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Technical Report

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Contents

Foreword

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1 Scope

The present document is a technical report of the work item for LTE Advanced Carrier Aggregation in Band 38 which was approved at TSG RAN #52 [2]. The report provides background, analysis of the requirements, and a list of recommended changes to the 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-110862: "LTE Advanced Carrier Aggregation in Band 38".

[3] 3GPP TR 25.810: "UMTS 2.6 GHz (FDD) Work Item Technical Report"

[4] 3GPP TR 25.811: "UMTS 2.6 GHz TDDWork Item Technical Report"[5] 3GPP TS 36.101: "Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception".

[6] 3GPP TS 36.104: "Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) radio transmission and reception".

[7] 3GPP TS 36.133: "Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of radio resource management".

[8] 3GPP TS 36.141: "Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) conformance testing".

[9] 3GPP TS 36.307: "Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements on User Equipments (UEs) supporting a release-independent frequency band".

[10] 3GPP TS 37.104: "E-UTRA, UTRA and GSM/EDGE; Multi-Standard Radio (MSR) Base Station (BS) radio transmission and reception".

[11] 3GPP TS 37.141: "E-UTRA, UTRA and GSM/EDGE; Multi-Standard Radio (MSR) Base Station (BS) conformance testing".

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

Void

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].

4 Background of the Work Item

Band 38 is a major global TDD band which had been allocated for TDD in European countries, China and other countries. Operators have big interest to support carrier aggregation in this band. This WI enables the operation of carrier aggregation in Band 38.

4.1 Task description

The objectives of the WI include:

1) Determine the appropriate deployment scenarios and specify the corresponding core RF requirements for the BS and UE supporting contiguous carrier aggregation in Band 38, taking the coexistence with adjacent Band 7 into account. Up to two contiguous 20MHz component carriers for UE are considered.

2) Specify band specific RRM requirements in RAN4 if any.

3) Add signalling support in RAN2 specifications if any.

4) Specify the performance requirements for BS and UE.

4.2 Spectrum and regulatory review

This Work Item [2] is based on the spectrum arrangement as shown below in Figure 4.2-1.

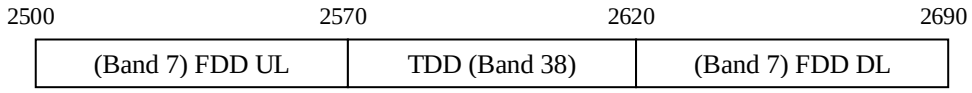

Figure 4.2-1: Band arrangement in 2500-2690 MHz

The frequency band 2500 – 2570 MHz is paired with 2620 – 2690 MHz for FDD operation with the mobile transmit within the lower band and base transmit within the upper band. This paired spectrum blocks are designated as Band 7 [3] in 3GPP EUTRA specifications. The frequency band 2570-2620 MHz is for TDD operation and is designated as Band 38 [4].

The Band 38 spectrum has been allocated in Region 1 based on 5 MHz frequency blocks. In China, 50 MHz spectrum (2570-2620 MHz) was allocated for TDD operation (with guard band) in 2010, while the frequency arrangement of other parts within 2500-2690 MHz is yet to be decided.

The requirements for both UE and BS are defined based on the coexistence requirements at the boundary between Band 7 and Band 38.

4.3 Coexistence with adjacent bands

4.3.1 Coexistence simulation results for CA single carrier operation

The simulation results and assumptions for CA single carrier operation are presented in Annex A.1.

4.3.2 Coexistence simulation results for CA dual carrier operation

The simulation results and assumptions for CA dual carrier operation are presented in Annex A.2.

4.3.3 Conclusions on the coexistence with the adjacent band

For CA operation in Band 38, the allowed emission levels shall be aligned with the ones for Rel-10 non-CA operation. To meet those requirements, the NS signalling for CA_38C shall be defined and the corresponding A-MPR shall be specified.

5 Band and channel bandwidth arrangement

5.1 CA Operating bands

The CA operating band for Band 38 is defined in Table 5.1-1.

Table 5.1-1: Intra-band contiguous carrier aggregation bands

CA Band	E-UTRA operating band
CA_38	38

5.2 Carrier frequency and EARFCN

There is no change needed for the carrier frequency and EARFCN defined for Band 38 to support intra-band carrier aggregation. The existing carrier frequency and EARFCN can well support the CA operation in Band 38.

5.3 CA channel bandwidth

Table 5.3-1 defines the supported E-UTRA bandwidths for intra-band contiguous CA in Band 38.

Table 5.3-1: Supported E-UTRA bandwidths for intra-band contiguous CA in Band 38

CA operating band / channel bandwidth							
E-UTRA CA Configurations	**E-UTRA Bands**	**1.4 MHz**	**3 MHz**	**5 MHz**	**10 MHz**	**15 MHz**	**20 MHz**
CA_38C[1]	38			Yes	Yes	Yes	Yes
NOTE: Combinations of component carriers with unequal channel bandwidth should be considered. The maximum number of CCs for combination is two.							

Channel combinations for 20 MHz+20 MHz and 15 MHz+15M Hz are supported in Rel-11.

6 E-UTRA RF requirements for UE

6.1 Required changes for the 5MHz component carriers

For intra-band contiguous carrier aggregation, the UE minimum controlled output power and the transmit OFF power are specified per component carrier. The requirements for the controlled minimum output power and the transmit OFF power can be specified for 5 MHz component carrier.

6.1.1 Minimum requirements for UE minimum output power

The minimum output power is defined as the mean power in one sub-frame (1 ms) for each component carrier. The minimum output power for 5 MHz component carrier shall not exceed the values specified in Table 6.1.1-1.

Table 6.1.1-1: Minimum output power for intra-band contiguous CA UE

	Channel bandwidth / Minimum output power / measurement bandwidth					
	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz
Minimum output power	-40 dBm					
Measurement bandwidth			4.5 MHz			

6.1.2 Minimum requirements for UE transmit OFF power

The transmit OFF power is defined as the mean power in a duration of at least one sub-frame (1ms) excluding any transient periods for each component carrier. The transmit OFF power for the 5 MHz component carrier shall not exceed the values specified in Table 6.1.2-1.

Table 6.1.2-1: Transmit OFF power for intra-band contiguous CA UE

	Channel bandwidth / Minimum output power / measurement bandwidth					
	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz
Transmit OFF power	-50 dBm					
Measurement bandwidth			4.5 MHz			

6.2 Out of band emission

6.2.1 General spectrum emission mask

For CA Bandwidth Class C in Band 38, the power of any UE emission shall not exceed the levels specified in Table 6.2.1-1 for the specified aggregated channel bandwidth.

Table 6.2.1-1: General E-UTRA CA spectrum emission mask for Bandwidth Class C

Spectrum emission limit [dBm]/$BW_{Channel\_CA}$					
Δf_{OOB} (MHz)	24.95	29.9 MHz	30 MHz	39.8 MHz	Measurement bandwidth
± 0-1	-22	-22.5	-22.5	-24	30 kHz
± 1-5	-10	-10	-10	-10	1 MHz
± 5-24.95	-13	-13	-13	-13	1 MHz
± 24.95-29.9	-25	-13	-13	-13	1 MHz
± 29.9-29.95	-25	-25	-13	-13	1MHz
± 29.95-30		-25	-13	-13	1 MHz
± 30-34.9		-25	-25	-13	1 MHz
± 34.9-35			-25	-13	1 MHz
± 35-39.8				-13	1 MHz
± 39.8-44.8				-25	1 MHz

6.3 UE MPR for modulation and CA bandwidth combinations

For UE MPR due to modulation and CA bandwidth combinations, the requirements specified in subclause 6.2.3A in TS 36.101 v11.1.0 applied for CA_38C.

6.4 UE A-MPR for coexistence with adjacent band

6.4.1 Coexistence requirements with Band 7 for contiguous CA

For CA Bandwidth Class C in Band 38, emission shall not exceed the levels specified in Table 6.4.1-1 for coexistence with protected bands.

Table 6.4.1-1: Emission requirements

E-UTRA Band	Spurious emission					
	Protected band	Frequency range (MHz)			Maximum Level (dBm)	MBW (MHz)
CA_38C	E-UTRA Band 1,3, 8, 20, 22, 33, 34, 42, 43	FDL_low	-	FDL_high	-50	1
	Frequency range	2620	-	2645	-15.5	5
	Frequency range	2645	-	2690	-40	1
NOTE 1: The requirement also applies for the frequency ranges that are less than ΔfOOB (MHz) in Table 6.6.3.1-1 and Table 6.6.3.1A-1 in TS 36.101 from the edge of the channel bandwidth.						
NOTE 2: This requirement is applicable for carriers with bandwidths confined in 2570-2615 MHz. For assigned carriers with bandwidths overlapping the frequency range 2615-2620 MHz the requirements apply with the maximum output power configured to +20 dBm in the IE P-Max.						

The mechanism to meet the emission level specified in Table 6.4.1-1 is to define CA_NS signaling and the corresponding A-MPR table.

6.4.2 A-MPR

Based on the simulation results presented in Annex A, the A-MPR requirements for contiguously allocated CA_38C are given in Table 6.4.2-1.

Table 6.4.2-1: Contiguous allocation A-MPR for CA_38C

CA_38C	RB_{end}	L_{CRB} [RBs]	A-MPR for QPSK and 16-QAM[dB]
100RB/100RB	0 – 12	>0	≤ 5 dB
	13 – 79	> RB_End – 13	≤ 2 dB
	80 – 180	>60	≤ 6 dB
	181 – 199	> 0	≤ 11 dB
75RB/75RB	0 – 70	> RB_end -10	≤ 2 dB
	71- 108	> 60	≤ 5 dB
	109 – 140	>0	≤ 5 dB
	140 – 149	≤ 70	≤ 2 dB
	140 – 149	>70	≤ 6 dB
NOTE 1: RB_{end} indicates the lowest RB index of transmitted resource blocks NOTE 2: L_{CRB} 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 NOTE 4: For intra-subframe frequency hopping which intersects regions, the larger A-MPR value may be applied for both slots in the subframe			

The allowed maximum output power reduction applied to transmissions on the PCell and the SCell due to multi-cluster transmission is defined as follows

$$\text{A-MPR} = \text{CEIL}\{M_A, 0.5\}$$

Where MA is defined as follows

$$M_A = -14.17\,A + 16.50 \quad ; 0 \le A < 0.60$$

$$-2.50\,A + 9.50 \quad ; 0.60 \le A \le 1$$

Where $A = N_{RB\_alloc} / N_{RB\_agg}$.

6.5 UE receiver RF requirements

Three subclauses in TS 36.101 (Rel-11) shall be updated for UE supporting intra-band contiguous CA in Band 38, and these subclauses cover the following aspects:

Reference sensitivity

In-band blocking

Out-of-band blocking

For CA Band 38 there is no restriction on the uplink RB allocations, and the uplink configuration shall be specified with full RB allocation for both PCC and SCC for all supported CC combinations. All of the relative changes for CA in Band 38 are captured in sub-clause 10.1 in the present document.

7 E-UTRA RRM requirements for UE

The measurement procedures and requirements for carrier aggregation specified in subclauses 8.3 and 8.4 in TS 36.133 are defined for Primary carrier and Secondary carrier in a band agnostic manner. There is no specific RRM procedure and requirement for carrier aggregation in Band 38.

The RRM performance requirements for carrier aggregation, as defined in subclause 9 in TS 36.133 are specified for each component carrier. The reporting delay and measurement accuracy requirements for single carrier in Band 38 have been defined in subclause 9 in TS 36.133 and no further change on reference sensitivity power level for CA is foreseen. Therefore, the existing performance requirements are complete for CA in Band 38.

In summary, there are no additional measurement procedure, measurement requirements, and measurement performance requirements specifically for CA in Band 38.

8 E-UTRA RF requirements for BS

Changes to BS specifications are identified in clauses 10.2, 10.4, 10.6 and 10.7.

9 CA Demodulation performance for BS and UE in Band 38

The BS and UE demodulation performance requirements are specified in clause 8 in TS 36.104 and TS 36.101. The demodulation performance requirements in both specifications are structured as band agnostic, and there is no specific CA demodulation performance requirement for Band 38 for both BS and UE. No change on demodulation performance is required for CA in Band 38.

10 Summary of required changes to E-UTRA specifications

10.1 Required changes to TS 36.101

Required changes for CA_38 in UE RF specification TS 36.101 are shown in Table 10.1-1.

Table 10.1-1: Required changes in TS 36.101

Section	Requirement	Required changes in TS 36.101
5.5A	Operating bands for CA	Add a new row for CA_38 in Table 5.5A-1.
5.6A.1	Channel bandwidths per operating band for CA	Add a new row in Table 5.6A.1-1 for the supported E-UTRA bandwidths of CA_38.
6.2.2A	UE Maximum Output Power for intra-band contiguous CA	Add a new row for CA_38 in Table 6.2.2A-1.
6.2.4A	UE Maximum Output Power with additional requirements for CA	It is proposed to evaluate the appropriate A-MPR requirement for CA_38.
6.6.3A	Additional spurious emission for CA_38	Add a new table in Section 6.6.3A for coexistence with protected bands, especially for protection of Band 7.
7.3.1A	Minimum requirements (QPSK) for CA	Add a new row in Table 7.3.1A-1 for intra-band CA uplink configuration for reference sensitivity of CA38.
7.6.1.1A	In-band blocking for intra-band contiguous CA	Add CA_38C in Table 7.6.1.1A-2. It is proposed to evaluate whether the existing CA_40C in-band blocking requirement is valid for CA_38 C or not.
7.6.2.1A	Out-of-band blocking for intra-band contiguous CA	Add CA_38C in in Table 7.6.2.1A-2. It is proposed to evaluate whether the existing CA_40C out-of-band blocking requirement is valid for CA_38 C or not.

10.2 Required changes to TS 36.104

Required changes in BS RF specification TS 36.104 are shown in Table 10.2-1.

Table 10.2-1: Required changes in TS 36.104

Section	Requirement	Required Changes in TS 36.104
5.5	Operating bands	A new row is expected to be added in Table 5.5-2 to support B38 intra-band contiguous carrier aggregation configuration.

10.3 Required changes to TS 36.133

No change identified in TS 36.133 specifically for CA in Band 38.

10.4 Required changes to TS 36.141

Required changes in BS test specification TS 36.141 are shown in Table 10.4-1.

Table 10.4-1: Required changes in TS 36.141

Section	Requirement	Required Changes in TS 36.141
5.5	Operating bands	A new row is expected to be added in Table 5.5-2 to support B38 intra-band contiguous carrier aggregation configuration.

10.5 Required changes to TS 36.307

Required changes in TS 36.307 are shown in Table 10.5-1.

Table 10.5-1: Required changes in TS 36.307

Section	Requirement	Required Changes in TS 36.307
X	Band 38 independent of release	Add some changes to 36.307 Rel-10 to provide the appropriate pointers to the Rel-11 specifications to enable backdating of CA_38 to Rel-10.

10.6 Required changes to TS 37.104

No change in TS 37.104.

10.7 Required changes to TS 37.141

No change in TS 37.141.

11 Project plan

The follows are the work plan for this WI:

By end of RAN4 #60-BIS in Zhuhai (Oct 2011): to reach agreement on the coexistence requirements in RAN4 specifications, particularly, the BEM (Block Edge Mask) for coexistence, whether to use A-MPR, and whether to use network signaling.

By end of RAN4 #61 in San Francisco (Nov 2011): to reach agreement on the requirements of A-MPR or restrictions on transmission bandwidth.

By end of RAN4 #62 in Dresdon (Feb 2012): to clean up the rests of the Tx and Rx requirements.

All the requirements are captured in Technical Report.

Technical report presented to RAN plenary #55 for information.

By end of RAN4 #64 (May 2012): to have all the CRs agreed.

CRs to be presented in RAN #56 for final approval.

Technical reports presented to RAN#56 for approval.

11.1 Schedule and Work Task Status

RAN# 52, WI created, June 2011

RAN# 53, 10% completed, Sept 2011

RAN# 54, 25% completed, Dec 2011

RAN# 55, 50% completed, March 2012

Annex A:

A.1 Coexistence simulation results for CA single carrier operation

Simulation Assumptions:

1) PA nonlinearity has been calibrated as UTRA/ACLR@33dBc for each transmission channel bandwidth @22dBm with full RB allocation.

2) The I/Q modulator is calibrated following the generic RAN4 assumptions:

LO leakage @ 25dBc

Image leakage @ 25dBc

Counter IM3 @ 60dBc

The spectrum emissions are measured by using measurement bandwidth at 5 MHz, 1 MHz, and 100 kHz, correspondingly.

Simulation Results:

Figure A.1-1 shows the PSD @ 22dBm for 15MHz @QPSK modulation with 1 RB allocated at channel edge, while the blue, red and back curves are the emission mask measured with 5 MHz, 1 MHz, and 100 kHz measurement bandwidth correspondingly.

