**3GPP TSG-RAN WG4 Meeting # 95-e R4-2008509**

**Electronic Meeting, 25 May – 5 June, 2020**

**Agenda item:** 6.13.2

**Source:** Huawei, HiSilicon

**Title:** Email discussion summary for [95e][220] NR\_RF\_FR1\_RRM

**Document for:** Information

# Introduction

This email thread discusses the RRM requirements for Tx switching between two uplink carriers in agenda 6.13.2 and the proposals on DL interruption in other papers in 6.13.1.5 are treated in this thread as well.

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

# Topic #1: Title

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [R4-2006035](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_95_e/Docs/R4-2006035.zip) | China Telecom | Proposal 1: Use Option 1 for the DL interruption length, and add in the CR that the requirements are applicable for co-located deployment.Observation 1: For the DL interruption location/Starting point, it seems the two options become the same, if only co-located deployment is considered. |
| [R4-2006211](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_95_e/Docs/R4-2006211.zip) | Apple | Proposal 1: Length of DL interruption due to UL Tx switching is proposed as

|  |  |  |
| --- | --- | --- |
|  u | NR slot length (ms)of victim cell | UL switching period |
| 35us | 140us | 210us |
| Uncertainty UL switching window |
| 101us | 206us | 276us |
| 0 | 1 | 3 | 5 | 5 |
| 1 | 0.5 | 4 | 7 | 9 |
| 2 | 0.25 | 7 | 13 | 17 |

Based on the analysis above, the starting point of DL interruption should be determined by TA+TA uncertainty+MRTD.  |
| [R4-2006572](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_95_e/Docs/R4-2006572.zip) | MediaTek inc. | Proposal 1: The length of the interruption is $\left⌈\frac{switch period+1 symbol}{symbol duration}\right⌉ $symbols.Proposal 2: The location of the interruption equals the OFDM symbols fully or partial overlapped with the UL switching period |
| [R4-2006805](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_95_e/Docs/R4-2006805.zip) | CMCC | Proposal 1: It is proposed to define DL interruption requirements based on option 1 in last meeting WF (i.e. switching period length + 1 OFDM symbol).Proposal 2: It is proposed that the DL interruption is the OFDM symbols fully or partial overlapped with the UL switching period. |
| [R4-2007346](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_95_e/Docs/R4-2007346.zip) | OPPO | Observation 1: DL interruption time may be larger than UL switching time. Proposal 1: The starting time should not be later than the end of UL switching period, which can be determined by TA + TA uncertainty + MRTD.Proposal 2: Define DL interruption length for EN-DC and NR SA according to Table 1, 2 and 3.Table 1: DL interruption on NR carrier(s) for switching between two uplink carriers in EN-DC (FR1)

|  |  |  |
| --- | --- | --- |
|  | NR Slot length (ms) | Uplink Tx switching period(symbol) Note1 |
| 35us | 140us |
| 0 | 1 | 3 | 5 |
| 1 | 0.5 | 4 | 7 |
| 2 | 0.25 | 7 | 13 |
| Note 1: Uplink Tx switching period depends on UE capability *[TBD]* |

Table 2: DL interruption on E-UTRA carrier(s) for switching between two uplink carriers in EN-DC (FR1)

|  |
| --- |
| Uplink Tx switching period(symbol) Note1 |
| 35us | 140us |
| 3 | 5 |
| Note 1: Uplink Tx switching period depends on UE capability [*TBD*] |

Table 3: DL interruption on NR carrier(s) for switching between two uplink carriers in NR SA (FR1)

|  |  |  |
| --- | --- | --- |
|  | NR Slot length (ms) | Uplink Tx switching period(symbol) Note1 |
| 35us | 140us | 210us |
| 0 | 1 | 3 | 5 | 5 |
| 1 | 0.5 | 4 | 7 | 9 |
| 2 | 0.25 | 7 | 13 | 17 |
| Note 1: Uplink Tx switching period depends on UE capability *[TBD]* |

 |
| [R4-2007731](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_95_e/Docs/R4-2007731.zip) | Huawei, Hisilicon | Proposal 1: For FDD-TDD uplink CA, due to Tx switching between two uplink carriers, UE is allowed to cause DL interruption on NR carrier(s) depending on UE capability of X OFDM symbols that overlap with the UL switching period. Table 1. DL interruption length in the unit of OFDM symbols (X) for FDD-TDD uplink CA

|  |  |  |
| --- | --- | --- |
| u | NR slot length (ms)of victim cell | UL switching period |
| 35us | 140us | 210us |
| 0 | 1 | 2 | 3 | 4 |
| 1 | 0.5 | 2 | 5 | 7 |
| 2 | 0.25 | 3 | 9 | 13 |

