**3GPP TSG RAN WG1 Meeting #104bis-e R1-21xxxxx**

**E-meeting, April 12 – 20, 2021**

**Agenda Item: 7.1**

**Source: Moderator (Huawei)**

**Title: Summary of [104b-e-NR-7.1CRs-02] Correction on prioritization rules of SRS carrier switching**

**Document for: Discussion and Decision**

# Introduction

This document is created to on following Email discussion.

**[104b-e-NR-7.1CRs-02]** Issue#21: Correction on prioritization rules of SRS carrier switching – ~~TBD~~ Keyvan (Huawei) by April 16

[**R1-2103759**](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_104b\Docs\R1-2103759.zip) Correction on prioritization rules of SRS carrier switching Huawei, HiSilicon

As the deadline for the email and the potential TP is set on April 16, I appreciate it if you could provide your views by **UTC 23:59 pm, April 13.**

# Discussion

The CR in [1] relates to prioritization/collision handling rules for SRS carrier switching defined in S6.2.1.3 of TS 38.214. However, it is unclear in S6.2.1.3 of TS 38.214 the prioritization rules affect the transmissions on which carriers and how to determine a case “beyond” a UE’s indicated UL-CA capability. For example, it is not clear whether the prioritization rules also apply to an uplink carrier in the same band as the uplink carrier configured as a “switch-from” carrier for SRS carrier switching. Such issue has been discussed in Rel-14 LTE by R1-1712771, R1-1714652 and R1-1809001, and solved in Rel-14 LTE by CR R1-1721095 and R1-1809554/R1-1809555. In particular, it was agreed and included in 36.213 that the prioritization rules apply to the set of carriers S(d)= {s0(d),… sN-1(d)} 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 CP as *s*0(d).

- {*s*0(*d*)… *s*N-1(*d*)} are in the same TAG as *s*0(d).

where d is the serving cell transmitting the carrier switching SRS, s0(d) is the “switch-from” carrier as indicated in *srs-SwitchFromServCellIndex,* and above definition of S(d) is based on the following agreement in RAN1#90:

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| ***Agreement in Principle:***  *Capture the following in 36.213:*   * *The “same PA” is implicitly identified by the following. Two “CC with the same PA” are those that:*   + *Are in the same band*   + *Are in the same TAG*   + *Have the same CP* * *Adopt the following solution for the cases of collision between SRS switching and victim CC:*   + *Extend collision rules to victim CC (i.e., the transmission of SRS depends on the information transmitted in the source CC and the victim CC).*   *CR to be prepared for RAN1#90bis.* |

The change request in [1] is based on a similar SRS carrier switching collision handling as in Rel-14 LTE. This is due to the fact that, according to the RAN1#90bis agreement below, a collision handling of SRS carrier switching similar to Rel-14 LTE should be specified (relevant parts of the agreement in highlighted in yellow):

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| ***Agreement:***  *Specify NR SRS switching among CCs similar to Rel-14 LTE SRS carrier-based switching design including*   * + *Periodic/aperiodic/semi-persistent SRS on a CC without PUCCH/PUSCH configured*   + *TA (through PRACH) on TAG without PUSCH/PUCCH configured*   + *Power control separated from that of PUSCH*   + *Group common DCI for aperiodic SRS triggering and TPC*   + *DL/UL interruptions and collision handling due to SRS switching* |

