3GPP TSG RAN WG1 #105-e R1-21xxxxx

**e-Meeting, May 10th – 27th, 2021**

**Agenda item: 7.2.12**

**Source: Moderator (China Telecom)**

**Title: [105-e-NR-R16-TxSwitching-01] Summary of email discussion on maintenance of Rel-16 uplink Tx switching**

**Document for: Discussion and Decision**

# Introduction

In [1], maintenance issues are summarized for Rel-16 uplink Tx switching. As per the guidance of Chairman, following issues are identified for email discussion/approval during RAN1 #105 e-meeting:

[105-e-NR-R16-TxSwitching-01] Email discussion/approval regarding issues #1 and #2 as in the summary, till 5/24 – Jianchi (China Telecom)

This contribution is the summary of email discussion/approval on maintenance of Rel-16 uplink Tx switching.

# Email discussion (1st round)

## Issue #1: Correction on RRC parameter “*tdm-PatternConfig-r15*” and “*tdm-PatternConfig-r16*” in TS 38.214

R1-2104731 mentioned that in RAN1#104bis-e meeting, it was agreed to update RRC parameter as below [R1-2104019 (TS38.213, CR0216, Rel-16)]

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| RAN1#104bis-e output for power control [R1-2104019 (TS38.213, CR0216, Rel-16)]   * *tdm-PatternConfig-r15* is updated to *tdm-PatternConfig* * *tdm-PatternConfig-r16* is updated to *tdm-PatternConfig2* |

However, the above modification/CR approved by NR CA/DC session is only applicable for the power control part of TS 38.213, and not applicable for the UL Tx switching part of TS 38.214. Thus, the same issue still exists for UL Tx switching.

**Proposal:**

* Adopt the following TP to TS 38.214.

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| **< unchanged text omitted>**   1. 6.1.6.1 Uplink switching for EN-DC   For 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 a MCG using E-UTRA radio access and with a SCG using NR radio access (EN-DC), if the UE is configured with uplink switching with parameter *uplinkTxSwitching*,  - for the UE configured with *switchedUL* by the parameter *uplinkTxSwitchingOption*, when the UE is to transmit in the uplink based on DCI(s) received before or based on a higher layer configuration(s):  - when the UE is to transmit an NR uplink that takes place after an E-UTRA uplink on another uplink carrier then the UE is not expected to transmit for the duration of on any of the two carriers.  - when the UE is to transmit an E-UTRA uplink that takes place after an NR uplink on another uplink carrier then the UE is not expected to transmit for the duration of on any of the two carriers.  - the UE is not expected to transmit simultaneously on the NR uplink and the E-UTRA uplink. If the UE is scheduled or configured to transmit any NR uplink transmission overlapping with an E-UTRA uplink transmission, the NR uplink transmission is dropped,  - for the UE configured with *uplinkTxSwitchingOption* set to 'dualUL'*,* when the UE is to transmit in the uplink based on DCI(s) received before or based on a higher layer configuration(s):  - when the UE is to transmit an NR two-port uplink that takes place after an E-UTRA uplink on another uplink carrier then the UE is not expected to transmit for the duration of on any of the two carriers.  - when the UE is to transmit an E-UTRA uplink that takes place after an NR two-port uplink on another uplink carrier then the UE is not expected to transmit for the duration of on any of the two carriers.  - the UE is not expected to transmit simultaneously a two- port transmission on the NR uplink and the E-UTRA uplink.  - in all other cases the UE is expected to transmit normally all uplink transmissions without interruptions.  - when the UE is configured with *tdm-PatternConfig~~-r15~~* or by *~~tdm-PatternConfig-r16~~ tdm-PatternConfig2*  - for the E-UTRA subframes designated as uplink by the configuration, the UE assumes the operation state in which one-port E-UTRA uplink can be transmitted.  - for the E-UTRA subframes other than the ones designated as uplink by the configuration, the UE assumes the operation state in which two-port NR uplink can be transmitted.  **< unchanged text omitted>** |

Companies are encouraged to provide views on the above TP.

