**3GPP TSG-RAN WG4 Meeting #94-e R4-20xxxxx**

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

**Agenda item:** 8.14.1.5, 8.14.1.6, 8.14.1.8

**Source:** Moderator (Nokia)

**Title:** Email discussion summary for RAN4#94e\_#23\_NR\_RF\_FR2\_req\_enh\_Part\_4

**Document for:** Information

# Introduction

Scope of this email discussion is listed in Table 1. No contributions were submitted to AI 8.14.1.5 thus it is out scoped from email discussion.

In this meeting following open issues will be discussed

**Sub-topic 1 Intra-band non-contiguous UL CA**

1.1 Will non-simultaneous UL for non-contiguous UL CA be part of REL-16

1.2 draft CR for non-contiguous uplink CA including MPR and A-MPR table format

1.3 Beam squint analysis for FR2 PC3 UEs

**Sub-topic 2 Improvement of UE MPR**

2.1 Will output power boosting be part of REL-16

2.2 Correction of Inner Allocation Definition for Powerclass 3

2.3 Simplification of In-Band Emissions Requirements (Editorial)

**Sub-topic 3 Multi-band requirement framework for FR2**

3.1 Is MBR definition changed

3.2 from which release if it is

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

* 1st round: TBA
* 2nd round: TBA

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| 23 | RAN4#94e\_#23\_NR\_RF\_FR2\_req\_enh\_Part\_4 | R16 NR FR2 RF | * Intra-band contiguous UL CA * Intra-band non-contiguous UL CA * Improvement of UE MPR * Response to RAN5 LS on MBR | 8.14.1.5, 8.14.1.6, 8.14.1.8, and R4-2000021, R4-2000022, R4-2000235, R4-2000236, R4-2002091, R4-2002104, R4-2000200, R4-2000201, R4-2000202,R4-2000526, R4-2001234 |

