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Technical Report

3rd Generation Partnership Project;
Technical Specification Group Radio Access Network;
New frequency range for NR (3.3-4.2 GHz)
(Release 15)

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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:

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1 Scope

The present document is a technical report for New frequency range for NR (3.3-4.2 GHz). The purpose of this technical report is to provide specification support for NR bands 3.3-3.8 GHz and 3.3-4.2 GHz.

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] R4-1706893, “WF on 3.5GHz NR band definition”, CMCC, Vodafone, Ericsson, Qualcomm, Skyworks, Huawei, HiSilicon, CATT, ZTE, Telecom Italia, Orange, Deutsche Telekom, BT, Broadcom, China Telecom, China Unicom

[3] R4-1709181, “WF on band numbering”, NTT DOCOMO

[4] R4-1708845, “WF on UE mandatory channel bandwidth”, Nokia

[5] R4-1711732, “WF on BS channel BW set”, Huawei, Hisilicon, Vodafone, Ericsson

[6] R4-1710957, “TP to TR 38.817-01: Futher ACLR agreements”, Nokia

[7] R4-1710962, “TP to TS 38.101-1 Output RF spectrum emissions”, Nokia

[8] TS 38.101-1: “NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone”.

[9] TR 37.843: “Radio Frequency (RF) requirement background for Active Antenna System (AAS) Base Station (BS) radiated requirements”.

[10] TR 38.817-01: “General aspects for UE RF for NR”.

3 Definitions, symbols 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 Symbols

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

$F_{Interferer}$ Frequency of the interferer
F_{DL_low} The lowest frequency of the downlink *operating band*
F_{DL_high} The highest frequency of the downlink *operating band*
F_{UL_low} The lowest frequency of the uplink *operating band*
F_{UL_high} The highest frequency of the uplink *operating band*
P_{CMAX} The configured maximum UE output power.

$P_{CMAX, c}$ The configured maximum UE output power for serving cell *c*.
$P_{Interferer}$ Modulated mean power of the interferer

3.3 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].

4 Background

In 3GPP RAN4 #AH2 meeting, it is proposed that new bands for NR are assigned band numbers on a "first come first served" basis in reserved ranges regardless of duplex mode or RAT. Then, in RAN4 #84 meeting, band 3.3-3.8 GHz and band 3.3-4.2GHz are assigned band number n78 and n77 respectively.

5 NR Frequency band definition

In 3GPP, RAN 4 specified two NR operating bands n77 and n78 in 3.3GHz-4.2GHz. A UE supporting n78 band is not required to support n77 band [2].

6 Band numbering and channel bandwidth

6.1 Band numbering

For 3.3-4.2GHz frequency range the NR frequency bands are defined as in Table 6.1-1.

Table 6.1-1: NR frequency bands

NR Operating Band	Uplink (UL) operating band BS receive UE transmit	Downlink (DL) operating band BS transmit UE receive	Duplex Mode
	FUL_low – FUL_high	FDL_low – FDL_high	
n77	3300MHz-4200MHz	3300MHz-4200MHz	TDD
n78	3300MHz-3800MHz	3300MHz-3800MHz	TDD

6.2 Channel bandwidth

6.2.1 Channel bandwidth Set [NR_newRAT]

The superset of channel bandwidth for UE was agreed in Table 6.2.1-1:

Table 6.2.1-1 UE channel bandwidth set

NR Band	Data SCS = 15kHz					Data SCS = 30kHz								Data SCS = 60kHz (for more than 1GHz bands)							
	10 MHZ	15 MHz	20 MHZ	40 MHz	50 MHz	10 MHZ	15 MHz	20 MHz	40 MHz	50 MHz	60 MHz	80 MHz	100 MHz	10 MHz (NOTE)	15 MHz	20 MHz	40 MHz	50 MHz	60 MHz	80 MHz	100 MHz
n77	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
n78	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
NOTE: 90% spectrum utilization may not be achieved																					

For band n77 and band n78, addition to the UE channel BWs for the band, 30 MHz, 70 MHz and 90 MHz are supported for BS. These new BS CBWs have low priority compared to the UE channel BWs.

7 NR band 3.3GHz - 3.8GHz specific issues

7.1 UE specific

7.1.1 Transmitter characteristics

7.1.1.1 UE maximum output power

The MOP requirements for Band 42 and 43 single-carrier were specified as 23 dBm +2/-3 dB for power class 3 based on simulation results shown in Table 7.1.1.1-1 in August 2011.

Table 7.1.1.1-1. Simulation results for combined Band 42 and Band 43 filter [R4-114656]

	Bandwidth	Max IL (corner)	$2f_0$ rejection	2.7 GHz rejection
Design 7	400 MHz	1.9	20 dB	30 dB
Design 8	400 MHz	2.3	15 dB	10 dB
Design 9	400 MHz	2.0	20 dB	15 dB

When specifying MOP requirements of Band n77 and n78, the delta to be checked is IL impact of BPF due to the extension of pass-bandwidth. It is shown in Table 7.1.1.1-2.

Table 7.1.1.1-2. Simulation results for Band n77 and n78

Parameter	Frequency range	Vendor 1		Vendor 2		Vendor 3	
		Band n78 BPF	Band n77 BPF	Band n78 BPF	Band n77 BPF	Band n78 BPF	Band n77 BPF
Insertion loss (ETC)	3300-3400 MHz	1.05 dB	1.05 dB	2.0 dB	2.0 dB	1.9 dB	1.9 dB
	3400-3800 MHz	1.0 dB	1.0 dB	1.5 dB	1.5 dB		
	3800-4200 MHz	-	1.25 dB	-	2.0 dB	-	
Attenuation (Typ)	698-2690 MHz	41.0 dB	41.0 dB	45 dB	35 dB (ETC)	46.3 dB	47.8 dB
	5150-5925 MHz	40.2 dB	40.2 dB	35 dB	35 dB (ETC)	40.8 dB	35.6 dB

With comparison between Table 7.1.1.1-1 and Table 7.1.1.1-2, it was concluded that there is no degradation of IL at ETC even with the extension and agreed to specify the same MOP as that of Band 42 and 43 (i.e., 23 dBm +2/-3 dB) for Band n77 and n78 of power class 3.

Agreement: MOP is to be specified as 23 dBm +2/-3 dB for Band n77 and n78 of power class 3

The following NR UE Power Classes define the maximum output power for any transmission bandwidth within the channel bandwidth for non-CA configuration and UL-MIMO unless otherwise stated.

Table 7.1.1.1-3: NR UE power classes

NR Operating band	Class 2	Class 3	Comments
n77	26 dBm +2/-3 dB	23 dBm +2/-3 dB	3.3 - 4.2 GHz
n78	26 dBm +2/-3 dB	23 dBm +2/-3 dB	3.3 - 3.8 GHz
n79	26 dBm +2/-3 dB	23 dBm +2/-3 dB	4.4 - 5 GHz

For a power class 2 UE, applicability to certain restriction of uplink/downlink configuration is TBD.

If UE is configured for power class 2 UE, the requirements in Table 7.1.1.1-4.

Table 7.1.1.1-4: P_{CMAX} tolerance

$P_{CMAX,c}$ (dBm)	Tolerance $T(P_{CMAX,c})$ (dB)
$23 < P_{CMAX,c} \leq 33$	2.0
$21 \leq P_{CMAX,c} \leq 23$	2.0
$20 \leq P_{CMAX,c} < 21$	2.5
$19 \leq P_{CMAX,c} < 20$	3.5
$18 \leq P_{CMAX,c} < 19$	4.0
$13 \leq P_{CMAX,c} < 18$	5.0
$8 \leq P_{CMAX,c} < 13$	6.0
$-40 \leq P_{CMAX,c} < 8$	7.0

7.1.1.2 UE maximum output power for modulation / channel bandwidth

For UE Power 2 and 3, the allowed Maximum Power Reduction (MPR) for the maximum output power is not band specific requirement. MPR follow the requirements of general aspects for UE RF in TR 38.817-01 [10].

