3GPP TR 38.815 V15.1.0 (2021-09)

Technical Report

3rd Generation Partnership Project;
Technical Specification Group Radio Access Network;
New frequency range for NR (24.25-29.5 GHz)
(Release 15)

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 Work Item on New Radio (NR) Access Technology, covering the new frequency range between 24.25-29.5 GHz for NR.

Note: NR band n261 (TDD 27500 - 28350 MHz) which was introduced by the same Rel-15 work item was not considered in TR 38.815. The n261 requirements are based on an FCC report [2] and differ from the n257 (TDD 26500 - 29500 MHz) requirements in several aspects.

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] FCC-16-89A1 https://apps.fcc.gov/edocs_public/attachmatch/FCC-16-89A1.pdf

[3] RSCOM16-40rev3 https://cept.org/Documents/ecc-pt1/34326/ecc-pt1-17-055_5g-mandate

[4] “International Telecommunications Union Radio Regulations”, Edition 2016, Volume 1 – Articles, ITU.

[5] Recommendation ITU-R SM.329-12, “Unwanted emissions in the spurious domain”.[6] Recommendation ITU-R SM.328-11, “Spectra and Bandwidth of Emissions”.

[7] Recommendation ITU-R SM.1539-1, “Variation of the boundary between the out-of-band and spurious domains required for the application of Recommendations ITU-R SM.1541 and ITU-R SM.329”.

[8] Recommendation ITU-R SM.1540, “Unwanted emissions in the out-of-band domain falling into adjacent allocated bands”.

[9] Recommendation ITU-R SM.1541-6, “Unwanted emissions in the out-of-band domain”.

[10] ECC Recommendation (02)05, “Unwanted Emissions”, October 2002, amended March 2012.

[11] CEPT/ERC/RECOMMENDATION 74-01, “Unwanted Emissions in the Spurious Domain”, Cardiff 2011.

[12] ETSI EN 301 908, “IMT cellular networks; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive;” (22 parts).

[13] 3GPP TS 38.213: "NR; Physical layer procedures for control".

[14] 3GPP TR 38.817-2: "General aspects for Base Station (BS) Radio Frequency (RF) for NR”.

[15] 3GPP TR 38.817-1: “General aspects for User Equipment (UE) Radio Frequency (RF) for NR”.

[16] 3GPP TS 38.101-2: "NR; User Equipment (UE) radio transmission and reception; Part 2: Range 2 Standalone".

[17] 3GPP TS 38.104: "NR; Base Station (BS) radio transmission and reception".

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].

Operating band: frequency range in which NR operates (paired or unpaired), that is defined with a specific set of technical requirements.

3.2 Symbols

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

ΔF_{Raster} Band dependent channel raster granularity

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
EIS	Equivalent Isotropic Sensitivity
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
TX	Transmitter
TRP	Total Radiated Power

4 Background

International Mobile Telecommunications (IMT) systems have contributed to global economic and social development of both developed and developing countries. IMT systems are now being evolved to provide diverse usage scenarios and applications such as enhanced mobile broadband (eMBB), massive machine-type (mMTC) and ultra-reliable and low-latency communications (URLLC) requiring larger contiguous blocks of spectrum than currently available bandwidth to realize those applications.

It is then important to note that the properties of higher frequency bands, such as shorter wavelength, would better enable the use of advanced antenna systems including multiple-input and multiple-output (MIMO) and beam-forming techniques in supporting enhanced broadband.

Adequate and timely availability of spectrum with appropriate regulatory provisions, as well as improved technologies, are essential to support the future growth of IMT. Harmonized worldwide frequency bands and harmonized frequency arrangements for these systems are highly desirable in order to facilitate global roaming and the benefits of economies of scale.

4.1 NR spectrum plans in the range between 24.25-29.5 GHz

Spectrum harmonization remains important for the development of NR and even more important for higher frequencies above 24 GHz in order to support the development of a new ecosystem as well as the deployment of very advanced antenna systems. Recently, many countries and regions such as USA, Europe, Korea, Japan and China have announced their “5G” spectrum strategies and roadmaps for the frequency range between 24.25-29.5 GHz as a key frequency band to deploy commercial systems for NR as follows.

On July 2016, the USA Federal Communications Commission (FCC) adopted a Report and Order (R&O) with new rules to enable rapid development and deployment of next generation (5G) technologies and services in the millimetre wave (mmW) bands [2]. These new rules open up nearly 11 GHz of high-frequency spectrum for flexible, mobile and fixed use wireless broadband: 3.85 GHz of licensed spectrum and 7 GHz of unlicensed spectrum by creating a new Upper Microwave Flexible Use service (UMFUS) in the 28 GHz (27.5-28.35 GHz), 37 GHz (37-38.6 GHz), and 39 GHz (38.6-40 GHz) bands, and a new unlicensed band at 64-71 GHz.

On December 2016, the European Commission (EC) and the 48 countries of European Conference of Postal and Telecommunications (CEPT) agreed to recommend the 24.25-27.5 GHz as a pioneer band for 5G above 24 GHz [3]. The European countries should develop harmonisation measures on the basis of the radio spectrum decision in this band before 2020 and make available a portion of this frequency band for 5G in response to market demand, taking into account that 5G deployment in this frequency range is likely to remain geographically limited by 2020.

