**3GPP TSG-RAN WG4 Meeting #97-e R4-20XXXX**

**Electronic Meeting, Nov .2nd – 13th 2020**

**Agenda item:** 12.2.1

**Source:** Huawei, HiSilicon

**Title:** Email discussion summary for RAN4#97\_#133\_NR\_RF\_FR1\_enh\_Part\_1

**Document for:** Information

# Introduction

This part includes contributions in agenda 12.2.1, 12.2.1.1 and 12.2.1.4.

Classify the contents into 3 topics:

1. Topic #1: Work Plan
2. Topic #2: UL MIMO configuration for SUL band configurations as in 12.2.1.1
3. Topic #3: intra-band contiguous UL CA for FR1 power class 2 which is for agenda 12.2.1.4

Candidate target of email discussion are as below:

* 1st round:
	+ Make agreement on work plan
	+ Reach consensus on enabling UL MIMO configuration for SUL
	+ Reach consensus on intra-band contiguous UL CA PC2
* 2nd round:
	+ Approve on the CR/LS for enabling UL MIMO configuration for SUL
	+ Approve on the WF for intra-band contiguous UL CA HPUE

#  Topic #1: Work plan for Rel-17 FR1 UE RF enhancement

*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** |
| R4-2016540 | Huawei, HiSilicon | This paper provides Work Plan on Rel-17 FR1 UE RF enhancement according to the time budget agreed in RAN#89 meeting. |

## Open issues summary

### Sub-topic 1-1 Work plan for Rel-17 FR1 UE RF enhancement

**Issue 1-1: Work plan**

* **Proposals: Agree on the work plan in R4-2016540**
* **Recommended WF**
	+ TBA

## Companies views’ collection for 1st round

### Open issues

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| **Sub-topic** | **Comments: (Company: …)** |
| 1-1 |  |
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### 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** |
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## 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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| Sub-topic#1 | *Recommendations for 2nd round:* |
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*Recommendations on WF/LS assignment*

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|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
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### 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**  |
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## Discussion on 2nd round (if applicable)

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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*

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| **CR/TP/LS/WF number** | **Title** | **T-doc Status update recommendation** |
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# Topic #2: UL MIMO configuration for SUL band configurations

*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** |
| R4-2014735 | CMCC | Summary of change:1. Section 5.2D: Introduce band n80 in the table of NR operating bands for UL-MIMO in Table 5.2D-1.
2. Section 6.2D: Introduce band n80 in UL MIMO configuration in Table 6.2D.1-1
3. Section 5.2C: Remove Note 3 for SUL band combination in Table 5.2C-1 and Table 5.2C-2 (For UE supporting SUL band combination, UL MIMO is not configured on SUL carrier)
 |
| LS R4-2014736 | CMCC | LS to RAN2:Remove restrictions of RAN2 specifications (38.331 and 38.306) on configuring UL MIMO for SUL bands. |
| R4-2015181 | ZTE | Observation 1: SAR issue may become more severe if enabling UL-MIMO support for SUL, in particular at a higher power class.Proposal 1: RAN4 introduce the missing power class definition for an SUL band combination before the UL-MIMO and 2Tx switching support is enabled for SUL. |
| R4-2015284 | Huawei | Proposal 1: Void note 3 in both table 5.2C-1 and 5.2C-2 in TS 38.101-1 to enable UL MIMO configuration on SUL carriers.Proposal 2: Send an LS to RAN2 tasking corresponding removal of the restrictions against configuring UL MIMO on SUL carriers and UE indicating correct UL MIMO capabilities for SUL bands.Proposal 3: Add n80 into table 5.2D-1 UL MIMO band list in TS 38.101-1.Proposal 4: Establish a new basket WI for introduction of bands supporting UL MIMO according to operators’ requests in Rel-17. |

## Open issues summary

### Sub-topic 2-1: enable UL MIMO configuration on SUL carriers in TS 38.101

**Issue 2-1-1: Revision on TS 38.101 to enable MIMO configuration for SUL**

* Proposals
	+ revise the spec as proposed in R4-2015284:
		- Void note 3 in both table 5.2C-1 and 5.2C-2 in TS 38.101-1
		- Add n80 into table 5.2D-1 and 6.2D UL MIMO band list in TS 38.101-1
* Recommended WF
	+ **TBA**