7.1.1.3 UE maximum output power with additional requirements

UE maximum output power with additional requirements follows A-MPR requirements of general aspects for UE RF in TR 38.817-01 [10].

7.1.1.4 Adjacent Channel Leakage Ratio (ACLR)

NR adjacent channel leakage power ratio (NR_{ACLR}) is the ratio of the filtered mean power centred on the assigned NR channel frequency to the filtered mean power centred on an adjacent NR channel frequency at nominal channel spacing.

The assigned NR channel power and adjacent NR channel power are measured with rectangular filters with measurement bandwidths specified in Table 7.1.1.4-1.

If the measured adjacent channel power is greater than [–50dBm] then the NR_{ACLR} shall be higher than the value specified in Table 7.1.1.4-2.

Table 7.1.1.4-1: NR ACLR measurement bandwidth

	10 MHz	15 MHz	20 MHz	40 MHz	50 MHz	60 MHz	80 MHz	100 MHz
NR ACLR measurement bandwidth	9.375	14.235	19.095	38.895	48.615	58.35	78.15	98.31

Table 7.1.1.4-2: NR ACLR requirement

	Power class 1	Power class 2	Power class 3
NR_{ACLR}		31 dB	30 dB

7.1.1.5 Spectrum emission mask

The power of any UE emission shall not exceed the levels specified in Table 7.1.1.5-1 for the specified channel bandwidth.

Table 7.1.1.5-1: NR General spectrum emission mask

Δf_{OOB} (MHz)	10 MHz	15 MHz	20 MHz	40 MHz	50 MHz	60 MHz	80 MHz	100 MHz	Measurement bandwidth
± 0-1	-18	-20	-21	-24	-24	-24	-24	-24	30 kHz
± 1-5	-10	-10	-10	-10	-10	-10	-10	-10	1 MHz
± 5-6	-13	-13	-13	-13	-13	-13	-13	-13	
± 6-10									
± 10-15	-25								
± 15-20		-25							
± 20-25			-25						
± 25-30									
± 30-40									
± 40-45				-25					
± 45-50									
± 50-55					-25				
± 55-60									
± 60-65						-25			
± 65-80									
± 80-85							-25		
± 85-100									
± 100-105								-25	

No changes to Table 7.1.1.5-1 are needed as a result of Band n78 power class 2 operation.

7.1.1.6 Spurious emissions

Since Band n77 and/or n78 will be used at least in Japan, bands operated in Japan need to be protected. In addition, protected bands required in Europe, Korea and China regions (i.e., operating bands specified for Band n78 of 3.3-3.8 GHz) should also be added for potential use of these bands. As a consequence, required protected bands for Band n77 and n78 will be the same. Note that it was already agreed not to specify the co-existence requirement between Band n77 and Band n79, which means that the co-existence will be guaranteed by the NR general emission requirements.

Table 7.1.1.6-1: Spurious emission band UE co-existence for Band n77 and n78

NR band	Spurious emission						
	Protected band	Frequency range (MHz)			Maximum Level (dBm)	MBW (MHz)	NOTE
n78	E-UTRA Band 1, 3, 5, 7, 8, 11, 18, 19, 20, 21, 26, 28, 34, 39, 40, 41, 65	F_{DL_low}	-	F_{DL_high}	-50	1	
	Frequency range	1884.5	-	1915.7	-41	0.3	PHS
	NR Band n257	26500	-	29500	[-5]	100	

Agreement: Protected bands required for Band n77 are to be the same as those for Band n78 (i.e., not only Japanese bands but also ones required for other regions such as Europe, Korea and China)

No changes to Table 7.1.1.6-1 are needed as a result of Band n78 power class 2 operation.

7.1.1.7 Tx requirements for UL MIMO with PC2

7.1.1.7.1 UE maximum output power

For PC2 UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the maximum output power for any transmission bandwidth within the channel bandwidth is specified in Table 7.1.1.7.1-1. For UE supporting UL-MIMO, the maximum output power is measured as the sum of the maximum output power at each UE antenna connector. The period of measurement shall be at least one sub frame (1ms).

The requirements shall be met with the UL-MIMO configurations of using 2-layer UL-MIMO transmission with codebook of $\frac{1}{\sqrt{2}}\begin{bmatrix}1 & 0\\ 0 & 1\end{bmatrix}$. Whether other code book will be introduced in Rel-15 is FFS. DCI Format for UE configured in PUSCH transmission mode for uplink single-user MIMO shall be used.

Table 7.1.1.7.1-1: UE Power Class for UL-MIMO in closed loop spatial multiplexing scheme

NR band	Class 1 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)	Class 4 (dBm)	Tolerance (dB)
n77			26	+2/-3				
n78			26	+2/-3				

If UE is configured for transmission on single-antenna port, the requirements in Table 7.1.1.7.1-2 shall apply.

Table 7.1.1.7.1-2: UE Power Class

EUTRA band	Class 1 (dBm)	Tolerance (dB)	Class 2 (dBm)	Tolerance (dB)	Class 3 (dBm)	Tolerance (dB)	Class 4 (dBm)	Tolerance (dB)
n77					23	±2		
n78					23	±2		

For a power class 2 capable UE supporting UL MIMO, applicability to certain restriction of uplink/downlink configuration is TBD.

7.1.1.7.2 Configured transmitted power

For UE supporting UL-MIMO, the transmitted power is configured per each UE.

For PC2 UE with two transmit antenna connectors in closed-loop spatial amultiplexing scheme, the tolerance is specified in Table 7.1.1.7.2-1. The requirements shall be met with UL-MIMO configurations described in sub-clause 7.1.1.7.1.

Table 7.1.1.7.2-1: $P_{CMAX,c}$ tolerance in closed-loop spatial multiplexing scheme

$P_{CMAX,c}$ (dBm)	Tolerance $T_{LOW}(P_{CMAX\_L,c})$ (dB)	Tolerance $T_{HIGH}(P_{CMAX\_H,c})$ (dB)
$P_{CMAX,c}$ =26	3.0	2.0
$23 \le P_{CMAX,c} < 26$	3.0	2.0
$22 \le P_{CMAX,c} < 23$	5.0	2.0
$21 \le P_{CMAX,c} < 22$	5.0	3.0
$20 \le P_{CMAX,c} < 21$	6.0	4.0
$16 \le P_{CMAX,c} < 20$	5.0	
$11 \le P_{CMAX,c} < 16$	6.0	
$-40 \le P_{CMAX,c} < 11$	7.0	

If UE is configured for transmission on single-antenna port, the requirements in Table 7.1.1.7.2-2 apply.

Table 7.1.1.7.2-2: P_{CMAX} tolerance

$P_{CMAX,c}$ (dBm)	Tolerance $T(P_{CMAX,c})$ (dB)
$23 < P_{CMAX,c} \le 33$	2.0
$21 \le P_{CMAX,c} \le 23$	2.0
$20 \le P_{CMAX,c} < 21$	2.5
$19 \le P_{CMAX,c} < 20$	3.5
$18 \le P_{CMAX,c} < 19$	4.0
$13 \le P_{CMAX,c} < 18$	5.0
$8 \le P_{CMAX,c} < 13$	6.0
$-40 \le P_{CMAX,c} < 8$	7.0

7.1.1.7.3 Minimum output power

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the minimum output power is defined as the sum of the mean power at each transmit connector in one sub-frame (1ms). The minimum output power shall not exceed the values specified for single carrier.

If UE is configured for transmission on single-antenna port, the requirements specified for single carrier shall apply.

7.1.1.7.4 Transmit OFF power

The transmit OFF power is defined as the mean power at each transmit antenna connector in a duration of at least one sub-frame (1ms) excluding any transient periods.

The transmit OFF power at each transmit antenna connector shall not exceed the values specified for single carrier.

7.1.1.7.5 ON/OFF time mask

For UE supporting UL-MIMO, the ON/OFF time mask requirements apply at each transmit antenna connector.

