**3GPP TSG-RAN WG4 Meeting # 98-bis-e R4-210XXXX**

**Electronic Meeting, 12th – 20th April, 2021**

**Agenda item:** 8.2.1

**Source:** Moderator (Huawei, HiSilicon)

**Title:** Email discussion summary for [98-bis-e][128]NR\_RF\_FR1\_enh\_Part\_1

**Document for:** Information

# Introduction

*Briefly introduce background, the scope of this email discussion (e.g. list of treated agenda items) and provide some guidelines for email discussion if necessary.*

Thread [128] includes following topics:

1. Topic #1: UL MIMO configuration for SUL band configurations as in 8.2.2.1
2. Topic #2: intra-band contiguous UL CA for FR1 power class 2 which is for agenda 8.2.2.4
3. Topic #3: intra-band NC UL CA for FR1 power class 2 which is for agenda 8.2.2.5
4. Topic #4: Intra-band UL contiguous CA for UL MIMO which is for agenda 8.2.2.6

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

* 1st round:
* Align the MPR values of PC2 intra-band UL contiguous CA for 1PA architecture
* Discuss on different views of MPR for 2\*23dBm PA architecture, to get some initial consensus
* Decide on the RF architecture options for intra-band UL NC CA
* Agree on some other RF requirements, and signalling issue for intra-band UL NC CA
* Agree on the RF requirement items for UL CA+UL MIMO
* 2nd round: TBA
* Try to have some initial agreements for MPR of contiguous UL CA
* Reach agreement on RF architecture for intra-band UL NC CA
* Agree on the baseline on evaluating the MPR/AMPR for intra-band UL NC CA
* Try to agree on draft CR for PC3 intra-band UL CA+UL MIMO
* Get consensus on the SUL and UL switching time left issue

# Topic #1: UL MIMO configuration for SUL band configurations

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2104637 | ZTE | Draft CR:Reason for change: The switching time between SUL and NUL cannot be 0us if enabling UL-MIMO for SULSummary of change: Change Note 1 in Table 5.3C-1/2/3/4 |

## 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

*Sub-topic description:*

*Open issues and candidate options before e-meeting:*

**Issue 1-1: Whether 0µs switching time is feasible between SUL and NUL when SUL is MIMO enabled?**

* Proposals
	+ Not feasible
* Recommended WF
	+ TBA

**Issue 1-2: Note 1 of Table 5.2C-1, 5.2C-2, 5.2C-3 and 5.2C-4 in TS 38.101-1**

* Proposals
	+ Change Note1 as in R4-2104637
* Recommended WF
	+ TBA

## Companies views’ collection for 1st round

### Open issues

Sub topic 1-1

**Issue 1-1: Whether 0µs switching time is feasible between SUL and NUL when SUL is MIMO enabled?**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| OPPO | Not feasible. |

Sub topic 1-2

**Issue 1-2: Note 1 of Table 5.2C-1, 5.2C-2, 5.2C-3 and 5.2C-4 in TS 38.101-1**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| OPPO | Agree with the change. |

### CRs/TPs comments collection

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

|  |  |
| --- | --- |
| **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.*

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

### CRs/TPs

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

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

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

# Topic #2: PC2 intra-band 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** |
| R4-2104655 | Nokia | 1PA architecture is assumed, MPR simulation results are provided on following configurations:* 20MHz+20MHz 15kHz SCS and 50MHz+50MHz 15kHz SCS (class B), and
* 60MHz+100MHz 30kHz SCS and 100MHz+100MHz 30kHz SCS (class C).

No IBE or EVM was evaluated. |
| R4-2104994 | LGE | **Proposal 1: Based on the MPR results, we propose following MPR Table for PC2 NR intra-band contiguous CA UE with contiguous RB allocation.**

|  |  |  |
| --- | --- | --- |
| Modulation | MPR for bandwidth class B(dB) | MPR for bandwidth class C(dB) |
|  | inner | outer | inner | outer |
| DFT-s-OFDM | Pi/2 BPSK | 1.0 | 3.5 | 2.5 | 7 |
| QPSK | 1.0 | 3.5 | 2.5 | 7 |
| 16QAM | 1.5 | 3.5 | 2.5 | 7 |
| 64QAM | 3.0 | 4.0 | 5 | 7 |
| 256QAM | 5.5 | 6.0 | 7 | 7.5 |
| CP-OFDM | QPSK | 2.0 | 4.0 🡪4.5 | 3.5 | 8 |
| 16QAM | 2.5 | 4.0 🡪4.5 | 3.5 | 8 |
| 64QAM | 3.5 | 4.0 🡪4.5 | 5 | 8 |
| 256QAM | 6.5 | 6.5 | 7 | 8 |

**Proposal 2. We propose MPR Table for PC2 NR intra-band contiguous CA UE with non-contiguous RB allocation.**

|  |  |  |
| --- | --- | --- |
| Modulation | MPR for bandwidth class B(dB) | MPR for bandwidth class C(dB) |
| inner | Outer11 | Outer22 | inner | Outer11 | Outer22 |
| DFT-s-OFDM | Pi/2 BPSK | 2 🡪3 | 5.5 🡪 6.5 | 11.5 🡪 13.0 | 2.5🡪3 | 6🡪 6.5 | 13 |
| QPSK | 2🡪3 | 5.5 🡪 6.5 | 2.5🡪3 | 6🡪 6.5 |
| 16QAM | 2.5🡪3 | 5.5 🡪 6.5 | 3 | 6🡪 6.5 |
| 64QAM | 4.5 | 6 🡪 6.5 | 5 | 6🡪 6.5 |
| 256QAM | 6 | 6.5 | 6.5 | 6.5 |
| CP-OFDM | QPSK | 2.5 🡪3 | 6.5 🡪 7.0 | 12 🡪14.0 | 3.5 | 7 | 14 |
| 16QAM | 3 | 7 | 3.5 | 7 |
| 64QAM | 5 | 7 | 5 | 7 |
| 256QAM | 7.5 | 7.5 | 7.5 | 7.5 |
| NOTE 1: Outer 1 MPR for Pi/2 BPSK and QPSK is reduced by 2dB for aggregated allocation bandwidth > 10MHz NOTE 2: Outer 2 MPR is reduced by 4.5dB for aggregated allocation bandwidth > 10MHz |

 |
| R4-2106304 | Skyworks | **Proposal 1 on MPR requirements:*** **The 2x100MHz PC2 PA+ 2LO architecture uses the same MPR than the baseline 200MHz single PC2 PA + 1LO case, is limited to bandwidth class D and should not drive higher MPR/A-MPR values.**
* **The 2x200MHz PC3 PA+1LO case has a dedicated MPR table covering both TxDiv and UL MIMO operation and should be treated under the intra-band UL contiguous CA for UL MIMO objective.**

