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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

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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:

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x the first digit:

1 presented to TSG for information;

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y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

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Introduction

"Study on New Radio Access Technology" SID mandates the WGs to work for unlicensed band support [2]:

(4) Study and identify the technical features necessary to enable the new radio access to meet objective 1 and 2, also including:

- *Operation in licensed bands (paired and unpaired), and licensed assisted operations in unlicensed bands*
  - *Survey on 60GHz regulatory landscape*
  - *[Standalone operation in unlicensed bands is FFS]*

Regulatory requirements on the unlicensed bands of initial interest would need to be studied. Way Forward on NR & standalone unlicensed was discussed at RAN#73 [3]. Conclusion was to have RAN reflector email discussion survey on 60 GHz regulatory landscape.

The results and findings of the study are documented in this technical report.

It should be noted that there are studies on frequency-related matters for International Mobile Telecommunications identification including possible additional allocations to the mobile services on a primary basis in portion(s) of the frequency range between 24.25 and 86 GHz for the future development of International Mobile Telecommunications for 2020 and beyond. In particular, 66-71 GHz is being studied for potential IMT identification.

1 Scope

The present document contains the results and findings from the study item, “Study on New Radio Access Technology” [2].

This technical report documents the existing regulatory requirements for unlicensed spectrum deployment in the 60 GHz bands.

This document is a ‘living’ document, i.e. it is permanently updated and presented to TSG-RAN meetings.

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 TD RP-162469: "Revision of SI: Study on New Radio Access Technology".

[3] 3GPP TD RP-161868: "Proposed Way Forward on NR & standalone unlicensed".

[4] CEPT/ERC Recommendation 70-03, "Relating to the Use of Short Range Devices (SRD)".

[5] EN 305 550, "Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Radio equipment to be used in the 40 GHz to 246 GHz frequency range; Part 1: Technical characteristics and test methods".

[6] EN 302 567, "Multiple-Gigabit/s radio equipment operating in the 60 GHz band; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU".

[7] Regulations for Enforcement of Radio Law, Ministry of Internal Affairs and Communications, Japan.

[8] Ordinance Regulating Radio Equipment, Ministry of Internal Affairs and Communications, Japan.

[9] Ordinance Concerning Terminal Facilities etc., Ministry of Internal Affairs and Communications, Japan

[10] FCC 47CFR 15.255: Code of Federal Regulations Title 47 part 15 - radio frequency devices (RF exposure requirements: 47CFR 1.1310, 2.1091, 2.1093).

[11] ISED RSS-210 Annex J: Radio Standards Specification RSS-210, Licence-Exempt Radio Apparatus: Category I Equipment (RF exposure requirements: ISED Safety Code 6 RSS102).

[12] ANATEL Res. 506, section XVII: regalement sobre equipamentos de radiocomunicação de radiação restrita (RF exposure requirements: ANATEL Resolution 303).

[13] NCC, "Low Power Radio Frequency Specification, 2016 Edition", National Communications Commission, Taiwan, revised August 2016.

[14] 2006-082 关于 60GHz 频段微功率（短距离）无线电技术应用有关问题的通知 2006-082 Notice on wireless technical applications with very low transmission power (short distance) in 60GHz. http://www.miit.gov.cn/n1146295/n1146592/n1146754/n1235566/n1235603/n1235609/n1235611/c3176263/part/3176264.pdf .

[15] 2005-423 微功率（短距离）无线电设备的技术要求 2005-043 Technical requiremeng of wireless devices with very low transmission power (short distance). http://www.miit.gov.cn/n1146295/n1146592/n1146754/n1235566/n1235603/n1235609/n1235611/c3176241/part/3176242.pdf .

3 Definitions, symbols and abbreviations

3.1 Definitions

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

example: text used to clarify abstract rules by applying them literally.

3.2 Symbols

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

B transmission bandwith
G antenna gain

3.3 Abbreviations

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

ECC Electronic Communications Committee
ECO European Communications Office
ERC European Research Council
ISM Industrial, Scientific and Medical
LBT Listen Before Talk
MCOT Maximum Channel Occupancy Time
NR New Radio
OCB OCcupied Bandwidth
OOBE Out-Of--Band Emission
PSD Power Spectral Density
RLAN Radio Local Area Network
SID Study Item Description
SRD Short Range Device
WAS Wireless Access System

4 Regulatory requirements

4.1 ITU Region 1

4.1.1 Europe and CEPT

CEPT/ERC recommendation 70-03 [4] sets out the general position on common spectrum allocations for Short Range Devices (SRDs) for countries within the CEPT. It is also intended that it can be used as a reference document by the CEPT member countries when preparing their national regulations in order to keep in line with the provisions of article 3.2 of Directive 2014/53/EU.

