

[100-e][215] NR_RF_FR1_enh_RRM_NWM - Version 0.0.5
RAN4

3GPP TSG-RAN WG4 Meeting # 100-e

R4-2115390

Electronic Meeting, August 16-27, 2021

Agenda item: 9.3.3

Source: Moderator (Huawei, HiSilicon)

Title: Email discussion summary for [100-e][215] NR_RF_FR1_enh_RRM_NWM

Document for: Information

1 Introduction

This email thread discusses the RRM part of NR FR1 RF enhancement in Rel-17[RP-202088] in agenda 9.3.3. This email discussion aims to discuss the DL interruption requirements due to R17 Tx switching.

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

- 1st round: Invite companies to review the recommended WF in each sub-topic, and provide comments.
- 2nd round: TBA

2 Tx switching enhancements

2.1 Companies' contributions summary

Table 1:

T-doc number	Company	Proposals / Observations
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R4-2112185	CMCC	<p>Proposal 1: it is proposed to consider the following Tx switching scenarios to specify DL interruption requirements:</p> <p>2Tx-2Tx switching between two uplink carriers for TDD+FDD UL CA and async TDD+TDD UL CA</p> <p>1Tx-2Tx and 2Tx-2Tx switching between 1 carrier on band A and 2 contiguous aggregated carriers on band B for TDD+FDD UL CA and async TDD+TDD UL CA</p> <p>Proposal 2: For Rel-17 2Tx-2Tx switching between two carriers, 1Tx-2Tx and 2Tx-2Tx between band A and band B, reuse Rel-16 values for length of DL interruption.</p> <p>Proposal 3: It is proposed to create new subclauses for Rel-17 DL interruptions at UE switching including:</p> <p>DL Interruptions at UE switching between two uplink carriers with two transmit antenna connectors</p> <p>DL Interruptions at UE switching between one uplink band with one transmit antenna connector and one uplink band with two transmit antenna connectors</p> <p>DL Interruptions at UE switching between two uplink bands with two transmit antenna connectors</p>
R4-2112229	China Telecom	<p>Proposal 1: Reuse the Rel-16 values for the length of DL interruption.</p> <p>Proposal 2: Reuse the Rel-16 agreement on the starting symbol of DL interruption, i.e., the DL interruption starts from the first OFDM symbol which fully or partially overlaps with the UL switching period.</p> <p>Proposal 3: For the three Tx switching scenarios in Rel-17, either to capture the DL interruption requirements in one or separate sub-clause(s).</p>

R4-2113142	Intel	<p>Proposal 1: Structure the RRM spec for Rel-17 UL Tx switching in the way that the requirements for newly added use cases are at the same spec level with the Rel-16 use case.</p> <p>Proposal 2: Reuse the lengths of allowed interruptions specified in Rel-16 for the RRM requirements of UE UL Tx switching in Rel-17.</p> <p>Proposal 3: Specify the DL interruption applicability in the same way as in Rel-16.</p>
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R4-2113844	Huawei, HiSilicon	<p>Proposal 1: R16 DL interruption length at UE switching between two uplink carriers can be reused for R17 uplink Tx switching.</p> <p>Proposal 2: There is no DL interruption for SUL related scenario in this R17 WI.</p> <p>Proposal 3: To create new sub-clause for Rel-17 DL interruptions at UE switching for CA, including:</p> <ul style="list-style-type: none"> – DL Interruptions at UE switching between two uplink carriers with two transmit antenna connectors for UL inter-band CA <ul style="list-style-type: none"> ◦ where NR UL carrier 1 is capable of two transmit antenna connectors and NR UL carrier 2 is capable of two transmit antenna connectors, and the two uplink carriers are in different bands with different carrier frequencies – DL Interruptions at UE switching between one uplink band with one transmit antenna connector and one uplink band with two transmit antenna connectors for UL inter-band CA <ul style="list-style-type: none"> ◦ where NR UL carrier 1 in band A is capable of one transmit antenna connector, NR UL carrier 2 and carrier 3 in band B are capable of two transmit antenna connectors. NR UL carrier 2 and carrier 3 are two contiguous aggregated carriers – DL Interruptions at UE switching between two uplink bands with two transmit antenna connectors for UL inter-band CA
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2.1.1 Sub-topic 1: DL interruption requirements

Issue 1-1: R17 Tx switching scenarios need to be considered

- Proposals
 - Option 1:
 - Consider the following Tx switching scenarios to specify DL interruption requirements (CMCC):
 - 2Tx-2Tx switching between two uplink carriers for TDD+FDD UL CA and async TDD+TDD UL CA
 - 1Tx-2Tx and 2Tx-2Tx switching between 1 carrier on band A and 2 contiguous aggregated carriers on band B for TDD+FDD UL CA and async TDD+TDD UL CA
 - No DL interruption for SUL related scenario (Huawei, CMCC)
 - No DL interruption for sync TDD+TDD CA (CMCC)
- Recommended WF
 - Is Option 1 agreeable?