On January 2017, Korean Ministry of Science and ICT (MSIT) announced the K-ICT Spectrum Plan in order to use the 28 GHz (26.5-29.5 GHz) band for 5G commercial service. In particular, the Republic of Korea is planning to use the band for not only 5G trial services during the 2018 Winter Olympic Games but also 5G commercial services around 2020.

Japanese Ministry of Internal Affairs and Communications (MIC) published the final report on the 2020 Japan Radio Policy on July 2016 with regard to the 5G candidate spectrum bands including 27.5-29.5 GHz band, in order to meet agreed international technical specifications for the 2020 summer Olympic games in Tokyo. Meanwhile the national policy makers and regulators are also investigating all bands for 5G that are within the scope of the ITU WRC-19 Agenda Item 1.13. Early system trials for 5G are planned for the ranges 3600 -4100 MHz, 4405-4895 MHz and 27.5-28.28 GHz.

On June 2017, Chinese Ministry of Industry and Information Technology (MIIT) is launching a consultation regarding the planning and use of mmW spectrum for the development of 5G networks. The MIIT is seeking industry advice on the planning and use of the 24.75-27.5GHz, 37-42.5GHz and other mmW bands. The public consultation is intended to collect feedback from the industry on such aspects as suggestions regarding the deployment status of the proposed frequency bands, future planning on the use of these bands for 5G system.

The following figure summarizes future plans and spectrum for NR from each country/region.

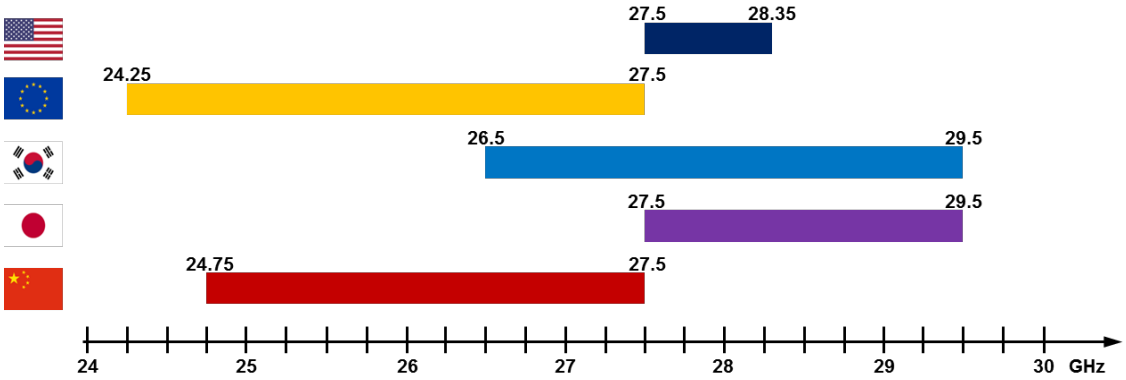

Figure 4.1-1: NR spectrum plans in the range between 24.25-29.5 GHz

4.2 Compatibility studies with services in adjacent bands

In World Radiocommunication Conference 2015 (WRC-15), Agenda item 1.13 to consider identification of frequency bands for the future development of IMT was adopted for WRC-19. The agenda item calls for studies to determine the spectrum needs for the terrestrial component of IMT in the frequency range between 24.25 GHz and 86 GHz, as well as sharing and compatibility studies, taking into account the protection of services to which the band is allocated on a primary basis, for the frequency bands:

- 24.25-27.5 GHz, 37-40.5 GHz, 42.5-43.5 GHz, 45.5-47 GHz, 47.2-50.2 GHz, 50.4-52.6 GHz, 66-76 GHz and 81-86 GHz, which have allocations to the mobile service on a primary basis; and

- 31.8-33.4 GHz, 40.5-42.5 GHz and 47-47.2 GHz, which may require additional allocations to the mobile service on a primary basis.

Task Group 5/1 is responsible for the development of draft Conference Preparation Meeting (CPM) text under WRC-19 Agenda item 1.13. In developing sharing studies and draft CPM text, Task Group 5/1 is to consider, conduct and complete in time for WRC-19, in accordance with Resolution 238 (WRC-15), the results of appropriate studies from Working Party 5D on the spectrum needs, technical and operational characteristics including protection criteria, and deployment scenarios for the terrestrial component of IMT, as well as propagation models, technical characteristics including protection criteria for existing services allocated in, or adjacent to, the bands identified in resolves to invite ITU-R 2 of Resolution 238 (WRC-15). Task Group 5/1 is also requested to conduct the appropriate sharing and compatibility studies, taking into account the protection of services to which the band is allocated on a primary basis.

Table 4.2-1 is the information of the services allocated in the 23.6-31 GHz as adjacent bands that to be studied on the sharing and compatibility with of the frequency range between 24.25-29.5 GHz by September 2018.