In using this Recommendation it should be remembered that it represents the most widely accepted position within the CEPT but it should not be assumed that all allocations are available in all countries. An indication of where allocations are not available or where deviations from the CEPT position occur is to be found in Appendix 3 [4].

It should also be remembered that the pattern of radio use is not static. It is continuously evolving to reflect the many changes that are taking place in the radio environment; particularly in the field of technology. Spectrum allocations must reflect these changes and the position set out in this Recommendation is therefore subject to continuous review.

Moreover, many administrations have designated additional frequencies or frequency bands for SRD applications on a national basis that do not conform to the CEPT position set out in this Recommendation.

CEPT has adopted this Recommendation to deal with Short Range Devices and the European Telecommunications Standards Institute (ETSI) has now developed harmonised European standards for the majority of these devices. Other standards or technical specifications will be applicable within the framework of article 3.2 of Directive 2014/53/EU for placing on the market.

The term “Short Range Device” (SRD) is intended to cover the radio transmitters which provide either uni-directional or bi-directional communication which have low capability of causing interference to other radio equipment. SRDs use either integral, dedicated or external antennas and all modes of modulation can be permitted subject to relevant standards.

This Recommendation describes the spectrum management requirements for SRDs relating to allocated frequency bands, maximum power levels, channel spacing or modulation/maximum occupied bandwidth, and duty cycle in Annex 1 [4]. For countries having implemented Directive 2014/53/EU further details can be found on the relevant EC website (http://ec.europa.eu/growth/sectors/electrical-engineering/rtte-directive_en) and the ECO web sites (www.cept.org/ecc).

4.1.1.1 Non-specific Short Range Devices

Annex 1 [4] covers frequency bands and regulatory as well as informative parameters recommended primarily for Telemetry, Telecommand, Alarms and Data in general and other similar applications. In table 4.1.1.1-1 below the parameters for 60 GHz spectrum are shown.

Table 4.1.1.1-1: Regulatory parameters for non-specific SRD

Frequency band		Power/Magnetic Field	Spectrum access and mitigation requirements	Modulation / maximum occupied bandwidth	ECC/ERC Deliverable	Notes
n1	57 – 64 GHz	100 mW e.i.r.p, a maximum transmitter output power of 10 mW, and a power density limited to 13 dBm/MHz e.i.r.p. applies	No requirement	Not specified		
n2	61.0 – 61.5 GHz	100 mW e.i.r.p	No requirement	Not specified		

Additional Information :

- Harmonised Standard
  - EN 305 550 [5] for sub-bands n1), n2)

Frequency issues

- The bands in Annex 1 [4] n1 and n2 are also designated for industrial, scientific and medical (ISM) applications as defined in ITU Radio Regulations.

Table 4.1.1.1-1 represents the most widely implemented position within the CEPT countries [4], but it should not be assumed that all designated bands are available in all countries.

4.1.1.2 Wideband Data Transmission Systems

Annex 3 [4] covers frequency bands and regulatory as well as informative parameters recommended for Wideband Data Transmission Systems and Wireless Access Systems including Radio Local Area Networks (WAS/RLANs) within the bands 2400-2483.5 MHz and for Multiple-Gigabit WAS/RLAN Systems within the band 57-66 GHz. In table 4.1.1.2-1 below the parameters for 60 GHz spectrum are shown.

Table 4.1.1.2-1: Regulatory parameters for wideband data transmission systems

Frequency band		Power/Magnetic Field	Spectrum access and mitigation requirements	Modulation / maximum occupied bandwidth	Notes
b	57 – 66 GHz	40 dBm mean e.i.r.p. This refers to the highest power level of the transmitter power control range during the transmission burst if transmitter power control is implemented	Adequate spectrum sharing mechanism (e.g. Listen-before-Talk, Detect-And-Avoid) shall be implemented by the equipment.	Not specified	Fixed outdoor installations are not allowed. The maximum mean e.i.r.p density is limited to 13 dBm/MHz. Point-to-point links of the Fixed Service are regulated by ECC/REC/(05)02 and ECC/REC/(09)01

Additional Information:

- Harmonised Standard
  - EN 302 567 [6] for sub-band b).

4.1.1.3 National restrictions

Appendix 3 [4] lists national restrictions. The first section contains general comments from administrations and these apply to all annexes in the Recommendation.