Proposal 2: DL interruption are the OFDM symbols fully or partial overlapped with the UL switching period.Proposal 3: For inter-band EN-DC, due to Tx switching between two uplink carriers, UE is allowed to cause DL interruption on LTE carriers depending on UE capability of Y OFDM symbols that overlap with the UL switching period and UE is allowed to cause DL interruption on NR carriers depending on UE capability of Z OFDM symbols that overlap with the UL switching periodTable 2. DL interruption length in the unit of OFDM symbols (Y) for inter-band EN-DC

|  |
| --- |
| UL switching period |
| 35us | 140us |
| 2 | 3 |

Table 3. DL interruption length on NR carrier(s) in the unit of OFDM symbols (Z) for inter-band EN-DC

|  |  |  |
| --- | --- | --- |
| u | NR slot length (ms)of victim cell | UL switching period |
| 35us | 140us |
| 0 | 1 | 2 | 3 |
| 1 | 0.5 | 2 | 5 |
| 2 | 0.25 | 3 | 9 |

 |

## Open issues summary

### Sub-topic 1-1: DL interruption length

* Proposals
	+ Option 1 (China Telecom, MediaTek, CMCC, Huawei):

- For FDD-TDD uplink CA, UE is allowed to cause X OFDM symbols DL interruption on NR carrier(s), depending on UE capability

|  |  |  |
| --- | --- | --- |
| u | NR slot length (ms)of victim cell | UL switching period |
| 35us | 140us | 210us |
| 0 | 1 | 2 | 3 | 4 |
| 1 | 0.5 | 2 | 5 | 7 |
| 2 | 0.25 | 3 | 9 | 13 |

-For inter-band EN-DC, UE is allowed to cause DL interruption of Y OFDM symbols on LTE carriers, depending on UE capability,

|  |
| --- |
| UL switching period |
| 35us | 140us |
| 2 | 3 |

UE is allowed to cause DL interruption of Z OFDM symbols on NR carriers, depending on UE capability

|  |  |  |
| --- | --- | --- |
| u | NR slot length (ms)of victim cell | UL switching period |
| 35us | 140us |
| 0 | 1 | 2 | 3 |
| 1 | 0.5 | 2 | 5 |
| 2 | 0.25 | 3 | 9 |

* + Option2 (Apple, OPPO)

|  |  |  |
| --- | --- | --- |
|  u | NR slot length (ms)of victim cell | UL switching period |
| 35us | 140us | 210us |
| Uncertainty UL switching window |
| 101us | 206us | 276us |
| 0 | 1 | 3 | 5 | 5 |
| 1 | 0.5 | 4 | 7 | 9 |
| 2 | 0.25 | 7 | 13 | 17 |

* Recommended WF
	+ WID [RP-192282] stated that UL switching only address the case of co-located and synchronized network deployment for the two UL carriers. **No** propagation delay between the two carriers is considered. Then MRTD could be 3us. As option 2 considers MRTD (**3**us) and TA adjustment accuracy (up to 130**ns**), if we recalculate the table of option 2, the interruption length is the same as option 1.

After the above analysis, is option 1 agreeable?

### Sub-topic 1-2: DL interruption location

* Proposals
	+ Option 1: The location of the interruption equals the OFDM symbols fully or partial overlapped with the UL switching period (China Telecom, MediaTek, CMCC, Huawei)
	+ Option 2: Starting point of DL interruption should be determined by TA+TA uncertainty+MRTD (China Telecom, Apple, OPPO)
* Recommended WF
	+ If the recommended WF of sub-topic 1-1 is agreed, option 1 and option2 are similar.

As the interruption length is the OFDM symbol level, is option1 agreeable?

