[106bis-e][217] NR_MC_enh - Version 0.0.3
RAN4
https://nwm-trial.etsi.org/#/documents/8453

3GPP TSG-RAN WG4 Meeting # 106bis-e R4-2306165

Online, April 17 – April 26, 2023

Agenda item: 5.24.4

Source: Moderator (Huawei, HiSilicon)

Title: Email discussion summary for [106bis-e][217] NR_MC_enh

Document for: Information

1 Introduction

This email thread discusses the RRM core requirements of WI on Multi-carrier enhancements.

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

- 1st round: Invite companies to comment in each sub-topic.
- 2nd round: TBA

2 Topic #1: DL interruption for Tx switching across 3/4 bands

2.1 Companies' contributions summary

Table 1:

T-doc number	Company	Proposals / Observations

R4-2304124	Nokia, Nokia Shanghai Bell	Proposal 1: The UE shall not perform UL Tx switching if it has performed an UL Tx switching within MinSeparationTime. Proposal 2: The UE is allowed to indicate the X values differentiating between single-TAG and multi-TAGs cases. Proposal 3: The UE shall not perform UL Tx switching if it has performed an UL Tx switching within MinSeparationTimeforMultiTAGs in multi-TAGs scenario.
R4-2304125	Nokia, Nokia Shanghai Bell	Draft CR
R4-2304170	ZTE Corporation	Proposal 1: For the scenario that one downlink carrier is indicated to be interrupted by two band pairs for dynamic switching simultaneously, the DL interruption length and location on the victim carrier is determined by the maximum of uplink switching periods of the two band pairs for the case of complete overlap. Proposal 2: UE shall inform network the RTD value or at least if the RTD side condition is fulfilled. Proposal 3: The UE shall not perform UL Tx switching if the minimum separation time is not satisfied.

R4-2304290	Apple	Proposal 1: RAN4 can discuss if scenario that one downlink carrier is indicated to be interrupted by two band pairs for dynamic switching simultaneously can be covered by interruption requirements for single band pair. Proposal 2: if specific requirements are to be introduced for scenario that one downlink carrier is indicated to be interrupted by two band pairs for dynamic switching simultaneously, the following principle is proposed: Option 2A: If one downlink carrier is indicated to be interrupted by two band pairs for dynamic switching simultaneously, the DL interruption length and location on the victim carrier is determined by the union of DL interruption length uplink switching periods of the two band pairs. Proposal 3: RAN4 can study whether it is beneficial for UE to inform network about RTD side condition is fulfilled or not. Proposal 4: considering signaling overhead, RTD value reporting is not preferred. Observation 1: no RRM impact is observed regarding minimum separation time between two consecutive UL Tx Switching. RAN4 RRM only defines interruption requirements and corresponding side condition when UL Tx switching actually occurs.
R4-2304358	Qualcomm, Inc.	Proposal 1: When one downlink carrier is indicated to be interrupted by two band pairs for dynamic switching simultaneously, derive switching period based on the RF agreement on time mask.

R4-2304623	MediaTek inc.	Proposal 1: If one downlink carrier is indicated to be interrupted by two band pairs for dynamic switching simultaneously, the DL interruption length and location on the victim carrier is determined by the union of uplink switching periods of the two band pairs. Proposal 2: DL interruption should be allowed when the switching Tx band pair has an impact on the downlink receiving signal. The Applicability of DL interruption according to band combinations is decided by RF session.
R4-2305049	vivo	Proposal 1: For the scenario that one downlink carrier is indicated to be interrupted by two band pairs, when the dynamic switching happens simultaneously (the starting point of the switching are the same), the interruption length on the victim carrier is determined by the maximum of uplink switching periods of the two band pairs. Proposal 2: It is not necessary for UE to inform network the RTD value or if the RTD side condition is fulfilled. Proposal 3: There is no RRM requirements impact regarding minimum separation time between two consecutive UL Tx switching.
R4-2305282	Huawei, HiSilicon	Proposal 1: If one downlink carrier is indicated to be interrupted by two band pairs for dynamic switching simultaneously, the DL interruption length and location on the victim carrier is determined by the maximum of uplink switching periods of the two band pairs.
R4-2305283	Huawei, HiSilicon	Draft CR

