TSG-RAN WG1 #113 R1-23xxxxx

Incheon, Korea, May 22 – 26, 2023

Source: Nokia

Title: Summary on the [113-R18-Others-02] Email discussion on MC-Enh draft CR for TS38.214

Agenda Item: 9.17

Document for: Discussion and Decision

# Introduction

This thread [113-R18-Others-02] is addressing the draft CR to 38.214 for NR\_MC\_enh-Core under agenda item #9.17 with the focus on the contentious issues of the RAN1#112bis that prevented RAN1 endorsement of the draft CR after 5 rounds of commenting and revising.

[113-R18-Others-02] Email discussion on MC-Enh draft CR for TS38.214 – Mihai (Nokia)

* To be used for coordinating discussions in the draft folder

The RAN1#112bis email discussion summary document can be found in [1], and the latest post-RAN1#112bis, unendorsed draft CR for introducing UL TX switching across up to 4 bands to TS38.214 in [2]

# References

1. [R1-2304205](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_112b-e/Docs/R1-2304205.zip) Summary of email discussion on the introduction of UL Tx switching across up to 4 bands in [112bis-e-R18-38.214-MC\_Enh] Moderator (Nokia)
2. [38214CRdraftv0](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_112b-e/Inbox/drafts/9.18(Other)/%5B112bis-e-R18-38.214-MC_Enh%5D/Draft%20CRs/R1-23XXXX%20draft%20CR%2038.214%20NR_MC_enh-Core_ULSwitching-v05.docx)5 Introduction of UL Tx switching across up to 4 bands, Nokia

# Discussion

## Issue #1: Simultaneous UL Tx when SUL is part of the configuration

The following alternatives can be identified when at least one cell with a SUL carrier is part of the UE’s configuration

**Alt 1**: Transmission may take place only on one uplink band at a time

**Alt 2**: One or more of the following simultaneous transmission cases is allowed

1. Transmission on two non-SUL UL bands may take place at the same time if UE reported ‘DualUL’ for that band pair
2. Transmission on one cell’s SUL carrier and another cell’s non-SUL band may take place at the same time if the UE reported ‘DualUL’ for that band pair
3. Transmission on one cell’s SUL carrier and another cell’s SUL carrier may take place at the same time if the UE reported ‘DualUL’ for that band pair

RAN had provided the following guidance on the UL Tx switching cases as below

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| **RAN provides following guidance to RAN1/2/4.**   * If Rel-18 UL Tx switching is supported,   + RAN1/2/4 shall ~~work~~ focus on defining necessary mechanisms and requirements for UL Tx switching across 3 or 4 different bands ~~at least for following scenarios during Rel-18 timeframe~~ in Q3 2022     - Inter-band UL-CA Option 1 (i.e., switched UL) and Option 2 (i.e., dual UL) without SUL band     - Inter-band UL CA Option 1 (i.e., switched UL) for {SUL band + corresponding NUL band} + 1 or 2 other NUL band(s)       * UL CA framework where UL CA is performed between NULs according to current RAN4 specifications should not be changed       * Note: switching across any band in this scenario is not precluded     - Intra-band two contiguous aggregated carriers within one non-SUL band out of 3 or 4 bands   + ~~Other~~Further check additional scenarios ~~as below can be discussed~~ in ~~RAN4#104e and~~ RAN#97e, e.g.,     - {SUL band + corresponding NUL band} + {SUL band + corresponding NUL band}     - Simultaneous transmission across 2 bands in {SUL band + corresponding NUL band} + 1 or 2 other NUL band(s) (excluding simultaneous transmission between SUL and corresponding NUL)   Mechanisms/requirements should not introduce restrictions on what were already supported in current specifications for UL Tx switching |

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## Issue #2: Applicability of the minimum time between two switches

Specifying the following RAN1#112 agreement was causing difficulty:

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| **Agreement**  Confirm the working assumption with following updates  (working assumption) If two uplink switching are triggered and UL transmissions involved in the two uplink switching are on more than 2 bands within any two consecutive reference slots, then the time duration between the start of all transmission(s) after the first uplink switching and the start of all transmission(s) after the second uplink switching within the two reference slots is expected to be not less than a minimum separation time   * The minimum separation time is a maximum of X us and the switching gap required for the second uplink switching. * X us is subject to UE capability with a value set of {0us, 500us} |

The argument made against the bracketed text was that the minimum separation time should not apply if the UE reported 0 us.