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| MTK | **Sub-topic 1-1: DL interruption length** Agree with the recommended WF**Sub-topic 1-2: DL interruption location**Agree with the recommended WF |
| China Telecom | **Sub-topic 1-1: DL interruption length** Agree with the recommended WF**Sub-topic 1-2: DL interruption location**Agree with the recommended WF |
| CMCC | **Sub-topic 1-1: DL interruption length** Agree with the recommended WF**Sub-topic 1-2: DL interruption location**Agree with the recommended WF |
| Huawei | **Sub-topic 1-1: DL interruption length** Agree with the recommended WF**Sub-topic 1-2: DL interruption location**Agree with the recommended WF |
| Apple | **Sub-topic 1-1:**The proposed WF to assume no propagation delay difference is helpful. However, the related calculation is still not 100% correct. With no propagation delay difference considered, the interruption length should be ceil((switching period+2\*TA uncertainty+6us-CP length)/symbol duration)+1. Let’s take 30kHz SCS with 35us switching period as an example, interruption time should be ceil((35+6+0.26)/35.7)+1=3. The new table should be

|  |  |  |
| --- | --- | --- |
|  u | NR slot length (ms)of victim cell | UL switching period |
| 35us | 140us | 210us |
| Uncertainty UL switching window with collocated assumption |
| 41.26 | 146.26 | 216.26 |
| 0 | 1 (symbol duration~71.4us) | 2 | 3 | 4 |
| 1 | 0.5(symbol duration~35.7us) | 3 | 6 | 7  |
| 2 | 0.25(symbol duration~17.9us) | 4 | 10 | 14 |

Highlighted entries are different from option 1. **Sub-topic 1-2:**Firstly, we think interruption can happen within the range of switching period+TA+2\*TA uncertainty+2\*3us. As what we commented in sub-topic 1-1, 1 extra symbol is needed for some cases compared with option 1. That means 1 symbol during the interruption is actually not overlapped with UL switching period. Since this information is unknown to NW, no DL reception is expected from UE.Let’s assume UL switching starts from the beginning UL slot n, denoted as Tn. Interruption on DL should happen between Tn-MRTD-TA uncertainty and Tn+MRTD+TA uncertainty+UL switching period. For collocated cases, it is within [Tn-3.14us, Tn+3.14us+UL switching period] |
| Qualcomm  | **Sub-topic 1-1: DL interruption length** Agree with the recommended WF**Sub-topic 1-2: DL interruption location**Agree with the recommended WF |

### CRs/TPs comments collection

*Major close-to-finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2007732 |  China Telecom: In the LS to RAN2 approved in the last meeting, it was agreed that: For the band where DL interruption is needed, the RRM interruption requirements defined in RAN4 shall be applied. So, we suggest to reflect this agreement in the RRM CR, i.e., the RRM interruption requirements apply for the band reporting that DL interruption is needed, and UE not reporting the capability means DL interruption is not required. |
| Huawei: to China TelecomIt is a good point. As “DL interruption is needed” is a capability, the interruption requirements are supposed to reflect two cases: 1. RRM interruption length we are discussing is applied for the band reporting that DL interruption is needed;2. No interruption is allowed for UE not reporting the capability “DL interruption is needed”. Otherwise a UE who interrupted DL may cheat to report “DL interruption is not needed”. |
|  |
| R4-2007733 | Same comment as that for R4-2007732. |
| Huawei: the comments make sense.  |
|  |

## 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** | **Sub-topic 1-1: DL interruption length**In the first round discussion, 6 companies discussed this issue. 5 companies agree with the recommended WF (i.e., option1), while 1 company supports revised option2 (shown in below).*Tentative agreements:*No.*Candidate options:** Option 1 (China Telecom, MediaTek, CMCC, Huawei, Qualcomm):

- For FDD-TDD uplink CA, UE is allowed to cause X OFDM symbols DL interruption on NR carrier(s), depending on UE capability

|  |  |  |
| --- | --- | --- |
| u | NR slot length (ms)of victim cell | UL switching period |
| 35us | 140us | 210us |
| 0 | 1 | 2 | 3 | 4 |
| 1 | 0.5 | 2 | 5 | 7 |
| 2 | 0.25 | 3 | 9 | 13 |

-For inter-band EN-DC, UE is allowed to cause DL interruption of Y OFDM symbols on LTE carriers, depending on UE capability,

|  |
| --- |
| UL switching period |
| 35us | 140us |
| 2 | 3 |

UE is allowed to cause DL interruption of Z OFDM symbols on NR carriers, depending on UE capability

|  |  |  |
| --- | --- | --- |
| u | NR slot length (ms)of victim cell | UL switching period |
| 35us | 140us |
| 0 | 1 | 2 | 3 |
| 1 | 0.5 | 2 | 5 |
| 2 | 0.25 | 3 | 9 |