Table 4.2-1: Allocation information in the 23.6-31 GHz frequency range [4]

23.6-31 GHz		
Allocation to services		
Region 1	**Region 2**	**Region 3**
23.6-24	EARTH EXPLORATION-SATELLITE (passive) RADIO ASTRONOMY SPACE RESEARCH (passive) 5.340	
24-24.05	AMATEUR AMATEUR-SATELLITE 5.150	
24.05-24.25	RADIOLOCATION Amateur Earth exploration-satellite (active) 5.150	
24.25-24.45 FIXED	**24.25-24.45** RADIONAVIGATION	**24.25-24.45** RADIONAVIGATION FIXED MOBILE

24.45-24.65 FIXED INTER-SATELLITE	**24.45-24.65** INTER-SATELLITE RADIONAVIGATION 5.533	**24.45-24.65** FIXED INTER-SATELLITE MOBILE RADIONAVIGATION 5.533
24.65-24.75 FIXED FIXED-SATELLITE (Earth-to-space) 5.532B INTER-SATELLITE	**24.65-24.75** INTER-SATELLITE RADIOLOCATION- SATELLITE (Earth-to-space)	**24.65-24.75** FIXED FIXED-SATELLITE (Earth-to-space) 5.532B INTER-SATELLITE MOBILE 5.533
24.75-25.25 FIXED FIXED-SATELLITE (Earth-to-space) 5.532B	**24.75-25.25** FIXED-SATELLITE (Earth-to-space) 5.535	**24.75-25.25** FIXED FIXED-SATELLITE (Earth-to-space) 5.535 MOBILE
25.25-25.5	FIXED INTER-SATELLITE 5.536 MOBILE Standard frequency and time signal-satellite (Earth-to-space)	
25.5-27	EARTH EXPLORATION-SATELLITE (space-to Earth) 5.536B FIXED INTER-SATELLITE 5.536 MOBILE SPACE RESEARCH (space-to-Earth) 5.536C Standard frequency and time signal-satellite (Earth-to-space) 5.536A	
27-27.5 FIXED INTER-SATELLITE 5.536 MOBILE	**27-27.5** FIXED FIXED-SATELLITE (Earth-to-space) INTER-SATELLITE 5.536 5.537 MOBILE	
27.5-28.5	FIXED 5.537A FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.539 MOBILE 5.538 5.540	
28.5-29.1	FIXED FIXED-SATELLITE (Earth-to-space) 5.484A 5.516B 5.523A 5.539 MOBILE Earth exploration-satellite (Earth-to-space) 5.541 5.540	
29.1-29.5	FIXED FIXED-SATELLITE (Earth-to-space) 5.516B 5.523C 5.523E 5.535A 5.539 5.541A MOBILE Earth exploration-satellite (Earth-to-space) 5.541 5.540	
29.5-29.9 FIXED-SATELLITE (Earth-to-space) 5.484A 5.484B 5.516B 5.527A 5.539 Earth exploration-satellite (Earth-to-space) 5.541 Mobile-satellite (Earth-to-space) 5.540 5.542	**29.5-29.9** FIXED-SATELLITE (Earth-to-space) 5.484A 5.484B 5.516B 5.527A 5.539 MOBILE-SATELLITE (Earth-to-space) Earth exploration-satellite (Earth-to-space) 5.541 5.525 5.526 5.527 5.529 5.540	**29.5-29.9** FIXED-SATELLITE (Earth-to-space) 5.484A 5.484B 5.516B 5.527A 5.539 Earth exploration-satellite (Earth-to-space) 5.541 Mobile-satellite (Earth-to-space) 5.540 5.542
29.9-30	FIXED-SATELLITE (Earth-to-space) 5.484A 5.484B 5.516B 5.527A 5.539 MOBILE-SATELLITE (Earth-to-space) Earth exploration-satellite (Earth-to-space) 5.541 5.543 5.525 5.526 5.527 5.538 5.540 5.542	
30-31	FIXED-SATELLITE (Earth-to-space) 5.338A MOBILE-SATELLITE (Earth-to-space) Standard frequency and time signal-satellite (space-to-Earth) 5.542	

4.3 Regulatory aspect

4.3.1 ITU-R

The Radio Regulations [4] is an international binding treaty for how RF spectrum is used. It is updated and agreed at the WRC that is held every 3 to 4 years. One RF parameter related to unwanted emissions is defined directly in the radio regulation:

- ITU Radio Regulations No. S1.153 [4] provides a definition of *Occupied bandwidth*.

ITU-R Study Group 1 is responsible for Spectrum management principles and techniques and develops international recommendations for unwanted emissions.

The following ITU-R recommendations provide generic limits and some guidelines for how to specify unwanted emissions:

- ITU-R SM.329-12 [5] provides terminology and definitions in the area of spurious emissions. It also gives recommendations of how limits are applied and recommended limit values and reference bandwidths. Limits are given in different "Categories", where Category A limits are generally applicable while other Categories have regional application for certain services. Some limits are further described in Annexes to the recommendation, where in particular Annex 7 gives reference bandwidths for Category B limits in the land mobile service.

- ITU-R SM.328-11 [6] provides terminology and definitions in the area of spectra and bandwidth of emissions. It is intended to provide guidance in deriving limits for out-of-band emissions and gives examples of how emitted spectra can be classified and what parameters can be used to specify it. Most of the text concerns analogue and narrowband modulation.

