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

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

**Agenda item:** xx.xx.xx

**Source:** Huawei, HiSilicon

**Title:** Email discussion summary for RAN4#94e\_#18\_NR\_RF\_FR1\_Part\_1

**Document for:** Information

# Introduction

This part includes contributions in agenda 8.13.1 except 8.13.1.6.

Classify the contents into four topics:

1. Topic #1: intra-band contiguous UL CA for FR1 power class 3 which is for agenda 8.13.1.1 and 8.13.1.4
2. Topic #2: CRs for intra-band DL CA for FR1 which is for agenda 8.13.1.2 and 8.13.1.3.
3. Topic #3: intra-band non-contiguous UL CA for FR1 power class 3 which is for agenda 8.13.1.5
4. Topic #4: transient period capability which is for agenda 8.13.1.7

For intra-band CA RF requirement, topic 1 and topic 2 are with high priority for this meeting, candidate target of email discussion are as below:

* 1st round:
  + Approve on the CRs on new configurations and editorial corrections
  + Approve on the CRs not related to the MPR and ACLR requirement
  + Reach consensus on ACLR MBW, MPR inner/outer RB allocations definition
  + Have agreement on whether MPR requirement is independent of PA architecture for contiguous CA
  + Have agreement on the MPR definition format for the spec, e.g. whether classify with Bandwidth class
  + If time is allowed, try to have some consensus on the assumption for intra-band NC UL CA, e.g. architecture
* 2nd round:
  + Approve on the CR for emission requirement which is related to MBW
  + Approve on the CR on MPR definition format which can leave the MPR value as TBD
  + Try to reach consensus on MPR value for intra-band UL contiguous CA in QPSK
  + Anything not completed in 1st round

For transient period capability, candidate target of email discussion are as below:

* 1st round:
  + Identify testability issues raised in the contributions
* 2nd round:
* Decision on the conclusion in RAN4 and feedback to RAN#87 meeting

# Topic #1: intra-band contiguous UL CA for FR1 power class 3

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000093 | Qualcomm | **Proposal 1:** Use CA MPR for contiguous allocations as shown in Table 2.3-1.  **Table 2.3-1 Contiguous allocation CA MPR**   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | Modulation | | MPR (dB) | | | | | | Edge | Inner CA;  All BW class | Outer CA;  BW class B LCRB >0 | Outer CA;  BW class C  LCRB ≤ β\*BWCA | Outer CA  BW class C; LCRB > β\*BWCA | | DFT-S-OFDM | Pi/2 BPSK | TBD | ≤ 0.0 | ≤ 1.5 | ≤ 1.5 | ≤ 6 | | QPSK | TBD | ≤ 0 | ≤ 2 | ≤ 2 | ≤ 6 | | 16 QAM | TBD | ≤ 1 | ≤ 3 | ≤ 3 | ≤ 6 | | 64 QAM | TBD | ≤ 2.5 | ≤ 3.5 | ≤ 3.5 | ≤ 6 | | 256 QAM | TBD | ≤ 4.5 | ≤ 5.5 | ≤ 5.5 | ≤ 6 | | CP-OFDM | QPSK | TBD | ≤ 1.5 | ≤ 3 | ≤ 3 | ≤ 6 | | 16 QAM | TBD | ≤ 2 | ≤ 3 | ≤ 3 | ≤ 6 | | 64 QAM | TBD | ≤ 3.5 | ≤ 3.5 | ≤ 3.5 | ≤ 6 | | 256 QAM | TBD | ≤ 6.5 | ≤ 6.5 | ≤ 6.5 | ≤ 6.5 | | Note 1: β = [0.75] and Inner CA and outer CA defined per [1] [2].  β = (NRB\_alloc,1\*SCS1 + NRB\_alloc,2\*SCS2)/ (NRB,1\*SCS1 +NRB,2\*SCS2). | | | | | | |   **Proposal 2**: Use CA MPR for non-contiguous allocations as shown in Table 2.4-1.  **Table 2.4-1:** MPR for non-contiguous allocations   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Modulation | | MPR (dB) | | | | MInner | MOuter1 | MOuter2 | | DFT-S-OFDM | Pi/2 BPSK | ≤ 0.0 | ≤ 4.5 | ≤ MA | | QPSK | ≤ 0 | ≤ 4.5 | | 16 QAM | ≤ 1 | ≤ 4.5 | | 64 QAM | ≤ 2.5 | ≤ 4.5 | | 256 QAM | ≤ 4.5 | ≤ 4.5 | | CP-OFDM | QPSK | ≤ 1.5 | ≤ 5.5 | ≤ MA + 1 | | 16 QAM | ≤ 2 | ≤5.5 | | 64 QAM | ≤ 3.5 | ≤5.5 | | 256 QAM | ≤ 6.5 | ≤6.5 |   MPR = CEIL { min(MInner, MOuter1, MOuter2), 0.5}]  MA [Pi/2 BPSK,QPSK, 16QAM, 64QAM] =  8.2 ; 0 ≤ A < 0.025  9.2 - 40A ; 0.025 ≤ A < 0.05  8 – 16A ; 0.05 ≤ A < 0.25  4.83 – 3.33A ; 0.25 ≤ A ≤ 0.4,  3.83 – 0.83A ; 0.4 ≤ A ≤ 1,  MA [256QAM] =  8.2 ; 0 ≤ A < 0.025  9.2 - 40A ; 0.025 ≤ A < 0.05  8 – 16A ; 0.05 ≤ A < 0.16  5.5 ; 0.16 ≤ A ≤ 1,  A = (NRB\_alloc,1\*SCS1 + NRB\_alloc,2\*SCS2)/ (NRB,1\*SCS1 +NRB,2\*SCS2)  Fagg\_alloc\_low Aggregated Transmission Bandwidth Configuration. The lowest frequency of the simultaneously transmitted resource blocks.  Fagg\_alloc\_high Aggregated Transmission Bandwidth Configuration. The highest frequency of the simultaneously transmitted resource blocks.  FC\_agg Aggregated Transmission Bandwidth Configuration. Centre frequency of the aggregated carriers.  NRB\_alloc Total number of simultaneously transmitted resource blocks in Channel bandwidth or Aggregated Channel Bandwidth.  **∆**IM3 = max( | FC\_agg  – (2\*Fagg\_alloc\_low – 1\*Fagg\_alloc\_high) |, | FC\_agg  – (2\*Fagg\_alloc\_high – 1\*Fagg\_alloc\_low) | )  **∆**IM5 = max( | FC\_agg  – (3\*Fagg\_alloc\_low – 2\*Fagg\_alloc\_high) |, | FC\_agg  – (3\*Fagg\_alloc\_high – 2\*Fagg\_alloc\_low) | )  FC\_agg = (Fedge\_high + Fedge\_low)/2 |
| R4-2000711 | Skyworks | **Proposal 1**: on contiguous inner/outer allocation equations: **Contiguous allocation is defined as: RBe1= SU1-1 AND RBs2 = 0**  **Contiguous inner equations is defined as:**  **RBs1\*2^mu1 ≥ max(1,floor((LCRB1\*2^mu1+LCRB2\*2^mu2)/2))**  **AND**  **RBs1\*2^mu1 ≤ (SU1-LCRB1)\*2^mu1+(SU2-LCRB2)\*2^mu2-max(1,floor((LCRB1\*2^mu1+LCRB2\*2^mu2)/2))**  **Any other allocation is an outer allocation.** **Proposal 2:** on non-contiguous inner/outer allocation equations: **Contiguous allocation is defined as: RBe1 < SU1-1 AND RBs2 > 0**  **Non-contiguous inner equations is defined as:**  **(2\*RBs1-SU1/2)\*2^mu1+(SU2/2-(RBe2+1))\*2^m2 ≥ BWCA/0.36**  **AND**  **(RBs1-SU1/2)\*2^mu1+3/2\*(3/2\*SU2-2\*(RBe2+1))\*2^mu2 ≥ BWCA/0.36**  **Any other allocation is an outer allocation.**  **Proposal 3:** on ENDC applicability:   * Contiguous/noncontiguous inner/allocation types should be studied to optimize intra-band contiguous ENDC MPR/AMPR * Same definition than for UL CA applies when using the ENDC bandwidth definition and LTE parameters for one of the CC |
| R4-2000712 | Skyworks | **Proposal 1: on CA bandwidth:**   * **There is no need for fundamental spec change which is aligned with the above definitions** * **Some text clarification may be done to remove any ambiguities**   **Proposal 2 : for ACLR definition:**   * **The wanted and adjacents measurement bandwidth is :**   **Nominal Channel Spacing + (SU, low\*12 +1)\*0.015/2\*2^(mu, low)+ (SU, low\*12 -1)\*0.015/2\*2^(mu, high)**   * **The offset frequency between the center of the wanted and adjacent channel is:**   **BWchannel, low + BWchannel, high**  **Proposal 3: for SEM definition:**   * **The OOB domain should start at:**   **+/-(BWchannel, low+BWchannel, high)/2**   * **The -15 dBm/MHz region should end at:**   **+/-3\*(BWchannel, low+BWchannel, high)/2**   * **The requirement in the first OOB MHz should be:**   **-13 dBm/Min(0.01\*(BWchannel, low+BWchannel, high);0.4) [MHz]**   * + **above 40 MHz aggregated bandwidth, the measurement bandwidth is clamped at 400 kHz** |
| R4-2000713 | Skyworks | **Proposal 1: ON SEM definition:**   * **The definition of the SEM mask in the first OOB MHz shall use the single CC definition of -13dBm/1% BW up to 40MHz aggregated bandwidth then -13dBm/ 400kHz for higher aggregated bandwidths** * **The OOB starting point is based on cumulated channel BW instead of CABW to be on par with single CC case**   **Proposal 2: for NS04 and NS27 AMPR:**   * **The measured values in this contribution (CShapter 2.4) should be used for A-MPR studies as 1RB+1RB cases are often worse in measurements than in simulation (as a consequence of memory effect)** * **NS04 A-MPR regions and frequency offsets must consider IMD3 and IMD5 with at least:**   + - **13 dB for IMD3**     - **7 dB for IMD5** * **NS27 A-MPR regions and frequency offsets must consider IMD3, IMD5 and IMD7 with at least:**   + - **20 dB for IMD3**     - **13 dB for IMD5**     - **9 dB for IMD7**   **Proposal 3: for MPR table:**  Table 7: Proposed PC3 MPR table structure and values for QPSK   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Modulation** | | **MPR for contiguous allocations (dB)** | | **MPR for non-contiguous allocations (dB)** | | | **Outer RB allocations** | **Inner RB allocations** | **Outer RB allocations** | **Inner RB allocations** | | DFT-s-OFDM | Pi/2 BPSK | TBD | TBD | TBD | TBD | | TBD | TBD | TBD | TBD | | QPSK | ≤ 5 | ≤ 1.5 | ≤ 91 | ≤ 1.51 | | 16 QAM | TBD | TBD | TBD | TBD | | 64 QAM | TBD\* | | TBD\* | | | 256 QAM | TBD | | TBD | | | CP-OFDM | QPSK | ≤ 8 | ≤ 3 | ≤ 101 | ≤ 31 | | 16 QAM | TBD | TBD | TBD | TBD | | 64 QAM | TBD | | TBD | | | 256 QAM | TBD | | TBD | | | Note: for aggregated BW>100MHz 0.5dB is added for inner allocations and 1dB for outer allocations Note 1: for large non-contiguous allocations, the value is relaxed by TDB dB | | | | | |   \*May still need to be split in inner/outer allocations |
| R4-2001129 | Skyworks | **Observations:**   * **Baseline approach when relative and/or absolute bandwidths are exceeded should use extra MPR or spectrum flatness relaxation and is applicable to linear and APT PAS** * **Optional approach may be developed to enable ET implementations but overall capability set and power class in different modes should be understood first** |
| R4-2001756 | Huawei, HiSilicon | **Proposal 1: for intra-band UL contiguous CA with contiguous RB allocation, inner/outer RB allocation is defined as in 2.2.1**   * For Aggregated channel bandwidth>100MHz, the inner allocation can be defined as below:   *For RBstart,low=max(1,NRB\_alloc), RBStart,High = NRB,agg – RBStart,Low –NRB\_alloc*  *Inner RB allocation is defined as RBStart,Low ≤ RBStart ≤ RBStart,High, and NRB\_alloc≤Floor[(1/3NRB,agg) ]*  *Where NRB\_alloc=LCRB1 + LCRB2\*(SCS2/SCS1), in which SCS2 ≥ SCS1*  *NRB,agg=NRB1+NRB2\*(SCS2/SCS1), in which SCS2 ≥ SCS1*  *SCS1 and SCS2 are the SCS for CC1 and CC2 respectively*   * For Aggregated channel bandwidth ≤ 100MHz, the inner allocation can be defined as below:   For RBStart,Low = max(1, floor(*NRB\_alloc* /2)), RBStart,High = NRB – RBStart,Low – LCRB,  *Inner RB allocation is defined as* RBStart,Low ≤ RBStart ≤ RBStart,High, LCRB ≤ ceil(*NRB,agg* /2)  *Where NRB\_alloc=LCRB1 + LCRB2\*(SCS2/SCS1), in which SCS2 ≥ SCS1*  *NRB,agg=NRB1+NRB2\*(SCS2/SCS1), in which SCS2 ≥ SCS1*  *SCS1 and SCS2 are the SCS for CC1 and CC2 respectively*  **Proposal 2: for intra-band UL contiguous CA with non-contiguous RB allocation, inner/outer RB allocation is defined as in 2.2.2**  *For RBstart,low=max(1,NRB\_alloc), RBStart,High = NRB,agg – RBStart,Low –NRB\_alloc*  *Inner RB allocation is defined as RBStart,Low ≤ RBStart ≤ RBStart,High, and NRB\_alloc≤Floor[(1/3NRB,agg) ]*  *Where NRB\_alloc=LCRB1 + LCRB2\*(SCS2/SCS1)+∆fc,gap/SCS1, in which SCS2 ≥ SCS1*  *NRB,agg=NRB1+NRB2\*(SCS2/SCS1), in which SCS2 ≥ SCS1*  *SCS1 and SCS2 are the SCS for CC1 and CC2 respectively*  *∆fc,gap is the frequency gap between the RB allocations on each CC*  **Initial MPR value recommendations:**  **Table 1 Contiguous allocation MPR >100MHz**   |  |  |  |  | | --- | --- | --- | --- | | Modulation | | MPR | | | inner | outer | | DFT-s-OFDM | Pi/2 BPSK | TBD | TBD | | QPSK | 1 | 2 | | 16QAM | 2 | 3 | | 64QAM | 3.5 | 4.5 | | 256QAM | 6 | 6.5 | | CP-OFDM | QPSK | 3.5 | 4 | | 16QAM | 3.5 | 4 | | 64QAM | 5.5 | 5.5 | | 256QAM | 7 | 8 |   **Table 2 Non-Contiguous allocation MPR >100MHz**   |  |  |  |  | | --- | --- | --- | --- | | Modulation | | MPR | | | inner | Outer | | DFT-s-OFDM | Pi/2 BPSK | TBD | TBD | | QPSK | 8 | 14 | | 16QAM | | 64QAM | | 256QAM | 9 | 15 | | CP-OFDM | QPSK | 9 | 14 | | 16QAM | | 64QAM | | 256QAM | 10 | 15 | |
| R4-2001385 | Nokia | **Move from agenda 8.13.1.2, there is discussion paper on the related aspects**  **Proposed solution 1:** Replace “for the said 𝜇 value” with “for 𝜇=𝜇0”.  **Proposed solution 2:** For the UEDefine ), indicating that the maximum is taken across the CCs, and the included minimum guard band widths correspond to, the largest *μ* value among the subcarrier spacing configurations supported in the operating band for both of the channel bandwidths (see the definition of CA channel spacing).  **Problem 3:** The definitions of channel spacing, Foffset,low, and Foffset,high  **Proposed solution 3:** To be solved.  This problem does not exist in the base station because 38.104 has a different definition of Foffset,low and Foffset,high. [1][2] |
| CR R4-2001759 | Huawei, HiSilicon | Provide initial intra-band contiguous CA MPR definition format with MPR value TBD which depends on the discussion |
| CR R4-2001772 | Huawei, HiSilicon | Provide CR on emission RF requirement for intra-band UL CA including:   * OBW * SEM * ACLR * SE |
| CR R4-2001773 | Huawei, HiSilicon | Provide CR on output power RF requirement for intra-band UL CA including:   * Power class * Configured output power * Minimum output power * Off power * On/off time mask * Power control |
| CR R4-2001774 | Huawei, HiSilicon | Provide CR on signal quality RF requirement for intra-band UL CA including:   * Frequency error * EVM * In-band emission |
| CR R4-2002051 | Huawei, HiSilicon | Move from agenda 9.1.2  This draft CR is to introduce related UL CA band combinations:  CA\_n41C  CA\_n41(2A) |
| CR R4-2001762 | Huawei, HiSilicon | As agreed in RAN4 #92bis meeting, almost contiguous RB allocation is not supported for intra-band CA. |

