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Technical Report

3rd Generation Partnership Project;
Technical Specification Group Radio Access Network;
New frequency range for NR (4.4-5.0 GHz)
(Release 15)

3GPP

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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 Work Item on New Radio (NR) Access Technology, covering the new frequency range between 4.4 – 5.0 GHz for NR.

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".

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
$P_{Interferer}$	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].

BW	Bandwidth
NR	New Radio
RF	Radio Frequency
SCS	Sub-Carrier Spacing
TDD	Time division Duplex
UE	User Equipment

4 Background

Recently, two countries such as Japan and China have announced their "5G" spectrum strategies and roadmaps for the frequency range between 4.4-5.0 GHz to deploy commercial stems for NR as follows.

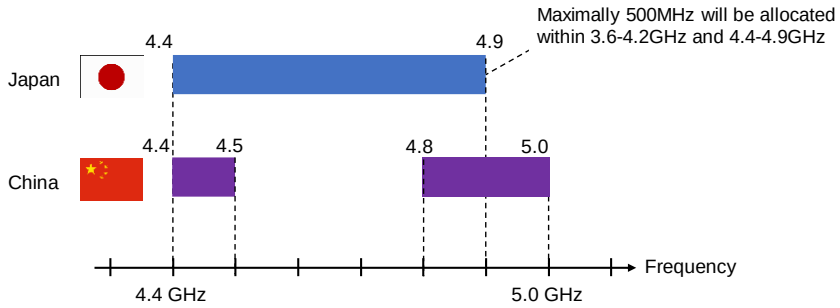


Figure 4-1: NR spectrum plans in the range between 4.4 – 5.0 GHz

5 NR Frequency band definition

Considering the spectrum plans in each country described in the section 4, the band plan for 4.4 – 5.0 GHz frequency range is decided as shown in Figure 5-1.

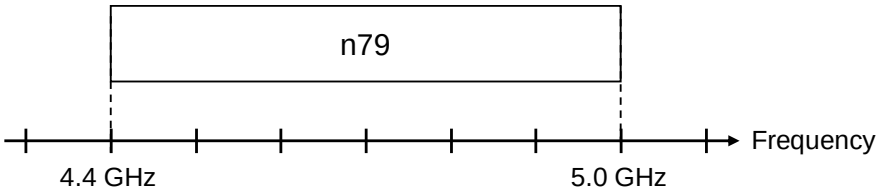


Figure 5-1: Band definition in the frequency range between 4.4 – 5.0 GHz

6 Channel numbering and channel bandwidth

Band numbering for the range and applicable duplex mode for 4.4 – 5.0 GHz are provided in Table 6-1.

Table 6-1: New NR band in the frequency range between 4.4 – 5.0 GHz

Band number	UL	DL	Duplex mode
n79	4.4 – 5.0 GHz	4.4 – 5.0 GHz	TDD

Available channel bandwidths for n79 are summarized below.

Table 6-2: Channel Bandwidths for n79

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	100 MHz
n79	15							Yes	Yes			
	30							Yes	Yes	Yes	Yes	Yes
	60							Yes	Yes	Yes	Yes	Yes
NOTE 1: 90% spectrum utilization may not be achieved for 30kHz SCS. NOTE 2: 90% spectrum utilization may not be achieved for 60kHz SCS. NOTE 3: This UE channel bandwidth is applicable only to downlink.												

7 NR band 4.4-5.0 GHz issues

7.1 UE specific

7.1.1 Transmitter characteristics

7.1.1.1 UE maximum output power

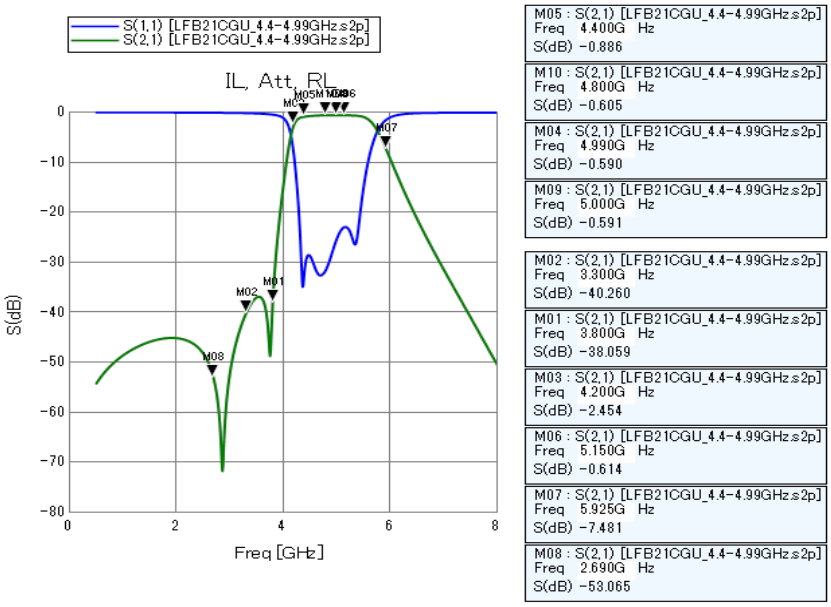
The MOP requirements for Band 42 and 43 single-carrier were specified as 23 dBm +2/-3 dB for power class 3 based on simulation results shown in Table 7.1.1.1-1 in August 2011.

