**3GPP TSG-RAN4 Meeting #110bis R4-2405273**

**Changsha, China, 15th – 19th April, 2024**

**Agenda item:** 6.13.4

**Source:** Moderator (China Telecom)

**Title:** Topic summary for [110bis][120] NR\_MC\_enh\_UERF\_R18

**Document for:** Information

# Introduction

This thread discusses the maintenance for UE RF requirements for Rel-18 Multi-carrier enhancements WI.

# Topic #1: Maintenance for UE RF requirements for single-TAG

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2404508 | Huawei, HiSilicon | **Title:** Discussion on the remaining issues for the feature list of Rel-18 Tx switching**Proposal 1:** Capture the feature group of ‘Switching period restriction for fallback band combination’ in the following table in RAN4 feature list for Rel-18 multi-carrier enhancements WI. |
| R4-2404509 | Huawei, HiSilicon | **Title:** draftCR for 38.101-1: Correction on time mask for Rel-18 Tx switching |
| R4-2405498 | MediaTek Inc. | **Title:** Discussion and draft reply LS on UL Tx switching for parallel switching on four bandsProposal 1: RAN2 to implement exactly and completely what the RAN4 LS requests for the approach to resolve the ambiguity issue, i.e., including both band-ordering capability, and RRC configuration. Proposal 2: For feature group FG38-5, remove square bracket in the columns of “Feature Group” and “Components”**Proposal 3: Proposed draft LS reply to RAN2 as below:****RAN4 thanks RAN2 for the LS on a capability of advanced UE capability that target to resolve four-band Tx switching ambiguity issue. According to RAN4 agreement and LS, UE is allowed to indicate its advanced capability of the solution, report its preferred switching band pair and network needs to configure the UE which case is applied. RAN4 respectively ask RAN2 to implement exactly and completely the RAN4 LS requests for the approach to resolve the ambiguity issue, i.e., including both band-ordering capability, and RRC configuration.** |
| R4-2405892 | Qualcomm Incorporated | **Title:** Capabilities discussion**Proposal:** RAN4 to reply to RAN2 that RAN4 has no concerns on the adopted approach.  |
| R4-2405943 | DOCOMO Beijing Labs | **Title:** Views on RAN2 LS and UE feature list for Rel-18 Tx switching**Proposal 1:** Agree there is no concern on RAN2 agreement captured in R2-2401969.**Proposal 2:** Approve the draft reply LS in R4-2405944.**Proposal 3:** Approve the following updated UE feature list: |
| R4-2405944 | DOCOMO Beijing Labs | **Title:** draft Reply LS on Rel-18 UL Tx switching for parallel switching on four bands RAN4 thanks RAN2 for the LS on UL Tx Switching for parallel switching on four bands.In RAN4#110bis, RAN4 discussed RAN2 LS. RAN4 found no concerns on the agreed solution captured in R2-2401969. |

## Open issues summary

### Sub-topic 1-1: LS related topics

Topics are related to incoming LS in this meeting:

* R4-2404116, Reply LS on Rel-18 UL Tx switching for parallel switching on four bands, OPPO, original LS: R2-2401969

#### Issue 1-1-1: R4-2404116 Reply LS on Rel-18 UL Tx switching for parallel switching on four bands

* **Background:** Theincoming LS R4-2404116 captures RAN2 agreement as shown below

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| RAN2 thanks RAN4 for the LS on UL Tx switching for parallel switching on four bands. In RAN2#124 and RAN2#125 meeting, RAN2 discussed RAN4 LS. RAN2 realize RAN4 asked RAN2 for “*Supporting the advanced capability of the switching period can be improved to min{max(Tswitch\_A-C, Tswitch\_B-D), max(Tswitch\_A-D, Tswitch\_B-C)}*” and thus agreed on the solution that:Rely on switchingAdditionalPeriodDualUL-r18 to report min{max(Tswitch\_A-C, Tswitch\_B-D), max(Tswitch\_A-D, Tswitch\_B-C)}.i.e., to address the intention to support the improved switching period by reporting the period length of *min{max(Tswitch\_A-C, Tswitch\_B-D), max(Tswitch\_A-D, Tswitch\_B-C)}* via *switchingAdditionalPeriodDualUL-r18* (i.e., the field introduced for *uplinkTxSwitching1T1Tto1T1T* upon R4 request in LS R4-2310495).RAN2 also realize RAN4 asked RAN2 to “*Introduce optional per-BC UE capability to distinguish the case-1 and case-2 based on scheduled order of uplink grants and report the preferred case by UE as illustrated in the attachment[1]*”:On one hand, this agreement was made by assuming no need for the network to be aware of those switching cases based on the description in the RAN4 LS. Instead, it is sufficient to signal the improved switching period itself as mentioned above. Such solution also has the benefit that common capability signalling framework can be used for different use cases. On the other hand, there is also concern raised in RAN2 on this solution. I.e., the RAN2 agreement only implements part of the technical solution illustrated in the attachment of the LS, i.e., the first key point of the three key points of the solution which are 1) UE indicating its advanced capability of this solution; 2) UE reports its preferred switching case; 3) the network configures which switching case applied. However, there is also concern raised on overlooking the other two key points in this solution. Pending RAN4 response to the above concern, RAN2 will revisit the agreement if needed. |

* **Proposals:**
* **Option 1:** RAN4 thanks RAN2 for the LS on a capability of advanced UE capability that target to resolve four-band Tx switching ambiguity issue. According to RAN4 agreement and LS, UE is allowed to indicate its advanced capability of the solution, report its preferred switching band pair and network needs to configure the UE which case is applied. **RAN4 respectively ask RAN2 to implement exactly and completely the RAN4 LS requests for the approach to resolve the ambiguity issue, i.e., including both band-ordering capability, and RRC configuration. (Media Tek)**
* **Option 2:** Agree there is no concern on RAN2 agreement captured in R4-2404116. (DOCOMO)
* **Option 2a**: RAN4 to reply to RAN2 that RAN4 has no concerns on the adopted approach. (Qualcomm)
* **Recommended WF:**
	+ Discuss on how/whether to reply the LS

### Sub-topic 1-2: UE feature list

* **Background:**

Per chairman guidance:



Thus, one UE capability of ***Preferred switching band pairs*** from Media Tek is highlighted, another UE capability of ***Switching period restriction for fallback band combination*** from Huaweiis highlighted.

#### Issue 1-2-1: UE capability of ***Preferred switching band pairs***

* **Proposals:**

**Proposal 1 (MTK):** For feature group FG38-5, remove square bracket in the columns of “Feature Group” and “Components”

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| ***Features*** | ***Index*** | ***Feature group*** | ***Components*** | ***Prerequisite feature groups*** | ***Need for the gNB to know if the feature is supported*** | ***Applicable to the capability signalling exchange between UEs (V2X WI only)”.*** | ***Consequence if the feature is not supported by the UE*** | ***Type******(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)*** | ***Need of FDD/TDD differentiation*** | ***Need of FR1/FR2 differentiation*** | ***Capability interpretation for mixture of FDD/TDD and/or FR1/FR2*** | ***Note*** | ***Mandatory/Optional*** |
| 38. NR\_MC\_enh  | 38-5 | preferredBandPairs for four-band switching case | 1. Support the indication of the switching period can be improved to min {max(Tswitch\_A-C, Tswitch\_B-D), max(Tswitch\_A-D, Tswitch\_B-C)} assuming UE’s preferred (switched-from, switched-to) band pairs for parallel UL transmission switching for a band combination consisting of four different bands. | 38-1 | Yes | N/A  | [Network can only assume the maximum switch period] | Per BC  | No | FR1 only |  Support mixture of FDD/TDD  | [Note: Detailed information can refer to the LS to RAN2 in R4-2317609] | Optional with capability signalling  |

**Proposal 2 (DOCOMO):** we would like to suggest merging features 38-4 and 38-5 into one feature to finalize the feature list for Multi carrier enhancement WI.

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| ***Features*** | ***Index*** | ***Feature group*** | ***Components*** | ***Prerequisite feature groups*** | ***Need for the gNB to know if the feature is supported*** | ***Applicable to the capability signalling exchange between UEs (V2X WI only)”.*** | ***Consequence if the feature is not supported by the UE*** | ***Type******(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)*** | ***Need of FDD/TDD differentiation*** | ***Need of FR1/FR2 differentiation*** | ***Capability interpretation for mixture of FDD/TDD and/or FR1/FR2*** | ***Note*** | ***Mandatory/Optional*** |
| 38. NR\_MC\_enh  | 38-4 | Additional switching Period for switching case across four bands for Dual UL | 1. Indicate additionally the supported Tx switching period for switching case across four bands, i.e., between {1T, 1T, 0T, 0T and {0T, 0T, 1T, 1T}}, when Rel-18 UL Tx switching is configured by uplinkTxSwitchingMoreBands-r18. If the capability is not reported, the switching period reported in switchingPeriodFor2T-r18 or switchingPeriodFor1T-r18 applies, as specified in TS 38.214 and TS 38.101-1. | 38-1 | Yes  | N/A  | UL Tx switching across more than 2 bands cannot be supported for the band pair in the band combination. | Per BC | No | FR1 only  | Support mixture of FDD/TDD  |  Component 1 candidate value: {35us, 140 us, 210us} | Optional with capability signaling  |
| 38. NR\_MC\_enh  | 38-5 | Void |  |  |  |  |  |  |  |  |  |  |  |

* **Recommended WF:**
	+ TBA

#### Issue 1-2-2: UE capability of ***Switching period restriction for fallback band combination***

Background:

In LS R4-2321986, RAN4 to RAN2 on the ambiguous switching period for the fallback band combinations:

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| * UE could additionally optionally indicate in a parent BC whether to support the fallback low order BC with the same Tx switching period capability. The network determines switching period for band pair among the applicable ones and signals to the UE with RRC signalling.
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The agreements in RAN2#125, Feb, 2024

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| * For a given BC supporting UL Tx switching across up to 4 bands:
* When the optional capability is not reported, it means all the fallback BCs are supported by the UE as legacy with the same switching capabilities reported in the parent BC including switching period as legacy.
* When the optional capability is reported, it means all the fallback BCs are supported by the UE with the largest switching period value, i.e. 210us.
* No matter the optional capability is reported or not, the UE can advertise fallback band combinations with different/same switching period by separate BandCombination entries as legacy in case of different fallback
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Considering it is RAN4 who identifies the issue and triggers the introduction of the capability, the feature should be included in the feature lists from RAN4

**• Proposals:**

**Proposal 1 (Huawei):** Capture the feature group of ‘Switching period restriction for fallback band combination’ in the following table in RAN4 feature list for Rel-18 multi-carrier enhancements WI..

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Features*** | ***Index*** | ***Feature group*** | ***Components*** | ***Prerequisite feature groups*** | ***Need for the gNB to know if the feature is supported*** | ***Applicable to the capability signalling exchange between UEs (V2X WI only)”.*** | ***Consequence if the feature is not supported by the UE*** | ***Type******(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)*** | ***Need of FDD/TDD differentiation*** | ***Need of FR1/FR2 differentiation*** | ***Capability interpretation for mixture of FDD/TDD and/or FR1/FR2*** | ***Note*** | ***Mandatory/Optional*** |
| 38. NR\_MC\_enh  | 38-7 | Switching period restriction for fallback band combination | Indicates the largest value, i.e. 210us is supported for each band pair in all fallback band combinations for a given band combination supporting UL Tx switching across up to 4 bands. | 38-1 | Yes | N/A | The same switching period reported for each band pair in this band combination is supported for the same band pair in all the fallback band combinations. | Per BC | No | FR1 only | Support mixture of FDD/TDD |  | Optional with capability signalling |

* **Recommended WF:**
	+ TBA

### Sub-topic 1-3: CRs

#### Issue 1-3-1: CRs for correction

**Background:** There is one CR submited to maintain and correct the time mask requirements

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| R4-2404509 | Huawei, HiSilicon | **Title:** draftCR for 38.101-1: Correction on time mask for Rel-18 Tx switchingSummary of change:1. To introduce the RRC signaling *switchingPeriodConfigForBandPair* according to the updated RAN2 agreement and spec to determine the switching period for a band pair. And the switching period per band pair is not indicated by UE capability any more in Rel-18.
2. To refine the Rel-18 multicarrier part in sub-clause 5.5C with RAN2 parameters according to the agreed CR R4-2400851.
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* **Recommended WF:**
	+ TBA

# Topic #2: Maintenance for UE RF requirements for Dual-TAG

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2404177 | Apple | **Title:** [draft] LS on Rel-18 Tx switching enhancement with dual-TAGRAN4 would like to inform RAN1 about the following agreement on dual-TAG UL Tx switching: **“When a UE is configured with dual-TAG, for up to two band pairs with at least two cells corresponding to two TAGs involved in one switching event, the timing advance difference should be considered additive to the switching period**”. |
| R4-2404379 | Apple, Qualcomm | **Title:** Tx switching time for dual-TAG**Proposal:** Send LS to RAN1 based on text in Appendix/ companions submission in [2] |

## Open issues summary

### Sub-topic 2-1: Timing advance difference for two bands involved in the switching for dual-TAG

* **Proposals (Apple):**
* **Proposal 1:** According to R4-2310503, the timing advance difference shall be added to the switching period when the two bands involved in the switching are from different TAGs
* **Proposal 2:** Send LS to RAN1 based on text in Appendix/ companions submission in R4-2404177
* **Recommended WF:**
	+ TBA