## Open issues summary

### Sub-topic 1-1 CRs for UL CA requirement not related to ACLR and MPR

**Issue 1-1-1: comments on the CR for R4-2001773 for output power RF requirement for intra-band UL CA**

**Issue 1-1-2: comments on the CR for R4-2001774 for signal quality RF requirement for intra-band UL CA**

**Issue 1-1-3: comments on the CR for R4-2001762 for almost contiguous allocation for intra-band UL CA**

**Issue 1-1-4: comments on the CR for R4-2002051 for configurations for intra-band UL CA**

### Sub-topic 1-2 CR for UL CA emission requirement

*In WF R4-1915417 approved in RAN4 #93, we have agreement: ACLR MBW as BWChannel\_CA – 2\***max(GB(low),GB(high)) for both wanted and adjacent.*

*Where BWChannel\_CA is defined in 5.3A.3 of TS 38.101-1/2:*

*BWChannel\_CA = Fedge,high - Fedge,low= nominal channel space+ Foffset,high + Foffset,low*

*Hence ACLR MBW issue is related to the calculation on BWChannel\_CA and max(GB(low),GB(high))*

**Issue 1-2-1: how to define ACLR MBW**

* Proposals
  + **Option 1:** ), indicating that the maximum is taken across the CCs, and the included minimum guard band widths correspond to, the largest μ value among the subcarrier spacing configurations supported in the operating band for both of the channel bandwidths

May Adopt Foffset,low and Foffset,high definition in TS 38.104

Need revision on the ambiguity part in TS 38.101, and align definition with TS 38.104

* + **Option 2:**

• ACLR MBW for both wanted and adjacent is :

Nominal Channel Spacing + (SU, low\*12 +1)\*0.015/2\*2^(mu, low)+ (SU, low\*12 -1)\*0.015/2\*2^(mu, high)

• The offset frequency between the center of the wanted and adjacent channel is: BWchannel, low + BWchannel, high

No need for fundamental spec change which is aligned with the above definitions

May Need revision on the ambiguity part in TS 38.101

* + **Option 3:** other options are not precluded
* Recommended WF
  + TBA

**Issue 1-2-2: How to define SEM offset and Measurement bandwidth**

* + **Option 1:**
* The OOB domain should start at:

+/-(BWchannel, low+BWchannel, high)/2

* The -15 dBm/MHz region should end at:

+/-3\*(BWchannel, low+BWchannel, high)/2

* The requirement in the first OOB MHz should be:

-13 dBm/Min(0.01\*(BWchannel, low+BWchannel, high);0.4) [MHz]

above 40 MHz aggregated bandwidth, the measurement bandwidth is clamped at 400 kHz

* + **Option 2:** As per agreed in WF R4-1910273:

|  |  |  |
| --- | --- | --- |
| ΔfOOB  (MHz) | Spectrum emission limit(dBm) | MBW |
| ± 0 - 1 | Max(Round(10\*log(0.15/BWchannel\_CA)),-24) | 30kHz |
| ± 1 - 5 | -10 | 1MHz |
| ± 5 – BWchannel\_CA | -13 | 1MHz |
| ±BWchannel\_CA- BWchannel\_CA+5 | -25 | 1MHz |
| Note 1: BWchannel\_CA=nominal channel spacing+Foffset,high + Foffset,low, where the nominal channel spacing, Foffset,high and Foffset,low refers to subclause 5.4A.1 and subclause 5.3A.3. | | |

