-target pair interrupts other bands (no, this cannot be derived based on current capability)   The capability *txSwitchWIthAnotherBand* indicates whether two bands share physical switches for antenna switching, regardless of carrier switching. The switches in different CCs have to be consistent.  To give one example, we may have 3 CCs that are all mid-band, thus they share the same physical switches to the physical antennas (thus the UE would indicate *txSwitchWithAnotherBand* to be common across all of them). However, it is possible that the UE can do carrier switching from CC1 to CC2 without affecting CC3 (and thus would indicate “no interruption” under the new capability). | |
| Huawei | We prefer to be discussed in Rel-17. | |

* 1. Text Proposals

TP#1: TP for 38.214 section 6.2.1.3

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

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:

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

|  |  |  |
| --- | --- | --- |
| Company | views | comments |
| ZTE | Agree | This is for Rel-16 |
| Futurewei | Agree |  |
| Samsung | Agree |  |
| Qualcomm | Do not agree | The wording « SRS transmission » is used in many parts of the specification, e.g. :   * *For n-th (n ≥ 1) aperiodic SRS transmission on a cell c […]* * *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*   Is the understanding that all the other « SRS transmissions » do not refer to SRS resources, but to SRS symbols ? |
| Intel | Agree | The original spec text ‘an SRS transmission’ is confusing. It’s not clear whether it means an SRS resource, an SRS resoruce set or even an SRS symbol.  In RAN1 #107-e, it was agreed that the individual timeline is applied for each SRS resource set. Therefore, the spec should be updated to align with the agreement reached in RAN1 #107-e. |
| MTK | Not agree | Similar concern as QC. Do we intend to modify all the wording for «SRS trransmission« in RAN1 spec ? |
| CATT |  | Similar concern as QC and MTK that “SRS resource set transmission” is not proper. |
| Moderator | From the comments above, there is no consensus on TP#1 | |
| Intel2 | Since the agreement in RAN1 #107-e only touches the timeline operation, the TP#1 just changes text in the paragraph related with timeline operation.  Question to QC, MTK and CATT, will the change of all the ‘SRS transmission’ in Section 6.2.1.3 to ‘SRS resource set transmission’ be acceptable to you? | |
| Huawei | Disagree with changes. We are not certain what consequence of changes are since existing words have no ambiguity. | |
| MTK2 | @Intel2: We prefer not to change current spec, unless an error case can be clearly specified due to current wording. In that case we can be willing to take a thorough check in 38.214 section 6.2.1.3. | |

TP#2: TP for 38.214 section 6.2.1.3

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

A 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*, and also the uplink transmission on carrier *c3* if the UE is configured with *uplinkTxSwitching-r16* for uplink switching between uplink carrier *c2* and *c3*.

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

|  |  |  |
| --- | --- | --- |
| Company | views | comments |
| ZTE | Agree |  |
| Futurewei | Agree |  |
| Apple | Don’t agree |  |
| Samsung | Agree |  |
| Qualcomm | Don’t agree | We suggest to revisit this once the inter/intra-band is solved. |
| Intel | Don’t agree | Same view as QC. |
| Ericsson | Don’t agree | Similar view as Qualcomm. Isn’t this a new feature ? |
| MTK | Don’t agree | Same view as QC. |
| vivo |  | There could be difference for the intra-band and inter-band cases, it can discussed later. |
| CATT | Don’t agree |  |
| Moderator | Most of companies don’t agree with TP#2. TP on similar line may be needed after concluding discussion in section 2.2 and 2.4. | |

