**3GPP TSG-RAN WG4 Meeting # 100-e R4-210XXXX**

**Electronic Meeting, 16 - 27 Aug, 2021**

**Agenda item:** 9.3.2.2, 9.3.2.3, 9.3.2.7.1

**Source:** Moderator (China Telecom)

**Title:** Email discussion summary for [100-e][128] NR\_RF\_FR1\_enh\_Part\_2

**Document for:** Information

# Introduction

This email thread covers the Rel-17 Tx switching maintenance in AI 9.3.2.2 & 9.3.2.3, and the clarification of Tx switching scenarios in AI 9.3.2.7.1.

List of candidate target of email discussion for 1st round and 2nd round:

* 1st round:
  + Review and comment the recommended WF in section 1.2 and 2.2.
* 2nd round:
  + TBA

# Topic #1: Rel-17 Tx switching maintenance

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2112228 | China Telecom | This contribution discusses the UE capability on UL MIMO coherence for the three Rel-17 Tx switching scenarios, with the following observations and proposals:  **Observation 1:** For 3CC 1Tx-2Tx switching, the difference with Rel-16 1Tx-2Tx switching is that the CC number is increased from 1 to 2 for the band with 2Tx, and the UE ability on maintaining UL-MIMO coherence for the 2 CCs in the same band can be the same.  **Proposal 1:** For 3CC 1Tx-2Tx switching, if UE capability on UL-MIMO coherence is needed, the Rel-16 per BC UE capability can be applied, i.e., the same capability applies to both Rel-16 and Rel-17 1Tx-2Tx switching.  **Observation 2:** For 2CC 2Tx-2Tx switching, it is not quite sure: a) whether the UE behavior for switching is the same or not compared to Rel-16 1Tx-2Tx switching, and b) whether the UE ability on maintaining UL-MIMO coherence for the 2 CCs in different bands is the same or not.  **Proposal 2:** For 2CC 2Tx-2Tx switching, if UE capability on UL-MIMO coherence is needed, further confirm whether the Rel-16 per BC UE capability can be applied for both CCs in different bands.  **Observation 3:** For 3CC 2Tx-2Tx switching, the difference with 2CC 2Tx-2Tx switching is that the CC number is increased from 1 to 2 in one of the bands, and the UE ability on maintaining UL-MIMO coherence for the 2 CCs in the same band can be the same.  **Proposal 3:** For 3CC 2Tx-2Tx switching, if UE capability on UL-MIMO coherence is needed, the capability for 2CC 2Tx-2Tx switching can be applied, i.e., the same capability applies to both 2CC and 3CC 2Tx-2Tx switching.  Based on the discussion in RAN4, if any agreements w.r.t. UE capability and UL-MIMO coherence exception will be reached, LS to RAN2 and RAN1 is needed. |

## Open issues summary

### Sub-topic 1-1: UL MIMO coherence for Rel-17 Tx switching

**Issue 1-1: UL MIMO coherence for Rel-17 Tx switching**

* *Background*
  + *For Rel-16 1Tx-2Tx switching between two carriers, it was identified that the coherence between two antenna ports can or cannot be maintained when the Tx chain(s) are used to transmit on an other band for different types of UE architectures.*
  + *As a result, it was agreed to introduce UE capability to differentiate the two types of UEs in RAN4 #99e, with the RAN4 CR agreed in R4-2109582 and the LS to RAN1/2 approved in R4-2107765.*
* Summary of Tx switching scenarios

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tx switching** | | **Band A** | **Band B** | |
| **CC1** | **CC2** | **CC3** |
| Rel-16 | 2CC 1Tx-2Tx | 1Tx | 2Tx |  |
| Rel-17 | 3CC 1Tx-2Tx | 1Tx | 2Tx | 2Tx |
| 2CC 2Tx-2Tx | 2Tx | 2Tx |  |
| 3CC 2Tx-2Tx | 2Tx | 2Tx | 2Tx |

Issue 1-1A: For 3CC 1Tx-2Tx switching

* Proposals:
  + Option 1: For 3CC 1Tx-2Tx switching, if UE capability on UL-MIMO coherence is needed, the Rel-16 per BC UE capability can be applied, i.e., the same capability applies to both Rel-16 and Rel-17 1Tx-2Tx switching. (CTC)
    - CTC: For 3CC 1Tx-2Tx switching, the difference with Rel-16 1Tx-2Tx switching is that the CC number is increased from 1 to 2 for the band with 2Tx, and the UE ability on maintaining UL-MIMO coherence for the 2 CCs in the same band can be the same.