**Proposal 2 on contiguous allocations PC2 class B and C UL CA MPR:*** **The following MPR table is adopted for PC2 contiguous allocation MPR (changes from PC3 highlighted in yellow)**

|  |  |  |
| --- | --- | --- |
| Modulation | MPR for bandwidth class B(dB) | MPR for bandwidth class C(dB) |
| inner | outer | inner | outer |
| DFT-s-OFDM | Pi/2 BPSK | 2.5 | 3.5 | 2.5 | 7 |
| QPSK | 2.5 | 3.5 | 2.5 | 7 |
| 16QAM | 2.5 | 3.5 | 2.5 | 7 |
| 64QAM | 3.0 | 4.0 | 5 | 7 |
| 256QAM | 5.5 | 6.0 | 7 | 7.5 |
| CP-OFDM | QPSK | 3 | 5 | 3.5 | 8 |
| 16QAM | 3 | 5 | 3.5 | 8 |
| 64QAM | 3.5 | 5 | 5 | 8 |
| 256QAM | 6.5 | 6.5 | 7 | 8 |

**Proposal 3 on contiguous allocations NS04 PC2 class C A-MPR:*** **NS04 A-MPR = MPR for outer class C PC2**
* **NS04 A-MPR = MPR+0.5dB for inner class C PC2 when RBstart ≤ 0.33\*BWchannel\_CA/0.18MHz**
* **NS04 A-MPR = MPR for inner class C PC2 when RBstart > 0.33\*BWchannel\_CA/0.18MHz**

**Proposal 4 on non-contiguous allocations MPR:*** **PC3 QPSK MPR is adopted for PC2 (1Tx) with additional back-off as in Table 6.2A.2.1-3 below (yellow highlight)**

Table 6.2A.2.1-3: non-contiguous RB allocation for Power Class 2

|  |  |  |
| --- | --- | --- |
| Modulation | MPR for bandwidth class B(dB) | MPR for bandwidth class C(dB) |
| inner | Outer11 | Outer22 | inner | Outer11 | Outer22 |
| DFT-s-OFDM | Pi/2 BPSK | 3 | 6.5 | 13 | 3 | 6.5 | 13 |
| QPSK | 3 | 6.5 | 3 | 6.5 |
| 16QAM | 3 | 6.5 | 3 | 6.5 |
| 64QAM | 4.5 | 6.5 | 5 | 6.5 |
| 256QAM | 6 | 6.5 | 6.5 | 6.5 |
| CP-OFDM | QPSK | 3 | 7 | 14 | 3.5 | 7 | 14 |
| 16QAM | 3 | 7 | 3.5 | 7 |
| 64QAM | 5 | 7 | 5 | 7 |
| 256QAM | 7.5 | 7.5 | 7.5 | 7.5 |
| NOTE 1: Outer 1 MPR for Pi/2 BPSK and QPSK is reduced by 2dB for aggregated allocation bandwidth > 10MHz NOTE 2: Outer 2 MPR is reduced by 4.5dB for aggregated allocation bandwidth > 10MHz |

**Proposal 5 on non-contiguous allocations NS04 A-MPR:*** **For channels and allocations where IM3 is within the -13dBm/MHz NS04 region, the PC2 MPR is sufficient**
* **PC2 (1Tx) NS04 A-MPR for outer 1 and outer 2 with IM3 in -25dBm/MHz region is 15.5 for B<2.16**
* **All SEM limited allocations will see the back-off increase for PC2 vs PC3 but ACLR limited region will stay the same thus the following AMPR curve are proposed: AMPRIM3 to meet -25dBm/MHz**

**MA = 15.5; 0 ≤ B < 2.16** **14; 2.16 ≤ B < 3.24****13; 3.24 ≤ B < 5.04****11.5; 5.04 ≤ B < 10.08** **10; 10.08 ≤ B < 16.56** **8; 16.56 ≤ B < 21.96****6; 21.96 ≤ B****Proposal 6 on removal of inner for non-contiguous allocation and addition of edge contiguous allocation for Class B MPR:*** **The 2x26dBm 2LO architecture should not drive the bandwidth class B MPR nor the baseline MPR for bandwidth class B.**
* **Inner allocation should not be removed from BW Class B non-contiguous allocation**
* **Edge allocation addition to BW class B contiguous allocation should be further justified and if introduced restricted to the relevant cases.**
 |
| R4-2107260 | Huawei, HiSilicon | ***Proposal 1: Define MPR for PC2 contiguous CA as in table 1 for contiguous RB allocation.***

|  |  |  |
| --- | --- | --- |
| Modulation | MPR for bandwidth class B(dB) | MPR for bandwidth class C(dB) |
|  | inner | outer | inner | outer |
| DFT-s-OFDM | Pi/2 BPSK |  |  |  |  |
|  | QPSK | 2.5 | 5.5 | 3 | 7 |
|  | 16QAM | 3 | 5.5 | 3 | 7 |
|  | 64QAM | 3.0 | 5.5 | 5 | 7 |
|  | 256QAM | 5.5 | 6.0 | 7 | 7.5 |
| CP-OFDM | QPSK | 3.0 | 6.5 | 4 | 8 |
|  | 16QAM | 3.5 | 6.5 | 4 | 8 |
|  | 64QAM | 3.5 | 6.5 | 5 | 8 |
|  | 256QAM | TBD | TBD | TBD | TBD |

***Proposal 2: Define MPR for PC2 contiguous CA as in table 2 for non-contiguous RB allocation.***

|  |  |  |
| --- | --- | --- |
| Modulation | MPR for bandwidth class B(dB) | MPR for bandwidth class C(dB) |
|  | inner | Outer11 | Outer22 | inner | Outer11 | Outer22 |
| DFT-s-OFDM | Pi/2 BPSK | 3 | 7 | 13 | 3.5 | 8 | 15 |
|  | QPSK | 3 | 7 |  | 3.5 | 8 |  |
|  | 16QAM | 3 | 7 |  | 3.5 | 8 |  |
|  | 64QAM | 4.5 | 7 |  | 5 | 8 |  |
|  | 256QAM | 6 | 7 |  | 6.5 | 8 |  |
| CP-OFDM | QPSK | 4 | 7.5 | 14 | 3.5 | 8.5 | 15 |
|  | 16QAM | 4 | 7.5 |  | 3.5 | 8.5 |  |
|  | 64QAM | 5 | 7.5 |  | 5 | 8.5 |  |
|  | 256QAM | 7.5 | 7.5 |  | 7.5 | 8.5 |  |
| NOTE 1: Outer 1 MPR for Pi/2 BPSK and QPSK is reduced by 2dB for aggregated allocation bandwidth > 10MHz NOTE 2: Outer 2 MPR is reduced by 4.5dB for aggregated allocation bandwidth > 10MHz |

