**3GPP TSG RAN WG1 #102-e R1-200xxxx**

**e-Meeting, August 17th – 28th, 2020**

**Agenda item:** 5

**Source:** Moderator (Qualcomm Incorporated)

**Title:** [102-e-LS-AI5-04] Discussion on NR SRS carrier switching

**Document for:** Discussion and Decision

# Background

In LS R1-2005209, RAN1 received the following questions from RAN2:

[…]

for typeA RAN2 didn’t achieve consensus on whether the following 2 cases on NR SRS carrier switching are allowed:

* Case 1: SRS carrier switching to a SUL without PUCCH/PUSCH while PUCCH/PUSCH is configured in NUL;
* Case 2: SRS carrier switching to both NUL and SUL, neither of which are configured with PUCCH/PUSCH.

**2. Actions:**

**To RAN1 group.**

**ACTION:** RAN2 respectively asks RAN1 to provide feedback on the above

As a result of this LS, the following contributions were submitted to this meeting (7 contributions, 5 different sources):

R1-2005466 Draft reply LS on NR SRS carrier switching ZTE

R1-2005553 Discussion for NR SRS carrier switching on SUL ZTE

R1-2005652 Draft reply LS to RAN2 on NR SRS carrier switching CATT

R1-2005654 Discussion on NR SRS carrier switching on SUL carrier CATT

R1-2006078 [Draft] Reply LS on NR SRS carrier switching Samsung

R1-2006757 Discussion on SRS carrier switching Qualcomm Incorporated

R1-2006945 Discussion on NR SRS carrier switching Huawei, HiSilicon

# Summary of input contributions

In the following, we summarize the received input:

* Three sources [ZTE, Samsung, Qualcomm] indicate that the two cases from RAN2 are not supported from RAN1 specification point of view.
* One source [CATT] indicates that Case 1 is not supported, and in Case 2 switching to SUL is not supported, but switching to NUL is supported.
* One source [Huawei/HiSi] indicates that both case 1 and Case 2 are supported.
* One source [Qualcomm] further states that SRS carrier switching is not supported for a target serving cell configured with SUL.

Several reasons are included in the contributions for the support / no support of this feature.

* Four sources [ZTE, CATT, Samsung, Qualcomm] mention the following specification snippet (TS 38.214) that indicates that SRS carrier switching is only supported for a “serving cell with slot formats comprised of DL and UL symbols”:

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| --- |
| 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*.…. |

* Two sources [Qualcomm, ZTE] mention that SRS carrier switching is for DL CSI acquisition (SRS resource set(s) with higher layer parameter *usage* set to *'antennaSwitching'*)and, therefore, there is no use case for SUL.
* One source [Huawei/HiSi] mentions the following two agreements (in RAN1#89 and RAN1#91) as justification for supporting both Case 1 and Case 2:

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| --- |
| **Agreements:*** For NR standalone operation for a UE,
	+ NR supports that the UE is allowed to transmit on UL carriers on different frequency ranges but the UE has the capability to only transmit on one of the carriers at a given time in the following case:
		- case of SRS carrier switching with at least one of the frequency ranges agreed for LTE-NR UL sharing by RAN4 (e.g. refer to R4-1704411)
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| **Agreement:*** For a UE configured two ULs in a cell, two TPC bit(s) fields within group common DCI for SRS power control can be configured to the UE, i.e., one for UL and one for SUL;
 |

# Discussion points

**Q1: Is the following case supported form RAN1 point of view?**

* Case 1: SRS carrier switching to a SUL without PUCCH/PUSCH while PUCCH/PUSCH is configured in NUL;

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| --- | --- |
| Company | Input |
| ZTE | Not supported. As we mentioned in our tdoc, SRS carrier switching is for DL CSI in TDD band. However, SUL has no DL symbols.  |
| Qualcomm | Agree with ZTE. The specification explicitly says that SRS carrier switching is for carriers with “slot formats comprised of DL and UL symbols” |
| CATT | Not supported. We share the same view as ZTE. |
| OPPO | Not supported. ZTE showed the obvious reason above.  |
| Samsung | Not supported. |

**Q2: Is the following case supported form RAN1 point of view? (NOTE: Sub-case of Case 2)**

* Case 2.1: SRS carrier switching to SUL, when neither SUL nor NUL of which are configured with PUCCH/PUSCH.

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| --- | --- |
| Company | Input |
| ZTE | Not supported. |
| Qualcomm | Not supported, same reasoning as Q1 |
| CATT | Not supported. |
| OPPO | Not supported |
| Samsung | Not supported. |

**Q3: Is the following case supported form RAN1 point of view? (NOTE: Sub-case of Case 2)**

* Case 2.2: SRS carrier switching to NUL, when neither SUL nor NUL of which are configured with PUCCH/PUSCH.

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| Company | Input |
| ZTE | Not supportedAs we explained in our tdoc, we don’t think it is a valid usecase that SUL is configured without PUCCH/PUSCH. |
| Qualcomm | Not supported. SUL should be configured with PUCCH or PUSCH.  |
| CATT | Maybe we should first clarify whether this is a valid configuration. At least Rel-15 specs do not prohibit such configuration. One possible use case of such configuration is offloading PRACH to SUL carrier. |
| OPPO | Share the same view as ZTE/QC |
| Samsung | SRS carrier switching to NUL is supported when PUCCH/PUSCH is not configured in NUL. We think that SUL configuration does not matter in current RAN1 specification. |

**Q4: Is SRS carrier switching supported for a target serving cell configured with SUL?**

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| Company | Input |
| ZTE | This question is not related with the LS. However, technically, we don’t think it is an appropriate usecase that SRS carrier switching to a target serving cell which is configured SUL. |
| Qualcomm | The case here would be when SUL is configured with PUSCH or PUCCH, but NUL is not. In this case, to transmit SRS in NUL, it wouldn’t make much sense to use SRS carrier switching (which has interruption / collisions / etc), but rather use the SUL framework to transmit SRS in the NUL. |
| CATT | We don’t think using SUL framework to transmit SRS in the NUL will always work. UE may not be able to switch RF chain from an SUL carrier to NUL carrier depending on UE implementation.  |
| OPPO | Not supported as the use case is quite questionable.  |
| Samsung | Same comment as in Q3. |

# Conclusion

<To be completed after discussion>

# Appendix: Summary of proposals in input contributions

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| --- | --- | --- |
| R1-2005466 / R1-2005553 | **ZTE** | **[…]** Thus, it is not valid that a SUL without any PUSCH and PUCCH transmission is configured with SRS carrier switching for DL CSI acquisition. Therefore, the above two cases are not allowed from RAN1 perspective.  |
| R1-2005652 / R1-2005654 | **CATT** | **[…]** that in both cases SRS carrier switching to SUL carrier shall NOT be allowed. In Case 2, SRS carrier switching to the NUL shall be allowed. |
| R1-2006078 | **Samsung** | […] Hence, the NR SRS carrier switching are not allowed for both Case 1 and Case 2. |
| R1-2006757 | **Qualcomm** | Indicate to RAN2 that Case 1 and Case 2 are not supported in RAN1 specifications.[…] Include the following conclusion in the LS to RAN2:* SRS carrier switching is not supported for a target serving cell configured with SUL.
* SRS carrier switching is supported for a source serving cell configured with SUL. The interrupted carrier is signaled by *srs-SwitchFromCarrier*.
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| R1-2006945 | **Huawei, HiSilicon** | Confirm that both Case 1 and Case 2 described in R1-2005209 are supported by Type A SRS carrier switching. |