The second section of Appendix 3 [4] contains comments from administrations and these are on specific frequency bands contained within this Recommendation. These indicate where administrations are not able to implement frequency allocations or where implementation is incomplete. For consistency, one of the following four standard positions are used:

- Implemented: If the Appendix entry is blank then Recommendation 70-03 has been fully implemented.
- Limited implementation: A short explanation can be provided. If under study or planned, then a date should be given.
- Not implemented: A short explanation can be provided. If under study or planned, then a date should be given.

- No information : No information has yet be provided by the administration.

Specific frequency range comments for 60 GHz spectrum are shown in Table 4.1.1.3-1.

Table 4.1.1.3-1: National restrictions for specific frequency ranges

Frequency band	Country	Implementation	Reason / remarks
Annex 1 Band K (Non-specific SRDs) 61.0 – 61.5 GHz	Georgia	Not implemented	
	Russian Federation	Not implemented	
Annex 1 Band K1 (Non- Specific SRDs) 57-64 GHz	Bosnia & Herzegovina	Not implemented	
	Georgia	Not implemented	
	Macedonia (FYROM)	Not implemented	
	Montenegro	Not implemented	
	Russian Federation	Not implemented	
	Serbia	Not implemented	
	Turkey	Not implemented	Under study
	Ukraine	Not implemented	
Annex 3 Band B Wideband Data Transmission systems 57-66 GHz	Bosnia & Herzegovina	Limited implementation	
	Georgia	Not implemented	
	Russian Federation	Not implemented	
	Serbia	Available in the range: 61.0-61.5 GHz	According to the Frequency Plan, only this part of the spectrum is aimed for the SRD applications
	Ukraine	Not implemented	

4.1.2 Israel

4.1.3 Russia

4.1.4 South Africa

4.1.5 Turkey

4.2 ITU Region 2

The following sections report some information on regulated (unlicensed) spectrum around 60GHz, e.g Max Power, PSD, OOBE, Indoor/Outdoor Restrictions etc., in few Region 2 countries.

4.2.1 USA

USA (FCC) regulations for frequency bands around 60GHz can be found in [10], particularly for the frequency range 57-71 GHz. Few (selected) rules are provided in the table below.

Table 4.2.1-1: Some spectrum regulations around 60GHz in USA

Regulated Freq. Band	Max Power	PSD	OOBE	Indoor/Outdoor Restrictions
57-71 GHz	Max Peak conducted power: - if BW >100MHz, 500mW - If BW<100MHz, 500mW * (Emission BW/100MHz) In EIRP: Indoor: 40 dBm avg/43dBm Peak Outdoor PtP: 82dBm when Gant>51dBi; 82-2*(51-Gant) when Gant≤51dBi	No requirement	Spurious emissions: 40-200 GHz: ≤ 90 pW / cm^2 @3m (-9.9dBm EIRP) Spurious emission levels shall not exceed the emission level at the fundamental radio frequency.	Indoor/outdoor with different limits

Further radio restrictions/rules and additional information (e.g. some non regulated aspects) are listed hereafter.

- Not allowed in aircraft and satellite. Not allowed for mobile field disturbance sensors; other requirements apply for fixed field sensors.
- The peak power shall be measured with an RF detector that has a detection bandwidth that encompasses the 57-71 GHz band and has a video bandwidth of at least 10 MHz. The average emission levels shall be measured over the actual time period during which transmission occurs.
- Frequency stability: Fundamental emissions shall be contained within the frequency bands specified in this section during all conditions of operation.
- No transmitter operating under the provisions of this section may be equipped with external phase-locking inputs that permit beam-forming arrays to be realized.
- No channel occupancy time requirements.
- No occupied channel bandwidth (OCB) requirements.
- No LBT requirements.

4.2.2 Canada

Canada regulations for frequency bands around 60GHz can be found in [11], particularly for the frequency range 57-64 GHz. Few (selected) rules are provided in the table below.

Table 4.2.2-1: Some spectrum regulations around 60GHz in Canada

Regulated Freq. Band	Max Power	PSD	OOBE	Indoor/Outdoor Restrictions
57-64GHz	Max Peak conducted power: - If BW >100MHz, 500mW - If BW<100MHz; 500mW * (Emission BW/100MHz) In EIRP: Indoor: 40dBm avg/43dBm Peak Outdoor PtP: 82dBm when Gant>51dBi; 82-2*(51-Gant) when Gant≤51dBi	No requirement	Spurious emissions: 40-200 GHz: ≤90 pW / cm^2 @3m (-9.9dBm EIRP)	Indoor/outdoor with different limits

Further radio restrictions/rules and additional information (e.g. some non-regulated aspects) are listed hereafter.