- ITU-R SM.1539-1 [7] specifically deals with the boundary between the out-of-band and spurious domains. It proposes variations to the default "250% rule" for wideband emissions for different frequency ranges, where the highest interval is above 26 GHz.

- ITU-R SM.1540 [8] gives recommendations for emissions falling into an adjacent band allocation.

- ITU-R SM.1541-6 [9] gives recommendations for emission in the out-of-band domain. Annex 11 covers land mobile services, but there is only discussion of narrowband systems (up to 30 kHz).

NOTE: The term *Out-of-band (OOB) emissions* can cause some confusion and is for this reason mostly avoided in 3GPP BS specifications. Regulation defines OOB emissions as "*Emission on a frequency or frequencies immediately outside the necessary bandwidth which results from the modulation process, but excluding spurious emissions*". OOB emissions are thereby the emissions closest to the transmitted carrier(s) and the term "Out-of-band" does not refer to emission being outside the operating band or an operator's assigned band. Note that spurious emissions and OOB emissions are mutually exclusive through the definition, making the boundary between them very important. OOB emissions are for WCDMA and LTE BS defined through ACLR, spectrum mask (for WCMDA) and operating band unwanted emissions (for LTE).

4.3.2 European regulation

The European regulations include unwanted emission levels. As basis, the limits included in ITU-R documents. Limits applicable in Europe are in ITU-R SM.329-12 [5] identified as *Category B* requirements are used. In addition, the following European recommendations are developed and maintained by CEPT/ECC regarding unwanted emissions as follows:

- ECC Rec (02)05 [10] is an "umbrella" recommendation on unwanted emissions, giving general guidelines on out-of-band and spurious emissions, the boundary between out-of-band and spurious domains, with reference to ITU-R recommendations and the ERC Rec. 74-01 on spurious emissions [11]

- ERC Rec. 74-01 [11] provides terminology and definitions in the area of spurious emissions, with recommended limit values and reference bandwidths for the spurious domain. It corresponds to the Category B limits in ITU-R Rec. SM 329-12 [5], but has in addition provisions for mobile services covering multi-carrier and multi-RAT base stations.

CEPT/ECC publishes decisions, recommendations and reports related to spectrum usage. These may include emission limits. In many cases, the spectrum decisions are also confirmed in a spectrum decision by the European Union (EU). Here it should be noted that the EU has 28 member states while CEPT has 48 national administrations as members. The spectrum decisions made by the EU are the basis for national licensing conditions in countries across Europe. In addition, ECC decision and/or recommendations are used.

The radio equipment requirements for products in Europe are set by *Harmonized Standards*. The harmonized standard for IMT equipment is EN 301 908 [12], divided into individual parts for each type of equipment. The parts for UMTS and LTE equipment are based on extracts from the 3GPP RAN4 and RAN5 test specifications.

4.3.3 U.S. regulation (FCC)

A new Part 30 (Upper Microwave Flexible Use Service) is added and licenses issued in the 27.5-28.35 GHz band. The following subparts relate directly to RF aspects [2]:

- § 30.202 Power limits: Max EIRP limits
- § 30.203 Emission limits: OOBE and spurious emissions limits (conducted or total radiated power)

The new Part 30 power limits from FCC-16-89A1 [2] are shown in Table 8.1.3-1 and the Emission limits in Table 8.1.3-2.

Table 4.3.3-1: Part 30.202 Power limits (from FCC-16-89A1 [2])

Stations	Maximum allowable EIRP
Fixed/Base stations	75 dBm/100 MHz(NOTE)
Mobile stations	43 dBm
Transportable stations	55 dBm
NOTE: For channel bandwidths less than 100 MHz the EIRP must be reduced proportionally and linearly based on the bandwidth relative to 100 MHz.	

Table 4.3.3-2: Part 30.203 Emission limits (from FCC-16-89A1 [2])

Outband frequency range	Conductive power /Total radiated power
Channel assignment[1] edge ~ 10% of the Authorized Bandwidth[2]	-5 dBm
Beyond 10% of Authorized Bandwidth	-13 dBm
NOTE 1: **Channel assignment** is the channel that is determined by standards (defining center frequency), the FCC usually defines this as the bandwidth at which 99% of the emission power is contained. NOTE 2: **Authorized bandwidth** is the maximum width of the band of frequencies permitted to be used by a station. This is normally considered to be the necessary or occupied bandwidth, whichever is greater. NOTE 3: **Measurement Requirements:** 1) Measurement is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. 2) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the licensee's frequency block edges as the design permits. 3) The measurements of emission power can be expressed in peak or average values.	

4.3.4 Korean regulation (MSIT)

The Korean regulation of the wireless equipment for the mobile system is divided into individual parts for each technical type of equipment, i.e., CDMA, PCS, UMTS, LTE-FDD and LTE-TDD. The parts for UMTS and LTE equipment include essential RF parameters such as frequency ranges, channel bandwidths and emission levels as summarized in Table 4.3.4-1, and they are based on extracts from the 3GPP RAN4 and RAN5 test specifications.