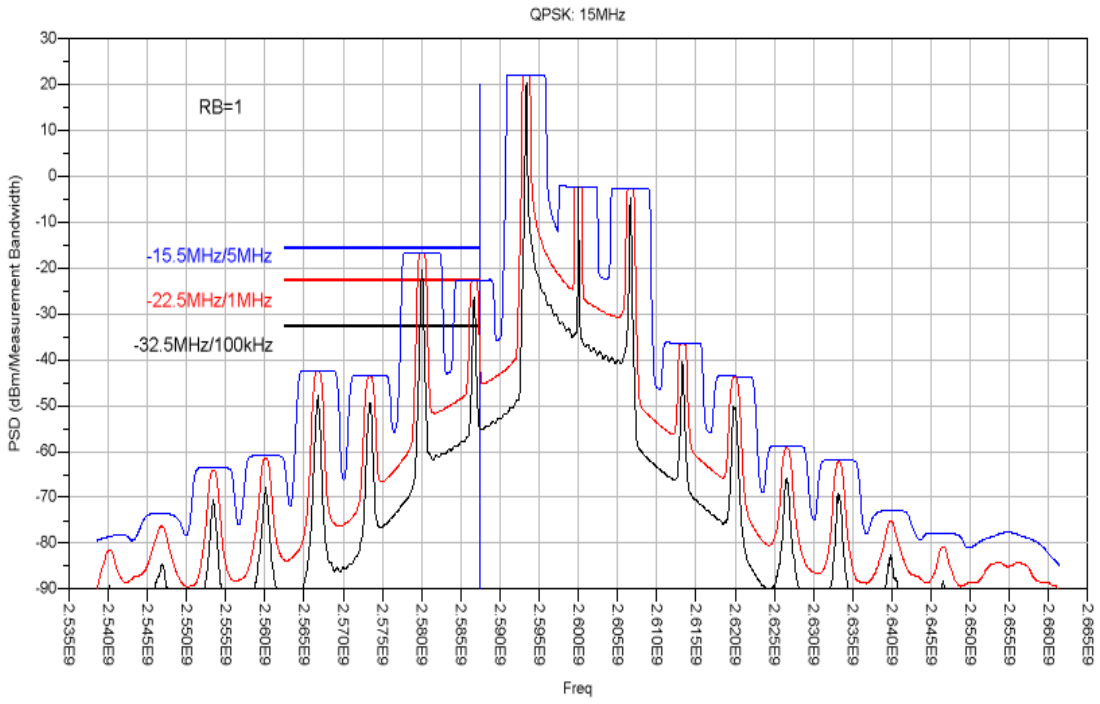

Figure A.1-1: PSD @ 22dBm for 15MHz @QPSK modulation with 1 RB allocated at channel edge

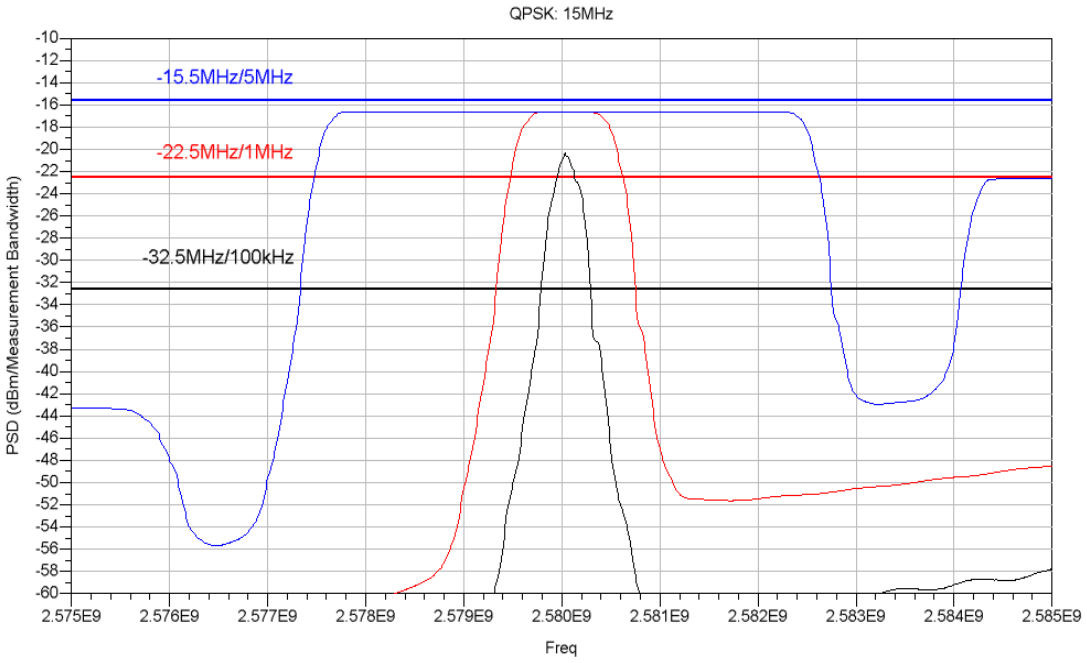

Figure A.1-2: (zoomed in) the differences of measurement bandwidth

In Figure A.1-3, we sweep the number of RBs allocated at band edge from 1 to 15. As the number of RBs increase, the Tx PSD level is lowered and consequently the PSD of the IMD products falling into the victim band are also lowered.

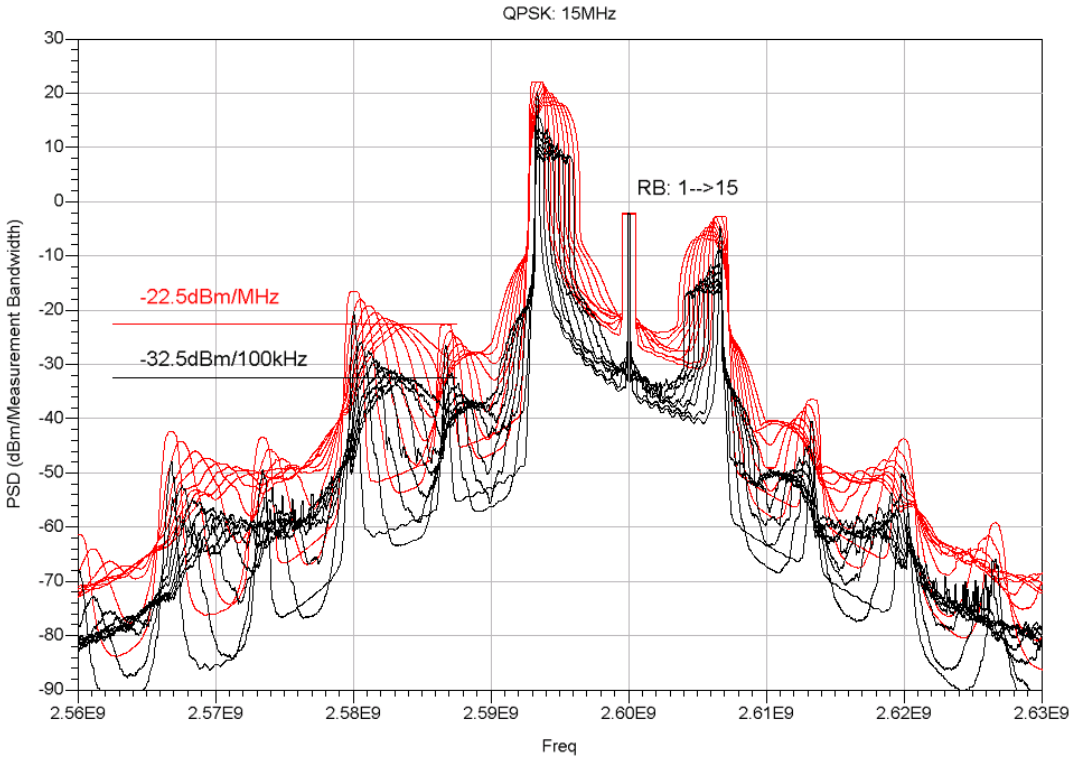

Figure A.1-3: Impact of narrow RB allocations at band edge @ 22dBm

Figure A.1-4 zooms into the frequency range where the IMD3 product is reduced gradually.

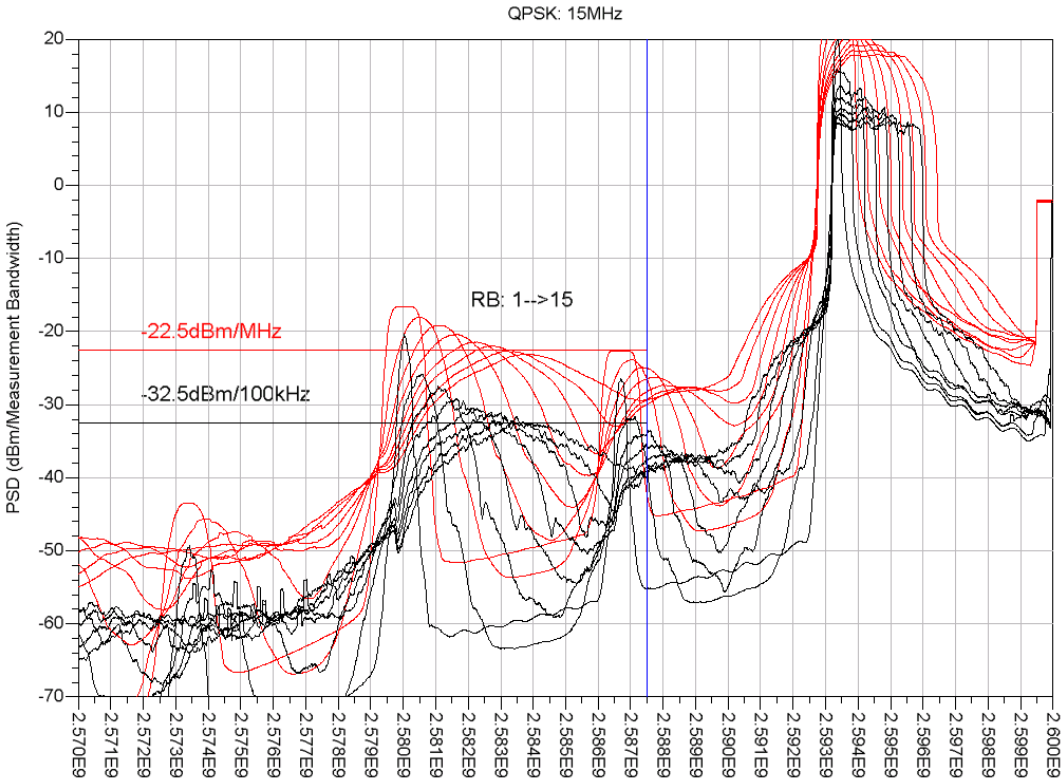

Figure A.1-4: (zoomed in) Impact of narrow RB allocations at band edge @ 22dBm

Figure A.1-5 shows the differences of RB numbers measured at 5 MHz, 1 MHz, and 100 kHz.

Figure A.1-6 zooms into to the area (basically the 2nd UTRA channel) where the emission levels are dominated by the up limit of the RB allocations

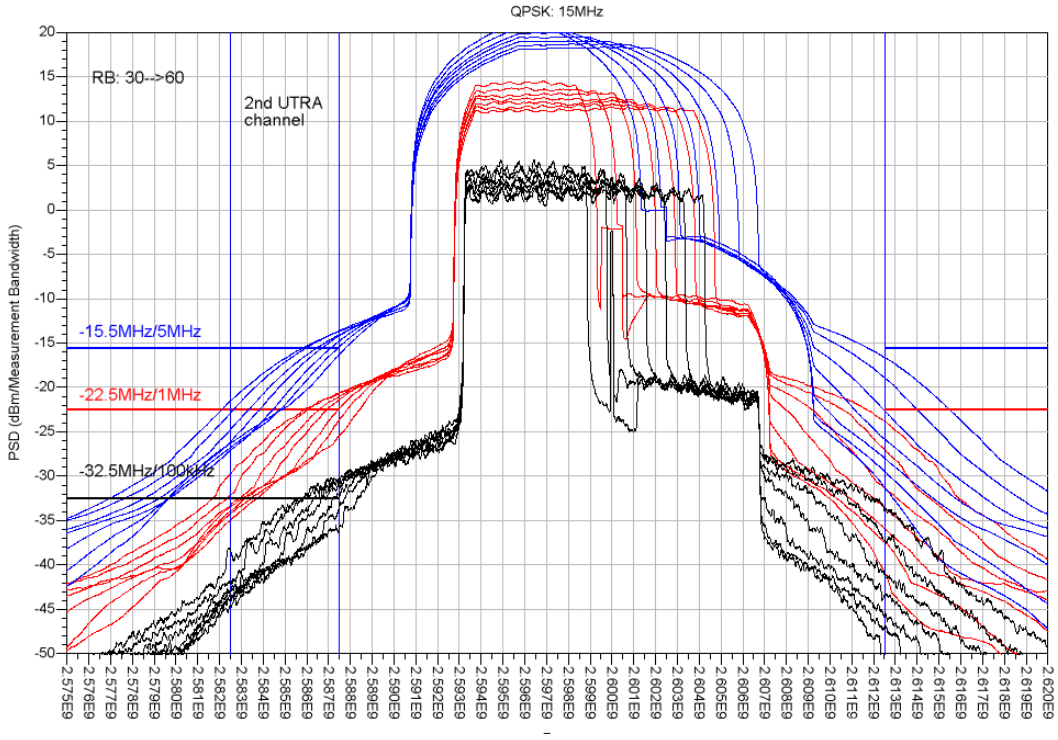

Figure A.1-5: Impact of up limit of RB allocations at band edge @ 22dBm

Figure A.1-7 shows the 2nd UTRA ACLR and the total interference power within the 2nd UTRA channel with the increase of RB allocations.

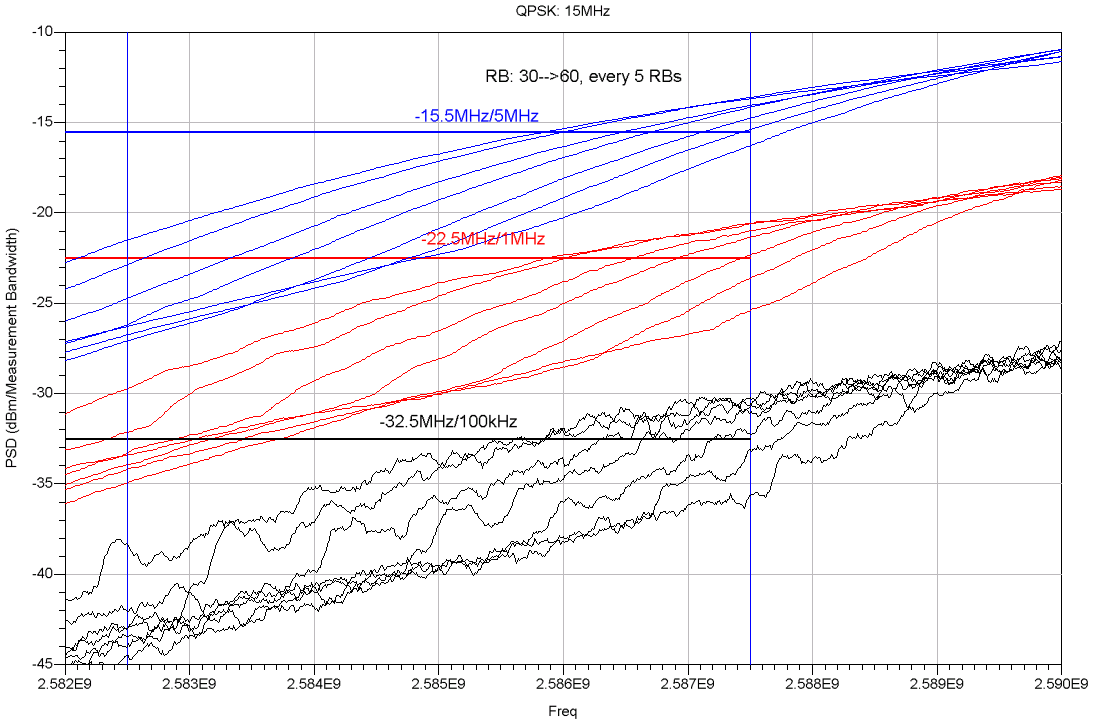

Figure A.1-6: (zoomed in) Impact of up limit of RB allocations at band edge @ 22dBm

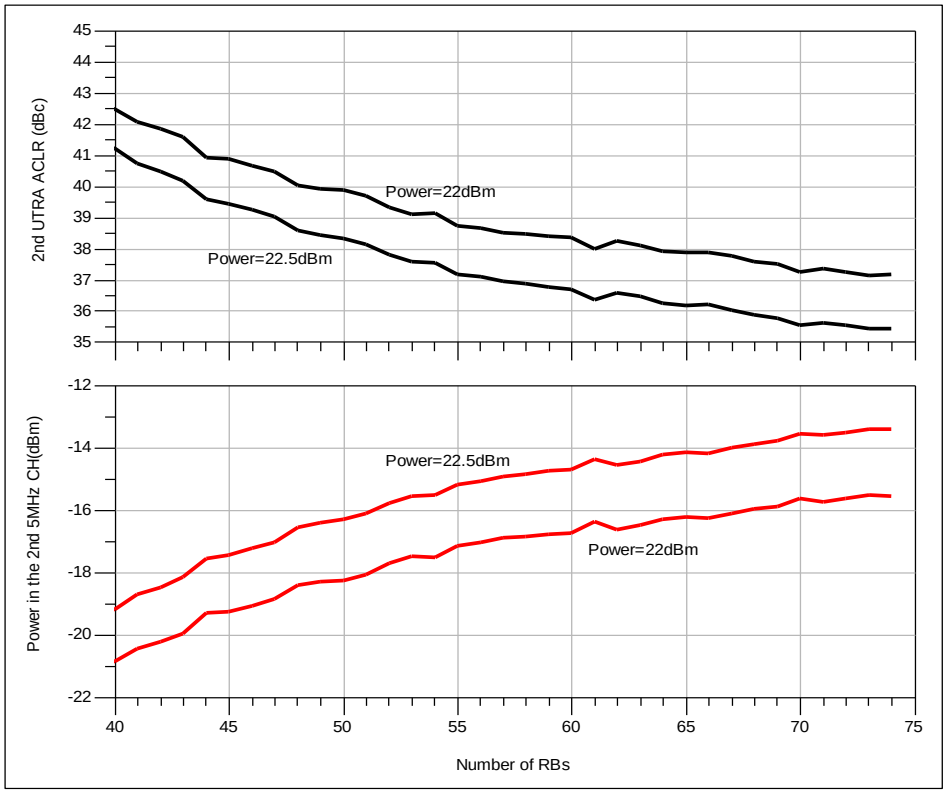

Figure A.1-7: ACLR and interference power level in the second UTRA channel @ 22dBm

Figure A.1-8 shows the emission level frequency range that is 30 MHz (for example beyond 2645 MHz, if for Band 38) away from the carrier edge configured at band edge, with the changes of RB block size (15 MHz: RB 1--->75, 20MHz: RB 1--->100, every 5 RBs). Nominal carrier central frequency is 2.6 GHz.