***Proposal 3: introduce edge RB case for contiguous allocation. MPR for edge RB is FFS.*** |
| R4-2107370 | Qualcomm | **Proposal 1: Use contiguous ULCA MPR for contiguous allocations for PC2 as shown in Table 2.2.1-1 based on 1PA reference architecture.**

|  |  |  |
| --- | --- | --- |
| Modulation | MPR for bandwidth class B(dB) | MPR for bandwidth class C(dB) (IE declare2A absent) |
| inner | outer | edge | inner | outer |
| DFT-s-OFDM | Pi/2 BPSK | 1.0 | 3.5  | [5.5] | 2.0 | 4.0 |
| QPSK | 1.0 | 3.5 | [5.5] | 2.0 | 4.0 |
| 16QAM | 1.5 | 3.5 | [5.5] | 3.0 | 4.5 |
| 64QAM | 3.0 | 4.0 | [5.5] | 4.0 | 4.5 |
| 256QAM | 5.5 | 6.0 | [FFS] | [FFS] |
| CP-OFDM | QPSK | 2.0 | 4.0 | [5.5] | 3.0 | 5.5 |
| 16QAM | 2.5 | 4.0 | [5.5] | 3.5 | 5.5 |
| 64QAM | 3.5 | 4.0 | [5.5] | 5.5 | 5.5 |
| 256QAM | 6.5 | 6.5 | [FFS] | [FFS] |

**Proposal 2: Use contiguous ULCA MPR for non-contiguous allocations for PC2 as shown in Table 2.2.2-1 regardless of PA architecture.**

|  |  |  |
| --- | --- | --- |
| Modulation | MPR for bandwidth class B(dB) | MPR for bandwidth class C(dB) (IE declare2A absent or not absent) |
|  | inner/ Outer11 | Outer22 | inner | Outer11 | Outer22 |
| DFT-s-OFDM | Pi/2 BPSK |  | 5.5 | 11.5 |  5.5 |  8.5 | 13 |
| QPSK |  | 5.5 |  5.5 |
| 16QAM |  | 5.5 |  5.5 |
| 64QAM |  | 6 |  5.5 |
| 256QAM |  | 6.5 |  6.5 |
| CP-OFDM | QPSK |  | 6.5 | 12 |  5.5 |  8.5 | 14 |
| 16QAM |  | 7 |  5.5 |
| 64QAM |  | 7 |  5.5 |
| 256QAM |  | 7.5 |  7.5 |
| NOTE 1: Outer 1 MPR for Pi/2 BPSK and QPSK is reduced by 2dB for aggregated allocation bandwidth > 10MHz NOTE 2: Outer 2 MPR is reduced by 4.5dB for aggregated allocation bandwidth > 10MHz. 256QAM MPR reduction is [FFS]. |

 |

## 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: MPR for contiguous RB allocation

*Sub-topic description:*

*Open issues and candidate options before e-meeting:*

**Issue 2-1-1: inner and outer MPR for Bandwidth class B**

*Moderator note：All proposed values are not less than the MPR defined for PC3*

* Proposals：Green coloured number seems aligned among companies

|  |  |  |
| --- | --- | --- |
| BW class B | Inner | Outer |
| Modulation | PC3 in R16 | Skws | QC | HW | LGE | Nokia(In figure) | PC3 in R16 | Skws | QC(no edge) | HW | LGE | Nokia(In figure) |
| DFT | QPSK | 1 | 2.5 | 1 | 2.5 | 1 |  | 3.5 | 3.5 | 3.5 | 5.5 | 3.5 |  |
| 16QAM | 1.5 | 2.5 | 1.5 | 3 | 1.5 |  | 3.5 | 3.5 | 3.5 | 5.5 | 3.5 |  |
| 64QAM | 3 | 3 | 3 | 3 | 3 |  | 4 | 4 | 4 | 5.5 | 4 |  |
| 256QAM | 5.5 | 5.5 | 5.5 | 5.5 | 5.5 |  | 6 | 6 | 6 | 6 | 6 |  |
| CP | QPSK | 2 | 3 | 2 | 3 | 2 |  | 4 | 5 | 4 | 6.5 | 4.5 |  |
| 16QAM | 2.5 | 3 | 2.5 | 3.5 | 2.5 |  | 4 | 5 | 4 | 6.5 | 4.5 |  |
| 64QAM | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |  | 4 | 5 | 4 | 6.5 | 4.5 |  |
| 256QAM | 6.5 | 6.5 | 6.5 | TBD | 6.5 |  | 6 | 6.5 | 6.5 | TBD | 6.5 |  |

* Recommended WF
	+ TBA

**Issue 2-1-2: inner and outer MPR for Bandwidth class C**

*Moderator note：one set of proposed values is less than current PC3 MPR.*

* Proposals：

|  |  |  |
| --- | --- | --- |
| BW class C | Inner | Outer |
| Modulation | PC3 in R16 | Skws | QC | HW | LGE | Nokia(In figure) | PC3 in R16 | Skws | QC | HW | LGE | Nokia(In figure) |
| DFT | QPSK | 2.5 | 2.5 | 2 | 3 | 2.5 |  | 7 | 7 | 4 | 7 | 7 |  |
| 16QAM | 2.5 | 2.5 | 3 | 3 | 2.5 |  | 7 | 7 | 4.5 | 7 | 7 |  |
| 64QAM | 5 | 5 | 4 | 5 | 5 |  | 7 | 7 | 4.5 | 7 | 7 |  |
| 256QAM | 7 | 7 | TBD | 7 | 7 |  | 7.5 | 7.5 | FFS | 7.5 | 7.5 |  |
| CP | QPSK | 3.5 | 3.5 | 3 | 4 | 3.5 |  | 8 | 8 | 5.5 | 8 | 8 |  |
| 16QAM | 3.5 | 3.5 | 3.5 | 4 | 3.5 |  | 8 | 8 | 5.5 | 8 | 8 |  |
| 64QAM | 5 | 5 | 5.5 | 5 | 5 |  | 8 | 8 | 5.5 | 8 | 8 |  |
| 256QAM | 7 | 7 | TBD | TBD | 7 |  | 8 | 8 | TBD | TBD | 8 |  |

* Recommended WF
	+ TBA

**Issue 2-1-3: Edge RB**

* Proposals：
	+ Option 1: Define edge RB for Bandwidth class B
	+ Option 2: Define edge RB for Bandwidth class B and class C
	+ Option 2: no need to define edge RB, it can be combined with outer allocation
	+ Option 3: need further justified and if introduced restricted to the relevant cases
* Recommended WF
	+ TBA

