3GPP TR 38.873 V16.0.0 (2019-06)

Technical Report

3rd Generation Partnership Project;
Technical Specification Group Radio Access Network;
Time Division Duplex (TDD) operating band in Band n48;
(Release 16)

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

Contents

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 the work item of TDD operating band in Band n48.

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-182865, "New WID on introduction of n48"

3   Definitions and abbreviations

3.1   Definitions

For the purposes of the present document, the terms and definitions given in 3GPP 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 3GPP TR 21.905 [1].

3.2   Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP 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 3GPP TR 21.905 [1].

A-MPR	Additional Maximum Power Reduction
BS	Base Station
CA	Carrier Aggregation
CBRS	Citizens Broadband Radio Service
CBSD	Citizens Broadband Radio Service Device
DC	Dual Connectivity
DL	Downlink
GSCN	Global Synchronization Channel Number
EUD	End User Device
E-UTRA	Evolved UTRA
NR	New Radio
NR-ARFCN	NR Absolute Radio Frequency Channel Number
NS	Network Signalling
PC3	Power Class 3
REFSENS	Reference Sensitivity
SCS	Subcarrier Spacing
SS	Synchronization Symbol
TDD	Time Division Duplex
UE	User Equipment
UL	Uplink

| UMTS	Universal Mobile Telecommunications System
UTRA	UMTS Terrestrial Radio Access

4 Background

On April 21st 2015, the FCC released a Report and Order (R&O) and Second Further Notice of Proposed Rulemaking (Second FNPRM) to establish new rules for commercial use of the 3550-3700 MHz band. This framework creates a contiguous 150 MHz block at 3550 – 3700 MHz (3.5 GHz) for mobile broadband that FCC calls "Citizens Broadband Radio Service (CBRS)" and regulated under new Part 96 of FCC's Rules. On May 2nd 2016, a second R&O and Order on Reconsideration was released by FCC to finalize the rules. On October 24, 2018, the FCC released an Order revising the licensing and technical rules in the CBRS band.

The objective of the Work Item is to specify a new NR TDD operating band (3550 – 3700 MHz) with support of the following SCS and bandwidths (for PC3 power class only):

NR Band	SCS kHz	5 MHz	10 MHz	15 MHz	20 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz
n48	15	Yes	Yes	Yes	Yes	Yes	Yes[1]				
	30		Yes	Yes	Yes	Yes	Yes[1]	Yes[1]	Yes[1]	Yes[1]	Yes[1]
	60		Yes	Yes	Yes	Yes	Yes[1]	Yes[1]	Yes[1]	Yes[1]	Yes[1]
Note 1: This UE channel bandwidth is applicable only to DL											
Note 2: Only symmetric UL/DL bandwidths are defined for non-CA operation											

5 Frequency band arrangements and regulatory background

The 3550 – 3700 MHz band plan is shown in Figure 5.1. The adjacent 3700 – 4200 MHz band is used by C-Band Fixed Satellite Services Earth Stations. On the lower side, the band 3100-3550MHz is used by US Department of Defense (DoD) for operating various types of shipborne, land-based, and aeronautical mobile radar systems.
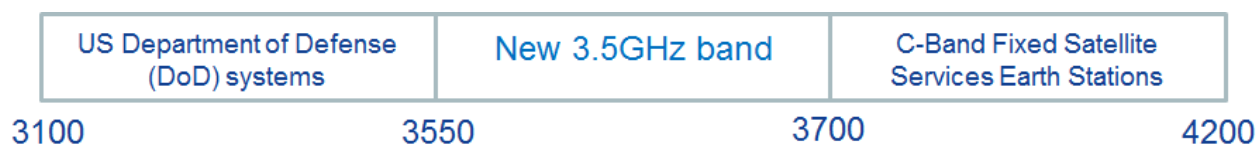
Figure 5.1: Band plan

Summary of the FCC's rules relevant to RAN4 work to define a new band for US 3.5GHz band are provided below:

3.5 GHz Emissions and Interference Limits:

(1) *General protection levels.* Except as otherwise specified below, for CBSD channel and frequency assignments, the conducted power of any CBSD emission outside the fundamental emission (whether in or outside of the authorized band) shall not exceed -13 dBm/MHz within 0-10 megahertz above the upper assigned channel edge and within 0-10 megahertz below the lower assigned channel edge. At all frequencies greater than 10 megahertz above the upper assigned channel edge and less than 10 MHz below the lower assigned channel edge, the conducted power of any CBSD emission shall not exceed -25 dBm/MHz. The upper and lower assigned channel edges are the upper and lower limits of any channel assigned to a CBSD, or in the case of multiple contiguous channels, the upper and lower limits of the combined contiguous channels.

For channel and frequency assignments made by a CBSD to End User Devices, the conducted power of any End User Device emission outside the fundamental emission (whether in or outside of the authorized band) shall not exceed -13 dBm/MHz within 0 to B megahertz (where B is the bandwidth in megahertz of the assigned channel or multiple contiguous channels of the End User Device) above the upper CBSD-assigned channel edge and within 0 to B megahertz below the lower CBSD-assigned channel edge. At all frequencies

greater than B megahertz above the upper CBSD assigned channel edge and less than B megahertz below the lower CBSD-assigned channel edge, the conducted power of any End User Device emission shall not exceed -25 dBm/MHz. Notwithstanding the emission limits in this paragraph, the Adjacent Channel Leakage Ratio for End User Devices shall be at least 30 dB.