Issue 1-1B: For 2CC 2Tx-2Tx switching

* Proposals:
  + Option 1: For 2CC 2Tx-2Tx switching, if UE capability on UL-MIMO coherence is needed, further confirm whether the Rel-16 per BC UE capability can be applied for both CCs in different bands. (CTC)
    - CTC: For 2CC 2Tx-2Tx switching, it is not quite sure: a) whether the UE behavior for switching is the same or not compared to Rel-16 1Tx-2Tx switching, and b) whether the UE ability on maintaining UL-MIMO coherence for the 2 CCs in different bands is the same or not.

Issue 1-1C: For 3CC 2Tx-2Tx switching

* Proposals:
  + Option 1: For 3CC 2Tx-2Tx switching, if UE capability on UL-MIMO coherence is needed, the capability for 2CC 2Tx-2Tx switching can be applied, i.e., the same capability applies to both 2CC and 3CC 2Tx-2Tx switching. (CTC)
    - CTC: For 3CC 2Tx-2Tx switching, the difference with 2CC 2Tx-2Tx switching is that the CC number is increased from 1 to 2 in one of the bands, and the UE ability on maintaining UL-MIMO coherence for the 2 CCs in the same band can be the same.
* Recommended WF
  + Encourage feedback on UL MIMO coherence for different Rel-17 Tx switching scenarios.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| OPPO | Issue 1-1A: For 3CC 1Tx-2Tx switching  Option 1. In 3CC 1T-2T switching, UE in the high band will use one PA to cover both CCs in order to support UL MIMO, thus, coherence is same with current 2Tx chain assumption.  Issue 1-1B: For 2CC 2Tx-2Tx switching  The coherence in the two bands could be different, and Rel-16 capability cannot be reused since it is per-band combination capability rather than per band per band combination (Rel-17 2 band case) capability.  Issue 1-1C: For 3CC 2Tx-2Tx switching  Option 1 with issue 1-1B assumption. |
| China Telecom | Issue 1-1A: For 3CC 1Tx-2Tx switching  Option 1.  Issue 1-1B: For 2CC 2Tx-2Tx switching  Depends on inputs from chipset/UE side.  Issue 1-1C: For 3CC 2Tx-2Tx switching  Option 1. |
| ZTE | Issue 1-1A: For 3CC 1Tx-2Tx switching  Option 1. For 1Tx-2Tx switching (for both 2CC or 3CC), the coherence only applies to the band with 2Tx, so no matter 2CC or 3CC, it should be the same.  Issue 1-1B: For 2CC 2Tx-2Tx switching  For 2Tx-2Tx switching, both bands work in MIMO mode, so if there is a switching in the time window, then the coherence may not be maintained.  Issue 1-1C: For 3CC 2Tx-2Tx switching  Option 1. 2CC and 3CC may have the same capability in 2Tx-2Tx switching. |
| Qualcomm | Issue 1-1A: Agree with option 1,  Issue 1-1B: Agree, this should be clarified. Our view is that it may depend on implementation, some frequency generation circuitry maybe impacted by switching and some may not depending on the frequencies and implementation choices.  Issue 1-1C: Agree with option 1 |
| CMCC | Issue 1-1A: For 3CC 1Tx-2Tx switching  Option 1  Issue 1-1B: For 2CC 2Tx-2Tx switching  If the coherence cannot be maintained in this case, then the Rel-16 signaling cannot be reused.  Issue 1-1C: For 3CC 2Tx-2Tx switching  Option1 |
| vivo | Issue 1-1A: For 3CC 1Tx-2Tx switching  Option 1  Issue 1-1B: For 2CC 2Tx-2Tx switching  Still not clear in current stage, may depend on implementation. More conservative way might be define new capability, or postpone the decision to have further analysis.  Issue 1-1C: For 3CC 2Tx-2Tx switching  Option1 |
| Huawei | Issue 1-1A: For 3CC 1Tx-2Tx switching  Option 1  Issue 1-1B: For 2CC 2Tx-2Tx switching  It depends on UE implementation. Agree it should be further clarified.  Issue 1-1C: For 3CC 2Tx-2Tx switching  Option1 |

## Companies views’ collection for 1st round

### Open issues

*Provided in section 1.2*

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

## Discussion on 2nd round

# Topic #2: Clarification of Tx switching scenarios

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2112825 | Ericsson | Draft LS to RAN1 and RAN2 to ask about possible impact on RAN1 and RAN2 specification of a removal of the single-TAG restriction for CA. |

