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

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

**Agenda item:** 7.11.1

**Source:** Huawei, HiSilicon

**Title:** Email discussion summary for RAN4#96\_#112\_NR\_RF\_FR1\_Part\_1

**Document for:** Information

# Introduction

This part includes contributions in agenda 7.11.1.

Classify the contents into 5 topics:

1. Topic #1: intra-band CA requirement in Rel-16
2. Topic #2: DC location
3. Topic #3: Switching period between case1 and case2

candidate target of email discussion are as below:

* 1st round:
  + Align AMPR and MSD for CA\_n7B
  + Reach consensus on other issue for intra-band UL CA
  + Agree on the CRs if possible
* 2nd round:
  + Agree on the CR for AMPR and MSD for CA\_n7B
  + Agree on the big CR for intra-band NC CA resubmission
  + Agree on the LS to RAN2 on the compression solution for DC location
  + Anything not completed in 1st round

# Topic #1: intra-band CA Rel-16

*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** |
| R4-2016042 | **Skyworks** | **NS\_27 (first change):**  **- Extend A7 region to match simulation results,**  **E-UTRA Band 10 protection (2nd,3rd,4th change):**  **- removed from NR bands: n2,n5/n89,n7,n12,n14,n25,n26,n28/n83,n30,n38,n41,n66/n86,n70,n77**  **- removed from the UE coexistence for relevant NR CA intra and inter-band combinations.** |
| R4-2014956 | ZTE | Summary of change  (1) Merge the contents of intra-band non-contiguous CA bands into Table 5.2A.1-1.  (2) Remove intra-band non-contiguous CA bands in Table 5.2A.1-2.  (3) Move section title for SUL bands from section 5.2B to 5.2C.  Correct NR band combination for SUL in Table 5.2C-2. |
| R4-2015557 | Huawei | Summary of change   1. To move the sentence “5.2C Operating band combination for SUL” as headline of sub-clause 5.2C. 2. To change the notation of CA\_n78(2A)\_SUL\_n78A-n86A into SUL\_n78(2A)-n86A. 3. To move the sentence “6.3C Output power dynamics for SUL” as headline of sub-clause 6.3C. |
| R4-2014171 | Qualcomm | Observation 1: Needed AMPR for contiguous allocations varies approximately according to the overall BW\_CA, independent of the constituent bandwidths.  Observation 2: Needed AMPR for non-contiguous allocations varies approximately according to the overall BW\_CA, independent of the constituent bandwidths.  Proposal 1: Contiguous AMPR values proposed in section 5.1.  Proposal 2: Non-contiguous AMPR values proposed in section 5.2.  Observation 3: TX distortion with single CC wide BW is like TX distortion with 1UL/2DLCA, but distortion is spread across 2 CCs. Only outer RB allocations will require MSD.  Proposal 3: For contiguous allocations, apply MSD and UL configuration as shown in Table 6.1.2. The RB boundary for contiguous allocations where no MSD applies is shown in Table 6.1.3.  Observation 4: For non-contiguous allocations, MSD and UL configuration is shown in Table 6.2.2 assuming MPR is taken to meet general spurious emission requirement. MSD values will be higher with less MPR. |
| R4-2014518 | Nokia | Addition of A-MPR definition for CA\_n7B, CA\_n41B, CA\_n41C and CA\_n48B and associated requirements including general CA A-MPR section. CA\_7B MSD defined. |
| R4-2014519 | Nokia | Proposals on CA\_7B A-MPR.   * Contiguous allocation   For all modulations and scs when BWChannel\_CA > 25 MHz and Fedge,high = 2570 MHz  IF RBEnd > NRB\_agg 5/6 OR  LCRB > NRB\_agg - LCRB + NRB\_agg /3  OR  RBEnd < NRB\_agg /6 AND LCRB < 5  THEN A-MPR = 9 dB,  ELSE IF LCRB 2/3 < RBend < NRB\_agg 5/6 AND LCRB < NRB\_agg /4  THEN A-MPR = 0 dB,  OTHERWISE A-MPR = 4 dB.  When BWChannel\_CA <= 25 MHz and Fedge,high = 2570 MHz  IF LCRB > NRB\_agg - LCRB + NRB\_agg /2  THEN AMPR = 6 dB.  OTHERWISE A-MPR = 0 dB.  When Fedge\_high <= 2570 MHz - BWChannel\_CA, A-MPR = 0 dB.   * Non-contiguous allocation   When BWChannel\_CA > 25 MHz and Fedge\_high = 2570 MHz,  A-MPR =  18 - 6e-06 B; 0 <= B <= 5e+05  15.9 - 1.75e-06 B; 5e+05 < B <= 4.5e+06  When BWChannel\_CA <= 25 MHz and Fedge\_high = 2570 MHz,  A-MPR =  11; 0 <= B <= 1e+06  11.4 - 3.85e-07 B; 1e+06 < B <= 7.5e+06  9.14 - 8.57e-08 B; 7.5e+06 < B <= 2.5e+07  When Fedge\_high <= 2570 MHz - BWChannel\_CA and 25 MHz < BWChannel\_CA <= 35 MHz,  A-MPR =  11; 0 <= A <= 2e+06  12.2 - 5.77e-07 A; 2e+06 < A <= 1.5e+07  3.5; 1.5e+07 < A <= 3.5e+07  When Fedge\_high <= 2570 MHz - BWChannel\_CA and BWChannel\_CA <= 25 MHz,  7.5; 0 <= A <= 1e+06  7.89 - 3.89e-07 A; 1e+06 < A <= 1e+07  4.67 - 6.67e-08 A; 1e+07 < A <= 2.5e+07 |
| R4-2014909 | Apple | ***Proposal 1****: Revise FR1 UL NC CA frequency separation classes definition to as shown in Table 2.1-2.*   |  |  | | --- | --- | | NR NC CA frequency separation class | Maximum allowed frequency separation | | I | 100 MHz | | II | 200 MHz | | III | [600 MHz] |   ***Proposal 2****: Revise UE power class specifications for FR1 intra-band UL NC CA to as shown in Table 2.2-2.*   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | NR CA Configuration | Class 1 (dBm) | Tolerance (dB) | Class 2 (dBm) | Tolerance (dB) | Class 3 (dBm) | Tolerance (dB) | Class 4 (dBm) | Tolerance (dB) | | CA\_n41(2A) |  |  |  |  | 23 | +2/-31 |  |  | | CA\_n77(2A) |  |  |  |  | 23 | +2/-31 |  |  | | CA\_n78(2A) |  |  |  |  | 23 | +2/-31 |  |  | | NOTE 1: For transmission bandwidths confined within FUL\_low and FUL\_low + 4 MHz or FUL\_high – 4 MHz and FUL\_high, the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB  NOTE 2: PPowerClass is the maximum UE power specified without taking into account the tolerance  NOTE 3: For intra-band non-contiguous carrier aggregation the maximum power requirement shall apply to the total transmitted power over all component carriers (per UE). | | | | | | | | | |
| R4-2016009 | Skyworks | **Proposal 1:**  **For an IMD3 falling in the -40dBm/MHz, the proposed MPR curve coefficients versus total RB bandwidth are:**  **-40dBm/MHz A-MPRCA\_IM3 = 20; 0 ≤ B <1.08**  **19.5; 1.08 ≤ B <2.16**  **19; 2.16 ≤ B <3.24**  **18.5; 3.24 ≤ B < 5.04**  **18; 5.04 ≤ B < 10.08**  **17; 10.08 ≤ B < 16.56**  **16; 16.56 ≤ B < 21.96**  **13; 21.96 ≤ B**  **For an IMD5 falling in the -40dBm/MHz region, the proposed MPR curve coefficients versus total RB bandwidth are:**  **-40dBm/MHz A-MPRCA\_IM5=    13; 0 ≤ B <1.08**  **12; 1.08 ≤ B <2.16**  **11; 2.16 ≤ B <3.24**  **10; 3.24 ≤ B < 5.04**  **8.5; 5.04 ≤ B < 10.08**  **7.5; 10.08 ≤ B < 16.56**  **7; 16.56 ≤ B < 21.96**  **6.5; 21.96 ≤ B**  **Proposal 2:**  **For aggregation of two or more downlink FDD carriers with one uplink carrier, the reference sensitivity is defined only for the specific uplink and downlink test points which are specified in Table 7.3A.2.1-1. The requirements apply with all downlink carriers active. Unless given by Table 7.3.2-4, the reference sensitivity requirements shall be verified with the network signaling value NS\_01 (Table 6.2.3.1-1) configured.**  Table 7.3A.2.1-1: Intra-band contiguous CA with dual uplink configuration for reference sensitivity   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | CA configuration | SCS  (kHz) | Aggregated channel bandwidth (PCC+SCC) | UL PCC allocation  (LCRB) | UL SCC allocation  (LCRB) | ΔRIBNC (dB) | Duplex mode | | CA\_n7B | 15+15 | 52RB+216RB | 20 (RBstart = 32) | 25 (RBstart = 191) | [34] | FDD | | NOTE 1: All combinations of channel bandwidths defined in Table 5.5A.1-1.  NOTE 2: The carrier centre frequency of SCC in the UL operating band is configured closer to the DL operating band.  NOTE 3: The transmitted power over both PCC and SCC shall be set to PUMAX as defined in subclause 6.2.4.  NOTE 4: The PCC allocation is same as Transmission bandwidth configuration NRB as defined in Table 5.3.2-1. | | | | | | | |
| R4-2016513 | Huawei, HiSilicon | Intra-band NC CA CR resubmission |
| R4-2016515 | Huawei, HiSilicon | ***Observation 1: According to RAN1/2 spec on PUSCH processing capability, the delay between UL DCI and PUSCH transmission can be different for CCs. It means that DCI timing for PUSCH transmission overlapped in time for CCs can be different. It can be depicted in figure 2:***    ***Observation 2: For NR intra-band UL CA, Pcmax,f,c for PHR reporting cannot be ensured to use the same Pcmax,f,c in physical layer: Ppowerclass-max(MPR, AMPR), where MPR and AMPR are specified for intra-band UL CA.***  ***Proposal 1: For NR intra-band contiguous and non-contiguous UL CA,*** ***the Pcmax,f,c for each CC is defined as the Pcmax using the MPR defined for single carrier.*** |

## Open issues summary

### Sub-topic 1-1 RF requirement for CA\_n7B

**Issue 1-1-1: AMPR**

* Proposals
  + Option 1: AMPR in R4-2014171
  + Option 2: AMPR in R4-2014518
  + Option 3: AMPR in R4-2016009
* Recommended WF
  + **TBA**

**Issue 1-1-2: MSD and UL configuration**

* Proposals
  + Option 1: MSD in R4-2014171
  + Option 2: MSD in R4-2014518
  + Option 3: MSD in R4-2016009
* Recommended WF
  + **TBA**

### Sub-topic 1-2 Other requirement

**Issue 1-2-1: Separation class for FR1 NC CA**

* Proposals
  + **Option 1:**  **Revise the frequency separation class for FR1 NC CA**

|  |  |
| --- | --- |
| NR NC CA frequency separation class | Maximum allowed frequency separation |
| I | 100 MHz |
| II | 200 MHz |
| III | [600 MHz] |

* + **Option 2: keep it as agreed in the last meeting**

|  |  |
| --- | --- |
| NR NC CA frequency separation class | frequency separation |
| I | 20 MHz ≤ BWChannel\_NC\_CA ≤ 100 MHz |
| II | 100 MHz < BWChannel\_NC\_CA ≤ 200 MHz |
| III | 200MHz<BWChannel\_NC\_CA≤ [600MHz] |

* Recommended WF
  + **TBA**

**Issue 1-2-2: power class tolerance for FR1 NC CA**

* Proposals
  + **Option 1:** 23dBm with +2/-3dB tolerance
  + **Option 2:** 23dBm with +2/-2dB tolerance
* Recommended WF
  + **TBA**

**Issue 1-2-3: Pcmax for intra-band UL CA**

* Proposals
  + ***the PCMAX,L,f,c for each CC is defined as: PCMAX\_L,f,c = MIN {PEMAX,c– ∆TC,c, (PPowerClass – ΔPPowerClass) – MAX(MAX(MPRc+∆MPRc, A-MPRc)+ ΔTIB,c + ∆TC,c + ∆TRxSRS, P-MPRc) }, where MPRc and AMPRc use the MPR and AMPR defined for single carrier.***
* Recommended WF
  + **TBA**

## Companies views’ collection for 1st round

### Open issues

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| **Sub-topic** | **Comments: (Company: …)** |
| 1-1 | **Issue 1-1-1:**  Skyworks: For non-contiguous allocations, presented results between each contribution are similar to those previously studied for CA\_n48B. We have a preference in adopting the same equation format that was agreed for CA\_n48B, ie option 1 or 3 format. We are open to adjust staircase equations values based on simulation results of option 1 & 2 and measurement data from option 1. There is little difference between option 1 and 3.  Qualcomm: Comparison between Nokia and Qualcomm is below using Nokia region thresholds. Nokia’s thresholds have to be modified per the diagram below: QC’s AMPR values mapped on Nokia’s proposal are as follows. AMPR2=7dB may not be needed everywhere, so there is room for adjustment here. Table and Diagram is shown below: Use QC values with Nokia regions at first. Also correct Nokia regions as shown          Noncontiguous allocations:  Choose Skyworks for AMPR\_IM3 and QCOM for AMPR\_IM5 |
| **Issue 1-1-2:**  Skyworks: Option 2 with several changes that can be discussed on reflector: 1) MSD table title change, 2) MSD table contents: should merge MSD TP from option 1 and option 3 so that we have similar approach to DC\_3\_n3 MSD table (worst, and best case MSD). Also MSD TP from option 3 should specify SCC MSD for proposed UL configuration, 3) Note 4 should refer to sub-clause 6.2A.4, 4) Definition of B should be added.  **Qualcomm:**  **Use Skyworks non-contiguous MSD test point along with QCs contiguous MSD testpoint.**  **We need to make sure that MPR can be taken to meet the general spurious requirement especially for non-contiguous allocation test point. Can we make this clear in the note or is it already implied?**   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | CA configuration | SCS  (kHz) | Aggregated channel bandwidth (PCC+SCC) | UL PCC allocation  (LCRB) | UL SCC allocation  (LCRB) | ΔRIBNC (PCC) (dB) | ΔRIBNC (SCC) (dB) | Duplex mode | | CA\_n7B | 15+15 | 52RB+216RB | 20 (RBstart = 32) | 25 (RBstart = 191) | [34] | [25] | FDD | | 52RB+216RB | 0 | 64 (RBstart = 152) | [8.5] | [5.3] | | 105RB+160RB | 0 | 64 (RBstart = 96) | [8.5] | [3.6] | | 79RB+160RB | 0 | 64 (RBstart = 15) | [8] | [0] | |  | NOTE 1:   All combinations of channel bandwidths defined in Table 5.5A.1-1.  NOTE 2:   The carrier centre frequency of SCC in the UL operating band is configured closer to the DL operating band.  NOTE 3:   The transmitted power over both PCC and SCC shall be set to PUMAX as defined in subclause 6.2A.4.  NOTE 4:   The PCC allocation is same as Transmission bandwidth configuration NRB as defined in Table 5.3.2-1. | | | | | | | |
| 1-2 | **Issue 1-2-1:**  **OPPO:** Option 1 is ok.  Skyworks: Option 1  Nokia: Option 1  **Apple**: Option 1  Huawei: Option 1 is actually we propose in the last meeting from the beginning. Most company prefer to revise it into a range value: it is because there comes the question “if UE signals class III with meaning of <600MHz&2PA and class II with meaning of <200MHz&1PA, then how many PA is needed when the CA configuration is 200MHz? And what is the max MIMO layer UE can support?” We would like to see more comment. Currently prefer to keep it as the current spec. |
| **Issue 1-2-2:**  **OPPO:** For clarification, in the paper it mentioned the FR1 UL NC CA RF requirements have been defined based on dual PA configuration, and the maximum output power lower tolerance limit should be relaxed by 1 dB as compared to the requirement using single PA implementation. Where the 1dB relaxation comes from?  Skyworks: Option 1  **Apple**: Option 1. To OPPO’s question, the 1 more dB lower limit tolerance for 2PA implementation is to account for mismatch between the 2 PAs and also each PA may operate at 3dB back-off from Pcmax where higher tolerance is allowed. The same lower tolerance has been defined for 2UL inter-band CA/EN-DC, UL MIMO, intra-band EN-DC.  Huawei: Option 1. |
| **Issue 1-2-3:**  **OPPO:** Ok with proposal.  Nokia: Thank you for sharing the issue.  Is Huawei’s intention to introduce a new text like Pcmax for inter band UL CA as special case of intra band CA? Or replacing the existing formula of intra band CA with the proposed formula?  Qualcomm: We would like to understand more about the issue since. It does not seem to be new issue, this different timeline, same issue existed in intra-band EN-DC and even in LTE STI feature. The concern seems to be PHR report trigger, but pocmax is also needed for UE emission compliance. What is the overall plan seem to be missing from the paper so we hope to get more clarifications on this issue.  **Apple**: It is not clear what the proposal is for and how it would be different from the current Pcmax definition for intra-band UL CA. The proposal in Issue 1-2-3 is a copy of Pcmax definition for single carrier. Is there something new on this proposal?  Huawei: To QC, this is new issue for NR. Because for LTE, N-4 DCI is assumed for PUSCH scheduling, however for NR it is more flexible. for ENDC, LTE side is slow, and only LTE transfer to NR is allowed. We are open to further discuss. To Nokia, in the approved CR R4-2011725, there is a bracket in intra-band NC CA Pcmax definition, where QC is not agreed in the last meeting. We just explain why we define NC CA Pcmax such way, it comes from RAN1 agreement on PHR report for NR CA. we are open to handle this problem in RAN4. |

### 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** |
| R4-2016042 |  |
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| R4-2014956 | Skyworks:: Question for clarification: in FR2, was the merge of contiguous and non-contiguous agreed because all bands supported both types of CA, so no distinction is needed? In FR1, some bands support only intra-band contiguous CA, for example n1. For Band combinations with SUL, is new sub-clause 5.2C needed? Or could 5.2B be renamed “Operating bands for SUL”, and rename tables Table 5.2C-1 and Table 5.2C-1 as Table 5.2B-1/ Table 5.2B-2?  ZTE: In last RAN4 meeting, the original CR was for FR2 to distinguish contiguous and non-contiguous cases in two separate tables as FR1 does now, however companies at last meeting pointed out that there is no need to distinguish contiguous and non-contiguous both in FR1 and FR2 for simplicity. The agreement was reached to submit a CR to merge contiguous and non-contiguous for FR1 in this meeting. For the clarification question 1, the reason for merge of contiguous and non-contiguous in FR2 is just for the purpose of simplification, not because all bands support both types of CA.  Regarding to the second question, this CR is an editorial correction. It is not to add a new sub-clause. Actually the sub-clause 5.2C has already been in the spec right now. The correction is to move the sentence from section 5.2B to next row with a line feed.  **Apple**: We agree with the CR. The support of intra-band contiguous and non-contiguous CA for each band listed in this table is detailed in clause 5.5A Configurations for CA.  Huawei: do not agree with the CR. Contiguous CA and non-contiguous CA cannot be differentiated. FR2 is totally different situation. Based on the agreed CR R4-2009948, The notation of SUL\_n78(2A)-n86A can be aligned with 38.101-3 which is captured in R4-2015557 for SUL part. This CR can be not pursued. |
| R4-2015557 |  |
| R4-2016513 |  |

## 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** |
| R4-2016042 |  |
| R4-2014956 |  |
| R4-2015557 |  |

## Discussion on 2nd round (if applicable)

|  |  |  |
| --- | --- | --- |
| T-doc number | Title | Comments |
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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** |
|  |  |  |

# Topic #2: DC location

*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** |
| R4-2014714 | Qualcomm | Observation 1: Since the list of possible BWP permutations is long and for CA network may not even have intent to activate all possible permutations of BWPs, a convenient way to simplify is for network to provide a list of likely BWP permutations to UE  Observation 2: RAN2 will need to develop new method to index the DC location for CA  Observation 3: With 2 PA reference architecture, two simultaneous DC locations need to be signalled  Observation 4: In some cases, DC is never located in some CC’s and UE will not include DC location those CC’s  Observation 5: Network can reduce the list of BWP permutations if UE informs that some BWP’s have no impact on DC location  And made one proposal:  Proposal: Send LS to ran2 about the future proof DC location framework information. |
| R4-2014910 | Apple | **Observation 1**: UL DC location reporting mechanism based on all BWP permutations is rather inefficient for large number of aggregated carriers.  **Observation 2**: For TDD bands, UL DC location may depend on either DL or UL BWP configuration for certain UE implementation.  **Observation 3**: UL DC location reporting mechanism based on all UL/DL BWP permutations could be rather inefficient even with only 2 activated carriers.  **Observation 4**: UL DC location reporting based on dynamic signalling is more efficient, flexible and independent of number of aggregated carriers which also implies better forward compatibility. |
| R4-2015212 | Nokia | **Observation 1: The frequency point in the middle of DC locations indicated for the 2 active BWPs is not the centre if the active BWPs do not have the same size.**  **Observation 2: The amount of signalling overhead would grow exponentially and generate complexity for both UEs and networks.**  **Observation 3: The method would increase frequency of retuning during transmission.**  **Observation 4: The method would force UE to make DC locations for each of the BWPs per CC the centre of each of the BWPs.**  As the results, in order to make the method in [3] more practical, we proposed the following alternative.  ***Proposal: Send an LS to RAN2 to share the following alternative***  Identify the DC location for intra band UL CA by establishing the following rule.   * **NW determines the BWP locations and transmission bandwidths according to the network configuration.** * **As default, network considers DC location for intra band UL CA is the centre of the lower edge of the lowest CC and the higher edge of the highest CC among all the active CCs.** * **If a UE has an additional DC location reporting for intra-band CA, the network considers DC location is the centre of the lower edge of the lowest active BWP and the higher edge of the highest active BWP among all the active CCs.** |
| R4-2015565 | Intel | ***Proposal: RAN4 agrees not to consider SUL in DC location information signaling.*** |
| R4-2015997 | Skyworks | **Proposal: A generic solution is designed in Release 17 for DC location signaling for intra or ganged bands combinations that supports:**   * **FR1 and FR2 with more than 2 UL contiguous or non-contiguous CCs and their combinations** * **Compatible with Implementations using one transmit path for multiple CC or one transmit path per CC and enabling dynamic configuration between the two.** |
| R4-2016514 | Huawei, HiSilicon | ***Observation 1: For 2 UL contiguous CCs, there is not much signalling introduced by additional DC location.***  ***Observation 2: The DC locations for a CA combination are determined by the activated lower bound CC in the lowest frequency and activated upper bound CC in the highest frequency.***  ***Observation 3:*** ***The maximum number of possible DC locations for UL CA with nth UL contiguous carrier in a band would be [42\* C n2].***  ***Proposal 1: Send LS to RAN2 to inform them on DC locations for a CA combination are determined by the activated lower bound CC in the lowest frequency and activated upper bound CC in the highest frequency.*** |

## Open issues summary

### Sub-topic 2-1: DC location reporting in Rel-16

**Issue 2-1-1: compression solution**

* Proposals
  + **Option 1:** 
    - * network to provide a list of likely BWP permutations to UE
      * DC is never located in some CC’s and UE will not include DC location those CC’s
      * Network can reduce the list of BWP permutations if UE informs that some BWP’s have no impact on DC location
  + **Option 2:** The DC locations for a CA combination are determined by the activated lower bound CC in the lowest frequency and activated upper bound CC in the highest frequency. Only report possible DC locations for all the 2CCs pairs within the configured CA band combination. The maximum number of possible DC locations for UL CA with nth UL contiguous carrier in a band would be [Cn2\*16].
  + **Option 3:** As default, network considers DC location for intra band UL CA is the centre of the lower edge of the lowest CC and the higher edge of the highest CC among all the active CCs.

If a UE has an additional DC location reporting for intra-band CA, the network considers DC location is the centre of the lower edge of the lowest active BWP and the higher edge of the highest active BWP among all the active CCs.

* **Option4: dynamic signalling without an specific solution**
* Recommended WF
  + **TBA**

**Issue 2-1-2: LS to RAN2**

* Proposals
  + **Option 1:** R4-2014714
  + **Option 2:** R4-2015212
  + **Option 3:** R4-2016514
  + **Option 4:** Other
* Recommended WF
  + **TBA**

**Issue 2-1-3: Whether DC location for SUL need to be considered**

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

### Sub-topic 2-2: DC location in Rel-17

*Provide comments for each CR, we are targeting to complete this part in the 1st round fast*

**Issue 2-2-1: If DC location reporting in Rel-16 solve signalling number with compression solution in issue1-1-1 for more than 2CC case, do we need any Rel-17 enhancement?**

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

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Sub-topic** | **Comments: (Company: …)** |
| 2-1 | **Issue 2-1-1:**  [OPPO]:  In our understanding, Option 2 and 3 here would like to limit UE implementation on the DC location. In principle limiting the DC locations might be possible but there are different potential DC locations, like the center of band, center of contiguous CCs, certer of configured BWPs, center of activated BWPs, etc. If we would like to report DC location by the limited scenarios then it should consider at least the above cases to give certain level of implementation flexibility to handle for example internal interference issues, etc.  Not clear whether BS can provide such preferred BWP combinations as Option 1 from scheduling complexity point of view considering there ae many UEs in the cell.  Not clear what the dynamic signalling means in Option 4 since this has been discussed before.  Skyworks:  First we believe that those proposals target R16 (but not sure), our proposal (option 4) is based on what scope a Release 17 solution should target not in this topic but rather for 2-2-1. This is why there is no specific solution proposed. We Note that R4-2014910 and R4-2015212 observations are similar to ours.  For option 1 we do not believe this is future proof as it does cover NC ULCA with 1 PA or ULCA where depending of BWP the UE may use one or two PAs. The proposed simplification is possibly useful to limit how dynamically the configuration may change  We are not OK with option 2 in terms of the DC location position to be future proof. Limitation to the number of permutations can also be done by the network by limiting the number of cases and how dynamically they change. Same issue with option 3 as it may not be useful for the UE to always use the center of activated BWPs and only change DC location depending on some BW threshold.  Nokia:  Option 3 has advantage in the least amount of signalling overhead and the smallest impact on the current RAN2 specifications. Also, this method can make network know DC location dynamically. This option can also accommodate the case that more than one DC carrier exist for UL CA. For example, if the UL CA consists of more than two CCs such as CA\_n78(2A) together with dualPAarchitecture capability. If the dualPAarchitecure is supported for a CA, each of the CC can be treated with Rel15 DC reporting mechanism. if dualPAarchitecture is not signalled for a CA, the number of DC is one so that the proposed method is applied.  [Option 1]  Network has to provide the intended list of permutations. Network, however, may not know all the possible future BWP permutations with priority at the time of request. Whenever suitable BWP configurations change, the NW has to provide the updated list with UE. This can reduce the number of permutations that UE reports at a time, but as the side effect, this increases the number of information exchanges between UE and NW instead.  [Option 2]  It is true that DC location is subject to the outermost CCs and/or BWPs. In that sense, the concept of Option 2 and Option 3 is similar. But option 3 can save even the number of signalling overhead of the outermost BWPs permutation.  [Option 4]  The original motivation of this discussion was how we limit the number of signalling overhead and the specification impact on RAN2 spec, since now Rel16 is completed (at least officially). From that perspective, this method should be avoided.  Qualcomm: Option 1 provided reduced overheadfor ther signallign and it is in the network control to defined which bwp permutation it wishes to cancel the LO. For testing, only one permuation is likely so in practice this is simple solution.  MTK:  Option 1 sounds like most practical solution to us. For Rel-16, some BWPs may be used only for changing UE’s dormancy behaviour, but not on the center frequency or BW. Therefore, we think Option 1 should be sufficient. To address dualPAarchitecture issues, we should also allow UE to report more than DC location.  CMCC:  Among the 4 options, option1 is more practical and simple. One question is that if UE has 2PA, can the existing DC location reporting per BWP per cell be reused?  **Apple**: We support Option 4.  Comments on other options:  [Option 1] It is not clear how network can reduce the list of BWP permutations if UE informs that some BWP’s have no impact on DC location. To our understanding, no impact on DC location does not necessarily mean DC is not in any of CC. As long as DC is located within a CC (BWP), it would need to be reported despite the location is the same for many different BWP combinations. On the other hand, the back-and-forth interaction between UE and network to determine what BWP permutations can be reduced could already consume substantial signalling capacity.  [Option 2] Despite the permutation number is not as large as previously anticipated, it still grows substantially with the CC number. And yet the DL BWP configurations have not been taken into consideration which could further increase the permutation number.  [Option 3] Looks to be the same as Option 2.  Huawei: For Option 1: how gNB notify UE the possible BWP permutation, by which signaling? Does the signaling occupy too much bit number? That seems a big topic. And whether gNB want to do this? As network vendor, we think it is hard to implement. We would like to see comments from gNB side on this solution.  For option 2: we would like to further explain on the solution:  Since the DC location is decided by the outermost 2CCs, then UE can firstly indicate any 2CC pair within the N UL CCs, so it is CN2. For each 2CC pair, UE can indicate all BWP permutations, it is 16. So the total bit number for N UL CC DC reporting is CN2\*16. It is not the exponential increase bit number in our imagination. It is very clear compression solution.  For option 3: we raise a similar solution in the last meeting. However it can not solve the issue that the DC location may not in the center RE of 2 outermost BWP, it is up to implementation. This is because, UE may not implement all possible BWP BW filter. TO Nokia, Offline discussion is welcome if more questions on option 2.  For option 4: dynamic solution relates to RAN1 spec revision. We already concluded in RAN meeting that Rel-16 time budget is not enough for this. To Apple, We ‘d better see the opportunity in Rel-17? And we are expecting to see your specific solution. Without any solution, I don't think option 4 could be a choice in Rel-16.  Ericsson:  General: it does not appear feasible for the UE to report every possible TX DC location for any configured BWP permutation for Rel-16 if the number of the cells is large and without any common structural information on the DC location among configured BWP permutations.  It is possible to develop an RRC-based request-response making the gNB aware of the TX DC location for activated BWPs. We note that knowledge of changed TX DC locations is not time critical in case these are used for improving the UL receive performance for a specific UE, this requires an evaluation period (e.g. using actual uplink performance). |
| **Issue 2-1-2**  [OPPO] LS should be discussed after the solution is agreed.  Skyworks: too early to select and need to agree on the scope: R16 or R17, information of FW compatible solution…  Nokia: Option 2 but of course, it depends on the outcome of the discussion…  Qualcomm: Option1 but agree that we need to agree the solution first.  MTK: pending on Issue 2-1-1  Huawei: to Skyworks, per RAN meeting agreement, we try to find solution for more than 2CC case. But if not agreed, at least 2CC solution should be concluded in the LS. |
| **Issue 2-1-3**  [OPPO] Option 2, in our understanding currently no intra-band SUL combination has been defined in RAN4. This can be discussed once such combination appears.  Skyworks: since ULSUP is TDM only and intra-band UL CA is not specified, there is no need for SUL currently  Nokia: Option 2  And if we cannot conclude this immediately, it would be better to avoid taking time for this discussion now.  Qualcomm: Is SUL CA a feature? Option 2 for now.  **Apple**: Let’s focus on intra-band UL CA first.  Huawei: agree with Apple, focus on intra-band UL CA first. |
| 2-2 | **Issue 2-2-1:**  [OPPO] Option 1, if we understand correctly the question means in Rel-16 only 2CC is considered then what to do with more CCs in Rel-17.  Skyworks: Option 1 yes as we have proposed in R4-2015997.  Nokia: We don’t see necessity of this question. It depends on the selected solution. If the solution taken in Rel16 is not enough, we would discuss if enhancement is needed or not later.  Qualcomm: We would need to know the agreed solution, seems strange to decide actions that depend on possible future agreements. If only two options are offered then better leave door open in future so Yes.  **Apple**: We propose the solution chosen for Rel-16 to be future proof already.  Huawei: we share the same view with Nokia. |

### 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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## 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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### CRs/TPs

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

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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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# Topic #3: Switching period between case 1 and case 2

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2014464 | CATT | Proposal 1: It is proposed to capture DL interruption applicability in 38.101-1/-2/-3 and reuse the corresponding CA/DC/SUL band combination tables.  - A reference to the DL interruption requirement in 38.133 can be added to the band table.  Proposal 2：A clear indication should be considered for each band combination in the table,  - If Tx switching between carriers are supported and DL interruption is allowed, adding “Yes”  - If Tx switching between carriers are supported but DL interruption is not allowed, adding “No”  - If Tx switching is not supported, adding “N/A” |
| R4-2015195 | China Telecom | **Summary of change**  Indicate that for some UL CA configurations, DL interruption is not allowed. |
| R4-2015196 | China Telecom | **Summary of change**  Indicate that for some EN-DC configurations, DL interruption is not allowed. |
| R4-2015975 | Ericsson | **Summary of change**  Clause 6.2A.1.3: for CA configuration of PC3, the requirements for PC2 for uplink operation in n41, n77, n78 and n79 apply when the *uplinkTxSwitchingPowerBoosting-r16* is enabled and *uplinkTxSwitching-PowerBoosting-r16* is supported.  Clause 6.2A.2.3: it is clarified that the MPR for power class 2 applies when boosting is enabled.  Clause 6.2A.3.1.3: it is clarified that the A-MPR for power class 2 applies when boosting is enabled.  Clause 6.2A.4.1.3: the PCmax for UL CA is modified with boosting for the default CA power class (PC3). This change does not modify the CA power class indicated for the band combination (the default), but the PCMAX for CA is increased (and the threshold at which the UE should start scaling according to clause 7.5 of 38.213) by Ppowerclass,CA = 3 dB (i.e. 26 dBm total for CA). The UE might support either PC3 or PC2 for the consituent bands but the CA power class is the default. The PEMAX,CA must be set to 26 dBm to enable boosting, configured by the gNB.  Clause 6.3A.3.3: a reference to the specification of the power boosting is added and the IE names corrected in accordance with the latest version of 38.331. |

