3GPP TR 38.847 V0.1.0 (2021-01)

Technical Report

3rd Generation Partnership Project;
Technical Specification Group Radio Access Network;
NR;
New frequency range for NR (47.2 – 48.2 GHz);
(Release 17)

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

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- 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 47.2- 48.2 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".

[2] 3GPP TS 38.141-2: "NR; Base Station (BS) conformance testing; Part 2: Radiated conformance testing".

[3] 3GPP TS 38.133: "NR; Radio Resource Control (RRC); Protocol specification".

[4] 3GPP TS 38.101-2: "NR; User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone"

[5] 3GPP TS 38.104: "NR; Base Station (BS) radio transmission and reception".

[6] World Radiocommunication Conference 2019 (WRC-19) Final Acts, ITU-R

[7] Title 47 of the Code of Federal Regulations (CFR) Part 30, FCC

3 Definitions of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms 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].

Definition format (Normal)

<defined term>: *<definition>.*

3.2 Symbols

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

ΔF_{Global}	Global frequency raster granularity
ΔF_{Raster}	Channel raster granularity
$F_{REF-Offs}$	Offset used for calculating F_{REF}
$F_{step,X}$	Frequency steps for the OTA transmitter spurious emissions
N_{REF}	NR Absolute Radio Frequency Channel Number (NR-ARFCN)
$N_{REF-Offs}$	Offset used for calculating N_{REF}

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].

ACLR	Adjacent Channel Leakage Ratio
ACS	Adjacent Channel Selectivity
BS	Base Station
BW	Bandwidth
EIRP	Effective Isotropic Radiated Power
FR	Frequency Range
GSCN	Global Synchronization Channel Number
ICS	In-Channel Selectivity
ITU-R	Radiocommunication Sector of the International Telecommunication Union
NR	New Radio
NR-ARFCN	NR Absolute Radio Frequency Channel Number
OTA	Over The Air
RF	Radio Frequency
RX	Receiver
SCS	Sub-Carrier Spacing
TDD	Time division Duplex

4 Background

4.1 ITU-R

As part of facilitating the development of 5G mobile networks, WRC-19 identified the 47 GHz frequency band (47.2-48.2 GHz) for International Mobile Telecommunications (IMT) under Footnote 5.553B of the ITU Radio Regulations for use in 71 nations across Africa, Europe, the Middle East and Asia Pacific (ITU Regions 1 and 3 respectively), in addition to the entire Americas Region (ITU Region 2, which consists of 35 nations) [6]. Table4.1-1 is the extract of the Radio Regulations (XX) table of allocations providing the services allocated in the 47.2-48.2 GHz frequency range

Table 4.1-1: Allocation information in the 47.2-48.2 GHz frequency range

Allocation to services		
Region 1	**Region 2**	**Region 3**
47.2-47.5	FIXED FIXED-SATELLITE (Earth-to-space) 5.550C 5.552 MOBILE 5.553B 5.552A	
47.5-47.9 FIXED FIXED-SATELLITE (Earth-to-space) 5.550C 5.552 (space-to-Earth) 5.516B 5.554A MOBILE 5.553B	**47.5-47.9** FIXED FIXED-SATELLITE (Earth-to-space) 5.550C 5.552 MOBILE 5.553B	

47.9-48.2	FIXED FIXED-SATELLITE (Earth-to-space) 5.550C 5.552 MOBILE 5.553B 5.552A