- Not allowed in aircraft and satellite. Not allowed for mobile field disturbance sensors; other requirements apply for fixed field sensors.
- The peak power shall be measured with an RF detector that has a detection bandwidth that encompasses the 57-64 GHz band and has a video bandwidth of at least 10 MHz. The average emission levels shall be measured over the actual time period during which transmission occurs.
- Frequency stability: Fundamental emissions shall be contained within the frequency bands specified in this section during all conditions of operation.
- No transmitter operating under the provisions of this section shall be equipped with external phase-locking inputs that permit beam-forming arrays to be realized.
- No channel occupancy time requirements.
- No occupied channel bandwidth (OCB) requirements.
- No LBT requirements.

4.2.3 Brazil

Brazilian regulations for frequency bands around 60GHz can be found in [12], particularly for the frequency range 57-64 GHz. Few (selected) rules are provided in the table below.

Table 4.2.3-1: Some spectrum regulations around 60GHz in Brazil

Regulated Freq. Band	Max Power	PSD	OOBE	Indoor/Outdoor Restrictions
57-64GHz	Total Peak Power at transmitter output ≤ 27dBm (500mW)	Max avg. Power Density: 9 microW/cm^2 @3m Max peak Power Density: 18 microW/cm^2 @3m	Spurious emissions: 40-200 GHz: ≤90 pW / cm^2 @3m (-9.9dBm EIRP) Spurious emission levels shall not exceed the emission level at the fundamental radio frequency.	No specific restriction

Further radio restrictions/rules and additional information (e.g. some non-regulated aspects) are listed hereafter.

- Not permitted for use in aircraft or satellites, and field disturbance sensors (including vehicular radar systems).

- No channel occupancy time requirements.
- No occupied channel bandwidth (OCB) requirements.
- No LBT requirements.

4.2.4 Mexico

4.3 ITU Region 3

4.3.1 China

The 59-64 GHz frequency range has been allowed for use by very low transmission power and short distant unlicensed applications in China since 2006 [14][15].

The key regulatory restrictions include:

- Carrier frequency tolerance: 500×10^{-6}
- Output power of antenna port: ≤ 10 dBm
- Peak EIRP: ≤ 47 dBm
- Mean EIRP: ≤ 44 dBm
- Out of Band Emission (EIRP): -5dBm/MHz
- Spurious Emission (corresponding to frequency range outside 2.5*carrier bandwidth): -20dBm/1MHz

There is no requirement on maximum channel occupancy time (MCOT), no requirement on occupied channel bandwidth (OCB), as well as no requirement on listen-before-talk (LBT).

The unlicensed devices operating in 59-64 GHz shall not interfere to the space research, earth resources exploration, radio astronomy and other legal wireless applications, and shall not demand radio interference protection.

4.3.2 Japan

With regard to the use of 60 GHz spectrum for the Low Power Data Communication System, the frequency band, 57-66GHz, is available for unlicensed operation. Table 4.3.2-1 summarizes the overview of technical regulatory requirements in Japan.

Table 4.3.2-1: Regulatory requirement for the low power data communication system in 60GHz band

Items	Requirement	Reference
Frequency	57-66 GHz	Article 6 [7]
Frequency error	+/-20 ppm if the output power is greater than10mW +/-500 ppm if the output power is 10mW or less	Article 5 [8]
Occupied bandwidth	9GHz or less (including the frequency error specified above)	Article 6 [8]
Maximum output power	250 mW	Article 49.20 [8]
Maximum output power accuracy	+50%/-70%	Article 14 [8]
Antenna gain	47dBi or less if the output power is greater than 10mW 10dBi or more if the output power is 10mW or less	Article 49.20 [8]
Maximum e.i.r.p.	40 dBm if the output power is greater than10mW. Not specified if the output power is 10mW or less.	Article 49.20 [8]
Carrier sense	Required if the output power is greater than 10mW	Article 49.20 [8]
Unwanted emissions	See Table 4.3.2-2 (Note 1)	Article 7 [8]
Receiver spurious emissions	See Table 4.3.2-3 (Note 1)	Article 24 [8]
Chassis	Shall be enclosed in one chassis and hard to open	Article 49.20 [8]
Interference control	Shall automatically transmit and receive an identification code. Or otherwise (only for the case that the equipment is not connected to a telecommunication circuit), users shall be able to reconfigure its transmit frequency or turn off the transmission easily.	Article 9.4 [8] Article 6.2 [7]
Identification code	19 or more bits	Article 9 [9]
Modulation	Not specified	
ACS, Intermodulation, and Spurious response	Not specified	
Location (Indoor/Outdoor)	Not specified	
Note 1: Exceptions are applied until March 31, 2023, regarding the unwanted emissions and receiver spurious emissions, i.e., the previous regulation (Category A emission requirement) can be used for the legacy equipment instead of Table 4.3.2-2 or Table 4.3.2-3.		