**Issue 1-2-3: CR for R4-2001772 on emission RF requirement for intra-band UL CA**

* + Recommended WF
  + Capture the agreements in the above two issues

### Sub-topic 1-3 Inner and outer RB allocation definition

*In WF R4-1915417, we have agreement on inner and outer RB allocation:*

* *[Aggregated channel bandwidth≤100MHz]: Inner RB allocation is defined according to 1CC inner and be up to Floor(1/2NRB,agg)*
* *[Aggregated channel bandwidth>100MHz]: for RBstart,low=max(1,NRB\_alloc), RBStart,High = NRB,agg – RBStart,Low –NRB\_alloc*

*Inner RB allocation is defined as RBStart,Low ≤ RBStart ≤ RBStart,High, and NRB\_alloc≤Floor[(1/3NRB,agg) ], this equation only based on the same SCS between CCs*

**Issue 1-3-1: contiguous allocations**

* Proposals
  + **Option 1:**

Contiguous inner equations is defined as:

RBs1\*2^mu1 ≥ max(1,floor((LCRB1\*2^mu1+LCRB2\*2^mu2)/2))

AND

RBs1\*2^mu1 ≤ (SU1-LCRB1)\*2^mu1+(SU2-LCRB2)\*2^mu2-max(1,floor((LCRB1\*2^mu1+LCRB2\*2^mu2)/2))

Any other allocation is an outer allocation.

* + **Option 2:**
* For Aggregated channel bandwidth>100MHz, the inner allocation can be defined as below:

For RBstart,low=max(1,NRB\_alloc), RBStart,High = NRB,agg – RBStart,Low –NRB\_alloc

Inner RB allocation is defined as RBStart,Low ≤ RBStart ≤ RBStart,High, and NRB\_alloc≤Floor[(1/3NRB,agg) ]

Where NRB\_alloc=LCRB1 + LCRB2\*(SCS2/SCS1), in which SCS2 ≥ SCS1

NRB,agg=NRB1+NRB2\*(SCS2/SCS1), in which SCS2 ≥ SCS1

SCS1 and SCS2 are the SCS for CC1 and CC2 respectively

* For Aggregated channel bandwidth ≤ 100MHz, the inner allocation can be defined as below:

For RBStart,Low = max(1, floor(NRB\_alloc /2)), RBStart,High = NRB – RBStart,Low – LCRB,

Inner RB allocation is defined as RBStart,Low ≤ RBStart ≤ RBStart,High, LCRB ≤ ceil(NRB,agg /2)

Where NRB\_alloc=LCRB1 + LCRB2\*(SCS2/SCS1), in which SCS2 ≥ SCS1

NRB,agg=NRB1+NRB2\*(SCS2/SCS1), in which SCS2 ≥ SCS1

SCS1 and SCS2 are the SCS for CC1 and CC2 respectively

* + **Option 3:** 
    - * Bandwidth class B: *[Aggregated channel bandwidth≤100MHz]: Inner RB allocation is defined according to 1CC inner and be up to Floor(1/2NRB,agg)*
      * Bandwidth class C: [Aggregated channel bandwidth>100MHz]: for RBstart,low=max(1,NRB\_alloc), RBStart,High = NRB,agg – RBStart,Low –NRB\_alloc
        + Outer 1: LCRB ≤ β\*BWCA
        + Outer 2: LCRB > β\*BWCA

β = (NRB\_alloc,1\*SCS1 + NRB\_alloc,2\*SCS2)/ (NRB,1\*SCS1 +NRB,2\*SCS2).

* Recommended WF
  + TBA

**Issue 1-3-2: non-contiguous allocations**

* Proposals
  + **Option 1:**

on-contiguous inner equations is defined as:

(2\*RBs1-SU1/2)\*2^mu1+(SU2/2-(RBe2+1))\*2^m2 ≥ BWCA/0.36

AND

(RBs1-SU1/2)\*2^mu1+3/2\*(3/2\*SU2-2\*(RBe2+1))\*2^mu2 ≥ BWCA/0.36

Any other allocation is an outer allocation.

* + **Option 2:**

For RBstart,low=max(1,NRB\_alloc), RBStart,High = NRB,agg – RBStart,Low –NRB\_alloc

Inner RB allocation is defined as RBStart,Low ≤ RBStart ≤ RBStart,High, and NRB\_alloc≤Floor[(1/3NRB,agg) ]

Where NRB\_alloc=LCRB1 + LCRB2\*(SCS2/SCS1)+∆fc,gap/SCS1, in which SCS2 ≥ SCS1

NRB,agg=NRB1+NRB2\*(SCS2/SCS1), in which SCS2 ≥ SCS1

SCS1 and SCS2 are the SCS for CC1 and CC2 respectively

∆fc,gap is the frequency gap between the RB allocations on each CC

* + **Option 3:**
  + The inner 1 region is defined for cases where the IM3 falls within the aggregated channel BW.
  + The outer 1 region is where the IM3 and IM5 falls within the -13dBm/MHz SEM mask and outside of the aggregated channel BW
  + The outer 2 region is defined when IM5 falls outside of the -13dBm/MHz SEM mask or in the -25dbm/MHz and -30dBm/MHz spurious region. For the outer 2 regions, we allow MPR to be reduced by the allocation ratio as was done for LTE CA.
* Recommended WF
  + TBA

### Sub-topic 1-4 MPR definition format

**Issue 1-4-1: contiguous allocations**

* Proposals
  + Option 1: classify into bandwidth class B and C with inner and outer allocation respectively
  + Option 2: define MPR based on bandwidth class B with inner and outer allocation respectively, MPR for bandwidth class C are added with extra part
* Recommended WF
  + Option 1

**Issue 1-4-2: non-contiguous allocations**

* Proposals
  + Option 1: classify into bandwidth class B and C with inner and outer allocation respectively
  + Option 2: define MPR based on bandwidth class B with inner and outer allocation respectively, MPR for bandwidth class C are added with extra part
* Recommended WF
  + Option 1

**Issue 1-4-3: CR for R4-2001759 on MPR requirement for intra-band contiguous UL CA**

* + Recommended WF
  + Capture the agreement we have in above issues

### Sub-topic 1-5 MPR value for intra-band UL contiguous CA in QPSK

**Issue 1-5-1: contiguous allocations for inner RB**

* Proposals
  + Option 1: 1.5dB/2dB for DFT-OFDM, 3dB/3.5dB for CP-OFDM
  + Option 2: 1dB for DFT-OFDM, 3.5dB for CP-OFDM
  + Option 3: 0dB for DFT-OFDM, 1.5dB for CP-OFDM
* Recommended WF
  + TBA

**Issue 1-5-2: contiguous allocations for outer RB: the data is not good aligned, provide the RB allocation position for further evaluation**

* Proposals
  + Option 1: 5.5dB/6.5dB for DFT-OFDM, 8dB/9dB for CP-OFDM, limited by full RB allocation
  + Option 2: 2dB for DFT-OFDM, 4dB for CP-OFDM
  + Option 3: 2~6dB for DFT-OFDM, 3~6dB for CP-OFDM, limited by LCRB > β\*BWCA
* Recommended WF
  + TBA

**Issue 1-5-3: non-contiguous allocations for inner RB**

* Proposals
  + Option 1: 1.5dB/2dB for DFT-OFDM, 1.5dB/2dB for CP-OFDM , relaxation for large non-contiguous allocation is TBD
  + Option 2: 8dB for DFT-OFDM, 9dB for CP-OFDM
  + Option 3: 0dB for DFT-OFDM, 1.5dB for CP-OFDM
* Recommended WF
  + TBA

**Issue 1-5-4: non-contiguous allocations for outer RB**

* Proposals
  + Option 1: 9dB/10dB for DFT-OFDM, 10dB/11dB for CP-OFDM, limited by 1+1 RB case which IMD fall into SEM part
  + Option 2: 14dB for DFT-OFDM, 14dB for CP-OFDM, limited by 1+1 RB case
  + Option 3: <=8.2dB for DFT-OFDM, <=9.2dB for CP-OFDM, limited by case which IMD5 fall into -25dBm/MHz and -30dBm/MHz region and small A, where A= (NRB\_alloc,1\*SCS1 + NRB\_alloc,2\*SCS2)/ (NRB,1\*SCS1 +NRB,2\*SCS2)
* Recommended WF
  + TBA

### Sub-topic 1-6 AMPR value for intra-band UL contiguous CA

**Issue 1-6-1: whether NS04 and NS27 need to be complete in Rel-16 FR1 WI**

* Proposals
  + Option 1: yes
  + Option 2: no
* Recommended WF
  + TBA

**Issue 1-6-2: AMPR for NS04 and NS27**

* Proposals
  + Option 1:

•NS04 A-MPR regions and frequency offsets must consider IMD3 and IMD5 with at least:

* 13 dB for IMD3
* 7 dB for IMD5

•NS27 A-MPR regions and frequency offsets must consider IMD3, IMD5 and IMD7 with at least:

* 20 dB for IMD3
* 13 dB for IMD5
* 9 dB for IMD7
  + Option 2:
* Recommended WF
  + We capture the key RB position for companies provide their simulation/measurement results in the next meeting