With the footnote 5.553B: In Region 2 and Algeria, Angola, Saudi Arabia, Australia, Bahrain, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Rep., Comoros, Congo (Rep. of the), Korea (Rep. of), Côte d'Ivoire, Djibouti, Egypt, United Arab Emirates, Eswatini, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Equatorial Guinea, India, Iran (Islamic Republic of), Iraq, Japan, Jordan, Kenya, Kuwait, Lesotho, Liberia, Libya, Lithuania, Madagascar, Malaysia, Malawi, Mali, Morocco, Mauritius, Mauritania, Mozambique, Namibia, Niger, Nigeria, Oman, Uganda, Qatar, the Syrian Arab Republic, the Dem. Rep. of the Congo, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Singapore, Slovenia, Somalia, Sudan, South Sudan, South Africa, Sweden, Tanzania, Chad, Togo, Tunisia, Zambia and Zimbabwe, the frequency band 47.2-48.2 GHz is identified for use by administrations wishing to implement International Mobile Telecommunications (IMT). This identification does not preclude the use of this frequency band by any application of the services to which it is allocated, and does not establish any priority in the Radio Regulations. Resolution 243 (WRC-19) applies. (WRC-19)
According to Resolution 243 (WRC-19) [6], IMT in 47.2-48.2 GHz may coexist with satellite services and IMT base stations may require some measure to protect the services by bilateral agreement and possibly with site engineering solutions. Such protection measure is not a scope of 3GPP work, therefore, no specific coexistence requirement is specified in 3GPP for the mobile and base stations to protect other services for example by having additional spurious emission requirements.

However, it cannot be excluded any requirement is introduced by individual administration in nation level in the future to protect the service in the same or adjacent bands. Current 3GPP framework is flexible enough to introduce additional requirement later by Network signalling mechanism. Therefore, this band can be reused even if additional coexistence requirement is introduced in future by some administrations.

4.2 FCC

The US FCC auctioned the 47 GHz band beginning in December 2019 as part of Auction 103. The 47 GHz band (47.2-48.2 GHz) was auctioned in 10 blocks of 100 megahertz in each PEA (Partial Economic Area) license. The auction was concluded on 3/5/2020.

The radio regulatory requirements in FCC rules are specified in CFR Title 47 Part 30 [7]. The channelization is 100 MHz starting from 47.2 GHz ending at 48.2 GHz. The emission requirements for both BS and UE are aligned with other FR2 bands in FCC, i.e., bands n260, and n261 in 3GPP.

The power limits and unwanted emissions for the transportable station (intended for CPE devices) are consistent with the existing UE power class 1 for FR2 bands. The ones for the mobile stations are consistent with the existing FR2 UE power class 2, 3, and 4.

Table 4.2-1 captures channel arrangement, power limits and unwanted emissions specified by FCC**Error! Reference source not found.**.

Table 4.2-1: FCC requirements

Channel arrangement	47.2-47.3 GHz; 47.3-47.4 GHz; 47.4-47.5 GHz; 47.5-47.6 GHz; 47.6-47.7 GHz; 47.7-47.8 GHz; 47.8-47.9 GHz; 47.9-48.0 GHz; 48.0-48.1 GHz; and 48.1-48.2 GHz
Power limit (EIRP)	Base station: +75 dBm/100MHz Mobile station: +43 dBm Transportable station: +55 dBm
Unwanted emissions	+5 dBm/MHz (within 10% of channel bandwidth separation) +13 dBm/MHz (outside more than 10% of channel bandwidth apart)

5 NR Frequency band definition

The new band 47.2-48.2 GHz is within the range of FR2 (24250 – 52600 MHz) and is proposed as a TDD band (Table 5-1). The first unused FR2 band number, n262, is proposed for this new band.

Table 5-1: New NR band in FR2

Band number	UL	DL	Duplex mode
n262	47.2 – 48.2 GHz	47.2 – 48.2 GHz	TDD

6 Channel numbering and channel bandwidth

Though the channelization in FCC rules is 100 MHz, it is not precluded to use 50 MHz channel bandwidth. Allocation block size is still unknown in other administrations. For maximum flexibility, the channel bandwidths for NR band n262 is proposed to be aligned with the existing FR2 bands as shown in Table 6-1.

