**3GPP TSG RAN WG1 #118 R1-2407197**

**Maastricht, NL, August 19th – 23rd, 2024**

Source: Moderator (NTT DOCOMO, INC.)

Title: Summary of discussion on Multi-carrier UL Tx switching scheme

Agenda Item: 8.1

Document for: Discussion and Decision

1. Introduction

This contribution summarizes contributions submitted to AI 8.1 regarding multi-carrier UL Tx switching scheme and corresponding discussion at RAN1#118 meeting.

Any announcement regarding this summary is provided in following email thread.

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| [118-R18-Maintenance] To be used for sharing updates on online/offline schedule, details on what is to be discussed in online/offline sessions, tdoc number of the moderator summary for online session, etc – Chair |

1. References

[1] R1-2406993 Corrections on Rel-18 UL Tx switching with two configured bands Huawei, HiSilicon

[2] R1-2405609 Summary#2 of discussion on Multi-carrier UL Tx switching scheme Moderator (NTT DOCOMO, INC.)

[3] R1-2400007 LS on UL Tx Switching RAN2, Huawei

[4] R1-2401776 Reply LS on UL Tx switching RAN1, NTT DOCOMO, INC.

1. Discussion

## 3.1 Further discussion on RAN2 LS

At the RAN1#116 meeting, RAN1 received a LS from RAN2 in [3], and RAN1 sent a reply LS in [4] based on following RAN1 agreement. RAN1 needs further discussion on yellow highlighted case.

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| **Agreement**RAN1 replies to RAN2 LS in R1-2400007 as below.* RAN1 confirms that the first RAN2 agreement in the LS R1-2400007/R2-2313959 has no issue from RAN1 perspective, except for a case where Rel-18 UL Tx switching is configured with band combination {A, B} to a UE reporting support of UL Tx switching for band combination {A, B, C} /{A, B, C, D} and no UL-MIMO on band A nor band B. For the case, RAN1 continues to discuss it.

Final LS is in R1-2401776. |

In contributions, following proposals were provided.

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| [1]Huawei, HiSilicon | **Reason for change:**Capture in TS 38.214 the following RAN2 and RAN1 agreements of configuring two bands uplink switching by Rel-18 configuration signaling.

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| R1-2400007/R2-2313959:For Rel-18 UL Tx switching, RAN2 achieved the following agreements in RAN2 #124 meeting:* RAN2 confirms that Rel-18 signalling can configure 2 bands UL Tx switching for a band pair that the UE supports according to the Rel-18 band pair list UE capability, in which case the network and UE assume the capability reported for R18 UL Tx switching is used. RAN2 respectfully asks RAN4 and RAN1 to take this into account, and feedback to RAN2 in case there is any concern.
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| R1-2401776:RAN1 confirms that the first RAN2 agreement in the LS R1-2400007/R2-2313959 has no issue from RAN1 perspective, except for a case where Rel-18 UL Tx switching is configured with band combination {A, B} to a UE reporting support of UL Tx switching for band combination {A, B, C} /{A, B, C, D} and no UL-MIMO on band A nor band B. For the case, RAN1 continues to discuss it. |

**Summary of change:**Replace the phrase of “with 3 or 4 uplink bands” with “with 2, 3 or 4 uplink bands”**Consequence if not approved:**Incomplete specification on uplink Tx switching with two configured bands.

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| 6.1.6 Uplink switchingThe UE may omit uplink transmission during the uplink switching gap $N\_{Tx1-Tx2}$if the conditions defined in this clause are met and the UE is configured with *uplinkTxSwitching* or *uplinkTxSwitchingMoreBands*. The switching gap $N\_{Tx1-Tx2}$is indicated by UE capability *uplinkTxSwitchingPeriod2T2T* if *uplinkTxSwitching-2T-Mode* is configured, and *uplinkTxSwitchingPeriod* otherwise in clauses 6.1.6.1, 6.1.6.2.0, 6.1.6.3, and is determined based on higher layer parameter *switchingPeriodConfigForBandPair* in clause 6.1.6.2.2 for uplink switching configured with 2, 3 or 4 uplink bands if *UplinkTxSwitchingMoreBands* is configured: - If a UE indicated a capability for uplink switching with *BandCombination-UplinkTxSwitch* for a band combination, and if it is for that band combination- Configured with a MCG using E-UTRA radio access and with a SCG using NR radio access (EN-DC), or- Configured with uplink carrier aggregation, or- Configured in a serving cell with two uplink carriers with higher layer parameter *supplementaryUplink*. The conditions under which the switching gap may be present are defined for each of the cases in clauses 6.1.6.1, 6.1.6.2, and 6.1.6.3 respectively.< Unchanged parts are omitted >6.1.6.2.2 Uplink switching with 3 or 4 uplink bandsFor a UE indicating a capability for uplink switching with *BandCombination-UplinkTxSwitch* for a band combination, and if it is for that band combination configured with uplink carrier aggregation with 2, 3 or 4 bands, the behaviour in subclause 6.1.6.2.0 applies when the two bands involved in the uplink switching belong to different uplink serving cells with the parameters *uplinkTxSwitching*, *uplinkTxSwitchingOption* and *uplinkTxSwitching-2T-Mode* beingreplaced by *UplinkTxSwitchingMoreBands, switchingOptionConfigForBandPair* and *switching2T-Mode,* respectively, and the behaviour in subclause 6.1.6.3 with the parameter *uplinkTxSwitching* being replaced by *UplinkTxSwitchingMoreBands* applies when the two bands involved in the uplink switching belong to one uplink serving cell, with the following exceptions:- If more than two bands are involved in the determination of one uplink switching and if on any two of the bands the UE is configured with *switchingOptionConfigForBandPair* set to 'dualUL',< Unchanged parts are omitted > |

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This issue was extensively discussed at RAN1#116bis and RAN1#117 meeting, but RAN1 could not achieve any consensus on whether/how to handle concerned scenario of 1T-1T switching with only 2 bands. The proponent has argued that the proposed TP is anyway necessary as RAN1 confirmed RAN2 agreement that Rel-18 signalling can configure 2 bands UL Tx switching for a band pair that the UE supports according to the Rel-18 band pair list UE capability. Since there is no contribution for the discussion on whether/how to handle concerned scenario of 1T-1T switching with only 2 bands at this meeting, the moderator assumes RAN1 can/should discuss the proposed TP to resolve remaining RAN1 specification impact for the RAN2 agreements of configuring two bands uplink switching by Rel-18 configuration signaling.