Feedback Form 1: Companies views' collection for Issue 1-1

1 – China Telecommunications Support Option 1, which is aligned with the Rel-16 agreements as well as Rel-17 agreements in RF session.
2 – Huawei Technologies France Does "sync" means the same TDD DL/UL configuration? if this, option 1 including all items are fine.
3 – MediaTek Inc. Want to clarify the definition for async TDD+TDD UL CA. Is this for different UL-DL configuration or for interCA-NonAlignedFrame-r16?
4 – China Mobile Com. Corporation To Huawei: Yes, sync means the same TDD DL/UL configuration. To MediaTek: async basically means that UL transmission collides with DL transmission, so it includes the cases for different UL-DL configuration and interCA-NonAlignedFrame-r16.
5 – Nokia Korea We'd like to ask about the 2nd bullet: No DL interruption for SUL related scenario. Is it referring to SUL with same TDD DL/UL pattern (i.e. sync), or both sync and async case? The texts here seems to be the later case?
6 – QUALCOMM JAPAN LLC. Why there are no interruptions for SUL related scenarios?

7 – Intel

We support option 1.

According to our understanding, the reason why SUL related cases within the scope of this Work Item imposes no DL interruption is because there is no DL reception at any time during switching. Since we believe SUL+DL CA is not considered or it is not addressed as 'SUL related cases' here.

Issue 1-2: DL interruption length

- Proposals
 - Option 1(CMCC, Huawei, China Telecom, Intel): R16 DL interruption length at UE switching between two uplink carriers can be reused for R17 uplink Tx switching.
- Recommended WF
 - Is Option 1 agreeable?

Feedback Form 2: Companies views' collection for Issue 1-2

1 – China Telecommunications Support Option 1
2 – Huawei Technologies France support option 1
3 – MediaTek Inc. OK with Option 1
4 – China Mobile Com. Corporation Support option 1
5 – Nokia Korea Option 1 is agreeable
6 – QUALCOMM JAPAN LLC. if the RF switching time is the same as in Rel.16(this seems to be the case so far) then Option 1 is agreeable

Issue 1-3: DL interruption starting point

- Proposals
 - Option 1(China Telecom): Reuse the Rel-16 agreement on the starting symbol of DL interruption, i.e., the DL interruption starts from the first OFDM symbol which fully or partially overlaps with the UL switching period.

- Recommended WF
 - Is Option 1 agreeable?

Feedback Form 3: Companies views' collection for Issue 1-3

1 – China Telecommunications Support Option 1
2 – Huawei Technologies France support option 1.
3 – MediaTek Inc. OK with Option 1
4 – China Mobile Com. Corporation Support option 1
5 – Nokia Korea Option 1 is agreeable.
6 – QUALCOMM JAPAN LLC. Option 1 is agreeable

Issue 1-4: DL interruption applicability for Rel-17 Tx switching

- Proposals
 - Option 1(Intel): Specify the DL interruption applicability in the same way as in Rel-16.
*(Moderator adds for clarification. In T38.133 R16, the applicability rule is specified as below:
 No DL interruption is allowed in the NR downlink carrier(s) which is not indicated by
 uplinkTxSwitching-DL-Interruption. No DL interruption is allowed for some inter-band UL CA
 configurations as specified in clause 5.2A.2 of TS 38.101-1 [18].)*
- Recommended WF
 - Is Option 1 agreeable?

Feedback Form 4: Companies views' collection for Issue 1-4

1 – China Telecommunications Support Option 1, considering that: 1) In RAN4 #97e, we have agreed to reuse the following Rel-16 agreements for Rel-17 switching, as seen in RF WF R4-2017815: • For SUL+TDD and TDD+TDD CA with the same UL-DL pattern, DL interruption is not required.