Table 4.3.4-1: Parameters in Korean regulation

	Parameters
Common	Frequency range
	Channel bandwidth

BS	**Tx**	Frequency error
		Output power
		ACLR
		Out-of-band emissions
		Spurious emissions
	Rx	Receiver spurious emissions
UE	**Tx**	Frequency error
		Maximum output power
		ACLR
		Spectrum emission mask
		Spurious emissions
	Rx	Rx spurious emissions

On July 2017, the MSIT established a study group to develop another part for NR system that will be operated in 28 GHz band. For the harmonized standard for IMT equipment, as the current regulation for the previous part of the systems, the group also has been waiting for the output of core specification from 3GPP RAN4 for the range of 26.5-29.5 GHz and willing to review the result within this year in order to launch NR service in timely manner in Korea.

5 NR Frequency band definition

The band plans for 24.25-29.5 GHz frequency range are shown in Figure 5-1. Two bands are defined in the range, one is for 26.5-29.5 GHz (n257) and the other is for 24.25-27.5 GHz (n258), and they are noticeably 1 GHz overlapped that can be considered allowing economies of scale and early equipment availability. NR as a technology will evolve over time and leverage a variety of spectrum ranges, but these two bands have broad support in FR2.

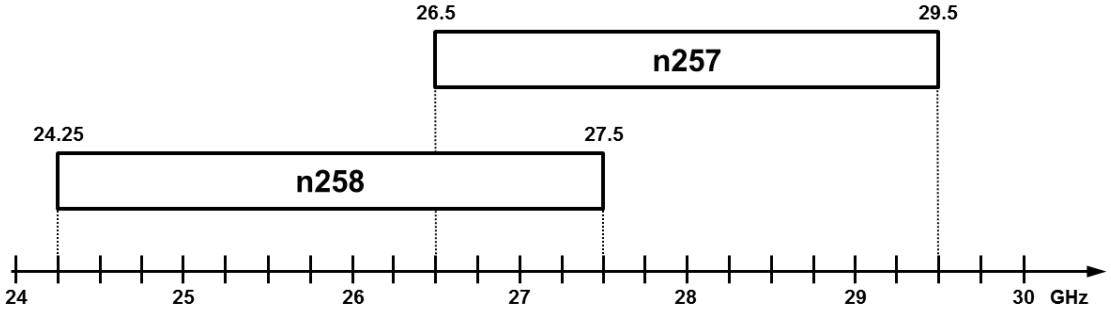

Figure 5-1: Band definition in the frequency range between 24.25-29.5 GHz

Summary of the new NR bands are provided in Table 5-1 below:

Table 5-1: New NR bands in the frequency range between 24.25-29.5 GHz

Band number	UL	DL	Duplex mode
n257	26.5 - 29.5 GHz	26.5 - 29.5 GHz	TDD
n258	24.25 - 27.5 GHz	24.25 - 27.5 GHz	TDD

6 Channel numbering and channel bandwidth

The NR-ARFCN that are applicable in the frequency range between 24.25-29.5 GHz are given in table 6-1.

Table 6-1: Applicable NR-ARFCN in the frequency range between 24.25-29.5 GHz

NR Operating Band	ΔF_{Raster} (kHz)	Uplink and Downlink Range of N_{REF} (First – <Step size> – Last)
n257	60	2054166 – <1> – 2104165
n258	60	2016667 – <1> – 2070832

The synchronization raster in the frequency range between 24.25-29.5 GHz is given in Table 6-2. The distance between applicable GSCN entries is given by the <Step size> indicated in Table 6-2 with the step size interval of 17.28MHz.

Table 6-2: Applicable SS raster entries in the frequency range between 24.25-29.5 GHz

NR Operating Band	SS Block SCS	SS Block pattern[1]	Range of GSCN (First – <Step size> – Last)
n257	120 kHz	Case D	[22388 – <1> – 22558]
	240 kHz	Case E	[22390 – <2> – 22556]
n258	120 kHz	Case D	[22257 – <1> – 22443]
	240 kHz	Case E	[22258 – <2> – 22442]
NOTE: SS Block pattern is defined in subclause 4.1 in TS 38.213 [13].			

BS and UE channel bandwidth and Bandwidth combination sets have been defined as found in TR 38.817-02 [14] and TR 38.817-01 [15], respectively. They are captured to support at least 50 MHz as a minimum channel bandwidth and up to 400 MHz as a maximum channel bandwidth in FR2 by using the different data sub-carrier spacing (SCS) in Rel-15. In order to apply the same requirement for Band n257 and 258 to Table 5.3.5-1 in TS 38.101-2 [16], Table 6-3 highlights in the extract of the table below.

Table 6-3: NR channel bandwidth in the frequency range between 24.25-29.5 GHz

NR band		Channel bandwidth			
Band number	data SCS(kHz)	50 MHz	100 MHz	200 MHz	400 MHz
n257	60	Yes	Yes	Yes	
	120	Yes	Yes	Yes	Yes
n258	60	Yes	Yes	Yes	
	120	Yes	Yes	Yes	Yes

7 Common RF requirements for band n257 and n258

According to current study in RAN4 at least RF requirements summarized in Table 7-1 should be the band agnostic RF requirements for FR2 which are applicable for band n257 and n258 as well. Besides that, the RF requirements which are band specific but common between band n257 and n258 are gathered in this section.