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the general ON/OFF time mask requirements apply to each transmit antenna connector. The requirements shall be met with the UL-MIMO configurations described in sub-clause 7.1.1.7.1.

If UE is configured for transmission on single-antenna port, the general ON/OFF time mask requirements apply.

7.1.1.7.6 Power control

For UE supporting UL-MIMO, the power control tolerance applies to the sum of output power at each transmit antenna connector.

The power control requirements specified for single carrier apply to UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme. The requirements shall be met with UL-MIMO configurations described in sub-clause 7.1.1.7.1.

If UE is configured for transmission on single-antenna port, the requirements for single carrier apply.

7.1.1.7.7 Frequency error for UL-MIMO

For UE(s) supporting UL-MIMO, the UE modulated carrier frequency at each transmit antenna connector shall be accurate to within ±0.1 PPM observed over a period of one sub-frame (1 ms) compared to the carrier frequency received from the NR Node B.

7.1.1.7.8 Transmit modulation quality

For UE supporting UL-MIMO, the transmit modulation quality requirements are specified at each transmit antenna connector.

If UE is configured for transmission on single-antenna port, the requirements specified for single carrier apply.

The transmit modulation quality is specified in terms of:

- Error Vector Magnitude (EVM) for the allocated resource blocks (RBs)
- EVM equalizer spectrum flatness derived from the equalizer coefficients generated by the EVM measurement process
- Carrier leakage (caused by IQ offset)
- In-band emissions for the non-allocated RB

7.1.1.7.9 Occupied bandwidth for UL-MIMO

For UE supporting UL-MIMO, the requirements for occupied bandwidth is specified at each transmit antenna connector. The occupied bandwidth is defined as the bandwidth containing 99 % of the total integrated mean power of the transmitted spectrum on the assigned channel at each transmit antenna connector.

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the occupied bandwidth at each transmitter antenna shall be less than the channel bandwidth specified for single carrier. The requirements shall be met with UL-MIMO configurations described in sub-clause 7.1.1.7.1.

If UE is configured for transmission on single-antenna port, the requirements specified for single carrier apply.

7.1.1.7.10 Out of band emission for UL-MIMO

For UE supporting UL-MIMO, the requirements for Out of band emissions resulting from the modulation process and non-linearity in the transmitters are specified at each transmit antenna connector.

For UEs with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the requirements specified for single carrier apply to each transmit antenna connector. The requirements shall be met with UL-MIMO configurations described in sub-clause 7.1.1.7.1.

If UE is configured for transmission on single-antenna port, the requirements specified for single carrier apply.

7.1.1.7.11 Spurious emission for UL-MIMO

For UE supporting UL-MIMO, the requirements for Spurious emissions which are caused by unwanted transmitter effects such as harmonics emission, parasitic emissions, intermodulation products and frequency conversion products are specified at each transmit antenna connector.

For UEs with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the requirements specified for single carrier apply to each transmit antenna connector. The requirements shall be met with the UL-MIMO configurations described in sub-clause 7.1.1.7.1.

If UE is configured for transmission on single-antenna port, the general requirements specified for single carrier apply.

7.1.1.7.12 Transmit intermodulation for UL-MIMO

For UE supporting UL-MIMO, the transmit intermodulation requirements are specified at each transmit antenna connector and the wanted signal is defined as the sum of output power at each transmit antenna connector.

For UEs with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the requirements specified for single carrier apply to each transmit antenna connector. The requirements shall be met with the UL-MIMO configurations described in sub-clause 7.1.1.7.1.

If UE is configured for transmission on single-antenna port, the requirements specified for single carrier apply.

7.1.1.7.13 Time alignment error for UL-MIMO

For UE(s) with multiple transmit antenna connectors supporting UL-MIMO, this requirement applies to frame timing differences between transmissions on multiple transmit antenna connectors in the closed-loop spatial multiplexing scheme.

The time alignment error (TAE) is defined as the average frame timing difference between any two transmissions on different transmit antenna connectors.

For UE(s) with multiple transmit antenna connectors, the Time Alignment Error (TAE) shall not exceed 130 ns.

7.1.2 Receiver characteristics

No changes to receiver characteristics are needed as a result of Band n78 power class 2 operation.

7.1.2.1 Reference sensitivity

Based on Table 7.1.1.1-2 and more simulation results in Table 7.1.2.1-1, 7.1.2.1-2 and 7.1.2.1-3 whose attenuation is at least typ. 35 dB below 2690 MHz and above 5150 MHz, the following was agreed.

Table 7.1.2.1-1. Filter simulation results reported by Vendor A in [R4-1711334]

Filter	Nominal IL [dB]		Min Attenuation [dB] @	
	w/o 30 dB Rejection in Radio Altimeter Band	with 30 dB Rejection in Radio Altimeter Band	693-2690 MHz	5150-5925 MHz
n77 (3.3-4.2 GHz)	1.8	2.7	>35	>35
n78 (3.3-3.8 GHz)	1.5	1.8	>35	>35

Table 7.1.2.1-2. Filter simulation results reported by Vendor B in [R4-1711334]

Filter	IL [dB]		Min Attenuation [dB] @		
	Nominal	Worst Case	693-2690 MHz	5150-5925 MHz	Radio Altimeter
n77 (3.3-4.2 GHz)	1.87	TBC	44	46	
n78 (3.3-3.8 GHz)	1.56	TBC	40.5	51	

Table 7.1.2.1-3. Filter simulation results reported in [R4-1711334]

Filter	IL [dB]						Min Attenuation [dB]					
	Nominal			Worst case								
Frequencies [GHz]	3.3	3.8	4.2	3.3	3.8	4.2	2.3-2.69	0.617-2.2	4.4-5.0	4.8-5.0	5.15-5.925	5.250-5.925
n77 (3.3-4.2 GHz)	2.6	1.9	2.4	2.9	2.1	2.6	35	45	5	18	40	45
n78 (3.3-3.8 GHz)	2.1	1.8	-	2.3	2.1	-	35	40	22	25	40	45

Agreement: REFSENS for Band n77 at 3.3-3.8 GHz and n78 should be 1 dB larger than that of bands which have NR smallest sensitivity (less RF challenges) such as Band n1. REFSENS for Band n77 at 3.8-4.2 GHz is increased by 0.5 dB compared to that of Band n78.

Table 7.1.2.1-4. Reference sensitivity for Band n78

Operating Band	SCS kHz	10 MHz (dBm)	15 MHz (dBm)	20 MHz (dBm)	40 MHz (dBm)	50 MHz (dBm)	60 MHz (dBm)	80 MHz (dBm)	100 MHz (dBm)	Duplex Mode
n78	15	-95.8	-94.0	-92.7	-89.6	-88.6				TDD
	30	-96.1	-94.1	-92.9	-89.7	-88.7	-87.9	-86.6	-85.6	
	60	-96.5	-94.4	-93.1	-89.9	-88.8	-88.0	-86.7	-85.7	

7.1.2.2 Adjacent Channel Selectivity (ACS)

Adjacent Channel Selectivity (ACS) is a measure of a receiver's ability to receive a NR signal at its assigned channel frequency in the presence of an adjacent channel signal at a given frequency offset from the centre frequency of the assigned channel. ACS is the ratio of the receive filter attenuation on the assigned channel frequency to the receive filter attenuation on the adjacent channel(s).

It is not possible to directly measure the ACS, instead the lower and upper range of test parameters are chosen in Table 7.1.2.2-2 and Table 7.1.2.2-3 where the throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 of TS 38.101-1 [8] (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1 of TS 38.101-1 [8]).