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Sub-topic** | **Comments: (Company: …)** |
| 1-1:CRs | Issue 1-1-1: CR R4-2001773 on output power  Sprint: The CR says  \*\*\*\*\*\*\*\*\*start of quote\*\*\*\*\*\*\*\*\*\*\*\*For uplink intra-band contiguous and non-contiguous carrier aggregation, MPR*c* = MPR and A-MPR*c* = A-MPR with MPR and A-MPR specified in subclause 6.2A.2 and subclause 6.2A.3 respectively. There is one power management term for the UE, denoted P-MPR, and P-MPR*c* = P-MPR. PCMAX,*c* is calculated under the assumption that the transmit power is increased by the same amount in dB on all component carriers. The PSD difference between UL CCs shall not exceed 3dB.”  \*\*\*\*\*\*\*\*\*end of quote\*\*\*\*\*\*\*\*\*\*\*\*  I don’t think that equal MPR on each cell is in line with RAN 1 requirements for UE behaviour when UL power is limited. From 38.213:  \*\*\*\*\*\*\*\*\*start of quote\*\*\*\*\*\*\*\*\*\*\*\*   * 7.5 Prioritizations for transmission power reductions   For single cell operation with two uplink carriers or for operation with carrier aggregation, if a total UE transmit power for PUSCH or PUCCH or PRACH or SRS transmissions on serving cells in a frequency range in a respective transmission occasion  would exceed , where  is the linear value of  in transmission occasion  as defined in [8-1, TS 38.101-1] for FR1 and [8-2, TS38.101-2] for FR2, the UE allocates power to PUSCH/PUCCH/PRACH/SRS transmissions according to the following priority order (in descending order) so that the total UE transmit power for transmissions on serving cells in the frequency range is smaller than or equal to  for that frequency range in every symbol of transmission occasion . When determining a total transmit power for serving cells in a frequency range in a symbol of transmission occasion , the UE does not include power for transmissions starting after the symbol of transmission occasion . The total UE transmit power in a symbol of a slot is defined as the sum of the linear values of UE transmit powers for PUSCH, PUCCH, PRACH, and SRS in the symbol of the slot.  - PRACH transmission on the PCell  - PUCCH transmission with HARQ-ACK information and/or SR or PUSCH transmission with HARQ-ACK information  - PUCCH transmission with CSI or PUSCH transmission with CSI  - PUSCH transmission without HARQ-ACK information or CSI  - SRS transmission, with aperiodic SRS having higher priority than semi-persistent and/or periodic SRS, or PRACH transmission on a serving cell other than the PCell  In case of same priority order and for operation with carrier aggregation, the UE prioritizes power allocation for transmissions on the primary cell of the MCG or the SCG over transmissions on a secondary cell. In case of same priority order and for operation with two UL carriers, the UE prioritizes power allocation for transmissions on the carrier where the UE is configured to transmit PUCCH. If PUCCH is not configured for any of the two UL carriers, the UE prioritizes power allocation for transmissions on the non-supplementary UL carrier.  \*\*\*\*\*\*\*\*\*end of quote\*\*\*\*\*\*\*\*\*\*\*\*  It seems like just like LTE is prioritized for EN-DC, the Pcell needs to be prioritized over the secondary cell for NR UL CA.  Skyworks: CA\_n41(2A) and CA\_n41C 160MHz (>6% BW) or 190MHz (>7%BW) exceeds 4%BW. It needs to be clear how >4% BW is addressed in the requirements before power class is fully defined and CR agreed  Huawei: The relative CBW criteria shall not be used everywhere. The current spec just says the MPR for CBW exceeds the limitation could be defined different compared to the values in the spec. Now the MPR for UL CA is still under study, which should consider the new scenario requested by operators with large aggregated CBW.  To Sprint, NR UL CA is unlike ENDC, the power scaling is based on the priority for physical channel defined in TS 38.213, not based on CG priority. The sentence in our CR is follow the definition in TS 36.101, however since the physical channel on CCs may different then power scaling may be different on each CC, so I add one sentence “The PSD difference between UL CCs shall not exceed [3]dB.” to ensure that the PSD on each CC are almost identical.  Nokia: CR should contain whole feature. Intra band CA requirements are put to interband CA clause.  Huawei: To Nokia, in the CR, I made the CA feature as a whole, and adding intra-band UL CA part into CA feature. I think it follows TS 36.101 type. |
| Issue 1-1-2: CR R4-2001774 for signal quality  Not agreeable: NR image and carrier leakage are 28dBc in NR not 25dB  Huawei: will revise CR on this part.  Qualcomm:   1. Why do we have to worry about LO location parameter when IBE exceptions for intra-band contiguous ULCA and if we propose 2 PA architecture for intra-band non-contiguous ULCA?   Nokia: CR should contain whole feature. Intra band CA requirements are put to interband CA clause.  Huawei: To Nokia, in the CR, I made the CA feature as a whole, and adding intra-band UL CA part into CA feature. I think it follows TS 36.101 type. To QC, it is agreed in RAN1 that 3301 is allowed for intra-band CA and RAN4 send reply LS confirm RAN1’s agreement in RAN4#93 meeting. Furthermore, LO location is related to LO number but not PA architecture. |
| Issue 1-1-3: CR R4-2001762 for almost contiguous allocation  Huawei: Seems no objective comments. |
| Issue 1-1-4: CR R4-2002051 for configuration on intra-band UL CA  Skyworks: for UL CA\_n41(2A) we need to understand the maximum instantaneous BW: 160MHz for NS01 and 190MHz for NS04? Is this intended with 1 or 2 PAs and with which support for UL MIMO or transparent TX diversity.  Huawei: NS\_04 can be considered later in order to complete the WI on time. The requirements shall be architecture agnostic, and UL MIMO or transparent Tx div are not excluded.  Nokia: Could be merged to feature CR.  Apple: Introduces CA\_n41C and CA\_n41(2A), however, the feature intra-band UL CA is not yet completed. And even when the general feature intra-band UL CA is specified, for band 41 specific emissions requirements are needed requiring MPR and A-MPR, this is not done yet.  Huawei: to Nokia, the UL CA feature includes too much contents, in case we stuck in one tiny issue that nothing can be approved, we propose to separate the feature CR into several parts, it make sure the WI can complete in time. We are open to discuss on this. |
| 1-2:emission requirement | Issue 1-2-1: ACLR MBW  NTT DOCOMO, INC.: We have a question that is it OK if the definition of the channel arrangement of UE and BS does not align each other, and how about using the same definition of BS. We would like to note that MBW of ACLR for intra-band contiguous CA in FR2 is specified as:  *BWChannel\_CA – GBChannel(1) - GBChannel(2)*  *NOTE 1: The GBChannel(i) is the minimum guard band of the component carriers at the lower edge Fedge, low and the upper edge Fedge,high of the sub-block respectively.*  , which seems to be the same definition as that of channel arrangement of BS specification.Skyworks: ACLR is easily defined from the channel spacing and Foffset, low, Foffset high srther than from removing GB to CA\_BW that is anyhow related to channel spacing and Foffst, low, Foffset high. The key is that channel spacing is properly defined and that the measurement BW ensures all the possible allocated RBS of the wanted signals fit in the measurement BW.  We believe it is fair that frequency offset is based on the sum of each individual CC channel BW as it would be for a single CC that would have the same BW.  Huawei: Firstly, we think the Foffset,low and Foffset,high need to be aligned between 38.101 and 38.104. The BWGB shall be identical on two sides of intra-band contiguous CA. For ACLR MBW, we now have two options:   * Two CCs are positioned with a certain channel space which is less than or equal to the nominal channel space, then the SCS adoption can defined as current 5.3A.3 of 38.101. It ensures the MBW always capture the signal within the wanted channel. * Two CCs are positioned definitely with nominal channel space, then the SCS adoption shall be revised as common largest µ defined in nominal channel space part. It ensures the verification condition is not flexible with CCs configuration, and ensures the aggregated channel bandwidth is not larger than CBW1+CBW2.   We are open to both options and welcome to better solution.  For FR2 ACLR MBW, I check f80 TS 38.101-2 , ACLR MBW is defined as BWChannel\_CA – 2\*BWGB, NOTE 1: BWGB is defined in clause 5.3A.2.  Qualcomm:   1. MBW=BWCA-2max(GB1, GB2). Do not use largest common mu. Largest common mu is only used for channel spacing. 2. Offset = +/-BWCA 3. Note that BWCA for different numerology can exceed sum(CCBW1, CCBW2). |
| Issue 1-2-2: SEM offset and MBW  NTT DOCOMO, INC.: We would like to take Option 2 which is the previous agreement.  Thank you for Skyworks R4-2000713. Is it correct understanding that if we take option2, MPR for non-contiguous allocation of both inner and outer allocation is increasing according to Table 3? To be more specific, MPR for DFT-s-OFDM for non-contiguous allocation of inner allocation increase from 1.5 to 6.6, and MPR for CP-OFDM for non-contiguous allocation of inner allocation increase from 3 to 6.9, and MPR for CP-OFDM for non-contiguous allocation of outer allocation increase from 10 to 12.3?  Skyworks: our document points at two separate issue:  What is the OOB starting position: based on CA\_BW or sum of channel BW. we belive the last one is fair compared to single CC case but we are open to discuss.  The measurement BW and requirement in the first OOB MHz. we believe this is a serious issue as it shows in our 1RB+1RB measurements that -24dBm/30kHz would be the cause of larger MPR even for inner allocations. Our measurements do account for memory effects in PA which simulations do not account for. Only other solution would be to reduce further the inner region. We do not understand the justification for a stricter requirement at larger bandwidth.  Huawei: we shall follow the agreement already reached in RAN4. We shall avoid to be back and forth on each requirement. We prefer option 2. Actually, we don’t see much difference on option 1 and option 2 except for the first OOB range, there may 1RB+1RB IMD falls into. We should not relax on SEM requirement, with this issue we prefer to have some relaxation on MPR.  Qualcomm:   1. Prefer to use the 1% BW for 0-1MHz SEM up until 40MHz BW then 400KHz thereafter. The 30KHz MBW is more pessimistic and may create larger inner MPR. |