Table 7-1: Summary on band agnostic of RF requirements for FR2

BS TX side capture in TS 38.104 [17]	BS RX side capture in TS 38.104 [17]	UE TX side capture in TS 38.101-2 [16]	UE RX side capture in TS 38.101-2 [16]
9.2 Radiated transmit power	10.3 OTA reference sensitivity level	6.3.1 Minimum output power	7.4 Maximum input level
9.3 OTA Base station output power	10.5 OTA In-band selectivity and blocking	6.4 Transmit signal quality	
9.4 OTA Output power dynamics	10.7 OTA Receiver spurious emissions	6.5.1 Occupied bandwidth	
9.5 OTA Transmit ON/OFF power	10.9 OTA In-channel selectivity	6.5.2.1 Spectrum emission mask: General	
9.6 OTA Transmitted signal quality			
9.7.2 OTA Occupied bandwidth			
9.7.5 OTA Transmitter spurious emissions			

The common RF requirements for Band n257 and n258 are listed in following sections with expected changes in TS 38.101-2 [16] and TS 38.104 [17] for UE and BS respectively.

7.1 UE specific

7.1.1 Transmitter characteristics

7.1.1.1 Adjacent Channel Leakage Ratio (ACLR)

For Band n257 and Band n258, and the general ACLR requirements is 17dB and more test parameters are shown in table 7.1.1.1-1:

Table 7.1.1.1-1: General ACLR requirements for Band n257 and Band n258

	Channel bandwidth / NR_{ACLR} / Measurement bandwidth			
	50 MHz	**100 MHz**	**200 MHz**	**400 MHz**
NR_{ACLR} for band n257, n258	17 dB	17 dB	17 dB	17 dB
NR channel Measurement bandwidth	47.52 MHz	95.04 MHz	190.08 MHz	380.16 MHz
Adjacent channel centre frequency offset [MHz]	+50 / -50	+100.0 / -100.0	+200 / -200	+400 / -400

7.1.2 Receiver characteristics

7.1.2.1 Adjacent Channel Selectivity (ACS)

For Band n257 and Band n258, the ACS requirements is 23dB and more parameter are shown in table 7.1.2.1-1, Table 7.1.2.1-2 and Table 7.1.2.1-3:

Table 7.1.2.1-1: Adjacent channel selectivity

		Channel bandwidth			
Rx Parameter	**Units**	**50 MHz**	**100 MHz**	**200 MHz**	**400 MHz**
ACS for band n257, n258	dB	23	23	23	23

Table 7.1.2.1-2: Test parameters for Adjacent channel selectivity, Case 1

Rx Parameter	**Units**	**Channel bandwidth**			
		50 MHz	**100 MHz**	**200 MHz**	**400 MHz**
Power in Transmission Bandwidth Configuration	dBm	REFSENS + 14 dB			
$P_{Interferer}$ for band n257, n258	dBm	REFSENS + 35.5 dB	REFSENS + 35.5 dB	REFSENS + 35.5 dB	REFSENS + 35.5 dB
$BW_{Interferer}$	MHz	50	100	200	400
$F_{Interferer}$ (offset)	MHz	50 / -50	100 / -100	200 / -200	400 / -400

Table 7.1.2.1-3: Test parameters for Adjacent channel selectivity, Case 2

Rx Parameter	Units	Channel bandwidth			
		50 MHz	100 MHz	200 MHz	400 MHz
Power in Transmission Bandwidth Configuration for band n257, n258	dBm	-46.5	-46.5	-46.5	-46.5
$P_{Interferer}$	dBm	-25			
$BW_{Interferer}$	MHz	50	100	200	400
$F_{Interferer}$ (offset)	MHz	50 / -50	100 / -100	200 / -200	400 / -400

7.2 BS specific

7.2.1 Transmitter characteristics

7.2.1.1 Adjacent Channel Leakage Ratio (ACLR)

The BS OTA ACLR limit for Band n257 and n258 is defined based on TRP and specified ACLR1 in table 7.2.1.1-1. The OTA ACLR2 limit is not specified since the emission level at the ACLR2 range will be close to noise floor.

Table 7.2.1.1-1: Base Station OTA ACLR

BS Channel bandwidth of lowest/highest NR carrier transmitted $BW_{Channel}$ [MHz]	BS adjacent channel centre frequency offset below the lowest or above the highest carrier centre frequency transmitted	Assumed adjacent channel carrier	Filter on the adjacent channel frequency and corresponding filter bandwidth	ACLR limit (dB)
50, 100, 200, 400	$BW_{Channel}$	NR of same BW (Note 2)	Square (BW_{Config})	28 (Note 3)
NOTE 1: $BW_{Channel}$ and BW_{Config} are the *BS channel bandwidth* and transmission bandwidth configuration of the lowest/highest NR carrier transmitted on the assigned channel frequency. NOTE 2: With SCS that provides largest transmission bandwidth configuration (BW_{Config}). NOTE 3: Applicable to bands defined within the frequency spectrum range of 24.25 – 33.4 GHz				

NOTE: BS OTA ACLR absolute limits are Band agnostic requirements in the frequency range between 24.25-29.5 GHz.