# Topic #1: Intra-band non-contiguous UL CA

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000019 | Apple Inc. | **TDoc: Non-simultaneous UL for non-contiguous UL CA in FR2**  Observation 1: Aggregation of non-contiguous uplink carriers in FR2 into a simultaneous transmission has the potential to introduce a significant penalty to the UL link budget.  Observation 2: Aggregation of non-contiguous uplink carriers in FR2 into a non-simultaneous transmissions can give the network additional scheduling flexibility in terms of coverage spectrum utilization.  **Proposal 1: For SA CA scenarios FR1 (PCell) + FR2 (SCells) and EN-DC scenarios LTE (PCell) + FR1 (PScell) + FR2 (SCells), RAN4 confirms the feasibility of non-simultaneous Tx for FR2 intra-band NC UL CA and agrees to introduce a capability for the UE indicate to the network that it only supports non-simultaneous UL operation in NC UL CA.**  **Proposal 2: Further effort on NSU requirements can proceed according to the Rel-16 NR RRM work item scope and associated work plan.**  **Proposal 3: Non-simultaneous Tx for UL intra-band non-contiguous CA can support operation with the same frequency separation as the DL CCs; thus, the entire frequency separation class table can be applicable to UL CA with non-simultaneous operation.** |
| R4-2000509 | Nokia, Nokia Shanghai Bell | **TDoc: FR2 nc-in-ca MPR**  This is a discussion paper providing MPR simulation results for non-contiguous UL CA. Simulated cases are 50+50, 100+100, 200+200 and 100+100+100 MHz. Gating factor for MPR is mainly OBW and spurious emissions in case allocation is such that all sub-blocks have very narrow allocation. It seems that MPR can be defined agnostic of modulation however such way that CP-OFDM and DFT-s-OFDM could have different MPRs. MPR is limited to max 5 dB in all cases. |
| R4-2000693 | Qualcomm Incorporated | **TDoc: On using Rel-15 CA MPR table format for FR2 NC UL CA**  Observation 1: CABW does not distinguish between the UE’s separate capabilities to support bidirectional DL spectrum and DL-only spectrum, respectively.  Observation 2: For UEs with common R/T LOs, back-off requirements depend on the size of the bidirectional spectrum and remain insensitive to the presence of additional parallel Rx chains to support DL-only spectrum.  Observation 3: For Rel-16, CABW is obsolete as the determining parameter for CA MPR.  Observation 4: For UEs with distinct R/T LOs, back-off requirements are tied to the Tx IF BW, which is determined by the UL CA configuration alone, and independent of DL CA configuration  Observation 6: For UEs with common R/T LOs, DL frequency separation can replace CABW in the MPR tables for CA operation.  Observation 7: UEs with distinct R/T LOs can also use DL frequency separation to determine MPR  Observation 8: For UEs with distinct R/T LOs, if DL frequency separation replaced CABW in the MPR tables, MPR for DL frequency separation >1400MHz can adopt values used for 1400MHz  **Proposal 1: MPR and A-MPR tables shall be changed to depend on ‘DL frequency separation’, instead of ‘Cumulative Aggregated BW’**  **Proposal 2: MPR (and A-MPR, if appropriate) tables for NC CA shall accommodate DL frequency separation larger than 1400MHz.**  **Contribution proposes a template for NC CA MPR table for Rel-16.** |
| R4-2000694 | Qualcomm Incorporated | **TDoc:** **dCR to 38.101-2: Simultaneous NC UL CA framework for Rel-16**  **Reason for change: Introduce framework to accommodate simultaneous Rel-16 NC UL CA feature:**  1. Generalize section 5.3A for non-contiguous UL CA  2. Removal of dependence on CABW due to obsolescence R4-2000693. DL frequency separation is equivalent to CABW, and adopting DL FS decouples DL CA BW enhancement to UL CA  3. Introduction of supporting definitions  **Summary of change:**  1. Introduce definition of ‘frequency separation’  2. Introduce MPR requirements table for NC CA, values left for consensus in a future meeting.  3. Modify requirements that depend on CABW and replace with DL aggregated BW.  4. Modify MPR section for contiguous UL CA to make consistent with removal of CABW  5. Modify A-MPR section to make consistent with removal of CABW |
| R4-2002147 | Qualcomm Incorporated | **TDoc:** **Beam squint analysis for FR2 PC3 UEs**  **Proposal: RAN4 to discuss how to capture consideration for radiative degradation mechanisms like beam squint for larger frequency separation.** |
| R4-2000396  From AI 8.14.1.8 | Intel Corporation | TDoc: FR2 CA MPR improvement  **Proposal: In Rel-16 for both UL contiguous and non-contiguous CA, MPR values for 1400MHz <CABW ≤ 2400MHz should be kept the same with their corresponding MPR values for 800MHz ≤ CABW ≤ 1400MHz.** |

## 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: Non-simultaneous UL for non-contiguous UL CA in FR2

**Issue 1-1-1: Non-simultaneous UL for non-contiguous UL CA in FR2**

* Proposals
  + Option 1: RAN4 confirms the feasibility of non-simultaneous Tx for FR2 intra-band NC UL CA and agrees to introduce a capability for the UE indicate to the network that it only supports non-simultaneous UL operation in NC UL CA.
  + Option 2: Non-simultaneous UL for non-contiguous UL CA in FR2 is not part of REL16 and is removed from the WID
* Recommended WF
  + TBA

### Sub-topic 1-2: Simultaneous UL for non-contiguous UL CA in FR2

**Issue 1-2-1: MPR and A-MPR tables shall be changed to depend on ‘DL frequency separation’, instead of ‘Cumulative Aggregated BW’**

* Proposals
  + Option 1: **Yes**
  + Option 2: **No**
* Recommended WF
  + TBA

**Issue 1-2-2: MPR (and A-MPR, if appropriate) tables for NC CA shall accommodate DL frequency separation larger than 1400MHz**

* Proposals
  + Option 1: **Yes**
  + Option 2: **Yes and** **MPR values for 1400MHz <CABW ≤ 2400MHz should be kept the same with their corresponding MPR values for 800MHz ≤ CABW ≤ 1400MHz.**
  + Option 3: **No**
* Recommended WF
  + TBA

**Issue 1-2-3: Beam squint analysis for FR2 PC3 UEs**

* Proposals
  + Option 1: **RAN4 to discuss how to capture consideration for radiative degradation mechanisms like beam squint for larger frequency separation.**
  + Option 2: **No need to discuss how to capture consideration for radiative degradation mechanisms like beam squint for larger frequency separation.**
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |

### 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** |
| R4-2000694 | 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** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

*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)

## 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”* |

# Topic #2: Improvement of UE MPR

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000518 | Nokia, Nokia Shanghai Bell | **TDoc: FR2 boosting**  **Proposal 1: No output power boost is specified for PI/2 PBSK due to suspended IBE in REL16**  **Proposal 2: No output power boost is specified for QPSK due to suspended IBE in REL16** |
| R4-2002091 | Motorola Mobility España SA | **TDoc: Correction of Inner Allocation Definition for Powerclass 3**  **This is a CAT F CR.**  **Reason for change:** There are conflicting definitions of the the inner allocations for Powerclass 3 with bandwidth configurations <= 200 MHz. The second definition of the inner allocations conflicts with first definition.  **Summary of change:** Removes the second definition of inner allocations |
| R4-2002104 | Motorola Mobility España SA | **TDoc: Simplification of In-Band Emissions Requirements**  **This CAT D editorial CR ís not strictly speaking for MPR improvement but it was never the less allocated to this email thread. Given that it is CAT D should not be too big issue to have it here.**  **Reason for change:** The first term in the general in-band emissions requirement is no longer needed as this term is <= -25 dB and Note 1 sets the lower limit as no less than -25 dB. As a result, the first term of the general in-band emissions requirement is never used. |
|  |  |  |

## 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 2-1:Output power boosting when IBE is suspended

**Issue 2-1-1: Output power boosting when IBE is suspended for PI/2 PBSK**

* Proposals
  + Option 1: This feature is not part of REL16 and is removed from the WID
  + Option 2: This feature is kept in WID
* Recommended WF
  + TBA

**Issue 2-1-2: Output power boosting when IBE is suspended for QPSK**

* Proposals
  + Option 1: This feature is not part of REL16 and is removed from the WID
  + Option 2: This feature is kept in WID
* Recommended WF
  + TBA

### Sub-topic 2-2: Correction of Inner Allocation Definition for Powerclass 3

**Issue 1-2: Inner Allocation Definition for Powerclass 3**

* Proposals
  + Option 1: CR is agreed
  + Option 2: CR is not agreed
* Recommended WF
  + Option 1

### Sub-topic 2-3: Simplification of In-Band Emissions Requirements

**Issue 1-2: Simplification of In-Band Emissions Requirements**

* Proposals
  + Option 1: CR is agreed
  + Option 2: CR is not agreed
* Recommended WF
  + Option 1

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |

### 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** |
| R4-2002091 | Company A |
| Company B |
|  |
| R4-2002104 | 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.*

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

*Suggestion on WF/LS assignment*

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

### CRs/TPs

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

|  |  |
| --- | --- |
| **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)