| Issue 1-2-3:CR R4-2001772 on emission RF requirement  Skyworks: we believe we need to have consensus on the issue described above and whther it has been properly been verified by other companies.  Qualcomm:   1. Prefer to use the 1% BW for 0-1MHz SEM up until 40MHz BW then 400KHz thereafter. The 30KHz MBW is more pessimistic. 2. Title in 6.5A.1.3 should change to “Occupied Bandwidth for CA”. (remove inter-band word). 3. Definition for no OBW is unclear. Is this Wgap > max(∆FOOBL, ∆FOOBH). Can we refer to the TR in FR2 as a guideline?   For different numerology, the aggregated channel BW > sum(CBW1, CBW2), and how does this align with FCC. This needs to be investigated before finalizing OBW requirement in 3GPP.  Nokia: CR should contain whole feature. Intra band CA requirements are put to interband CA clause.  Huawei: To Nokia, in the CR, I made the CA feature as a whole, and adding intra-band UL CA part into CA feature. I think it follows TS 36.101 type. |
| 1-3:inner/outer allocation | Issue 1-3-1: contiguous allocation  Skyworks:  We suggest the condition for contiguous allocation is added as per our proposal independently to inner/outer definition.  In our measurements and the requirements we do not see the justification that wider bandwidth should have a smaller inner region (other than 1MHz OOB which should not reguce the region from ½ to 1/3rd. We believe using a single inner definition is better and allocated additional MPR for >100MHz but also potentially for >4% fractional BW.  At this point we believe that the defining two types of outer has proposed by Qualcomm is an unnecessary complexity compared to increasing the inner region for BW class C.  Whether equation uses mu or SCS is not important to us although it is confusing to see different notations for different things: SCS for allocation, mu for bandwidths…  Huawei:  For option 1, the meaning is similar as inner/outer allocation for single CC. we think it is better to align the terminology with single CC. The other issue is for aggregated channel bandwidth>100MHz, we already agree in WF R4-1915417 that inner/outer allocation is different with aggregated channel bandwidth≤100MHz.  We prefer option1. Actually option1 and option2 is the same for aggregated channel bandwidth ≤100MHz.  Qualcomm:   1. **In both R4-2000711 and R4-2000756**, the RBstart condition is missing for when contiguous allocation is only in the 2nd CC. So, RBstart1\*2^mu1 covers cases for only when CC1 is allocated or there is allocation across the gap. For cases, where CC! is not allocated, then the RBstart\_composite should be SU1\*2^mu1 + RBstart2\*2^mu2. 2. **In R4-2000711**, Proposal 3 needs further study. 3. **In R4-2000756**, the RBstart condition must be a composite RBstart value as indicated in R4-2000711 to account for different numerology.   **In R4-2000756**, inner/outer condition should cover all BW class and not 2 different inner/outre conditions. MPR should be adjusted in BW class C to account for the difference to reduce implementation complexity.  Nokia: Problems in interpreting Table 2.3-1: NOTE 1 is ambiguous, β is defined twice. What is the difference between LCRB and NRB\_alloc,*i*? LCRB is used as a bandwidth even though it is an RB count. |
| Issue 1-3-2: non-contiguous allocation  Skyworks: we believe there may not be significant difference between the two the two definition but we are cross checking if one might have better behavior (especially with regard to the issue in the first OOB MHz that Skyworks has found)  Huawei: option 3 is what we mentioned in our contribution in the last RAN4 meeting. We agree with option3, and we can see that MPR is with big difference between outer1 and outer2,  Qualcomm:   1. **In R4-2000756**, **R4-2000711, and R4-2000093** all agree on the IM3 all falling within BWCA as an inner waveform. The question is which is easier or better for implementation. |
| 1-4:MPR definition format | Issue 1-4-1: contiguous allocation  Skyworks: as already stated our preference is for a larger inner region for class C with a small delta MPR for inner, slightly larger for outer)  Huawei: prefer option1. The extra MPR may not fair to each waveform or modulation order, it is better more specific.  Qualcomm:   1. We are fine with different MPR as a function of BW class as long as the MPR definition is structured so that it can default back to LTE back-off with equivalent RB allocation. Companies must agree on Inner/Outer condition, preferably one condition for all BW class. |
| Issue 1-4-2: non-contiguous allocation  Skyworks: for non-contiguous case there is anyhow only one inner definition for class B and C. If outer 1 and outer 2 is defined (we find it too complex) we believe it sould use a single value and not depend on allocation ratio. In the end we believe that the scheduler only needs to distinguish between good and less good allocations like in the single CC case. We also believe that a simple MPR reduction could be given to large non-contiguous allocations.  Huawei: prefer option1. The extra MPR may not fair to each waveform or modulation order, it is better more specific.  Qualcomm:   1. We are fine with different MPR as a function of BW class as long as the MPR definition is structured so that it can default back to LTE back-off with equivalent RB allocation. Companies agree on IM3 falling in BWCA as inner. |
| Issue 1-4-3:CR for R4-2001759  Skyworks: it is too early to agree inner/outer and table structure based on current results unless we have a way forward on allocation definition and difference between class B and C  Huawei: we target on completing the format discussion in this meeting, the CR will capture the agreement.  Qualcomm:   1. Need consensus before finalizing values and agreement. 2. Qualcomm prefers same inner/outer for all BW class.   Nokia: Cannot have a CR with all entry’s TBD. CR should contain whole feature. Intra band CA requirements are put to interband CA clause. |
| 1-5:MPR value | Issue 1-5-1: contiguous allocation for inner RB  Skyworks: the key is to settle on QPSK first and pay attention to measurements which account properly for worst case asymmetry in spectral regrowth which may be the reason for slightly higher MPR for Skyworks notably for inner contiguous. Some of the difference between CP-OFDM and DFT-s-OFDM is due to the feasible number of RB in DFT-s-OFDM which means that the CP-OFDM region is larger than for DFT-s-OFDM. Delta is around 1-1.5dB and there is no significant difference between class C and B justifying to use the same inner/outer definition. Delta of 2.5dB seems very high for Huawei. It would be of interest that companies provide background on what was the worst case limitation and for which allocation.  Huawei: we can see that the results provided in this meeting quite aligned for contiguous inner RB allocation. For option 3, we see 0dB MPR with 2PA architecture. For contiguous allocation, 1PA architecture was agreed in the last meeting. Propose to define MPR for contiguous inner RB allocation as 1.5dB for DFT-OFDM, 3.5dB for CP-OFDM for aggregated channel bandwidth ≤200MHz.  For the difference between DFT-s-OFDM and CP-OFDM, we think DFT-s-OFDM is under estimate with 1dB(from some initial measurement). For inner case, the 1+1RB case which IMD5 falls into SEM part seems worst case.  Qualcomm:   1. [R4-2000713]: What is the cause of inner MPR for DFT QPSK from contiguous measurements since ACLR should be very good for inner waveforms? |
| Issue 1-5-2: contiguous allocation for outer RB  Skyworks: our measurements show that fully allocated is the worst case and due to IMD assynmetry is worse than for QCOM and Huawei.  Huawei: According to the contributions, the limitation is full RB(large RB) allocation. We would like further evaluation on the MPR for full RB(large RB) allocation. At least, we can align on 2dB for DFT-OFDM, 4dB for CP-OFDM for RB allocation with NRBalloc≤β\*BWCA, where β is TBD.  Qualcomm:   1. [R4-2001129]: For BW class B, only CA\_n7B and CA\_n40B have the MPR threshold failure. For BW class C, CA\_n41C always fails this threshold. Rather than define a % failure threshold as in single CC, it is better to adjust MPR values to account for the worst-case relative BW. 2. [R4-2000713]:, Why is there 4.5dB MPR for outer 20+20 DFT-s-OFDM measurement which should be same as LTE (2dB). Is the PA calibration point different? 3. [R4-2001756]. Why no MPR values for < 100MHz? the MPR values for > 100MHz are too low. |
| Issue 1-5-3: non-contiguous allocations for inner RB  Skyworks: we do not understand the large MPR from Huawei, some explantion on which limitatiuon and allocation is needed. For QCOM and Skyworks the differences are similar than for contiguous case and Skyworks values account for IMD5/7 asymmetry in 1RB+1RB that are the worst cases. As we suggested some improvement could be done for large allocation (but in a simple way)  Huawei: from simulation, we see that some non-contiguous allocations for inner RB may limited by ACLR, for 1RB+1RB case. We need further evaluation with measurement.  Qualcomm:   1. [R4-2001756]. For the defined inner region, the MPR values look to be too high. Qualcomm needs to submit MPR numbers once requirements and definition is finalized. 2. [R4-2000713]. Your measurements show that IM5 in SEM -13dBm/M region is the cause for 1.5dB MPR for inner waveforms. Or is it the IM3 leaking into 0-1MHz of SEM region? Need Clarification. |
| Issue 1-5-4: non-contiguous allocations for outer RB  Skyworks: this is where using -24dBm/30kHz could hurt significantly. This may be the reason for Huawei large MPR. When considering worst case 1RB+1RB Skyworks and QCOM results are close. As we suggested some improvement could be done for large allocation (but in a simple way)  Huawei: the worst case come from 1RB+1RB edge case. For outer2 RB allocation(IM3 in -13dBm/MHz, at least one IM5 in -25dBm/MHz or -30dBm/MHz), We think take MPR be reduced by the allocation ratio would be fair to each allocations.  Qualcomm:  Regarding, [R4-2001756], Qualcomm needs to submit MPR numbers once requirements and definition is finalized. We expect similar back-off as intra-band ENDC. |
| 1-6: AMPR NS04 and NS27 | Issue 1-6-1: whether NS04 and NS27 need to be complete in Rel-16 FR1 WI  Skyworks: we believe band 41 and 48 (and C-band) could be key deployements in the US like band 41/77/78/790 in the rest of the world. We also belive there is potentially other emission issues for n77/78/79 that could arise with bandwidth class C.  Huawei: considering the MPR discussion status, we recommend NS04 and NS27 AMPR be completed in Rel-17 to ensure the WI can be completed in time. |
| Issue 1-6-2: AMPR for NS04 and NS27  Skyworks: our values are indicative a possible worst case and need to pay attention up to IMD5/7 for the strict OOB emissions rules of FCC for band 41 and 48 |