### **Proposed agreement 3.1**

* Agree on following TP

**Reason for change:**

Capture in TS 38.214 the RAN2 agreements of configuring two bands uplink switching by Rel-18 configuration signaling.

**Summary of change:**

Replace “3 or 4 uplink bands” by “2, 3 or 4 uplink bands” in section 6.1.6 and 6.1.6.2.2.

**Consequence if not approved:**

Rel-18 configuration signaling cannot be used for the case of configuring two bands uplink switching.

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| 6.1.6 Uplink switchingThe UE may omit uplink transmission during the uplink switching gap $N\_{Tx1-Tx2}$if the conditions defined in this clause are met and the UE is configured with *uplinkTxSwitching* or *uplinkTxSwitchingMoreBands*. The switching gap $N\_{Tx1-Tx2}$is indicated by UE capability *uplinkTxSwitchingPeriod2T2T* if *uplinkTxSwitching-2T-Mode* is configured, and *uplinkTxSwitchingPeriod* otherwise in clauses 6.1.6.1, 6.1.6.2.0, 6.1.6.3, and is determined based on higher layer parameter *switchingPeriodConfigForBandPair* in clause 6.1.6.2.2 for uplink switching configured with 2, 3 or 4 uplink bands if *UplinkTxSwitchingMoreBands* is configured: - If a UE indicated a capability for uplink switching with *BandCombination-UplinkTxSwitch* for a band combination, and if it is for that band combination- Configured with a MCG using E-UTRA radio access and with a SCG using NR radio access (EN-DC), or- Configured with uplink carrier aggregation, or- Configured in a serving cell with two uplink carriers with higher layer parameter *supplementaryUplink*. The conditions under which the switching gap may be present are defined for each of the cases in clauses 6.1.6.1, 6.1.6.2, and 6.1.6.3 respectively.< Unchanged parts are omitted >6.1.6.2.2 Uplink switching with 3 or 4 uplink bandsFor a UE indicating a capability for uplink switching with *BandCombination-UplinkTxSwitch* for a band combination, and if it is for that band combination configured with uplink carrier aggregation with 2, 3 or 4 bands, the behaviour in subclause 6.1.6.2.0 applies when the two bands involved in the uplink switching belong to different uplink serving cells with the parameters *uplinkTxSwitching*, *uplinkTxSwitchingOption* and *uplinkTxSwitching-2T-Mode* beingreplaced by *UplinkTxSwitchingMoreBands, switchingOptionConfigForBandPair* and *switching2T-Mode,* respectively, and the behaviour in subclause 6.1.6.3 with the parameter *uplinkTxSwitching* being replaced by *UplinkTxSwitchingMoreBands* applies when the two bands involved in the uplink switching belong to one uplink serving cell, with the following exceptions:- If more than two bands are involved in the determination of one uplink switching and if on any two of the bands the UE is configured with *switchingOptionConfigForBandPair* set to 'dualUL',< Unchanged parts are omitted > |

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| Company | Comment |
| Moderator (NTT DOCOMO) | According to the discussion in previous meetings, there would still be arguments that RAN1 should discuss whether/how to handle concerned scenario of 1T-1T switching with only 2 bands before agreeing on the proposed TP.In such case, the moderator’s understanding is that all companies are fine with following two points.* UE with only 1 Tx chain is not assumed for UL Tx switching.
* For a UE with 2 Tx chains, if the UE supporting Rel-18 UL Tx switching supports dual UL on band A and B with only 1 port support on each band, the UE is required to support UL-CA for the band combination {A, B} and the UE is not expected to be configured with two-bands UL Tx switching for the band combination {A, B}.

Remaining issue is that for a UE with 2 Tx chains, if the UE supporting Rel-18 UL Tx switching supports **only switched UL on band A and B with only 1 port support on each band**, whether UE can be configured with 2 bands UL Tx switching for band combination {A, B} or UE is not expected to be configured with two-bands UL Tx switching for the band combination {A, B}. Or, we can discuss whether the UE can perform zero-gap switching for the case or not, assuming the UE can be configured with 2 bands UL Tx switching for band combination {A, B}. |
| MediaTek | * We agree with the moderator’s view, and we support the following two points:
	1. UE with only 1 Tx chain is not assumed for UL Tx switching.
	2. For a UE with 2 Tx chains, if the UE supporting Rel-18 UL Tx switching supports dual UL on band A and B with only 1 port support on each band, the UE is required to support UL-CA for the band combination {A, B} and the UE is not expected to be configured with two-bands UL Tx switching for the band combination {A, B}.
* If the UE is configured with only two bands, and the UE supports **only switched UL on band A and B with only 1 port support on each band**, the UE is not expected to be configured with two-bands UL Tx switching for the band combination {A, B}. There is no UL Tx switching occurring in this scenario, and the UL Tx switching framework is not applicable.
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1. Conclusion

TBD