**3GPP TSG-RAN WG1 Meeting #112bis-e R1-23xxxxx**

**E-meeting, 17-26 April, 2023**

**Agenda Item: 7.1**

**Source: Moderator (Huawei)**

**Title: Summary on [112bis-e-AI7.1-16]**

**Document for: Discussion and Decision**

# **Introduction**

This contribution summarizes the discussion of following email discussion, as the continuation of email discussion [112bis-e-LS-02] [7], regarding the LS from RAN4 [1], on the impact of SRS antenna switching for TDD-FDD band combinations. The companies’ proposals are summarized in Appendix.

[112bis-e-AI7.1-16] Potential RAN1 specification change with regards to the issue raised in R1-2302268 by April 26 – Yubo (Huawei)

# **Discussion**

In discussion [7], majority companies agreed on potential specification change for the impact of uplink transmission.

In [4], a text proposal is proposed for this issue, as copied below:

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| ============================<TP1, 38.214>===========================6.2.1.2 UE sounding procedure for DL CSI acquisition**<Unchanged parts are omitted>**For a UE configured with multiple component carriers, and for a first component carrier configured with uplink in a first band and a second component carrier configured with uplink in a second band that are signalled to switch together according to higher layer parameter *txSwitchWithAnotherBand* the UE is not expected to follow inconsistent transmissions related to antenna switching.For a UE configured with multiple component carriers configured with uplink in intra-band CA, the UE is not expected to follow inconsistent transmissions related to antenna switching.For a UE configured with EN-DC, and for a first component carrier configured with uplink corresponding to in an E-UTRA band and a second component carrier configured with uplink in a NR band that are signalled to switch together according to higher layer parameter *txSwitchWithAnotherBand*, the UE is not expected to follow inconsistent transmissions related to antenna switching in E-UTRA and NR.For a UE configured with intra-band EN-DC, the UE is not expected to follow inconsistent transmissions related to antenna switching in E-UTRA and NR. |

Please provide your comments regarding the above TP:

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| Companies | Comments |
| Samsung | We have two clarification questions on the current version of TP * What is the definition of ‘inconsistent transmissions related to antenna switching’? According to LTE, at least followings could be involved
	+ SRS AS + SRS on different antenna ports simultaneously
	+ SRS AS + PUSCH on different antenna ports simultaneously

We think more specific clarification seems needed to make spec clearer. And if we need to consider other UL (e.g. PUCCH), we should discuss the additional clarification.* For intra-band CA, we could understand the intention for the TP. But is it always correct that two UL CCs for intra-band CA could be affected on SRS antenna switching? If our understanding is correct, some UEs can transmit SRS and other UL signal simultaneously with capability report. For example, the UE can capable to support simultaneous transmission of SRS on different CCs for intra band UL CA if the UE reports ‘simulTX-SRS-AntSwitchingIntraBandUL-CA-r16’ (or other UE capability related to parallel transmission for intra-band CA).
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| Ericsson | Similar to Samsung, we wonder what ‘inconsistent’ means. We do take Qualcomm’s point that LTE and NR antenna ports are defined differently, and so see why different terminology and/or behavior would be needed in NR if we were to clarify 214. But looking at 38.133 (e.g. from 8.2.1.2.18 copied below), the behavior seems clear to us. Also, the behavior is defined somewhat differently in 38.133 for EN-DC, CA, NE-DC, and NR-DC, and so this feels better suited to 38.133 than 38.214.