Table 7.1.2.2-1: Adjacent channel selectivity

NR band	Rx Parameter	Units	Channel bandwidth							
			10 MHz	15 MHz	20 MHz	40 MHz	50 MHz	60 MHz	80 MHz	100 MHz
n78	ACS	dB	[33.0]	[33.0]	[33.0]	[33.0]	[33.0]	[33.0]	[33.0]	[33.0]

Table 7.1.2.2-2: Test parameters for Adjacent channel selectivity, Case 1

NR band	Rx Parameter	Units	Channel bandwidth							
			10 MHz	**15 MHz**	**20 MHz**	**40 MHz**	**50 MHz**	**60 MHz**	**80 MHz**	**100 MHz**
n78	Power in Transmission Bandwidth Configuration	dBm	REFSENS + 14 dB							
	PInterferer	dBm	REFSENS [+45.5]dB	REFSENS [+45.5] dB	REFSENS [+45.5]dB	REFSENS [+45.5] dB	REFSENS [+45.5] dB	REFSENS [+45.5]dB	REFSENS [+45.5]dB	REFSENS [+45.5]dB
	BWInterferer	MHz	10	15	20	40	50	60	80	100
	FInterferer (offset) For SCS of 15kHz	MHz	10+0.0125 / -10-0.0125	15+0.0075 / -15-0.0075	20+0.0025 / -20-0.0025	40+0.0125 / -40-0.0125	50+0.0025 / -50-0.0025	N/A	N/A	N/A
	FInterferer (offset) For SCS of 30kHz	MHz	10+0.005 / -10-0.005	15+0.015 / -15-0.015	20+0.025 / -20-0.025	40+0.005 / -40-0.005	50+0.025 / -50-0.025	60+0.015 / -60-0.015	80+0.025 / -80-0.025	100+0.005 / -100-0.005
	FInterferer (offset) For SCS of 60kHz	MHz	10+0.050 / -10-0.050	15+0.030 / -15-0.030	20+0.010 / -20-0.010	40+0.050 / -40-0.050	50+0.010 / -50-0.010	60+0.030 / -60-0.030	80+0.010 / -80-0.010	100+0.050 / -100-0.050

Table 7.1.2.2-3: Test parameters for Adjacent channel selectivity, Case 2

NR band	Rx Parameter	Units	Channel bandwidth							
			10 MHz	**15 MHz**	**20 MHz**	**40 MHz**	**50 MHz**	**60 MHz**	**80 MHz**	**100 MHz**
n78	Power in Transmission Bandwidth Configuration	dBm	[-56.5]	[-56.5]	[-56.5]	[-56.5]	[-56.5]	[-56.5]	[-56.5]	[-56.5]
	PInterferer	dBm	-25							
	BWInterferer	MHz	10	15	20	40	50	60	80	100
	FInterferer (offset) For SCS of 15kHz	MHz	10+0.0125 / -10-0.0125	15+0.0075 / -15-0.0075	20+0.0025 / -20-0.0025	40+0.0125 / -40-0.0125	50+0.0025 / -50-0.0025	NA	NA	NA
	FInterferer (offset) For SCS of 30kHz	MHz	10+0.005 / -10-0.005	15+0.015 / -15-0.015	20+0.025 / -20-0.025	40+0.005 / -40-0.005	50+0.025 / -50-0.025	60+0.015 / -60-0.015	80+0.025 / -80-0.025	100+0.005 / -100-0.005
	FInterferer (offset) For SCS of 60kHz	MHz	10+0.050 / -10-0.050	15+0.030 / -15-0.030	20+0.010 / -20-0.010	40+0.050 / -40-0.050	50+0.010 / -50-0.010	60+0.030 / -60-0.030	80+0.010 / -80-0.010	100+0.050 / -100-0.050

7.1.2.3 Blocking

7.1.2.3.1 Out-of-band blocking

Based on filter performance shown in Table 7.1.1.1-2, out-of-band blocking requirement needs to be optimized as with LTE band 42 and 43 as shown in Table 7.1.2.3-1. Wanted signal level is the same as that of LTE refarming bands.

Agreement: Out-of-band blocking for n78 should be specified as below.

Table 7.1.2.3.1-1: Out-of-band blocking parameters for n78

Rx Parameter	Units	Channel bandwidth							
		10 MHz	15 MHz	20 MHz	40 MHz	50 MHz	60 MHz	80 MHz	100 MHz
Power in Transmission Bandwidth Configuration	dBm	REFSENS + channel bandwidth specific value below							
		6	7	9	9	9	9	9	9
NOTE 1: The transmitter shall be set to 4dB below P_{CMAX_L} at the minimum uplink configuration specified TBD with P_{CMAX_L} as defined in subclause 6.2.5. NOTE 2: Reference measurement channel is TBD NOTE 3: The REFSENS power level is TBD									

Table 7.1.2.3.1-2: Out of band blocking for Band n78

NR band	Parameter	Units	Frequency		
			Range 1	Range 2	Range 3
	$P_{Interferer}$	dBm	-44	-30	-15
n78 (NOTE 2)	$F_{interferer}$ (CW)	MHz	$-60 < f - F_{DL\_low} < -3CBW$ or $3CBW < f - F_{DL\_high} < 60$	$-200 < f - F_{DL\_low} \le -60$ or $60 \le f - F_{DL\_high} < 200$	$1 \le f \le F_{DL\_low} - 200$ or $F_{DL\_high} + 200 \le f \le 12750$
n78 (NOTE 3)	$F_{Interferer}$ (CW)	MHz	N/A	$-200 < f - F_{DL\_low} \le -MIN(200,3CBW)$ or $MIN(200,3CBW) \le f - F_{DL\_high} < 200$	$1 \le f \le F_{DL\_low} - MIN(200,3CBW)$ or $F_{DL\_high} + MIN(200,3CBW) \le f \le 12750$
NOTE 1: CBW denotes the channel bandwidth of the wanted signal NOTE 2: For CBW < 20 MHz 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 larger than 60 MHz, the requirement for Range 2 is not applicable and Range 3 applies from the frequency offset of 3*CBW from the band edge.					

7.1.2.4 Rx requirements for UL MIMO with PC2

7.1.2.4.1 Reference sensitivity level

For UE with two transmitter antenna connectors in closed-loop spatial multiplexing scheme, the minimum requirements specified for single carrier shall be met with the UL-MIMO configurations described in sub-clause 7.1.1.7.1. For UL-MIMO, the parameter P_{UMAX} is the total transmitter power over the two transmits power over the two transmit antenna connectors.

7.1.2.4.2 Maximum input level

For UE with two transmitter antenna connectors in closed-loop spatial multiplexing, the minimum requirements specified for single carrier shall be met with the UL-MIMO configurations described in sub-clause 7.1.1.7.1. For UL-MIMO, the parameter P_{CMAX_L} is defined as the total transmitter power over the two transmit antenna connectors.

7.1.2.4.3 ACS

For UE(s) with two transmitter antenna connectors in closed-loop spatial multiplexing scheme, the minimum requirements specified for single carrier shall be met with the UL-MIMO configurations described in sub-clause 7.1.1.7.1. For UL-MIMO, the parameter P_{CMAX_L} is defined as the total transmitter power over the two transmit antenna connectors.

7.1.2.4.4 Blocking

For UE with two transmitter antenna connectors in closed-loop spatial multiplexing scheme, the minimum requirements specified for single carrier shall be met with the UL-MIMO configurations described in sub-clause 7.1.1.7.1. For UL-MIMO, the parameter P_{CMAX_L} is defined as the total transmitter power over the two transmit antenna connectors.

7.1.2.4.5 Spurious response

For UE with two transmitter antenna connectors in closed-loop spatial multiplexing scheme, the minimum requirements specified for single carrier shall be met with the UL-MIMO configurations described in sub-clause 7.1.1.7.1. For UL-MIMO, the parameter P_{CMAX_L} is defined as the total transmitter power over the two transmit antenna connectors.

7.1.2.4.6 Receiver intermodulation

For UE(s) with two transmitter antenna connectors in closed-loop spatial multiplexing scheme, the minimum requirements specified for single carrier shall be met with the UL-MIMO configurations described in sub-clause 7.1.1.7.1. For UL-MIMO, the parameter P_{CMAX_L} is defined as the total transmitter power over the two transmit antenna connectors.

7.1.2.5 4Rx requirements

Table 7.1.2.5-1 and 7.1.2.5-1a are the REFSENS and $\Delta R_{IB,4R}$ for n77 and n78 to support 4Rx.

Table 7.1.2.5-1: 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)**	**40 MHz (dBm)**	**50 MHz (dBm)**	**60 MHz (dBm)**	**80 MHz (dBm)**	**100 MHz (dBm)**	**Duplex Mode**
n77 (3.3 to 3.8 GHz)[1]	15		-95.8	-94.0	-92.7		-89.6	-88.6				TDD
	30		-96.1	-94.1	-92.9		-89.7	-88.7	-87.9	-86.6	-85.6	
	60	-	-96.5	-94.4	-93.1		-89.9	-88.8	-88.0	-86.7	-85.7	
n77 (3.8 to 4.2 GHz) [1]	15		-95.3	-93.5	-92.2		-89.1	-88.1				TDD
	30		-95.6	-93.6	-92.4		-89.2	-88.2	-87.4	-86.1	-85.1	
	60	-	-96.0	-93.9	-92.6		-89.4	-88.3	-87.5	-86.2	-85.2	
n78[1]	15		-95.8	-94.0	-92.7		-89.6	-88.6				TDD
	30		-96.1	-94.1	-92.9		-89.7	-88.7	-87.9	-86.6	-85.6	
	60		-96.5	-94.4	-93.1		-89.9	-88.8	-88.0	-86.7	-85.7	
NOTE 1: Four Rx antenna ports shall be the baseline for this operating band.												

For UE(s) equipped with 4 antenna ports, the minimum requirement for reference sensitivity in Table 7.1.2.5-1 shall be modified by the amount given in $\Delta R_{IB,4R}$ in Table 7.1.2.5-1a for the applicable NR bands.

Table 7.1.2.5-1a: ΔRIB,4R

NR Band	$\Delta R_{IB,4R}$ [dB]
1.7GHz < NR band <3GHz	- 2.7
NR band > 3GHz	- 2.2

For the ACS and blocking requirements in section in 7.1.2.2 and 7.1.2.3 as well as Spurious response and Receiver intermodulation requirements, it should be noted that the REFSENS power level for these requirements represents for two and four antenna ports, respectively.

7.2 BS specific

The operating band Band n78 is 3300MHz~3800MHz, belonging to FR1, therefore only 3 distinct types of NR BS each has a different architecture and requirements set are applied, which are *BS type 1-C*, *BS type 1-H* and *BS type 1-O.*

For Band n78 power class 2 HPUE, it can be foreseen that there are no additional BS receive blocking such as in-band blocking and out-of-band blocking requirements introduced.

7.2.1 Operating band unwanted emissions

The operating band unwanted emission (OBUE) limits are defined from Δf_{OBUE} below the lowest frequency of each supported downlink operating band up to Δf_{OBUE} above the highest frequency of each supported downlink operating band. According to the WF in R4-1706223, Δf_{OBUE}=40 MHz for NR bands wider than 100 MHz as baseline for the boundary between UEM and spurious emission(for both Cat A and Cat B). Therefore for Band n78, Δf_{OBUE} should be40 MHz.

7.2.1.1 Minimum requirement for BS type 1-C and BS type 1-H

The *basic limits* of the operating band unwanted emission for Band n78 is the based on the same principles as for LTE, where the unwanted emission limits for >=5MHz channel bandwidth of each BS classes(Wide Area BS(band >1GHz), Medium Range BS and Local Area BS) can be applied to Cat A and Cat B for the unwanted emission basic limits for Band n78.

- For BS type 1-C, the operating band unwanted emissions requirement for each *antenna connector* shall be defined based on *basic limits* with no scaling and no antenna considered.

- For BS type 1-H, the operating band unwanted emissions requirements are for each *TAB connector TX* shall be defined based on *base limits*. The power summation emission at the *TAB connectors* of the *TAB connector TX min cell* shall not exceed the *basic limit* + X, where $X = 10\log_{10}(N_{TXU,countedpercell})$.

7.2.1.2 Minimum requirement for BS type 1-O

The OTA operating band unwanted emissions requirements are applied at RIB and based on the emission scaling, where the emission limits are defined as basic limit+9dB, where the basic limits are specified in subclause 7.2.1.1.

7.2.2 Additional spurious emissions requirements

7.2.2.1 Minimum requirement for BS type 1-C and BS type 1-H

The additional spurious emission requirement may be applied for the protection of system operating in frequency ranges other than the BS downlink operating band. It is proposed that the same limits as TDD E-UTRA bands (i.e. -52 dBm/MHz) can be applied for the *basic limits* for NR band n78.

In addition, since the Band n77 and n78 are overlapping operating bands, and these two bands may be deployed in the same geographical area, thus this requirement does not apply to BS operating in Band n77 and n78.

For BS type 1-C, the emissions requirements for each *antenna connector* shall be defined based on *basic limits* with no scaling and no antenna considered.

For BS type 1-H, the emissions requirements are for each *TAB connector* shall be defined based on the *basics limits,* The power summation emission at the *TAB connectors* of the *TAB connector TX min cell* shall not exceed the *basic limit* + X, where $X = 10\log_{10}(N_{TXU,countedpercell})$.

7.2.2.2 Minimum requirement for BS type 1-O

The OTA minimum requirements are applied at RIB and based on the emission scaling, where the emission limits are defined as basic limits+9dB, where the basic limits are specified in subclause 7.2.2.1.

7.2.3 Co-location with other base stations

7.2.3.1 Minimum requirement for BS type 1-C and BS type 1-H

The conduct requirements assume a 30dB coupling loss between transmitter and receiver and are based on co-location with base stations of the same class. Thus, it is proposed that the same limits as E-UTRA for different BS classes can be applied for the *basic limits* of co-location requirements for each BS classes for NR Bands n78.

For BS type 1-C, the emissions requirements for each antenna connector shall be defined based on basic limits with no scaling and no antenna considered.

For BS type 1-H, the emissions requirements are for each *TAB connector* shall be defined based on the *basics limits,* The power summation emission at the *TAB connectors* of the *TAB connector TX min cell* shall not exceed the *basic limit* + X, where $X = 10\log_{10}(N_{TXU,countedpercell})$.

7.2.3.2 Minimum requirement for BS type 1-O

The OTA co-location with other base stations requirements are specified as co-location requirements using the co-location reference antenna, as described in TR 37.843 [9].

The output of the *co-location reference antenna* of any spurious emission shall not exceed the *basic limits* in subclause 7.2.3.1 + X dB, where X = -21 dB.

7.2.4 General blocking requirement

7.2.4.1 Minimum requirement for BS type 1-C and BS type 1-H

The blocking requirements apply in the in-band blocking frequency range, which is from 60 MHz below the lowest frequency of the uplink operating band up to 60 MHz above the highest frequency of the uplink operating band for NR Band n78, but excludes the downlink frequency range of the operating band.

The blocking requirements apply in the out-of-band blocking frequency range, which is from 1MHz to 60 MHz below the lowest frequency of the uplink operating band or from 60 MHz above the highest frequency of the uplink operating band to 12750MHz for NR BS operating in Band n78, but includes the downlink frequency range of the operating band.

Minimum conducted requirement is defined at the *antenna connector* for *BS type 1-C* and at the *TAB connector* for *BS type 1-H.*

7.2.4.2 Minimum requirement for BS type 1-O

The blocking requirements apply in the in-band blocking frequency range, which is from 60 MHz below the lowest frequency of the uplink operating band up to 60 MHz above the highest frequency of the uplink operating band for NR Band n78, but excludes the downlink frequency range of the operating band.

The *BS type 1-O* in-band blocking requirements apply at the RIB when the AoA of the incident wave of a received signal and the interfering signal are from the same direction and are within OTA REFSEN *RoAOA* and *minSENS RoAoA.*

The blocking requirements apply in the out-of-band blocking frequency range, which is from 30MHz to 60 MHz below the lowest frequency of the uplink operating band or from 60 MHz above the highest frequency of the uplink operating band to 12750MHz for NR BS operating in Band n78, but includes the downlink frequency range of the operating band.