**Issue 2-1-2: new basket WI for introduction of bands supporting UL MIMO**

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

**Issue 2-1-3: Whether introducing SUL BC power class is a prerequisite to enabling UL MIMO configuration on SUL bands?**

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

### Sub-topic 2-2: LS to RAN2 on removing restrictions for SUL MIMO

**Issue 2-2-1: Send the LS to RAN2(CC RAN1) as proposed in R4-2014736**

* Proposals
	+ **Option 1:** Yes, contents for the LS follows R4-2014736
	+ **Option 2:** other
* Recommended WF
	+ **TBA**

## Companies views’ collection for 1st round

### Open issues

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| **Sub-topic** | **Comments: (Company: …)** |
| 2-1 | **Issue 2-1-1:** |
| **Issue 2-1-2** |
| **Issue 2-1-3** |
| 2-2 | **Issue 2-2-1:** |

### 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** |
| R4-2014735 | Company A |
| Company B |
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## 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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| **Sub-topic** | **Status summary**  |
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*Suggestion on WF/LS assignment*

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

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

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| **CR/TP number** | **CRs/TPs Status update recommendation**  |
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## Discussion on 2nd round (if applicable)

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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*

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| T-doc number | Title | **T-doc Status update recommendation** |
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# Topic #3: PC2 intra-band contiguous UL CA

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2014392 | CATT | Observation 1: Duty cycle based solution and fall back/P-MPR solution were chosen for the closed HPUE topics.Observation 2: The RAN1 transmission power priority considers both physical channels and cells. It’s difficult to say which cell of Pcell or Scell should be prioritized.Proposal 1: Duty cycle based SAR solution is used by TDD intra-band contiguous UL CA.Proposal 2: Total duty cycle capability for the two UL carriers can be reported to the network.Proposal 3: TDD intra-band contiguous UL CA total duty cycle capability can be defined referring TDD single carrier HPUE duty cycle capability, i.e. 50% is the default total duty cycle capability and the reported IE can be defined as ENUMERATED {n60, n70, n80, n90, n100}.Observation 3: The solution for the UE behaviour when the scheduling is beyond UE duty cycle capability and/or the capability is absent needs more discussion. |
| R4-2014508 | Skyworks | **Proposal 1 on HPUE architecture for class C contiguous UL CA:****• A single TX PC2 PA is the baseline to develop requirement****• Additional requirement for two PC3 PAs architecture is FFS once single CC related requirements are finalized.****Proposal 2 on ACLR and SEM requirements for PC2 contiguous UL CA:****• PC2 ACLR is PC3 ACLR+1 dB at 31 dB****• PC2 SEM is the same as for PC3.*****Furthermore, back-off measurements are presented for contiguous and non-contiguous allocation MPR and A-MPR.*****Proposal 3 on contiguous allocations:****• Contiguous Inner and Outer allocations definition for PC3 is adopted for PC2 (1Tx)****• PC3 QPSK Inner MPR is adopted for PC2 (1Tx)****• PC3 QPSK Outer MPR is adopted for PC2 (1Tx) with a potential reduction due to better ACLR****• PC2 (1Tx) NS04 A-MPR is FFS but larger than PC3 especially for some inner allocation.****Proposal 4 on non-contiguous allocations:****• Contiguous Inner, Outer1 and Outer 2 allocations definition for PC3 is adopted for PC2****• PC3 QPSK MPR is adopted for PC2 (1Tx) with 1 dB additional back-off****• PC2 (1Tx) NS04 A-MPR is FFS but larger than PC3 especially for some inner allocation.** |
| R4-2015038 | ZTE | Observation 1: Rx RF requirements are not impacted.Proposal 1: No changed for the spectrum emission mask and additional spurious emission requirements, regardless of the RF implementation architectures Proposal 2: The UE maximum output power is 26dBm+ +/-2dB, regardless of the RF implementation architectures Proposal 3: Same requirement for PC2 single carrier (i.e. ACLR=31dB) is re-used for PC2 intra-band contiguous UL CA.Observation 2: P-MPR solution can be used as basedline SAR solution Proposal 4. For duty cycle based solutions, report duty cycle of PCell. Proposal 5: A new parameter i.e ΔPPowerClass needs to be introduced on top of the currently PC3 PCMAX\_L equations in case of the duty cycle solution is identified. |
| R4-2015261 | Xiaomi | Proposal 1: required changes for TS 38.101-1 in table 1 shall be considered when HP UE intra-band contiguous CA is introduced.Observation 1: power class is defined per band other than per CCProposal 2: no need to consider different power class configuration of each CC for HP UE intra-band contiguous CA.Proposal 3: the mechanism for single carrier for PC2 to meet SAR requirments can be reused for high power UE intra-band contiguous CA. |
| R4-2015326 | Vivo | **Observation 1**: The SAR control scheme is one issue that need to be solved for TDD intra-band contiguous UL CA.**Observation 2**: Intra-band EN-DC (TDD-TDD) scheme can be considered somehow similar to UL CA case in that similar restrictions for two carriers for in-device co-existence.**Observation 3**: It is already recommended in the WID that “*- Mechanism for HPUE on single carrier can be a start point considering the same UL-DL configuration assumption*”.**Proposal 1**: Optionally report one UL duty cycle threshold or reuse the capability for single carrier case, make mandatory power class back off if actual transmission exceeded.**Proposal 2**: Conceptually, one carrier transmission in intra-band contiguous CA configuration can also be regarded as CA transmission if needed in requirements definition.**Proposal 3**: For default case without the capability reporting, default value solution which is identical to NR single carrier case can be reused.**Proposal 4**: Do not consider any power class fallback optimization since it was already down scoped. |
| R4-2015354 | OPPO | 2.1 Basic configurationsObservation 1: In Rel-15, same UL/DL configuration and synchronized scenario are adopted for intra-band EN-DC based on the NW deployment reality.Proposal 1: It is proposed to adopt same UL/DL configuration and synchronized condition for Rel-17 intra-band contiguous UL CA HPUE.2.2 UE architectureObservation 2: In Rel-15, dual PA architecture was adopted as reference for the intra-band EN-DC HPUE.Observation 3: There is possibility that UE might use single PA with 200MHz or two PAs with 100MHz each to support PC2 CA.Proposal 2: It is proposed to consider two UE reference architectures for intra-band contiguous UL CA HPUE, one is single PA with 200MHz, the other is two PAs with 100MHz each.2.3 power classObservation 4: The power class definition between single CC and intra-band contiguous CA are same as the discussion in UL MIMO/TxD and should be clarified from the beginning.Proposal 3: It is proposed to assume same power class for CA and single CC to simplify the discussion.2.4 SARObservation 5: SAR effects for the two CCs in intra-band contiguous CA are same which makes reusing the solution of SA single band HPUE is possible.Proposal 4: It is proposed to reuse the solution of SA single band HPUE SAR solution, i.e. based on the reported maxUplinkDutyCycle capability.2.5 MPR/AMPRObservation 6: The discussions in Rel-15 B41+n41 intra-band contiguous EN-DC can be used as a reference for two PA architecture scenario. |
| R4-2016537 | Huawei, HiSilicon | ***Proposal 1: use type2 architecture as the default assumption for PC2 intra-band contiguous UL CA, i.e. 2PA architecture, each PA supports up to 200MHz, assumes 23dBm+23dBm, 1LO.*** ***Observation 1: if UE supports PC2 for 2 contiguous CCs on Band A, it should support PC2 for single carrier on Band A.*** ***Proposal 2: Band set for PC2 contiguous CA is the subset of bands for PC2 single carrier.******Proposal 3: Multiple sets of Band combination capability are indicated if PA architecture is different for power class2 and 3 for a certain intra-band combination.******Proposal 4: RAN4 study whether CA UL MIMO RF requirement is specified in TS 38.101-1.*** |

## Open issues summary

### Sub-topic 3-1 architecture baseline and power class signaling

**Issue 3-1-1: RF architecture baseline**

* Proposals
	+ Option 1: A single TX PC2 PA is the baseline to develop requirement
	+ Option 2: two UE reference architectures for intra-band contiguous UL CA HPUE, one is single PA with 200MHz, the other is two PAs with 100MHz each.
	+ Option 3: 2PA architecture, each PA supports up to 200MHz, assumes 23dBm+23dBm, 1LO.
* Recommended WF
	+ TBA

**Issue 3-1-2: Relation between PC2 for single carrier and contiguous CA**

* Proposals
	+ Option 1: Assume same power class for CA and single CC to simplify the discussion.
	+ Option 2: Band set for PC2 contiguous CA is the subset of bands for PC2 single carrier.

**Issue 3-1-3: Power class signalling for intra-band contiguous UL CA**

* Proposals
	+ Option 1: No need to consider different power class configuration of each CC for HP UE intra-band contiguous CA.
	+ Option 2: Multiple sets of Band combination capability are indicated if PA architecture is different for power class2 and 3 for a certain intra-band combination.

### Sub-topic 3-2 RF requirements

**Issue 3-2-1: MPR/AMPR**

* Proposals
	+ Option 1: Rel-15 B41+n41 intra-band contiguous EN-DC can be used as a reference for two PA architecture scenario
	+ Option 2:

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| **1PA architecture*** **on contiguous allocations:**
	+ **Contiguous Inner and Outer allocations definition for PC3 is adopted for PC2 (1Tx)**
	+ **PC3 QPSK Inner MPR is adopted for PC2 (1Tx)**
	+ **PC3 QPSK Outer MPR is adopted for PC2 (1Tx) with a potential reduction due to better ACLR**
* **on non-contiguous allocations:**
	+ **Contiguous Inner, Outer1 and Outer 2 allocations definition for PC3 is adopted for PC2**
	+ **PC3 QPSK MPR is adopted for PC2 (1Tx) with 1 dB additional back-off**
 |

* Recommended WF
	+ TBA

**Issue 3-2-2: UL-DL configuration**

* Proposals
	+ Adopt same UL/DL configuration and synchronized condition for Rel-17 intra-band contiguous UL CA HPUE.
* Recommended WF
	+ TBA

**Issue 3-2-3: ACLR**

* Proposals
	+ 31dB
* Recommended WF
	+ 31dB

**Issue 3-2-4: SEM/Spurious emission/ASE**

* Proposals
	+ Same as for PC3
* Recommended WF
	+ Same as for PC3

**Issue 3-2-5: Power class definition for PC2**

* Proposals
	+ Option 1: 26dBm with +/-2dB torlerance
	+ Option 2: other
* Recommended WF
	+ TBA

**Issue 3-2-6: Whether CA UL MIMO requirement is needed?**

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

### Sub-topic 3-3 solution for SAR issue

*Sub-topic description*

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

**Issue 3-3-1: Solution for TDD contiguous UL CA**

* Proposals
* Option 1: Duty cycle based SAR solution is used. Total duty cycle capability for the two UL carriers can be reported to the network.
* Option 2: P-MPR solution can be used as basedline SAR solution. For duty cycle based solutions, report duty cycle of PCell.
* Option 3: Other
* Recommended WF
	+ TBA

**Issue 3-3-2: If duty cycle based SAR solution, how to define the UE capability？**

* Proposals
	+ Option 1: New Total duty cycle capability：50% is the default total duty cycle capability and the reported IE can be defined as ENUMERATED {n60, n70, n80, n90, n100}.
	+ Option 2: Reuse the capability for single carrier case
	+ Option 3: Other
* Recommended WF
	+ TBA

**Issue 3-3-3: Is there need for power class fallback optimization?**

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

## Companies views’ collection for 1st round

### Open issues

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| **Sub-topic** | **Comments (Company: …)** |
| 3-1 | **Issue 3-1-1** |
| **Issue 3-1-2** |
| **Issue 3-1-3** |
| 3-2 | **Issue 3-2-1** |
| **Issue 3-2-2** |
| **Issue 3-2-3** |
| **Issue 3-2-4** |
| **Issue 3-2-5** |
| **Issue 3-2-6** |
| 3-3 | **Issue 3-3-1** |
| **Issue 3-3-2** |
| **Issue 3-3-3** |

### 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** |
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## 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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| **Sub-topic#3** | **Status summary**  |
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*Suggestion on WF/LS assignment*

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

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

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| **CR/TP number** | **CRs/TPs Status update recommendation**  |
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## Discussion on 2nd round (if applicable)

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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*

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| T-doc number | Title | **T-doc Status update recommendation**  |
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