## 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 DL interruption

**Issue 3-1-1: Applicability on DL interruption**

* Proposals
  + Option 1: Capture DL interruption applicability in 38.101-1/-2/-3 and reuse the corresponding CA/DC/SUL band combination tables, a reference to the DL interruption requirement in 38.133 can be added to the band table. A clear indication should be considered for each band combination in the table with ‘yes’, ‘no’ and ‘N/A’
  + Option 2: Other
* 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**  [OPPO] Ok with Option 1.  CMCC: prefer to discuss the CRs directly  CATT: Support option 1. We think a clear indication for each combination is needed. Otherwise for those combinations without any note, it will have 2 interpretations, e.g. either not support Tx switching feature or supporting Tx switching feature but with DL interruptions. |

### 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** |
| R4-2015195 | CMCC: The CR follows previous meeting agreement on the band combinations that DL interruption is not allowed. One thing we need to consider is that the agreed band combinations with no DL interruption are based on operator input and checked by vendors. There is no general principle agreed in RAN4. If we add this note to band combination table, then companies may need to check whether DL interruption is allowed every time when new band combination is introduced, and companies may request “No DL interruption” for existing band combinations.  CATT: A clear indication for each combination is needed. Otherwise for those combinations without any note, it will have 2 interpretations, e.g. either not support Tx switching feature or supporting Tx switching feature but with DL interruptions. So we prefer to introduce DL interruption indicaiton in a clear manner for each combination. |
| R4-2015196 | CMCC: Same comments |
| R4-2015975 | CMCC: Same comments  Huawei: The agreements in the June plenary meeting say that there is not new spec change needed for the power boosting except RAN2 signalling introduction. Without having this CR, the spec is not broken in any aspect and the UE is required to meet first normal UL CA requirements to support Tx switching. It is clear that in case 2 for UL CA Tx switching, the maximum output power is 26dBm. Besides, we have concern on the CR contents: 1) MPR and A-MPR subject to requirements related to 2Tx, it is not proper to enhance in the way the CR proposed; 2) P\_EMAX configuration needs to follow RAN4 spec and in Rel-16 there is no 26dBm BC power class defined thus if the CR was implemented, the MOP on C-band is capped with 23dBm.  Huawei: The agreements in the June plenary meeting say that there is not new spec change needed for the power boosting except RAN2 signalling introduction. Without having this CR, the spec is not broken in any aspect and the UE is required to meet first normal UL CA requirements to support Tx switching. It is clear that in case 2 for UL CA Tx switching, the maximum output power is 26dBm. Besides, we have concern on the CR contents: 1) MPR and A-MPR subject to requirements related to 2Tx, it is not proper to enhance in the way the CR proposed; 2) P\_EMAX configuration needs to follow RAN4 spec and in Rel-16 there is no 26dBm BC power class defined thus if the CR was implemented, the MOP on C-band is capped with 23dBm.  Ericsson: the RAN plenary allowed for maintenance of the specifications to enable the agreed power boosting, if needed. Without agreement of this CR, the Pcmax limits restrict the total maximum output power for the configured band combination to 23 dBm. Clearly, this does not allow a 3dB boosting on the maximum output power for transmission on carrier2. This is corrected by the CR.  The network has to enable the power boosting by the *uplinkTxSwitchingPowerBoosting-r16* in the *CellGroupConfig*, from 38.331,  ***uplinkTxSwitchingPowerBoosting***  Indicates whether the UE is allowed to enable 3dB boosting on the maximum output power for transmission on carrier2 under the operation state in which 2-port transmission can be supported on carrier2 for inter-band UL CA case with dynamic UL Tx switching as defined in TS 38.101-1 [15]. Network can only configure this field for dynamic UL Tx switching in inter-band UL CA case with power Class 3 as defined in TS 38.101-1 [15].  and this is only applicable for PC3 CA band combinations (there are no other in Rel-16). We remark that the RAN4 specifications cannot add any UE behaviour, this is specified in the RAN1 and RAN2 specifications.  Regarding the CR contents,  1. the possibility for the UE use MPR and A-MPR for a power class 2 was added in case this is needed, still conditioned on enabling the *uplinkTxSwitchingPowerBoosting-r16* with the conditions shown above;  2. the P\_EMAX,CA specification is unchanged; the 38.331 specifies that “If absent, the UE applies the maximum power according to TS 38.101-1 [15]” [in this case the power class of the CA configuration, no additional cap]; if present the P\_EMAX,CA can obviously not be set to 23 dBm in case boosting is to be enabled.  By analogy with the SUL switching case, not agreeing this CR is like limiting the NUL and SUL power to 23 dBm, which is presumably not agreeable. The same “UE implementation” is used for facilitating SAR compliance in the UL CA and SUL cases, no difference.  We are open to discussing clarifications of the text in the CR during the meeting weeks. |

## 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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### CRs/TPs

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

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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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