The *BS type 1-O* out-of -band blocking requirements apply at the RIB when the AoA of the incident wave of a received signal and the interfering signal are from the same direction and are within *minSENS RoAoA.*

7.2.5 Blocking requirement for co-location with other base stations

7.2.5.1 Minimum requirement for *BS type 1-C* and *BS type 1-H*

The conduct requirements assume a 30dB coupling loss between interfering transmitter and receiver and are based on co-location with base stations of the same class. Thus, it is proposed that the same limits as E-UTRA for different BS classes can be applied for the *base limits* of co-location requirements for each BS classes for NR Bands n78.

Minimum conducted requirement is defined at the *antenna connector* for *BS type 1-C* and at the *TAB connector* for *BS type 1-H.*

7.2.5.2 Minimum requirement for *BS type 1-O*

The OTA co-location blocking requirements are specified as co-location requirements using the co-location reference antenna, as described in TR 37.843 [9].

The interferer power level is specified per polarization and defined as a power into the conducted input of the co-location reference antenna.

8 NR band 3.3GHz - 4.2GHz specific issues

8.1 UE specific

For Power Class 2 UE in Band n77 supporting UL MIMO, the requirements in Clause 7.1.1.7 and 7.1.2.4 apply.

For UE in Band n77 supporting 4Rx, the requirements in Clause 7.1.2.5 apply.

8.1.1 Transmitter characteristics

8.1.1.1 UE maximum output power

Based on the same discussion as UE maximum output power of Band n78 described in clause 7.1.1.1, the following was agreed.

Agreement: MOP is to be specified as 23 dBm +2/-3 dB for Band n77 and n78 of power class 3

The following NR UE Power Classes define the maximum output power for any transmission bandwidth within the channel bandwidth for non-CA configuration and UL-MIMO unless otherwise stated.

Table 8.1.1.1-1: NR UE power classes

NR Operating band	Class 2	Class 3	Comments
n77	26 dBm +2/-3 dB	23 dBm +2/-3 dB	3.3 - 4.2 GHz
n78	26 dBm +2/-3 dB	23 dBm +2/-3 dB	3.3 - 3.8 GHz
n79	26 dBm +2/-3 dB	23 dBm +2/-3 dB	4.4 - 5 GHz

For a power class 2 UE, applicability to certain restriction of uplink/downlink configuration is TBD.

If UE is configured for power class 2 UE, the requirements in Table 8.1.1.1-2.

Table 8.1.1.1-2: PCMAX tolerance

$P_{CMAX,c}$ (dBm)	Tolerance $T(P_{CMAX,c})$ (dB)
$23 < P_{CMAX,c} \leq 33$	2.0
$21 \leq P_{CMAX,c} \leq 23$	2.0
$20 \leq P_{CMAX,c} < 21$	2.5
$19 \leq P_{CMAX,c} < 20$	3.5
$18 \leq P_{CMAX,c} < 19$	4.0
$13 \leq P_{CMAX,c} < 18$	5.0
$8 \leq P_{CMAX,c} < 13$	6.0
$-40 \leq P_{CMAX,c} < 8$	7.0

8.1.1.2 UE maximum output power for modulation / channel bandwidth

For UE Power 2 and 3, the allowed Maximum Power Reduction (MPR) for the maximum output power is not band specific requirement. MPR follow requirements of general aspects for UE RF in TR 38.817-01 [10].

8.1.1.3 UE maximum output power with additional requirements

UE maximum output power with additional requirements follows A-MPR requirements of general aspects for UE RF in TR 38.817-01 [10].

8.1.1.4 Adjacent Channel Leakage Ratio (ACLR)

NR adjacent channel leakage power ratio (NR_{ACLR}) is the ratio of the filtered mean power centred on the assigned NR channel frequency to the filtered mean power centred on an adjacent NR channel frequency at nominal channel spacing.

The assigned NR channel power and adjacent NR channel power are measured with rectangular filters with measurement bandwidths specified in Table 8.1.1.4-1.

If the measured adjacent channel power is greater than [–50dBm] then the NR_{ACLR} shall be higher than the value specified in Table 8.1.1.4-2.

Table 8.1.1.4-1: NR ACLR measurement bandwidth

	10 MHz	15 MHz	20 MHz	40 MHz	50 MHz	60 MHz	80 MHz	100 MHz
NR ACLR measurement bandwidth	9.375	14.235	19.095	38.895	48.615	58.35	78.15	98.31

Table 8.1.1.4-2: NR ACLR requirement

	Power class 1	Power class 2	Power class 3
NR_{ACLR}		31 dB	30 dB

8.1.1.5 Spectrum emission mask

The power of any UE emission shall not exceed the levels specified in Table 8.1.1.5-1 for the specified channel bandwidth.

Table 8.1.1.5-1: NR General spectrum emission mask

Δf_{OOB} (MHz)	10 MHz	15 MHz	20 MHz	40 MHz	50 MHz	60 MHz	80 MHz	100 MHz	Measurement bandwidth
± 0-1	-18	-20	-21	-24	-24	-24	-24	-24	30 kHz
± 1-5	-10	-10	-10	-10	-10	-10	-10	-10	1 MHz
± 5-6	-13	-13	-13	-13	-13	-13	-13	-13	
± 6-10									
± 10-15	-25								
± 15-20		-25							
± 20-25			-25						
± 25-30									
± 30-40									
± 40-45				-25					
± 45-50									
± 50-55					-25				
± 55-60									
± 60-65						-25			
± 65-80									
± 80-85							-25		
± 85-100									
± 100-105								-25	

No changes to Table 8.1.1.5-1 are needed as a result of Band n77 power class 2 operation.

8.1.1.6 Spurious emissions

Based on the same discussion as Spurious emissions of Band n78 described in clause 8.1.1.6, the following was agreed.

Table 8.1.1.6-1: Spurious emission band UE co-existence for Band n77 and n78

NR band	Spurious emission						
	Protected band	Frequency range (MHz)			Maximum Level (dBm)	MBW (MHz)	NOTE
n77	E-UTRA Band 1, 3, 5, 7, 8, 11, 18, 19, 20, 21, 26, 28, 34, 39, 40, 41, 65	F_{DL_low}	-	F_{DL_high}	-50	1	
	Frequency range	1884.5	-	1915.7	-41	0.3	PHS
	NR Band n257	26500	-	29500	[-5]	100	

Agreement: Protected bands required for Band n77 are to be the same as those for Band n78 (i.e., not only Japanese bands but also ones required for other regions such as Europe, Korea and China)

No changes to Table 8.1.1.6-1 are needed as a result of Band n77 power class 2 operation.

8.1.2 Receiver characteristics

No changes to receiver characteristics are needed as a result of Band n77 power class 2 operation.

8.1.2.1 Reference sensitivity

Based on the same discussion as reference sensitivity of Band n78 described in clause 7.1.2.1, the following was agreed.

Agreement: REFSENS for Band n77 at 3.3-3.8 GHz and n78 should be 1 dB larger than that of bands which have NR smallest sensitivity (less RF challenges) such as Band n1. REFSENS for Band n77 at 3.8-4.2 GHz is increased by 0.5 dB compared to that of Band n78.