* Option 2 (Apple)

|  |  |  |
| --- | --- | --- |
|  u | NR slot length (ms)of victim cell | UL switching period |
| 35us | 140us | 210us |
| Uncertainty UL switching window with collocated assumption |
| 41.26 | 146.26 | 216.26 |
| 0 | 1 (symbol duration~71.4us) | 2 | 3 | 4 |
| 1 | 0.5(symbol duration~35.7us) | 3 | 6 | 7  |
| 2 | 0.25(symbol duration~17.9us) | 4 | 10 | 14 |

*Note: Highlighted entries are different from option 1.* *Recommendations for 2nd round:*Needs further discussion.  |
| **Sub-topic 1-2** | **Sub-topic 1-2: DL interruption location**In the first round discussion, 6 companies discussed this issue. 5 companies agree with the recommended WF (i.e., option1), while 1 company supports option2.*Tentative agreements:*No.*Candidate options:** Option 1 (China Telecom, MediaTek, CMCC, Huawei, Qualcomm):

The location of the interruption equals the OFDM symbols fully or partial overlapped with the UL switching period* Option 2 (Apple)

Interruption on DL should happen between Tn-MRTD-TA uncertainty and Tn+MRTD+TA uncertainty+UL switching period (UL switching starts from the beginning UL slot n, denoted as Tn).*Recommendations for 2nd round:*Needs further discussion. |

*Recommendations on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 | Way forward on DL interruption on LTE carriers at Tx switching between two uplink carriers | Huawei, HiSilicon |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provides recommendation on CRs/TPs Status update*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| R4-2007732 | to be revised |
| R4-2007733 | to be revised |

## Discussion on 2nd round (if applicable)

**Sub-topic 1-1: DL interruption length**

* Option 1 (China Telecom, MediaTek, CMCC, Huawei, Qualcomm):

- For FDD-TDD uplink CA, UE is allowed to cause X OFDM symbols DL interruption on NR carrier(s), depending on UE capability

|  |  |  |
| --- | --- | --- |
| u | NR slot length (ms)of victim cell | UL switching period |
| 35us | 140us | 210us |
| 0 | 1 | 2 | 3 | 4 |
| 1 | 0.5 | 2 | 5 | 7 |
| 2 | 0.25 | 3 | 9 | 13 |

-For inter-band EN-DC, UE is allowed to cause DL interruption of Y OFDM symbols on LTE carriers, depending on UE capability,

|  |
| --- |
| UL switching period |
| 35us | 140us |
| 2 | 3 |

UE is allowed to cause DL interruption of Z OFDM symbols on NR carriers, depending on UE capability

|  |  |  |
| --- | --- | --- |
| u | NR slot length (ms)of victim cell | UL switching period |
| 35us | 140us |
| 0 | 1 | 2 | 3 |
| 1 | 0.5 | 2 | 5 |
| 2 | 0.25 | 3 | 9 |

* Option 2 (Apple)

|  |  |  |
| --- | --- | --- |
|  u | NR slot length (ms)of victim cell | UL switching period |
| 35us | 140us | 210us |
| Uncertainty UL switching window with collocated assumption |
| 41.26 | 146.26 | 216.26 |
| 0 | 1 (symbol duration~71.4us) | 2 | 3 | 4 |
| 1 | 0.5(symbol duration~35.7us) | 3 | 6 | 7  |
| 2 | 0.25(symbol duration~17.9us) | 4 | 10 | 14 |

*Note: Highlighted entries are different from option 1.*

* Recommended WF

In the first round discussion, 6 companies discussed this issue. 5 companies agree with option1, while 1 company supports option2.

Encourage companies to provide views on this issue.

**Sub-topic 1-2: DL interruption location**

* Option 1 (China Telecom, MediaTek, CMCC, Huawei, Qualcomm):

The location of the interruption equals the OFDM symbols fully or partial overlapped with the UL switching period

* Option 2 (Apple)

Interruption on DL should happen between Tn-MRTD-TA uncertainty and Tn+MRTD+TA uncertainty+UL switching period (UL switching starts from the beginning UL slot n, denoted as Tn).

* Recommended WF

In the first round discussion, 6 companies discussed this issue. 5 companies agree with option1, while 1 company supports option2.

Encourage companies to provide views on this issue.

## Companies views’ collection for 2nd round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| xxx | Sub topic 1-1: Sub topic 1-2:  |
|  |  |

### CRs/TPs comments collection

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-20xxxxx(Revised from R4-2007732) | Company A |
| Company B |
|  |
| R4-20xxxxx(Revised form R4-2007733) | Company A |
| Company B |
|  |

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |