**3GPP TSG-RAN WG4 Meeting #94-e R4-2002315**

**Electronic Meeting, Feb.24th – Mar.6th 2020**

**Agenda item:** 8.14.1.7

**Source: Moderator (**Apple)

**Title:** Email discussion summary for RAN4#94e\_#61\_NR\_RF\_FR2\_req\_enh\_RRM

**Document for:** Information

# Introduction

*Two RRM core requirements related aspects are identified in Rel-16 FR2 RF enhancement WI. One is related to MRTD in FR2 and the other is related to non-simultanous UL transmission*

# Topic #1: RRM for inter-band CA in FR2

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2000456**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000456.zip) | MediaTek | Observation 1: Given no deployments or devices for FR2 inter-band CA at this moment, the concern of backward compatibility due to revising the MRTD requirements should not be a problem hereObservation 2: According to current inter-band CA MRTD and TAE requirements, the max difference in propagation delay is 1500m which is obvious an over design of the FR2 system. It is possible to reduce the MRTD so that we can save some UE complexity without scarifying the flexibility in FR2 deployment.Proposal 1: To align with the discussion in FR session, RRM session should also consider 2 different MRTD requirements for FR2 inter-band CA from the same group (28+28 or 39+39) and different groups (28+39).Proposal 2: Revise the MRTD requirement for FR2 inter-band CA to * Within the same group (28+28 or 39+39): 260ns
* Across different groups (28+39): [4 or 5]us
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| [**R4-2000786**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000786.zip) | Apple | Proposal 1: reduce the MRTD for FR2 inter-band CA to 4us: Max propagation delay difference is 1us.Proposal 2: If the DL symbols are not SSB symbols or CSI-RS symbols or RSSI symbols for mobility measurement, it is UE implementation issue to discard DL symbols that cannot be processed overlapped/before/after UL symbols, and no RAN4 requirement will be defined for this case.Observation: If UE can indicate network the exact time difference between CCs, that would be helpful to network to decide how many symbols can be scheduled during Rx/Tx transition.Proposal 3: If the DL symbols are SSB symbols or CSI-RS symbols or RSSI symbols for mobility measurement, the R15 FR2 scheduling restriction requirement shall apply, and those DL symbols shall be prioritized than the UL transmission to serving cell. |
| [**R4-2001581**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001581.zip) | Huawei, HiSilicon | Observation 1: For UE capable of common beam management, 3us~8us MRTD would cause that additional 1 symbol margin need to be considered for defining measurement and scheduling restriction requirements for FR2 inter-band CA.Proposal 1: From RRM perspective, there is no need to reduce current MRTD requirements for FR2 inter-band CA. |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 1-1: MRTD for inter-band CA in FR2

Sub-topic description: In RAN4#93, it was agreed in R4-1916024 that

* There shall be no change in BS TAE requirement.
* In RRM session in RAN4#94, discuss if MRTD can be reduced or not.
	+ Alt.1: Max propagation delay difference is 1 us, and MRTD can be revised to 4 us
	+ Alt.2: No change in MRTD, i.e., 8us.
	+ Alt.3: Other values not precluded.

**Issue 1-1: MRTD value**

* Proposals
	+ Option 1: Reduce the MRTD for FR2 inter-band CA (2 companies)
		- Option 1-1: 2 different MRTD requirements for FR2 inter-band CA from the same group (28+28 or 39+39) and different groups (28+39).
			* Within the same group (28+28 or 39+39): 260ns
			* Across different groups (28+39): [4 or 5]us
		- Option 1-2: Reduce the MRTD for FR2 inter-band CA to 4us: Max propagation delay difference is 1us.
	+ Option 2: Keep MRTD for FR2 inter-band CA unchanged ( 4 companies)
* Recommended WF

### Sub-topic 1-2: Interruption and scheduling restriction for UE not supporting simultanous Tx/Rx for inter-band CA

Sub-topic description: In RAN4#93, it was agreed in R4-1916024 that

* For UE not supporting simultaneous Tx/Rx for inter-band CA, a solution to avoid simultaneous Tx & Rx in FR2 DL CA scenarios is needed; potential alternatives are:
	+ Alt. 1: Assume all CCs in FR2 inter-band CA combinations have the same UL/DL TDD configuration and reflect the worst case alignment as an interruption requirement; further specification details can be discussed as part of the Rel-16 RRM work
	+ Alt. 2: It is UE implementation issue to discard DL symbols that can not be processed before UL; the specification impact is FFS and can be discussed as part of the Rel-16 RRM work
	+ Alt. 3: Other solutions are not precluded

**Issue 1-2: Interruption and scheduling restriction for UE not supporting simultaneous Tx/Rx for inter-band CA**

* **Proposal on interruption:** If the DL symbols are not SSB symbols or CSI-RS symbols or RSSI symbols for mobility measurement, it is UE implementation issue to discard DL symbols that cannot be processed overlapped/before/after UL symbols, and no RAN4 requirement will be defined for this case.
* **Proposal on scheduling restriction:** If the DL symbols are SSB symbols or CSI-RS symbols or RSSI symbols for mobility measurement, the R15 FR2 scheduling restriction requirement shall apply, and those DL symbols shall be prioritized than the UL transmission to serving cell.
* Recommended WF

## Companies views’ collection for 1st round

### Open issues

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| **Company** | **Comments** |
| Ericsson | Sub topic 1-1: The message from 3GPP regarding gNodeB synchronization accuracy for non-collocated antennas has been that the BS TAE requirement is max 3us. Many operators have been looking into ITU-T G.8275.1 / G.871.1 which aims at complying with this requirement. If the non-collocated antenna case would require much more stringent accuracy at the gNodeB antennas, operators will have to again rebuild their networks in many cases. Note that, currently available LTE sites will be used for fast and low cost NR deployment, thus BS TAE requirements (which in turns impact MRTD) cannot be changed at this time. MRTD is the discussion point while this of course also impacts the already fixed and specified TAE of 3us (38.104) for FR2 inter-band CA. Changing MRTD cannot be done without changing TAE, changing TAE this late will thus create backward compatibility issue. For inter-site deployment and TDD deployment, BS TAE of 3us is needed.Regarding Option 1-1, the case between 28+28 and 39+39 poses some other questions. The proposed MRTD of 260ns “within same group” is very challenging since MRTD= TAE+ ΔRF propagation; the 260ns alone equals a ΔRF propagation=78m and that would mean significant deployment restrictions for non-collocated inter band CA AND leave TAE=0ns which is not acceptable in any sense. So, this means that, if we agree on option 1-1, then all bands within 28GHz or within 39GHz will be treated as collocated. We need to hear from operators if this is reasonable from their deployment plans. One additional complexity is also on how to define bands “within the same group”. Option 1-2 severely restricts the deployment flexibilities for FR2 cells. We need to hear from operators regarding this restriction. ***So, we propose to adopt option 2 (i.e. Keep MRTD for FR2 inter-band CA unchanged).***Sub topic 1-2: We can agree with the proposals in this subtopic.….Others: |
| MTK | Sub topic 1-1: No matter we go with option 1 or 2, in our opinion, the inter-band MRTD requirement has to be re-structured based 28+28, 39+39, 28+39. From UE implementation point of view, same Rx beam will be used for 28+28 (or 39+39). In that case, we see no benefit for network to deployment 28+28 with non-colocated gNBs, because UE can only receive or transmit along one direction at a time. Then we can actually follows the same logic as what we did for intra-band FR2 CA, in which the MRTD was already agreed to be 260ns. The reason to reduce MRTD for intra-band CA is that UE has to find a common CP duration among all CCs in the same FR2 band to switch its Rx beam. Otherwise, interruption is expected every time UE switches its Rx beam, leading to very poor system throughput. Regarding 28+39, it is ok to us to keep the current BS TAE, which is 3us. On the other hand, since RAN4 has the agreement confirming the feasibility of independent Rx beam for 28 and 39, we do not have the above Rx beam concern here. The additional discussion point is that current 8us MRTD actually allows 5us difference between the propagation delays of 2 cells. In terms of distance, it is roughly 1500 meter, which is definitely an over design of the system. It is possible to reduce this value a bit without impacting network deployment flexibility. Therefore MRTD 4us or 5us was suggested.  |
| Nokia | Sub-topic 1-1: Regarding option 1-1, Since this is the minimum requirement of MRTD for inter-band CA, we can focus on the worst case and define the requirements. to distinguish inter-band CA in same group and in different group will make the requirements more complex. The typical FR2 coverage is mainly in 200m ~ 600m, if we consider the PRACH with C2 format defined in 3GPP, ~1km will be supported. From this point of view, if we consider to reduce MRTD for inter-band CA in FR2, we would propose 7us.Sub-topic 1-2: we agree with the proposals |
| Qualcomm | As a general comment, in the RF agenda for this WI we have a paper in R4-2000357 in which it is proposed to split the FR2 combos into combos with common beam management and independent beam management depending on the RF architecture. RRM requirements should be discussed separately for these 2 categories of combos.Sub topic 1-1: For combinations with independent beam management (like 28+39), the current MRTD of 8us should be kept. For combinations with common beam management it should be further discussed whether MRTD can be lowered or not. For now our preference is Option 2. Sub-topic 1-2: in principle we agree with the proposals but some requirements in terms of maximum number of symbols that can be dropped should be specified. |
| Apple | Sub-topic 1-1: According to TR38.803, 300m ISD can represent the most challenging scenario considered in terms of propagation delay difference for FR2. This means up to 1us propagation should be enough to be considered in the current design. For 28+28 and 39+39 cases, we should further restrict them to co-located scenarios due to common beam management, which means MRTD can be further reduced.  |
| NTT DOCOMO, INC. | Sub topic 1-1: We prefer option 2 (keep 8us) considering deployment flexibility and the possibility of different Rx beam case discussed in RRM enhancement WI. We can discuss the common Rx beam case separately.Sub topic 1-2: The proposals are fine for us. Regarding interruption, we would like to identify the number of symbols to be discarded. |
| LG Electronics | Sub topic 1-1 : As general comment, at first RAN4 needs to clarify which scenarios to be considered for RRM requirements. * UE supporting common beam only & gNB col-location
* UE supporting common beam only & gNB non-collocation
* UE supporting independent beam & gNB col-location
* UE supporting independent beam & gNB non-collocation
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| Huawei | Issue 1-1Non-colocated deployment needs to be considered for inter-band CA, 3us TAE shall be not changed. Besides the propagation delay difference due to location difference, the propagation delay difference between LOS path and NLOS path shall also be covered by MRTD requirements. We propose option 2 to keep MRTD for FR2 inter-band CA unchanged.Issue 2-1Generally we are fine with the proposals. However, for scheduling restriction, not all the UL transmissions shall be deprioritized, e.g. PRACH. RAN4 can further check which UL transmissions can be deprioritized. |
| Ericsson2 | Sub topic 1-1: As we have stated earlier, the operators need to express their understanding on the network deployment for bands in 28GHz. If the non-collocated deployment is needed by the operators, then we cannot treat bands within 28GHz range as “intra-band”. Currently, we have band n257 and band n258 in 24-27GHz and 26-29GHz range. In this case, what will be the criteria to define such groups? We would like to understand this further.For 28+39 case, the same also applies. As MTK proposes, there is no such common RX beam issue, so we do not see the need for reducing the MRTD. Keeping the same BS TAE, reducing MRTD will mean reducing the deployment flexibilities. Since no common/independent beam issue is present here, we do not see any strong reason for reducing MRTD here.  |
| MTK | **Issue 1-1: MRTD value**We are OK with LGE’s proposal to clarify the scenarios first. We can first try to understand the need from operators’ collocated/non-colocated deployment and UE’s limitation in common/independent Rx beam. Regarding, MRTD for 28+39, we want to understand the possible system performance loss if the value reduced to 4 or 5us.**Issue 1-2:**We want to check whether L1 measurements should also be included in the “Proposal on scheduling restriction”. |
|  Verizon | Issue 1-1: Support Option 2. This option would support more scenarios of 5G network deployment and enable flexibility capability from more mobility features.   |

### 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.*

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| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## 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.*

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|  | **Status summary**  |
| **Sub-topic#1** | *Issue 1-1:**Status summary** + Option 1: Reduce the MRTD for FR2 inter-band CA
		- MTK: 4~5us for non collocated cases and 260ns for collocated cases
		- Nokia: 7us to cover up to ~1000m ISD
		- Qualcomm: for common beam management (collocated case), whether MRTD can be lowered is FFS
		- Apple: 4us for non collocated cases and FFS MRTD for collocated cases
		- NTT DCM: we can discuss the common Rx beam case separately.
	+ Option 2: Keep MRTD for FR2 inter-band CA unchanged
		- Ericsson: keep existing MRTD of 8us unchanged.
		- Qualcomm: keep existing MRTD of 8us for independent beam management (non collocated cases)
		- NTT DCM: keep existing MRTD of 8us for independent beam management (non collocated cases)
		- Huawei: keep existing MRTD of 8us unchanged for covering both collocated and non collocated cases.
		- Verizon: support option 2
* Operators’ inputs are requested on collocated and non-collocated deployment for 28+28, 28+39 and 39+39, respectively. (LGE, MTK and Ericsson)

[Verizon] We had the requirement on collocated and non-collocated deployments for mmWave 28+28, 28+39 and 39+39 CA from beginning of Rel-16. There would be some challenges in both RF and RRM requirements, but the requirement should consider the synchronization accuracy for non-collocated antennas at gNB from begging. *Recommendations for 2nd round:*1. MRTD for FR2 inter-band CA with collocated deployment
	1. Option 1: 260us
	2. Option 2: 3us
	3. Option 3: 8us

Note: the related conclusion is subject to the confirmation of details (e.g. band combinations, band groups within a spectrum range, common/independent BM at eNB and UE, etc) and feasibility of collocated FR2 inter-band CA deployments.  1. MRTD for FR2 inter-band CA with non-collocated deployment
	1. Option 1: 8us
	2. Option 2: 7us
	3. Option 3: 4~5us
2. **Tentative agreement:** If the DL symbols are SSB symbols or CSI-RS symbols or RSSI symbols for mobility measurement, the R15 FR2 scheduling restriction requirement shall apply, and those DL symbols shall be prioritized than the UL transmission to serving cell.
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*Recommendations on WF/LS assignment*

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|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 |  |  |

### CRs/TPs

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

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| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

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| Verizon | We had the requirement on collocated and non-collocated deployments for mmWave 28+28, 28+39 and 39+39 CA from beginning of Rel-16. There would be some challenges in both RF and RRM requirements, but the requirement should consider the synchronization accuracy for non-collocated antennas at gNB from beginning. |
| Apple | *260ns for collocated scenario and 4-5us for non-collocated scenario.*  |
| Ericsson | Recommendation item-1: First of all, ” MRTD for FR2 inter-band CA with collocated deployment” may not be completely correct, since a 28+39GHz inter-band deployment may also be collocated in some cases. Thus, we propose to update the title as follows: “MRTD for FR2 inter-band CA with ~~collocated deployment~~ common beam management”. According to our understanding, related RF work on common beam and independent beam management is still ongoing. There is a need further understand the RF architecture, and understand the impact of the different architectures. What we mean is that, we need to understand further the impact of different UE implementation on deployment, scheduling, timing, band combinations, etc. This should be done first instead of proactively changing MRTD parameter at this stage. In our understanding in general, if some restrictions are applied to deployment, etc due to RF architecture, we need to understand the issues in detail first, thus handling the discussion from top-down approach. The current issue with common/independent beam is not related to timing requirements, however we are trying to change timing requirements here. Also, we need to understand the need for such strict MRTD requirement, e.g. 260ns. This will drive the deployment cost for operators. We also need to understand the impact on the network side with such MRTD requirement. Potentially, smaller MRTD may be required in the end for UEs with certain UE capability. However, those UEs should be identifiable by the network, such as only applicable to certain bands, etc.So, our opinion is that, we need to under the UE RF architectures in further details and the need for such revision of MRTD parameter should be motivated further before we consider any revision of the timing parameters. Recommendation item-2: Same reasoning as above, we propose to update the title as follows: “MRTD for FR2 inter-band CA with ~~non-collocated deployment~~ independent beam management”. In this case, we propose to keep the requirement same as Rel-15, i.e. option1:8us should be kept as it is now.  |
| Qualcomm | Recommendation item-1: Our comment on “common beam management” and “independent beam management” was stemming from the UE implementation. For some combinations, it is not feasible to have independent beams at the UE so in order to have CA, the UE can only use a common beam across beams(low+low bands are likely to be like this). This will “force” the deployment to be quai collocated(signals will have to come from the same direction) but this will apply only to certain band combinations and it has nothing to do with MRTD. For some band combinations, the UE will have independent Rx beams so this will result in some more flexibility in the deployment and this also has nothing to do with MRTD. The differentiation for this should be based on the frequency of the bands and not on the network deployment. If we differentiate based on deployment we will end up in the situation where we have UEs that can support CA in any deployment and UEs that can support CA only in a certain type of deployments(only co-located). This kind of fragmentation is highly undersirable.Our preference is to keep 8us for all cases.Recommendation item-2: Please see the comment above on differentiating CA scenarios. Should be based on the combination itself(e.g. low+low vs. low+high) and not based on deployment scenario. |
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## 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*

**Issue 1-1: MRTD value**

There is no concrete agreement on MRTD value for FR2 inter-band CA. It turns out that MRTD discuss is extended into different deployment scenarios, e.g. collocated and non-collocated, and different beam management schemes, e.g. common and independent beam management. Companies have different views if and how MRTD is relevant to the different deployment scenarios and different beam management schemes. At the same time, some companies indicate that common and independent beam management is still an ongoing topic. MRTD related impact should be revisited later.

With this, it is recommended to continue MRTD discussion in the next meeting.

The following proposal on scheduling restriction is agreeable and can be captured in chairman’s notes as an agreement.

Agreement: If the DL symbols are SSB symbols or CSI-RS symbols or RSSI symbols for mobility measurement, the R15 FR2 scheduling restriction requirement shall apply, and those DL symbols shall be prioritized than the UL transmission to serving cell.

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| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| R4-2002279 | *withdraw* |