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| . An UL interruption is allowed on any of the serving cells as indicated in *txSwitchWithAnotherBand*, and a DL interruption is allowed on any of the serving cells as indicated in *txSwitchImpactToRx*.The UE shall perform SRS antenna port switching only if the below conditions are met. - the SRS switching is not colliding with any other UL transmission with higher priority defined in TS 38.214 [26] if the serving cell on which the higher priority transmission is performed is a victim cell based on *txSwitchWithAnotherBand* or is the same carrier on which SRS is transmitted.- the SRS switching is not colliding with any NR measurements (i.e. SSB/CSI-RS based L1/L3 measurements) and the measurements for RLM/BFD/CBD if the serving cell on which the NR measurements and the measurements for RLM/BFD/CBD is performed is a victim cell based on *txSwitchImpactToRx* or is the same carrier on which SRS is transmitted. No requirements are defined for SRS antenna port switching if aperiodic SRS switching is colliding with aperiodic L1-RSRP/L1-SINR measurements and the serving cell on which the aperiodic L1-RSRP/L1-SINR measurement is configured is indicated in *txSwitchImpactToRx* or is the same carrier on which aperiodic SRS is scheduled/configured.No requirements apply when SRS antenna port switching is colliding with E-UTRA measurement if the carrier on which the E-UTRA measurement is performed is indicated in *txSwitchImpactToRx* or is the same carrier on which SRS is scheduled/configured.When 1 SRS symbol is configured in a slot for SRS antenna switching and the aggressor and victim cells are synchronized, the interruption requirement in Table 8.2.1.2.18-1 applies. When 1 SRS symbol is configured in a slot for SRS antenna switching and the aggressor and victim cells are asynchronized, the interruption requirement in Table 8.2.1.2.18-2 applies. For the rest of SRS configurations, the interruption requirement in Table 8.2.1.2.18-3 applies. |

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| Huawei, HiSilicon | The wording “inconsistent transmission related to antenna switching” is not clear. In spec as copied below, the UE antenna port is in fact the physical antenna port of the UE, which is independent to the SRS antenna port or PUSCH antenna port. Therefore, we can use the wording “UE is not expected to use different UE antenna port(s)” to be clear.(TS 38.214)otherwise, for 1T2R, up to two SRS resource sets configured with a different value for the higher layer parameter *resourceType* in *SRS-ResourceSet* set, where each set has two SRS resources transmitted in different symbols, each SRS resource in a given set consisting of a single SRS port, and the SRS port of the second resource in the set is associated with a different UE antenna port than the SRS port of the first resource in the same set, orFor intra-band case, we have similar view with Samsung that this may depend on UE implementation and capability. The UEs supporting simulTX-SRS-AntSwitchingIntraBandUL-CA-r16 or simulTX-SRS-AntSwitchingIntraBandUL-CA-r16 should not be included in the case.Anyway, the intra-band case is not an issue in the RAN4 LS, we don’t need to touch them in the discussion.Regarding Ericsson’s comment on 38.214 vs 38.133, the 38. 133 only specifies the interruption length, there’s no clear statement on whether UEs can use different antenna port between those bands, the UE behaviour is not clear. |
| Apple | Similar to comments above, we don’t see ‘inconsistent transmission’ a good term of specification. We also don’t think using “different UE antenna ports” applies here, given that there is no clear way to indicate whether parallel transmissions are on the same or different antenna ports. We are thinking a text like what follows:* If UE is indicated to transmit AS SRS for a first UL CC in a first band, UE is not expected to simultaneously transmit an uplink, except SRS, on the second UL CC in a second band if UE indicates through *txSwitchWithAnotherBand* that the second UL band switches together with the first UL.
* If UE is indicated to transmit AS SRS for a first CC configured with uplink in a first band, UE may be indicated to simultaneously transmit SRS on the second UL CC in a second band, subject to UE capability.

For the second sub-bullet, we don’t need to mention what UE capabilities enable such inter/intra band simultaneous transmission of SRS for antenna switching in one CC, and another SRS (AS/BM/CB/NCB) on another CC. Those capabilities are already defined in 38.822, FGs FGs 22-5a/b/c/d   |
| ZTE | The suggested wording from Qualcomm is not clear for us as well. It doesn’t help for the implementation at gNB side. Apple’s version seems to just reflect the existing UE capability parallelTxSRS-PUCCH-PUSCH, not very related to the LS.  |

# **Conclusion**

TBD

# **References**

1. R1-2302268 (R4-2303633), Huawei/Hisilicon, LS on clarification on impact of SRS antenna switching for TDD-FDD band combinations, From: RAN4, To: RAN1, RAN2.
2. R1-2302451 Discussion on impact of SRS antenna switching for TDD-FDD band combinations vivo
3. R1-2303095 Draft Reply LS on clarification on impact of SRS antenna switching for TDD-FDD band combinations Samsung
4. R1-2303558 Clarification on SRS antenna switching Qualcomm Incorporated
5. R1-2303861 Discussion on SRS antenna switching for TDD-FDD band combinations Huawei, HiSilicon
6. R1-1712769, Qualcomm Incorporated, Discussion on simultaneous PUSCH and SRS transmission from different antenna ports.
7. R1-23xxxxx, Summary on impact of SRS antenna switching for TDD-FDD band combinations, Moderator (Huawei).