### 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:* |

*Recommendations on WF/LS assignment*

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

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #2: intra-band DL CA for FR1

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

**Topic2 includes contributions for agenda 8.13.1.2 and 8.13.1.3**

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| CR R4-2000754 | Media Tek | Clarify on n48 receiver requirements |
| CR R4-2000234 | Huawei, HiSilicon | BCS0 configurations for CA\_n77C and CA\_n78C lack 10+100\20+100\30+100\40+100, etc. Because of the stronge market demand and uncertainty of spectrum auction in EU, we need to add BCS1 configurations for CA\_n77C and CA\_n78C. It’s inconveniet and unsuitable to place CA\_n77C, CA\_n78C and CA\_79C into one grid. |
| CR R4-2001077 | Huawei, HiSilicon | Editorial correction |
| CR R4-2001771 | Huawei, HiSilicon | Adding Bandwidth class D CA configuration and corresponding receiver requirement. |
| CR R4-2001074 | Huawei, HiSilicon | simply intra-band CA operating band table in clause 5.2A.1 |

## Open issues summary

### Sub-topic 2-1: comments on other CRs for new configuration and editorial correction

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

**Issue 2-1-1: R4-2000754**

**Issue 2-1-2: R4-2000234**

**Issue 2-1-3: R4-2001077**

**Issue 2-1-4: R4-2001771**

**Issue 2-1-5: R4-2001074**

* Recommended WF
  + Approved

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Sub-topic** | **Comments (Company: …)** |
| 2-1 | Issue 2-1-1: CR R4-2000754 n48 receiver requirement clarify  Skyworks: question for clarification: has it been verified that using <2700MHz blocking requirements for n48 is compatible with co-banding with n78/n77 and associated RF front-end filters? |
| Issue 2-1-2: CR R4-2000234 new BCS introduction  Skyworks: since the the combination is no longer in the order of the CCs it seems a lot of rows are redundant.  Huawei: We can revise this paper based on your comments. |
| Issue 2-1-3: CR R4-2001077 editorial correction  Nokia: Also Class F needs maintenance, we have a CR to fix both B and F R4-2000525.  Skyworks: overlaps with CRs in basket thread  Huawei: This paper has been merged into R4-2002575. This contribution can be noted. |
| Issue 2-1-4: CR R4-2001771 Adding Bandwidth class D CA configuration  Nokia: What is the reasoning saying that class D was wrongly removed  Skyworks: Can huawei clarify in which band there is 300MHz of contiguous spectrum available to a single operator? In our view this is not urgent for release 16.  MediaTek Inc:   1. MediaTek would like to clarify that CA\_n77D, CA\_n78D, CA\_n79D were not wrongly removed since there was no TP in TR37.865-01-01 neither in TR38.716-01-01.We offline checked with some companies in last Sep. and online checked during last Oct. meeting, there was no sound that bandwidth class D/E for n77/n78/n79 are required. This was the reason why n77/n78/n78 class D/E were removed in Rel-15 and Rel-16. We recommend people shall avoid introduce new feature in TS before there is TP/TR.   MediaTek would like to know who the operators request for bandwidth class D  China Unicom:  We support this CR to add back bandwidth class D CA configuration and corresponding requirements. China Unicom does have demand to support maximum of 300MHz CA bandwidth in n77/n78 band in the specification.  China Telecom: We have the potential request for n78D. Regarding timeline/procedure for CA work, we don’t have strong opinion.  Huawei: see comments from operators. |
| Issue 2-1-5: CR R4-2001074 simply intra-band CA operating band table  Nokia: We would like to keep CA band as it may be used later to address all caonfigurations that have different CA BW Class. Table 5.2A.1-2 has some erronous entries which could be fixed  Skyworks: to be revised as in any case CA\_nXX\_nXX should be CA\_nXX(2A)  Huawei: The specific configuration can be found in 5.5A. This subclause is only about operating bands. In this sub-clause, we can just indicate which bands support intra-band contiguous or non-contiguous CA  Apple: We agree on the simplification of the table. However, our recommendation is to keep the first column and delete the second column. |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2001771 | MediaTek Inc:   1. MediaTek would like to clarify that CA\_n77D, CA\_n78D, CA\_n79D were not wrongly removed since there was no TP in TR37.865-01-01 neither in TR38.716-01-01.We offline checked with some companies in last Sep. and online checked during last Oct. meeting, there was no sound that bandwidth class D/E for n77/n78/n79 are required. This was the reason why n77/n78/n78 class D/E were removed in Rel-15 and Rel-16. We recommend people shall avoid introduce new feature in TS before there is TP/TR. 2. MediaTek would like to know who the operators request for bandwidth class D |
| China Unicom:  We support this CR to add back bandwidth class D CA configuration and corresponding requirements. China Unicom does have demand to support maximum of 300MHz CA bandwidth in n77/n78 band in the specification. |
| China Telecom: We have the potential request for n78D. Regarding timeline/procedure for CA work, we don’t have strong opinion. |
| 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:* |

*Suggestion on WF/LS assignment*

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

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #3: intra-band non-contiguous UL CA for FR1 power class 3

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000104 | Qualcomm | **Observation 1:** In gap ACLR relaxation or no ACLR requirement due to image offers reduced protection of another user in the gap.  **Observation 2:** Large back-off is required for LO leakage to meet SEM requirement even with in-gap ACLR relaxation.  **Proposal 1**: RF Requirements for non-contiguous ULCA shall assume dual PA architecture due to LO and image in-gap emissions.  **Proposal 2**: Use SEM, ACLR, EVM, and Spurious requirements as specified in 2.2, 2.3, 2.4, and 2.5 respectively.  **Proposal 3**: Use MPR regions as specified in 2.6. |
| CR R4-2001772 | Huawei, HiSilicon | Provide CR on emission RF requirement for intra-band UL CA including:   * OBW * SEM * ACLR   SE |
| CR R4-2001773 | Huawei, HiSilicon | Provide CR on output power RF requirement for intra-band UL CA including:   * Power class * Configured output power * Minimum output power * Off power * On/off time mask * Power control |
| CR R4-2001774 | Huawei, HiSilicon | Provide CR on signal quality RF requirement for intra-band UL CA including:   * Frequency error * EVM * In-band emission |

## 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 PA architecture

*Sub-topic description:*

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

**Issue 3-1-1: PA architecture for intra-band UL NC CA**

* Proposals
  + Option 1: Assume dual PA architecture due to LO and image in-gap emissions
  + Option 2: as captured in R4-1915417, depends on the largest gap between 2CC and aggregated CC BW
  + Option 3: report UE capability on PA architecture as for EN-DC
* Recommended WF
  + TBA

### Sub-topic 3-2 RF requirements other than MPR

*Sub-topic description*

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

**Issue 3-2-1: SEM**

* Proposals
* Option 1: composite SEM mask of the individual sub-blocks, ± ΔfOOB starting from the edges of the sub-blocks, it is already captured in R4-2001772
  + Option 2:
* Recommended WF
  + Capture it in the CR.

**Issue 3-2-2: ACLR treatment of in-gap and out of gap**

* Proposals
  + Option 1:
  + Adjacent Channel Leakage Power Ratio is the ratio of the sum of the filtered mean powers centered on each of the assigned sub-block frequency to the filtered mean power centered on an adjacent sub-block frequency at nominal channel spacing equal to the aggregated bandwidth of the sub-block.
  + Measurement BW is the aggregated sub-block bandwidth minus twice the maximum of the guard bands of the carriers within the aggregated sub-block configuration containing one or more CCs.
  + No ACLR requirement if Wgap < BWsub\_block to prevent excessive in-band emission with other sub-block.
  + Option 2:
* Recommended WF
  + Capture it in the CR.

**Issue 3-2-3: other RF requirements for NC CA** **as proposed in R4-2001773**/**R4-2001774**

* Proposals
  + Option 1: Approve the CR R4-2001773/R4-2001774, complete all RF requirement other than MPR for intra-band NC CA in this meeting
  + Option 2:
* Recommended WF
  + Option 1

### Sub-topic 3-3 inner/outer RB allocation for intra-band NC CA

**Issue 3-3-1: MPR**

* Proposals
  + Option 1:
* MInner\_NC region: **∆**IM3\_L ≤ 0.5 \* BW Channel, block1 and **∆**IM3\_H ≤ 0.5 \* BW Channel, block2
  + IM3 within edges of Channel block 1 and Channel block 2
* MOuter1\_NC region: 0.5 \* BW Channel, block1 < **∆**IM3\_L ≤ 1.5 \* BW Channel, block1 and 0.5 \* BW Channel, block2 < **∆**IM3\_H ≤ 1.5 \* BW Channel, block2
  + IM3 within composite -13dBm/MHz spec
* MOuter2\_NC region: **∆**IM3\_L > 1.5 \* BW Channel, block1 and **∆** IM3\_H > 1.5 \* BW Channel, block2
  + IM3 outside of composite -13dBm/MHz emission limit.
  + Option 2:
* Recommended WF
  + TBA