Table 6-1: NR channel bandwidth in the frequency range between 47.2-48.2 GHz

NR band		Channel bandwidth			
Band number	data SCS(kHz)	50 MHz	100 MHz	200 MHz	400 MHz
n262	60	Yes	Yes	Yes	
	120	Yes	Yes	Yes	Yes

NR-ARFCN parameters for the global frequency raster are presented in TS 38.104, table 6-2:

Table 6-2: NR-ARFCN parameters for the global frequency raster

Frequency range (MHz)	ΔF_{Global} (kHz)	$F_{REF-Offs}$ (MHz)	$N_{REF-Offs}$	Range of N_{REF}
0 – 3000	5	0	0	0 – 599999
3000 – 24250	15	3000	600000	600000 – 2016666
24250 – 100000	60	24250.08	2016667	2016667 – 3279165

Using information above and the equation $F_{REF} = F_{REF-Offs} + \Delta F_{Global} (N_{REF} – N_{REF-Offs})$, the channel raster for n262 is also proposed to cover all the frequency with the 60/120 kHz channel raster aligned with the other F2 band as presented in Table 6-3.

Table 6-3: Applicable NR-ARFCN in the frequency range between 47.2-48.2 GHz

NR Operating Band	ΔF_{Raster} (kHz)	Uplink and Downlink Range of N_{REF} (First – <Step size> – Last)
n262	60	2399166 – <1> – 2415832
	120	2399167 – <2> – 2415831

The synchronization raster in the frequency range between 47.2-48.2 GHz is given in Table 6-4. The distance between applicable GSCN entries is given by the <Step size> indicated in Table 6-4 with the step size interval of 17.28 MHz.

Table 7-4: Applicable SS raster entries in the frequency range between 39.5-43.5 GHz

NR Operating Band	SS Block SCS	SS Block pattern[1]	Range of GSCN (First – <Step size> – Last)
n262	120 kHz	Case D	23586 – <1> – 23641
	240 kHz	Case E	23588 – <2> – 23640
NOTE: SS Block pattern is defined in subclause 4.1 in TS 38.213.			

7 Configurations for intra-band contiguous CA

8 RF requirements

8.1 UE specific

8.1.1 Transmitter characteristics

8.1.2 Receiver characteristics

8.2 BS specific

8.2.1 Band agnostic requirements

The BS RF requirements summarized in Table 8.2.1-2 is band agnostic RF requirements for FR2 which are applicable for band n262 as well.

Table 8.2.1-2: Summary on band agnostic of BS RF requirements for FR2

BS TX side capture in TS 38.104	BS RX side capture in TS 38.104
9.2 Radiated transmit power	10.3 OTA reference sensitivity level
9.3 OTA Base station output power	10.5 OTA In-band selectivity and blocking
9.4 OTA Output power dynamics	
9.5 OTA Transmit ON/OFF power	10.9 OTA In-channel selectivity
9.6 OTA Transmitted signal quality	
9.7.2 OTA Occupied bandwidth	
9.7.5 OTA Transmitter spurious emissions (cat A)	

8.2.2 Transmitter characteristics

8.2.2.1 Adjacent Channel Leakage Ratio (ACLR)

The BS OTA ACLR limit for spectrum range 37 – 52.6 GHz has been defined in TS 38.104. This is also applicable for Band n262.

8.2.2.2 OTA operating band unwanted emissions

The BS OTA operating band unwanted emission for spectrum range 37 – 52.6 GHz has been specified in TS 38.104, section 9.7. Those limits are applicable for Band n262.

8.2.2.3 Step frequencies for Tx spurious emission

The 47.2-48.2 GHz frequency range has not yet been regulated in Region where Category B limits are applicable. The Category B Tx spurious limits doesn't have to updated (at least for the time being).

8.2.3 Receiver characteristics

8.2.3.1 Step frequencies for Rx spurious emission

The band n262 shall be added to Table 10.7.3-2 in TS 38.104 as proposed below.