# **Appendix** **List of companies’ proposals**

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| Companies | Proposals |
| Vivo [2] | Proposal: for the UEs supporting SRS antenna switching and signaling corresponding *txSwitchImpactToRx* and *txSwitchWithAnotherBand* capabilities, introduce a CR to reflect restriction on simultaneous SRS and PUSCH transmission in NR spec 38.213. |
| Samsung [3] | In RAN1’s understanding, the UE can report the UE capability ‘srs-TxSwitch’ to indicate whether to support SRS antenna switching including following component parameters in TS 38.306:*[… copied description of srs-TxSwitch, srs-TxSwitch-v1610 from TS 38.306 is omitted]*Based on the above UE capability report, the gNB can acknowledge whether SRS antenna switching can affect DL reception or UL transmission in the band combination if the UE would report ‘txSwitchImpactToRx’ and ‘txSwitchWithAnotherBand’. Based on reported UE capability parameters, the gNB can avoid that problematic scheduling and will implement the scheduling restriction not to support SRS antenna switching and DL reception/UL transmission simultaneously if the UE reports ‘txSwitchImpactToRx’ and ‘txSwitchWithAnotherBand’ in the band combination. However, making the clarification for this scheduling restriction makes RAN1 specification clearer if there is no NBC issue. Therefore, RAN1 can further discuss whether this clarification is required for RAN1 specification and there are no NBC issues. |
| Qualcomm [4] | **Observation 1: In LTE, there is a clear mapping between SRS ports and PUSCH ports. In NR, this is not the case.****Proposal 1: RAN1 to adopt TP1 for TS 38.214.**

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| ============================<TP1, 38.214>============================6.2.1.2 UE sounding procedure for DL CSI acquisition**<Unchanged parts are omitted>**For a UE configured with multiple component carriers, and for a first component carrier configured with uplink in a first band and a second component carrier configured with uplink in a second band that are signalled to switch together according to higher layer parameter *txSwitchWithAnotherBand* the UE is not expected to follow inconsistent transmissions related to antenna switching.For a UE configured with multiple component carriers configured with uplink in intra-band CA, the UE is not expected to follow inconsistent transmissions related to antenna switching.For a UE configured with EN-DC, and for a first component carrier configured with uplink corresponding to in an E-UTRA band and a second component carrier configured with uplink in a NR band that are signalled to switch together according to higher layer parameter *txSwitchWithAnotherBand*, the UE is not expected to follow inconsistent transmissions related to antenna switching in E-UTRA and NR.For a UE configured with intra-band EN-DC, the UE is not expected to follow inconsistent transmissions related to antenna switching in E-UTRA and NR. |

**Proposal 2: RAN1 does not intend to specify any UE behavior related to *txSwitchImpactToRx*. It is RAN1’s understanding that *txSwitchImpactToRx* will result in a ‘glitch’ in downlink reception, which can be captured by RAN4 specifications.** |
| Huawei, HiSilicon [5] | ***Observation 1: For FDD-TDD band combinations, the SRS antenna switching in TDD band impacts on the uplink transmission and downlink receiving of the FDD band.******Observation 2: For LTE, a CR in RAN1 was approved and RAN2 introduced UE capabilities txAntennaSwitchDL and txAntennaSwitchUL to resolve the issues in FDD-TDD band combinations.******Observation 3: For NR, there is no clarification for the expected scheduling restrictions for both UL and DL in the affected band in EN-DC/NR CA FDD-TDD band combinations.******Proposal 1: Support the following restrictions for TDD-FDD combinations where some bands support Tx antenna switching:**** ***For each uplink band, the UE is not expected to transmit uplink channels/signals on different antenna ports with bands reported by*** ***txSwitchWithAnotherBand.***
* ***For each uplink band, the UE is not required to receive PDSCH on bands reported by txSwitchImpactToRx in symbols where antenna switching is performed.***
* ***The above is clarified in spec by CR.***
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