### Sub-topic 2-2: MPR for non-contiguous RB allocation

*Sub-topic description*

*Open issues and candidate options before e-meeting:*

**Issue 2-2-1: MPR for Bandwidth class B**

*Moderator note：All proposed values are not less than the MPR defined for PC3*

* Proposals

|  |  |  |
| --- | --- | --- |
| BW class B | **Inner** | **Outer1** |
| Modulation | PC3 | Skws | QC | HW | LGE | Nokia | PC3 | Skws | QC | HW | LGE | Nokia |
| DFT | QPSK | 2 | 3 | 5.5 | 3 | 3 |  | 5.5 | 6.5 | 5.5 | 7 | 6.5 |  |
| 16QAM | 2.5 | 3 | 5.5 | 3 | 3 |  | 5.5 | 6.5 | 5.5 | 7 | 6.5 |  |
| 64QAM | 4.5 | 4.5 | 6 | 4.5 | 4.5 |  | 6 | 6.5 | 6 | 7 | 6.5 |  |
| 256QAM | 6 | 6 | 6.5 | 6 | 6 |  | 6.5 | 6.5 | 6.5 | 7 | 6.5 |  |
| CP | QPSK | 2.5 | 3 | 6.5 | 4 | 3 |  | 6.5 | 7 | 6.5 | 7.5 | 7 |  |
| 16QAM | 3 | 3 | 7 | 4 | 3 |  | 7 | 7 | 7 | 7.5 | 7 |  |
| 64QAM | 5 | 5 | 7 | 5 | 5 |  | 7 | 7 | 7 | 7.5 | 7 |  |
| 256QAM | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 |  | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 |  |
| BW class B | **Outer2** |
| Modulation | PC3 | Skws | QC | HW | LGE | Nokia |
| DFT | QPSK | 11.5 | 13 | 11.5 | 13 | 13 |  |
| 16QAM |  |
| 64QAM |  |
| 256QAM |  |
| CP | QPSK | 12 | 14 | 12 | 14 | 14 |  |
| 16QAM |  |
| 64QAM |  |
| 256QAM |  |

* Recommended WF
	+ TBA

**Issue 2-2-2: MPR for Bandwidth class C**

* Proposals

|  |  |  |
| --- | --- | --- |
| BW class C | Inner | Outer1 |
| Modulation | PC3 | Skws | QC | HW | LGE | Nokia | PC3 | Skws | QC | HW | LGE | Nokia |
| DFT | QPSK | 2.5 | 3 | 5.5 | 3.5 | 3 |  | 6 | 6.5 | 8.5 | 8 | 6.5 |  |
| 16QAM | 3 | 3 | 5.5 | 3.5 | 3 |  | 6 | 6.5 | 8 | 6.5 |  |
| 64QAM | 5 | 5 | 5.5 | 5 | 5 |  | 6 | 6.5 | 8 | 6.5 |  |
| 256QAM | 6.5 | 6 | 6.5 | 6.5 | 6.5 |  | 6.5 | 6.5 | 8 | 6.5 |  |
| CP | QPSK | 3.5 | 3.5 | 5.5 | 3.5 | 3.5 |  | 7 | 7 | 8.5 | 8.5 | 7 |  |
| 16QAM | 3.5 | 3.5 | 5.5 | 3.5 | 3.5 |  | 7 | 7 | 7 |  |
| 64QAM | 5 | 5 | 5.5 | 5 | 5 |  | 7 | 7 | 7 |  |
| 256QAM | 7.5 | 7.5 | 7.5 | 7.5 | 7.5 |  | 7.5 | 7.5 | 7.5 |  |
| BW class B | Outer2 |
| Modulation | PC3 | Skws | QC | HW | LGE | Nokia |
| DFT | QPSK | 13 | 13 | 13 | 15 | 13 |  |
| 16QAM |  |
| 64QAM |  |
| 256QAM |  |
| CP | QPSK | 14 | 14 | 14 | 15 | 14 |  |
| 16QAM |  |
| 64QAM |  |
| 256QAM |  |

* Recommended WF
	+ TBA

**Issue 2-2-3: Combine inner and outer 1 for Bandwidth class B?**

* Proposals
	+ Option 1: Yes
	+ Option 2: No
* Recommended WF
	+ TBA, companies please provide the reason for choosing the option.

### Sub-topic 2-3: MPR for 2\*23dBm 200MHz PA

**Issue 2-3-1: MPR for 2\*23dBm 200MHz PA and 1LO**

* Proposals
	+ Option 1: Define the MPR under intra-band UL contiguous CA for UL MIMO objective, and a dedicated MPR table is defined
	+ Option 2: BW class C MPR is independent of PA architecture.
* Recommended WF
	+ TBA

**Issue 2-3-2: MPR for 2\*23dBm 100MHz PA and 2LO**

* Proposals
	+ Option 1: The 2x100MHz PC2 PA+ 2LO architecture uses the same MPR than the baseline 200MHz single PC2 PA + 1LO case, is limited to bandwidth class D and should not drive higher MPR/A-MPR values.
* Recommended WF
	+ TBA

### Sub-topic 2-4: AMPR for NS\_04

**Issue 2-4-1: Contiguous allocation**

* Proposals
	+ From R4- R4-2106304:
* **NS04 A-MPR = MPR for outer class C PC2**
* **NS04 A-MPR = MPR+0.5dB for inner class C PC2 when RBstart ≤ 0.33\*BWchannel\_CA/0.18MHz**
* **NS04 A-MPR = MPR for inner class C PC2 when RBstart > 0.33\*BWchannel\_CA/0.18MHz**
* Recommended WF
	+ TBA

**Issue 2-4-2: Non-Contiguous allocation**

* Proposals
	+ From R4- R4-2106304:
* **For channels and allocations where IM3 is within the -13dBm/MHz NS04 region, the PC2 MPR is sufficient**
* **PC2 (1Tx) NS04 A-MPR for outer 1 and outer 2 with IM3 in -25dBm/MHz region is 15.5 for B<2.16**
* **All SEM limited allocations will see the back-off increase for PC2 vs PC3 but ACLR limited region will stay the same thus the following AMPR curve are proposed: AMPRIM3 to meet -25dBm/MHz**