7.2.1.2 Spectrum emission mask

BS unwanted emissions for Band n257 and n258 shall not exceed the maximum levels specified in table 7.2.1.2-1 and table 7.2.1.2-2.

Table 7.2.1.2-1: SEM applicable for [$P_{Tx} \geq 35$ dBm] in the frequency range 24.25 – 33.4 GHz

Frequency offset from "edge of transmission" Δf	Limit	Measurement bandwidth
$0 \leq \Delta f <$ 10% of the total transmission bandwidth	-5 dBm	1 MHz
10% of the total transmission bandwidth $\leq \Delta f <$ OOB boundary	-13 dBm	1 MHz

Table 7.2.1.2-2: SEM applicable for [P_{Tx} < 35 dBm] in the frequency range 24.25 – 33.4 GHz

Frequency offset from "edge of transmission" Δf	Limit	Measurement bandwidth
0 ≤ Δf < 10% of the total transmission bandwidth	[Max(P_{Tx} – 40 dB, -12 dBm)]	1 MHz
10% of the total transmission bandwidth ≤ Δf < OOB boundary	[Max(P_{Tx} – 48 dB, -20 dBm)]	1 MHz
Δf ≥ OOB boundary	Spurious domain limits	

7.2.2 Receiver characteristics

7.2.2.1 Adjacent Channel Selectivity (ACS)

The BS OTA ACS for Band n257 and n258 is defined based on EIS and the OTA wanted and the interfering signal are specified in table 7.2.2.1-1 and table 7.2.2.1-2 for ACS.

Table 7.2.2.1-1: OTA ACS requirement in the frequency range 24.25 – 33.4 GHz

BS channel bandwidth of the lowest/highest carrier received [MHz]	Wanted signal mean power [dBm]	Interfering signal mean power [dBm]
50, 100, 200, 400	$EIS_{REFSENS}$ + 6dB	$EIS_{REFSENS}$ + 27.7

Table 7.2.2.1-2: OTA ACS interferer frequency offset in the frequency range 24.25 – 33.4 GHz

BS channel bandwidth of the lowest/highest carrier received [MHz]	Interfering signal centre frequency offset from the lower/upper Base Station RF Bandwidth edge or sub-block edge inside a sub-block gap [MHz]	Type of interfering signal
50	±24.29	50MHz DFT-s-OFDM NR signal 60kHz SCS
100	±24.31	50MHz DFT-s-OFDM NR signal 60kHz SCS
200	±24.29	50MHz DFT-s-OFDM NR signal 60kHz SCS
400	±24.31	50MHz DFT-s-OFDM NR signal 60kHz SCS

8 NR band n257 specific issues

This section captures band specific RF requirements for n257.

8.1 UE specific

8.1.1 Transmitter characteristics

8.1.1.1 Transmitter power

8.1.1.1.1 Maximum output power

For FR2, a single power class is defined for handheld UEs, the power class value is defined as the minimum peak EIRP and is band dependent, and table 8.1.1.1.1-1 lists the value for n257.

Table 8.1.1.1.1-1: NR FR2 UE Power Class for n257

NR band	Handheld Power Class Min Peak EIRP (dBm)
n257	22.4
NOTE: minimum peak EIRP is defined as the lower limit without tolerance	

The maximum output power requirements on upper limit TRP and max allowed EIRP are defined as table 8.1.1.1.1-2 for n257.

Table 8.1.1.1.1-2: NR UE Maximum Output Power Limits for n257

NR band	TRP Handheld (dBm)	EIRP (dBm) Handheld
n257	TBD	43

8.1.1.1.2 Maximum output power with additional requirements

8.1.1.2 Additional spectrum emission mask

8.1.1.3 Spurious emission

8.1.1.3.1 Additional spurious emission

8.1.1.3.2 Spurious emission band UE co-existence

This clause specifies the requirements for the specified NR band, for coexistence with protected bands.

Table 8.1.1.3.2-1: Requirements

NR Band	Spurious emission						
	Protected band/frequency range	Frequency range (MHz)			Maximum Level (dBm)	MBW (MHz)	NOTE
n257	NR Band n260	F_{DL_low}	-	F_{DL_high}	[-2]	100	
	Frequency range	23600	-	24000	[TBD]	200	
	Frequency range	57000	-	66000	[2]	100	
NOTE: The protection of frequency range 23600-2400MHz is meant for protection of satellite passive services.							

8.1.2 Receiver characteristics

8.1.2.1 Reference sensitivity power level

The Reference sensitivity power level is specified as table 8.1.2.1-1 for n257.

Table 8.1.2.1-1: Reference sensitivity for n257

Operating band	REFSENS (dBm) / Channel bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
n257	88.3	[-89.1 to -82.4]		[-83.1 to -76.4]

8.1.2.2 In-band blocking

In-band blocking requirements for n257 are specified as table 8.1.2.2-1.