<ul style="list-style-type: none"> • For the other duplex mode combinations, define different capabilities for UEs with and without DL interruption. – UE capability is defined as per band per band combination for each band pair supporting UL Tx switching. <p>2) In RAN4 #98e, we have reached the following agreements, as seen in RF WF R4-2103235:</p> <ul style="list-style-type: none"> • There is no need to differentiate the DL interruption applicability between Rel-16 1Tx-2Tx switching and Rel-17 Tx switching scenarios, which means that “DL interruption allowed” specified in existing TS 38.101-1 should also be applied to the Rel-17 Tx switching scenarios including: <ul style="list-style-type: none"> – 2Tx-2Tx switching between carrier 1 and carrier 2 – 1Tx-2Tx and 2Tx-2Tx switching between band A (carrier 1) and band B (carrier 2+3)
<p>2 – Huawei Technologies France</p> <p>agree with option 1. The similar <i>applicability rule for R17 TX switching can be specified as below:</i></p> <p><i>”No DL interruption is allowed in the NR downlink carrier(s) which is not indicated by IE name. No DL interruption is allowed for some inter-band UL CA configurations as specified in clause xxx of TS 38.101-1 [18].”</i></p>
<p>3 – MediaTek Inc.</p> <p>Fine with Option 1 in principle, but the cited section in RF spec may need to be kept open at this moment.</p>
<p>4 – China Mobile Com. Corporation</p> <p>Support option 1</p>
<p>5 – Nokia Korea</p> <p>Fine with option 1 in principle.</p>

Issue 1-5: Spec structure for DL interruption requirements for Rel-17 Tx switching

– Proposals

- Option 1(CMCC, China Telecom, Intel, Huawei): To create new subclause for Rel-17 DL interruptions at UE switching for CA, including:
 - DL Interruptions at UE switching between two uplink carriers with two transmit antenna connectors for UL inter-band CA
 - where NR UL carrier 1 is capable of two transmit antenna connectors and NR UL carrier 2 is capable of two transmit antenna connectors, and the two uplink carriers are in different bands with different carrier frequencies
 - DL Interruptions at UE switching between one uplink band with one transmit antenna connector and one uplink band with two transmit antenna connectors for UL inter-band CA
 - where NR UL carrier 1 in band A is capable of one transmit antenna connector, NR UL carrier 2 and carrier 3 in band B are capable of two transmit antenna connectors. NR UL carrier 2 and carrier 3 are two contiguous aggregated carriers
 - DL Interruptions at UE switching between two uplink bands with two transmit antenna connectors for UL inter-band CA
 - where NR UL carrier 1 in band A is capable of two transmit antenna connectors, NR UL carrier 2 and carrier 3 in band B are capable of two transmit antenna connectors

- Recommended WF
 - Is Option 1 agreeable?

Feedback Form 5: Companies views' collection for Issue 1-5

1 – China Telecommunications Support option 1.
2 – Huawei Technologies France support option 1.
3 – MediaTek Inc. OK with Option 1
4 – China Mobile Com. Corporation Support option 1
5 – Nokia Korea Option 1 is agreeable.

2.2 Summary for 1st round

2.2.1 Open issues

7 companies discussed this issue. 4 companies support option 1. Some companies need further clarification.

No Tentative agreements.

Candidate options:

- Option 1(China Telecom, Huawei, CMCC, Intel):
 - Consider the following Tx switching scenarios to specify DL interruption requirements:
 - 2Tx-2Tx switching between two uplink carriers for TDD+FDD UL CA and async TDD+TDD UL CA
 - 1Tx-2Tx and 2Tx-2Tx switching between 1 carrier on band A and 2 contiguous aggregated carriers on band B for TDD+FDD UL CA and async TDD+TDD UL CA
 - No DL interruption for SUL related scenario
 - No DL interruption for sync TDD+TDD CA

Recommendations for 2nd round: Further discussion

Issue 1-2: DL interruption length

All companies support option 1.

Tentative agreements:

R16 DL interruption length at UE switching between two uplink carriers can be reused for R17 uplink Tx switching.

Recommendations for 2nd round: No further discussion

Issue 1-3: DL interruption starting point

All companies support option 1.

Tentative agreements:

Reuse the Rel-16 agreement on the starting symbol of DL interruption, i.e., the DL interruption starts from the first OFDM symbol which fully or partially overlaps with the UL switching period.

Recommendations for 2nd round: No further discussion

Issue 1-4: DL interruption applicability for Rel-17 Tx switching

All companies support option 1.

Tentative agreements □

- Specify the DL interruption applicability in the same way as in Rel-16.

(Moderator adding for clarification. In R16, the applicability rule is specified as below:

No DL interruption is allowed in the NR downlink carrier(s) which is not indicated by uplinkTxSwitching-DL-Interruption. No DL interruption is allowed for some inter-band UL CA configurations as specified in clause 5.2A.2 of TS 38.101-1 [18].)