**MA = 15.5; 0 ≤ B < 2.16**

 **14; 2.16 ≤ B < 3.24**

**13; 3.24 ≤ B < 5.04**

**11.5; 5.04 ≤ B < 10.08**

 **10; 10.08 ≤ B < 16.56**

 **8; 16.56 ≤ B < 21.96**

**6; 21.96 ≤ B**

* Recommended WF
	+ TBA

## Companies views’ collection for 1st round

### Open issues

Sub-topic 2-1

**Issue 2-1-1: inner and outer MPR for Bandwidth class B**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| LGE | LGE can acceptable for the revised MPR table with green color by Moderator  |
| Ericsson | A general comment: unlike for LTE and contiguous UL CA in FR2, the MPRc per serving cell c for contiguous and non-contiguous UL CA in FR1 (PC3) *still* apply when the UE is configured with CA whereas the total power can be reduced by up to MPR ≥ MPRc for the supported power class. In practice this means that the power levels of all serving cells can be reduced due to the power prioritization rules in 38.213. Example: if the UE reaches PCMAX as determined by the allowed MPR for CA, then the PCell power can be reduced below this level even if the MPRc < MPR for the PCell, and all SCell power levels can be further reduced or SCell(s) dropped. From 38.101-1 (note the second paragraph)6.2A.4.1.1 Configured transmitted power for Intra-band contiguous CAFor uplink carrier aggregation the UE is allowed to set its configured maximum output power PCMAX,*c* for serving cell *c* and its total configured maximum output power PCMAX.The configured maximum output power PCMAX,*c* on serving cell *c* shall be set as specified in clause 6.2.4, MPR*c* and A-MPR*c* are determined by clause 6.2.2. There is one power management term for the UE, denoted P-MPR, and P-MPR*c* = P-MPR. The total configured maximum output power PCMAX shall be set within the following bounds:Moreover, if all SCells are dropped (PCMAX exceeded), does the MPR as determined by the UL grants and “equal PSD” for all active serving cells or the MPRc apply for the PCell? In the latter case the allowed power reduction would be smaller (it is recognized that the UE is still configured for CA).The same applies for the non-contiguous case.  |

**Issue 2-1-2: inner and outer MPR for Bandwidth class C**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| LGE | The worst MPR value can be define the MPR requirement among interested companies’ results |

**Issue 2-1-3: Edge RB**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| LGE | Prefer option 2 or option 3. |

Sub-topic 2-2

**Issue 2-2-1: MPR for Bandwidth class B**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| LGE | LGE can acceptable for the revised MPR table with green color by Moderator. Other MPR value can be consider with worst MPR values among interested companies’ results |

**Issue 2-2-2: MPR for Bandwidth class C**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| LGE | LGE can acceptable for the revised MPR table with green color by Moderator. Other MPR value can be consider with worst MPR values among interested companies’ results |

**Issue 2-2-3: Combine inner and outer 1 for Bandwidth class B?**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| LGE | Prefer option 2 to keep the existing PC3 MPR table format. |

Sub-topic 2-3

**Issue 2-3-1: MPR for 2\*23dBm 200MHz PA and 1LO**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| LGE | Prefer option 2. Need more discussion to decide more detail RF architecture |
| OPPO | Option 1, Define the MPR under intra-band UL contiguous CA for UL MIMO objective, and a dedicated MPR table is defined. |
| Ericsson | The MPR should be the same for 1TX PC2 and PC2 supported by 2 x 23 dBm. The latter should not drive increased MPR. We note that in general, PC2 already has a relaxed lower tolerance (+2/-3 dB instead of +2/-2 dB for PC3). |

**Issue 2-3-2: MPR for 2\*23dBm 100MHz PA and 2LO**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| OPPO | The title is incorrect, should be 2\*100MHz PC2 PA and 2LO? The Option 1 is ok to use same MPR for 2x100MHz PC2 PA+ 2LO as baseline. |

Sub-topic 2-4

**Issue 2-4-1: Contiguous allocation**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| LGE | Need more A-MPR results from companies |

**Issue 2-4-2: Non-Contiguous allocation**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| LGE | Need more A-MPR results from companies |

### 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** |
| 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.*

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

### 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)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

# Topic #3: PC2 intra-band NC 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** |
| R4-2104437 | Nokia | **Proposal: In case RAN4 develops PC2 intra band non-contiguous CA requirements, challenges to develop MPR requirements and re-consideration of exception for general spurious emission/SEM should be considered.** |
| R4-2104819 | Skyworks | **Proposal on architecture:*** **Baseline architecture #1 (2x26dBm x2LO) is used to derive MPR/A-MPR values without accounting for the issues of other architectures and can be started immediately.**
* **Architecture #3 (2x23dBm 1LO + TxDiv/UL MIMO) requires additional MPR, further study to handle exceptions and is better pursued in the new WI addressing UL MIMO and TxDiv issues as done for the contiguous UL CA + UL MIMO case. It anyhow deserves a separate MPR/A-MPR specification than baseline.**
* **Architecture #2 (1x26dBm 1LO) has similar issues than #3 with slightly lower back-off required and can be covered together with #3 for the MPR table.**
* **Architecture #4 (26dBm+23dBm 2LO) has significant drawbacks in terms of switching time and MPR for questionable benefits.it is proposed not to pursue this option.**
 |
| R4-2106366 | ZTE | Proposal 1: Use the single CC parameter for the capability of MaxUplinkDutyCycle for PC2 intra-band contiguous CA. Proposal 2: Pcmax: re-use Pcmax from PC3 intra-band NC UL CA:- Changes to 38.101-1, if any, are FFSProposal 3:For PC2 intra-band UL non-contiguous CA with 2PA architecture, the emission requirement is defined as the sum from both UE transmit antenna connectors. |
| R4-2106542 | Xiaomi | Proposal 1: for high power UE TDD intra-band contiguous and non-contiguous CA cases, it is proposed no dedicated signaling is introduced and the reporting value maxUplinkDutyCycle-PC2-FR1 signaling for single carrier can be reused.Proposal 2: if proposal 1 is agreeable, the LS as attached in the annex is needed to inform RAN2 above agreements. |
| R4-2107261 | Huawei, HiSilicon | Observation 1: #2 and #3 architecture can support UL NC CA, and #3 can support UL MIMO for NC CA in nature. Band limitation of <3.3GHz can be removed.Proposal 1: for #2 and #3 architecture, reuse the in-gap exception requirement defined for PC3 intra-band UL NC CA.Observation 2: #4 architecture can support intra-band UL NC CA, it may need Tx swap time when transmission scheduling are switching among 3 cases in fig 1. The switching time can be 0us or 35us or 140us.Proposal 2: All the 4 architectures should be kept in the WI study, RAN4 should evaluate MPR requirements based on all architectures, and check whether 1 set of MPR can be used for all architectures. |
| R4-2107282 | Qualcomm | Proposal 1: Do not consider 2x23 dBm case for NC UL CA PC2Proposal 2: 1x26 dBm case for NC UL CA is not considered in MPR evaluation until carrier leakage handling is clarified. |
| R4-2105088 | Ericsson | <this contribution relates to new solution for preventing scell dropping>**Observation 1: the power prioritization rules in 38.213 imply that the power control for UL CA is similar to that of EN-DC for which the MCG is prioritized subject to a total EN-DC power, the PCMAX for EN-DC. For UL CA, the total SCell power would be capped at 23 dBm and the SCell(s) reduced or dropped for a concurrent PCell transmissions at 23 dBm that is of equal or higher priority. This affects the actual power reductions (back-off) used on the UL serving cells and an MPR specification based on “equal PSD”.****Observation 2: preventing SCell power reductions and “equal PSD” in conformance tests can be achieved by specifying limits relative to the configured power for the serving cells. This would account for the *actual* power back-off (up to MPR and same for all serving cells) that is applied by the UE. The UE-specific limits are configured by RRC and could be activated and deactivated by a MAC-CE.** |

