3GPP TR 36.716-01-01 V16.0.0 (2020-06)

6

3rd Generation Partnership Project;

Technical Specification Group Radio Access Networks;

LTE Intra-band CA for xDL/yUL including contiguous and non-contiguous spectrum, (x>=y)

(Release 16)

** 

The present document has been developed within the 3rd Generation Partnership Project (3GPP TM) and may be further elaborated for the purposes of 3GPP.  
The present document has not been subject to any approval process by the 3GPPOrganizational Partners and shall not be implemented.  
This Report is provided for future development work within 3GPPonly. The Organizational Partners accept no liability for any use of this Specification.  
Specifications and Reports for implementation of the 3GPP TM system should be obtained via the 3GPP Organizational Partners' Publications Offices.

Keywords

<keyword[, keyword]>

***3GPP***

Postal address

3GPP support office address

650 Route des Lucioles - Sophia Antipolis

Valbonne - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Internet

http://www.3gpp.org

***Copyright Notification***

No part may be reproduced except as authorized by written permission.  
The copyright and the foregoing restriction extend to reproduction in all media.

© 2020, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TTA, TTC).

All rights reserved.

UMTS™ is a Trade Mark of ETSI registered for the benefit of its members

3GPP™ is a Trade Mark of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners  
LTE™ is a Trade Mark of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners

GSM® and the GSM logo are registered and owned by the GSM Association

Contents

Foreword 4

1 Scope 5

2 References 5

3 Definitions, symbols and abbreviations 6

3.1 Definitions 6

3.2 Symbols 6

3.3 Abbreviations 6

4 Background 7

4.1 TR Maintenance 7

5 Intra-Band Contiguous Carrier Aggregation: Specific Band Combination Part 7

5.1 CA\_3DL\_41D\_3UL\_41D\_BCS0 CA\_4DL\_41E\_3UL\_41D\_BCS0 CA\_5DL\_41F\_3UL\_41D\_BCS0 7

5.1.1 Channel bandwidths per operating band 7

5.1.2 UE maximum output power 7

5.1.3 Spurious emission band UE co-existence 8

5.1.4 UE maximum output power with additional requirements 8

5.1.5 Additional Spectrum emission mask for CA\_41D 9

5.2 2DL\_48C\_2UL\_48C\_BCS0 3DL\_48D\_2UL\_48C\_BCS0 4DL\_48E\_2UL\_48C\_BCS0 3DL\_48A-48C\_2UL\_48C\_BCS0 4DL\_48C-48C\_2UL\_48C\_BCS0 11

5.2.1 Channel bandwidths per operating band for CA 11

5.2.2 Coexistence studies 11

5.2.3 REFSENS requirements 12

5.2.4 Vendor A, A-MPR for uplink CA bandwidth class C 12

5.2.4.1 Simulation Assumptions 12

5.2.4.2 Contiguous RB Transmission 14

5.2.4.3 2-cluster RB transmission 18

5.2.5 Vendor B, A-MPR for uplink CA bandwidth class C 21

5.2.5.1 A-MPR concept 21

5.2.5.2 Simulation assumptions 21

5.2.5.3 Results for Contiguous CA Resource Allocations 22

5.2.5.4 Results for Non-contiguous CA Resource Allocations 25

5.3 CA\_48B CA\_48A-48B CA\_48B-48B CA\_48B-48C CA\_48B-48D CA\_48B-48E CA\_48B CA\_48B CA\_48A-48B CA\_48B CA\_48B-48B CA\_48B CA\_48B-48C CA\_48B CA\_48B-48D CA\_48B CA\_48B-48E CA\_48B 26

5.3.1 Channel bandwidths per operating band for CA 26

5.3.2 Co-existence studies 27

5.3.3 ΔTIB,c and ΔRIB,c values 28

5.3.4 MSD 28

5.3.5 Vendor A, A-MPR for uplink CA bandwidth class B 28

5.3.5.1 Contiguous RB Transmission 28

5.3.5.2 2-cluster RB transmission 30

5.3.5.3 Vendor B, A-MPR for uplink CA bandwidth class B 31

5.3.5.3.1 A-MPR concept 31

5.3.5.3.2 Simulation assumptions 31

5.3.5.3.3 Results for Contiguous CA Resource Allocations 31

5.3.5.3.4 Results for Non-contiguous CA Resource Allocations 35

6 Intra-Band Non-Contiguous Carrier Aggregation: Specific Band Combination Part 36

6.1 CA\_2DL\_42A-42A \_1UL\_ BCS1, CA\_3DL\_42A-42C\_2UL\_42C\_BCS1, CA\_4DL\_42C-42C\_2UL\_42C\_BCS1 36

6.1.1 Channel bandwidths per operating band for CA 36

Annex A: Change history 37

# Foreword

This Technical Report has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

# 1 Scope

The present document is a technical report for Intra-band Carrier Aggregation Rel-16 for xDL/yUL including contiguous and non-contiguous spectrum under Rel-16 time frame. The purpose is to gather the relevant background information and studies in order to address Intra-band Carrier Aggregation requirements for the Rel-16 band combinations in Table 1-1 and Table 1-2.

Table 1-1: Release 16 Intra-band carrier contiguous aggregation combinations

|  |
| --- |
| CA combination |
| CA\_3DL\_41D\_3UL\_41D\_BCS0 |
| CA\_4DL\_41E\_3UL\_41D\_BCS0 |
| CA\_5DL\_41F\_3UL\_41D\_BCS0 |
| CA\_2DL\_48C\_2UL\_48C\_BCS0 |
| CA\_3DL\_48D\_2UL\_48C\_BCS0 |
| CA\_4DL\_48E\_2UL\_48C\_BCS0 |
| CA\_2DL\_48B\_1UL\_48A\_BCS0 |
| CA\_2DL\_48B\_1UL\_48B\_BCS0 |

Table 1-2: Release 16 Intra-band carrier non-contiguous aggregation combinations

|  |
| --- |
| CA combination |
| CA\_3DL\_48A-48C\_2UL\_48C\_BCS0 |
| CA\_4DL\_48C-48C\_2UL\_48C\_BCS0 |
| 48C-48A-48A\_1UL\_48A\_BCS0 |
| 42A-42A\_BCS1 |
| 42A-42C\_BCS1 |
| 42C-42C\_BCS1 |
| 42A-42C\_UL\_42C\_BCS1 |
| 42C-42C\_UL\_42C\_BCS1 |
| CA\_66A-66B\_UL\_66B |
| CA\_2DL\_48A-48B\_1UL\_48A\_BCS0 |
| CA\_2DL\_48B-48B\_1UL\_48A\_BCS0 |
| CA\_2DL\_48B-48C\_1UL\_48A\_BCS0 |
| CA\_2DL\_48B-48D\_1UL\_48A\_BCS0 |
| CA\_2DL\_48B-48E\_1UL\_48A\_BCS0 |
| CA\_2DL\_48A-48B\_1UL\_48B\_BCS0 |
| CA\_2DL\_48B-48B\_1UL\_48B\_BCS0 |
| CA\_2DL\_48B-48C\_1UL\_48B\_BCS0 |
| CA\_2DL\_48B-48D\_1UL\_48B\_BCS0 |
| CA\_2DL\_48B-48E\_1UL\_48B\_BCS0 |

This TR contains a band specific combination part. The actual requirements are added to the corresponding technical specifications.

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] RP-180806, “New WID on Rel16 LTE Intra-band CA for x DL/y UL including contiguous and non-contiguous spectrum(x>=y)”, RAN#80, Ericsson

# 3 Definitions, symbols and abbreviations

## 3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] and the following apply.   
A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

## 3.2 Symbols

For the purposes of the present document, the following symbols apply:

BWChannel\_CA Aggregated channel bandwidth, expressed in MHz.

FInterferer Frequency of the interferer

FIoffset Frequency offset of the interferer (between the center frequency of the interferer and the closest edge of the carrier measured)

FDL\_low The lowest frequency of the downlink operating band

FDL\_high The highest frequency of the downlink operating band

FUL\_low The lowest frequency of the uplink operating band

FUL\_high The highest frequency of the uplink operating band

Foffset Frequency offset from FC\_high to the *higher edge* or FC\_low to the *lower edge.*

ΔRIB,c Allowed reference sensitivity relaxation due to support for inter-band CA operation, for serving cell *c*.

ΔTIB,c Allowed maximum configured output power relaxation due to support for inter-band CA operation, for serving cell *c*.

## 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply.   
An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

BS Base Station

BCS Bandwidth Combination Set

CA Carrier Aggregation

CA\_X Intra-band contiguous CA of component carriers in one sub-block within Band X where X is the applicable E-UTRA operating band

CA\_X-X Intra-band non-contiguous CA of component carriers in two sub-blocks within Band X where X is the applicable E-UTRA operating band

CA\_X-Y Inter-band CA of component carrier(s) in one sub-block within Band X and component carrier(s) in one sub-block within Band Y where X and Y are the applicable E-UTRA operating band

CA\_X-X-Y CA of component carriers in two sub-blocks within Band X and component carrier(s) in one sub-block within Band Y where X and Y are the applicable E-UTRA operating bands

CC Component Carriers

DL Downlink

E-UTRA Evolved UMTS Terrestrial Radio Access

FDD Frequency Division Duplex

PA Power Amplifier

PCC Primary Component Carrier

REFSENS Reference Sensitivity power level

SCC Secondary Component Carrier

TDD Time Division Duplex

UE User Equipment

UL Uplink

# 4 Background

The present document is a technical report for Intra-band Carrier Aggregation under Rel-16 timeframe. The document covers each band combination specific issues (i.e. one sub-clause defined per band combination)

## 4.1 TR Maintenance

A single company is responsible for introducing all approved TPs in the current TR, i.e. TR editor. However, it is the responsibility of the contact person of each band combination to ensure that the TPs related to the band combination have been implemented.

# 5 Intra-Band Contiguous Carrier Aggregation: Specific Band Combination Part

## 5.1 CA\_3DL\_41D\_3UL\_41D\_BCS0 CA\_4DL\_41E\_3UL\_41D\_BCS0 CA\_5DL\_41F\_3UL\_41D\_BCS0

### 5.1.1 Channel bandwidths per operating band

Table 5.1.1-1 defines the supported E-UTRA CA configurations and bandwidth combination set for LTE-advanced 3UL intra-band contiguous CA in Band 41.