Table 4.3.2-2: Unwanted emissions

Frequency range	Average power
f ≤ 55.62 GHz	≤ -30dBm/MHz
55.62 < f ≤ 57 GHz	≤ -26dBm/MHz
66 < f ≤ 67.5 GHz	≤ -26dBm/MHz
67.5 GHz < f	≤ -30dBm/MHz

Table 4.3.2-3: Receiver spurious emissions

Frequency range	Average power
f < 1 GHz	≤ 4 nW/100 kHz
1 GHz ≤ f	≤ 20 nW/1 MHz

4.3.3 Korea

Unlicensed spectrum range 57 to 66GHz needs to meet following regulations:

- Antenna power shall be less than 500mW. For omni-directional antenna, power shall be less than 100mW
- Power Density shall be less than 13dBm/MHz
- EIRP shall be less than 43dBm. Except for point to point communication purpose where EIRP shall be less than 57dBm
- Antenna absolute gain shall be less than 16dBi. However, when antenna absolute gain is over the regulation limit, equivalent amount of antenna power shall be decreased
- Occupied bandwidth shall be within the range of 57 to 66GHz

- Unwanted emission for 57 – 66GHz spectrum shall satisfy below table 4.3.3-1:

Table 4.3.3-1: Unwanted emissions

Spectrum Range	Unwanted Emission Limit	Measurement Bandwidth
Less than 1GHz	-36dBm	100kHz
1GHz to 40GHz	-30dBm	1MHz
More than 40GHz	-10dBm	1MHz

- Standby status of transmit/receive secondary emissions shall follow below limits:

Table 4.3.3-2: Transmit/receive secondary emissions

Frequency	Reference Value (Average)	Reference Bandwidth
Less than 1GHz	-54dBm	100kHz
1GHz and above	-47dBm	1MHz

- To avoid malfunction of/from other equipment, devices shall use unique identification code. However this regulation does not apply to fixed point to point communication devices.

- For spectrum range of 57 to 58GHz, EIRP of more than 27dBm shall indicate following text in the manual: "When device is needed to be installed within 300m of Radio Astronomical Antenna, prearranged mutual agreement with Astronomical Observatory shall be made in advance."

4.3.4 India

4.3.5 Taiwan

In Taiwan, the band 57-66 GHz is available for unlicensed operation. Table 4.3.5-1 summarizes the current regulatory requirements for low power radio-frequency devices to use the 60 GHz spectrum in Taiwan [13].

Table 4.3.5-1: Regulatory requirements for 60GHz band in Taiwan

Items	Requirement	Condition	Comments
Frequency	57-66 GHz		
Maximum output power	500 mW if transmission bandwidth B ≥ 100 MHz 500×(B/100) mW if transmission bandwidth B < 100 MHz		
Maximum mean EIRP	82 dBm if antenna gain G > 51 dBi 82-2×(51-G) dBm if antenna gain G < 51 dBi	Outdoor devices	except for fixed operation field disturbance sensors
	40 dBm	Others	
Maximum EIRP	85 dBm if antenna gain G > 51 dBi 85-2×(51-G) dBm if antenna gain G < 51 dBi	Outdoor devices	
	43 dBm	Others	
Spurious Emission	See Table 4.3.5-2	for frequency < 40 GHz	Power density out of the band 57-66 GHz can only come from spurious emission
	power density ≤ 90 pW/cm^2 (measured at 3 meter distance)	for frequency between 40 GHz and 200 GHz	

Table 4.3.5-2: Maximum electric field intensity for spurious emission in Taiwan

Frequency (f) (MHz)	Maximum electric field intensity (μV/m)	Measured distance (meter)
0.009 ≤ f ≤ 0.490	2.4 / f	300
0.490 < f ≤ 1.705	24 / f	30
1.705 < f < 30	30	30
30 ≤ f ≤ 88	100	3
88 < f ≤ 216	150	3
216 < f ≤ 960	200	3
960 < f	500	3

4.3.6 Singapore

4.3.7 Australia

Annex A:
Change history

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
03/2017	RAN#75	RP-170137				Skeleton TR 38.805 v0.0.1 “Study on New Radio Access Technology; 60 GHz Unlicensed Spectrum”	0.0.1
03/2017	RAN#75	RP-170738				pCRs from RP-170138 and RP-170249 included following TSG RAN pCR approval	1.0.0
03/2017	RAN #75	=				As approved by RAN #75	14.0.0