Table 8.1.2.1-1. Reference sensitivity for Band n77

Operating Band	SCS kHz	10 MHz (dBm)	15 MHz (dBm)	20 MHz (dBm)	40 MHz (dBm)	50 MHz (dBm)	60 MHz (dBm)	80 MHz (dBm)	100 MHz (dBm)	Duplex Mode
n77 (3.3 to 3.8 GHz)	15	-95.8	-94.0	-92.7	-89.6	-88.6				TDD
	30	-96.1	-94.1	-92.9	-89.7	-88.7	-87.9	-86.6	-85.6	
	60	-96.5	-94.4	-93.1	-89.9	-88.8	-88.0	-86.7	-85.7	
n77 (3.8 to 4.2 GHz)	15	-95.3	-93.5	-92.2	-89.1	-88.1				TDD
	30	-95.6	-93.6	-92.4	-89.2	-88.2	-87.4	-86.1	-85.1	
	60	-96.0	-93.9	-92.6	-89.4	-88.3	-87.5	-86.2	-85.2	

8.1.2.2 Adjacent Channel Selectivity (ACS)

Adjacent Channel Selectivity (ACS) is a measure of a receiver's ability to receive a NR signal at its assigned channel frequency in the presence of an adjacent channel signal at a given frequency offset from the centre frequency of the assigned channel. ACS is the ratio of the receive filter attenuation on the assigned channel frequency to the receive filter attenuation on the adjacent channel(s).

It is not possible to directly measure the ACS, instead the lower and upper range of test parameters are chosen in Table 8.1.2.2-2 and Table 8.1.2.2-3 where the throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.2.2, A.2.3 and A.3.2 of TS 38.101-1 [8] (with one sided dynamic OCNG Pattern OP.1 FDD/TDD for the DL-signal as described in Annex A.5.1.1/A.5.2.1 of TS 38.101-1 [8]).

Table 8.1.2.2-1: Adjacent channel selectivity

NR band	Rx Parameter	Units	Channel bandwidth							
			10 MHz	15 MHz	20 MHz	40 MHz	50 MHz	60 MHz	80 MHz	100 MHz
n77	ACS	dB	[33.0]	[33.0]	[33.0]	[33.0]	[33.0]	[33.0]	[33.0]	[33.0]

Table 8.1.2.2-2: Test parameters for Adjacent channel selectivity, Case 1

NR band	Rx Parameter	Units	Channel bandwidth							
			10 MHz	15 MHz	20 MHz	40MHz	50 MHz	60MHz	80MHz	100 MHz
n77	Power in Transmission Bandwidth Configuration	dBm	REFSENS + 14 dB							
	PInterferer	dBm	REFSENS [+45.5]dB	REFSENS [+45.5]dB	REFSENS [+45.5]dB	REFSENS [+45.5]dB	REFSENS [+45.5]dB	REFSENS [+45.5]dB	REFSENS [+45.5]dB	REFSENS [+45.5]dB
	BWInterferer	MHz	10	15	20	40	50	60	80	100
	FInterferer (offset) For SCS of 15kHz	MHz	10+0.0125 / -10-0.0125	15+0.0075 / -15-0.0075	20+0.0025 / -20-0.0025	40+0.0125 / -40-0.0125	50+0.0025 / -50-0.0025	N/A	N/A	N/A
	FInterferer (offset) For SCS of 30kHz	MHz	10+0.005 / -10-0.005	15+0.015 / -15-0.015	20+0.025 / -20-0.025	40+0.005 / -40-0.005	50+0.025 / -50-0.025	60+0.015 / -60-0.015	80+0.025 / -80-0.025	100+0.005 / -100-0.005
	FInterferer (offset) For SCS of 60kHz	MHz	10+0.050 / -10-0.050	15+0.030 / -15-0.030	20+0.010 / -20-0.010	40+0.050 / -40-0.050	50+0.010 / -50-0.010	60+0.030 / -60-0.030	80+0.010 / -80-0.010	100+0.050 / -100-0.050

Table 8.1.2.2-3: Test parameters for Adjacent channel selectivity, Case 2

NR band	Rx Parameter	Units	Channel bandwidth							
			10 MHz	15 MHz	20 MHz	40MHz	50 MHz	60MHz	80MHz	100 MHz
n77	Power in Transmission Bandwidth Configuration	dBm	[-56.5]	[-56.5]	[-56.5]	[-56.5]	[-56.5]	[-56.5]	[-56.5]	[-56.5]
	PInterferer	dBm	-25							
	BWInterferer	MHz	10	15	20	40	50	60	80	100
	FInterferer (offset) For SCS of 15kHz	MHz	10+0.0125 / -10-0.0125	15+0.0075 / -15-0.0075	20+0.0025 / -20-0.0025	40+0.0125 / -40-0.0125	50+0.0025 / -50-0.0025	N/A	N/A	N/A
	FInterferer (offset) For SCS of 30kHz	MHz	10+0.005 / -10-0.005	15+0.015 / -15-0.015	20+0.025 / -20-0.025	40+0.005 / -40-0.005	50+0.025 / -50-0.025	60+0.015 / -60-0.015	80+0.025 / -80-0.025	100+0.005 / -100-0.005
	FInterferer (offset) For SCS of 60kHz	MHz	10+0.050 / -10-0.050	15+0.030 / -15-0.030	20+0.010 / -20-0.010	40+0.050 / -40-0.050	50+0.010 / -50-0.010	60+0.030 / -60-0.030	80+0.010 / -80-0.010	100+0.050 / -100-0.050

8.1.2.3 Blocking

8.1.2.3.1 Out-of-band blocking

Based on the same discussion as out-of-band blocking of Band n78 described in clause 7.1.2.3.1, the following was agreed.

Agreement: Out-of-band blocking for Band n77 and n78 should be specified as below.

Table 8.1.2.3.1-1: Out-of-band blocking parameters for Band n77 and n78

Rx Parameter	Units	Channel bandwidth							
		10 MHz	15 MHz	20 MHz	40 MHz	50 MHz	60 MHz	80 MHz	100 MHz
Power in Transmission Bandwidth Configuration	dBm	REFSENS + channel bandwidth specific value below							
		6	7	9	9	9	9	9	9
NOTE 1: The transmitter shall be set to 4dB below P_{CMAX_L} at the minimum uplink configuration specified TBD with P_{CMAX_L} as defined in subclause 6.2.5. NOTE 2: Reference measurement channel is TBD NOTE 3: The REFSENS power level is TBD									

Table 8.1.2.3.1-2: Out of band blocking for Band n77 and n78

NR band	Parameter	Units	Frequency		
			Range 1	Range 2	Range 3
	$P_{Interferer}$	dBm	-44	-30	-15
n77 (NOTE 2)	$F_{interferer}$ (CW)	MHz	$-60 < f - F_{DL\_low} < -3CBW$ or $3CBW < f - F_{DL\_high} < 60$	$-200 < f - F_{DL\_low} \le -60$ or $60 \le f - F_{DL\_high} < 200$	$1 \le f \le F_{DL\_low} - 200$ or $F_{DL\_high} + 200 \le f \le 12750$
n77 (NOTE 3)	$F_{Interferer}$ (CW)	MHz	–N/A	$-200 < f - F_{DL\_low} \le -MIN(200,3CBW)$ or $MIN(200,3CBW) \le f - F_{DL\_high} < 200$	$1 \le f \le F_{DL\_low} - MIN(200,3CBW)$ or $F_{DL\_high} + MIN(200,3CBW) \le f \le 12750$
NOTE 1: CBW denotes the channel bandwidth of the wanted signal NOTE 2: For CBW < 20 MHz 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 larger than 60 MHz, the requirement for Range 2 is not applicable and Range 3 applies from the frequency offset of 3*CBW from the band edge.					

8.2 BS specific

The operating band Band n77 is 3300MHz~4200MHz, belonging to FR1, therefore only 3 distinct types of NR BS each has a different architecture and requirements set are applied, which are *BS type 1-C*, *BS type 1-H* and *BS type 1-O.*

For Band n77 power class 2 HPUE, it can be foreseen that there are no additional BS receive blocking such as in-band blocking and out-of-band blocking requirements introduced.

8.2.1 Operating band unwanted emissions

The operating band unwanted emission (OBUE) limits are defined from Δf_{OBUE} below the lowest frequency of each supported downlink operating band up to Δf_{OBUE} above the highest frequency of each supported downlink operating band. According to the WF in R4-1706223, Δf_{OBUE}=40 MHz for NR bands wider than 100 MHz as baseline for the boundary between UEM and spurious emission(for both Cat A and Cat B). Therefore for Band n77, Δf_{OBUE} should be 40 MHz.