Table 5.1.1-1: E-UTRA CA configurations and bandwidth combination sets for CA\_41D

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | E-UTRA CA configuration / Bandwidth combination set | | | | | | | |
| E-UTRA CA configuration | Uplink CA configurations  (NOTE 3) | Component carriers in order of increasing carrier frequency | | | | | Maximum aggregated  bandwidth [MHz] | Bandwidth combination set |
| Channel bandwidths for carrier [MHz] | Channel bandwidths for carrier [MHz] | Channel bandwidths for carrier [MHz] | Channel bandwidths for carrier [MHz] | Channel bandwidths for carrier [MHz] |
| CA\_41D | CA\_41D | 10 | 20 | 15 |  |  | 60 | 0 |
| 10 | 15, 20 | 20 |  |  |
| 15 | 20 | 10, 15 |  |  |
| 15 | 10, 15, 20 | 20 |  |  |
| 20 | 15, 20 | 10 |  |  |
| 20 | 10, 15, 20 | 15, 20 |  |  |
| CA\_41E | CA\_41D | 15, 20 | 15, 20 | 15, 20 | 20 |  | 80 | 0 |
| CA\_41F | CA\_41D | 10,15, 20 | 15, 20 | 20 | 20 | 20 | 100 | 0 |

### 5.1.2 UE maximum output power

The UE maximum output power for CA\_41D is proposed to reuse requirement for bandwidth class C.

Table 5.1.2-1 CA UE Power Class for intra-band contiguous CA\_41D

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA CA Configuration | Class 1 (dBm) | Tolerance (dB) | Class 2 (dBm) | Tolerance (dB) | Class 3 (dBm) | Tolerance (dB) | Class 4 (dBm) | Tolerance (dB) |
| CA\_41D |  |  |  |  | 23 | +2/-22 |  |  |
| NOTE 2: If all transmitted resource blocks (Figure 5.6A-1) over all component carriers are confined within FUL\_low and FUL\_low + 4 MHz or/and FUL\_high – 4 MHz and FUL\_high, the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB | | | | | | | | |

### 5.1.3 Spurious emission band UE co-existence

Table 5.1.3-1 shows the spurious emission band UE co-existence for CA\_41D.

Table 5.1.3-1: Spurious emission band UE co-existence for CA\_41D

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA CA Configuration | Spurious emission | | | | | | |
| Protected band | Frequency range (MHz) | | | Maximum Level (dBm) | MBW (MHz) | NOTE |
| CA\_41D | E-UTRA Band 1, 2, 3, 4, 5, 8, 10, 12, 13 , 14, 17, 24, 25, 26, 27, 28, 29, 30, 34, 39, 40, 42, 44, 65, 66, 70 | FDL\_low | - | FDL\_high | -50 | 1 |  |

### 5.1.4 UE maximum output power with additional requirements

Simulations were completed to determine A-MPR for 3CC in B41D. It was used a validated PA model with PA calibration point MPR0 with QPSK 18RB single CC waveform to meet minimum general requirements for E-UTRA ACLR, UTRA1 ACLR, UTRA2 ACLR and General Spurious emissions. Carrier Leakage and Image suppression were both at -25dBc with Counter IM3 at -60dBc.

Supporting simulation results are shown in the appendix.

Proposal to use A-MPR for contiguous allocations as shown in Table 5.1.4-1

Table 5.1.4-1: Contiguous Allocation A-MPR for CA\_NS\_04 (power class 3)

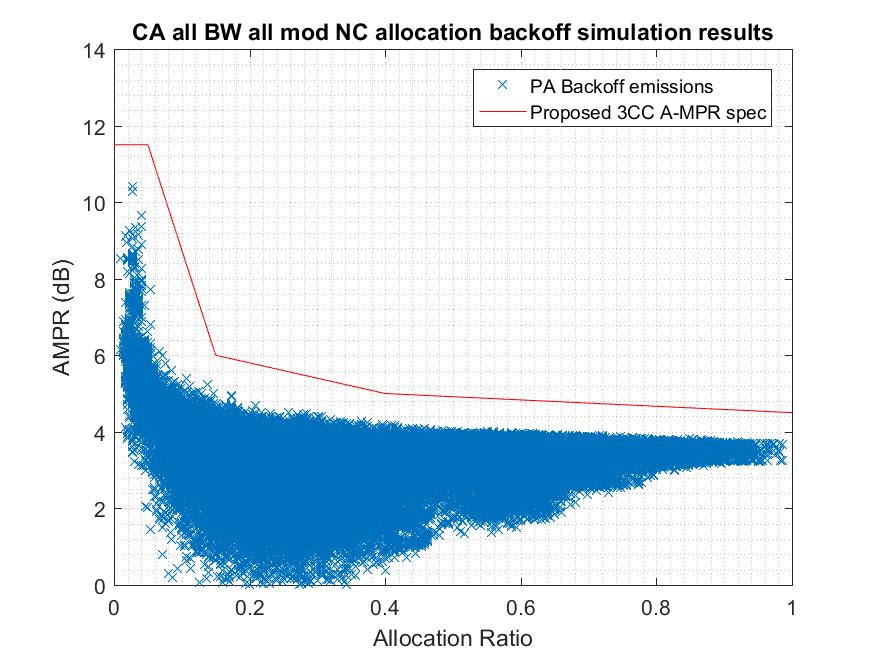
|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| CA Bandwidth Class D | RBStart | LCRB [RBs] | RBstart + LCRB [RBs] | A-MPR for QPSK [dB] | A-MPR for 16 QAM, 64 QAM and 256 QAM [dB] |
| 50 RB / 75 RB/ 100 RB | 0 – 64 and 161 – 224 | >0 | N/A | ≤4dB | ≤4.5dB |
| 65 – 160 | N/A | >161 | ≤3dB | ≤3.5dB |
| 50 RB / 100 RB / 100 RB | 0 – 72 and 178 – 249 | >0 | N/A | ≤4dB | ≤4.5dB |
| 73 – 177 | N/A | >178 | ≤3dB | ≤3.5dB |
| 75 RB / 75 RB / 100 RB | 0 – 72 and 178 – 249 | >0 | N/A | ≤4dB | ≤4.5dB |
| 73 – 177 | N/A | >178 | ≤3dB | ≤3.5dB |
| 75 RB / 100 RB / 100 RB | 0 – 78 and 197 – 274 | >0 | N/A | ≤3.5dB | ≤4dB |
| 79 - 196 | N/A | >197 | ≤2.5dB | ≤3dB |
| 100 RB / 100 RB / 100 RB | 0 – 96 and 204 – 300 | >0 | N/A | ≤3.5dB | ≤4dB |
| 97– 203 | N/A | >204 | ≤2.5dB | ≤3dB |
| NOTE 1: RBstart indicates the lowest RB index of transmitted resource blocks  NOTE 2: LCRB is the length of a contiguous resource block allocation  NOTE 3: For intra-subframe frequency hopping which intersects regions, notes 1 and 2 apply on a per slot basis. For intra-slot or intra-subslot frequency hopping which intersects regions, notes 1 and 2 apply on a per Tno\_hopping basis..  NOTE 4: For intra-subframe frequency hopping which intersects regions, the larger A-MPR value may be applied for both slots in the subframe. For intra-slot frequency hopping which intersects regions, the larger A-MPR value may be applied for the slot. For intra-subslot frequency hopping which intersects regions, the larger A-MPR value may be applied for the subslot. | | | | | |

Non-contiguous Allocations

For 3CC, there will be extra back-off required because of the triple beat product, even though the PSD is lower for each allocation in each CC. A simple study shows that the product is ~1.7dB higher than the equivalent 2 tone IMD product in the 2CC case for the same power in the 2CC and 3CC case. The back off required, assuming 3:1 will be ~0.57dB. A simple simulation study shows this effect in Figure 1, and a more comprehensive simulation was completed and shown in the appendix. As a result, the specification is bumped up by 0.5dB for non-contiguous allocations.

Figure 5.1.4-2 is comparing Power Back-off for the same non-contiguous allocation ratio for 2CC Vs 3CC (left). Comprehensive 3CC non-contiguous simulation with proposed spec (right).

Figure 5.1.4-2

****

Proposal to use A-MPR algorithm below for non-contiguous allocations.

If the UE is configured to CA\_41D or any uplink inter-band CA configuration containing CA\_41D and it receives IE CA\_NS\_04 the allowed maximum output power reduction applied to transmissions on two serving cells assigned to Band 41 with non-contiguous resource allocation is defined as follows for UE power class 3

A-MPR = CEIL {MA, 0.5}

Where MA is defined as follows:

MA = 11.5, 0≤ A < 0.05

= -55.0A + 14.25, 0.05≤ A < 0.15

= -4.0A + 6.60, 0.15≤ A < 0.40

= -0.833A + 5.333, 0.40 ≤ A ≤ 1

Where A = NRB\_alloc / NRB\_agg.

### 5.1.5 Additional Spectrum emission mask for CA\_41D

The FCC emission requirements defines emission boundaries as a function of emission bandwidth. For the purpose of deriving 3GPP specifications, the occupied bandwidth has been taken as equivalent to the FCC definition of emission bandwidth. The existing specification for CA\_NS\_04 emissions only considers uplink carrier aggregation class C with two component carriers. Therefore, the emission requirement is symmetric; that is, the emission requirement for BWA+BWB is the same as it is for BWA+BWB. However, when extending the same emission table to bandwidth class D with three component carriers, the symmetry does not hold. For example, the emission requirement for BWA+BWB+BWC is not necessarily the same as that for BWA+BWC+BWB. The reason is that the channel spacing between carriers, and therefore the overall occupied bandwidth, is not necessarily the same. In this example, the spacing between AB and BC is different than the spacing between AC and CB (or BC). Thus, we define the CA\_NS\_04 SEM table for CA\_41D as shown below.

It is observed that the requirement within the first MHz of the channel edge is progressively more challenging with increasing bandwidth. The FCC requirement in the first MHz allows for the use of a measurement bandwidth that is 2% of the emission bandwidth requiring an attenuation of 40+10logP while 3GPP specifications have typically used 30 kHz measurement bandwidth. Given the larger channel bandwidths for uplink bandwidth class D, it is proposed to increase the measurement bandwidth to 300 kHz to more closely reflect a 2% emission bandwidth for the bandwidths of interest. Note that this formulation still complies with the -13 dBm requirement in 1% emission bandwidth for the range from 2495 – 2496 MHz as required by FCC rules, for the CA\_41D bandwidths of interest.

Table 5.1.5-1: Additional SEM requirements for CA\_41D and CA\_NS\_04

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Spectrum emission limit [dBm]/BWChannel\_CA | | | | | | | |
| ΔfOOB  (MHz) | 75+50+100 or 100+50+75 RB  (44.15 MHz) | 50+75+100 or 100+75+50 RB  (44.6 MHz) | 75+100+50 or 50+100+75 RB  (44.75 MHz) | 100+50+100 RB (48.8 MHz) | 75+100+75 or 100+100+50 or 50+100+100 RB (49.7 MHz) | 75+75+100 or 100+75+75 RB (49.85 MHz) | Measurement bandwidth |
| ± 0-1 | -14.5 | -14.5 | -14.5 | -15 | -15 | -15 | 300 kHz |
| ± 1-5 | -10 | -10 | -10 | -10 | -10 | -10 | 1 MHz |
| ± 5-42.15 | -13 | -13 | -13 | -13 | -13 | -13 | 1 MHz |
| ± 42.15-42.6 | -25 | -13 | -13 | -13 | -13 | -13 | 1 MHz |
| ±42.6-42.75 | -25 | -25 | -13 | -13 | -13 | -13 | 1 MHz |
| ± 42.75-46.8 | -25 | -25 | -25 | -13 | -13 | -13 | 1 MHz |
| ± 46.8-47.7 | -25 | -25 | -25 | -25 | -13 | -13 | 1 MHz |
| ± 47.7-47.85 | -25 | -25 | -25 | -25 | -25 | -13 | 1 MHz |
| ± 47.85-49.15 | -25 | -25 | -25 | -25 | -25 | -25 | 1 MHz |
| ± 49.15-49.6 |  | -25 | -25 | -25 | -25 | -25 | 1 MHz |
| ± 49.6-49.75 |  |  | -25 | -25 | -25 | -25 | 1 MHz |
| ± 49.75-53.8 |  |  |  | -25 | -25 | -25 | 1 MHz |
| ± 53.8-54.7 |  |  |  |  | -25 | -25 | 1 MHz |
| ± 54.7-54.85 |  |  |  |  |  | -25 | 1 MHz |
|  | | | | | | | |
| Spectrum emission limit [dBm]/BWChannel\_CA | | | | | | | |
| ΔfOOB  (MHz) | 100+75+100 RB  (54.2 MHz) | 75+100+100 or 100+100+75 RB  (54.65 MHz) | 100+100+100 RB (59.6 MHz) |  |  |  | Measurement bandwidth |
| ± 0-1 | -15.5 | -15.5 | -16 |  |  |  | 300 kHz |
| ± 1-5 | -10 | -10 | -10 |  |  |  | 1 MHz |
| ± 5-52.2 | -13 | -13 | -13 |  |  |  | 1 MHz |
| ± 52.2-52.65 | -25 | -13 | -13 |  |  |  | 1 MHz |
| ±52.65-57.6 | -25 | -25 | -13 |  |  |  | 1 MHz |
| ± 57.6-59.2 | -25 | -25 | -25 |  |  |  | 1 MHz |
| ± 59.2-59.65 |  | -25 | -25 |  |  |  | 1 MHz |
| ± 59.65-64.6 |  |  | -25 |  |  |  | 1 MHz |

Additionally, a spurious emission requirement is also applicable when CA\_NS\_04 is signaled. This requirement also applies for CA\_41D.

Table 5.1.5-2: Additional spurious emissions requirements for CA\_NS\_04

|  |  |  |
| --- | --- | --- |
| Frequency band  (MHz) | Spectrum emission limit (dBm) | Measurement bandwidth |
| 2490.5 ≤ f < 2495 | -13 | 1 MHz |
| 0 < f < 2490.5 | -25 | 1 MHz |

## 5.2 2DL\_48C\_2UL\_48C\_BCS0 3DL\_48D\_2UL\_48C\_BCS0 4DL\_48E\_2UL\_48C\_BCS0 3DL\_48A-48C\_2UL\_48C\_BCS0 4DL\_48C-48C\_2UL\_48C\_BCS0

### 5.2.1 Channel bandwidths per operating band for CA

Table 5.2.1-1: Bandwidth combinations for Intra band contiguous CA configurations

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA CA Configuration | Uplink CA configurations | E-UTRA Bands | CBW  {MHz] | CBW  {MHz] | CBW  {MHz] | CBW  {MHz] | Maximum aggregated bandwidth  [MHz] | Bandwidth combination set |
| CA\_48C | CA\_48C | 48 | 5, 10, 15, 20 | 20 |  |  | 40 | 0 |
| 20 | 5, 10, 15 |  |  |
| CA\_48D | CA\_48C | 48 | 5, 10, 15, 20 | 20 | 20 |  | 60 | 0 |
| 20 | 20 | 5, 10, 15 |  |
| CA\_48E | CA\_48C | 48 | 5, 10, 15, 20 | 20 | 20 | 20 | 80 | 0 |
| 20 | 20 | 20 | 5, 10, 15 |

Table 5.2.1-2: Bandwidth combinations for Intra band non-contiguous CA configurations

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA CA Configuration | Uplink CA configurations | E-UTRA Bands | CBW  {MHz] | CBW  {MHz] | CBW  {MHz] | CBW  {MHz] | Maximum aggregated bandwidth  [MHz] | Bandwidth combination set |
| CA\_48A-48C | CA\_48C | 48 | 5, 10, 15, 20 | See CA\_48C Bandwidth combination set 0 in 36.101 Table 5.6A.1-1 | |  | 60 | 0 |
| See CA\_48C Bandwidth combination set 0 in 36.101 Table 5.6A.1-1 | | 5, 10, 15, 20 |  |
| CA\_48C-48C | CA\_48C | 48 | See CA\_48C Bandwidth combination set 0 in 36.101 Table 5.6A.1-1 | | See CA\_48C Bandwidth combination set 0 in 36.101 Table 5.6A.1-1 | | 80 | 0 |

### 5.2.2 Coexistence studies

No co-existence studies needed for these combinations.

### 5.2.3 REFSENS requirements

No REFSENS requirements need to be defined for these combinations.

### 5.2.4 Vendor A, A-MPR for uplink CA bandwidth class C

#### 5.2.4.1 Simulation Assumptions

A new spectrum emission mask for band 48 for running carrier aggregation was proposed and Figure 5.2.4.1-1 shows the new accepted mask. It has more relaxed requirements within the band compare to the out-of-band emissions.



Figure 5.2.4.1-1: FCC agreed on a new mask for CA\_48C [2]

Figure 5.2.4.1-1 shows that the hardest requirements are when transmitting on the edge of the band. All simulations are allocated at the lower end of the band shown in Figure 5.2.4.1-2 with the implemented mask.

Adjacent Channel Leakage Ratio (ACLR) simulation assumptions were as follows:

* UTRAACLR1 = 33dB
* UTRAACLR2 = 36dB
* CA E-UTRAACRL = 30dB
* CA NRACRL = 30 dB

Spurious emissions limit was -30dBm with 1MHz measurement bandwidth

PA operating point: UTRAACLR1 = 33 dBc with Pout = 22 dBm.

* All further back off (to fulfil the A-MPR requirements) is calculated from the operating point of 22 dBm.

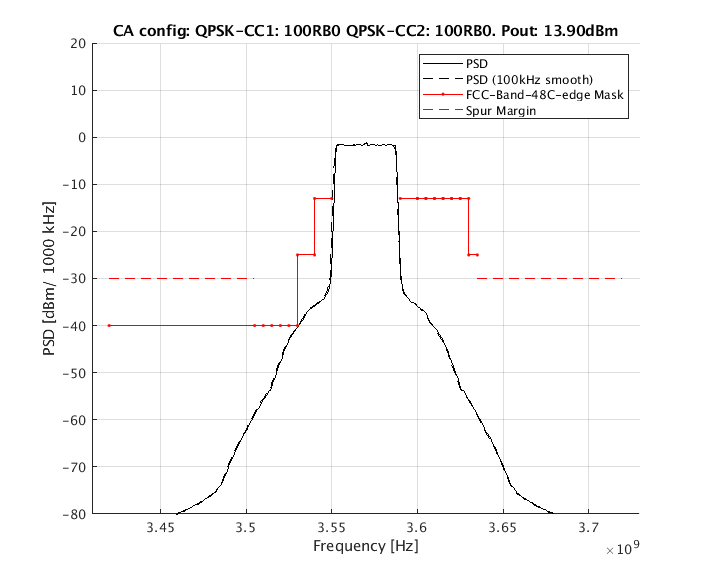


Figure 5.2.4.1-2. Visualizing the mask when the CA is located on the edge of band 48.

The spectrum emission mask may be formed as one within the band and with an additional requirement out-of-band. It may give us Table 5.2.4.1-3 and Table 5.2.4.1-4, respectively where B is either 3530 MHz or 3720 MHz depending on if it is the above or the below the band.

Table 5.2.4.1-3: Additional requirement for CA\_48C within the band

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Spectrum emission limit [dBm]/BWChannel\_CA | | | | | |
| ΔfOOB  (MHz) | 25+100RB (25 MHz) | 50+100RB  (30 MHz) | 75+100RB (35MHz) | 100+100RB (40 MHz) | Measurement bandwidth |
| ± 0-25 | -13 | -13 | -13 | -13 | 1 MHz |
| ± 25-30 | -25 | -13 | -13 | -13 | 1 MHz |
| ± 30-35 | -25 | -25 | -13 | -13 | 1 MHz |
| ± 35-40 | -25 | -25 | -25 | -13 | 1 MHz |
| ± 40-B | -25 | -25 | -25 | -25 | 1 MHz |

.

Table 5.2.4.1-4: Additional requirement for CA\_48C out-of-band emissions

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Spectrum emission limit [dBm]/BWChannel\_CA | | | | | |
| ΔfOOB  (MHz) | 25+100RB (25 MHz) | 50+100RB  (30 MHz) | 75+100RB (35MHz) | 100+100RB (40 MHz) | Measurement bandwidth |
| ± 0-10 | -13 | -13 | -13 | -13 | 1 MHz |
| ± 10-20 | -25 | -25 | -25 | -25 | 1 MHz |
| ± 20- | -40 | -40 | -40 | -40 | 1 MHz |

#### 5.2.4.2 Contiguous RB Transmission

Results from these simulations are shown in the figures below.

A close up of a logo

Description generated with very high confidence

Figure 5.2.4.2-1. Required A-MPR for 25 + 100 RB, QPSK

A close up of a logo

Description generated with very high confidence

Figure 5.2.4.2-2. Required A-MPR for 100 + 25 RB, QPSK

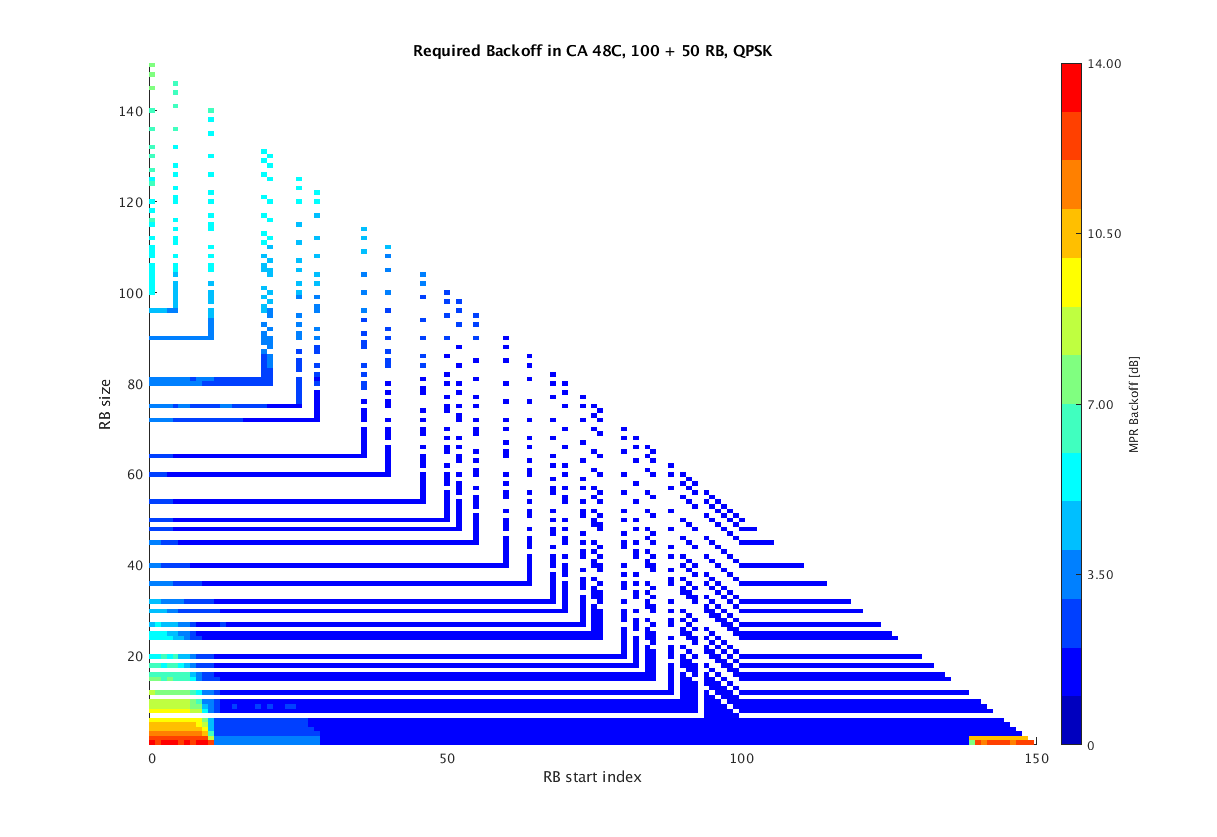


Figure 5.2.4.2-3. Required A-MPR for 50 + 100 RB, QPSK

A close up of a logo

Description generated with very high confidence

Figure 5.2.4.2-4. Required A-MPR for 100 + 50 RB, QPSK

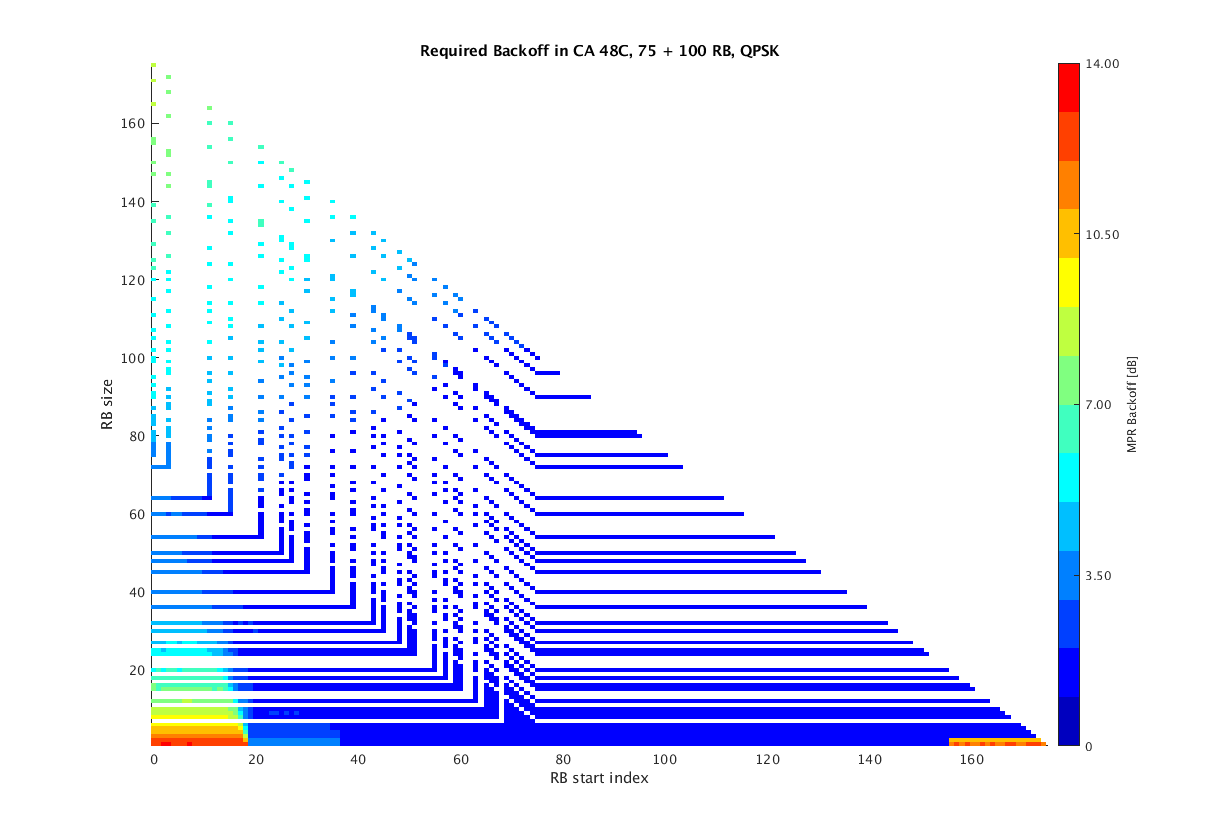


Figure 5.2.4.2-5. Required A-MPR for 75 + 100 RB, QPSK

A close up of a logo

Description generated with very high confidence

Figure 5.2.4.2-6. Required A-MPR for 100 + 75 RB, QPSK

A screenshot of a computer

Description generated with high confidence

Figure 5.2.4.2-7. Required A-MPR for 100 + 100 RB, QPSK

Based on the simulation results presented from Figure 5.2.4.2-1 to Figure 5.2.4.2-7, the A-MPR requirements for contiguously allocated CA\_48C is given in Table 5.2.4.2-1.

Table 5.2.4.2-1: A-MPR requirements for contiguously allocated CA\_48C configuration

|  |  |  |  |
| --- | --- | --- | --- |
| **CA\_48C:**  CA\_NS\_xx | RBStart | L\_CRB [RBs] | A-MPR for QPSK [dB] |
| 25 RB / 100 RB  and  100 RB / 25 RB | 0 – 2 and 121 - 124 | >0 | ≤11dB |
| 3 – 27 | <85 | ≤3dB |
| >85 | ≤5dB |
| 27 – 120 | >0 | ≤2dB |
| 50 RB / 100 RB  and  100 RB / 50 RB | 0 – 10 and 139 – 149 | >0 | ≤13dB |
| 11 – 28 | <85 | ≤3dB |
| >85 | ≤5dB |
| 29 – 138 | >0 | ≤4dB |
| 75 RB / 100 RB  and  100 RB / 75 RB | 0 – 18 and 156 – 174 | >0 | ≤13dB |
| 19 – 42 | <95 | ≤3dB |
| >95 | ≤6dB |
| 43 – 155 | >0 | ≤4dB |
| 100 RB / 100 RB | 0 – 26 and 173 – 199 | >0 | ≤14dB |
| 27 – 45 | ≤100 | ≤3dB |
| >100 | ≤6dB |
| 46 – 172 | ≤100 | ≤2dB |
| >100 | ≤5dB |

#### 5.2.4.3 2-cluster RB transmission

The simulations for 2-cluster RB transmission shall have the same simulation assumptions and requirement as Contiguous RB transmission.

Because of the large number of scenarios (almost 5 million combinations for 20 + 20 MHz) a set of around 20 000 randomly created allocation scenarios were simulated per bandwidth combination and appropriate back off value was searched.

Results from these simulations with proposed A-MPR mask are shown in the figures below

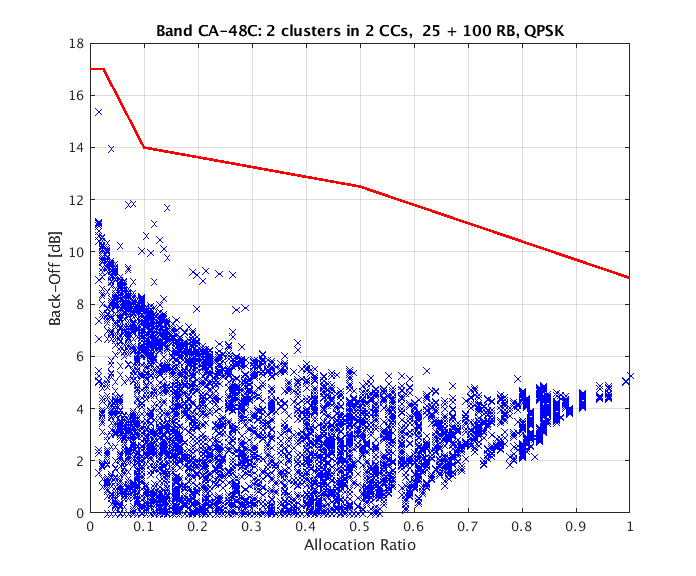


Figure 5.2.4.3-1: 2 clusters in 2CCs vs. allocation ratio, 25 RB + 100 RB

A close up of a map

Description generated with high confidence

Figure 5.2.4.3-2: 2 clusters in 2CCs vs. allocation ratio, 50 RB + 100 RB

A close up of a map

Description generated with high confidence

Figure 5.2.4.3-3: 2 clusters in 2CCs vs. allocation ratio, 75 RB + 100 RB

A picture containing text

Description generated with very high confidence

Figure 5.2.4.3-4: 2 clusters in 2CCs vs. allocation ratio, 100 RB + 100 RB

The mask shown in from figures 5.2.4.3-1 to figures 5.2.4.3-4 can be formally defined as follows

A-MPR = CEIL {MA, 0.5}

Where MA is defined as follows

MA = 17; 0 ≤ A < 0.025

-40A + 18; 0.025 ≤ A < 0.1

-3.75A + 14.375; 0.1 ≤ A < 0.5

-7A + 16; 0.5 ≤ A ≤ 1

Where A = NRB\_alloc / NRB\_agg.

### 5.2.5 Vendor B, A-MPR for uplink CA bandwidth class C

#### 5.2.5.1 A-MPR concept

Emission requirements are tighter outside of the band compared to inside the band with an exception that first 10 MHz on high side of that band has same -13 dBm requirement as within the band. Therefore, it would be beneficial to define two different A-MPRs firstly the band edge A-MPR which has higher -25 dBm...-40 dBm emission requirement on IMD3 region and secondly an inner-band A-MPR which would have lower A-MPR as -13 dBm requirement would apply on IMD3 region. This concept is presented in Figure 5.2.5.1-1.



Figure 5.2.5.1-1: Two different A-MPRs per CC combination

#### 5.2.5.2 Simulation assumptions

**Simulation assumptions were as follows**

IQ-Image and LO leakage = 28 dBc

CIM3 = 60 dBc

PA calibration point was 20 MHz, 15 kHz, QPSK, DFT-S-OFMA, 100 RB at lower channel edge with 0.5 dB MPR

SEM, ACLR, spurious emission and additional CBRS emission limits are calculated for A-MPR.

The simulated A-MPR is assumed applied as max(A-MPR, MPR), where MPR is the 1CC MPR.

#### 5.2.5.3 Results for Contiguous CA Resource Allocations

The A-MPR regions illustrated in Figure5.2.5.1-1 are defined in Table 5.2.5.3-1.

Table 5.2.5.3-1: A-MPR regions for CA\_48C

|  |  |  |
| --- | --- | --- |
| Channel Bandwidth, MHz | Carrier Centre Frequency, Fc, MHz | A-MPR |
| 20+5 / 5 + 20 | FL + BWCA/2 ≤ FC ≤ FH + BWCA/2 | A |
| FL + 3\*BWCA/2 - 10 MHz ≤ FC ≤ FH - 3\*BWCA/2 - 10 MHz | B |
| 20+10 / 10 + 20 | FL + BWCA/2 ≤ FC ≤ FH + BWCA/2 | A |
| FL + 3\*BWCA/2 - 10 MHz ≤ FC ≤ FH - 3\*BWCA/2 - 10 MHz | B |
| 20+15 / 15 + 20 | FL + BWCA/2 ≤ FC ≤ FH + BWCA/2 | A |
| FL + 3\*BWCA/2 - 10 MHz ≤ FC ≤ FH - 3\*BWCA/2 - 10 MHz | B |
| 20+20 | FL + BWCA/2 ≤ FC ≤ FH + BWCA/2 | A |
| FL + 3\*BWCA/2 - 10 MHz ≤ FC ≤ FH - 3\*BWCA/2 - 10 MHz | B |
| NOTE: FL = 3550 MHz, FH = 3700 MHz and BWCA is the combined bandwidth of the contiguous CCs in the CA combination indicated. | | |

A-MPR at the band edge positions defined in Table 5.2.5.3-1 is given in Table 5.2.5.3-2 this is the A-case. For the lower A-MPR region, the results are given in Table 5.2.5.3-3 this is the B-case.

Herein, applied A-MPR should be considered as max(A-MRP, MPR), where A-MPR is given in Table 5.2.5.3-2 and Table 5.2.5.3-3 and MPR for single CC scenario in Table 6.2.3-1 of LTE specification 36.101.

Table 5.2.5.3-2: A-MPR regions for CA\_48C at the band edge, (A)

|  |  |  |  |
| --- | --- | --- | --- |
| BWs [MHz] | RB\_start | L\_CRB | A-MPR [dB] |
| max(mods) |
| 20+5 / 5 + 20 | 0 – 7 and 117 - 124 |  | ≤ 12 |
| 5 - 25 | < 85 | ≤ 5.5 |
| > 85 | ≤ 6.5 |
| 26 - 120 |  | ≤ 5 |
| 20+10 / 10 + 20 | 0 - 13 and 135 - 149 |  | ≤ 11 |
| 14 - 33 | < 85 | ≤ 5 |
| > 85 | ≤ 7 |
| 34 - 134 |  | ≤ 6 |
| 20+15 / 15 + 20 | 0 - 22 and 152 -174 |  | ≤ 11 |
| 23 - 42 | < 95 | ≤ 5.5 |
| > 95 | ≤ 7 |
| 43 - 151 |  | ≤ 6 |
| 20+20 | 0 - 31 and 165 - 199 |  | ≤ 11 |
| 31 - 51 | < 100 | ≤ 5.5 |
| > 100 | ≤ 7 |
| 52 - 164 | < 100 | ≤ 4.5 |
| > 100 | ≤ 6 |

Table 5.2.5.3-3: A-MPR regions for CA\_48C at the band center (“range for lower A-MPR”) (B)

|  |  |  |  |
| --- | --- | --- | --- |
| BWs [MHz] | RB\_start | L\_CRB | A-MPR [dB] |
| max(mods) |
| 20+5 / 5 + 20 | 0 – 7 and 117 - 124 |  | ≤ 4 |
| 5 - 25 | < 85 | ≤ 2 |
| > 85 | ≤ 2.5 |
| 26 - 120 |  | ≤ 2 |
| 20+10 / 10 + 20 | 0 - 13 and 135 - 149 |  | ≤ 4.5 |
| 14 - 33 | < 85 | ≤ 1.5 |
| > 85 | ≤ 2.5 |
| 34 - 134 |  | ≤ 1.5 |
| 20+15 / 15 + 20 | 0 - 22 and 152 -174 |  | ≤ 4.5 |
| 23 - 42 | < 95 | ≤ 1 |
| > 95 | ≤ 2.5 |
| 43 - 151 |  | ≤ 1 |
| 20+20 | 0 - 31 and 165 - 199 |  | ≤ 4.5 |
| 31 - 51 | < 100 | ≤ 1 |
| > 100 | ≤ 1.5 |
| 52 - 164 | < 100 | ≤ 1 |
| > 100 | ≤ 1 |

Furthermore, an example A-MPR scenario of 20+20 MHz CA combination with QPSK modulation is shown in Figure 3 with contiguous CA allocations, considering both the band edge scenario (“0 Hz offset”) and the lower A-MPR region (“29.8 MHz offset”).

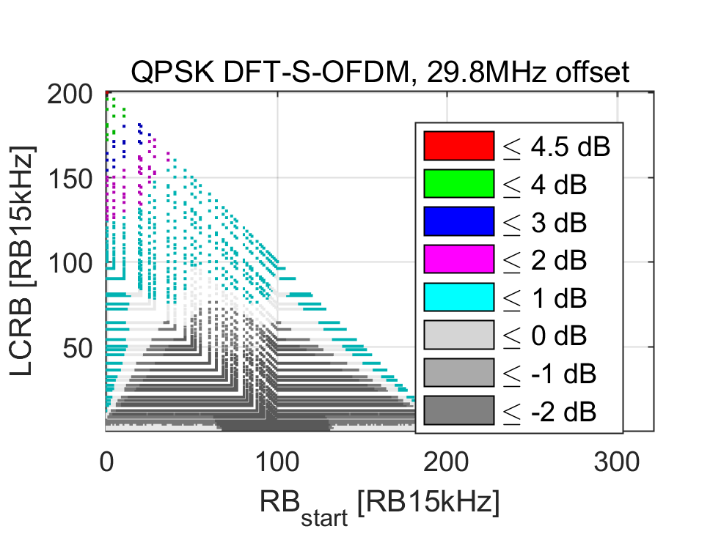
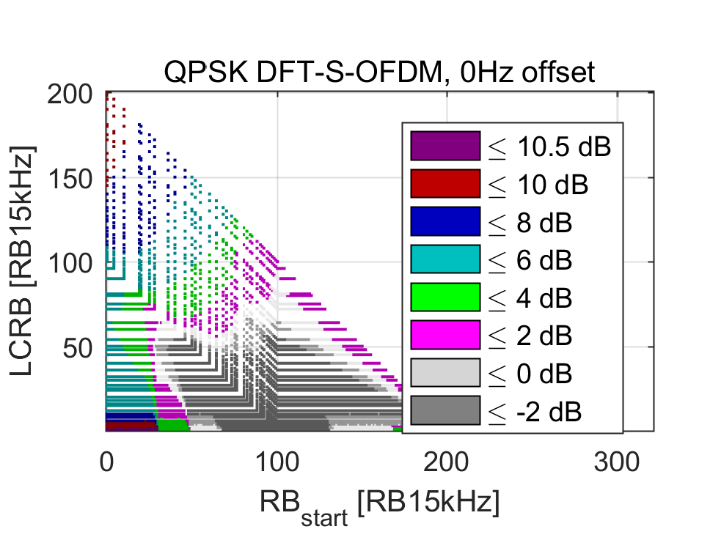


Figure 5.2.5.3-1: The A-AMPR triangles for contiguous resource allocations of 20+20 MHz CA combination at the lower band edge (left) and at the lower edge of the range for lower A-MPR (right). EVM and IBE are not consider for A-MPR.

#### 5.2.5.4 Results for Non-contiguous CA Resource Allocations

As illustrated, with an example scenario of 20+20 MHz CA combination, in Figure 5.2.5.4-1 with non-contiguous CA allocations higher A-MPR is needed. In here, non-contiguous channel edge allocations are simulated as a worst-case-scenario.

For the channel edge positions indicated in Figure 5.2.5.1-1, 18 dB A-MPR is needed for the smallest allocation ratio resource allocations, i.e. the narrowest non-contiguous edge allocations.

For the lower A-MPR range indicated in Figure 5.2.5.1-1, 12 dB A-MPR is needed for the smallest allocation ratio resource allocations, i.e. the narrowest non-contiguous edge allocations.

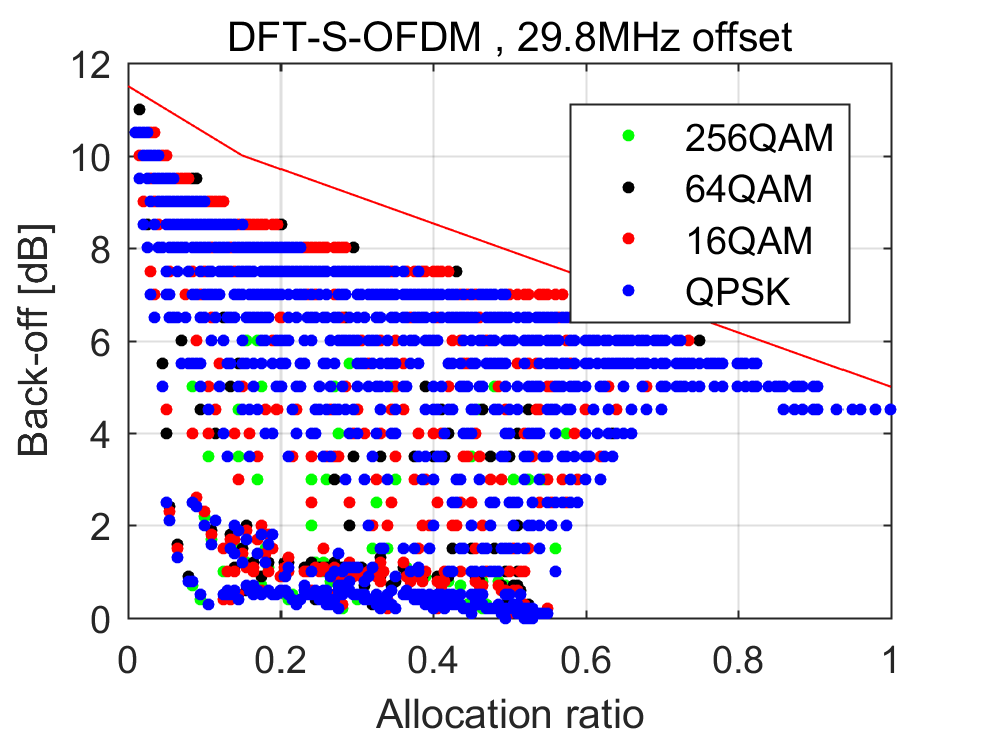
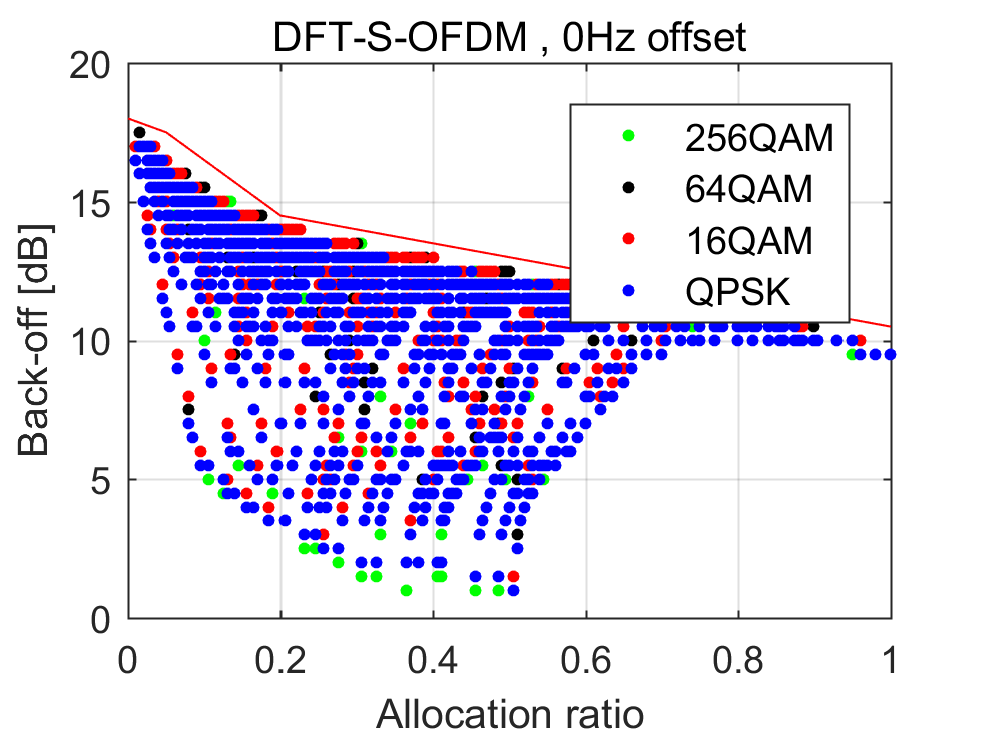


Figure 5.2.5.4-1: The A-MPR for non-contiguous edge allocations of 20+20 MHz CA combination at the lower band edge (left) and at the lower edge of the range for lower A-MPR (right). EVM and IBE are not consider for A-MPR.

Considering the maximum A-MPR needed in the case of small allocation ratio, the results for other BW combinations are quite consistent with 20+20 MHz scenario presented in Figure 5.2.5.3-1.

Based on these results, the following formulation for A-MPR is proposed for the edge scenario:

A-MPR = CEIL {MA, 0.5}

where MA is defined as follows

MA = 18.00 - 10.00 A; 0 ≤ A < 0.05

18.50 - 20.00 A; 0.05 ≤ A < 0.2

15.50 - 5.00 A; 0.2 ≤ A < 1

where A = NRB\_alloc / NRB\_agg.

Furthermore, the following formulation for A-MPR is proposed for the center scenario:

A-MPR = CEIL {MA, 0.5}

where MA is defined as follows

MA = 11.50 - 10.00 A; 0 ≤ A < 0.15

10.88 - 5.88\*A; 0.15 ≤ A < 1

where A = NRB\_alloc / NRB\_agg.

## 5.3 CA\_48B CA\_48A-48B CA\_48B-48B CA\_48B-48C CA\_48B-48D CA\_48B-48E CA\_48B CA\_48B CA\_48A-48B CA\_48B CA\_48B-48B CA\_48B CA\_48B-48C CA\_48B CA\_48B-48D CA\_48B CA\_48B-48E CA\_48B

### 5.3.1 Channel bandwidths per operating band for CA

Table 5.3.1-1: Supported E-UTRA bandwidths per CA configuration for Intra-band CA for x CC DL/ y CC UL including contiguous and non-contiguous spectrum (x>=y)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | E-UTRA CA configuration / Bandwidth combination set | | | | | | |
| E-UTRA CA configuration | Uplink CA configurations  (NOTE 3) | Component carriers in order of increasing carrier frequency | | | | | Maximum aggregated  bandwidth [MHz] | Bandwidth combination set |
| Channel bandwidths for carrier [MHz] | Channel bandwidths for carrier [MHz] | Channel bandwidths for carrier [MHz] | Channel bandwidths for carrier [MHz] | Channel bandwidths for carrier [MHz] |
| **CA\_48B** | **CA\_48B** | **10** | **10** |  |  |  | **20** | **0** |

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA CA Configuration | Uplink CA configurations (NOTE 4) | 1.4 | | 3 | 5 | 10 | 15 | 20 | Maximum aggregated bandwidth | Bandwidth combination set |
| MHz | | MHz | MHz | MHz | MHz | MHz | [MHz] |
| **CA\_48A-48B** | **CA\_48B** |  |  | | Yes | Yes | Yes | Yes | **40** | **0** |
| See CA\_48B Bandwidth combination set 0 in 36.101 Table 5.6A.1-3 | | | | | | |
| **CA\_48B-48B** | **CA\_48B** | **See CA\_48B Bandwidth combination set 0 in 36.101 Table 5.6A.1-3** | | | | | | | **40** | **0** |
| **See CA\_48B Bandwidth combination set 0 in 36.101 Table 5.6A.1-3** | | | | | | |
| **CA\_48B-48C** | **CA\_48B** | **See CA\_48B Bandwidth combination set 0 in 36.101 Table 5.6A.1-3** | | | | | | | **40** | **0** |
| **See CA\_48C Bandwidth combination set 0 in 36.101 Table 5.6A.1-3** | | | | | | |
| **CA\_48B-48D** | **CA\_48B** | **See CA\_48B Bandwidth combination set 0 in 36.101 Table 5.6A.1-3** | | | | | | | **80** | **0** |
| **See CA\_48D Bandwidth combination set 0 in 36.101 Table 5.6A.1-3** | | | | | | |
| **CA\_48B-48E** | **CA\_48B** | **See CA\_48B Bandwidth combination set 0 in 36.101 Table 5.6A.1-3** | | | | | | | **100** | **0** |
| **See CA\_48E Bandwidth combination set 0 in 36.101 Table 5.6A.1-3** | | | | | | |
|  |  |  |  |  |  |  |  |  |  |  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | E-UTRA CA configuration / Bandwidth combination set | | | | | | |
| E-UTRA CA configuration | Uplink CA configurations  (NOTE 3) | Component carriers in order of increasing carrier frequency | | | | | Maximum aggregated  bandwidth [MHz] | Bandwidth combination set |
| Channel bandwidths for carrier [MHz] | Channel bandwidths for carrier [MHz] | Channel bandwidths for carrier [MHz] | Channel bandwidths for carrier [MHz] | Channel bandwidths for carrier [MHz] |
| CA\_48B | CA\_48B | 10 | 10 |  |  |  | 20 | 0 |

### 5.3.2 Co-existence studies

Table 5.3.2-1 summarizes frequency ranges where harmonics occur due to Band 48 CA with 1 UL.

Table 5.3.2-1: Impact of 1 UL Harmonic Interference

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  | |  | | 2nd Harmonic | | | 3rd Harmonic | | | 4th Harmonic | | | 5th Harmonic | | |
| Band | | UL Low Band Edge | | UL High Band Edge | | UL Low Band Edge | UL High Band Edge | | UL Low Band Edge | UL High Band Edge | | UL Low Band Edge | UL High Band Edge | | UL Low Band Edge | UL High Band Edge | |
| **48** | | **3550** | | **3700** | | **7100** | **7400** | | **10650** | **11100** | | **14200** | **14800** | | **17750** | **1850** | |

Table 5.3.2-1 shows there are no harmonic issues for this combination.

So we can conclude that there is no issue on both DL/UL harmonic interference.

### 5.3.3 ΔTIB,c and ΔRIB,c values

No ΔTIB,c and ΔRIB,c values for intra-band combinations are needed

### 5.3.4 MSD

Table 5.4.1A-0eA: Reference sensitivity QPSK PREFSENS (CA 48)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Channel bandwidth | | | | | | | | |
| EUTRA CA Configuration | EUTRA band | 1.4 MHz  (dBm) | 3 MHz  (dBm) | 5 MHz  (dBm) | 10 MHz  (dBm) | 15 MHz  (dBm) | 20 MHz  (dBm) | Duplex mode |
| **CA\_48B** | 48 |  |  | -99 | -96 | -94.2 | -93 | TDD |

The MSD analysis was conducted when CA\_48Awas discussed. Because of similarity of CA\_48B, we apply the MSD specified for CA\_48A to that for CA\_48

### 5.3.5 Vendor A, A-MPR for uplink CA bandwidth class B

#### 5.3.5.1 Contiguous RB Transmission

Results from these simulations are shown in the figures below.

A close up of a logo

Description generated with very high confidence

Figure 5.3.5..1-1. Required A-MPR for 25 + 100 RB, QPSK

Based on the simulation results presented from Figure 5.3.5.1-1, the A-MPR requirements for contiguously allocated CA\_48B is given in Table 5.3.5.1-1.

Table 5.3.5.1-1: A-MPR requirements for contiguously allocated CA\_48B configuration

|  |  |  |  |
| --- | --- | --- | --- |
| **CA\_48B**:  CA\_NS\_xx | RBStart | L\_CRB [RBs] | A-MPR for QPSK [dB] |
| **25 RB / 100 RB**  **and**  **100 RB / 25 RB** | **0 – 2 and 121 - 124** | **>0** | **≤11dB** |
| **3 – 27** | **<85** | **≤3dB** |
| **>85** | **≤5dB** |
| **27 – 120** | **>0** | **≤2dB** |

#### 5.3.5.2 2-cluster RB transmission

The simulations for 2-cluster RB transmission shall have the same simulation assumptions and requirement as Contiguous RB transmission.

Because of the large number of scenarios (almost 5 million combinations for 20 + 20 MHz) a set of around 20 000 randomly created allocation scenarios were simulated per bandwidth combination and appropriate back off value was searched.

Results from these simulations with proposed A-MPR mask are shown in the figures below

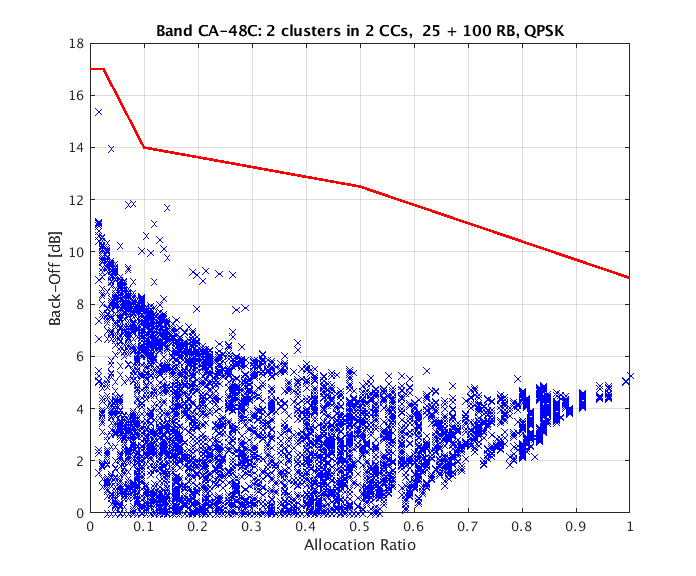


Figure 5.3.5.2-1: 2 clusters in 2CCs vs. allocation ratio, 25 RB + 100 RB

The mask shown in figure 5.3.5.2-1 can be formally defined as follows

A-MPR = CEIL {MA, 0.5}

Where MA is defined as follows

MA = 17; 0 ≤ A < 0.025

-40A + 18; 0.025 ≤ A < 0.1

-3.75A + 14.375; 0.1 ≤ A < 0.5

-7A + 16; 0.5 ≤ A ≤ 1

Where A = NRB\_alloc / NRB\_agg.

### 5.3.5.3 Vendor B, A-MPR for uplink CA bandwidth class B

#### 5.3.5.3.1 A-MPR concept

Emission requirements are tighter outside of the band compared to inside the band with an exception that first 10 MHz on high side of that band has same -13 dBm requirement as within the band. Therefore, it would be beneficial to define two different A-MPRs firstly the band edge A-MPR which has higher -25 dBm...-40 dBm emission requirement on IMD3 region and secondly an inner-band A-MPR which would have lower A-MPR as -13 dBm requirement would apply on IMD3 region. This concept is presented in Figure 5.2.5.1-1.



Figure 5.3.5.3.1-1: Two different A-MPRs per CC combination

#### 5.3.5.3.2 Simulation assumptions

Simulation assumptions were as follows

IQ-Image and LO leakage = 28 dBc

CIM3 = 60 dBc

PA calibration point was 20 MHz, 15 kHz, QPSK, DFT-S-OFMA, 100 RB at lower channel edge with 0.5 dB MPR

SEM, ACLR, spurious emission and additional CBRS emission limits are calculated for A-MPR.

The simulated A-MPR is assumed applied as max(A-MPR, MPR), where MPR is the 1CC MPR.

#### 5.3.5.3.3 Results for Contiguous CA Resource Allocations

***The A-MPR regions illustrated in Figure5.3.5.3 1-1 are defined in Table 5.2.5.3-1.***

Table 5.3.5.3-1: A-MPR regions for CA\_48C

|  |  |  |
| --- | --- | --- |
| Channel Bandwidth, MHz | Carrier Centre Frequency, Fc, MHz | A-MPR |
| **20+5 / 5 + 20** | **FL + BWCA/2 ≤ FC ≤ FH - BWCA/2** | **A** |
| **FL + 3\*BWCA/2 - 10 MHz ≤ FC ≤ FH - 3\*BWCA/2 + 10 MHz** | **B** |
| **20+10 / 10 + 20** | **FL + BWCA/2 ≤ FC ≤ FH - BWCA/2** | **A** |
| **FL + 3\*BWCA/2 - 10 MHz ≤ FC ≤ FH - 3\*BWCA/2 + 10 MHz** | **B** |
| **20+15 / 15 + 20** | **FL + BWCA/2 ≤ FC ≤ FH - BWCA/2** | **A** |
| **FL + 3\*BWCA/2 - 10 MHz ≤ FC ≤ FH - 3\*BWCA/2 + 10 MHz** | **B** |
| **20+20** | **FL + BWCA/2 ≤ FC ≤ FH - BWCA/2** | **A** |
| **FL + 3\*BWCA/2 - 10 MHz ≤ FC ≤ FH - 3\*BWCA/2 + 10 MHz** | **B** |
| **NOTE: FL = 3550 MHz, FH = 3700 MHz and BWCA is the combined bandwidth of the contiguous CCs in the CA combination indicated.** | | |

A-MPR at the band edge positions defined in Table 5.3.5.3-1 is given in Table 5.3.5.3-2 this is the A-case. For the lower A-MPR region, the results are given in Table 5.2.5.3-3 this is the B-case.

Herein, applied A-MPR should be considered as max(A-MRP, MPR), where A-MPR is given in Table 5.3.5.3-2 and Table 5.3.5.3-3 and MPR for single CC scenario in Table 6.2.3-1 of LTE specification 36.101.

Table 5.3.5.3-2: A-MPR regions for CA\_48C at the band edge, (A)

|  |  |  |  |
| --- | --- | --- | --- |
| BWs [MHz] | RB\_start | L\_CRB | A-MPR [dB] |
| max(mods) |
| **20+5 / 5 + 20** | **0 – 7 and 117 - 124** |  | **≤ 12** |
| **5 - 25** | **< 85** | **≤ 5.5** |
| **> 85** | **≤ 6.5** |
| **26 - 120** |  | **≤ 5** |
| **20+10 / 10 + 20** | **0 - 13 and 135 - 149** |  | **≤ 11** |
| **14 - 33** | **< 85** | **≤ 5** |
| **> 85** | **≤ 7** |
| **34 - 134** |  | **≤ 6** |
| **20+15 / 15 + 20** | **0 - 22 and 152 -174** |  | **≤ 11** |
| **23 - 42** | **< 95** | **≤ 5.5** |
| **> 95** | **≤ 7** |
| **43 - 151** |  | **≤ 6** |
| **20+20** | **0 - 31 and 165 - 199** |  | **≤ 11** |
| **31 - 51** | **< 100** | **≤ 5.5** |
| **> 100** | **≤ 7** |
| **52 - 164** | **< 100** | **≤ 4.5** |
| **> 100** | **≤ 6** |

Table 5.3.5.3-3: A-MPR regions for CA\_48C at the band center (“range for lower A-MPR”) (B)

|  |  |  |  |
| --- | --- | --- | --- |
| BWs [MHz] | RB\_start | L\_CRB | A-MPR [dB] |
| max(mods) |
| **20+5 / 5 + 20** | **0 – 7 and 117 - 124** |  | **≤ 4** |
| **5 - 25** | **< 85** | **≤ 2** |
| **> 85** | **≤ 2.5** |
| **26 - 120** |  | **≤ 2** |
| **20+10 / 10 + 20** | **0 - 13 and 135 - 149** |  | **≤ 4.5** |
| **14 - 33** | **< 85** | **≤ 1.5** |
| **> 85** | **≤ 2.5** |
| **34 - 134** |  | **≤ 1.5** |
| **20+15 / 15 + 20** | **0 - 22 and 152 -174** |  | **≤ 4.5** |
| **23 - 42** | **< 95** | **≤ 1** |
| **> 95** | **≤ 2.5** |
| **43 - 151** |  | **≤ 1** |
| **20+20** | **0 - 31 and 165 - 199** |  | **≤ 4.5** |
| **31 - 51** | **< 100** | **≤ 1** |
| **> 100** | **≤ 1.5** |
| **52 - 164** | **< 100** | **≤ 1** |
| **> 100** | **≤ 1** |

Furthermore, an example A-MPR scenario of 20+20 MHz CA combination with QPSK modulation is shown in Figure 3 with contiguous CA allocations, considering both the band edge scenario (“0 Hz offset”) and the lower A-MPR region (“29.8 MHz offset”).

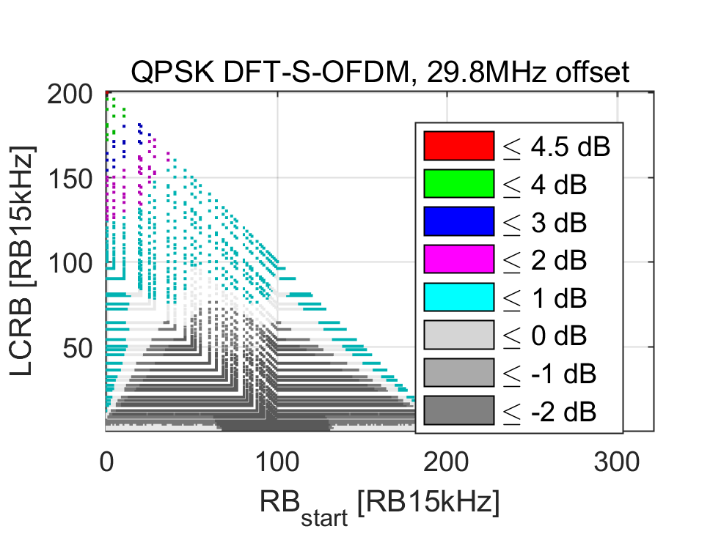
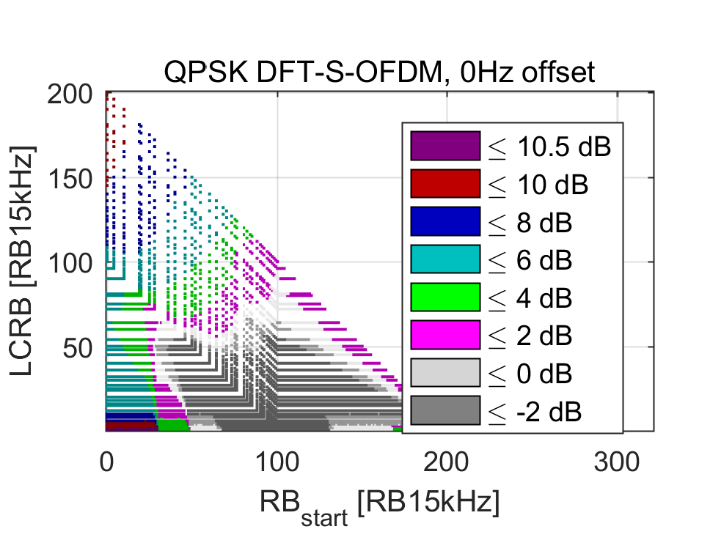


Figure 5.3.5.3-1: The A-AMPR triangles for contiguous resource allocations of 20+20 MHz CA combination at the lower band edge (left) and at the lower edge of the range for lower A-MPR (right). EVM and IBE are not consider for A-MPR.

#### 5.3.5.3.4 Results for Non-contiguous CA Resource Allocations

As illustrated, with an example scenario of 20+20 MHz CA combination, in Figure 5.3.5.3-1 with non-contiguous CA allocations higher A-MPR is needed. In here, non-contiguous channel edge allocations are simulated as a worst-case-scenario.

For the channel edge positions indicated in Figure 5.3.5.1-1, 18 dB A-MPR is needed for the smallest allocation ratio resource allocations, i.e. the narrowest non-contiguous edge allocations.

For the lower A-MPR range indicated in Figure 5.3.5.1-1, 12 dB A-MPR is needed for the smallest allocation ratio resource allocations, i.e. the narrowest non-contiguous edge allocations.

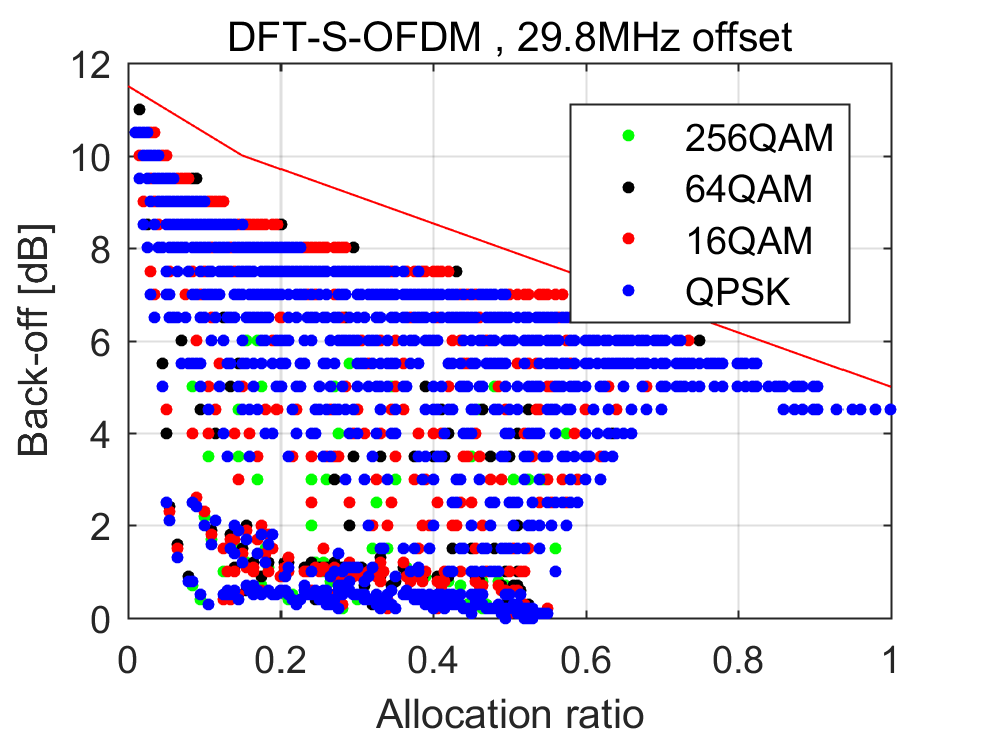
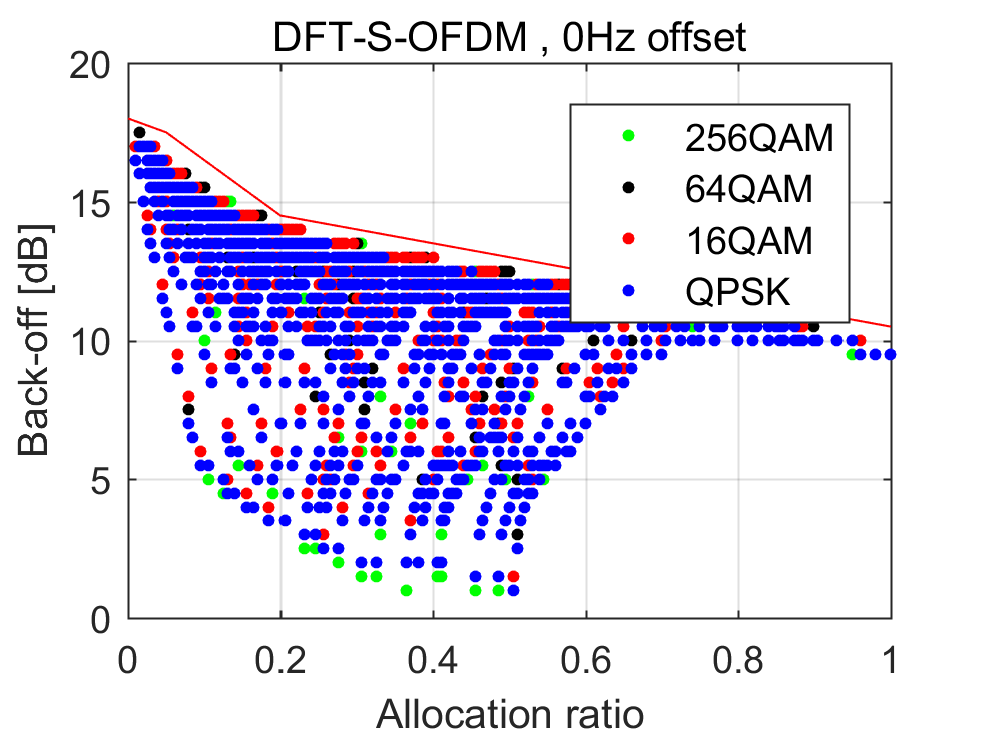


Figure 5.2.5.4-1: The A-MPR for non-contiguous edge allocations of 20+20 MHz CA combination at the lower band edge (left) and at the lower edge of the range for lower A-MPR (right). EVM and IBE are not consider for A-MPR.

Considering the maximum A-MPR needed in the case of small allocation ratio, the results for other BW combinations are quite consistent with 20+20 MHz scenario presented in Figure 5.3.5.3-1.

Based on these results, the following formulation for A-MPR is proposed for the edge scenario:

A-MPR = CEIL {MA, 0.5}

where MA is defined as follows

MA = 18.00 - 10.00 A; 0 ≤ A < 0.05

18.50 - 20.00 A; 0.05 ≤ A < 0.2

15.50 - 5.00 A; 0.2 ≤ A < 1

where A = NRB\_alloc / NRB\_agg.

Furthermore, the following formulation for A-MPR is proposed for the center scenario:

A-MPR = CEIL {MA, 0.5}

where MA is defined as follows

MA = 11.50 - 10.00 A; 0 ≤ A < 0.15

10.88 - 5.88\*A; 0.15 ≤ A < 1

where A = NRB\_alloc / NRB\_agg.

# 6 Intra-Band Non-Contiguous Carrier Aggregation: Specific Band Combination Part

## 6.1 CA\_2DL\_42A-42A \_1UL\_ BCS1, CA\_3DL\_42A-42C\_2UL\_42C\_BCS1, CA\_4DL\_42C-42C\_2UL\_42C\_BCS1

### 6.1.1 Channel bandwidths per operating band for CA

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CA\_42A-42A | - | 10, 15, 20 | 10, 15, 20 |  |  |  | 40 | 1 |
| CA\_42A-42C | CA\_42C | 10, 15, 20 | See CA\_42C Bandwidth Combination Set 1 in Table 5.6A.1-1 | |  |  | 60 | 1 |
| See CA\_42C Bandwidth Combination Set 1 in Table 5.6A.1-1 | | 10, 15, 20 |  |
| CA\_42C-42C | CA\_42C | See CA\_42C Bandwidth Combination Set 1 in Table 5.6A.1-1 | | See CA\_42C Bandwidth Combination Set 1 in Table 5.6A.1-1 | |  | 80 | 1 |

Annex A: Change history

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Change history** | | | | | | | |
| **Date** | **TSG #** | **TSG Doc.** | **CR** | **Rev** | **Subject/Comment** | **Old** | **New** |
| 2018-08 | 3GPP RAN4 #88 | R4-1810380 |  |  | Initial TR skeleton |  | 0.0.1 |
| 2018-10 | 3GPP RAN4 #88bis | R4-1812778 |  |  | Transferred CA\_3DL\_41D\_3UL\_41D\_BCS0 chapters from Rel-15 TR 36.715-00-00  Implemented TP´s from RAN4 #88:  R4-1810383, “Scope TP from RAN 80 for 36.716-01-01”, Ericsson  R4-1810896, “A-MPR B41D Power Class 3”, Qualcomm Tech. Netherlands B.V | 0.0.1 | 0.1.0 |
| 2018-11 | 3GPP RAN4 #89 | R4-1815793 |  |  | Implemented TP´s from RAN4 #88bis:  R4-1812781, “TP for 36.716-01-01 for updated scope at RAN 81”, Ericsson  R4-1812413, “Draft CR for TS 36.101: Additions of BCS1 to LTE Intra-band non-cont CAs of Band 42”, SoftBank Corp. | 0.1.0 | 0.2.0 |
| 2019-02 | 3GPP RAN4 #90 | R4-1901415 |  |  | Implemented TP from RAN4 #89:  R4-1816171, “TP for 36.716-01-01 for 48C\_UL”, Ericsson | 0.2.0 | 0.3.0 |
| 2019-04 | 3GPP RAN4 #90bis | R4-1904401 |  |  | Implemented TP´s from RAN4 #90:  R4-1901418, “TP for 36.716-01-01 for updated scope at RAN 82”, Ericsson  R4-1901421, “TP for TR 36.716-01-01 for symbols and abbreviations”, Ericsson  R4-1902144, “TP to TR TR 36.716-01-01: A-MPR for CA\_48C”, Nokia  R4-1900082, “TP for TR 36.716-01-01 on CA\_41E&F\_UL\_41D\_BCS0”, SPRINT Corporation  R4-1901452, “TP for TR 36.716-01-01 to include CA\_2DL\_48C\_2UL\_48C\_BCS0, CA\_3DL\_48D\_2UL\_48C\_BCS0, CA\_4DL\_48E\_2UL\_48C\_BCS0”, Ericsson, T-Mobile US | 0.3.0 | 0.4.0 |
| 2019-10 | 3GPP RAN4 #92 | R4-1912233 |  |  | Implemented TP from RAN4 #92:  R4-1909787, “ TP for TR 36.716-01-01: updated scope of the NR REL-16 Intra-band basket WI”, Ericsson | 0.4.0 | 0.5.0 |
| 2020-04 | 3GPP RAN4 #94bis | R4-2004575 |  |  | Implemented TP from RAN4 #94:  R4-2001505, “TP for TR 36.716-01-01 for updated scope from RAN #86”, Ericsson  R4-2002568, “TP for Rel-16 Intra-band CA for x CC DL/ y CC UL including contiguous and non-contiguous spectrum (x>=y): Bandwidth combination set, REFSENS and insertion loss parameters for CA\_48B, CA\_48A-48B, CA\_48B-48B, CA\_48B-48C, CA\_48B-48D, CA\_48B-48E with 1UL and “, Charter Communications | 0.5.0 | 0.6.0 |
| 2020-05 | 3GPP RAN4 #95 | R4-2006044 |  |  | No TP’s implemented. Just a correction of version number to align with 3GU database. | 0.6.0 | 0.9.0 |
| 2020-06 | 3GPP RAN #88 | RP-200659 |  |  | No TP’s implemented. Presented for approval at RAN plenary. | 0.9.0 | 1.0.0 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Change history** | | | | | | | |
| **Date** | **Meeting** | **TDoc** | **CR** | **Rev** | **Cat** | **Subject/Comment** | **New version** |
| 2020-06 | RAN#88 |  |  |  |  | Approved by plenary – Rel-16 spec under change control | 16.0.0 |