## 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: Architecture options handling

*Sub-topic description:*

*Open issues and candidate options before e-meeting:*

**Issue 3-1-1: For 1x26dBm PA + 1LO with 200MHz BW and 2x23dBm PA + 1LO with 200MHz BW, how to handle in-gap requirement when LO or image fall inside?**

* Proposals
	+ Option 1: Reuse in-gap exception under some conditions(e.g. Sync) as defined for PC3
	+ Option 2: use MPR to meet in-gap emission requirement
	+ Option 3: other
* Recommended WF
	+ TBA

**Issue 3-1-2: For 1x23dBm + 1x26dBm PA + 2LO with 100MHz BW, how to handle the swap time between PAs?**

* Proposals
	+ Option 1: define new swap time specifically for this architecture
	+ Option 2: swap time is 0us
	+ Option 3: 0us or 35us or 140us
* Recommended WF
	+ TBA

**Issue 3-1-3: architecture option(s) for intra-band UL NC CA: architecture No. is as in the table**

|  |  |
| --- | --- |
| Arch | description |
| #1 | 2x26dBm PA + 2LO with 100MHz BW |
| #2 | 1x26dBm PA + 1LO with 200MHz BW |
| #3 | 2x23dBm PA + 1LO with 200MHz BW |
| #4 | 1x23dBm+1x26dBm + 2LO with 100MHz BW |

* Proposals
	+ Option 1: All 4 architectures need to be studied on RF requirements
	+ Option 2: #1 and #4 are considered
	+ Option 3: #1,#2 and #3
	+ Option 4: Other
* Recommended WF
	+ TBA

### Sub-topic 3-2: MPR

**Issue 3-2-1: MPR comparison among architecture options**

<Recommend discussion on the analysis provided in R4-2104819>

* Proposals
* Compared with MPR based on architecture #1, Architecture #3 (2x23dBm 1LO + TxDiv/UL MIMO) requires additional MPR
* Architecture #2 (1x26dBm 1LO) has similar issues than #3 with slightly lower back-off required
* Compared with MPR based on architecture #1, Architecture #4 requires for higher MPR
* Recommended WF
	+ TBA

**Issue 3-2-2: baseline architecture to derive MPR/AMPR**

* Proposals
	+ Option 1:
* Baseline architecture #1 (2x26dBm x2LO) is used to derive MPR/A-MPR values
* Architecture #3 (2x23dBm 1LO + TxDiv/UL MIMO) is better pursued in the new objective addressing UL MIMO and TxDiv issues as done for the contiguous UL CA + UL MIMO case.
	+ Option 2: All architectures need to be considered on MPR/AMPR, and check whether 1 set of MPR can be used for all architectures.
	+ Option 3: Other
* Recommended WF
	+ TBA

### Sub-topic 3-3: MaxUplinkDutyCycle Signalling

**Issue 3-3-1: MaxUplinkDutyCycle Signalling for intra-band UL NC CA**

* Proposals
	+ No dedicated signaling is introduced, the reporting value of maxUplinkDutyCycle-PC2-FR1 signaling for single carrier can be reused.
* Recommended WF
	+ TBA

**Issue 3-3-2: LS**

* Proposals
	+ Option 1: send the LS with contents in R4-2106542 annex
	+ Option 2: send the LS after some revision of R4-2106542 annex
	+ Option 3: other
* Recommended WF
	+ TBA

### Sub-topic 3-4: RF requirements other than MPR

**Issue 3-4-1: Pcmax**

* Proposals
	+ re-use Pcmax from PC3 intra-band NC UL CA:

- Changes to 38.101-1, if any, are FFS

* Recommended WF
	+ TBA

**Issue 3-4-2: emission requirement**

* Proposals
	+ For PC2 intra-band UL non-contiguous CA with 2PA architecture, the emission requirement is defined as the sum from both UE transmit antenna connectors.
* Recommended WF
	+ TBA

###  Sub-topic 3-5: other

**Issue 3-5-1: Are discussions of R4-2105088 in the current scope of Rel-17 FR1 RF enh WID?**

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

**Issue 3-5-2: If ‘no’ of issue 3-5-1, do we need to add “preventing scell power dropping in conformance test” into the WID?**

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

## Companies views’ collection for 1st round

### Open issues

Sub topic 3-1

**Issue 3-1-1: For 1x26dBm PA + 1LO with 200MHz BW and 2x23dBm PA + 1LO with 200MHz BW, how to handle in-gap requirement when LO or image fall inside?**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| LGE | Prefer option 1 to reuse same approach in PC3 |
| OPPO | Either option 1 (*Reuse in-gap exception under some conditions (e.g. Sync) as defined for PC3*) and option 2 (*use MPR to meet in-gap emission requirement*) are ok, and more prefer Option 1. |

**Issue 3-1-2: For 1x23dBm + 1x26dBm PA + 2LO with 100MHz BW, how to handle the swap time between PAs?**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| LGE | Prefer option 3 for switching time 0us/35us/140us |
| OPPO | Option 1. This case only related to PA switch, comparing to the Tx switching feature less time is expected. |

**Issue 3-1-3: architecture option(s) for intra-band UL NC CA: architecture No. is as in the table**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| LGE | Prefer option 1 to keep all 4 candidate RF architecture for MPR/A-MPR requirements |
| OPPO | Option 3, i.e. #1,#2 and #3 architecture can be considered. |

Sub topic 3-2

**Issue 3-2-1: MPR comparison among architecture options**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| LGE | LGE acceptable Moderator proposal for this issue |
| OPPO | Ok with proposal. |

**Issue 3-2-2: baseline architecture to derive MPR/AMPR**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| LGE | Prefer option 2 to consider all RF architectures |
| OPPO | Option 2 is preferred (All architectures need to be considered on MPR/AMPR, and check whether 1 set of MPR can be used for all architectures). If go with Option 1 (Baseline architecture #1 (2x26dBm x2LO) is used to derive MPR/A-MPR) then this means UE architectures need to be differentiated by signalling, this hasn’t been discussed whether it is desired or not. |
| Ericsson | Option 2 or Option 3. The network should be able to derive expected MPR based the CA configuration, the supported power and the BCS conveyed in the BC capability, not the UE architecture or LO configuration. |

