**3GPP TSG RAN WG1 #106-e R1-21xxxxx**

**e-Meeting, August 16th – 27th, 2021**

**Agenda item: 7.2.12**

**Source: Moderator (China Telecom)**

**Title: [106-e-NR-Maintenance-Others-02] Remaining issues on Rel-16 uplink Tx switching**

**Document for: Discussion and Decision**

# Introduction

In [1], maintenance issues are summarized for Rel-16 uplink Tx switching. This contribution is the summary of the following email discussion.

[106-e-NR-Maintenance-Others-02] Remaining issues on Rel-16 uplink Tx switching (CA based SRS carrier switching) by August 20 – Jianchi (China Telecom)

# Email discussion (1st round)

## Issue: CA based SRS carrier switching

SRS carrier switching was intensively discussed in RAN1 #104e, RAN1 #104b-e and RAN1 #105e. Companies acknowledged that some clarification is needed, but no consensus has been achieved.

R1-2106501 proposed TPs for both uplink suspension and prioritization rules of SRS carrier switching. R1-2107322 proposed to conclude that the combination of SRS carrier switching and UL Tx switching is not supported in R16 and suggested solving the issues in R17 for the combined feature of SRS carrier switching and UL Tx switching.

Based on the discussion in RAN1 #105e, it seems the following proposal on suspension can be accepted by the majority.

**Proposal 1:**

* Adopt the following TP to TS 38.214.

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| **<Unchanged parts are omitted – 38.214>**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>** |

Companies are encouraged to provide views on the above proposal.

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| **Company** | **Comments** |
| CATT | For proposal 1, it is better to add below description because similar topic will be discussed in [106-e-NR-7.1CRs-02].“Subject to the prerequisite of retaining the “suspending” function as an outcome from [106-e-NR-7.1CRs-02] discussion, for a UE configured with both UL Tx switching and SRS carrier switching, if a SRS transmission is triggered by SRS carrier switching and its “switch-from” uplink carrier is configured with uplinkTxSwitching-r16, then the UE also temporarily suspend the UL transmission on the other uplink carrier configured with uplinkTxSwitching-r16. “ |
| ZTE | Ideally, it would be better if we can first clarify the ambiguity issue between prioritization and suspension for SRS carrier switching. But considering the late stage, we can accept the above TP with the understanding that further updates can be further discussed if any confliction is observed between this Rel-16 TP and the ongoing Rel-15 CR discussion on SRS carrier switching.  |
| Huawei, HiSilicon | The TP is technically correct and have no technical concern according to the discussion of multiple meetings. We hope it could be accepted and the “suspending” issue can be resolved.@CATT, we would like to remind that no company is proposing to remove “suspending” function any more according to the summary R1-2106100 last meeting, as copied below, i.e. consensus has been achieved on retaining the “suspending” function, the remaining issue for this part is only the necessity of some further clarification. As a result, similarly, there is no proposal to remove “suspending” function either in the FL summary of this meeting (refer to the summary [v03](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_106-e/Inbox/drafts/7.1/%5B106-e-NR-7.1CRs-02%5D/R1-21xxxxx%20%5B106-e-NR-7.1CRs-02%5D%20Issue%232%20SRS%20Carrier%20Switching_v03_QC_ZTE.docx)). Therefore, the TP can be adopted without any further clarification with the “subject to” as you proposed. Please have a check.**R1-2106100**“**Proposal 1:** −         The prioritization rules of SRS  carrier switching apply to at least the source CC. −         Revise the following sentence in 38.214 as When SRS  transmission on carrier c1 is performed according to the prioritization/dropping rules in this subclause , d ~~D~~ uring  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. ”BTW,  |
| CATT | Based on HW’s explanation, we are fine with the above TP without any note. We can come back if there is any conflict between Rel-16 TX switching and Rel-15 CR on SRS carrier switching. |
| Qualcomm | During the email discussion in RAN1 #104b-emeeting, companies agreed that we could wait for the conclusion of email thread [104b-e-NR-7.1CRs -02] which is trying to solve similar ambiguity issue. However, the CR discussion is still ongoing until now. We would sustain our objection to an incomplete proposal as some of the key issues are not solved, for example if C3 is configured with UCI, it should be with higher priority than SRS of C1. We can’t find this statement in the current specification. As Rel-16 UL Tx switching has been delayed for several meetings already due to incompletion of the dependent CR discussion. Meanwhile, the time is already very late for Rel-16 and the implementation would be challenged. We propose to conclude that the combination of SRS carrier switching and UL Tx switching is not supported in R16. Furthermore, we would suggest solving the issues in Rel-17 for this combined feature. **Proposal 1: We propose to conclude that the combination of SRS carrier switching and UL Tx switching is not supported in Rel-16.****Proposal 2: We suggest solving the issues in Rel-17 for the combined feature of SRS carrier switching and UL Tx switching.** |

R1-2106501 proposed TP for prioritization rules of SRS carrier switching.

**Proposal 2:**

* Adopt the following TP to TS 38.214.