1. Reference:

|  |  |  |
| --- | --- | --- |
| [R1-2201064](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201064.zip) | Maintenance on SRS carrier switching | vivo |
| Proposal 1: Support Alt 3 and no specification change is needed.  Proposal 2: It is better to make a conclusion to avoid ambiguities on UE implementation for carrier switching if Alt 3 is supported. | | |
| [R1-2201450](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201450.zip) | Discussion on SRS carrier switching | ZTE |
| Proposal 1: Adopt the following text proposal for Rel-16 38.214 [4] 6.2.1.3 UE sounding procedure between component carriers 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:  **Proposal 2:** Make the following as a conclusion for Rel-16.   * 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:   + 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. | | |
| [R1-2201681](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201681.zip) | Discussion on SRS carrier switching | Intel Corporation |
| Proposal 1:  Adopt the following text change for SRS carrier switching timeline operation in 38.214.  …  For an SRS resource set transmission ~~an SRS 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:  Proposal 2:   * 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. | | |
| [R1-2201986](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201986.zip) | Discussion on ambiguity for SRS carrier switching. | Samsung |
| Proposal 1: Need discussion related to ambiguity according to the application order between directional collision handling and priority check for SRS carrier switching.  Proposal 2: As a simple method to solve the ambiguity, we can consider that the application order follows the order of transmission or reception from the UE side in timeline. | | |
| [R1-2202112](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2202112.zip) | Discussion on SRS carrier switching | Qualcomm Incorporated |
| Proposal 1: For Rel-17, define joint prioritization rules for carriers that are in the same band as the source CC, taking as baseline the CR in R1-2103759.  Proposal 3: RAN1 concludes that current ASN.1 does not include a capability to indicate “beyond UE’s indicated uplink CA capability”   * Based on current specification, UEs not supporting simultaneous transmission in the target band and a third band (other than source and target bands) are allowed to drop transmissions in the third band (per RAN4 requirements)   Proposal 4: If a new capability for cases other than intra-band CA is to be introduced in Rel-17, the design should be as follows:   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). | | |
| [R1-2200973](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2200973.zip) | Discussion on the remaining issues of UL Tx switching | Huawei, HiSilicon |
| **Proposal 2:** Adopt the TP in Appendix A.2 for uplink suspension of SRS carrier switching in TS 38.214 clause 6.2.1.3.  **<Unchanged parts are omitted – 38.214>** 6.2.1.3 UE sounding procedure between component carriers A 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*, and also the uplink transmission on carrier *c3* if the UE is configured with *uplinkTxSwitching-r16* for uplink switching between uplink carrier *c2* and *c3*.  **<Unchanged parts are omitted – 38.214>**  **Proposal 3:** Adopt the TP in Appendix A.3 for prioritization rules of SRS carrier switching in TS 38.214 clause 6.2.1.3.  **<Unchanged parts are omitted – 38.214>** 6.2.1.3 UE sounding procedure between component carriers For a carrier of a serving cell *d* 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 and are both configured with *uplinkTxSwitching-r16*.  - is in the same TAG as .  where .  **<Unchanged parts are omitted – 38.214>**  For an SRS transmission starting in symbol of carrier and a conflicting transmission in carrier starting in symbol, where , 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 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 :  - 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].  - 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].  - 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 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].  - 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 set 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 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 parts are omitted – 38.214>**  **Proposal 4:** For a UE configured with UL Tx switching on two uplinks and configured with SRS carrier switching for a third uplink, if a uplink transmission is scheduled after a SRS carrier switching occurrence and the time interval between the first symbol of the uplink transmission and the last symbol of SRS transmission is less than or equal to an interval of 13 symbols plus the RF retuning time required by SRS carrier switching, then the last symbol of PDCCH scheduling the uplink transmission should be no later than at symbol L, where the time interval between symbol L and the first symbol of SRS transmission is larger than symbols plus the RF retuning time.   * In case of different SCS between the uplink transmission and the SRS transmission, the 13 symbols are with respect to the smaller SCS. | | |
| [R1-2201181](https://www.3gpp.org/ftp/TSG_RAN/WG1_RL1/TSGR1_108-e/Docs/R1-2201181.zip) | Discussion on other Rel-17 UE features | ZTE |
| **Proposal 2:** Introduce a new Rel-17 UE FG to indicate if UL transmission in one band within a BandCombination impacts UL transmission in another band within the BandCombination for SRS carrier switching. | | |