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2.2 Open issues summary

Issue 1-1: If one downlink carrier is indicated to be interrupted by two band pairs for dynamic switching simultaneously

- Proposals
  - Option 1(ZTE, vivo, Huawei): If one downlink carrier is indicated to be interrupted by two band pairs for dynamic switching simultaneously, the DL interruption length and location on the victim carrier is determined by the maximum of uplink switching periods of the two band pairs.
  - Option 2 (Apple):
    - RAN4 can discuss if scenario that one downlink carrier is indicated to be interrupted by two band pairs for dynamic switching simultaneously can be covered by interruption requirements for single band pair.
    - if specific requirements are to be introduced for scenario that one downlink carrier is indicated to be interrupted by two band pairs for dynamic switching simultaneously, the following principle is proposed:
      - If one downlink carrier is indicated to be interrupted by two band pairs for dynamic switching simultaneously, the DL interruption length and location on the victim carrier is determined by the union of DL interruption length of the two band pairs.
  - Option 3 (MTK):If one downlink carrier is indicated to be interrupted by two band pairs for dynamic switching simultaneously, the DL interruption length and location on the victim carrier is determined by the union of uplink switching periods of the two band pairs.
  - Option 3(QC): derive switching period based on the RF agreement on time mask.
- Recommended WF

Further discussion

Feedback Form 1: Comments collection for Issue 1-1

1 – Huawei Technologies France

Support option 1.

RAN1 had reached the following agreement:

==RAN1 agreements start==

Alt.5: gNB configures priorities to each carrier/band.

The gNB configures priority for each band. The UE determines the switching period location on either switching-from band(s) or switching-to band(s) that is involved in the UL Tx switching and is not with the highest priority band.

==RAN1 agreements end==

It means 1) the switching period location is supposed to be on either switching-from band(s) or switching-to band(s). The switching period is not allowed to be overlapped with two types of bands; 2) The switching

period is not allowed to be on highest priority band.

In the below, we provide one example. Assuming the configured priorities for the bands are X>Y>Z, according to RAN1 agreement,

• switching period location from band X to band Z should not be on band X, as Band X is the highest priority band.

• "switching-from bands" are Band X and Band Y, and "switching-to band" is Band Z. The switching period location is supposed to be on either switching-from band(s) or switching-to band(s). Thus Tx switching from band Y to band Z shall not happen in OS#3 in Figure 1 (https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_106b e/Inbox/Drafts/%5B106bis-e%5D%5B217%5D%20NR_MC_enh/Figures/Figure%201.jpg), because switching period T2 is overlapped with "switching from band"(band X) and "switching-to band"(band Z), which violates RAN1 agreements. Therefore Tx switching from band Y to band Z shall happen in OS#7.

Based on the above analysis, the expected Tx switching operation is illustrated in Figure 2 (https://www.3gpp.org/ftp/tsg_ra e/Inbox/Drafts/%5B106bis-e%5D%5B217%5D%20NR_MC_enh/Figures/Figure%202.%20Tx%20switching%20accord Thus the DL interruption length on Band Z is supposed to be determined by Max {T1, T2}.

2 – Qualcomm Incorporated

Downlink interruption and uplink switching time/time mask should be consistent, and therefore we need to wait for RF session to conclude it (option 3).

In addition, a few comments to Huawei's contribution R4-2305282, also in the comments above:

1. In the example, during switch period 2, it's not obvious why band X can consider as "switch from" band, given that switch of band X to Z is not yet happened when band Y start switching to Z. For switching period 1, switch from band is Y and switching to band is Z, and X is not involved. In fact, determining location of swiching period on based on band prioritize is well-defined only when all the switching happens at the same time (in the example, both X>Z and Y>X happen at symbol 3, or both at symbol 7), and no scheduling gap exists.