Table 10.7.3-2: Step frequencies for defining the radiated Rx spurious emission limits for *BS type 2-O*

Operating band	$F_{step,1}$ (GHz)	$F_{step,2}$ (GHz)	$F_{step,3}$ (GHz)	$F_{step,4}$ (GHz)	$F_{step,5}$ (GHz)	$F_{step,6}$ (GHz)
n257	18	23.5	25	31	32.5	41.5
n258	18	21	22.75	29	30.75	40.5
n259	23,5	35,5	38	45	47,5	59,5
n260	25	34	35.5	41.5	43	52
n261	18	25.5	26.0	29.85	30.35	38.35
n262	37.2	45.2	45.7	49.7	50.2	58.2

8.2.4 BS conformance aspects

On top of generic FR2 BS test requirements, the following 38.141-2 transmitter test requirements changes are expected due to introduction of n262:

1. Update test requirements for radiated transmit power/TRP measurement results range/measured mean EIRP spectral density

	Normal test environment	Extreme test environment
BS type 1-H	f ≤ 3 GHz: ± 3.3 dB	N/A
	3 GHz < f ≤ 6 GHz: ± 3.5 dB	
BS type 1-O	f ≤ 3 GHz: ± 3.3 dB	f ≤ 3 GHz: ± 5.2 dB
	3 GHz < f ≤ 6 GHz: ± 3.5 dB	3 GHz < f ≤ 4.2 GHz: ± 5.3 dB
		4.2 GHz < f ≤ 6 GHz: ± 5.3 dB
BS type 2-O	24.15 GHz < f ≤ 29.5 GHz: ± 5.1 dB 37 GHz < f ≤ [48.2] GHz: ± 5.4 dB …	24.15 GHz < f ≤ 29.5 GHz: ± 7.6 dB 37 GHz < f ≤ [48.2] GHz: ± 7.8 dB

- within +5.4 dB and –5.4 dB of the manufacturer's declared *rated carrier TRP* $P_{rated,c,TRP}$ for carrier frequency 37 GHz < f ≤ [48.2] GHz.

The measured mean EIRP spectral density according to subclause 6.5.2.4.2 shall be less than - 32.7 + $P_{rated,c,EIRP}$ - $P_{rated,c,TRP}$ dBm/MHz for carrier frequency 37 GHz < f ≤ [48.2] GHz, where $P_{rated,c,EIRP}$ is the value declared for the *reference beam direction pair* (D.8) for the beam identifier (D.3) which provides the highest intended EIRP.

2. Define maximum OTA test system uncertainty for FR2 OTA transmitter tests to be applicable up to 48.2GHz

Subclause	Maximum OTA Test System uncertainty
6.2 Radiated transmit power	Normal condition: ±1.7 dB (24.25 – 29.5 GHz) ±2.0 dB (37 – 43.5 GHz) ±2.2 dB (43.5 – 48.2 GHz)
	Extreme condition: ±3.1 dB (24.25 – 29.5 GHz) ±3.3 dB (37 – 43.5 GHz) ±3.5 dB (43.5 – 48.2 GHz)
6.3 OTA base station output power	±2.1 dB (24.25 – 29.5 GHz) ±2.4 dB (37 – 43.5 GHz) ±2.6 dB (43.5 – 48.2 GHz)
6.4.2 OTA RE power control dynamic range	N/A
6.4.3 OTA total power dynamic range	±0.4 dB
6.5.1 OTA transmitter OFF power	±2.9 dB (24.25 – 29.5 GHz) ±3.3 dB (37 – 43.5 GHz) ±[3.5-3.6] dB (43.5 – 48.2 GHz)
6.5.2 OTA transmitter transient period	N/A
6.6.2 OTA frequency error	±12 Hz
6.6.3 OTA modulation quality	1%
6.6.4 OTA time alignment error	±25 ns
6.7.2 OTA occupied bandwidth	600 kHz
6.7.3 OTA ACLR	Relative ACLR: ±2.3 dB (24.25 – 29.5 GHz) ±2.6 dB (37 – 43.5 GHz) ±2.8 dB (43.5 – 48.2 GHz) Absolute ACLR: ±2.7 dB (24.25 – 29.5 GHz) ±2.7 dB (37 – 43.5 GHz) ±[2.7-2.9] dB (43.5 – 48.2 GHz)
6.7.4 OTA operating band unwanted emissions	±2.7 dB (24.25 – 29.5 GHz) ±2.7 dB (37 – 43.5 GHz) ±[2.7-2.9] dB (43.5 – 48.2 GHz)
6.7.5.2 OTA transmitter spurious emissions, mandatory requirements	±2.3 dB, 30 MHz ≤ f ≤ 6 GHz ±2.7 dB, 6 GHz < f ≤ 40 GHz ±5.0 dB, 40 GHz < f ≤ 60 GHz
6.7.5.4 OTA transmitter spurious emissions, additional requirements	±2.3 dB, 30 MHz ≤ f ≤ 6 GHz ±2.7 dB, 6 GHz < f ≤ 40 GHz ±5.0 dB, 40 GHz < f ≤ 60 GHz
NOTE: Test system uncertainty values are applicable for normal condition unless otherwise stated.	