Table 8.1.2.2-1: In band blocking requirements for n257

Rx parameter	Units	Channel bandwidth			
		50 MHz	100 MHz	200 MHz	400 MHz
Power in Transmission Bandwidth Configuration	dBm	REFSENS + 14dB			
$BW_{Interferer}$	MHz	50	100	200	400
$P_{Interferer}$ for bands n257	dBm	REFSENS + 35.5 dB	REFSENS + 35.5 dB	REFSENS + 35.5 dB	REFSENS + 35.5 dB
$F_{loffset}$	MHz	100 / -100 NOTE 5	200 / -200 NOTE 5	400 / -400 NOTE 5	800 / -800 NOTE 5
$F_{Interferer}$	MHz	F_{DL_low} + 25 to F_{DL_high} - 25	F_{DL_low} + 50 to F_{DL_high} - 50	F_{DL_low} + 100 to F_{DL_high} - 100	F_{DL_low} + 200 to F_{DL_high} - 200

8.2 BS specific

8.2.1 Radiated transmitter characteristics

The related requirement limits have been covered by section 7.2.1.

8.2.2 Radiated receiver characteristic

The related requirement limits have been covered by section 7.2.2.

9 NR band n258 specific issues

This section captures band specific RF requirement for n258.

9.1 UE specific

9.1.1 Transmitter characteristics

9.1.1.1 Transmitter power

9.1.1.1.1 Maximum output power

For FR2, a single power class is defined for handheld UEs, the power class value is defined as the minimum peak EIRP and is band dependent, and table 9.1.1.1.1-1 lists the value for n258.

Table 9.1.1.1.1-1: NR FR2 UE Power Class for n258

NR band	Handheld Power Class Min Peak EIRP (dBm)
n258	22.4
NOTE: minimum peak EIRP is defined as the lower limit without tolerance	

The maximum output power requirements on upper limit TRP and max allowed EIRP are defined as table 9.1.1.1.1-2 for n258.

Table 9.1.1.1.1-2: NR UE Maximum Output Power Limits for n258

NR band	TRP Handheld (dBm)	EIRP (dBm) Handheld
n258	TBD	43

9.1.1.1.2 Maximum output power with additional requirements

9.1.1.2 Additional spectrum emission mask

9.1.1.3 Spurious emission

9.1.1.3.1 Additional spurious emission

9.1.1.3.2 Spurious emission band UE co-existence

This clause specifies the requirements for the specified NR band, for coexistence with protected bands.

Table 9.1.1.3.2-1: Requirements

NR Band	Spurious emission						
	Protected band/frequency range	Frequency range (MHz)			Maximum Level (dBm)	MBW (MHz)	NOTE
n258	Frequency range	23600	-	24000	[TBD]	200	
	Frequency range	57000	-	66000	[2]	100	
NOTE 1: The protection of frequency range 23600-2400MHz is meant for protection of satellite passive services.							

9.1.2 Receiver characteristics

9.1.2.1 Reference sensitivity power level

The Reference sensitivity power level is specified as table 9.1.2.1-1 for n258.

Table 9.1.2.1-1: Reference sensitivity for n258

Operating band	REFSENS (dBm) / Channel bandwidth			
	50 MHz	100 MHz	200 MHz	400 MHz
n258	[-92.1 to -85.4]	[-89.1 to -82.4]		[-83.1 to -76.4]

9.1.2.2 In-band blocking

In-band blocking requirements for n258 are specified as table 9.1.2.2-1.

Table 9.1.2.2-1: In band blocking requirements for n258

Rx parameter	Units	Channel bandwidth			
		50 MHz	100 MHz	200 MHz	400 MHz
Power in Transmission Bandwidth Configuration	dBm	REFSENS + 14dB			
$BW_{Interferer}$	MHz	50	100	200	400
$P_{Interferer}$ for bands n258	dBm	REFSENS + 35.5 dB	REFSENS + 35.5 dB	REFSENS + 35.5 dB	REFSENS + 35.5 dB
$F_{loffset}$	MHz	100 / -100 NOTE 5	200 / -200 NOTE 5	400 / -400 NOTE 5	800 / -800 NOTE 5
$F_{Interferer}$	MHz	F_{DL_low} + 25 to F_{DL_high} - 25	F_{DL_low} + 50 to F_{DL_high} - 50	F_{DL_low} + 100 to F_{DL_high} - 100	F_{DL_low} + 200 to F_{DL_high} - 200

9.2 BS specific

9.2.1 Radiated transmitter characteristics

The related requirement limits have been covered by section 7.2.1.

9.2.2 Radiated receiver characteristic

The related requirement limits have been covered by section 7.2.2.

10 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	R4-1708842				Skeleton TR 38.815	0.0.1
2017-11	RAN4#85	R4-1712936				TR 38.815 in order to define Band n257 and n258	0.1.0
2018-01	RAN4AH-1801	R4-1800198				Updated TR 38.815	0.2.0
2018-04	RAN4#86 Bis	R4-1804001				Draft TR 38.815 v0.3.0	0.3.0
2018-05	RAN4#87	R4-1807081				TR 38.815 v0.4.0	0.4.0
2018-06	RAN#79	RP-180831				TR 38.815 v1.0.0 presented to plenary for approval	1.0.0
2018-06	RAN#80					Approved by plenary – Rel-15 spec under change control	15.0.0
2021-09	RAN#93	RP-211921	0001			CR to TR 38.815: Adding n261 to TR scope	15.1.0