2. When the two switches happen at the same time (in the example, considering X>Z and Y>Z both at symbol 3), in our opinion, the time required to finish both actions is the summation of X>Z switch time when performed by itself and Y>Z switch time when performed by itself. But we believe that RF session covers the same discussion since it determines switching period time mask, and therefore we suggest to leverage RF session's conclusion and avoid conflicting decisions.

3 – Nokia Korea

Option 3: Since discussion is ongoing on time mask in RF, it is better to derive switching period once RF agreement is in place.

4 – ZTE Photonics

Support Option3.

According to our understanding, we should first unify the meaning of "simultaneously" if we want to discuss this issue, whether it means that the starting point of two interruptions is the same. Meanwhile,

To avoid repeated discussions, we can wait and refer to RF agreement on related issues, and option 3 is acceptable for us.

5 – China Telecom Corporation Ltd.

We support Option 3(QC).

In the RF thread in this meeting, there is a Sub-topic 1-4 on "Length of switching time for certain scenarios", and there are proposals like summing up of the two switching periods, or adding new capability values for switching period length, for switching case of "{1T, 1T, 0T, 0T} to {0T, 0T, 1T, 1T}" and "{1T, 1T, 0T} to {0T, 0T, 2T}".

6 – China Mobile Com. Corporation

Agree to wait for RF session conclusion.

7 – Apple GmbH

support option 2 and 3 (MTK). considering different timing and switch period on different carriers, if one downlink carrier is indicated to be interrupted by two band pairs for dynamic switching simultaneously, the DL interruption length and location on the victim carrier is determined by the union of DL interruption length of the two band pairs.

8 – MediaTek Inc.

Support Option 3 (MTK). Also fine to wait for the conclusion from RF session.

Regarding HW comment, the given example for the band priorities (X>Y>Z) where DL interruption would result in being Max {T1, T2}. In our view, this is not always the case if one consider a different order of band priorities (e.g., X>Z>Y), where T1 could happen in band Z and T2 could happen in band Y, the resulting DL interruption in this case should the union of both T1 and T2.

Furthermore, in our view, even though Max {T1, T2} can be applied for some cases, the union between T1 and T2 could also give the same result as Max {T1, T2} for the same cases. Therefore, it is always safer to consider the resulting DL interruption as the union between T1 and T2 than Max {T1, T2} such that to consider different scenarios for different timing of switching period on different carriers.

9 – vivo Mobile Communication (S)

Support option 1. It is kind of relevant to UE implementation. We understand the UE can always start the switching at the same time. Thus, max of switching time should be used to determine DL interruption length.

It is also fine to wait for RF conclusion that may impact the decision.

Issue 1-2: Additional signalling for Tx switching with 2 TAGs

- Proposals
  - Option 1(ZTE): UE shall inform network the RTD value or at least if the RTD side condition is fulfilled.
  - Option 2a (Apple, vivo): RTD value reporting is not preferred.
- Recommended WF

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Need further discussion.

Feedback Form 2: Comments collection for Issue 1-2

1 – Huawei Technologies France Support option 2. In last meeting, the interruption length derived from 9us RTD were agreed. 9us RTD is able to accommodate typical non-collocated inter-band scenario for 2 TAGs and responds to 900m inter-site distance. There is no requirement if RTD is larger than 9us. Network knows its deployment, so it is not necessary to let UE report the exact RTD values.
2 – Qualcomm Incorporated Suppot option 2.
3 – Oy LM Ericsson AB Support option 2. We still believe the side condition is not needed), so there is no need to signal it.
4 – Nokia Korea Option 2 is ok for us.
5 – ZTE Photonics Option 2 is ok for us. The MRTD value is 33us, while the RTD value we currently define is 9us. Therefore, some scenarios may be ignored and it is recommended that UE notify the network of the RTD value. However, considering signaling overhead, this report may not be necessary.
6 – China Telecom Corporation Ltd. Support option 2. The network knows its own deployment such as ISD, and there is no need for UE to report.
7 – China Mobile Com. Corporation Option 2
8 – Apple GmbH we are open for simple indication to inform NW whether condition is met or not. however, reporting actual RTD is not expected.
9 – MediaTek Inc. Support Option 2.
10 – vivo Mobile Communication (S) Support option 2.