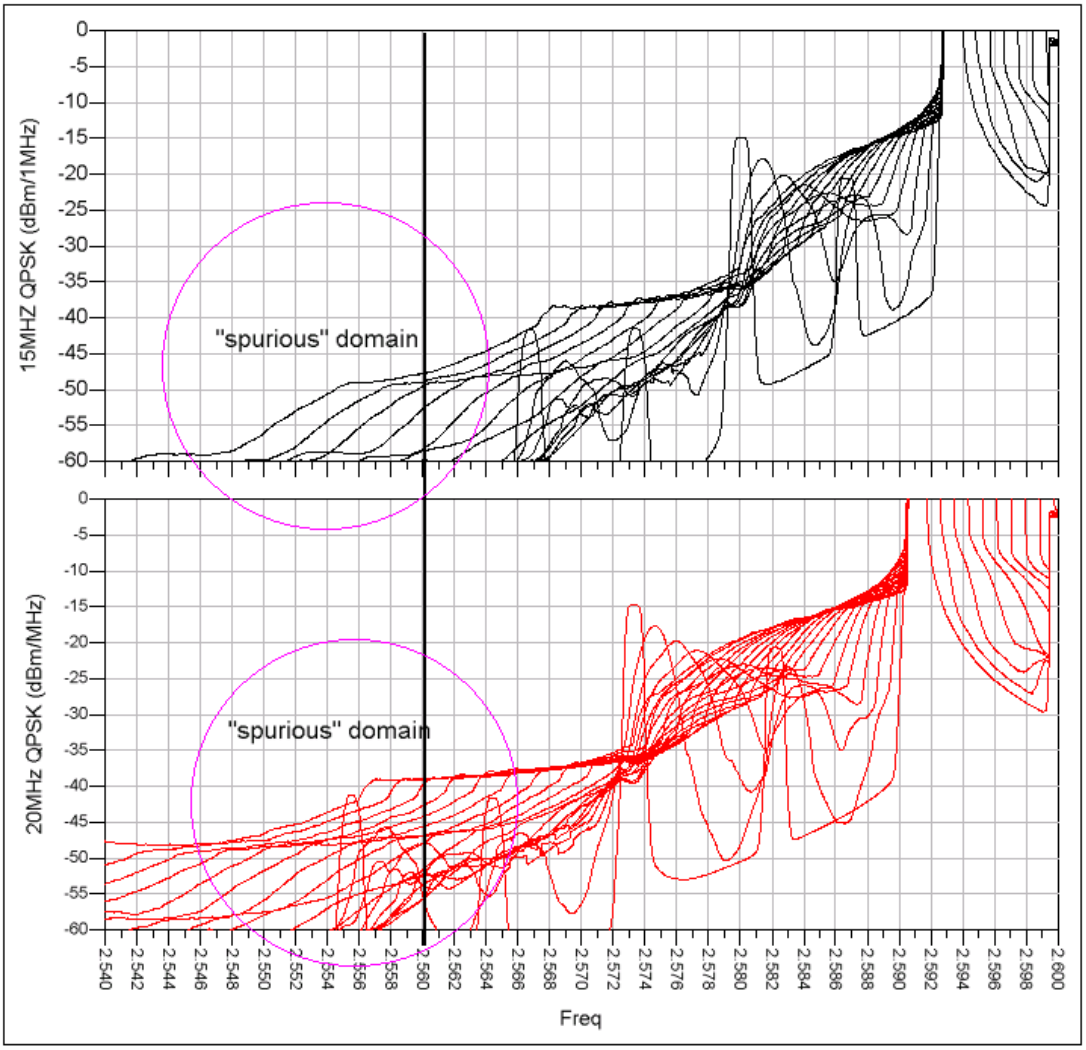

Figure A.1-8: Emission level (per MHz) at the "spurious" domain @ 22dBm

A.2 Coexistence simulation results for CA dual carrier operation

Simulation Assumptions:

1) PA nonlinearity has been calibrated as UTRA/ACLR@33dBc for each transmission channel bandwidth @22dBm with full RB allocation.

2) The I/Q modulator is calibrated following the generic RAN4 assumptions:

LO leakage @ 25dBc

Image leakage @ 25dBc

Counter IM3 @ 60dBc

The spectrum emissions are measured by 1 MHz.

Simulation Results:

NOTE: It is impossible to plot the spectrum at all the power level simulated. The power levels presented in the pictures are only for illustration purpose.

Figure A.2-1 shows the PSD @ 21dBm for QPSK transmission in 20MHz+20MHz, while the RB number is swept from 1to 200 with the step equals to 2.

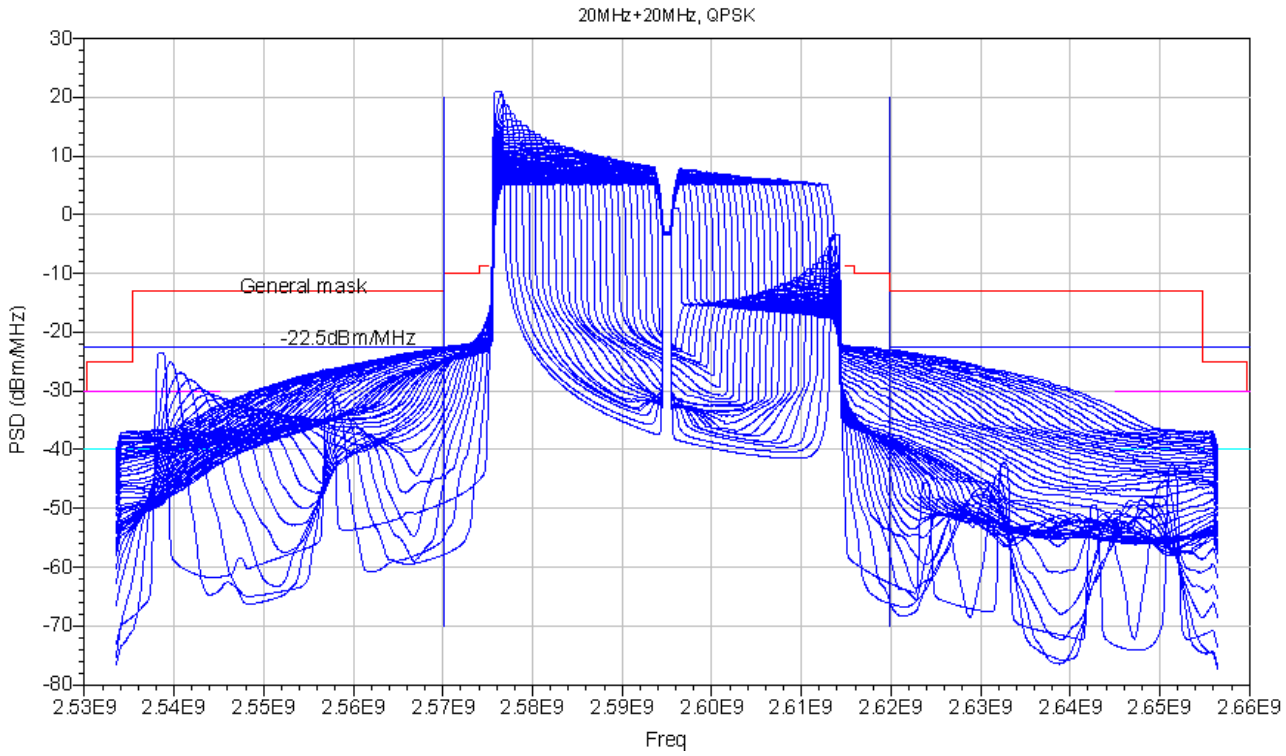

Figure A.2-1: PSD @ 21dBm for QPSK transmission in 20MHz+20MHz

Figure A.2-2 shows the PSD @ 20dBm for QPSK transmission in 20MHz+20MHz, while the RB number is swept from 1 to 200 with the step equals to 2.

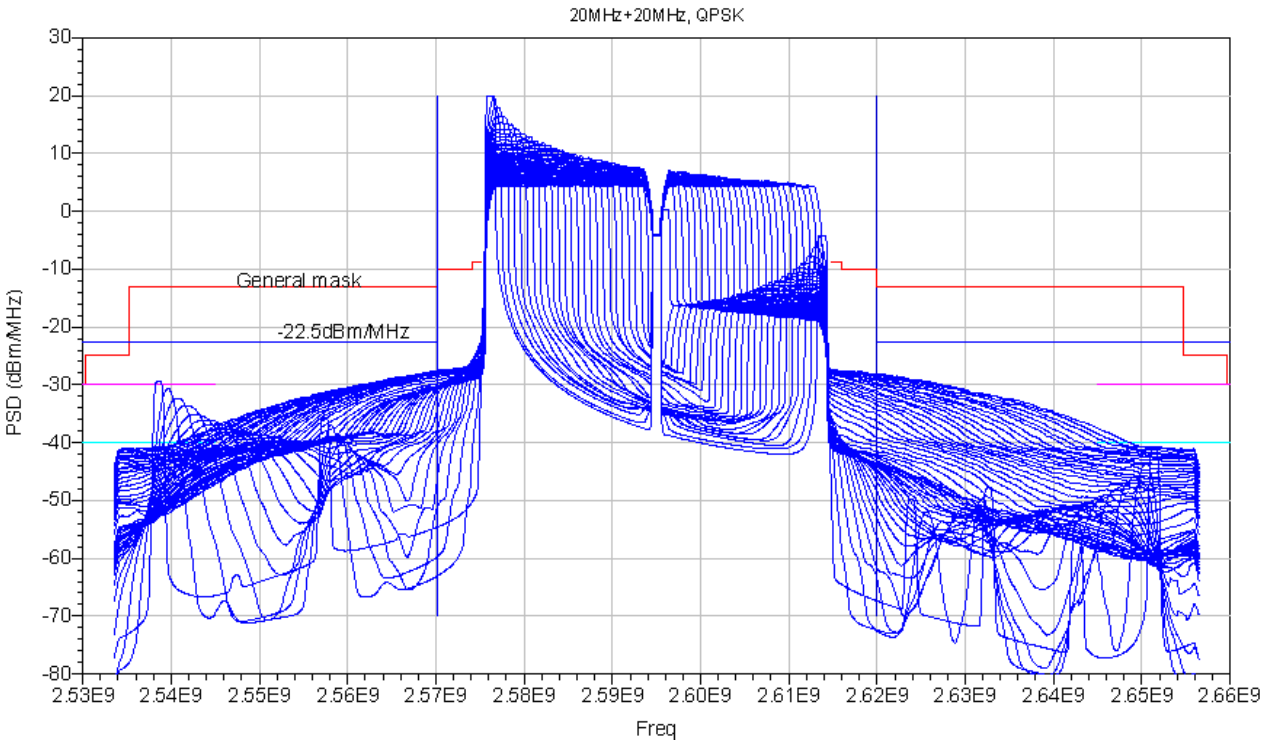

Figure A.2-2: PSD @ 20dBm for QPSK transmission in 20MHz+20MHz

Figure A.2-3 shows the PSD @ 18.5dBm for QPSK transmission in 20MHz+20MHz, while the RB number is swept from 1 to 200 with the step equals to 2.

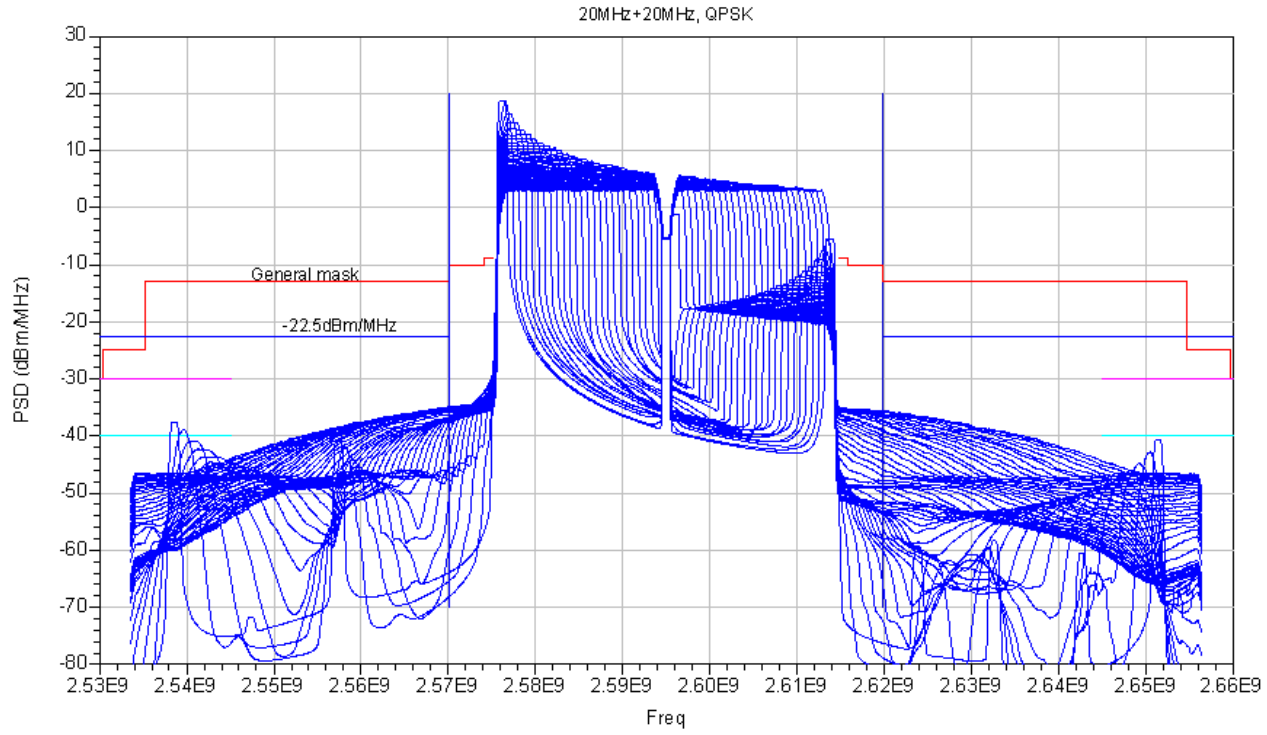

Figure A.2-3: PSD @ 18.5dBm for QPSK transmission in 20MHz+20MHz

Figure A.2-4 shows the PSD @ 21dBm for QAM16 transmission in 20MHz+20MHz, while the RB number is swept from 1 to 200 with the step equals to 2.

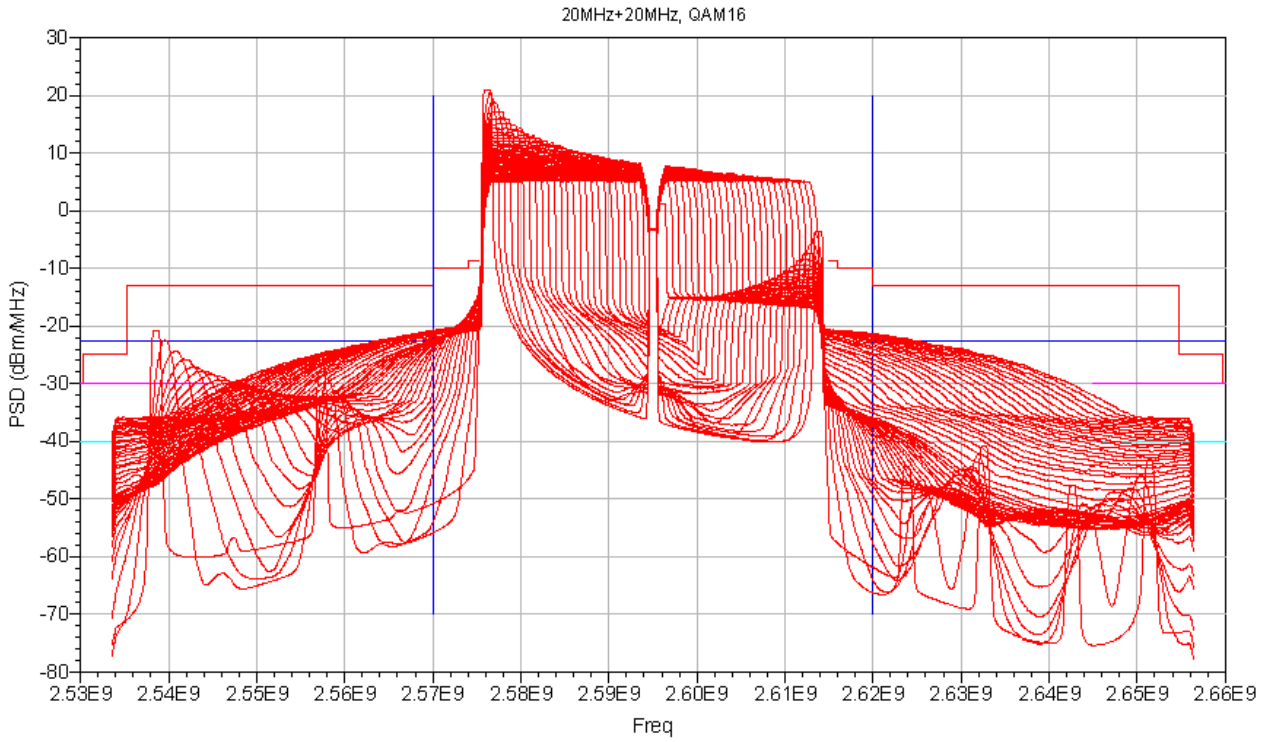

Figure A.2-4: PSD @ 21dBm for QAM16 transmission in 20MHz+20MHz

Figure A.2-5 shows the PSD @ 20dBm for QAM16 transmission in 20MHz+20MHz, while the RB number is swept from 1 to 200 with the step equals to 2.