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| **Company** | **Comments** |
| CATT | We are fine with FL proposal. |
| ZTE | Ok with the above proposal. |
| Huawei, HiSilicon | OK |
| OPPO | Support the proposal |
| Qualcomm | We are ok with the proposal |

## Issue #2: Clarification on CA based SRS carrier switching

SRS carrier switching was intensively discussed in RAN1 #104e and RAN1 #104b-e. Companies acknowledged that some clarification is needed, but no consensus has been achieved. R1-2104325, R1-2105925 proposed to further discuss this issue in Rel-16, while R1-2104653 proposed to conclude that the combination of SRS carrier switching and UL Tx switching is not supported in R16 and suggested solving the issues in R17 for the combined feature of SRS carrier switching and UL Tx switching. Based on the views from companies, we have following alternatives:

* Alt 1: Conclude that the combination of SRS carrier switching and UL Tx switching is not supported in R16.
* Alt 2: Further discuss SRS carrier switching and UL Tx switching in Rel-16.
  + Alt 2-1: focus on clarification on UE behavior of suspension.
  + Alt 2-2: clarification on both dropping rule and suspension.
* Alt 3: Suspend the discussion until Rel-15 CR on SRS carrier switching has been finalized.

Companies are encouraged to provide views on the above alternatives.

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| **Company** | **Comments** |
| CATT | We prefer to Alt.3 with modification on “Suspend the discussion until Rel-~~15~~ 16 CR on SRS carrier switching has been finalized.” Because the email thread on [105-e-NR-7.1CRs-12] only focuses on Rel-16 and there is NBC issue for Rel.15. |
| ZTE | We support Alt.2 and Alt.3.  RAN1 is discussing related issue in [105-e-NR-7.1CRs-12]. The detailed TP for Alt.2 here may have dependency on the discussion in [105-e-NR-7.1CRs-12]. There are chances that companies can converge in [105-e-NR-7.1CRs-12] in this meeting by May 25. In that case, then companies can start discussing the issue here. |
| Huawei, HiSilicon | Similar view as CATT, the ongoing email discussion in [xx-7.1CRs-12] is for Rel-16. We prefer Alt 2-1. We understand company’s preference on Alt 3. But as explained in our tdoc, “the “suspending” function and the function of prioritization rules are two non-overlapping functions of SRS carrier switching feature. Such understanding is also verified by the latest agreed CR [3] (i.e. R1-2104043) where both functions are kept for updating prioritization rules for SRS carrier switching.”, and we have the following observation,  ***Observation:*** *Before a SRS carrier switching occurs, a UE will determine whether to transmit the SRS based on the prioritization/dropping rules defined in TS 38.214 clause 6.2.1.3, while the determination of any suspension on any relevant uplink carriers is performed only* ***AFTER*** *a SRS carrier switching has occurred, which specifies the UE behavior to handle any DCI arrived later than the determination of prioritization/dropping.*  Additionally, the discussion in [xx-7.1 CRs-12] seems not converge very timely in this meeting, if we would suspend the discussion here, then we could have no time left for discussion this meeting. Therefore, we propose to focus on Alt 2-1, and make some consensus specific to UL Tx switching with some assumption,  ***Proposal****: Subject to the prerequisite of retaining the “suspending” function as an outcome from [105-e-NR-7.1CRs-12] discussion, for a UE configured with both UL Tx switching and SRS carrier switching, if a SRS transmission is triggered by SRS carrier switching and its “switch-from” uplink carrier is configured with uplinkTxSwitching-r16, then the UE also temporarily suspend the UL transmission on the other uplink carrier configured with uplinkTxSwitching-r16.*   * *Adopt the TP listed below for Alt 2-1 by FL*   If the outcome from [105-e-NR-7.1CRs-12] does not keep the “suspending” function, then any agreement for the above proposal is automatically obsolete as the main bullet says.  Additionally, if time permits, in the same way we can discuss prioritization rules for UL Tx switching. Please note that, there is no proposal to remove prioritization rules in [105-e-NR-7.1CRs-12]. We can focus on whether the similar rules can be directly applied to the case of UL Tx switching |
| Qualcomm | We prefer Alt 1. We could not accept Alt.2 or Alt. 3 at this point because partial solution that we would have to keep revisiting.  During the email discussion in RAN1 #104b-emeeting, companies agreed that we could wait for the conclusion of email thread [104b-e-NR-7.1CRs -02] which is trying to solve similar ambiguity issue. However, the email thread [104b-e-NR-7.1CRs -02] didn’t conclude in RAN1 #104b-e and seems more meetings are needed.  As this R16 UL Tx switching has been delayed for couples of meetings already and the ambiguity of SRS carrier switching might not be able to be solved in a short time, we propose to conclude that the combination of SRS carrier switching and UL Tx switching is not supported in R16. Furthermore, we would suggest solving the issues in R17 for this combined feature. |