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| **<Unchanged parts are omitted – 38.214>**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 $S\left(d\right)=\{s\_{0}\left(d\right)…s\_{N-1}(d)\}$ as the set of carriers of serving cells that each carrier meets one of the following conditions:- $s\_{i}(d)$ is in the same band as $s\_{0}(d)$, or $s\_{0}(d)$ and $s\_{i}(d)$ are both configured with *uplinkTxSwitching-r16*.- $s\_{i}(d)$ is in the same TAG as $s\_{0}(d)$.where $1\leq i\leq N-1$.**<Unchanged parts are omitted – 38.214>**For an SRS transmission starting in symbol $N\_{\_{}}$ of carrier $d$$\_{}$ and a conflicting transmission in carrier $\_{}$ starting in symbol$ N\_{\_{}}$, where $1\leq i\leq N-1$, 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 least$ N\_{2} $symbols and an additional time duration $T\_{SRS\_{CS}}$, and the time interval between the last symbol of PDCCH and $\_{\_{}}\_{\_{}}$ is at least$ N\_{2}$ symbols*;* and- semi-persistent CSI reports or SRS considered active at least $N\_{2}$ symbols and an additional time duration $T\_{SRS\_{CS}}$ before $N\_{\_{}}$, and considered active at least $N\_{2}$ symbols before $N\_{\_{}\_{}}$.where $T\_{SRS\_{CS}}=max⁡\{switchingTimeUL,switchingTimeDL\}$, 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 $S\left(d\right)$:- 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 $S\left(d\right)$ 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 $d$ and PUSCH transmission carrying aperiodic CSI on a carrier of a serving cell in set $S\left(d\right)$ 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 $S\left(d\right)$ 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 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$ S\left(d\right)$ 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 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>** |

Companies are encouraged to provide views on the above proposal.

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| **Company** | **Comments** |
| CATT | We want to clarify whether this issue on prioritization rules of SRS carrier switching will be handled in this email thread or [106-e-NR-7.1CRs-02] because some contribution on similar topic will be handled in [106-e-NR-7.1CRs-02]. |
| ZTE | Some companies submitted similar proposals under [106-e-NR-7.1CRs -02]. To avoid confliction, it is better to wait for the outcome of Rel-15 CR discussion first. |
| Huawei, HiSilicon | Last meeting, at the last minute to agree the TP/FL proposal of “suspending function”, it was proposed by one company to resolve the prioritization rules together with the TP of “suspending” function, which is the reason to have the TP proposal on prioritization rules here. However, it is quite clear that “suspending” function is about the UE behavior after SRS transmission is determined according to the prioritization rules, based on summary R1-2106100. Here, we can focus only on the ”suspending” function specific to UL Tx switching while leaving prioritization rules in the other thread xx-7.1CRs-02, unless any company still prefer to couple them together. |
| Qualcomm | Similar question as CATT, and seems Huawei confirmed this is a duplication of the proposal in the email thread of [106-e-NR-7.1CRs-02]. If this is correct understanding, we would suggest only discussing this issue under [106-e-NR-7.1CRs-02] to avoid parallel discussion.@Huawei, seems we have to repeat our views. Suspension and prioritization are not separable functions. Agreeing on one without the other means that we don’t know what we are agreeing to. Therefore, we think the SRS switching maintenance needs to be decided first and we should not discuss either any partial solutions for UL Tx switching before then. |

# Email discussion (2nd round)

## Issue: CA based SRS carrier switching

**FL comments: For proposal 1 on suspension, the majority companies accept the TP while one company sustains objection. Regarding proposal 2 on prioritization rules, it seems we still need to wait for the outcome of [106-e-NR-7.1CRs-02].**

**For proposal 1, since only one company objects to it, I encourage Qualcomm to check again whether proposal 1 can be accepted as an agreement or working assumption.**

**Proposal 1:**

* Adopt the following TP to TS 38.214.

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| **<Unchanged parts are omitted – 38.214>**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>** |

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| **Company** | **Comments** |
| Qualcomm | As commented above, we would sustain our objection to an incomplete proposal as some of the key issues are not solved, for example if C3 is configured with UCI, it should be with higher priority than SRS of C1. We can’t find this statement in the current specification. From previous discussion, all the companies agreed on the dependency with [[106-e-NR-7.1CRs-02]](https://list.etsi.org/scripts/wa.exe?A2=3GPP_TSG_RAN_WG1;aea15642.2108C&S=) which is still ongoing. We are quite confusing why we need to agree an incomplete solution building on sand.  |
| CATT | We are fine with FL proposal. |
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# References

1. R1-2107136, Summary of Rel-16 uplink Tx switching, Moderator (China Telecom), August 16th – 27th, 2021.
2. R1-2106501, Discussion on the remaining problems of supporting Tx switching between two uplink, Huawei, HiSilicon, RAN1 #106-e, August 16th – 27th, 2021.
3. R1-2107322, Remaining issues for 1Tx-2Tx switching, Qualcomm Incorporated, RAN1 #106-e, August 16th – 27th, 2021.