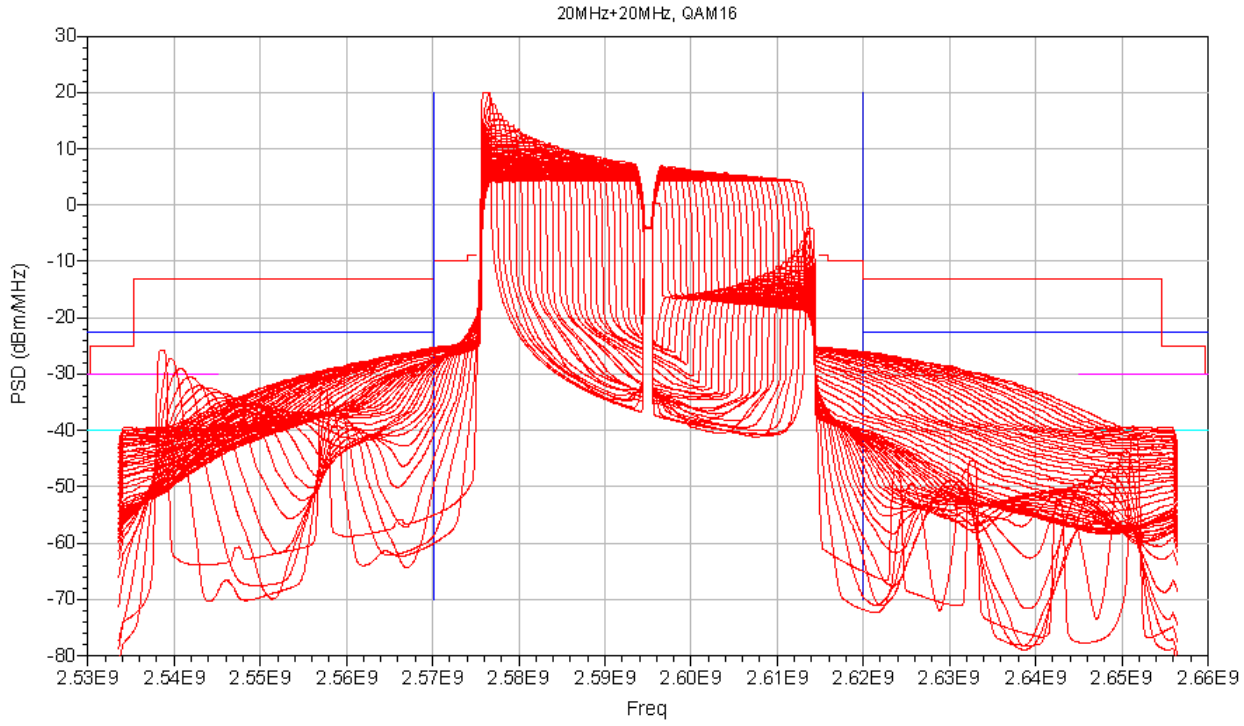

Figure A.2-5: PSD @ 20dBm for QAM16 transmission in 20MHz+20MHz

Figure A.2-6 shows the PSD @ 19dBm for QAM16 transmission in 20MHz+20MHz, while the RB number is swept from 1to 200 with the step equals to 2.

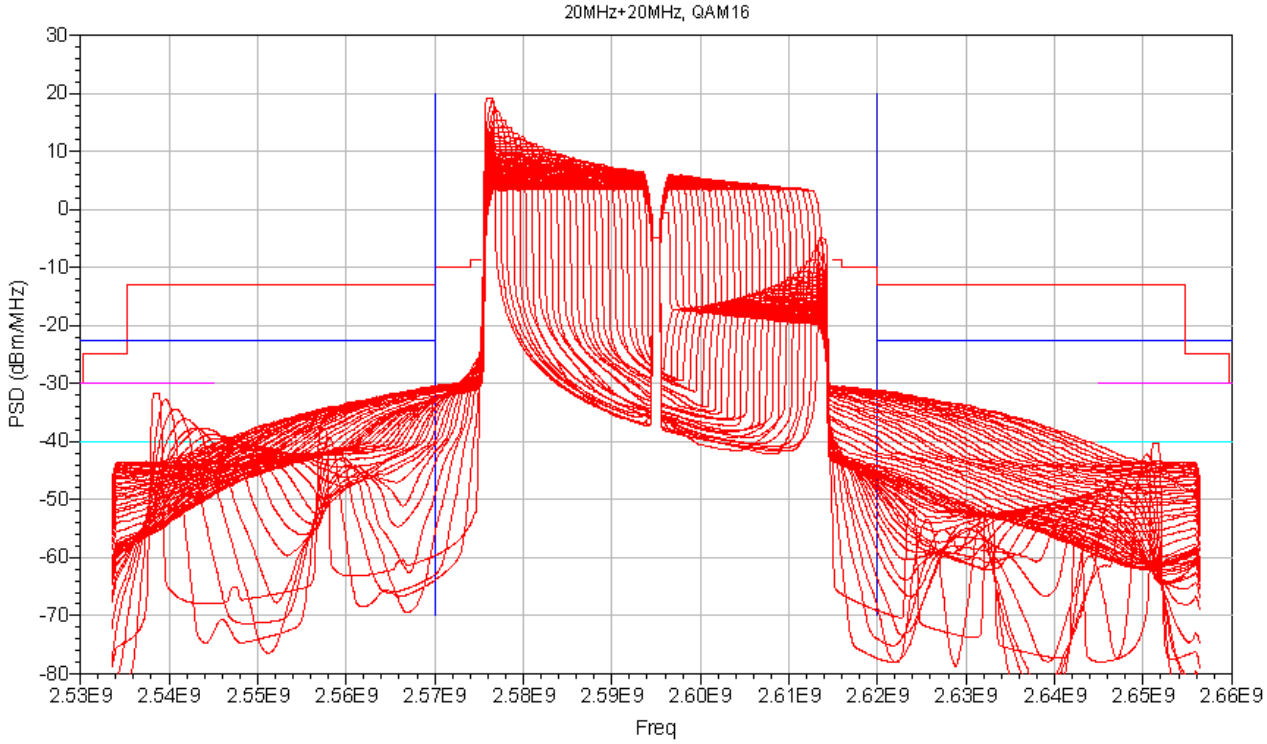

Figure A.2-6: PSD @ 19dBm for QAM16 transmission in 20MHz+20MHz

Figure A.2-7 shows the PSD @ 18.5dBm for QAM16 transmission in 20MHz+20MHz, while the RB number is swept from 1 to 200 with the step equals to 2.

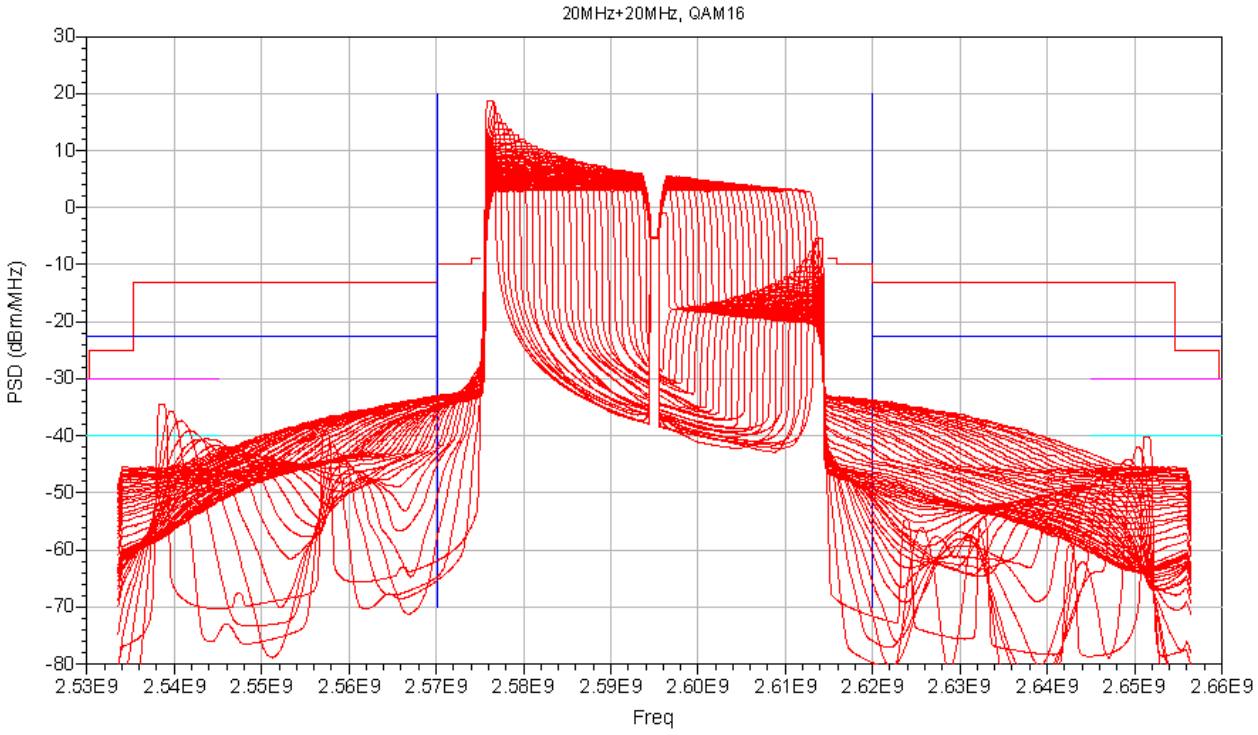

Figure A.2-7: PSD @ 18.5dBm for QAM16 transmission in 20MHz+20MHz

Figure A.2-8 shows the PSD @ 21dBm for QPSK transmission in 15MHz+15MHz, while the RB number is swept from 1 to 150 with the step equals to 2.

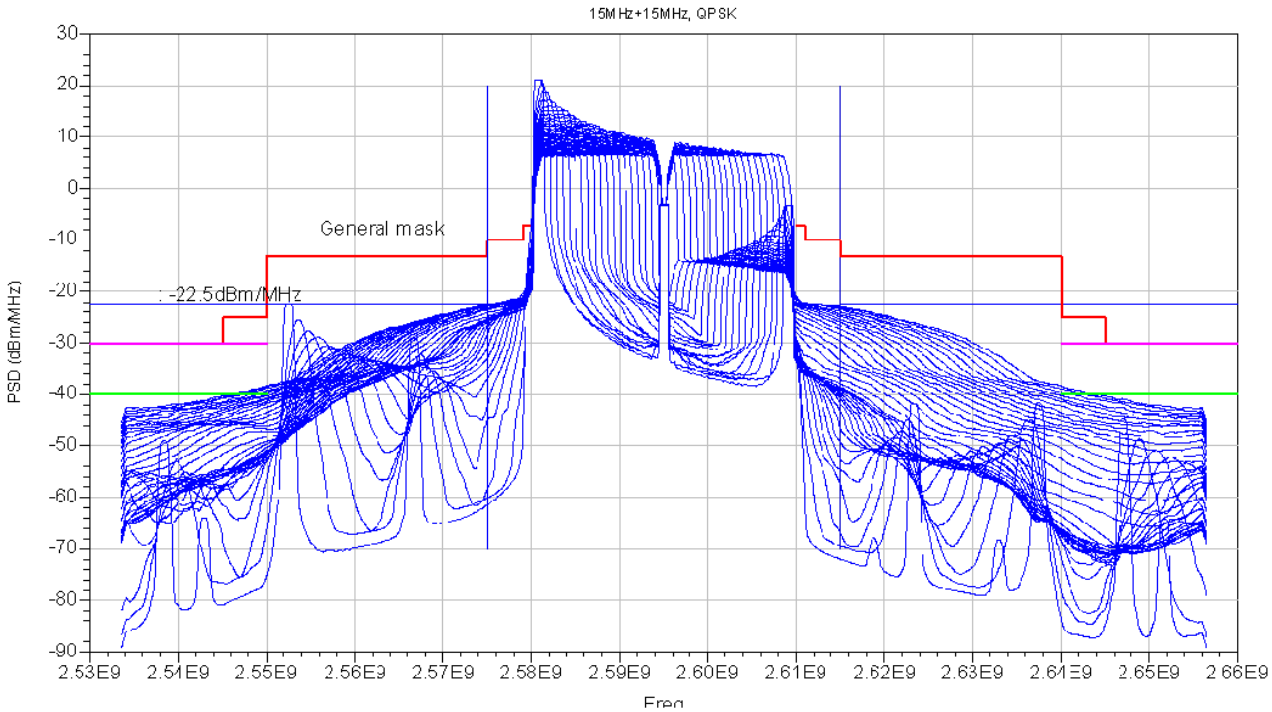

Figure A.2-8: PSD @ 21dBm for QPSK transmission in 15MHz+15MHz

Figure A.2-9 shows the PSD @ 20dBm for QPSK transmission in 15MHz+15MHz, while the RB number is swept from 1 to 150 with the step equals to 2.

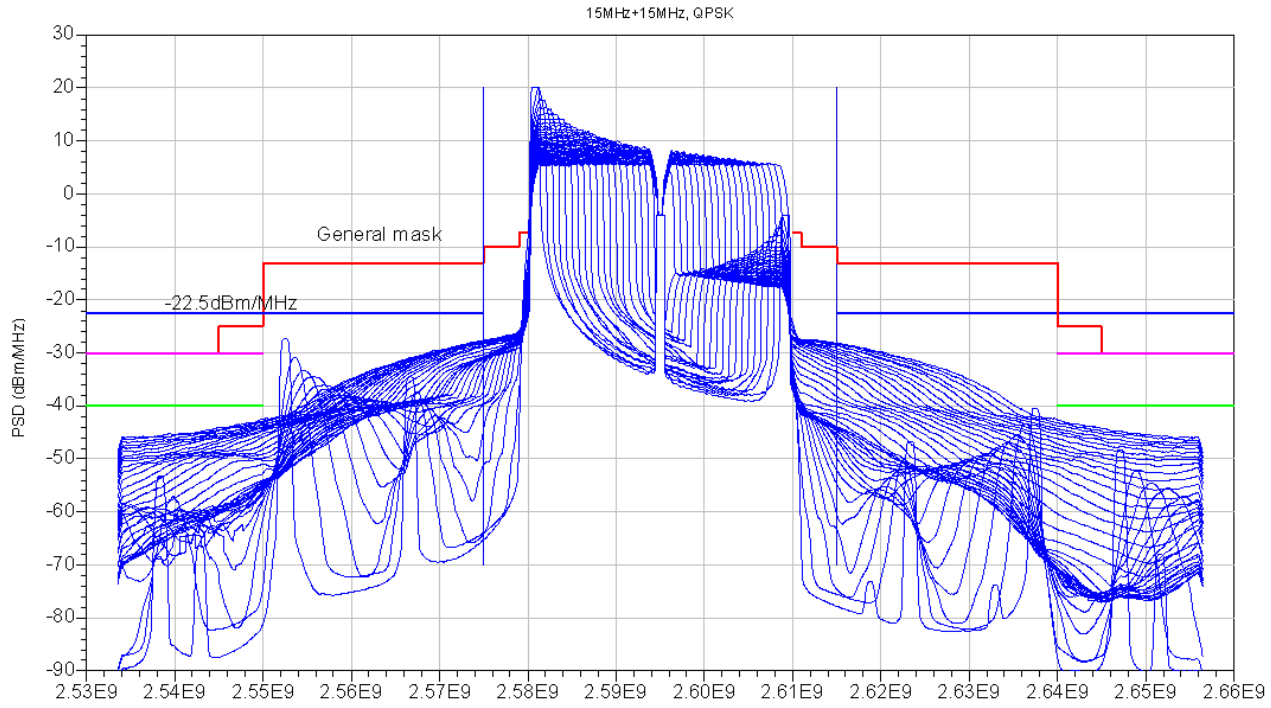

Figure A.2-9: PSD @ 20dBm for QPSK transmission in 15MHz+15MHzFigure A.2-10 shows the PSD @ 21dBm for QAM16 transmission in 15MHz+15MHz, while the RB number is swept from 1 to 150 with the step equals to 2.

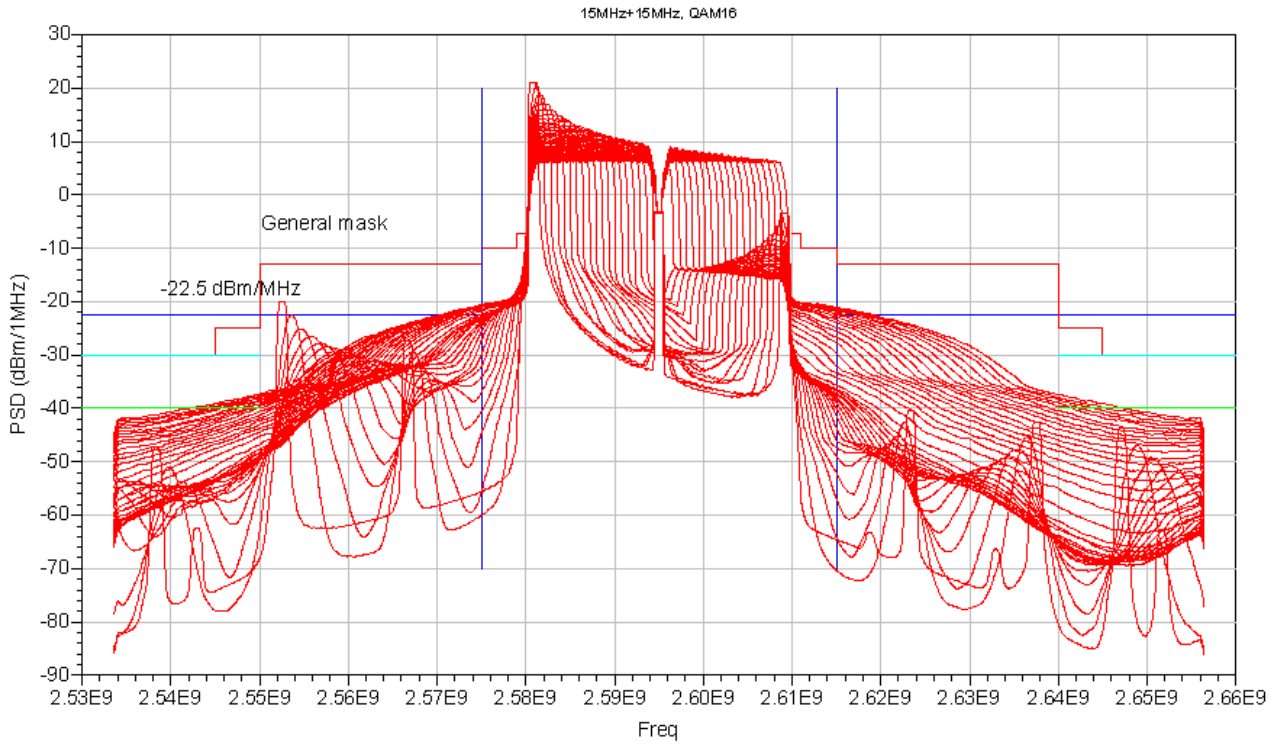

Figure A.2-10: PSD @ 21dBm for QAM16 transmission in 15MHz+15MHz

Figure A.2-11 shows the PSD @ 20dBm for QAM16 transmission in 15MHz+15MHz, while the RB number is swept from 1 to 150 with the step equals to 2.