Sub topic 3-3

**Issue 3-3-1: MaxUplinkDutyCycle Signalling for intra-band UL NC CA**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| LGE | Acceptable moderator proposal |
| OPPO | Ok with reuse single carrier signalling. This has already been agreed? |
| Ericsson | Reuse single-carrier signalling. |

**Issue 3-3-2: LS**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| OPPO | Option 1 |
| Ericsson | Option 3: we don’t need to tell RAN2 that they should do nothing, unless we would like to extend the applicability of an existing field to include CA configurations. The existing field applies per band. |

Sub topic 3-4

**Issue 3-4-1: Pcmax**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| LGE | Acceptable moderator proposal |
| OPPO | Ok with proposal, i.e. re-use Pcmax from PC3 intra-band NC UL CA: - Changes to 38.101-1, if any, are FFS |

**Issue 3-4-2: emission requirement**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| LGE | Acceptable moderator proposal |
| OPPO | Ok with proposal, i.e. For PC2 intra-band UL non-contiguous CA with 2PA architecture, the emission requirement is defined as the sum from both UE transmit antenna connectors. |

Sub topic 3-5

**Issue 3-5-1: Are discussions of R4-2105088 in the current scope of Rel-17 FR1 RF enh WID?**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| OPPO | Option 2 (no). The Scell dropping related testing issue was discussed in FR2 and the outcome is an LS (R4-2103124) goes to RAN5 to clarify that equal PSD is the condition to derive MPR/AMPR and no changes to FR2 RAN4 spec. Similar issue also happens in FR1, and probably no changes are needed either? |
| Ericsson | Option 1. Yes, the discussions do not only concern a method for preventing SCell dropping. According to the WF “equal PSD” is assumed for the specification of the MPR for the total signal. However, if the UE is power limited (PCMAX exceeded) the UE will prioritize transmissions amongst the serving cells (PCell or any other serving-cell transmission with higher priority), which means that the UE PSD would be unequal. Regarding compliance with unwanted emissions, the “equal PSD” case is not the worst case given a total UE output power but should nevertheless cover all cases. This is obviously relevant for the MPR evaluation for UL CA and hence in the scope of the WID. Another consequence of 38.213: if SCells are dropped, does the (higher) MPR for the CA configuration still apply for the remining PCell? See the comment on sub-topic 2-1-1.The UE will follow the behaviour specified in 38.213, this may have an impact on MPR determination regardless of any proposed methods for preventing SCell dropping. |

**Issue 3-5-2: If ‘no’ of issue 3-5-1, do we need to add “preventing scell power dropping in conformance test” into the WID?**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| OPPO | Option 2 (no). No change was made for FR2, and similarly no change probably needs to FR1. |
| Ericsson | This is a RAN discussion but the same issues in conformance tests for FR1 – and in the field (even more importantly) – as for the corresponding FR2 case. Note that the cell-specific P-Max cannot be used in this case for limiting e.g. the PCell power, not even for conformance testing. |

### 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** |
| 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.*

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

### 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)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

# Topic #4: Intra-band UL contiguous CA for UL MIMO

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2104956 | vivo | **Proposal 1:** Extend most of the requirements of UL-MIMO + Intra-band C CA based on current configuration and basic requirements.**Proposal 2**: For MPR and Transmit modulation quality requirements, special attention and some study is needed for UL-MIMO + Intra-band C CA.**Proposal 3**: The detailed case-by-case requirements analysis in Table 1be used as a basis for the requirments definition.Table 1. Tx Characteristics Background and analysis for UL-MIMO + Intra-band UL C CA

|  |  |  |  |
| --- | --- | --- | --- |
| **Tx characteristics** | **UL-MIMO**  | **Intra-band UL C CA** | **UL-MIMO +** **Intra-band UL C CA** |
| UE maximum output power | 6.2D.1Per-UE (Sum of each Tx) | 6.2A.1.1Per-UE (Sum of each CC) | Per-UE(Sum of all Tx and CC) |
| UE maximum output power reduction | 6.2D.2Per-UE[Requirements under discussion] | 6.2A.2.1Per-UE | [FFS, Per-UE but requirements need study] |
| UE addition maximum output power reduction | 6.2D.3Per-UE | 6.2A.3.1.1Per-UE | Per-UE |
| Configured transmitted power | 6.2D.4Per-UE, defined for one CC | 6.2A.4.1.1Per-UE | Per-UE |
| Minimum output power  | 6.3D.1Per-UE | 6.3A.1.1Per-carrier | Per-carrier, sum of 2Tx |
| Transmit OFF power | 6.3D.2Per connector | 6.3A.2.1Per-carrier | Per-carrier per connector |
| Transmit ON/OFF time mask | 6.3D.3Per connector | 6.3A.3.1Per-carrier | Per-carrier per connector |
| Power control  | 6.3D.4Per-UE | 6.3A.4.1Per-carrier | Per-carrier, sum of 2Tx |
| Frequency error | 6.4D.1Per connector | 6.4A.1.1Per-carrier | Per-carrier per connector |
| Transmit modulation quality (EVM, Carrier leakage, IBE and EVM spectrum flatness) | 6.4D.2[Per antenna connector. Under discussion] | 6.4A.2.1Both active and RB allocation in one carrier | [FFS] |
| Time alignment error  | 6.4D.3Difference between 2Tx | N/A | [N/A] |
| Requirements for coherent | 6.4D.4Difference between 2Tx | N/A | [N/A] |
| Occupied bandwidth  | 6.5D.1Per-UE | 6.5A.1.1aPer-UE | Per-UE |
| Out of band emission | 6.5D.2Per-UE | 6.5A.2.2.1Per-UE  | Per-UE |
| Spurious emission  | 6.5D.3Per-UE | 6.5A.3Per-UE | Per-UE |
| Transmit intermodulation | 6.5D.4Per connector | 6.5A.4.2.1Per-UE | Per connector, 2carreirs active |

 |
| R4-2106562 | OPPO | ***Observation 1: For UL CA+UL MIMO, the potential UE architecture is two PAs with each PA supporting the aggregated CBW.******Proposal 1: Take the two PAs architecture with each PA supporting the aggregated CBW as baseline to define requirements.******Observation 2: When UE indicates it supports UL CA+UL MIMO feature, the supported aggregated CBW shall also be clear to NW.******Proposal 2: Consider reporting the supported aggregated CBW within UL CA+UL MIMO feature to NW.******Observation 3: Requirements for UL MIMO only considered 100MHz, requirements for UL CA only considered single layer transmission, both may not be applicable directly to UL CA+UL MIMO.*** |
| R4-2107274 | Huawei, HiSilicon | **Proposal 1: For intra-band contiguous UL CA with MIMO, RF requirements with following configuration is defined:*** **2 layer configuration with codebook TPMI index 0.**
* **1 layer 2 port configuration with full power transmission: mode 0/1/2**
* **Tx diversity**