8.2.1.1 Minimum requirement for BS type 1-C and BS type 1-H

The *basic limits* of the operating band unwanted emission for Band n77 is the based on the same principles as for LTE, where the unwanted emission limits for >=5MHz channel bandwidth of each BS classes(Wide Area BS(band >1GHz), Medium Range BS and Local Area BS) can be applied to Cat A and Cat B for the unwanted emission basic limits for Band n77.

For *BS type 1-C*, the operating band unwanted emissions requirement for each *antenna connector* shall be defined based on *basic limits* with no scaling and no antenna considered.

For *BS type 1-H*, the operating band unwanted emissions requirements are for each *TAB connector TX* shall be defined based on *base limits*. The power summation emission at the *TAB connectors* of the *TAB connector TX min cell* shall not exceed the *basic limit* + X, where $X = 10\log_{10}(N_{TXU,countedpercell})$.

8.2.1.2 Minimum requirement for BS type 1-O

The OTA operating band unwanted emissions requirements are applied at RIB and based on the emission scaling, where the emission limits are defined as basic limit+9dB, where the basic limits are specified in subclause 8.2.1.1.

8.2.2 Additional spurious emissions requirements

8.2.2.1 Minimum requirement for BS type 1-C and BS type 1-H

The additional spurious emission requirement may be applied for the protection of system operating in frequency ranges other than the BS downlink operating band. It is proposed that the same limits as TDD E-UTRA bands (i.e. -52 dBm/MHz) can be applied for the *basic limits* for NR band n77.

In addition, since the Band n77 and n78 are overlapping operating bands, and these two bands may be deployed in the same geographical area, thus this requirement does not apply to BS operating in Band n77 and n78.

For *BS type 1-C*, the emissions requirements for each *antenna connector* shall be defined based on *basic limits* with no scaling and no antenna considered.

For *BS type 1-H*, the emissions requirements are for each *TAB connector TX* shall be defined based on the *basics limits*, The power summation emission at the *TAB connectors* of the *TAB connector TX min cell* shall not exceed the *basic limit* + X, where $X = 10\log_{10}(N_{TXU,countedpercell})$.

8.2.2.2 Minimum requirement for BS type 1-O

The OTA minimum requirements are applied at RIB and based on the emission scaling, where the emission limits are defined as basic limit+9dB, where the basic limits are specified in subclause 8.2.2.1.

8.2.3 Co-location with other base stations

8.2.3.1 Minimum requirement for BS type 1-C and BS type 1-H

The conduct requirements assume a 30dB coupling loss between transmitter and receiver and are based on co-location with base stations of the same class. Thus, it is proposed that the same limits as E-UTRA for different BS classes can be applied for the *basic limits* of co-location requirements for each BS classes for NR Bands n77.

For BS type 1-C, the emissions requirements for each *antenna connector* shall be defined based on *basic limits* with no scaling and no antenna considered.

For BS type 1-H, the emissions requirements are for each *TAB connector* shall be defined based on the *basics limits*, The power summation emission at the *TAB connectors* of the *TAB connector TX min cell* shall not exceed the *basic limit* + X, where $X = 10\log_{10}(N_{TXU,countedpercell})$.

8.2.3.2 Minimum requirement for BS type 1-O

The OTA co-location with other base stations requirements are specified as co-location requirements using the co-location reference antenna, as described in TR 37.843 [9].

The output of the *co-location reference antenna* of any spurious emission shall not exceed the *basic limits* in subclause 7.2.3.1 + X dB, where X = -21 dB.

8.2.4 General blocking requirement

8.2.4.1 Minimum requirement for BS type 1-C and BS type 1-H

The blocking requirements apply in the in-band blocking frequency range, which is from 60 MHz below the lowest frequency of the uplink operating band up to 60 MHz above the highest frequency of the uplink operating band for NR Band n77, but excludes the downlink frequency range of the operating band.

The blocking requirements apply in the out-of-band blocking frequency range, which is from 1MHz to 60 MHz below the lowest frequency of the uplink operating band or from 60 MHz above the highest frequency of the uplink operating band to 12750MHz for NR BS operating in Band n77, but includes the downlink frequency range of the operating band.

Minimum conducted requirement is defined at the *antenna connector* for *BS type 1-C* and at the *TAB connector* for *BS type 1-H.*

8.2.4.2 Minimum requirement for BS type 1-O

The blocking requirements apply in the in-band blocking frequency range, which is from 60 MHz below the lowest frequency of the uplink operating band up to 60 MHz above the highest frequency of the uplink operating band for NR Band n77, but excludes the downlink frequency range of the operating band.

The *BS type 1-O* in-band blocking requirements apply at the RIB when the AoA of the incident wave of a received signal and the interfering signal are from the same direction and are within OTA REFSEN *RoAOA* and *minSENS RoAoA.*

The blocking requirements apply in the out-of-band blocking frequency range, which is from 30MHz to 60 MHz below the lowest frequency of the uplink operating band or from 60 MHz above the highest frequency of the uplink operating band to 12750MHz for NR BS operating in Band n77, but includes the downlink frequency range of the operating band.

The *BS type 1-O* out-of -band blocking requirements apply at the RIB when the AoA of the incident wave of a received signal and the interfering signal are from the same direction and are within *minSENS RoAoA.*

8.2.5 Blocking requirement for co-location with other base stations

8.2.5.1 Minimum requirement for *BS type 1-C* and *BS type 1-H*

The conduct requirements assume a 30dB coupling loss between interfering transmitter and receiver and are based on co-location with base stations of the same class. Thus, it is proposed that the same limits as E-UTRA for different BS classes can be applied for the *base limits* of co-location requirements for each BS classes for NR Bands n77.

Minimum conducted requirement is defined at the *antenna connector* for *BS type 1-C* and at the *TAB connector* for *BS type 1-H.*

8.2.5.2 Minimum requirement for *BS type 1-O*

The OTA co-location blocking requirements are specified as co-location requirements using the co-location reference antenna, as described in TR 37.843 [9].

The interferer power level is specified per polarization and defined as a power into the conducted input of the co-location reference antenna.

9 Required changes to NR, E-UTRA, UTRA and MSR specifications

No changes identified

Annex A:
Change history

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
2017-08	RAN4#84	R4-1707861				TR skeleton	0.0.1
2017-11	RAN4#85	R4-1713002				R4-1711816, TP for TR 38.813 UE RF requirements of Band n77 and n78	0.1.0
2018-01	RAN4# AH-1801	R4-1800511				R4-1713002, TR 38.813 v0.1.0 New frequency range for NR 3.3GHz - 4.2GHz R4-1714322, TP to TR38.813: BS specific requirements(Clause 8.2); R4-1714323, TP to TR38.813: BS specific requirements(Clause 7.2); R4-1712815,TP for TR 38.813 Finalization of Band n77 and n78; R4-1714341 [NR] TP for TR 38.813 UL MIMO UE RF requirements of Band n78 and n77; R4-1714374 TP to TR 38.813 NR band for n77 and n78	0.2.0
2018-02	RAN4#86	R4-1801424				R4-1800511, TR 38.813 v0.2.0_New frequency range for NR 3.3GHz - 4.2GHz; R4-1800436, TP to TR 38.813 for NR bands n77 and n78; R4-1800452 [NR] TP for 38.813 4Rx for n77 and n78	0.3.0
2018-03	RAN#79	RP-180156				Presented to plenary for approval R4-1801424, Draft TR 38.813 v0.3.0 for New frequency range 3.3GHz - 4.2GHz; R4-1801428, TP for TR 38.813 HPUE of n78 and n77; R4-1801473, TP to TR38.813 BS specific; requirements(Section 7.2); R4-1801474, TP to TR38.813 BS specific requirements(Section 8.2); R4-1801429, Update to TR 38.813 v0.4.0 Finalization	1.0.0
2018-03	RAN#79					Approved by plenary – Rel-15 spec under change control	15.0.0