For Alt 2-1: focus on clarification on UE behavior of suspension, R1-2105925 proposed the following TP to TS 38.214.

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| **<Unchanged parts are omitted – 38.214>**  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*, and also the uplink transmission on carrier *c3* if the UE is configured with *uplinkTxSwitching-r16* for uplink switching between uplink carrier *c2* and *c3*.  **<Unchanged parts are omitted – 38.214>** |

Companies are encouraged to provide views on the above TP.

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| **Company** | **Comments** |
| Huawei, HiSilicon | Support. |
| Qualcomm | As we comment before, we think this suspension is needed but is incomplete to enable SRS carrier switch together with UL Tx switching. One simple example is if C3 is configured with UCI, it should be with higher priority than SRS of C1. We can’t find this statement in current specification. As our target is to enable the whole feature which would need multiple updates of the specification. As suggested above, we propose to wait for SRS CR discussion conclude and then make further discussion. |
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Alt 2-2: clarification on both dropping rule and suspension, R1-2104325 proposed the following TP to TS 38.214.

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| For an aperiodic SRS triggered in DCI format 2\_3 and if the UE is configured with higher layer parameter *srs-TPC-PDCCH-Group* set to 'typeB' without PUSCH/PUCCH transmission, the order of the triggered SRS transmission on the serving cells follow the order of the serving cells with aperiodic SRS triggered in the DCI, and the UE in each serving cell transmits the configured one or two SRS resource set(s) with higher layer parameter *usage* set to 'antennaSwitching' and higher layer parameter *resourceType* in *SRS-ResourceSet* set to 'aperiodic'.  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~~ *~~c~~~~1~~* ~~(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~~ *~~c~~~~2.~~*After applying the prioritization/dropping rules in this subclause in case of collision between a transmission of SRS over a carrier *c1* and transmission of a physical signal/channel over a carrier *c2*, during [2-port] 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 *c3* if the UE is configured with *uplinkTxSwitching-r16* for uplink switching between uplink carrier *c2* and *c3*.  If the UE is not configured for PUSCH/PUCCH transmission on carrier *c1* with slot formats comprised of DL and UL symbols, and if the UE is not capable of simultaneous reception and transmission on carrier *c1*and serving cell *c2*, the UE is not expected to be configured or indicated with SRS resource(s) such that 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*) would collide with the REs corresponding to the SS/PBCH blocks configured for the UE or the slots belonging to a control resource set indicated by *MIB* or *SIB1* on serving cell *c2*. |

Companies are encouraged to provide views on the above TP.

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| **Company** | **Comments** |
| Qualcomm | Please refer to the comments above. |
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# Email discussion (2nd round)

**FL comments: Proposal 1 is stable. Please refrain from any further comments.**

**Proposal 1:**

* Adopt the following TP to TS 38.214.