## Open issues summary

### Sub-topic 2-1: TX switching with multiple TAG for UL CA

**Issue 2-1: TX switching with multiple TAG for UL CA**

* Proposals
  + LS to RAN1/2 (E///)
    - RAN4 asks RAN1/2 whether removal of the Rel-16 single-TAG restriction for UL CA with TX switching has any impact on RAN1/2 specifications with an UL timing difference between carriers up to a symbol duration (SCS = 30k) as seen at the UE.
* Recommended WF
  + Encourage feedback from companies

|  |  |
| --- | --- |
| **Company** | **Comments** |
| OPPO | It seems this LS is for Rel-16 Tx switching, which in our understanding should be stable and no changes is expected especially for extending the scope of a frozen WID. Maybe further discussion can happen in future Rel-18 discussions. For now, not clear of the necessity. |
| Nokia | We understand the motivation, but now Rel-17 is on-going and Rel-16 WI is completed. It is not the appropriate timing to introduce this into Rel-16. |
| ZTE | Single TAG is an important assumption for the work on Tx switching in Rel-16. If this assumption is lifted, we may need to revisit and check agreements made under this assumption in RAN4 before we send an LS to RAN1/2. |
| Qualcomm | Removing the single TAG would make the switching location ambiguous. Why this comes up now is unclear. Prefer not to make the agreement. |
| vivo | Propose not to consider multiple TAG for UL CA in current stage. |
| Ericsson | Combinations of UL-MIMO and UL CA are enabled for the collocated scenario with the single-TAG assumption with UE capable of switching across two TX chains. But it is not possible for a non-collocated case. CA band combinations with cells in bands below 2 GHz and cells in bands at e.g. 3.5 GHz are common and non-collocation is a common scenario due to the different cell sizes in these bands. Hence the multiple-TAG general case for combination of UL-MIMO and UL CA is therefore a common deployment case. The single-TAG is an unnecessary restriction of deployment scenarios for the feature unless there are hurdles in the RAN1 and RAN2 standards.  To Qualcomm: the position of the switching period is not ambiguous for the multiple-TAG case, the switching period precedes time T0 (the start of the uplink transmission) just as for the single-TAG case according to the time masks proposed:    The gNB scheduler ensures that there is no transmissions in the switching periods by not scheduling the last UL symbol before the switching gap (maximum one symbol at MRTD < 30 us). The timing of an UL transmission at T0 is determined by the corresponding DL carrier, hence there may be slight UL timing shifts also for the collocated case due to DL timing errors. The timing requirements on T0 – Toffset w r t the received DCI are not modified. Moreover, The MRTD up to 30 us does not modify the DL interruptions allowed.  We are proposing to send an LS to RAN1 and RAN2 to ask about any implications. If confirmed by RAN1 and RAN2 that there are no changes, it is straightforward to accommodate the multiple-TAG case. The time masks have to be modified as shown in R4-2112825 for the two cases along the same principles as the single-TAG case. A capability might be needed to handle legacy implication with single-TAG.  Since CA band combinations with cells in bands below 2 GHz and cells in bands at e.g. 3.5 GHz are common and non-collocation is a common scenario, we see no reason not to ask RAN1 and RAN2 about implications. If none we can combine UL CA and UL-MIMO for Ues supporting TX switching for the non-collocated case common in deployments. A most useful enhancement of the feature. |
| Huawei | It’s clear in the scope of the completed WI and the on-going WI that the scenario is for single-TAG. The proposal for scenarios out of the scope could be considered in future release if the scenario is justified. |

## Companies views’ collection for 1st round

### Open issues

*Provided in section 2.2*

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

## Discussion on 2nd round

1. Recommendations for Tdocs
   1. 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on … | YYY |  |
| LS on … | ZZZ | To: RAN\_X; Cc: RAN\_Y |
|  |  |  |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics incl. existing and new tdocs.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. For new LS documents, please include information on To/Cc WGs in the comments column
4. Do not include hyper-links in the documents
   1. 2nd round

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-210xxxx | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-210xxxx | LS on … | ZZZ | Agreeable, Revised, Noted |  |
|  |  |  |  |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. Do not include hyper-links in the documents

# Annex

Contact information

|  |  |  |
| --- | --- | --- |
| **Company** | **Name** | **Email address** |
| OPPO | Jinqiang Xing | [xingjinqiang@oppo.com](mailto:xingjinqiang@oppo.com) |
| Nokia | Hiromasa Umeda | [hiromasa.umeda@nokia.com](mailto:hiromasa.umeda@nokia.com) |
| China Telecom | Shan YANG | [yangshan@chinatelecom.cn](mailto:yangshan@chinatelecom.cn) |
| ZTE | Aijun Cao | [Cao.aijun@zte.com.cn](mailto:Cao.aijun@zte.com.cn) |
| CMCC | Xiaoran ZHANG | [zhangxiaoran@chinamobile.com](mailto:zhangxiaoran@chinamobile.com) |
| Ericsson | Christian Bergljung | [christian.bergljung@ericsson.com](mailto:christian.bergljung@ericsson.com) |
| Huawei | Ye Liu | leo.liuye@huawei.com |

Note:

1. Please add your contact information in above table once you make comments on this email thread.
2. If multiple delegates from the same company make comments on single email thread, please add you name as suffix after company name when make comments i.e. Company A (XX, XX)