**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 CLCRB ≤ β\*BWCA | Outer CABW 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 < 0.0259.2 - 40A ; 0.025 ≤ A < 0.058 – 16A ; 0.05 ≤ A < 0.254.83 – 3.33A ; 0.25 ≤ A ≤ 0.4,3.83 – 0.83A ; 0.4 ≤ A ≤ 1,MA [256QAM] = 8.2 ; 0 ≤ A < 0.0259.2 - 40A ; 0.025 ≤ A < 0.058 – 16A ; 0.05 ≤ A < 0.165.5 ; 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 allocationsNote 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 9.1.2This draft CR is to introduce related UL CA band combinations:CA\_n41CCA\_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 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 |
| Issue 1-1-2: CR R4-2001774 for signal qualityNot agreeable: NR image and carrier leakage are 28dBc in NR not 25dB |
| Issue 1-1-3: CR R4-2001762 for almost contiguous allocation |
| Issue 1-1-4: CR R4-2002051 for configuration on intra-band UL CASkyworks: 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. |
| 1-2:emission requirement | Issue 1-2-1: ACLR MBWSkyworks: 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. |
| Issue 1-2-2: SEM offset and MBWSkyworks: 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. |
| Issue 1-2-3:CR R4-2001772 on emission RF requirementSkyworks: we believe we need to have consensus on the issue described above and whther it has been properly been verified by other companies. |
| 1-3:inner/outer allocation | Issue 1-3-1: contiguous allocationSkyworks: 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… |
| Issue 1-3-2: non-contiguous allocationSkyworks: 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) |
| 1-4:MPR definition format | Issue 1-4-1: contiguous allocationSkyworks: 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) |
| Issue 1-4-2: non-contiguous allocationSkyworks: 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. |
| Issue 1-4-3:CR for R4-2001759Skyworks: 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 |
| 1-5:MPR value | Issue 1-5-1: contiguous allocation for inner RBSkyworks: 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. |
| Issue 1-5-2: contiguous allocation for outer RBSkyworks: our measurements show that fully allocated is the worst case and due to IMD assynmetry is worse than for QCOM and Huawei. |
| Issue 1-5-3: non-contiguous allocations for inner RBSkyworks: 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) |
| Issue 1-5-4: non-contiguous allocations for outer RBSkyworks: 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) |
| 1-6: AMPR NS04 and NS27 | Issue 1-6-1: whether NS04 and NS27 need to be complete in Rel-16 FR1 WISkyworks: 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. |
| Issue 1-6-2: AMPR for NS04 and NS27Skyworks: 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 clarifySkyworks: 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 introductionSkyworks: since the the combination is no longer in the order of the CCs it seems a lot of rows are redundant.  |
| Issue 2-1-3: CR R4-2001077 editorial correctionSkyworks: overlaps with CRs in basket thread |
| Issue 2-1-4: CR R4-2001771 Adding Bandwidth class D CA configurationSkyworks: 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. |
| Issue 2-1-5: CR R4-2001074 simply intra-band CA operating band tableSkyworks: to be revised as in any case CA\_nXX\_nXX should be CA\_nXX(2A) |

### 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 #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 CASkyworks: 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.  |
| 3-2 | Issue 3-2-1: SEM requirementSkyworks: 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. |
| 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. |
| Issue 3-2-3: NC CA CRs as in R4-2001773/R4-2001774Skyworks: 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 agreedR4-2001774: Not agreable: NR image and carrier leakage are 28dBc in NR not 25dB |
| 3-3 | Issue 3-3-1:inner and outer RB allocationSkyworks: 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. |
| 3-4 | Issue 3-4-1:whether NS04 AMPR need to be complete in Rel-16 FR1 WISkyworks: 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. |

### 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 capabilitySkyworks: We do not see the relation to testability and this is not what is proposed. |
| Issue 4-1-2: for RMS EVM over 1 slot, whether EVM measurement procedure on equalizing is clear for UESkyworks: 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 |
| Issue 4-1-3: For RMS EVM over 1 symbol, how to define EVM measurement procedure in the specSkyworks: 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. |
| 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 Skyworks: The 55dB value has not been proposed or discussed in any paper and is not related to testability. |
| Issue 4-1-5: how to ensure the transient period is symmetrically positionedSkyworks: Only the EVM measurement exclusion period is symmetrically placed. |
| Issue 4-1-6: whether EVM=min(EVML, EVMH) can differentiate UE with different transient period abilitySkyworks: 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. |
| Issue 4-1-7: whether RMS EVM with DFT-OFDM measurement similar with LTE can be tested for transient period 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. |
| 4-2 other test configuration discussion | Issue 4-2-1: UL DL configurationSkyworks: our preference is TDD pattern Figure 2.3-2 from R4-2000442 |
| Issue 4-2-2: how to calculate EVM for symbols in which the transient occursSkyworks: 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. |
| 4-3 EVM budget for symbol | Issue 4-3: EVM budget for symbol where the transient occursSkyworks: we can keep the current numbers in brackets and evaluate further in next meeting as proposed in our contribution (especially for 64QAM).  |
| 4-4 LS | Issue 4-4: LS to RANSkyworks: at this moment we do not see the reason to send an LS to RAN as the guidance from December RAN plenary is clear. |
|  |  |

### 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”* |