### Sub-topic 3-4 AMPR value for intra-band UL non-contiguous CA

**Issue 3-4-1: whether NS04 AMPR need to be complete in Rel-16 FR1 WI**

* Proposals
  + Option 1: yes
  + Option 2: no
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Sub-topic** | **Comments (Company: …)** |
| 3-1 | Issue 3-1-1: PA architecture for intra-band UL NC CA  KDDI: Since the big technical challenge of this wide band and limited Rel-16 time frame, it’s better to make use cases of this topic clearer. We have collected requirements from some Japanese operators as follows.   * TX BW (BWCC1+gap+BWCC2): 280MHz for n78 and 600MHz for n77. The following figure (sourced by Softbank) shows Japanese spectrum allocation of n77 and n78.      * Instantaneous UL and DL BW: 180MHz for n78 and 200MHz for n77. * MIMO (2x2 or 4x4): prefer to support 4x4MIMO   Others aspects  Skyworks: we can agree that two PA is an option especilally for very wide BW but it is too restrictive for all cases (smaller BW, small gaps...), If two PA option, we should assume two UL antennas, should this be an option only if UL MIMO is supported? if this is the case how to cover UL CA + UL MIMO, separate/different capabilities in single CC vs CA? it is not clear that it is sufficient to report capability as we have found in EN\_DC cases, it also must be clear what is the UE capability in the different CA and MIMO modes. Carrier leakage could be treated as an exception.  Huawei: Thanks for KDDI providing the spectrum information. Encourage operators provide more NC CA information, the PA architecture is highly related with the gap between 2 CCs. For Uplink, we think 2\*2 MIMO would be the upper limitation?  Currently, both 1PA and 2PA architecture should not be precluded. Even with small gap, we have some consideration on IMD product falling region may have impact on other RF requirement with 2PA. RAN4 may need discuss on the scenario that UE can use 1 PA architecture.(the gap value)  With 2PA architecture, if 2\*2 MIMO is supported, UE need 4Tx for intra-band NC CA.  For EN-DC, we introduce UE capability on PA architecture per band combination. We may reuse the capability for UL CA?  LGE: it may not be relevant to this issue but I would like to clarify about baseline PA architecture for intra-band UL contiguous CA. I assume that a single PA architecture should be baseline for intra-band UL contiguous CA. |
| 3-2 | Issue 3-2-1: SEM requirement  Skyworks: Composite SEM can be used as in ENDC but we need to clarify if we start from individual CC SEM and the related different requirements in the first OOB MHz. this is probably lees critical for non-contiguous UL CA but worth discussing.  Huawei: agree with composite SEM. We recommend to agree on this issue. |
| Issue 3-2-2: ACLR treatment  Skyworks: For non-contiguous UL CA it is not clear why aggregated bandwidth is used for ACLR unless one of the sub-block uses contiguous CA: the single CC ACLR requirement applies to each CC and if one sub-block uses contiguous CA then contiguous CA ACLR applies. The only question is how to treat the in gap requirement when the gap is smaller than the aggregated bandwidth or one of the CC/sub-block bandwidth. As for EN\_DC the in-gap ACLR of one CC does not apply when the gap is smaller than its channel bandwidth. Still the caes described in our previous papers exists and we believe that relaxation to 27dB ACLR in-gap for these cases is a suitable compromise as it is representative of the interference of two collocated UEs using the one of the channel each. We have commented on this in the NR basket thread. Also ACLR applies referred to the power sum of all active carriers.  Huawei: Prefer Option1. |
| Issue 3-2-3: NC CA CRs as in R4-2001773/R4-2001774  Nokia: CR should contain whole feature. Intra band CA requirements are put to interband CA clause.  Skyworks:  R4-2001773: CA\_n41(2A) and CA\_n41C 160MHz (>6% BW) or 190MHz (>7%BW) exceeds 4%BW. It needs to be clear how >4% BW is addressed in the requirements before power class is fully defined and CR agreed  R4-2001774: Not agreable: NR image and carrier leakage are 28dBc in NR not 25dB  Huawei: The relative CBW criteria shall not be used everywhere. The current spec just says the MPR for CBW exceeds the limitation could be defined different compared to the values in the spec. Now the MPR for UL CA is still under study, which should consider the new scenario requested by operators with large aggregated CBW.  For R4-2001774, we will revise the CR. |
| 3-3 | Issue 3-3-1:inner and outer RB allocation  Skyworks: proposal in R4-2000104 is similar to an approach presented by Skyworks in previous meeting. If we support the concept we are not sure it should define 3 types of allocations. The inner do not exist anytime the gap is larger than one of the CC so we think the outer 1 and outer 2 are the only cases that are worth. Then inner+outer1 becomes inner and outer2 becomes outer.  Huawei: we propose to discuss clearly on PA architecture first. |
| 3-4 | Issue 3-4-1:whether NS04 AMPR need to be complete in Rel-16 FR1 WI  Skyworks: we believe that it is too early to exclude NS04 being covered but we believe OOB emission and total instantaneous BW needs to be discussed for both band 41 and Band 77/78/79. For band 77/78/79 even with a two PA approach that would help for BW there are still issues to discuss in terms of support of UL MIMO or not and potential RIMD emission issues within radio altimeters or other C bands. We have commented on this in the NR basket thread.  Huawei: is there deployment requirement from north America on n41 NC CA. |

### 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:* |

*Suggestion on WF/LS assignment*

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

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #4: transient period capability

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

**Topic2 includes contributions for agenda 8.13.1.1, 8.13.1.2 and 8.13.1.3**

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000442 | Anritsu | ***Observation 1: EVM measurement with a 20 dB power step (1 RB to 100 RB, or vice versa) is feasible under a condition of CBW 20 MHz and SCS 15 kHz.***  ***Observation 2: Test equipment has enough sampling resolution to differentiate EVM measurement results between transient periods (1, 2, 4, 7, 10 s).***  ***Proposal 1: Clarify the UL/ DL configuration pattern for TDD on-to-on transient period requirements.***  ***Proposal 2: With regards to transient edges to include, clarify a way to calculate EVM including only symbols in which the transient occurs.***  ***Option 1: Calculate EVM which includes symbols in which only rising or falling edges of transient occur.***  ***Option 2: Calculate EVM which includes symbols in which both rising and falling edges of transient occur.***  ***Proposal 3: Create Annex F.8 (new) “Averaged EVM including symbols with transient period” to clarify assumptions for on-to-on transient period once the common assumptions have been established.*** |
| R4-2001757 | Huawei, HiSilicon | ***Observation 1: the RMS EVM over 1 slot with exclusion window cannot reflects the real transient period. This issue is also identified by most of companies which are interested in the topic.***  ***Observation 2: in the current spec, both RS symbol and data symbol are used for equalizing, and the equalizing result is used to calculate the EVM.***  ***Observation 3: three columns DMRS in one slot is defined in the current RMC, which can increase EVM measurement accuracy much with DMRS interpolation. Data symbols are also used for equalizing which further increase EVM measurement accuracy.***  ***Observation 4: Even for RMS EVM measurement, different channel estimates implementations for UE test are allowed, which will lead to EVM measurement inaccuracy.***  ***Observation 5: there are several problems on 1 OS EVM measurement unsolved or unexperienced in RAN4 and RAN5, no technical study is processed in the history.***  ***Observation 6: Based on the EVM measurement procedure defined in the current RAN4 and RAN5 spec, RMS EVM on one OFDM is not supported.***  ***Proposal 1: RAN4 agrees to lead a new WI in Rel-17 on defining EVM measurement processing procedure especially for one symbol RMS EVM.***  ***Observation 7: the test method proposed by [1] cannot differentiate UEs with different UE capability.***  ***Observation 8: there is no method to guarantee transient period is symmetrically positioned.***  ***Proposal 2: If RAN4 agrees the new WI on detailing the EVM measurement procedure, defining transient period capability can be one objective of the new WI.*** |
| R4-2002096 | Qualcomm | Proposal  **🡪 The new feature of transient capability reporting is agreed and its testability is established by modified/new EVM requirements.**  **🡪 LS is sent to RAN plenary to inform that RAN4 has agreed that testability of the new feature on transient capability reporting is captured in the CR.**  **🡪 CR in RP-192948 to be resubmitted at RAN #87.** |
| R4-2002143 | Skyworks | **Proposal 1 for operation in FR1:**   * **20 MHz Channel Bandwidth,** * **Highest supported modulation scheme,** * **Power change triggered by a 1:100 RB allocation change,** * **Initial PUSCH RB allocation is 1 RB,** * **Initial PUSCH power class 3 transmit power of [-3dBm] ± [3.2] dB for carrier frequency f ≤ [3.0] GHz or [-3dBm] ± [3.5] dB for carrier frequency [3.0] GHz < f ≤ 7.125 GHz,** * **Slot type: 14 OFDM symbols / slot,** * **PUSCH mapping type A** * **rmsEVM to be averaged over 10 subframes for the symbols that are not impacted by the RF transient,** * **rmsEVM to be averaged over [70] subframes for the symbols where the transient occurs,** * **Test pattern: Alternating 1 subframe modulating 1RB at offset position 0, 1 subframe modulating 100 RB at offset position 0.**   **Proposal 2: We invite interested companies to provide their views on the maximum EVM budget of [5%] and [15%] for 256QAM and 64QAM respectively, for the symbols where the transient occurs.** |

## 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 feasibility of transient period measurement

**Issue 4-1-1: whether RMS EVM over 1 slot can represent the transient period capability**

* Proposals
  + Option 1: no
  + Option 2: yes
* Recommended WF
  + Option 1

**Issue 4-1-2: for RMS EVM over 1 slot, whether EVM measurement procedure on equalizing is clear for UE**

* Proposals
  + Option 1: no, for equalizing procedure there is difference between TS 38.101 and 38.104. RAN4 need evaluation on this topic for transient period testability study.
  + Option 2: yes
* Recommended WF
  + Option 1

**Issue 4-1-3: For RMS EVM over 1 symbol, how to define EVM measurement procedure in the spec**

* Proposals
  + Option 1:RAN4 agrees to lead a new WI in Rel-17 on defining EVM measurement processing procedure especially for one symbol RMS EVM.
  + Option 2: Create Annex F.8 (new) “Averaged EVM including symbols with transient period” to clarify assumptions for on-to-on transient period once the common assumptions have been established.
* Recommended WF
  + TBA

**Issue 4-1-4: whether 20dB power change can represent the maximum power change in the network, if not, whether TE can provide the test condition for the maximum power change**

* Proposals
  + Option 1: no, the worst case for the on-on power change in FR1 is up to 55dB. Comments from TE company are welcome
  + Option 2: 20dB is enough
* Recommended WF
  + TBA

**Issue 4-1-5: how to ensure the transient period is symmetrically positioned**

* Proposals
  + Option 1: currently we cannot ensure the UE always position transient period symmetrically in the boundary.
  + Option 2: Setting the RF transient Timing Advance to -75% CP length gives UE vendors sufficient margin to pass EVM with transient conformance test
  + Option 3: detecting ‘tp’ with Timing Advance Violating the EVM Exclusion Period using EVM=min(EVM\_l,EVM\_h) for CP-OFDM.
* Recommended WF
  + Option 1

**Issue 4-1-6: whether EVM=min(EVML, EVMH) can differentiate UE with different transient period ability**

* Proposals
  + Option 1: it cannot differentiate UEs with different UE capability.
  + Option 2: EVM=min(EVM\_l,EVM\_h) in symbols where the transient occurs effectively creates an EVM measurement exclusion period of 150% CP length, i.e., approximately 7, 3.5 and 1.75μs for SCS 15,30,60 kHz respectively.
* Recommended WF
  + Option 1