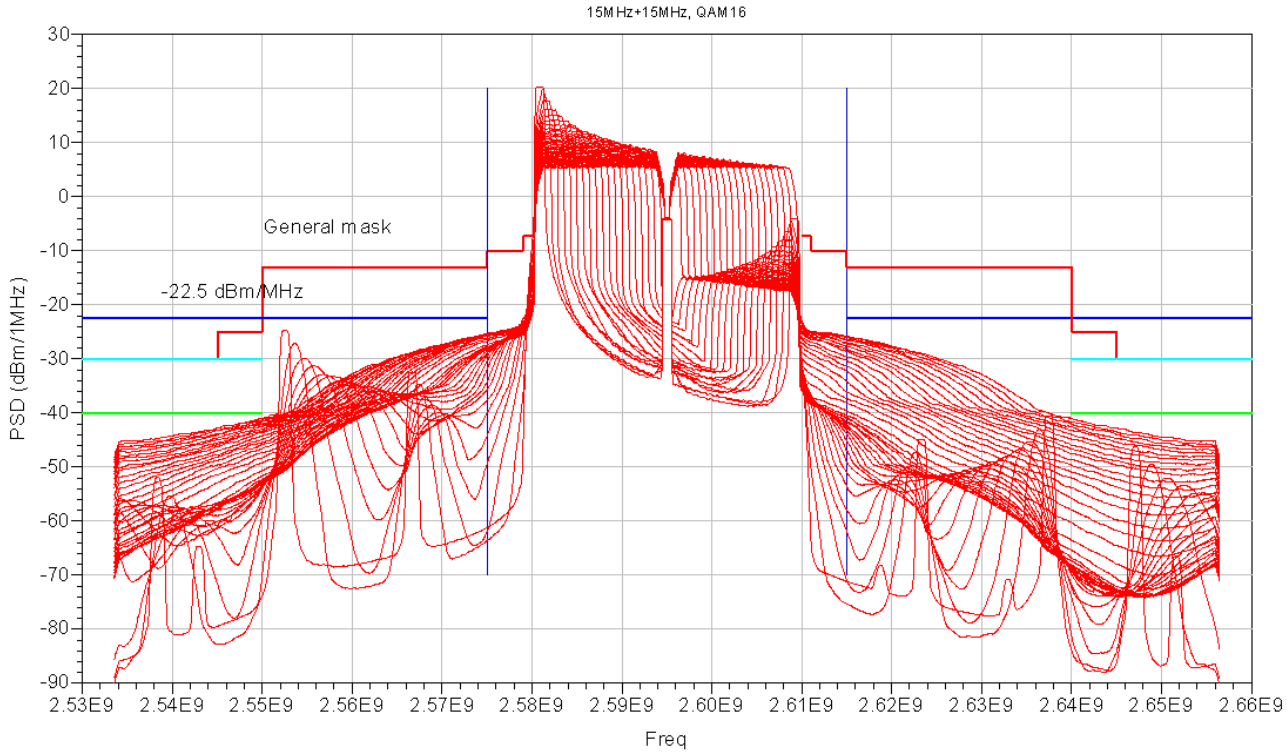

Figure A.2-11: PSD @ 20dBm for QAM16 transmission in 15MHz+15MHz

A.3 A-MPR simulation results 1

A.3.1 Simulation campaign

In these simulations emissions from band 38 to band 7 were studied and sufficient backoff to reach emission limits was searched. Simulations were performed with 100+100RB and 75+75RB configurations and they were placed in the worst case position at the upper edge of band 38. 2615 – 2620 MHz was considered as guard band and therefore uplink center frequency was 2595.1MHz for 100+100 RB configuration and 2600 MHz for 75+75RB configuration.

Emission limits for band 38 frequencies were as follows

Table A.3-1: Emission limits from band 38 to band 7

Frequency range	Emission limit	Measurement bandwidth
2620 – 2645 MHz	-15.5 dBm	5 MHz
2645 – 2690 MHz	-40.0 dBm	1 MHz

For OOB region below transmitted signal general E-UTRA CA spectrum emission mask was used.

Table A.3-2: General E-UTRA CA spectrum emission mask

Spectrum emission limit [dBm]/$BW_{Channel\_CA}$					
Δf_{OOB} (MHz)	29.9 MHz	30 MHz	34.85 MHz	39.8 MHz	Measurement bandwidth
± 0-1	-22.5	-22.5	-23.5	-24	30 kHz
± 1-5	-10	-10	-10	-10	1 MHz
± 5-29.9	-13	-13	-13	-13	1 MHz
± 29.9-30	-25	-13	-13	-13	1 MHz
± 30-34.85	-25	-25	-13	-13	1 MHz
± 34.85-34.9	-25	-25	-25	-13	1 MHz
± 34.9-35		-25	-25	-13	1 MHz
± 35-39.8			-25	-13	1 MHz
± 39.8-39.85			-25	-25	1 MHz
± 39.85-44.8				-25	1 MHz

The following ACLR limits were used.

- $UTRA_{ACLR1}$ = 33dB
- $UTRA_{ACLR2}$ = 36dB
- CA E-$UTRA_{ACRL}$ = 30dB

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

Simulation assumptions were as follows:

- PA operating point: with fully allocated REL-8 100RB QPSK signal $UTRA_{ACLR1}$ = 33 dBc with Pout = 22 dBm.
- Modulator IQ – image = 25 dB
- Modulator carrier leakage = 25 dBc
- Modulator C_IM3 = 60 dBc

When setting the PA operating point it was checked that all ACLR results were within the limits.

A.3.2 Simulation results for contiguous allocation

Simulated allocations and required backoff are shown in Figures 1-12.

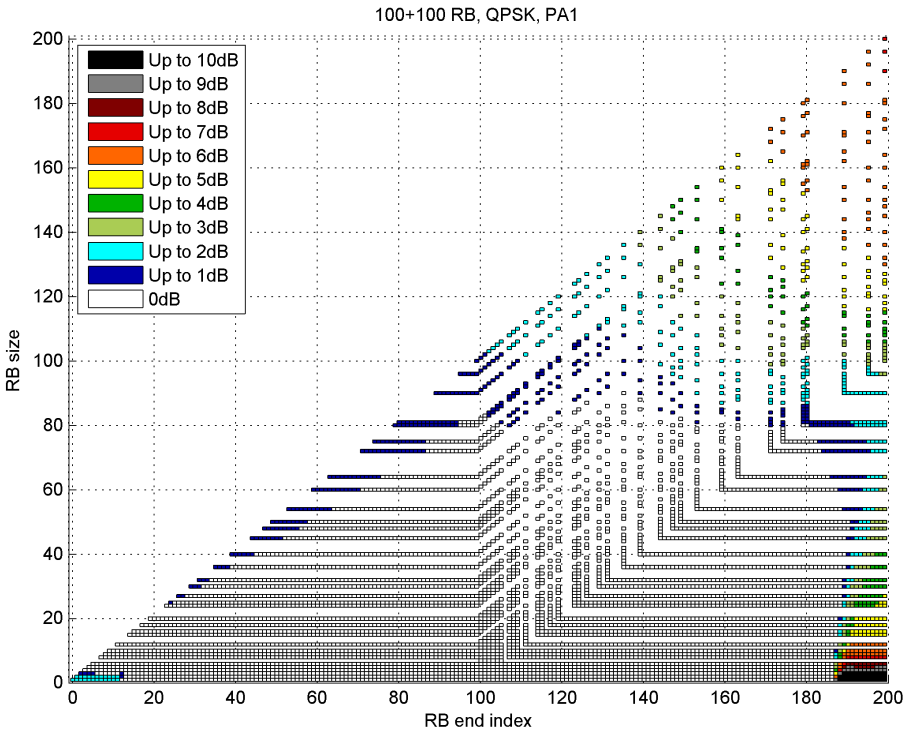

Figure A3-1: Required backoff with 100+100RB configuration, QPSK, PA1

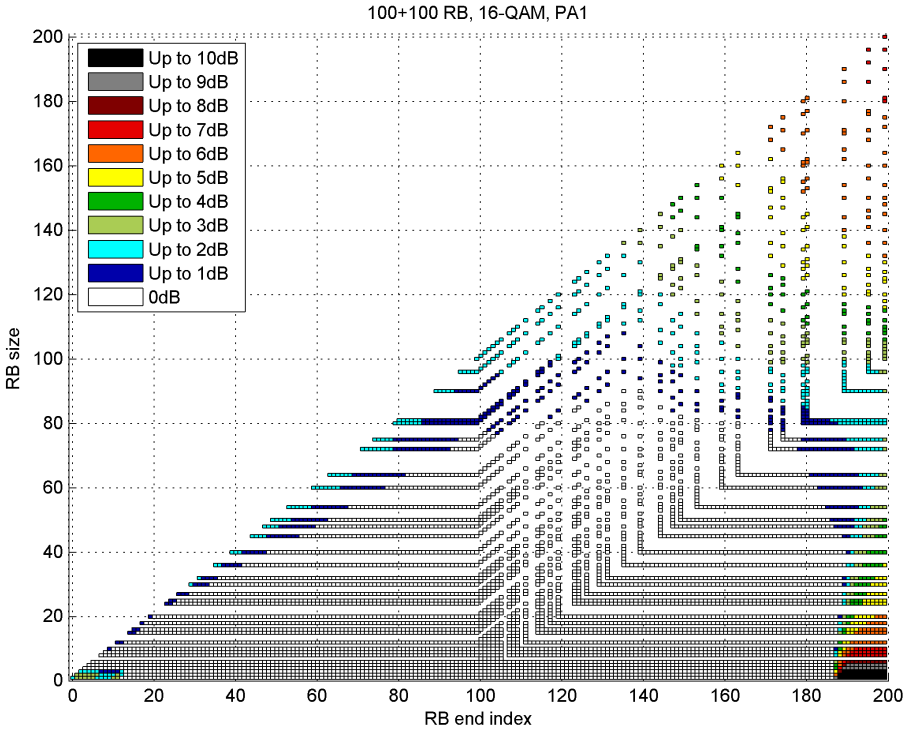

Figure A3-2: Required backoff with 100+100RB configuration, 16-QAM, PA1

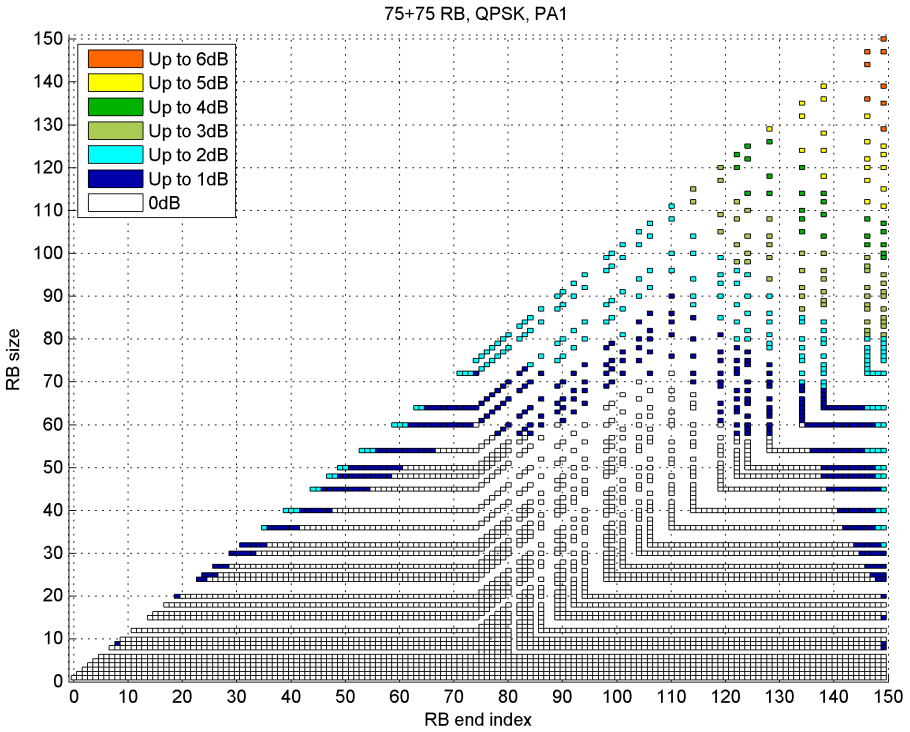

Figure A3-3: Required backoff with 75+75RB configuration, QPSK, PA1

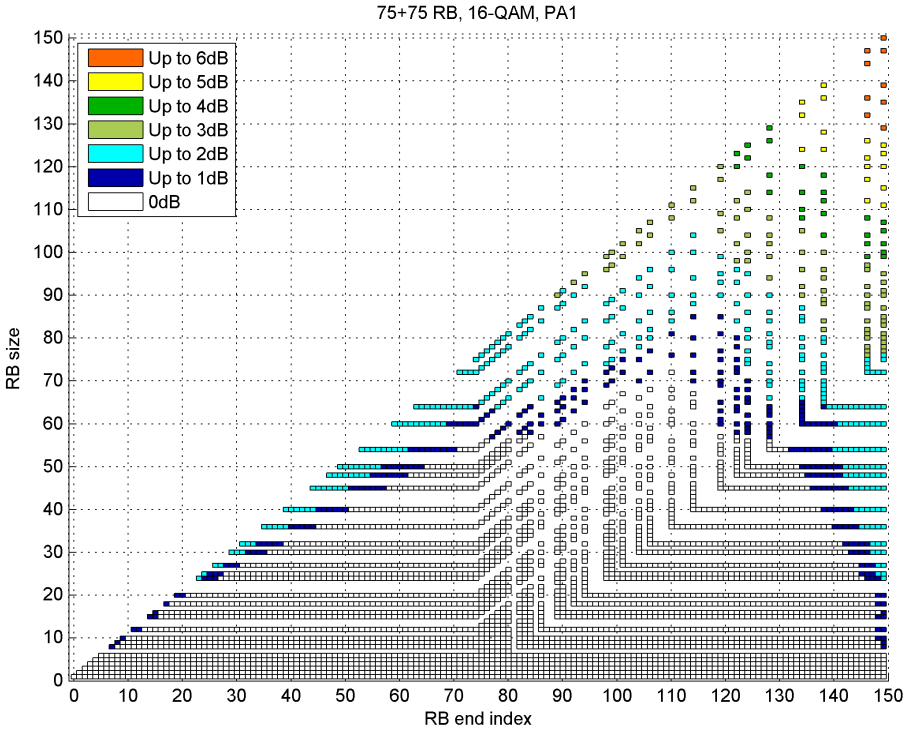

Figure A3-4: Required backoff with 75+75RB configuration, 16-QAM, PA1

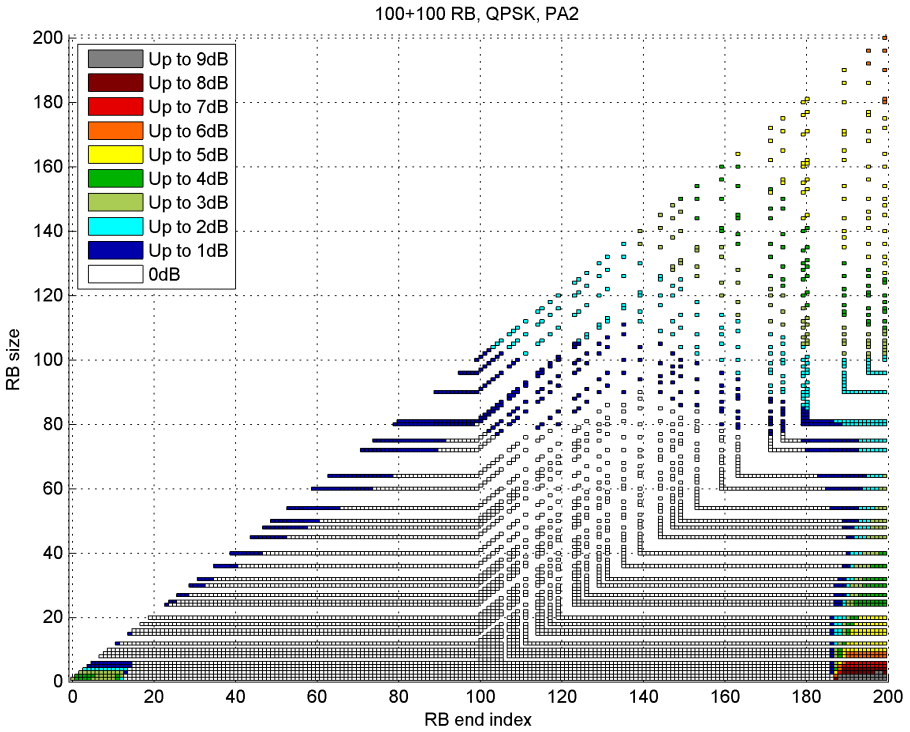

Figure A3-5: Required backoff with 100+100RB configuration, QPSK, PA2

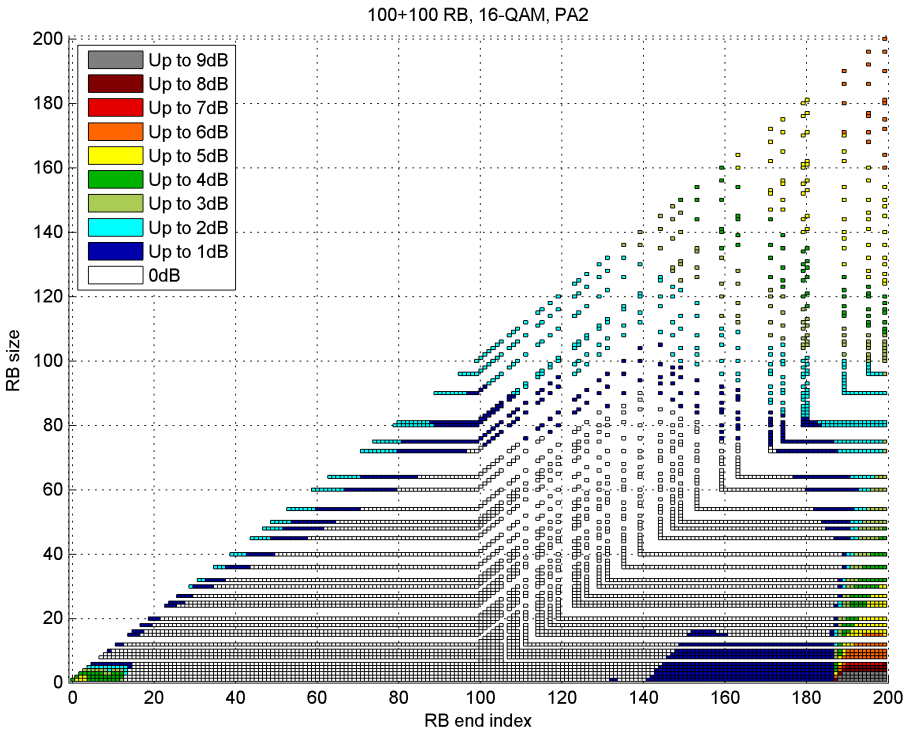

Figure A3-6: Required backoff with 100+100RB configuration, 16-QAM, PA2

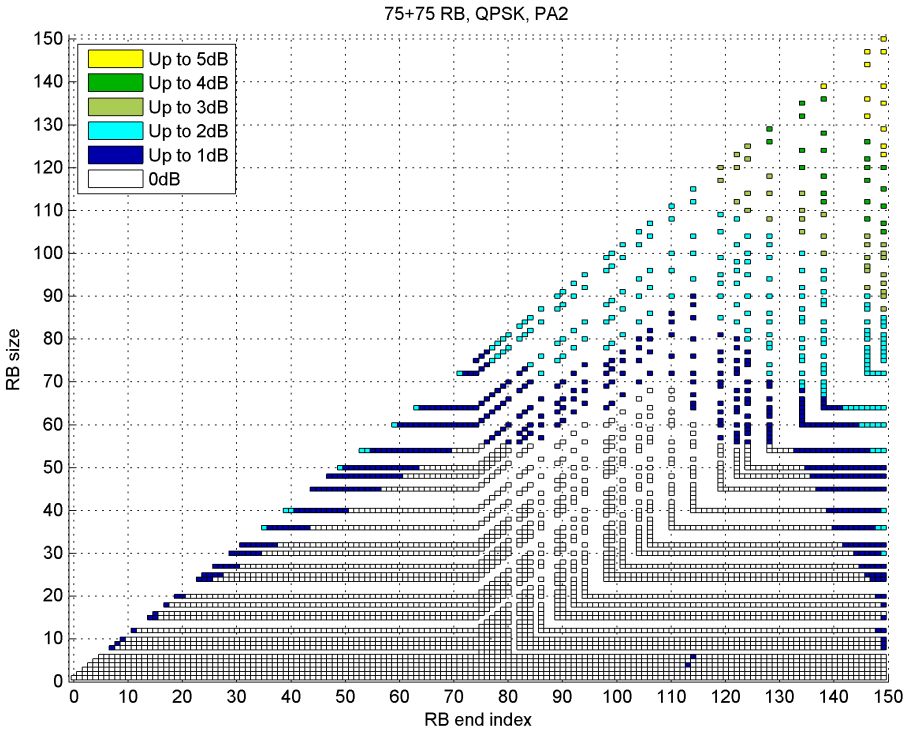

Figure A3-7: Required backoff with 75+75RB configuration, QPSK, PA2

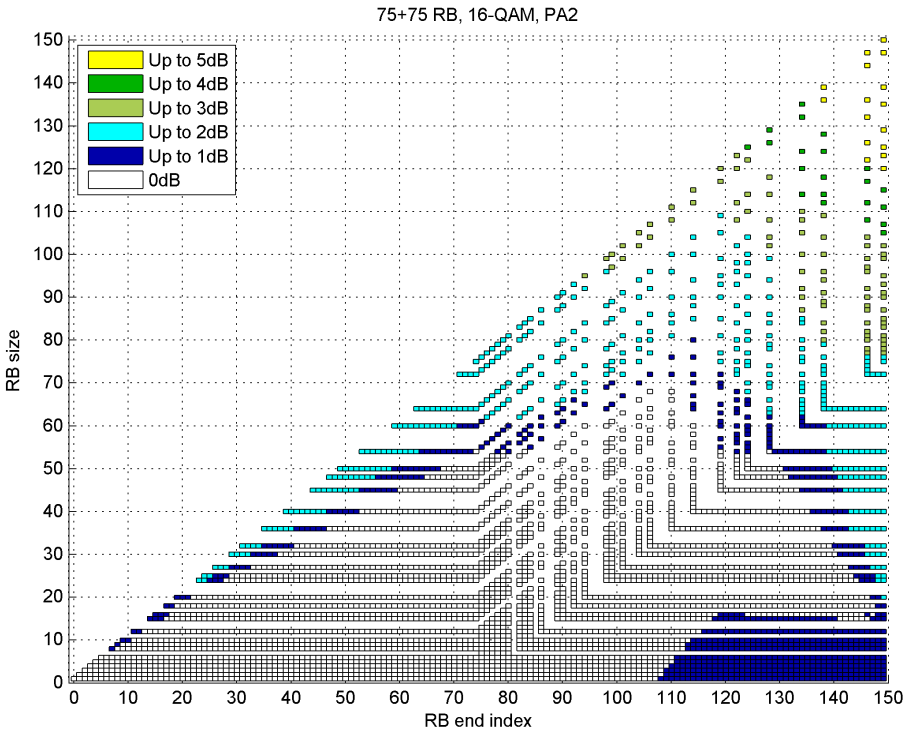

Figure A3-8: Required backoff with 75+75RB configuration, 16-QAM, PA2

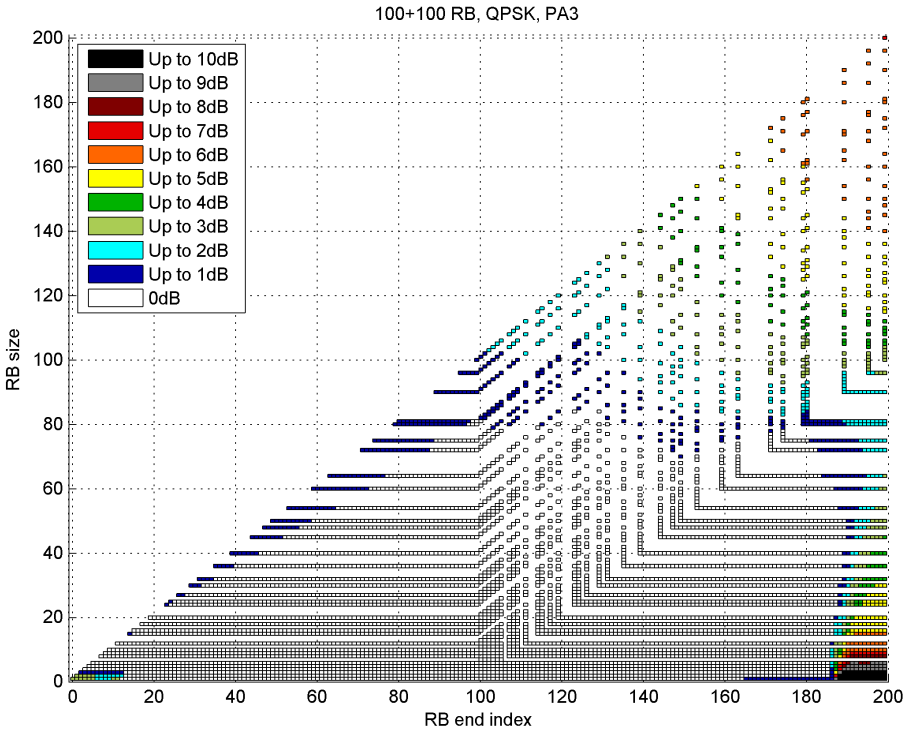

Figure A3-9: Required backoff with 100+100RB configuration, QPSK, PA3

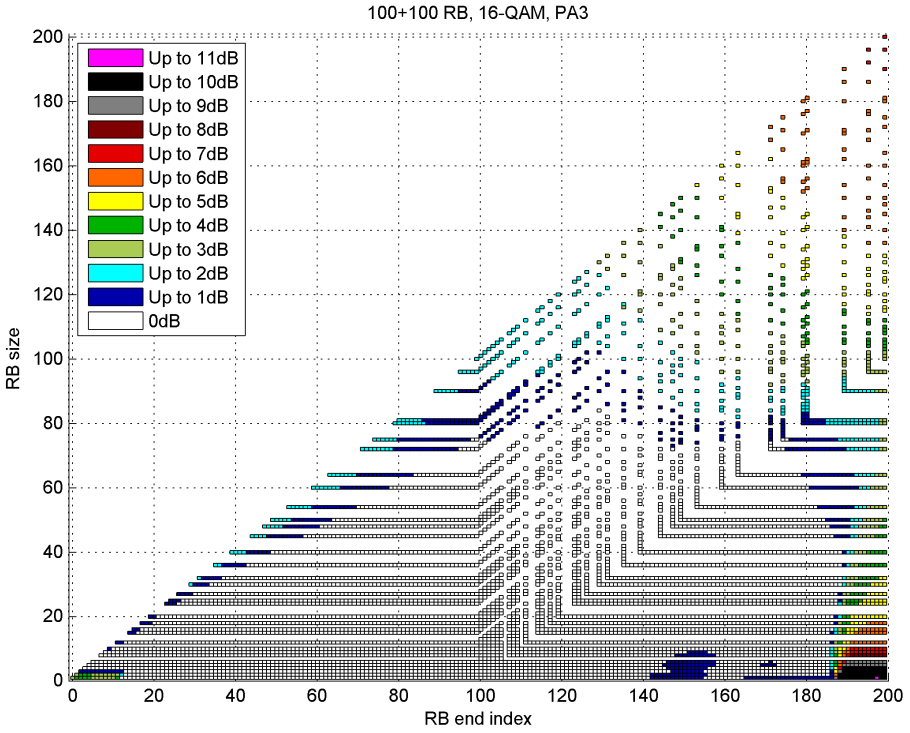

Figure A3-10: Required backoff with 100+100RB configuration, 16-QAM, PA3

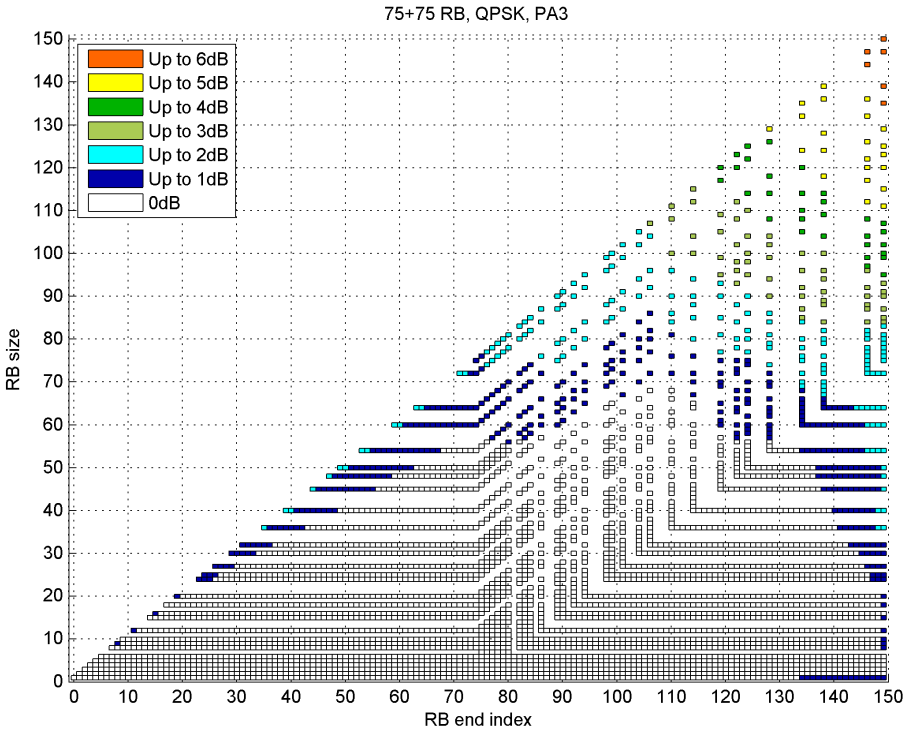

Figure A3-11: Required backoff with 75+75RB configuration, QPSK, PA3

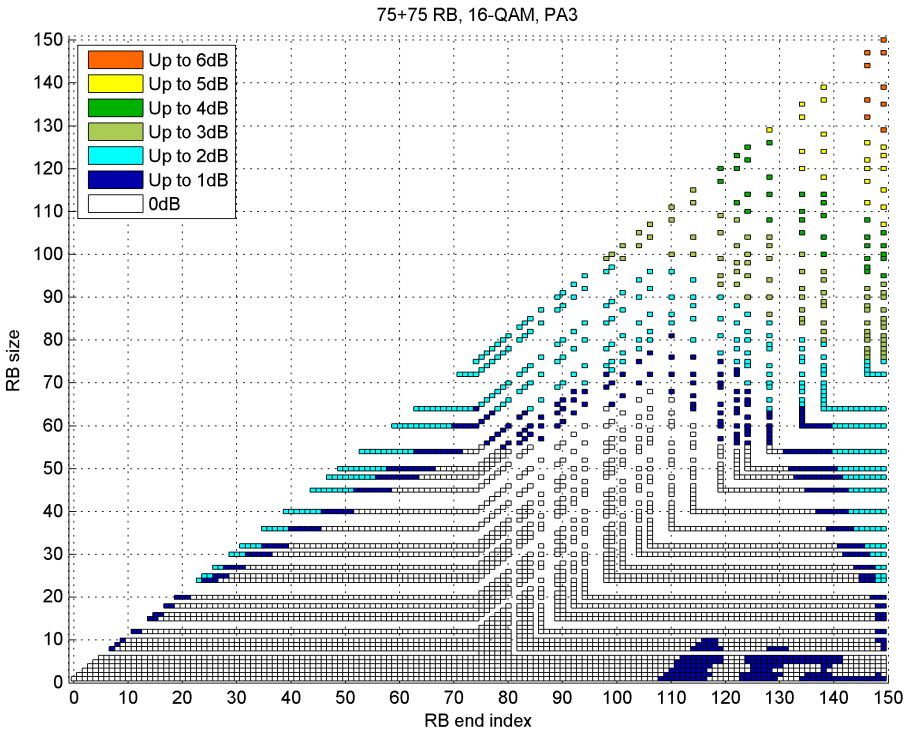

Figure A3-12: Required backoff with 75+75RB configuration, 16-QAM, PA3

A.3.3 Simulation results for multicluster allocation

Simulated allocations and required backoff are shown in Figures 1- 4.

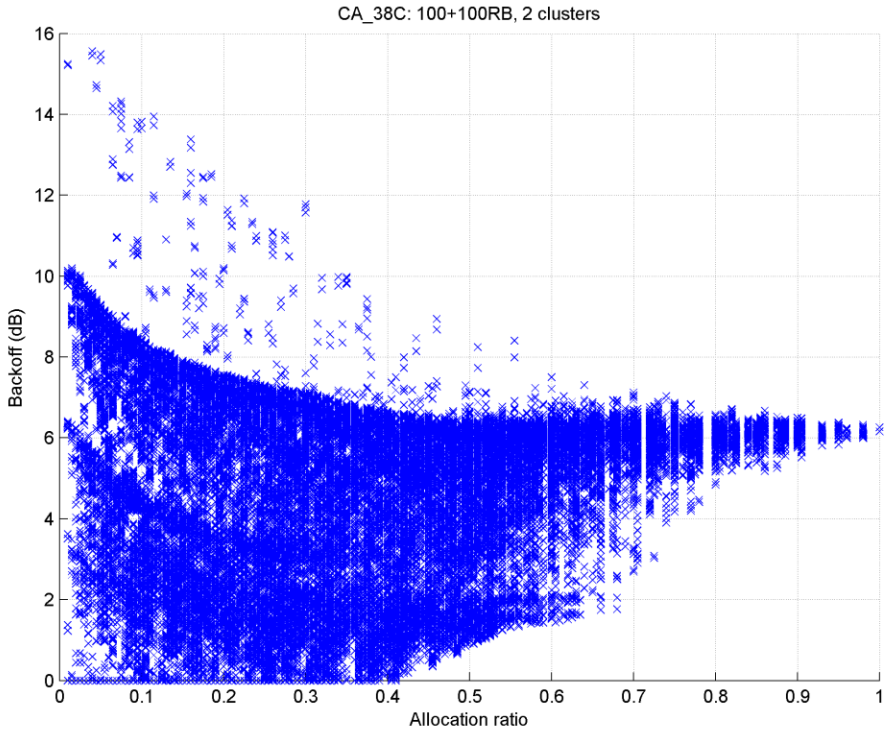

Figure A.3.3-1: Required backoff with 100+100RB configuration, 2 clusters

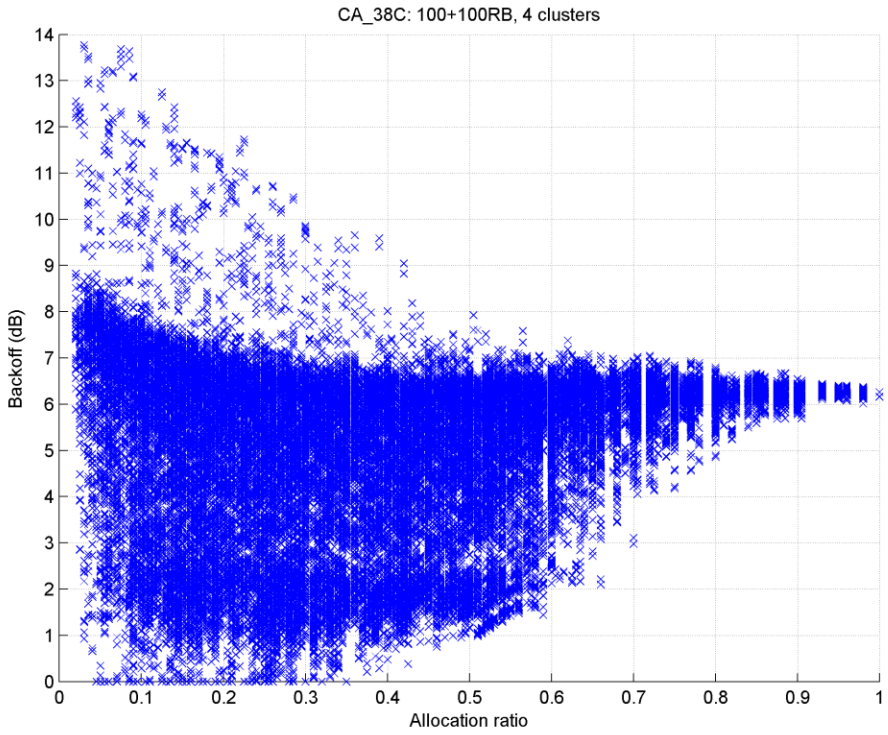

Figure A.3.3-2: Required backoff with 100+100RB configuration, 4 clusters

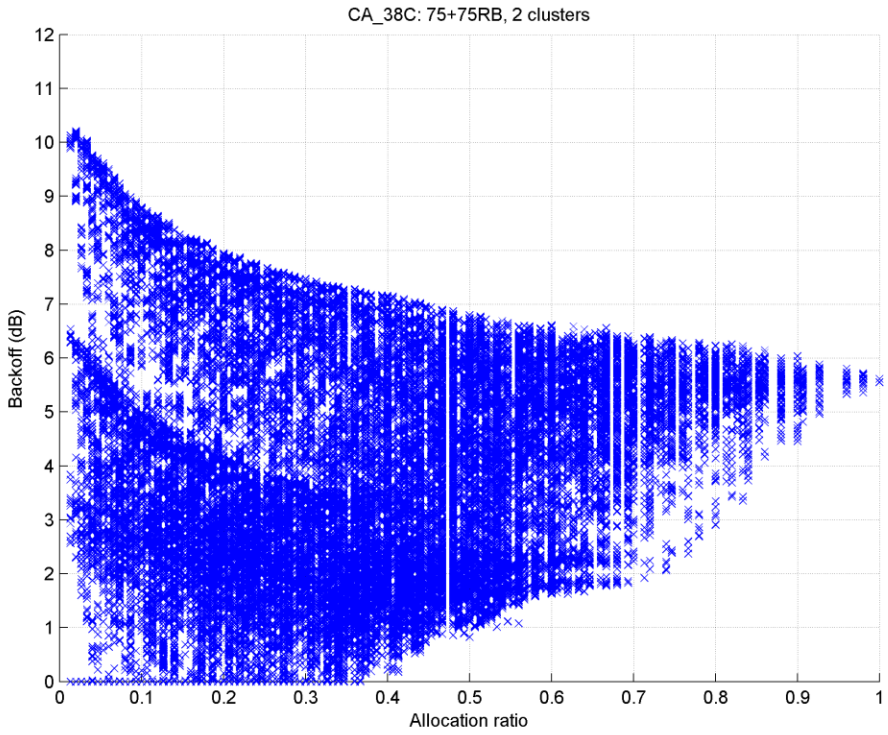

Figure A.3.3-3: Required backoff with 75+75RB configuration, 2 clusters

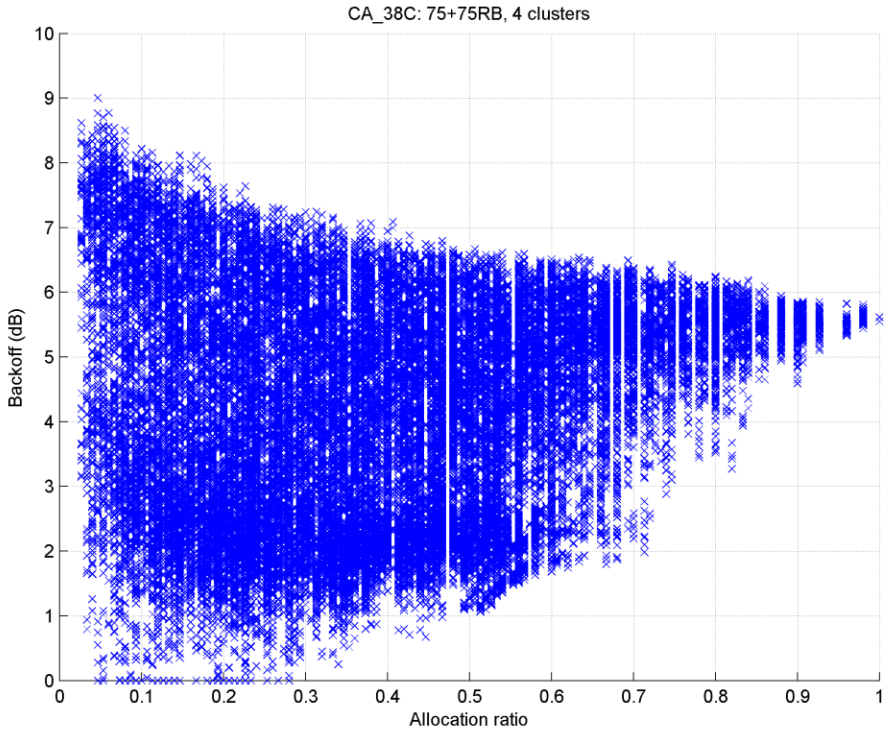

Figure A.3.3-4: Required backoff with 75+75RB configuration, 4 clusters

Based on the large amount of simulated allocations the A-MPR mask illustrated in Figure 5 is proposed.

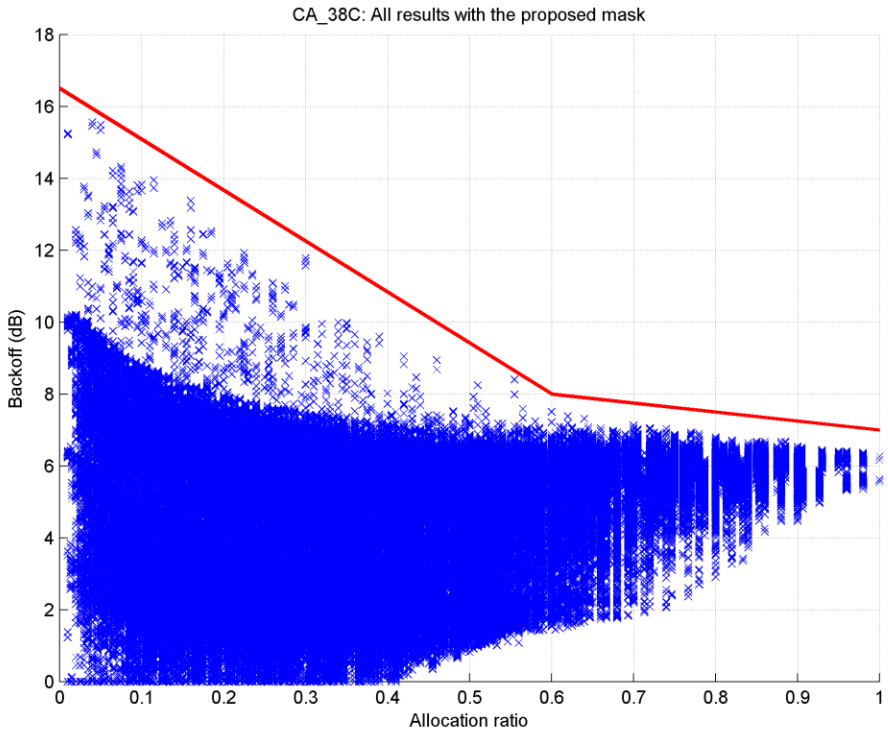

Figure A4.2-5: All simulation results with the proposed A-MPR mask

A.4 A-MPR simulation results 2

A.4.1 Simulation results for contiguous RB allocations

Simulation Assumptions:

1. PA nonlinearity for 20MHz+20MHz is calibrated as UTRA/ACLR@33dBc for 20MHz channel bandwidth @22dBm with full RB allocation. PA nonlinearity for 15MHz+15MHz is calibrated as UTRA/ACLR@33dBc for 15MHz channel bandwidth @22dBm with full RB allocation.

   The tuning step for UE output power is 0.5dB.

2. The I/Q modulator is calibrated following the generic RAN4 assumptions:

   LO leakage @ 25dBc

   Image leakage @ 25dBc

   Counter IM3 @ 60dBc

Simulation Results:

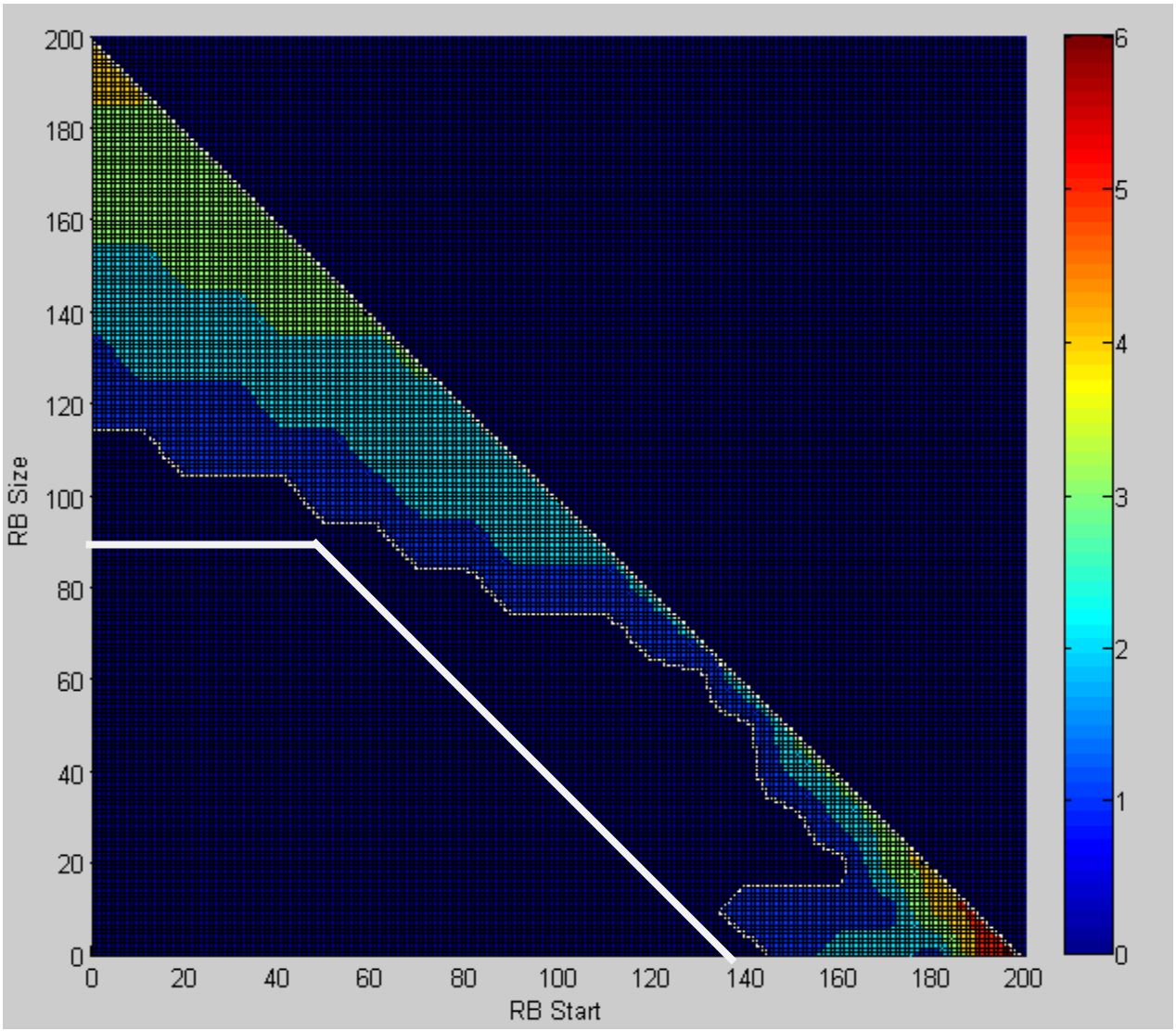

Figure A.4.1-1: QPSK transmission for 20MHz+20MHz

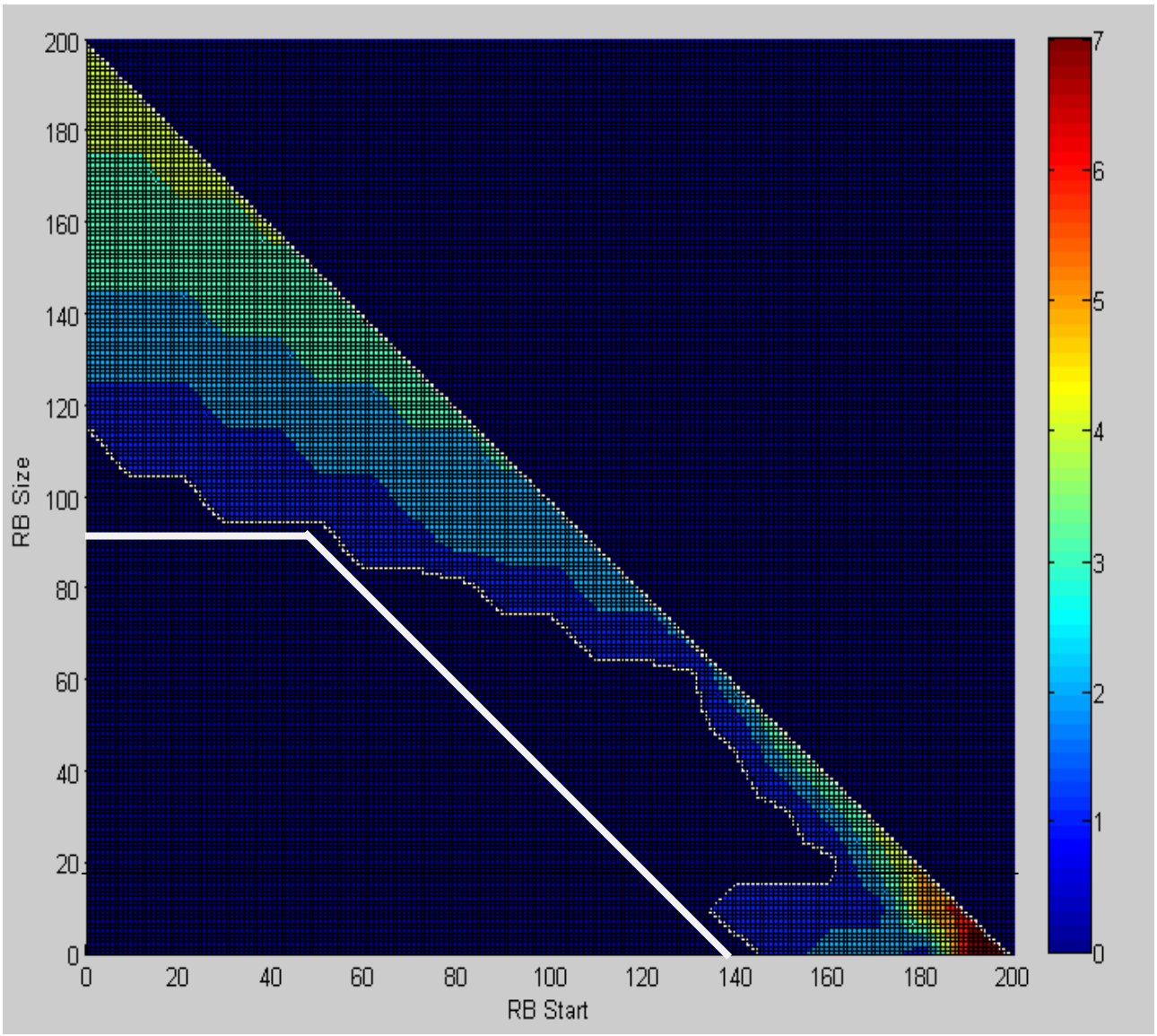

Figure A.4.1-2: QAM16 transmission for 20MHz+20MHz

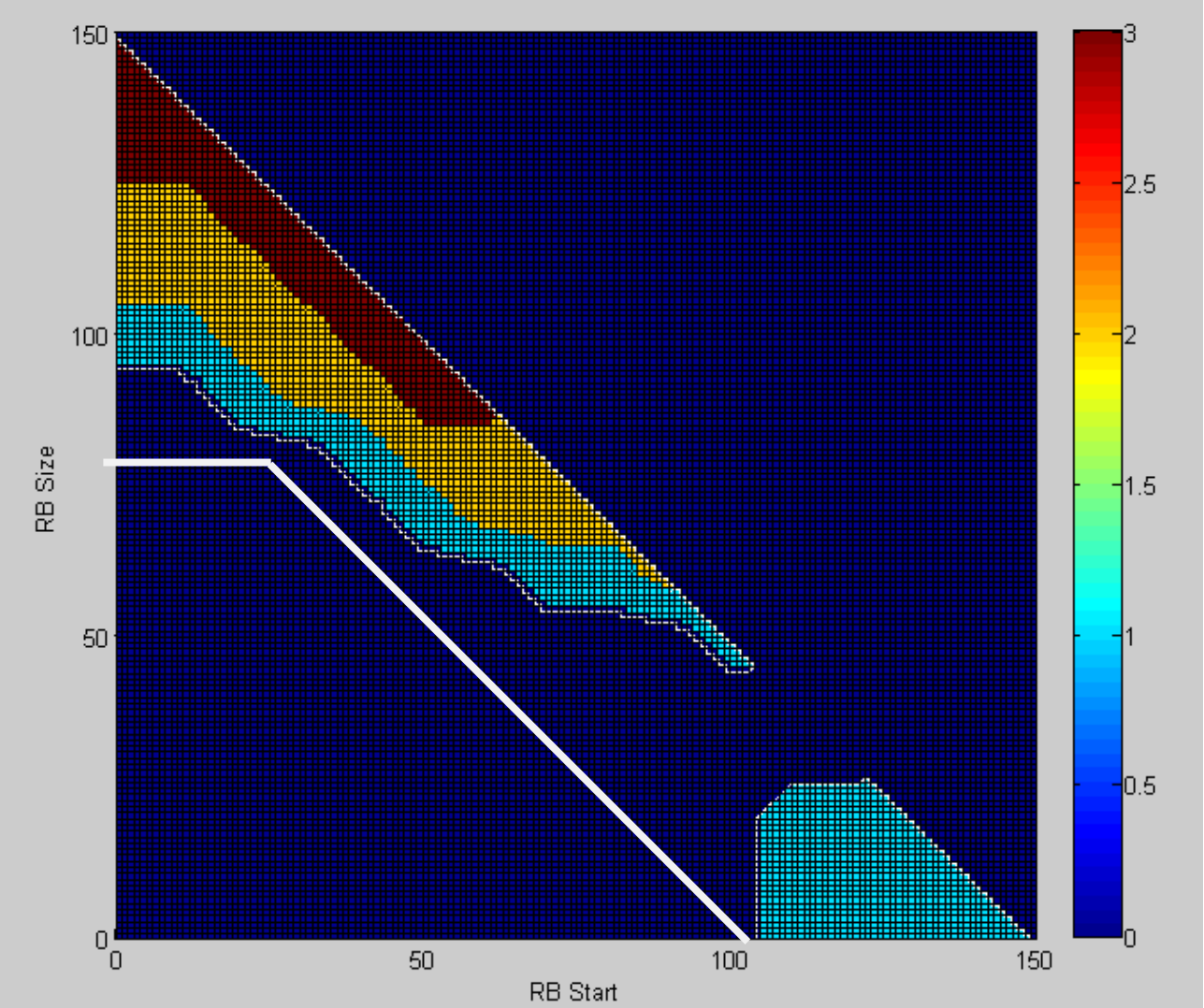

Figure A.4.1-3: QPSK transmission for 15MHz+15MHz

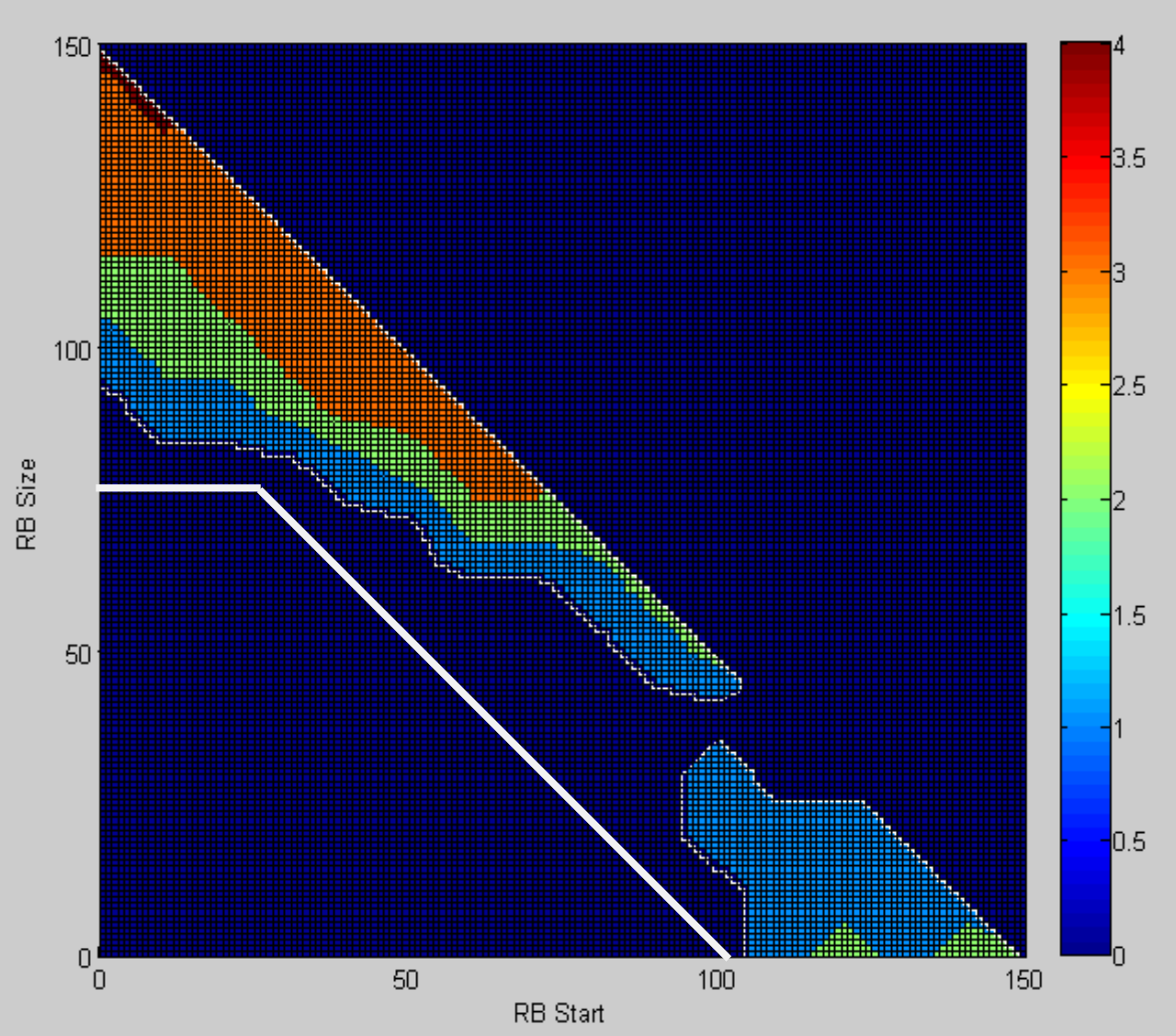

Figure A.4.1-4: QAM16 transmission for 15MHz+15MHz

A.4.2 Simulation results for cluster RB allocations

Simulation Assumptions:

1. PA nonlinearity for 20MHz+20MHz is calibrated as UTRA/ACLR@33dBc for 20MHz channel bandwidth @22dBm with full RB allocation. PA nonlinearity for 15MHz+15MHz is calibrated as UTRA/ACLR@33dBc for 15MHz channel bandwidth @22dBm with full RB allocation.

   The tuning step for UE output power is 0.5dB.

2. The I/Q modulator is calibrated following the generic RAN4 assumptions:

   LO leakage @ 25dBc

   Image leakage @ 25dBc

   Counter IM3 @ 60dBc

Simulation Results:

Figure A.4-1 is a simple comparison of the cluster transmission for 15MHz+15MHz and 20MHz+20MHz. The key difference is the IMD3 products for 20MHz+20MHz fall into the frequency zone governed by the -40dBm/MHz requirements, while the IMD3 products for 15MHz+15MHz is governed by the -15.5dBm/5MHz requirements. The A-MPR values required for 20MHz+20MHz are much higher than 15MHz+15MHz.

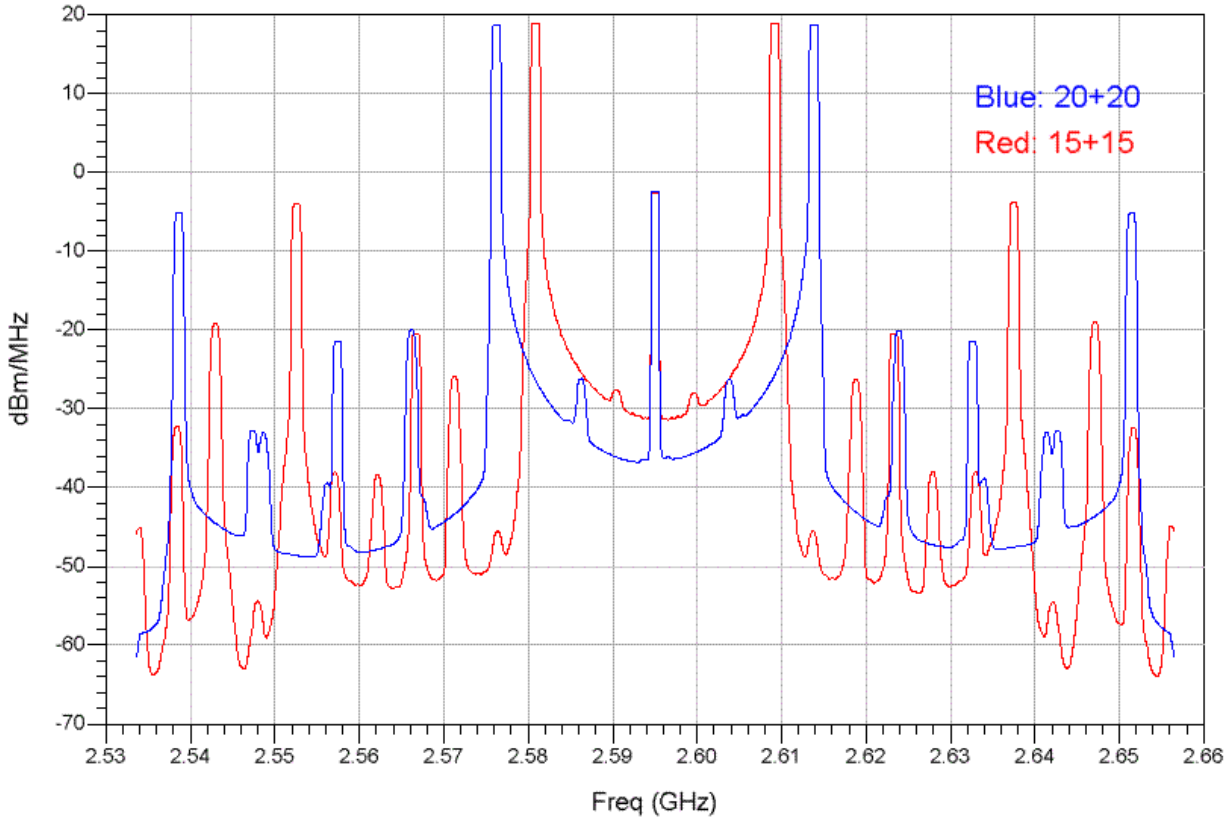

Figure A.4.2-1: A comparison of cluster transmission for 20MHz+20MHz and 15MHz+15MHz

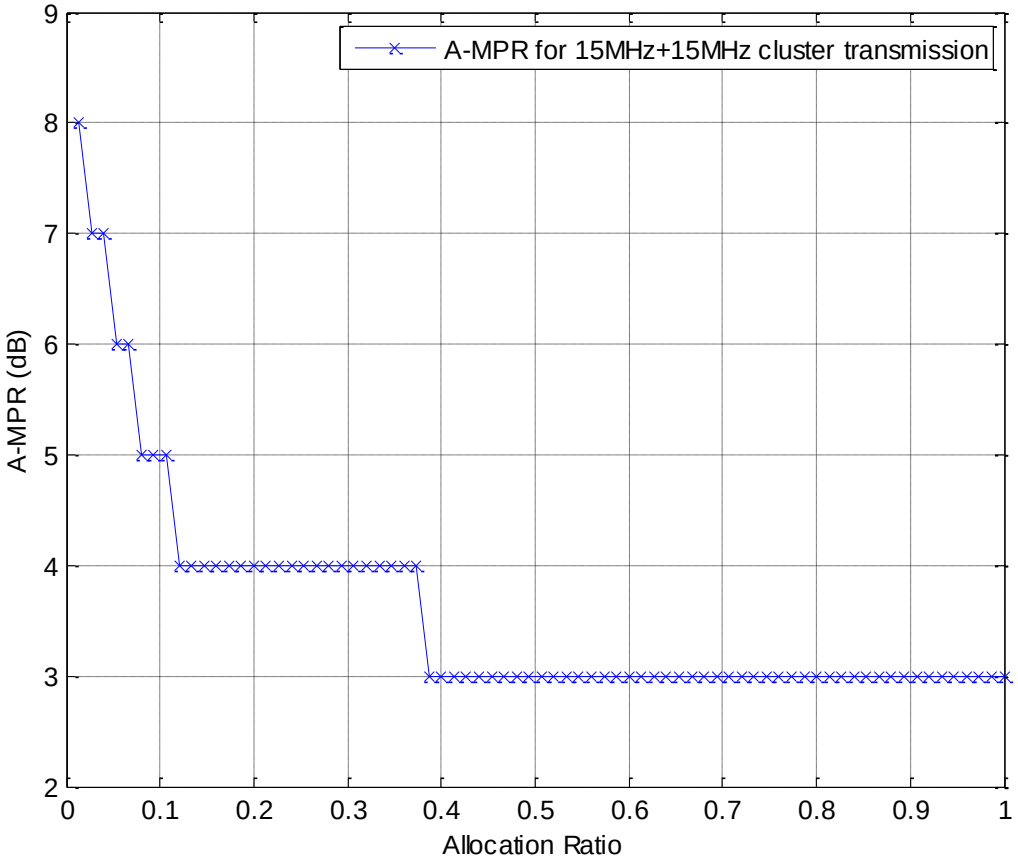

Figure A.4.2-2: A-MPR required for 15MHz+15MHz

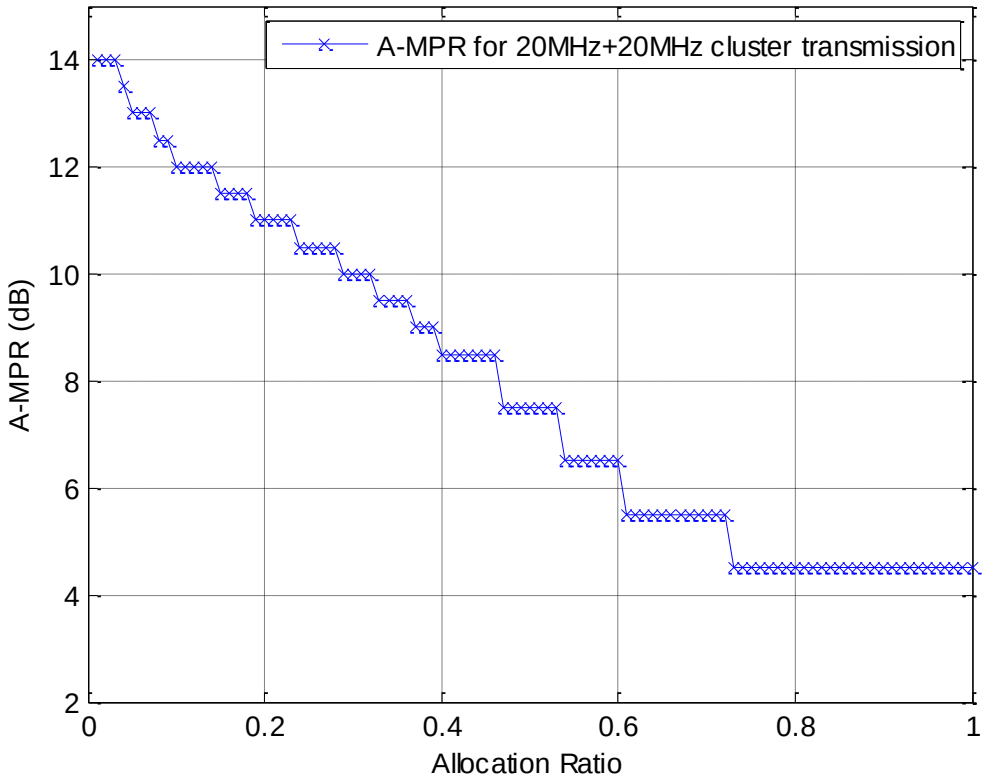

Figure A.4.2-3: A-MPR required for 20MHz+20MHz

Annex B:
Change history

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
2011-06	RAN4#59AH	R4-113755			Skeleton	N/A	0.0.1
2011-08	RAN4 #60	R4-114478			Text proposals in the following contributions are implemented: R4-114477: Band 38 spectrum and regulation review for CA 38 R4-114158: Text proposals on operating bands and channel bandwidth for CA_38	0.0.1	0.1.0
2011-11	RAN4 #61	R4-116016			Text proposals in the following contributions are implemented: R4-115147 Text proposal of require changes to BS RF requirements for B38 CA R4-115203 Text proposal on UE SEM for CA_38	0.1.0	0.2.0
2012-03	RAN4#62bis	R4-121926			Text proposals in the following contributions are implemented: R4-120217, Coexistence simulation results in non-CA case R4-120219, Required changes to TS36.101 R4-120220, Text proposal: Required changes to TS36.307 R4-120221, Text proposal: E-UTRA RRM requirements for UE R4-120224, Demodulation performance requirements for CA in Band 38 R4-120553, Text proposal on UE minimum output power for CA_38 R4-120554, Text proposal on UE transmit off power for CA_38 R4-120981, TP Coexistence simulation results in CA	0.2.0	0.3.0
2012-05	RAN4#63	R4-122575			Text proposals in the following contributions are implemented: R4-122067, TP for TR36830 for CA38: conclusion on the coexistence with adjacent band R4-122093, TP for CA38: B7/38 coexistence for CA R4-122094, Text proposal on UE receiver characteristics for CA in Band 38	0.3.0	0.4.0
2012-08	RAN4#64	R4-123938			Text proposals in the following contributions are implemented: R4-124974	0.4.0	0.5.0
2012-09	RAN#57	RP-121255			Presentation of the report to TSG RAN for approval	0.5.0	1.0.0
2012-09	RAN#57				Report approved at TSG-RAN and placed under change control	1.0.0	11.0.0
2012-12	RAN#58	RP-121886	0001		CR to capture the simulation results of A-MPR to TR36.830	11.0.0	11.1.0