# Company views

**Do you agree with changes in proposed CR? If not, why?**

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| **Company** | **Agree or not** | **Comment** |
| FUTUREWEI | YES | Agree in principle and may need to check further the details of the CR |
| ZTE | Not fully agree | We have the following comments:  Comment 1: the spec change will cause NBC issue, it is better to discuss this for Rel-16 instead of Rel-15  Comment 2: The current 38.214 describes other UL signals such as which ‘can result in uplink transmissions beyond the UE's indicated uplink carrier aggregation capability included in [13, TS 38.306]’. In our view, that means, once the uplink signals cause the scheduling beyond UE capability, the prioritization rules should be applied no matter the uplink signals are in the same band or different bands as the carrier configured as a “switch-from” carrier for SRS carrier switching. So we think even we don’t use LTE liked rule, NR spec still works.  Comment 3: If we adopt the above draft CR, it seems conflicted with the following yellow part in 38.214 (it seems LTE has no such description?). In the yellow part, signals in ‘from CC’ always be suspended. However, in the prioritization rules, signals in ‘from CC’ may still be transmitted depends on priority between SRS and the signals’. So should we remove the following yellow part?  -------------------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*. |
| MediaTek | Agree in principle | Please see our comments below.  Comment #1:   * For SCS 60kHZ, normal and extended CP are both supported. To reflect the agreements correctly, “same CP” should be kept. * Considering the easier UE implementation and realistic deployment, we think “same PUCCH group” can be added to the restriction in S(d).   Comment #2:   * The following paragraph in Section 6.2.1.3 of TS 38.214 captures UE behavior on switching-from CC (source CC). However, it seems to be redundant on top of the prioritization rule. We suggest to remove the following paragraph to avoid confusion.   + 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*.   Comments #3:   * The UE behavior in some cases is not defined. E.g,   + UE behavior for the overlap of A-CSI (only CQI/PMI/L1-RSRP/L1-RSRP/L1-SINR) on a carrier of serving cell in set S(d) and A-SRS on the carrier of the serving cell d is defined in current spec, but there is no counterpart for P/SP-SRS on the carrier of the serving cell d.   + UE behavior for the overlap of A-SRS on the carrier of the serving cell d and PUSCH transmission carrying A-CSI on a carrier of serving cell in set S(d) is also not defined.   We suggest to also discuss the prioritization rule for above cases at least for Rel-16. |
| Samsung | No. Need to check NBC issue. | First of all, SRS carrier switching in the current NR specification is similar to LTE spec 36.213 (v14.4.0) that is before updating the agreement on LTE carrier switching in RAN1#90. I think this is because there was misalignment between updating LTE spec and capturing LTE spec for NR. Followings are a part of SRS carrier switching in 36.213 v14.4.0 and v14.5.0:  [36.213 v14.4.0]  “For a TDD serving cell 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 [10]) on the serving cell and PUSCH/PUCCH transmission carrying HARQ-ACK/positive SR/RI/PTI/CRI and/or PRACH 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 the *UE-EUTRA-Capability* [12].”  [36.213 v14.5.0]  “For a TDD serving cell *d* not configured for PUSCH/PUCCH transmission, denote as *s*0(*d*)the corresponding serving cell whose UL transmissions may be interrupted as signalled by *srs-SwitchFromServCellIndex*. Define the set *S*(*d*)*=* {*s*0(*d*)… *s*N-1(*d*)} as the set of serving cells that meet the 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 CP 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 when transmitting SRS over serving cell *d* when the simultaneous transmission of SRS and other signal/channel would result in uplink transmissions beyond the UE's indicated uplink carrier aggregation capability included in the *UE-EUTRA-Capability* [12]:  - If PUSCH/PUCCH transmission carrying HARQ-ACK/positive SR/RI/PTI/CRI and/or PRACH on a serving cell in set *S(d)* overlaps in the same symbol with the SRS transmission (including any interruption due to uplink or downlink RF retuning time [10]) on serving cell *d*, then the UE shall not transmit SRS. Otherwise,  - …”  As above part of 36.213 v14.5.0, the agreement in RAN1#90 was updated and the other enhancements for LTE (e.g., Corrections related to capabilities for SRS Carrier Switching for 36.213 14.8.0) were updated independently of NR. But, NR specification was not modified as LTE’s updates. As a result, LTE spec and NR spec for SRS carrier switching becomes different.  Based on the above history, we are not sure that there is no NBC issue for NR SRS carrier switching if we adopt this CR. So, we should check the NBC carefully and then decide whether this CR can be adopted or not. |
| Huawei/HiSilicon | Yes | Thank you for the comments. Herein, we try to clarify some issues brought up so far:   1. NBC issue (by ZTE comment#1 and Samsung): We do not see how the proposed CR can cause an NBC issue. As per the aforementioned agreement in RAN1#90, PA is shared among all cells belonging to S(d). Therefore, if PA is “borrowed” from s\_0(d) that is indicated in *srs-SwitchFromServCellIndex* to transmit carrier switching SRS in carrier d, the PA would be in fact be borrowed from all cells in S(d). This is a behavior that, in practice, UE has even if it is not explicitly mentioned in the specifications. This CR only tries to specify this behavior that UE, anyway, would show in practice. This is exactly the same reason that a similar agreement was made in LTE as reflected in changes in 36.213 v14.5.0. Further, CR relaxes the stringent current priority conditions in 38.214 to something that is more relaxed and aligned with UE’s actual behavior: For instance, “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 […] on the carrier of the serving cell d happen to overlap in the same symbol” instead of dropping the PUSCH transmission carrying aperiodic CSI comprising only CQI/PMI/L1-RSRP/L1-SINR on only s\_0(d) as the current spec indicate. 2. ZTE comment#2: In fact, as Samsung also brought up the relevant part of the LTE spec, originally, 36.213 had a similar text as the current 38.214 6.2.1.3:   [36.213 v14.4.0]: “…. carrying HARQ-ACK/positive SR/RI/PTI/CRI and/or PRACH 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 the *UE-EUTRA-Capability* [12]”. However, the yellow part was removed and the priority rules were clarified as in the current LTE specifications. We believe that a similar approach should also be taken in NR as per the agreement in RAN1 90-bis brought up in Section 2 of this document.   1. ZTE comment#3 and MediaTek comment#2: We agree that the mentioned paragraph is redundant and can be removed. 2. MediaTek comment#3: Agree. The mentioned cases need to be further discussed for Rel-16. |
| Ericsson | OK to consider for Rel-16, but not Rel-15 | As ZTE points out, we think the Rel-15 spec works, and for us it is difficult to agree to this change in Rel-15. However, we are open to the greater flexibility the CR allows, and so it can be considered in Rel-16. We would like to further check the additional proposed changes from Mediatek and ZTE. |
| Qualcomm | Generally agree | We agree that the case of intra-band CA should be captured as done in LTE. We would be OK with correcting this in Rel-15. A couple of comments:  1) Agree with Mediatek’s comment#2, the paragraph describing “source CC interruption” would be contradicting the CR. Maybe we can also add the “s(d)” notation in that paragraph instead of removing it.  2) One change with respect to LTE is that SCS and CP are properties of BWPs, not cells. Therefore we cannot use this condition for determining same / different PA. We suggest to remove “SCS” and “CP” as conditions for same PA.  3) The part of removing *“and that can result in uplink transmissions beyond the UE capability …”* is a bit unclear to us. In our view, the UE behavior would be different depending on whether the UE exceeds its capability or not. Could the proponent clarify this point? Note that this “beyond UE capability” specification is also discussed in our paper R1-2103149. |
| Apple | Please see comments | We are not sure if CR is mature enough to address all concerns, some are mentioned above by other colleagues. On applicability of prioritization rules and set definition, we share same view with ZTE. In our interpretation, SRS switching can be inter-band and that may impact inter-band CCs as well, not just intra-band CCs.  We think “and that can result in uplink transmissions beyond the UE's indicated uplink carrier aggregation capability included in [13, TS 38.306].” should be kept |
| vivo | Ok in general, consider for Rel-16 | As pointed out by companies, we would prefer further checking on additional proposed corrections. |
| Huawei, HiSilicon |  | Regarding companies’ comment as to whether or not we should keep “and that can result in uplink transmissions beyond the UE's indicated uplink carrier aggregation capability included in [13, TS 38.306].”, we think that this expression is vague and is not helpful in describing UE’s prioritization behaviour (which, our CR attempts to do). As such, our first preference is to remove it. However, it is OK for us to keep this text and further clarify the possible meaning of “beyond the UE's indicated uplink carrier aggregation capability” in later CRs if companies believe that there are still some cases that are beyond “UE's indicated uplink carrier aggregation capability” and are not addressed by the current CR. |

# Conclusions

# References

1. R1-2103759, Correction on prioritization rules of SRS carrier switching, Huawei, HiSilicon

# Appendix: Proposed CR in R1-2103759

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| **<Unchanged parts are omitted>**  3.3 Abbreviations  TAG Timing advance group  TB Transport Block  TCI Transmission Configuration Indicator  TDM Time division multiplexing  UE User equipment  UL Uplink  **<Unchanged parts are 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 *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.  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'.  **<Unchanged parts are omitted>** |