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| **< unchanged text omitted>**   1. 6.1.6.1 Uplink switching for EN-DC   For 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 a MCG using E-UTRA radio access and with a SCG using NR radio access (EN-DC), if the UE is configured with uplink switching with parameter *uplinkTxSwitching*,  - for the UE configured with *switchedUL* by the parameter *uplinkTxSwitchingOption*, when the UE is to transmit in the uplink based on DCI(s) received before or based on a higher layer configuration(s):  - when the UE is to transmit an NR uplink that takes place after an E-UTRA uplink on another uplink carrier then the UE is not expected to transmit for the duration of on any of the two carriers.  - when the UE is to transmit an E-UTRA uplink that takes place after an NR uplink on another uplink carrier then the UE is not expected to transmit for the duration of on any of the two carriers.  - the UE is not expected to transmit simultaneously on the NR uplink and the E-UTRA uplink. If the UE is scheduled or configured to transmit any NR uplink transmission overlapping with an E-UTRA uplink transmission, the NR uplink transmission is dropped,  - for the UE configured with *uplinkTxSwitchingOption* set to 'dualUL'*,* when the UE is to transmit in the uplink based on DCI(s) received before or based on a higher layer configuration(s):  - when the UE is to transmit an NR two-port uplink that takes place after an E-UTRA uplink on another uplink carrier then the UE is not expected to transmit for the duration of on any of the two carriers.  - when the UE is to transmit an E-UTRA uplink that takes place after an NR two-port uplink on another uplink carrier then the UE is not expected to transmit for the duration of on any of the two carriers.  - the UE is not expected to transmit simultaneously a two- port transmission on the NR uplink and the E-UTRA uplink.  - in all other cases the UE is expected to transmit normally all uplink transmissions without interruptions.  - when the UE is configured with *tdm-PatternConfig~~-r15~~* or by *~~tdm-PatternConfig-r16~~ tdm-PatternConfig2*  - for the E-UTRA subframes designated as uplink by the configuration, the UE assumes the operation state in which one-port E-UTRA uplink can be transmitted.  - for the E-UTRA subframes other than the ones designated as uplink by the configuration, the UE assumes the operation state in which two-port NR uplink can be transmitted.  **< unchanged text omitted>** |

**FL comments: For CA based SRS carrier switching, it seems companies’ views are quite divergent. Note that the deadline of this email thread is May 24th. We cannot wait for the outcome of [105-e-NR-7.1CRs-12] and continue the discussion of this thread in this meeting. From FL understanding, if we really want to make some progress, the best choice we can do in this meeting is Alt 2-1. We can revisit the UE behavior of suspension and discuss prioritization rules after the outcome of [105-e-NR-7.1CRs-12]. FL would like to encourage companies to check the following proposal. Comments on the refinement of the proposal or TP are welcome. If companies have any concerns, please provide constructive comments.**

**Proposal 2:**

* Subject to the prerequisite of retaining the “suspending” function as an outcome from [105-e-NR-7.1CRs-12] discussion, for a UE configured with both UL Tx switching and SRS carrier switching, if a SRS transmission is triggered by SRS carrier switching and its “switch-from” uplink carrier is configured with uplinkTxSwitching-r16, then the UE also temporarily suspend the UL transmission on the other uplink carrier configured with uplinkTxSwitching-r16.
* Adopt the following TP to TS 38.214.

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| --- |
| **<Unchanged parts are omitted – 38.214>**  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*, and also the uplink transmission on carrier *c3* if the UE is configured with *uplinkTxSwitching-r16* for uplink switching between uplink carrier *c2* and *c3*.  **<Unchanged parts are omitted – 38.214>** |

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| **Company** | **Comments** |
| CATT | In principal, we are fine with proposal 2 with below modification as  “the UE also temporarily suspends the UL transmission on the other uplink carrier configured with uplinkTxSwitching-r16.”  For proposed TP, it is better to wait for discussion result of [105-e-NR-7.1CRs-12] |
| ZTE | We are generally ok with the proposal. Regarding the TP, to be safe, maybe we can say “Adopt the following TP to TS 38.214 in principle.” if companies are ok with that. |
| Huawei, HiSilicon | Support.  OK with CATT’s revision to the proposal.  OK with ZTE’s suggestion of “in principle” |
| Qualcomm | Thanks for the FL’s promotion and efforts.  We agree with that the outcome of [105-e-NR-7.1CRs-12] would be important and prerequisite to current discussion. We agree that we should wait for the outcome of the CR before further discussion.  However, as the CR discussion is still ongoing, we can’t forecast whether it would solve all the issue we need for UL Tx switching. From this sense, we can’t agree with proposal 2 which give us the impression that outcome of [105-e-NR-7.1CRs-12] plus the above TP would be the full package we need.  We have an objection to Proposal 2 with or without a TP. As explained in the first round, prioritization of SRS over UCI should not be introduced in the specification.  We checked the status of the thread [105-e-NR-7.1CRs-12], seems more discussion would be needed. As this is already very late for R16 features, to avoid implementation of late NBC CR, we would propose to conclude that the combination of SRS carrier switching and UL Tx switching is not supported in Rel-16, and propose to solve it in Rel-17. |