## 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”* |

# Topic #3: Multi-band requirement framework for FR2

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000021 | Apple Inc. | **TDoc: Multi-band requirement framework for FR2 in Rel-16 and beyond**  Proposal 1: RAN4 shall introduce a maximum cap to the per-band relaxation factors, such that ∆MBP,n ≤ 0.75 dB and ∆MBS,n ≤ 0.75 dB.  Proposal 2: RAN4 shall introduce the changes to MBR in the Rel-15 specification. |
| R4-2000022 | Apple Inc. | **TDoc: [draft] LS response on Multiband relaxation for FR2**  **RAN4 informs RAN5 that**   * RAN4 shall introduce a maximum cap to the per-band relaxation factors, such that ∆MBP,n ≤ 0.75 dB and ∆MBS,n ≤ 0.75 dB * RAN4 shall introduce the changes to MBR in the Rel-15 specification. |
| R4-2000235 | Apple Inc. | **TDoc:** **Correction of the FR2 multi-band requirement framework**  **This is a CAT F CR to introduce the proposals in R4-2000021** |
| R4-2000200 | Qualcomm Incorporated, Verizon, Ericsson, Sony, Samsung | **TDoc: On LS from RAN5 on multi-band relaxations**  Observation 1: RAN5 concludes that the RAN4 framework of flexible band-specific relaxations is not feasible to implement  Observation 2: RAN5 concludes that it is untenable that RAN4 retains flexibility to increase the maximum allowed MBP and MBS in the future  Observation 3: Instituting an upper limit on MBP and MBS is neither feasible nor a sufficient solution  Observation 4: Instituting per-band limits (MB) on multiband relaxation solves RAN5’s problems with MBR, while practically preserving cumulative relaxations (MB) and allowing future growth in supported bands.  **Proposal 1: Change Rel-15 multiband relaxation framework from table 6.2.1.3-4 in TS38.101-2 v15.8 to per-band allowance in table below:**   |  |  |  | | --- | --- | --- | | **Band** | **MBP (dB)** | **MBS (dB)** | | n257 | 0.73 | 0.73 | | n258 | 0.6 | 0.7 | | n260 | 0.51 | 0.41 | | n261 | 0.52,4 | 0.74 | | Note 1: n260 peak and spherical relaxations are 0 dB for UE that exclusively supports n261+n260  Note 2: n261 peak relaxation is 0 dB for UE that exclusively supports n261+n260  Note 3: n257 peak and spherical relaxations are 0 dB for UE that exclusively supports n261+n257  Note 4: n261 peak and spherical relaxations are 0 dB for UE that exclusively supports n261+n257 | | | |
| R4-2000201 | Qualcomm Incorporated | **TDoc: Reply to LS R5-199424 on FR2 Multiband Relaxations** |
| R4-2000202 | Qualcomm, Verizon, Ericsson, Sony, Samsung | **TDoc: CR to 38.101-2: Revision to Multiband Relaxations**  **REL15 CAT F CR to introduce the content of R4-2000200** |
| R4-2000203 | Qualcomm, Verizon, Ericsson, Sony, Samsung | **TDoc: CR to 38.101-2: Revision to Multiband Relaxations**  **REL16 CAT A CR to introduce the content of R4-2000200** |
| R4-2000526 | Nokia, Nokia Shanghai Bell | **TDoc: Discussion on RAN5 LS on Multiband relaxation for FR2**  **Proposal: Multi-band relaxations are removed from REL-16 38.101-2 and are not applicable for REL-16 and beyond UEs. Inform RAN5.** |
| R4-2001234 | OPPO | **TDoc: About multi-band relaxation tests**  Observation 1: RAN5 found the problem in multi-band relaxation, i.e. UE may declare support several bands and apply larger relaxation values but actually only certify part of the supported bands.  Observation 2: GCF might confront with the issue found by RAN5 due to its certification mechanism, while PTCRB can solve it by testing all the bands that UE supports.  Observation 3: Any changes to the multi-band relaxation will probably cause other requirements are impacted.  **Proposal 1: Encourage GCF could adopt flexible solutions in their certification, for example like PTCRB does to avoid the multi-band relaxation certification issue.**  Observation 4: RAN5 could use relatively larger relaxation value at the beginning to avoid of re-evaluating issue.  **Proposal 2: Encourage RAN5 to adopt a relatively larger values from the testability perspective at beginning to avoid possible future new bands caused testability re-evaluation issue.** |

## 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 3-1: Multi-band requirement framework for FR2

**Issue 1-1: Does Multi-band requirement framework needs some enhancements**

* Proposals
  + Option 1: No because GCF could adopt flexible solutions in their certification and RAN5 adopt a relatively larger values from the testability perspective at beginning
  + Option 2: Yes, some enhancements are needed
* Recommended WF
  + TBA

**Issue 1-1: If Multi-band requirement framework needs some enhancements**

* Proposals
  + Option 1: Keep current format but introduce a cap to the per-band relaxation factors
  + Option 2: Change the format as in R4-2000200. Relaxation is defined per band and it is same no matter what band combinations UE supports, with the exceptions listed in notes. Change is from REL-15
  + Option 3: Remove the Multi-band requirement framework from REL16 specification
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |

### 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** |
| R4-2000235 | Company A |
| Company B |
|  |
| R4-2000202 | Company A |
| Company B |
|  |
| R4-2000203 | 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.*

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

*Suggestion 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 provided recommendation on CRs/TPs Status update suggestion*

|  |  |
| --- | --- |
| **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)

## 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”* |