**Alt 1:** Keep the agreement as it was and remove the square brackets on the following

- Within any two consecutive reference slots corresponding to numerology *µUL*, when the UE first performs one uplink switch and later performs another uplink switch and at least three bands are involved in the transmissions before the first switch, between the first switch and the second switch, and after the second switch,

[- the separation time between the start of all transmission(s) after the first switch and the start of all transmission(s) after the second switch is not expected to be less than max {*X*, *Y*}, where

- *X* = 500 µs if the UE reported [*MinSwitchSeparation*] capability, otherwise *X* = 0 µs, and

- *Y* is the switching gap applied to the second switch.]

**Alt 2:** Clarify the RAN1#112 agreement by making the modification stating that minimum time between switches definition only applies when the UE reported a non-zero X, by adding the following bullet, and revising the CR text as

* If the UE does not report non-zero X, the minimum time duration definition does not apply

- If the UE reported [*MinSwitchSeparation*] capability, w~~W~~ithin any two consecutive reference slots corresponding to numerology *µUL*, when the UE first performs one uplink switch and later performs another uplink switch and at least three bands are involved in the transmissions before the first switch, between the first switch and the second switch, and after the second switch,

[- the separation time between the start of all transmission(s) after the first switch and the start of all transmission(s) after the second switch is not expected to be less than max {*X*, *Y*}, where

- *X* = 500 µs ~~if the UE reported [~~*~~MinSwitchSeparation~~*~~] capability, otherwise~~ *~~X~~* ~~= 0 µs~~, and

- *Y* is the switching gap applied to the second switch.]

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## Issue #3: Same SCS definition for contiguous intra-band CA?

RAN1#112bis draft CR had the following statement square-bracketed

[- If there are two contiguous intra-band carriers in one band, the UE may assume that the two carriers will be configured with the same subcarrier spacing.]

This was motivated by the following RAN1#112 conclusion:

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| **Conclusion [RAN1#112]**  For Rel-17 UL Tx switching, if there are two carriers configured on the same band of the uplink transmission for a UE, the UE does not expect that the active UL BWPs of the two carriers on the band are of different numerologies. |

**Alt 1.** Do not capture anything on the same SCS assumption to the specs

**Alt 2.** Capture the suggested text to 38.214 subclause 6.1.6

**Alt 3.** Capture the suggested text as a generic specification statement that applies to intra-band UL CA regardless of UL Tx Switching

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## Issue #4: Conditions where one Tx switch switches two Tx chains and >2 bands are involved in the switch

In the following draft CR text, three sub-bullets were left in square brackets requiring further discussion.

- 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 [*uplinkTxSwitchingOptionForBandPair*] set to 'dualUL',

- When the UE is to transmit a 2-port transmission on one uplink carrier on the 1st band and if the preceding uplink transmission was a 1-port transmission on a carrier on the 2nd and/or 3rd band and the UE is under the operation state in which 1-port transmission can be supported in the 2nd and 3rd band, then the UE is not expected to transmit for the duration of *N*Tx1-Tx2 on any of the carriers, where *N*Tx1-Tx2 is the max of [*uplinkTxSwitchingPeriod*] that UE indicates for the band pair {1st band, 2nd band} and for the band pair {1st band, 3rd band}.

- When the UE is to transmit a 1-port transmission on one uplink carrier on the 1st band and the 2nd band, and if the preceding uplink transmission was a 1-port or 2-port transmission on a carrier on the 3rd band and the UE is under the operation state in which 2-port transmission can be supported on the 3rd band, then the UE is not expected to transmit for the duration of *N*Tx1-Tx2 on any of the carriers, where *N*Tx1-Tx2 is the max of [*uplinkTxSwitchingPeriod*] that UE indicates for the band pair {1st band, 3rd band } and for the band pair {2nd band, 3rd band}.

[- When the UE is to transmit a 1-port transmission on one uplink carrier on the 1st band and the 2nd band, and if the preceding uplink transmission was a 1-port transmission on a carrier on the 1st band and/or the 3rd band, then the UE is not expected to transmit for the duration of *N*Tx1-Tx2 on any of the carriers if UE doesn’t indicate [*AdvancedCapabilityDefinedbyRAN4*], where *N*Tx1-Tx2 is the [*uplinkTxSwitchingPeriod*] that UE indicates for the band pair {2nd band, 3rd band}, otherwise the UE is not expected to transmit for the duration of *N*Tx1-Tx2 on any of the carriers on the 2nd band and the 3rd band, where *N*Tx1-Tx2 is the max of [*uplinkTxSwitchingPeriod*] that UE indicates for the band pair {1st band, 2nd band}, band pair {1st band, 3rd band}, band pair {2nd band, 3rd band}.]

[- When the UE is to transmit a 1-port transmission on one uplink carrier on the 1st band and the 2nd band, and if the preceding uplink transmission was a 1-port transmission on a carrier on the 1st band and/or the 3rd band and the UE is under the operation state in which 1-port transmission can be supported in the 1st and 3rd band, if UE indicates [*AdvancedCapabilityDefinedbyRAN4*] for the 1st band then the UE is not expected to transmit for the duration of NTx1-Tx2 on any of the carriers on the 2nd band and the 3rd band, otherwise then the UE is not expected to transmit for the duration of *N*Tx1-Tx2 on any of the carriers , where *N*Tx1-Tx2 is the [*uplinkTxSwitchingPeriod*] that UE indicates for the band pair {2nd band, 3rd band}.]

[- When the UE is to transmit a 1-port transmission on one uplink carrier on the 1st band and if the preceding uplink transmission was a 1-port transmission on a carrier on the 2nd and/or 3rd band and the UE is under the operation state in which 1-port transmission can be supported in the 2nd and 3rd band,

- if UE indicates [*AdvancedCapabilityDefinedbyRAN4*] for the 2nd band and is configured with uplinkTxSwitching-DualUL-TxState set to 'oneT', and the band associated with the 1st band is configured as 2nd band, then the UE is not expected to transmit for the duration of *N*Tx1-Tx2 on any of the carriers on the 1st band and the 3rd band, where *N*Tx1-Tx2 is the [uplinkTxSwitchingPeriod] that UE indicates for the band pair {1st band, 3rd band}.

- if UE indicates [*AdvancedCapabilityDefinedbyRAN4*] for the 3rd band and is configured with uplinkTxSwitching-DualUL-TxState set to 'oneT', and the band associated with the 1st band is configured as 3rd band, then the UE is not expected to transmit for the duration of *N*Tx1-Tx2 on any of the carriers on the 1st band and the 2nd band, where *N*Tx1-Tx2 is the [*uplinkTxSwitchingPeriod*] that UE indicates for the band pair {1st band, 2nd band}.

- otherwise, then the UE is not expected to transmit for the duration of *N*Tx1-Tx2 on any of the carriers, where *N*Tx1-Tx2 is the max of [*uplinkTxSwitchingPeriod*] that UE indicates for the band pair {1st band, 2nd band} and for the band pair {1st band, 3rd band}.]

- When the UE is to transmit a 1-port transmission on one uplink carrier on the 1st band and the 2nd band, and if the preceding uplink transmission was a 1-port transmission on a carrier on the 3rd band and/or the 4th band and the UE is under the operation state in which 1-port transmission can be supported in the 3rd and 4th band, then the UE is not expected to transmit for the duration of *N*Tx1-Tx2 on any of the carriers, where *N*Tx1-Tx2 is the max of [*uplinkTxSwitchingPeriod*] that UE indicates for the band pair {1st band, 3rd band}, band pair {1st band, 4th band}, band pair {2nd band, 3rd band}and band pair {2nd band, 4th band}

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## Issue #5: Any other critical issue?

Any other critical issues needing a resolution for RAN1 to be able to endorse the draft CR?

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