**Proposal 2: For power class3, intra-band UL contiguous CA in MIMO** **RF requirements are defined as in [1]. ->** draft CR R4-2107278**Proposal 3: RAN4 Evaluate PC2 intra-band UL contiguous CA in MIMO from the start of PC3 MPR requirement.**  |
| R4-2107278 | Huawei, HiSilicon | Provide draft CR for power class 3 intra-band UL contiguous CA for UL MIMO |

## 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 4-1: RF requirements framework

*Sub-topic description:*

*Open issues and candidate options before e-meeting:*

**Issue 4-1-1: Configurations for CA+UL MIMO requirements**

* Proposals
	+ RF requirements with following configuration is defined:
* 2 layer configuration with codebook TPMI index 0.
* 1 layer 2 port configuration with full power transmission: mode 0/1/2
* Tx diversity
* Recommended WF
	+ TBA

**Issue 4-1-2: RF requirement items to be defined for CA+UL MIMO requirements**

* Proposals

|  |  |
| --- | --- |
| **Tx characteristics** | **UL-MIMO +** **Intra-band UL C CA** |
| UE maximum output power | Per-UE(Sum of all Tx and CC) |
| UE maximum output power reduction | [FFS, Per-UE but requirements need study] |
| UE addition maximum output power reduction | Per-UE |
| Configured transmitted power | Per-UE |
| Minimum output power  | Per-carrier, sum of 2Tx |
| Transmit OFF power | Per-carrier per connector |
| Transmit ON/OFF time mask | Per-carrier per connector |
| Power control  | Per-carrier, sum of 2Tx |
| Frequency error | Per-carrier per connector |
| Transmit modulation quality (EVM, Carrier leakage, IBE and EVM spectrum flatness) | [FFS] |
| Occupied bandwidth  | Per-UE |
| Out of band emission | Per-UE |
| Spurious emission  | Per-UE |
| Transmit intermodulation | Per connector, 2carreirs active |

* Recommended WF
	+ TBA

**Issue 4-1-3: Baseline RF architecture**

* Proposals
	+ Two PAs architecture with each PA supporting the aggregated CBW
* Recommended WF
	+ TBA

### Sub-topic 4-2: MPR

**Issue 4-2: MPR**

* Proposals
	+ PC3 intra-band UL contiguous CA in MIMO reuse the MPR defined for PC3 contiguous CA
	+ For PC2 intra-band UL contiguous CA in MIMO, Evaluate value of delta MPR needed from the start of PC3 MPR requirement.
* Recommended WF
	+ TBA

### Sub-topic 4-3 signalling

*Sub-topic description*

*Open issues and candidate options before e-meeting:*

**Issue 4-3: Signalling**

* Proposals
* Report the supported aggregated CBW within UL CA+UL MIMO feature to NW(R4-2106562)
* Recommended WF
	+ TBA

### Sub-topic 4-4 Draft CR

*Sub-topic description*

*Open issues and candidate options before e-meeting:*

**Issue 4-4: Draft CR for PC3 intra-band UL contiguous CA for UL MIMO**

* Proposals
* Option 1: Endorse draft CR R4-2107278
* Option 2: Endorse the draft CR after revision
* Option 3: other
* Recommended WF
	+ TBA

## Companies views’ collection for 1st round

### Open issues

Sub topic 4-1

**Issue 4-1-1: Configurations for CA+UL MIMO requirements**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| OPPO | Ok with proposal, i.e. UL MIMO, TxD and 1layer two port configurations needs to be considered since the main point is for CA+2Tx even in the WID it is CA+UL MIMO. |
| Ericsson | Wait until the discussions on TX diversity for the non-CA case are concluded.  |

**Issue 4-1-2: RF requirement items to be defined for CA+UL MIMO requirements**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| OPPO | FFS, Requirements for UL MIMO only considered 100MHz, requirements for UL CA only considered single layer transmission, both may not be applicable directly to UL CA+UL MIMO. |

**Issue 4-1-3: Baseline RF architecture**

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| --- | --- |
| **Company** | **Comments** |
| OPPO | Ok with proposal, i.e. Two PAs architecture with each PA supporting the aggregated CBW |

Sub topic 4-2

**Issue 4-2: MPR**

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| --- | --- |
| **Company** | **Comments** |
| OPPO | Requirements for PC3 UL CA only considered single layer Tx, the IMD might happen in UL CA+UL MIMO which leads to more MPR, therefore, MPR defined for PC3 contiguous CA can be used as starting point but not reuse directly. |

Sub topic 4-3

**Issue 4-3: Signalling**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| OPPO | Currently the UL CA bandwidth class is reported via *ca-BandwidthClassUL-NR*, however, it doesn’t consider the UL MIMO impact. For UE with two PAs, it can support for example 200MHz UL CA without UL MIMO or it can support 100MHz with UL MIMO. However, with current one UL CA bandwidth capability reported, NW cannot know the restriction of UL MIMO configuration. If NW simultaneously configure UE with CA+MIMO, then this UE needs to use two PAs to support the aggregated 200MHz CBW but MIMO is not possible. The aggregated CBW under UL CA+UL MIMO feature shall be clear to NW. |

Sub topic 4-4

**Issue 4-4: Draft CR for PC3 intra-band UL contiguous CA for UL MIMO**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| OPPO | Same comment as issue 4-2. Requirements for PC3 UL CA only considered single layer Tx, the IMD might happen in UL CA+UL MIMO which leads to more MPR, therefore, MPR defined for PC3 contiguous CA can be used as starting point but not reuse directly. |

### 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** |
| 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.*

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

### 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)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on … | YYY |  |
| LS on … | ZZZ | To: RAN\_X; Cc: RAN\_Y |
|  |  |  |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation**  | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics incl. existing and new tdocs.
2. For the Recommendation column please include one of the following:
	1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
	2. Other documents: Agreeable, Revised, Noted
3. For new LS documents, please include information on To/Cc WGs in the comments column
4. Do not include hyper-links in the documents

## 2nd round

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation**  | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-210xxxx | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-210xxxx | LS on … | ZZZ | Agreeable, Revised, Noted |  |
|  |  |  |  |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics.
2. For the Recommendation column please include one of the following:
	1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
	2. Other documents: Agreeable, Revised, Noted
3. Do not include hyper-links in the documents