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Issue 1-3: Minimum Separation Time between two consecutive UL Tx Switching

Table 2:

The following is agreed in RAN1#112: 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}

- Proposals
  - Option 1(Nokia):
    - The UE shall not perform UL Tx switching if it has performed an UL Tx switching within MinSeparationTime.
    - The UE is allowed to indicate the X values differentiating between single-TAG and multi-TAGs cases.
    - The UE shall not perform UL Tx switching if it has performed an UL Tx switching within MinSeparationTimeforMultiTAGs in multi-TAGs scenario.
  - Option 2(Apple, vivo): no RRM impact is observed regarding minimum separation time between two consecutive UL Tx Switching.
- Recommended WF

Further discussion

Feedback Form 3: Comments collection for Issue 1-3

1 – Huawei Technologies France Support option 2. Minimum separation time between two consecutive UL Tx switching will be specified in TS38.214.
2 – Qualcomm Incorporated Support option 2.
3 – China Telecom Corporation Ltd. Option 2. The minimum separation time is not a new concept for Rel-18 Tx switching, and it is defined since Rel-16 Tx switching.

4 – China Mobile Com. Corporation Option 2
5 – Apple GmbH Option 2.
6 – MediaTek Inc. Option 2.
7 – vivo Mobile Communication (S) Support option 2.

Issue 1-4: DL interruption Applicability

- Proposals
  - Option 1(MTK): DL interruption should be allowed when the switching Tx band pair has an impact on the downlink receiving signal. The Applicability of DL interruption according to band combinations is decided by RF session.
- Recommended WF

This issue has been discussed in RF session for several meeting cycles. The conclusion (if made) would impact RF specification. It is recommended that this issue is not discussed in RRM session.

2.3 CRs/TPs comments collection

Feedback Form 4: Comments collection for R4-2304125 (Nokia)

1 – Huawei Technologies France Depends on conlusion in issue 1-3.
2 – Qualcomm Incorporated Based on our comment in issue 1-3, we don't need this CR
3 – China Telecom Corporation Ltd. In the current CR, is already says: 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 and SUL band configurations with inter-band CA as specified in TS 38.101-1 [18]. So, we don't think any additional clarification is needed for RRM spec.

4 – Apple GmbH fine with recommended WF.
5 – MediaTek Inc. Depends on conlcusion in issue 1-3.
6 – vivo Mobile Communication (S) Depends on conlusion on issue 1-3. We don't need the change in our view.

Feedback Form 5: Comments collection for R4-2305283 (Huawei)

1 – Qualcomm Incorporated Depends on the conclusion of 1-1
2 – Apple GmbH Depends on issue 1-1
3 – MediaTek Inc. Depends on the conclusion of 1-1
4 – vivo Mobile Communication (S) Depends on conlusion on issue 1-1.

2.4 Summary for 1st round

2.4.1 Open issues

Issue 1-1: If one downlink carrier is indicated to be interrupted by two band pairs for dynamic switching simultaneously

Since there is an ongoing discussion in RF session, companies think RRM can wait for RF conclusion

Tentative agreements:

Derive switching period based on the RF agreement on time mask.

Recommendations for 2nd round: No further discussion in 2nd round. If RF has conclusion, companies can directly comment the corresponding RRM CR.

Issue 1-2: Additional signalling for Tx switching with 2 TAGs

All companies agree on option 2.

Tentative agreements:

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RTD value reporting is not preferred.

Recommendations for 2nd round: No further discussion.

Issue 1-3: Minimum Separation Time between two consecutive UL Tx Switching

All companies agree on option 2.

Tentative agreements:

No RRM impact is observed regarding minimum separation time between two consecutive UL Tx Switching.

Recommendations for 2nd round: No further discussion.

2.5 Discussion on 2nd round (if applicable)

No techical discussion is needed in 2nd round. If there is revised CR, companies directly provide comments on CR.

3 Recommendations for Tdocs

3.1 1st round

New tdocs

R4-23XXXX Huawei, HiSilicon WF on RRM requirements for MC enhancements for NR

Existing tdocs

3.2 2nd round