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

BPFs for Band n79 are provided in Table 7.1.1.1-2 and 7.1.1.1-3.

Table 7.1.1.1-2: Simulation results for combined Band 42 and Band 43 filter [R4-114656]



F [GHz]	4.4	4.8	4.99	5.0
IL +25C [dB]	0.88	0.60	0.59	0.59
IL ETC -40~+90C [dB]	1.1	0.8	0.80	0.80

Table 7.1.1.1-3: Simulation results for combined Band 42 and Band 43 filter [R4-114656]

	typ IL [dB]			worst IL [dB]			Attenuation [dB]					
frequencies [GHz]	4.4	4.8	5	4.4	4.8	5	2.3-2.69	0.617-2.2	3.3-4.2	3.3-3.8	5.15-5.925	5.250-5.925
n79 filter TR	2.3	1	2.3	2.5	1.2	2.5	>35	>25	>15	>15	>40	>40
comment	4.4-4.5GHz range must demonstrate coexistence with altimeter band for China											
	improved rejection in WiFi band											

From these tables, no significant filter IL degradation for Band n79 can be seen compared to that of Band 42 and 43 at ETC condition. Therefore, MOP for Band n79 should be aligned with those of Band 42 and 43 at least.

Agreement: MOP for Band n79 is to be 23 dBm +2/-3 dB

7.1.2 Receiver characteristics

7.1.2.1 Reference sensitivity

With the same investigation as UE maximum output power described in 7.1.1.1, no significant filter IL degradation for Band n79 can be seen compared to that of Band 42 and 43 at ETC condition. In addition, from LNA perspective, the fractional bandwidth of Band n79 pass-band is 12.8 % which is smaller than that of Band n78 (14.1 %). Hence, NF of Band n79 shouldn't be higher than that of Band n78. Therefore, reference sensitivity for Band n79 should also be aligned with those of Band n78 at least.

Agreement: REFSENS for Band n79 should be 1 dB larger than that of bands which have NR smallest sensitivity (less RF challenges) such as Band n1.

Table 7.1.2.1-1: Reference sensitivity for Band n79

Operating Band	SCS kHz	40 MHz (dBm)	50 MHz (dBm)	60 MHz (dBm)	80 MHz (dBm)	100 MHz (dBm)	Duplex Mode
n79	15	-89.6	-88.6				TDD
	30	-89.7	-88.7	-87.9	-86.6	-85.6	
	60	-89.9	-88.8	-88.0	-86.7	-85.7	

7.1.2.2 Blocking

7.1.2.2.1 Out-of-band blocking

Based on filter performance shown in Table 7.1.1.1-1 and 7.1.1.1-2, out-of-band blocking requirement needs to be optimized as with LTE band 42 and 43 as below.

Table 7.1.2.2.1-1: Out-of-band blocking parameters for Band n79

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

Table 7.1.2.2.1-2: Out of band blocking for Band n79

NR band	Parameter	Units	Frequency		
			Range 1	Range 2	Range 3
	$P_{Interferer}$	dBm	-44	-30	-15
n79 (NOTE 2)	$F_{Interferer}$ (CW)	MHz	N/A	$-150 < f - F_{DL\_low} \leq -MIN(150,3CBW)$ or $MIN(150,3CBW) \leq f - F_{DL\_high} < 150$	$1 \leq f \leq F_{DL\_low} - MIN(150,3CBW)$ or $F_{DL\_high} + MIN(150,3CBW) \leq f \leq 12750$
NOTE 1: CBW denotes the channel bandwidth of the wanted signal NOTE 2: 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 equal or larger than 50 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 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	R4-1708172				Skeleton TR 38.814	0.0.1
2018-01	ARN4AH-1801	R4-1800831				draft TR 38.814 (NR 4.4-5.0GHz band)	0.1.0
2018-03	RAN#79	RP-180334				v1.0.0 presented to plenary for information	1.0.0
2018-06	RAN#80					v2.0.0 presented to plenary for approval	2.0.0
2018-06	RAN#80					Approved by plenary – Rel-15 spec under change control	15.0.0