Recommendations for 2nd round: No further discussion

Issue 1-5: Spec structure for DL interruption requirements for Rel-17 Tx switching

All companies support option 1.

Tentative agreements □

- To create new subclause for Rel-17 DL interruptions at UE switching for CA, including:
 - DL Interruptions at UE switching between two uplink carriers with two transmit antenna connectors for UL inter-band CA
 - where NR UL carrier 1 is capable of two transmit antenna connectors and NR UL carrier 2 is capable of two transmit antenna connectors, and the two uplink carriers are in different bands with different carrier frequencies
 - DL Interruptions at UE switching between one uplink band with one transmit antenna connector and one uplink band with two transmit antenna connectors for UL inter-band CA

- where NR UL carrier 1 in band A is capable of one transmit antenna connector, NR UL carrier 2 and carrier 3 in band B are capable of two transmit antenna connectors. NR UL carrier 2 and carrier 3 are two contiguous aggregated carriers
- DL Interruptions at UE switching between two uplink bands with two transmit antenna connectors for UL inter-band CA
 - where NR UL carrier 1 in band A is capable of two transmit antenna connectors, NR UL carrier 2 and carrier 3 in band B are capable of two transmit antenna connectors

Recommendations for 2nd round: No further discussion

2.3 Discussion on 2nd round (if applicable)

2.3.1 Sub-topic 1: DL interruption requirements

Issue 1-1: R17 Tx switching scenarios need to be considered

During 1st round discussion, some clarifications are made:

1. "sync" means the same TDD DL/UL configuration;
2. async basically means that UL transmission collides with DL transmission, so it includes the cases for different UL-DL configuration and interCA-NonAlignedFrame-r16;
3. the reason why SUL related cases within the scope of this Work Item imposes no DL interruption is because there is no DL reception at any time during switching.

Candidate options:

- Option 1(China Telecom, Huawei, CMCC, Intel):
 - Consider the following Tx switching scenarios to specify DL interruption requirements:
 - 2Tx-2Tx switching between two uplink carriers for TDD+FDD UL CA and async TDD+TDD UL CA
 - 1Tx-2Tx and 2Tx-2Tx switching between 1 carrier on band A and 2 contiguous aggregated carriers on band B for TDD+FDD UL CA and async TDD+TDD UL CA
 - No DL interruption for SUL related scenario
 - No DL interruption for sync TDD+TDD CA

Recommended WF:

With the above clarification, whether option 1 is acceptable.

Feedback Form 6: 2nd Companies views' collection for Issue 1-1

1 – MediaTek Inc.

We prefer not to use sync or async CA in the candidate options. It can be interpreted as different MRTD requirements. The clarification on in bullet 1 and 2 are good. Suggest to directly add them in the candidate options, e.g.,

Option 1(China Telecom, Huawei, CMCC, Intel):

- Consider the following Tx switching scenarios to specify DL interruption requirements:
 - o 2Tx-2Tx switching between two uplink carriers for TDD+FDD UL CA and ~~async~~-TDD+TDD UL CA
 - o 1Tx-2Tx and 2Tx-2Tx switching between 1 carrier on band A and 2 contiguous aggregated carriers on band B for TDD+FDD UL CA and ~~async~~-TDD+TDD UL CA
 - o **TDD+TDD UL CA includes scenarios with different UL-DL configurations or interCA-NonAlignedFrame-r16**
- No DL interruption for SUL related scenario
- No DL interruption for TDD+TDD CA **with the same UL-DL configuration and without interCA-NonAlignedFrame-r16**

Appreciated if companies can help make the wording better.

2 – China Telecommunications

OK with option 1 with additional clarification #1 and #2.

For clarification #3, technically it might be not true if the UL switching period is configured to be located in the SUL carrier. In such case, the UL switching period can overlap with the DL symbols of the TDD carrier(s) in some cases. If I remember correctly, the agreement on "no DL interruption for SUL + TDD" is based on the feedback from UE implementations in RF session (originally for Rel-16, and then same agreement reused for Rel-17).

3 – Huawei Technologies France

OK with option 1

4 – Intel

We agree with option 1 in general. open to explore if better wording reaches consensus in the group.

3 Recommendations for Tdocs

3.1 1st round

New tdocs

Table 2:

Title	Source	Comments
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WF on R17 NR FR1 RF enhancement RRM	Huawei, HiSilicon	
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3.2 2nd round

Table 3:

Tdoc number	Title	Source	Recommendation
R4-2115331	WF on R17 NR FR1 RF enhancement RRM	Huawei, HiSilicon	Agreeable