On top of generic FR2 BS test requirements, the following 38.141-2 receiver test requirements changes are expected due to introduction of n262:

1. Introduction of step frequencies for defining the radiated Rx spurious emission limits for n262

Operating band	$F_{step,1}$ (GHz)	$F_{step,2}$ (GHz)	$F_{step,3}$ (GHz)	$F_{step,4}$ (GHz)	$F_{step,5}$ (GHz)	$F_{step,6}$ (GHz)
n257	18	23.5	25	31	32.5	41.5
n258	18	21	22.75	29	30.75	40.5
n259	23.5	35.5	38	45	47.5	59.5
n260	25	34	35.5	41.5	43	52
n261	18	25.5	26.0	29.85	30.35	38.35
n262	37.2	45.2	45.7	49.7	50.2	58.2

Define maximum OTA test system uncertainty for FR2 OTA receiver tests to be applicable up to 48.2GHz

Subclause	Maximum OTA Test System uncertainty
7.3 OTA reference sensitivity level	±2.4 dB, 24.25 GHz < f ≤ 29.5 GHz ±2.4 dB, 37 GHz < f ≤ [48.2] GHz
7.5.1 OTA adjacent channel selectivity	±3.4 dB, 24.25 GHz < f ≤ 29.5 GHz ±3.4 dB, 37 GHz < f ≤ [48.2] GHz
7.5.2 In-band blocking (General)	±3.4 dB, 24.25 GHz < f ≤ 29.5 GHz ±3.4 dB, 37 GHz < f ≤ [48.2] GHz
7.6 OTA out-of-band blocking	±4.1 dB
7.7 OTA receiver spurious emissions	±2.5 dB, 30 MHz ≤ f ≤ 6 GHz ±2.7 dB, 6 GHz < f ≤ 40 GHz ±5.0 dB, 40 GHz < f ≤ 60 GHz
7.8 OTA receiver intermodulation	±3.9 dB, 24.25 GHz < f ≤ 29.5 GHz ±3.9 dB, 37 GHz < f ≤ [48.2] GHz
7.9 OTA in-channel selectivity	±3.4 dB, 24.25 GHz < f ≤ 29.5 GHz ±3.4 dB, 37 GHz < f ≤ [48.2] GHz
NOTE: Test system uncertainty values are applicable for normal condition unless otherwise stated.	

9 RRM

9.1 Frequency bands grouping

9.2 Conditions for RRM requirements applicability for operating bands

9.2.1 Minimum SSB_RP values for Rx Beam Peak angle of arrival

9.2.2 Minimum SSB_RP values for angle of arrival within Spherical coverage

Annex A (informative): Change history

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
08/2020	RAN4-96e					TR Skeleton	0.0.0
02/2021	RAN4-98e					Agreed Test Proposal from RAN4#97-e: - R4-2016883 BS RF Requirements and System parameters - TP to TR 38.847 - R4-2016884 TP to TR 38.847: BS RF requirements	0.1.0