**Issue 4-1-7: whether RMS EVM with DFT-OFDM measurement similar with LTE can be tested for transient period**

* Proposals
  + Option 1: yes
  + Option 2: no, the RMS EVM test method which used for LTE is not serving for transient period
* Recommended WF
  + TBA

### Sub-topic 4-2 other clarification on the transient period measurement

**Issue 4-2-1: UL DL configuration**

* Proposals
  + Option 1: For TDD, DDSUUDDSUU and/or DDDDDDSUUU
  + Option 2:
* Recommended WF
  + TBA

**Issue 4-2-2: how to calculate EVM for symbols in which the transient occurs**

* Proposals
  + Option 1: Calculate EVM which includes symbols in which only rising or falling edges of transient occur.
  + Option 2: Calculate EVM which includes symbols in which both rising and falling edges of transient occur.
* Recommended WF
  + TBA

### Sub-topic 4-3

Sub-topic 4-3 is only discussed after the above testability issues are solved

**Issue 4-3: EVM budget for symbol where the transient occurs**

* Proposals
  + Option 1: [5%] and [15%] for 256QAM and 64QAM
  + Option 2:
  + Option 3:
* Recommended WF
  + TBA

### Sub-topic 4-4 feedback to RAN #87

Based on the discussion on the 3 subtopics, draft LS is prepared

**Issue 4-4: LS to RAN**

* Proposals
  + Option 1: TBA
  + Option 2: TBA
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Sub-topic** | **Comments (Company: …)** |
| 4-1 | Issue 4-1-1: whether RMS EVM over 1 slot can represent the transient period capability  Qualcomm: The direction from RAN plenary was to focus on testability rather than discussion of the CR. This is not related to testability.  Anritsu: Share the same view with QC. And also the transient period can be included in every slot, which we think is different understanding from Huawei’s paper.  Skyworks: We do not see the relation to testability and this is not what is proposed.  Huawei: for introducing transient period capability, RAN4 agrees to discuss on testability issue. It means we need to ensure the capability UE indicating can be captured by TE accurately. For RMS EVM over 1slot, 14 symbols are participating into the average EVM calculating, the symbols without transient occurs will drastically smooth the test result on the symbol with transient occurs. It definitely within the scope of testability. And we think RAN4 already have discussion on this issue, and it is the intention on introducing 1 symbol EVM measurement.  Ericsson: This is not the proposal to test the transient, this question is out of scope. |
| Issue 4-1-2: for RMS EVM over 1 slot, whether EVM measurement procedure on equalizing is clear for UE  Qualcomm: Equalization procedure is for the basestation, not the UE since this is a UE Tx requirement. Since the basestation is not limited to channel estimation on a single symbol, the existing procedure for equalization does not need any modification.  Skyworks: There may be differences in equalizing procedure between TS 38.101 and 38.104 but they are not specific to the case with transient period so this does not justify delaying introduction of the capability  Huawei: Equalization procedure is not clear for UE since both data symbols and DMRS are allowed to do the equalization. While which one is used and whether interpolation is used are all depending on TE implementation. In our view, EVM result would be different with different equalization implementation. We think the clear definition in TS 38.104 is better than UE spec. There may be different view from TE vendors, thus we think a new WI can be led by RAN4.  Ericsson: EVM is UE Tx requirement, so what’s the point to compare equalization procedures in between BS and UE? This is out of scope. |
| Issue 4-1-3: For RMS EVM over 1 symbol, how to define EVM measurement procedure in the spec  Qualcomm: RAN4 does not decide or propose a new work item. Work items are proposed by individual companies and can only be decided at RAN plenary. Therefore, discussion of new work items in RAN4 is meaningless.  Anritsu: Support Option 2. As explained in Anritsu’s paper (R4-2000442) proposal 1 and 2, this relates to the test case implementation not only for EVM over 1 symbol, but also for over 1 slot. We need a clarification of the TDD configuration pattern and assumption of transient edges to include in the EVM calculation. Especially if there is a case that the EVM varies depending on the case that we calculate EVM only with the rising ede or falling edge.  Skyworks: The CR proposes a method and we agree that this can be reflected in Annex in the release 16 timeframe like proposed in R4-2000442. Release 17 WI is not in line with RAN plenary guidance and not needed.  Huawei: equalization procedure is even more vague for 1symbol case. For front-loaded DMRS, whether it can be used for equalizing? For data symbol, whether all symbols in 1 slot is used for equalizing on the symbol with transient occurs?  Ericsson: There is no point to further delay this feature, it has already been postponed from Rel-15 to Rel-16 to give companies more time to study it. Option is definitively the way to go. |
| Issue 4-1-4: whether 20dB power change can represent the maximum power change in the network, if not, whether TE can provide the test condition for the maximum power change  Qualcomm: This has already been discussed by RAN4 and is not related to testability.  Anritsu: From the testability point of view, there is a limit of power level difference up to approx 20 dB due to the limit of dynamic range in the test equipment.  Skyworks: The 55dB value has not been proposed or discussed in any paper and is not related to testability.  Huawei: we provide analysis in R4-1915367, in real network, the maximum power change range for NR will be up to 55dB since the P0 configuration could be different for each physical channel. If TE can not provide the environment with maximum power change range, how we can verify UE’s transient period capability? The UE may pass the test with 2us TP verifiacation but need 10us transient period in the network. Attention!! PA with APT and ET switch will consume much time on transient period, such issue is not raised only by Huawei but other chipset vendor in previous RAN4 meetings. As we see in UL CA part, SKW mentioned that all PAs are evaluated with only APT.  Ericsson: This was already discussed in past RAN4 meetings. There might be limitation due to the test equipment, but this is not related to the proposed method, and is applicable already for existing requirements. This is separate discussion. |
| Issue 4-1-5: how to ensure the transient period is symmetrically positioned  Qualcomm: This has already been discussed by RAN4 and is not related to testability  Anritsu: This is rather the UE implementation and not related to the testability.  Skyworks: Only the EVM measurement exclusion period is symmetrically placed.  Huawei: in SKW’s contribution, TA commanding for PA is mentioned. It means UE vendor can control UE on-on power switching point, the power adjustment can be configured in advance, it means all transient period can be placed on the before-symbol. Then exclusion window cannot capture any transient occurs on the first symbol.  Ericsson: This is not the point and has already been addressed in previous RAN4 meetings. The UE shall report the exclusion period corresponding to its supported transient time. So, if the transient period is not symmetrically positioned (e.g. 2us in one symbol and 3us in the other symbol), UE shall report a transient time equivalent to the corresponding exclusion period (e.g. any value >6us in the given example). The reported UE transient time shall always correspond to the worst case situation that could be tested. |
| Issue 4-1-6: whether EVM=min(EVML, EVMH) can differentiate UE with different transient period ability  Qualcomm: The proposed CR allows testing of reported transient with 15 kHz SCS. If finer resolution is needed by RAN5, one possibility is to use a higher SCS.  Skyworks: option 2 allows to create exclusion period for the different transient period capabilities for CP-OFDM. We have shown that even with the rounding to the upper 1us the test is valid.  Huawei: firstly, each capability proposed need to be rounded, we don’t see enough accuracy.  For NSA UE, it may not support every SCS, e,g, 15kHz, 30kHz, 60kHz, it can be indicated in the featuresetlist defined in TS 38.331. How could a UE only support 15kHz have measurement on 2us and 1us?  Ericsson: Contributions are demonstrating that several transient period values could be tested, no contribution is showing the opposite. |
| Issue 4-1-7: whether RMS EVM with DFT-OFDM measurement similar with LTE can be tested for transient period  Qualcomm: It has already been established in LTE that a method to exclude samples within the transient period post-FFT for DFT-S-OFDM is a reliable means to measure EVM that extends beyond 150% CP.  Anritsu: We assume Option 1: yes.  Skyworks: current exclusion period created for SC-FDMA in LTE is applicable to NR DFT-s-OFDM at the iFFT stage. Exclusion can be made to match declared transient period capability (or default one) and thus EVM test be valid.  Huawei: as the issues mentioned above are not solved, we can not take RMS EVM with DFT-OFDM measurement similar with LTE on transient period.  Ericsson: This was demonstrated with LTE and is so applicable to NR for DFT-s-OFDM. |
| 4-2 other test configuration discussion | Issue 4-2-1: UL DL configuration  Qualcomm: This is not related to testability  Skyworks: our preference is TDD pattern Figure 2.3-2 from R4-2000442  Huawei: we propose to discuss on this topic after testability issue is solved.  Ericsson: This is not impacting testability and could be decided later. |
| Issue 4-2-2: how to calculate EVM for symbols in which the transient occurs  Qualcomm: This is not related to testability  Skyworks: the proposal from RAN plenary CR is clear that the EVM of the two symbols affected by the exclusion should be evaluated and check against a separate EVM requirement for 64QAM and 256QAM.  Ericsson: EVM shall be calculated for the two symbols impacted by the transient. This is what the proposed method is doing. |
| 4-3 EVM budget for symbol | Issue 4-3: EVM budget for symbol where the transient occurs  Qualcomm: This is not related to testability  Skyworks: we can keep the current numbers in brackets and evaluate further in next meeting as proposed in our contribution (especially for 64QAM).  Huawei: relaxation on EVM may have impact on high order modulation, it is not our intention on introducing transient period capability. If 5% for 256QAM is enough on throughput, why not just change the EVM requirement?  Ericsson: This could be finalized later as it doesn’t impact testability. |
| 4-4 LS | Issue 4-4: LS to RAN  Qualcomm: Send LS to RAN plenary to inform that RAN4 has agreed that testability of the new feature on transient capability reporting is captured in the CR, as co-signed by a vast majority of companies  Skyworks: at this moment we do not see the reason to send an LS to RAN as the guidance from December RAN plenary is clear.  Huawei: Send LS to RAN plenary to inform that RAN4 cannot make consensus on testability of the new feature on transient period reporting.  Ericsson: We could send a LS to RAN and let them know RAN4 has an agreement on the testability of this feature. |

### 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:* |

*Suggestion on WF/LS assignment*

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

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |