**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
5. Topic #5: time masks for ULSUP-TDM which is for agenda 8.13.1 (second round only)

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 (e.g. time masks for ULSUP-TDM)

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. |
| Issue 1-1-2: CR R4-2001774 for signal quality |
| Issue 1-1-3: CR R4-2001762 for almost contiguous allocation |
| Issue 1-1-4: CR R4-2002051 for configuration on intra-band UL CA |
| 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. |
| 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? |
| Issue 1-2-3:CR R4-2001772 on emission RF requirement |
| 1-3:inner/outer allocation | Issue 1-3-1: contiguous allocation |
| Issue 1-3-2: non-contiguous allocation |
| 1-4:MPR definition format | Issue 1-4-1: contiguous allocation |
| Issue 1-4-2: non-contiguous allocation |
| Issue 1-4-3:CR for R4-2001759 |
| 1-5:MPR value | Issue 1-5-1: contiguous allocation for inner RB |
| Issue 1-5-2: contiguous allocation for outer RB |
| Issue 1-5-3: non-contiguous allocations for inner RB |
| Issue 1-5-4: non-contiguous allocations for outer RB |
| 1-6: AMPR NS04 and NS27 | Issue 1-6-1: whether NS04 and NS27 need to be complete in Rel-16 FR1 WI |
| Issue 1-6-2: AMPR for NS04 and NS27 |

### 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 |
| Issue 2-1-2: CR R4-2000234 new BCS introduction |
| Issue 2-1-3: CR R4-2001077 editorial correction |
| Issue 2-1-4: CR R4-2001771 Adding Bandwidth class D CA configuration |
| Issue 2-1-5: CR R4-2001074 simply intra-band CA operating band table |

### 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  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 |
| Issue 3-2-2: ACLR treatment |
| Issue 3-2-3: NC CA CRs as in R4-2001773/R4-2001774 |
| 3-3 | Issue 3-3-1:inner and outer RB allocation |
| 3-4 | Issue 3-4-1:whether NS04 AMPR need to be complete in Rel-16 FR1 WI |

### 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.  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.  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.  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.  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.  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.  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.  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  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  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  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  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.*

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

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| --- | --- |
|  | **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*

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| **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 #5: time masks for ULSUP-TDM

## Companies’ contributions summary

## 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 5-1: specification of time mask for ULSUP-TDM

**Issue 5-1-1: TBD**

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