(2) *Addi*tional protection levels: the conducted power of emissions below 3540 MHz or above 3710 MHz shall not exceed -25 dBm/MHz, and the conducted power of emissions below 3530 MHz or above 3720 MHz shall not exceed -40dBm/MHz.
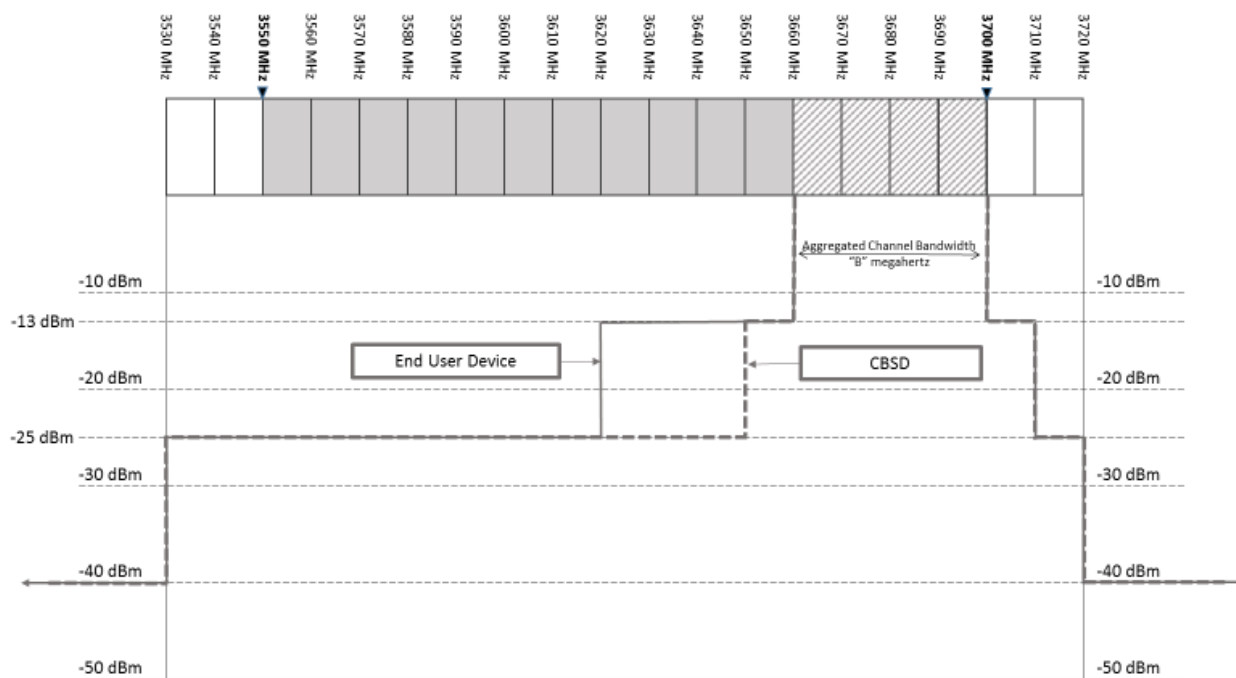
Figure 5.2: CBSD & EUD Emission Limits

(3) *Measurement procedure*:

(i) Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee's authorized frequency channel, a resolution bandwidth of no less than one percent of the fundamental emission bandwidth may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full reference bandwidth (*i.e.*, 1 MHz or 1 percent of emission bandwidth, as specified). The fundamental emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

6 Operating band, channel bandwidths, channel numbering

5.2 Operating bands

Because in this case E-UTRA band 48 is re-farmed the band number is re-used.

NR operating band	Uplink (UL) *operating band* BS receive / UE transmit F_{UL_low} – F_{UL_high}	Downlink (DL) *operating band* BS transmit / UE receive F_{DL_low} – F_{DL_high}	Duplex Mode
n41	2496 MHz – 2690 MHz	2496 MHz – 2690 MHz	TDD
n48	3550 MHz – 3700 MHz	3550 MHz – 3700 MHz	TDD

5.3 UE channel bandwidth

From the WID we can determine the Channel bandwidths. Channel bandwidth of 5 MHz can be used only as a part of DC or CA-configuration as it is not discoverable in initial acquisition because the synchronization raster does not support 15 kHz. Channel bandwidths of 50 MHz – 100 MHz are listed in WID as applicable only for DL. Furthermore, the WID states that only symmetric UL/DL bandwidths are defined for non-CA operation, therefore channel bandwidths of 50 MHz – 100 MHz can be used only as Scell in CA-configuration.

NR band / SCS / UE Channel bandwidth													
NR Band	SCS kHz	5 MHz	10[1,2] MHz	15[2] MHz	20[2] MHz	25[2] MHz	30 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz
n41	15		Yes	Yes	Yes			Yes	Yes				
	30		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes
	60		Yes	Yes	Yes			Yes	Yes	Yes	Yes	Yes	Yes
n48	15	Yes[4]	Yes	Yes	Yes			Yes	Yes[5]				
	30		Yes	Yes	Yes			Yes	Yes[5]	Yes[5]	Yes[5]	Yes[5]	Yes[5]
	60		Yes	Yes	Yes			Yes	Yes[5]	Yes[5]	Yes[5]	Yes[5]	Yes[5]
NOTE 3: This UE channel bandwidth is applicable only to downlink.													
NOTE 4: For this bandwidth, the minimum requirements are restricted to operation when carrier is configured as an Scell part of DC or CA configuration.													
NOTE 5: For this bandwidth, the minimum requirements are restricted to operation when carrier is configured as an downlink SCell part of CA configuration													

5.4.2.1 NR-ARFCN and channel raster

Table 5.4.2.3-1: Applicable NR-ARFCN per operating band

NR Operating Band	ΔF_{Raster} (kHz)	Uplink Range of N_{REF} (First – <Step size> – Last)	Downlink Range of N_{REF} (First – <Step size> – Last)
n41	15	499200 – <3> – 537999	499200 – <3> – 537999
	30	499200 – <6> – 537996	499200 – <6> – 537996
n48	15	636667 – <1> – 646666	636667 – <1> – 646666
	30	636668 – <2> – 646666	636668 – <2> – 646666

5.4.3.1 Synchronization raster and numbering

Table 5.4.3.3-1: Applicable SS raster entries per operating band

NR Operating Band	SS Block SCS	SS Block pattern[1]	Range of GSCN (First – <Step size> – Last)
n41	15kHz	Case A	6246 – <3> – 6717
	30 kHz	Case C	6252 – <3> – 6714
n48	30 kHz	Case C	7884 – <1> – 7982

7 Study of UE and BS requirements

7.1 UE requirements

6.2.1 UE maximum output power

This work-item is for PC3 power class only. Tolerances are copied from E-UTRA band 48.

Table 6.2.1-1: UE Power Class

NR band	Class 1 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)
n41			26	+2/-3[3]	23	±2[3]
n48					23	+2/-3

6.2.3 UE additional maximum output power reduction

NS- signalling is needed due to FCC emission requirements. NS_27 is copied from E-UTRA band 48. NS_100 or NS_27U is not needed as UTRA is not deployed in this band.

Table 6.2.3.1-1: Additional maximum power reduction (A-MPR)

Network Signalling label	Requirements (subclause)	NR Band	Channel bandwidth (MHz)	Resources Blocks (N_{RB})	A-MPR (dB)
NS_27	6.5.2.3.8 6.5.3.3.10	n48	5, 10, 15, 20, 40	Table 6.2.3.15-1	Table 6.2.3.15-2
NOTE 1: This NS can be signalled for NR bands that have UTRA services deployed					
NOTE 2: No A-MPR is applied for 5 MHz CBW where the lower channel edge is ≥ 1930 MHz, 10 MHz CBW where the lower channel edge is ≥ 1950 MHz and 15 MHz CBW where the lower channel edge is ≥ 1955 MHz.					
NOTE 3: Applicable when the NR carrier is within 1447.9 – 1462.9 MHz					

Table 6.2.3.1-1A: Mapping of Network Signaling label

NR band	Value of additionalSpectrumEmission							
	0	1	2	3	4	5	6	7
n41	NS_01	NS_04						
n48	NS_01	NS_27						
NOTE: *additionalSpectrumEmission* corresponds to an information element of the same name defined in sub-clause 6.3.2 of TS 38.331 [7].								

6.2.3.15 A-MPR for NS_27

A-MPR studies are presented in clause 7.1.1 of present contribution.

Following A-MPR definition was agreed.

Table 6.2.3.15-1: A-MPR for NS_27

Channel Bandwidth, MHz	Carrier Centre Frequency, Fc, MHz	Region A				Region B	
		RBstart*12*SCS	RBend*12*SCS	LCRB*12*SCS	A-MPR	LCRB*12*SCS	A-MPR
5 MHz	3552.5 ≤ F_C ≤ 3697.5						
10 MHz	3555 ≤ F_C ≤ 3695						
15 MHz	3557.5 ≤ F_C < 3562.5	<1.8MHz			A3		
	3687.5 < F_C ≤ 3692.5	>11.52 MHz					
15 MHz	3562.5 ≤ F_C ≤ 3687.5	Note 1	Note 2	<1.44MHz	A4		

Channel Bandwidth, MHz	Carrier Centre Frequency, Fc, MHz	Region A				Region B	
		RBstart*12* SCS	RBend*12* SCS	LCRB*12* SCS	A-MPR	LCRB*12* SCS	A-MPR
20 MHz	3560 ≤ F$_C$ < 3570	<3.6MHz			A5		
	3680 < F$_C$ ≤ 3690	>12.96MHz					
20 MHz	3570 ≤ F$_C$ ≤ 3680	Note 1	Note 2	<1.44MHz	A6		
40 MHz	3570 ≤ F$_C$ < 3600	<11.34M			A7		
			>31.0MHz	<1.8MHz			
	3650 < F$_C$ ≤ 3680	>24.48MHz					
			<6.48MHz	<1.8MHz			
40 MHz	3600 ≤ F$_C$ ≤ 3650	Note 1	Note 2	<1.44MHz	A8	>[20]MHz	[2]
NOTE 1: <[(3530M-Fc)+5*BW/2]/5, Fc<3567.5M for BW=15M, Fc<3580M for BW=20M, Fc<3625M for BW=40M							
NOTE 2: >[(Fc-3720M)+5*BW/2]/5, Fc>3682.5M for BW=15M, Fc>3670M for BW=20M, Fc>3625M for BW=40M							

Table 6.2.3.15-2: A-MPR for modulation and waveform type

Modulation/Waveform		A1	A2	A3	A4	A5	A6	A7	A8
		Outer	Outer/Inner	Outer/Inner	Outer/Inner	Outer/Inner	Outer/Inner	Outer/Inner	Outer/Inner
DFT-s-OFDM	PI/2 BPSK			4	4	4	4	10.5	4
	QPSK			4	4	4	4	10.5	4
	16 QAM			5	4	5	4	11	4
	64 QAM			5	4	5	4	11	4
	256 QAM							11	
CP-OFDM	QPSK			6	4	6	4	11.5	4
	16 QAM			6	4	6	4	11.5	4
	64 QAM			6	4	6	4	11.5	4
	256 QAM							11.5	
NOTE 1: The backoff applied is max (MPR, A-MPR) where MPR is defined in Table 6.2.2-1									
NOTE 2: Outer and inner allocations are defined in clause 6.2.2									

6.5.2.3 Additional spectrum emission mask

6.5.2.3.8 Requirements for network signalled value "NS_27"

Following the FCC requirements additional spectrum emission mask is defined as follows.

Table 6.5.2.3.8-1: Additional requirements for "NS_27"

Spectrum emission limit (dBm) / measurement bandwidth for each channel bandwidth						
Δf$_{OOB}$ MHz	5 MHz	10 MHz	15 MHz	20 MHz	40 MHz	Measurement bandwidth
± 0 - 1	-13					1 % channel bandwidth
± 1 - X	-13					1 MHz
< – X or > X when 3540 MHz < Δf$_{OOB}$ < 3710 MHz	-25					
NOTE: X is occupied channel bandwidth as defined in Table 6.5.1-1						

6.5.3.3 Additional spurious emissions

6.5.3.3.9 Requirement for network signalled value "NS_27"

Following the FCC requirements additional spurious emissions is defined as follows.

Table 6.5.3.3.9-1: Additional requirements

Frequency range (MHz)	Channel bandwidth / Spectrum emission limit (dBm) 5, 10, 15, 20, 40 MHz	Measurement bandwidth
9 kHz – 3530 MHz	-40	1 MHz
3530 MHz – 3540 MHz	-25	
3710 MHz – 3720 MHz	-25	
3720 MHz – 12.75 GHz	-40	

7.3.2 Reference sensitivity power level

n77 and n78 REFSENS is used to allow co-banding. Channel bandwidths larger than 40 MHz can be used only in CA as these bandwidths are DL-only therefore the REFSENS can also only be verified in CA mode.

Table 7.3.2-1: Two antenna port reference sensitivity QPSK PREFSENS

		Operating band / SCS / Channel bandwidth / Duplex-mode												
Operating Band	SCS kHz	5 MHz (dBm)	10 MHz (dBm)	15 MHz (dBm)	20 MHz (dBm)	25 MHz (dBm)	30 MHz (dBm)	40 MHz (dBm)	50 MHz (dBm)	60 MHz (dBm)	80 MHz (dBm)	90 MHz (dBm)	100 MHz (dBm)	Duplex Mode
n41[1]	15		-94.8	-93.0	-91.8			-88.6	-87.6					TDD
	30		-95.1	-93.1	-92.0			-88.7	-87.7	-86.9	-85.6	-85.1	-84.7	
	60		-95.5	-93.4	-92.2			-88.9	-87.8	-87.1	-85.6	-85.1	-84.7	
n48[1]	15	-99	-95.8	-94.0	-92.7			-89.6	-88.6[4]					TDD
	30		-96.1	-94.1	-92.9			-89.7	-88.7[4]	-87.9[4]	-86.6[4]	-86.1[4]	-85.6[4]	
	60		-96.5	-94.4	-93.1			-89.9	-88.8[4]	-88.0[4]	-86.7[4]	-86.2[4]	-85.7[4]	
NOTE 1: Four Rx antenna ports shall be the baseline for this operating band except for two Rx vehicular UE.														
NOTE 4: For these bandwidths, the minimum requirements are restricted to operation when carrier is configured as an downlink carrier part of CA configuration														

For UE(s) equipped with 4 Rx antenna ports, reference sensitivity for 2Rx antenna ports in Table 7.3.2-1 shall be modified by the amount given in $\Delta R_{IB,4R}$ in Table 7.3.2-2 for the applicable operating bands.

Operating band	$\Delta R_{IB,4R}$ (dB)
n1, n2, n3, n40, n7, n34, n38, n39, n41, n66, n70	-2.7
n48, n77, n78, n79	-2.2

The reference receive sensitivity (REFSENS) requirement specified in Table 7.3.2-1 and Table 7.3.2-2 shall be met for an uplink transmission using QPSK DFT-s-OFDM waveforms and for uplink transmission bandwidth less than or equal to that specified in Table 7.3.2-3.

Table 7.3.2-3: Uplink configuration for reference sensitivity

Operating band / SCS / Channel bandwidth / Duplex mode														
Operating Band	SCS kHz	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	80 MHz	90 MHz	100 MHz	Duplex Mode
n41	15		50	75	100			216	270					TDD
	30		24	36	50			100	128	162	216	243	270	
	60		10	18	24			50	64	75	100	120	135	
n48	15	25	50	75	100			216						TDD
	30		24	36	50			100						
	60		10	18	24			50						
n50	15	25	50	75	100			216	270					TDD
	30		24	36	50			100	128	162	NOTE 3			
	60		10	18	24			50	64	75	NOTE 3			

NOTE 1: [1] Refers to the UL resource blocks shall be located as close as possible to the downlink operating band but confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.3.2-1).

NOTE 2: [2] refers to Band 20; for 15 kHz SCS, in the case of 15 MHz channel bandwidth, the UL resource blocks shall be located at RB_{start} 11 and in the case of 20 MHz channel bandwidth, the UL resource blocks shall be located at RB_{start} 16; for 30 kHz SCS, in the case of 15 MHz channel bandwidth, the UL resource blocks shall be located at RB_{start} 6 and in the case of 20 MHz channel bandwidth, the UL resource blocks shall be located at RB_{start} 8; for 60 kHz SCS, in the case of 15 MHz channel bandwidth, the UL resource blocks shall be located at RB_{start} 3 and in the case of 20 MHz channel bandwidth, the UL resource blocks shall be located at RBstart 4;

NOTE 3: For DL channel bandwidths that do not have symmetric UL channel bandwidth, highest valid UL configuration with lowest duplex distance shall be used.

Unless given by Table 7.3.2-4, the minimum requirements specified in Tables 7.3.2-1 and 7.3.2-2 shall be verified with the network signalling value NS_01 (Table 6.2.3-1) configured.

Table 7.3.2-4: Network signaling value for reference sensitivity

Operating band	Network Signalling value
n2	NS_03
n12	NS_06
n25	NS_03
n48	NS_27
n66	NS_03
n70	NS_03
n71	NS_35

7.6.2 In-band blocking

n48 is added into in-band blocking table.

Table 7.6.2-4: In-band blocking for NR bands with $F_{DL\_low} \geq 3300$ MHz and $F_{UL\_low} \geq 3300$ MHz

NR band	Parameter	Unit	Case 1	Case 2
n48, n77, n78, n79	$P_{interferer}$	dBm	-56	-44
	$F_{interferer}$ (offset)	MHz	-CBW/2 – $F_{Ioffset, case 1}$ and BW/2 + $F_{Ioffset, case 1}$	≤ -CBW/2 – $F_{Ioffset, case 2}$ and ≥ CBW/2 + $F_{Ioffset, case 2}$
	$F_{interferer}$		NOTE 2	F_{DL_low} − 3CBW to F_{DL_high} + 3CBW
NOTE 1:	The absolute value of the interferer offset Finterferer (offset) shall be further adjusted to $\left(\left\lceil |F_{interferer}| / SCS \right\rceil + 0.5\right) SCS$ MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with an SCS equal to that of the wanted signal.			
NOTE 2:	For each carrier frequency, the requirement applies for two interferer carrier frequencies: a: -CBW/2 – $F_{Ioffset, case 1}$; b: CBW/2 + $F_{Ioffset, case 1}$			
NOTE 3:	CBW denotes the channel bandwidth of the wanted signal			

7.6.3 Out-of-band blocking

n48 is added into out-of-band blocking table. Note 3 is assigned to band 48 to allow usage of n77/n78 filter. Same approach is used in E-UTRA to allow band 48 share filter with bands 42 and 43.

Table 7.6.3-4: Out of-band blocking for NR bands with $F_{DL\_low} \geq 3300$ MHz and $F_{UL\_low} \geq 3300$ MHz

NR band	Parameter	Unit	Range1	Range 2	Range 3
n48, n77, n78 (NOTE 3)	$P_{interferer}$	dBm	-44	-30	-15
	$F_{interferer}$ (CW)	MHz	-60 < f − F_{DL_low} ≤ -3CBW or 3CBW ≤ f − F_{DL_high} < 60	-200 < f − F_{DL_low} ≤ -MAX(60,3CBW) or MAX(60,3CBW) ≤ f − F_{DL_high} < 200	1 ≤ f ≤ F_{DL_low} − MAX(200,3CBW) or F_{DL_high} + MAX(200,3CBW) ≤ f ≤ 12750
n79 (NOTE 4)	$F_{interferer}$ (CW)	MHz	N/A	-150 < f − F_{DL_low} ≤ -MAX(60,3CBW) or MAX(60,3CBW) ≤ f − F_{DL_high} < 150	1 ≤ f ≤ F_{DL_low} − MAX(150,3CBW) or F_{DL_high} + MAX(150,3CBW) ≤ f ≤ 12750
NOTE 1:	The power level of the interferer ($P_{Interferer}$) for Range 3 shall be modified to -20 dBm for $F_{Interferer}$ > 6000 MHz.				
NOTE 2:	CBW denotes the channel bandwidth of the wanted signal				
NOTE 3:	The power level of the interferer ($P_{Interferer}$) for Range 3 shall be modified to -20 dBm, for $F_{Interferer}$ > 2700 MHz and $F_{Interferer}$ < 4800 MHz. For CBW > 15 MHz, the requirement for Range 1 is not applicable and Range 2 applies from the frequency offset of 3CBW from the band edge. For CBW larger than 60 MHz, the requirement for Range 2 is not applicable and Range 3 applies from the frequency offset of 3CBW from the band edge.				
NOTE 4:	The power level of the interferer ($P_{Interferer}$) for Range 3 shall be modified to -20 dBm, for $F_{Interferer}$ > 3650 MHz and $F_{Interferer}$ < 5750 MHz. For CBW ≥ 40 MHz, the requirement for Range 2 is not applicable and Range 3 applies from the frequency offset of 3CBW from the band edge.				

7.1.1 A-MPR

7.1.1.1 Vendor A

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

A-MPR concept and results

FCC 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.
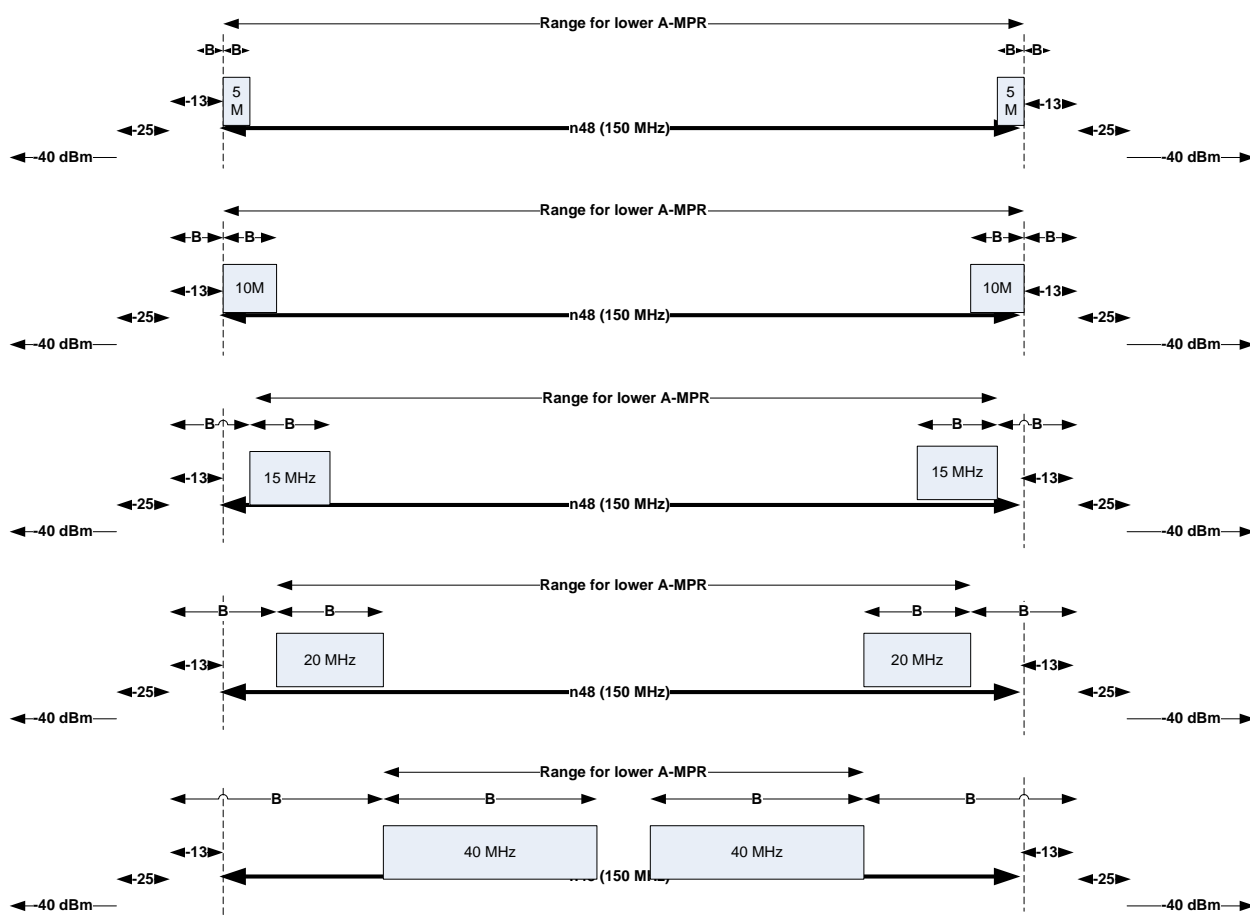

Figure 7.1.1.1-1: Two different A-MPRs per CH BW

Based on concept presented in Figure 7.1.1.1-1 we provide simulation results in Tables 7.1.1.1-1 and 7.1.1.1-2 below. Total UE output power backoff is max(MPR, A-MPR).

Table 7.1.1.1-1: A-MPR regions for n48

Channel Bandwidth, MHz	Carrier Centre Frequency, Fc, MHz	A-MPR
5 MHz	$3552.5 \leq F_C \leq 3697.5$	A1
10 MHz	$3555 \leq F_C \leq 3695$	A2
15 MHz	$3557.5 \leq F_C < 3562.5$ $3687.5 < F_C \leq 3692.5$	A3
15 MHz	$3562.5 \leq F_C < 3687.5$	A4
20 MHz	$3560 \leq F_C < 3570$ $3680 < F_C \leq 3690$	A5
20 MHz	$3570 \leq F_C < 3680$	A6
40 MHz	$3570 \leq F_C < 3600$ $3650 < F_C \leq 3680$	A7
40 MHz	$3600 \leq F_C < 3650$	A8

Table 7.1.1.1-2: n48 A-MPR

		5 MHz Edge		10 MHz Edge		15 MHz Edge		15 MHz Center	
		A1		A2		A3		A4	
		Outer	Inner	Outer	Inner	Outer	Inner	Outer	Inner
SC-FDMA	pi/2-BPSK	-	-	-	-	1,5	1,5	-	-
	QPSK	-	-	-	-	3	2	-	-
	16QAM	-	-	-	-	3	2,5	-	-
	64QAM	-	-	-	-	3	-	-	-
	256QAM	-	-	-	-	-	-	-	-
OFDMA	QPSK	-	-	-	-	4	3	-	-
	16QAM	-	-	-	-	4	3	-	-
	64QAM	-	-	-	-	4	-	-	-
	256QAM	-	-	-	-	-	-	-	-
		20 MHz Edge		20 MHz Center		40 MHz Edge		40 MHz Center	
		A5		A6		A7		A8	
		Outer	Inner	Outer	Inner	Outer	Inner	Outer	Inner
SC-FDMA	pi/2-BPSK	3	1,5	-	-	8	8	1	-
	QPSK	3,5	2	2	-	8	8	2	-
	16QAM	4,5	2,5	-	-	8,5	8,5	2,5	-
	64QAM	4,5	-	-	-	8	8,5	-	-
	256QAM	5	-	-	-	8	8,5	-	-
OFDMA	QPSK	6	3,5	-	-	8,5	8,5	-	-
	16QAM	6	3,5	-	-	8,5	9	-	-
	64QAM	6	-	-	-	8,5	9	-	-
	256QAM	-	-	-	-	8,5	8	-	-

As can be seen from results presented in Table 7.1.1.1-2 our results indicate there is no need to specify A-MPR for A1, A2, A4, A6 inner and A8 inner scenarios. A-MPR needed for A6 and A8 outer allocations is limited to only few

modulations. For A5 there is an A-MPR need for many modulations but additive backoff compared to MPR is 1.5 – 3 dB. A8 requires always substantial A-MPR.

7.2 BS requirements

The following BS specific 38.104 changes are expected due to introduction of Band n48:

6.6.4.2.1 Basic limits for Wide Area BS (Category A)

For BS operating in Bands n1, n2, n3, n7, n25, n34, n38, n39, n40, n41, n48, n50, n65, n66, n70, n74, n75, n77, n78, n79, *basic limits* are specified in table 6.6.4.2.1-2:

Table 6.6.4.2.1-2: Wide Area BS *operating band* unwanted emission limits (NR bands above 1 GHz) for Category A

Frequency offset of measurement filter -3dB point, Δf	Frequency offset of measurement filter centre frequency, f_offset	*Basic limits* (Note 1, 2)	Measurement bandwidth
0 MHz $\leq \Delta f <$ 5 MHz	0.05 MHz $\leq$ f_offset < 5.05 MHz	$-7dBm - \dfrac{7}{5} \cdot \left(\dfrac{f\_offset}{MHz} - 0.05 \right) dB$	100 kHz
5 MHz $\leq \Delta f <$ min(10 MHz, Δf_{max})	5.05 MHz $\leq$ f_offset < min(10.05 MHz, f_offset$_{max}$)	-14 dBm	100 kHz
10 MHz $\leq \Delta f \leq \Delta f_{max}$	10.5 MHz $\leq$ f_offset < f_offset$_{max}$	-13 dBm (Note 3)	1MHz
NOTE 1: For a BS supporting non-contiguous spectrum operation within any *operating band*, the emission limits within sub-block gaps is calculated as a cumulative sum of contributions from adjacent sub blocks on each side of the sub block gap, where the contribution from the far-end sub-block shall be scaled according to the measurement bandwidth of the near-end sub-block. Exception is $\Delta f \geq$ 10MHz from both adjacent sub blocks on each side of the sub-block gap, where the emission limits within sub-block gaps shall be -13 dBm/1 MHz.			
NOTE 2: For a *multi-band connector* with Inter RF Bandwidth gap < 2*Δf_{OBUE} the emission limits within the Inter RF Bandwidth gaps is calculated as a cumulative sum of contributions from adjacent sub-blocks or RF Bandwidth on each side of the Inter RF Bandwidth gap, where the contribution from the far-end sub-block or RF Bandwidth shall be scaled according to the measurement bandwidth of the near-end sub-block or RF Bandwidth.			
NOTE 3: The requirement is not applicable when $\Delta f_{max} <$ 10 MHz.			

6.6.4.2.2.1Category B requirements (Option 1)

For BS operating in Bands n1, n2, n3, n7, n25, n34, n38, n39, n40, n41, n48, n50, n65, n66, n70, n75, n77, n78, n79, *basic limits* are specified in tables 6.6.4.2.2.1-2:

Table 6.6.4.2.2.1-2: Wide Area BS operating band unwanted emission limits (NR bands above 1 GHz) for Category B

Frequency offset of measurement filter -3dB point, Δf	Frequency offset of measurement filter centre frequency, f_offset	*Basic limits* (Note 1, 2)	Measurement bandwidth
0 MHz $\leq \Delta f$ < 5 MHz	0.05 MHz $\leq$ f_offset < 5.05 MHz	$-7dBm - \dfrac{7}{5} \cdot \left(\dfrac{f\_offset}{MHz} - 0.05 \right) dB$	100 kHz
5 MHz $\leq \Delta f$ < min(10 MHz, Δf_{max})	5.05 MHz $\leq$ f_offset < min(10.05 MHz, f_offset$_{max}$)	-14 dBm	100 kHz
10 MHz $\leq \Delta f \leq \Delta f_{max}$	10.5 MHz $\leq$ f_offset < f_offset$_{max}$	-15 dBm (Note 3)	1MHz
NOTE 1: For a BS supporting non-contiguous spectrum operation within any *operating band*, the emission limits within sub-block gaps is calculated as a cumulative sum of contributions from adjacent sub blocks on each side of the sub block gap, where the contribution from the far-end sub-block shall be scaled according to the measurement bandwidth of the near-end sub-block. Exception is $\Delta f \geq$ 10MHz from both adjacent sub blocks on each side of the sub-block gap, where the emission limits within sub-block gaps shall be -15 dBm/1 MHz.			
NOTE 2: For a *multi-band connector* with Inter RF Bandwidth gap < 2*Δf_{OBUE} the emission limits within the Inter RF Bandwidth gaps is calculated as a cumulative sum of contributions from adjacent sub-blocks or RF Bandwidth on each side of the Inter RF Bandwidth gap, where the contribution from the far-end sub-block or RF Bandwidth shall be scaled according to the measurement bandwidth of the near-end sub-block or RF Bandwidth.			
NOTE 3: The requirement is not applicable when Δf_{max} < 10 MHz.			

6.6.4.2.5.3 Additional operating band unwanted emissions limits for Band n48

The following requirement may apply to BS operating in Band n48 in certain regions. Emissions shall not exceed the maximum levels specified in Table 6.6.4.2.5.3-1.

Table 6.6.4.2.5.3-1: Additional operating band unwanted emission limits for Band n48

Channel bandwidth	Frequency offset of measurement filter -3dB point, Δf	Frequency offset of measurement filter centre frequency, f_offset	Minimum requirement	Measurement bandwidth (Note)
All	0 MHz $\leq \Delta f$ < 10 MHz	0.5 MHz $\leq$ f_offset < 9.5 MHz	-13 dBm	1 MHz

Note: The resolution bandwidth of the measuring equipment should be equal to the measurement bandwidth. However, to improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth may be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement bandwidth in order to obtain the equivalent noise bandwidth of the measurement bandwidth.

6.6.5.2.3 Additional spurious emissions requirements

Table 6.6.5.2.3-1: BS spurious emissions *basic limits* for BS for co-existence with systems operating in other frequency bands

System type for NR to co-exist with	Frequency range for co-existence requirement	*Basic limits*	Measurement bandwidth	Note
UTRA FDD Band XXII or E-UTRA Band 22	3510 – 3590 MHz	-52 dBm	1 MHz	This is not applicable to BS operating in Band n48.
	3410 – 3490 MHz	-49 dBm	1 MHz	
E-UTRA Band 42	3400 – 3600 MHz	-52 dBm	1 MHz	This is not applicable to BS operating in Band n48, n77 and n78.
E-UTRA Band 43	3600 – 3800 MHz	-52 dBm	1 MHz	This is not applicable to BS operating in Band n48, n77 and n78.
E-UTRA Band 48 or NR Band n48	3550 – 3700 MHz	-52 dBm	1 MHz	This is not applicable to BS operating in Band n48, n77 and n78.
NR Band n77	3.3 – 4.2 GHz	-52 dBm	1 MHz	This requirement does not apply to BS operating in Band n48, n77 and n78
NR Band n78	3.3 – 3.8 GHz	-52 dBm	1 MHz	This requirement does not apply to BS operating in Band n48, n77 and n78

The following requirement may apply to BS operating in Band n48 in certain regions. The power of any spurious emission shall not exceed:

Table 6.6.5.2.3-6: Additional BS Spurious emissions limits for Band n48

Frequency range	Maximum Level	Measurement Bandwidth (NOTE)	Note
3530MHz – 3720MHz	-25dBm	1 MHz	Applicable 10MHz from the assigned channel edge
3100MHz – 3530MHz 3720MHz – 4200MHz	-40dBm	1 MHz	

NOTE: The resolution bandwidth of the measuring equipment should be equal to the measurement bandwidth. However, to improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth may be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement bandwidth in order to obtain the equivalent noise bandwidth of the measurement bandwidth.

6.6.5.2.4 Co-location with other base stations

Table 6.6.5.2.4-1: BS spurious emissions *basic* limits for BS co-located with another BS

Type of co-located BS	Frequency range for co-location requirement	Basic limits			Measurement bandwidth	Note
		WA BS	MR BS	LA BS		
UTRA FDD Band XXII or E-UTRA Band 22	3410 – 3490 MHz	-96 dBm	-91 dBm	-88 dBm	100 kHz	This is not applicable to BS operating in Band n48
E-UTRA Band 42	3400 – 3600 MHz	-96 dBm	-91 dBm	-88 dBm	100 kHz	This is not applicable to BS operating in Band n48
E-UTRA Band 43	3600 – 3800 MHz	-96 dBm	-91 dBm	-88 dBm	100 kHz	This is not applicable to BS operating in Band n48
E-UTRA Band 48 or NR Band n48	3550 – 3700 MHz	-96 dBm	-91 dBm	-88 dBm	100 kHz	This is not applicable to BS operating in Band n48
NR Band n77	3.3 – 4.2 GHz	-96 dBm	-91 dBm	-88 dBm	100 kHz	This is not applicable to BS operating in Band n48
NR Band n78	3.3 – 3.8 GHz	-96 dBm	-91 dBm	-88 dBm	100 kHz	This is not applicable to BS operating in Band n48

Annex A:
Change history

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
2019-04	RAN4#90 bis	R4-1904591				Initial TR skeleton	0.0.1
2019-04	RAN4#90 bis	R4-1904592				The following agreed text proposals have been included: R4-1900392 TP to TR 38.173: Definitions and abbreviations, Nokia R4-1900393 TP to TR 38.173: Background information, Nokia R4-1900395 TP to TR 38.173: Frequency band arrangements and regulatory background, Nokia R4-1900055 TP to TR 38.173: n48 A-MPR, Nokia R4-1902447 TP to TR 38.173: Analysis on UE requirements for n48, Nokia R4-1900394 TP to TR 38.173: BS requirements, Nokia	0.1.0
2019-06	RAN#84	RP-190910				V1.0.0 is submitted for 1 step approval	1.0.0
2019-06	RAN#84					Approved by plenary – Rel-16 spec under change control	16.0.0