**FL comments: It seems the majority are fine with the following revised proposal 2. I understand the outcome of [105-e-NR-7.1CRs-12] may or may not have impact on the proposal. Considering the concerns from Qualcomm, I suggest to make the revised proposal 2 as a working assumption. Companies can revisit it after the outcome of [105-e-NR-7.1CRs-12] in next meeting.**

**Revised Proposal 2:**

**Working assumption:**

* Subject to the prerequisite of retaining the “suspending” function as an outcome from [105-e-NR-7.1CRs-12] discussion, for a UE configured with both UL Tx switching and SRS carrier switching, if a SRS transmission is triggered by SRS carrier switching and its “switch-from” uplink carrier is configured with uplinkTxSwitching-r16, then the UE also temporarily suspends the UL transmission on the other uplink carrier configured with uplinkTxSwitching-r16.
* Adopt the following TP to TS 38.214 in principle.

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| **<Unchanged parts are omitted – 38.214>**  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*, and also the uplink transmission on carrier *c3* if the UE is configured with *uplinkTxSwitching-r16* for uplink switching between uplink carrier *c2* and *c3*.  **<Unchanged parts are omitted – 38.214>** |

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| **Company** | **Comments** |
| CATT | We are fine with revised proposal 2. |
| Qualcomm | We have an objection to this revised Proposal 2 and former Proposal 2, no matter if it’s agreement or working assumption.  The technical reason is that the proposal prioritizes SRS over UCI, which we view to be a broken solution and inconsistent with prioritization decisions made in all other cases.  We would further ask the proponents to kindly provide answer to following questions:   * On the dependency of the thread [105-e-NR-7.1CRs-12], we found most of the companies agreed that the CR would be prerequisite to solve the issue of UL TRX switching together with SRS carrier switching. However, the CR discussion is ongoing, * As we commented above, a complete proposal should be discussed and recommended for agreement, not incomplete parts that are technically inconsistent.   Based on above considerations, we object this proposal as it is a broken solution. |
| Huawei | @Yiqing, could you please point out which part of the FL proposal 2 implies any prioritization of SRS over UCI? In our understanding, the proposal introduces no change to prioritization rules, i.e. in line with the existing rules.           Regarding your second question, it was replied in the summary. Please double check it. |
| Qualcomm | We think we already replied the question in this meeting, I just paste the wording.  “As we comment before, we think this suspension is needed but is incomplete to enable SRS carrier switch together with UL Tx switching. **One simple example is if C3 is configured with UCI, it should be with higher priority than SRS of C1. We can’t find this statement in current specification.** As our target is to enable the whole feature which would need multiple updates of the specification. As suggested above, we propose to wait for SRS CR discussion conclude and then make further discussion.” |

# References

1. R1-2104858, Summary of Rel-16 uplink Tx switching, Moderator (China Telecom), RAN1#105-e, May 10th – 27th, 2021.
2. R1-2104325, Remaining Issues of Rel-16 UL Tx Switching, ZTE, RAN1#105-e, May 10th – 27th, 2021.
3. R1-2104653, Remaining issues for 1Tx-2Tx switching, Qualcomm Incorporated, RAN1#105-e, May 10th – 27th, 2021.
4. R1-2104731, Text Proposals for Tx Switching between Two Uplink Carriers, OPPO, RAN1#105-e, May 10th – 27th, 2021.
5. R1-2105925, Discussion on the remaining problems of supporting Tx switching between two uplink carriers, Huawei, HiSilicon, RAN1#105-e, May 10th – 27th, 2021.