Recommendation ITU-R M.1450-6

(02/2026)

M Series: Mobile, radiodetermination, amateur and related satellite services

Characteristics of broadband radio local area networks

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S	Fixed-satellite service
SA	Space applications and meteorology
SF	Frequency sharing and coordination between fixed-satellite and fixed service systems
SM	Spectrum management
SNG	Satellite news gathering
TF	Time signals and frequency standards emissions
V	Vocabulary and related subjects

Note*: This ITU-R Recommendation was approved in English under the procedure detailed in Resolution ITU-R 1.*

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RECOMMENDATION ITU-R M.1450-6

Characteristics of broadband radio local area networks

(Questions ITU-R 212/5 and ITU-R 238/5)

(2000-2002-2003-2008-2010-2014-2026)

Scope

This Recommendation provides the characteristics of broadband radio local area networks (RLANs) including technical parameters, and information on RLAN standards and some operational characteristics. Basic characteristics of broadband RLANs and information for their system design are also provided.

Abbreviations/Glossary

Access method	Scheme used to provide multiple access to a channel
AP	Access point
ARIB	Association of Radio Industries and Businesses
ATM	Asynchronous transfer mode
Bit rate	The rate of transfer of a bit of information from one network device to another
BPSK	Binary phase-shift keying
BRAN	Broadband Radio Access Networks (A technical committee of ETSI)
Channelization	Bandwidth of each channel and number of channels that can be contained in the RF bandwidth allocation
Channel indexing	The frequency difference between adjacent channel centre frequencies
CSMA/CA	Carrier sensing multiple access with collision avoidance
DAA	Detect and avoid
DFS	Dynamic frequency selection
DFT	Discrete Fourier Transform
DFT-S OFDM	DFT-spread OFDM
DSSS	Direct sequence spread spectrum
e.i.r.p.	Equivalent isotropically radiated power
ENG	Electronic News Gathering
ETSI	European Telecommunications Standards Institute
Frequency band	Nominal operating spectrum of operation
FHSS	Frequency hopping spread spectrum
HIPERLAN2	High performance radio LAN 2
HiSWANa	High speed wireless access network – type a
HSWA	High speed wireless access

IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
LAN	Local area network
LBT	Listen before talk
LPI	Low power indoor
MIMO	Multiple input multiple output
MMAC	Multimedia mobile access communication
Modulation	The method used to put information onto an RF carrier
MU	Medium utilisation
OFDM	Orthogonal frequency division multiplexing
OFDMA	Orthogonal frequency division multiple access
PSD	Power spectral density
PSTN	Public switched telephone network
QAM	Quadrature amplitude modulation
QoS	Quality of Service
QPSK	Quaternary phase-shift keying
RF	Radio frequency
RLAN	Radio local area network
RU	Resource unit
SLB	SparkLink Basic
SSMA	Spread spectrum multiple access
Tx power	Transmitter power – RF power in Watts produced by the transmitter
TCP	Transmission control protocol
TDD	Time division duplex
TDMA	Time-division multiple access
TPC	Transmit power control
TTA	Telecommunications Technology Association (A standards developing organization in the Republic of Korea)
VLP	Very low power
WATM	Wireless asynchronous transfer mode

The ITU Radiocommunication Assembly,

considering

a) that broadband radio local area networks (RLANs) are widely used for fixed, semi-fixed (transportable) and portable computer equipment for a variety of broadband applications;

b) that broadband RLANs are used for fixed, nomadic and mobile wireless access applications;

c) that broadband RLAN standards currently being developed are compatible with current wired LAN standards;

d) that it is desirable to establish guidelines for broadband RLANs in various frequency bands;

e) that broadband RLANs should be implemented with careful consideration to compatibility with other radio applications,

recognizing

a) that the use of the frequency bands 5 150-5 250 MHz, 5 250-5 350 MHz and 5 470-5 725 MHz by RLANs is covered in Resolution **229 (Rev.WRC-23)**;

b) that the frequency band 6 425-7 125 MHz may be used by various mobile service applications as described in the Radio Regulations (see RR Nos. **5.457E** and **5.457F**);

c) that the frequency band 6 425-7 125 MHz, or parts thereof, is also used by other radiocommunication services including the fixed service and fixed-satellite service;

d) that other characteristics of broadband WAS, including RLANs, are contained in Recommendations ITU-R F.1763, ITU-R M.1652, ITU-R M.1739 and ITU-R M.1801;

e) that measures may need to be considered by administrations to protect other radiocommunication services when implementing broadband RLANs;

f) that the use of the frequency bands 2 400-2 500 MHz and 5 725-5 875 MHz is addressed in RR No. **5.150**, which states that radiocommunication services operating within these bands must accept harmful interference which may be caused by ISM applications;

g) that, depending on national regulations, broadband RLANs typically operate on a non-interference/non-protection basis with respect to other applications of allocated radiocommunication services,

noting

a) that Annex 2 provides information on how to obtain the standards described in Table 1 of Annex 1;

b) that Annex 3 provides basic characteristics of broadband RLANs and general characteristics for deployment and system design applicable in certain administrations and/or regions,

recommends

1 that the broadband RLAN standards in Annex 1 should be considered by administrations wishing to implement broadband RLANs, taking into account *recognizing g)*;

1*bis* that administrations wishing to implement broadband RLANs should carefully assess their interference environment in the considered frequency band(s) in order to ensure coexistence with other systems and applications, taking into account the relevant national, regional, or ITU-R study results where appropriate;

2 that Annex 3[1] should be considered for information on broadband RLAN technical requirements applied by certain administrations and/or regions to facilitate consideration of coexistence with current and planned use of incumbent services;

3 that the following Note should be considered as part of this Recommendation.

NOTE – The implementation of this Recommendation is subject to compliance with the provisions of the Radio Regulations.

[1] Annex 3 is provided for information, which can be used for consideration at national level.

Annex 1

Broadband RLAN standards

TABLE 1

Characteristics including technical parameters associated with broadband RLAN standards: IEEE and ATIS

Characteristics	IEEE Std 802.11-2020 (Clause 16, commonly known as 802.11b)	IEEE Std 802.11-2020 (Clause 17, commonly known as 802.11a[(1)])	IEEE Std 802.11-2020 (Clause 18, commonly known as 802.11g[(1)])	IEEE Std 802.11-2020 (Clause 17, Annex D and Annex E, commonly known as 802.11j)	IEEE Std 802.11-2020 (Clause 19, commonly known as 802.11n)	IEEE Std 802.11-2020- (Clause 20, commonly known as 802.11ad)	IEEE Std 802.11-2020 (Clause 21, commonly known as 802.11ac)	IEEE Std 802.11-2020 (Clause 23, commonly known as 802.11ah)	IEEE Std 802.11ax-2021	IEEE Std 802.11ay-2021	ATIS RLAN [(2)]
Access method	**CSMA/ CA, SSMA**	**CSMA/CA**				**Scheduled, CSMA/CA**	**CSMA/CA**	**CSMA/CA**	**CSMA/CA, Trigger-based access and OFDMA**	**Scheduled, CSMA/CA**	**Scheduled, CSMA, TDMA/TDD**
Modulation	CCK (8 complex chip spreading)	64-QAM-OFDM 16-QAM-OFDM QPSK-OFDM BPSK-OFDM 52 subcarriers (see Fig. 1)	DSSS/CCK OFDM PBCC DSSS-OFDM	64-QAM-OFDM 16-QAM-OFDM QPSK-OFDM BPSK-OFDM 52 subcarriers (see Fig. 1)	64-QAM-OFDM 16-QAM-OFDM QPSK-OFDM BPSK-OFDM 56 subcarriers in 20 MHz 114 subcarriers in 40 MHz MIMO, 1-4 spatial streams	Single Carrier: DPSK, π/2-BPSK, π/2-QPSK, π/2-16QAM OFDM: 64-QAM, 16-QAM, QPSK, SQPSK 352 subcarriers	256-QAM-OFDM 64-QAM-OFDM 16-QAM-OFDM QPSK-OFDM BPSK-OFDM 56 subcarriers in 20 MHz 114 subcarriers in 40 MHz 242 subcarriers in 80 MHz 484 subcarriers in 160 MHz and 80+80 MHz MIMO, 1-8 spatial streams	256-QAM-OFDM 64-QAM-OFDM 16-QAM-OFDM QPSK-OFDM BPSK-OFDM 26 subcarriers in 1 MHz 56 subcarriers in 2 MHz 114 subcarriers in 4 MHz 242 subcarriers in 8 MHz 484 subcarriers in 16 MHz MIMO, 1-4 spatial streams	1024-QAM 256-QAM-OFDM 64-QAM-OFDM 16-QAM-OFDM QPSK-OFDM BPSK-OFDM Non-OFDMA: 242 subcarriers/frequency segment in 20 MHz 484 subcarriers/frequency segment in 40 MHz 996 subcarriers/frequency segment in 80 and 80+80 MHz 1992 subcarriers/frequency segment in 160 MHz OFDMA RU Size: 26, 52, 106, 242, 484, 996, 1992 subcarriers/RU MIMO, 1-8 spatial streams	Single Carrier: DPSK, π/2-BPSK, π/2-QPSK, π/2-8-PSK, π/2-16QAM, π/2-64-QAM, π/2-64-NUC OFDM: DCM BPSK, DCM QPSK, 16-QAM, 64-QAM 355 subcarrriers in 2.16 GHz 773 subcarrriers in 4.32 GHz 1193 subcarrriers in 6.48 GHz 1611 subcarrriers in 8.64 GHz	OFDM: 256-QAM, 64-QAM, 16-QAM, QPSK MIMO 1-4 spatial streams DFT-S-OFDM: 256-QAM, 64-QAM, 16-QAM, QPSK, π/2-BPSK

TABLE 1 (*continued*)

Characteristics	IEEE Std 802.11-2020 (Clause 16, commonly known as 802.11b)	IEEE Std 802.11-2020 (Clause 17, commonly known as 802.11a(1))	IEEE Std 802.11-2020 (Clause 18, commonly known as 802.11g(1))	IEEE Std 802.11-2020 (Clause 17, Annex D and Annex E, commonly known as 802.11j)	IEEE Std 802.11-2020 (Clause 19, commonly known as 802.11n)	IEEE Std 802.11-2020 (Clause 20, commonly known as 802.11ad)	IEEE Std 802.11-2020 (Clause 21, commonly known as 802.11ac)	IEEE Std 802.11-2020 (Clause 23, commonly known as 802.11ah)	IEEE Std 802.11ax-2021	IEEE Std 802.11ay-2021	ATIS RLAN (2)
Data rate	1, 2, 5.5 and 11 Mbit/s	6, 9, 12, 18, 24, 36, 48 and 54 Mbit/s	1, 2, 5.5, 6, 9, 11, 12, 18, 22, 24, 33, 36, 48 and 54 Mbit/s	3, 4.5, 6, 9, 12, 18, 24 and 27 Mbit/s for 10 MHz channel spacing 6, 9, 12, 18, 24, 36, 48 and 54 Mbit/s for 20 MHz channel spacing	From 6.5 to 288.9 Mbit/s for 20 MHz channel spacing From 6 to 600 Mbit/s for 40 MHz channel spacing	From 693.00 to 6756.75 Mbit/s	From 6.5 to 693.3 Mbit/s for 20 MHz channel spacing From 13.5 to 1 600 Mbit/s for 40 MHz channel spacing From 29.3 to 3 466.7 Mbit/s for 80 MHz channel spacing From 58.5 to 6 933.3 Mbit/s for 160 MHz and 80+80 MHz channel spacing	From 0.300 to 17.7778 Mbit/s for 1 MHz channel spacing From 0.650 to 34.6667 Mbit/s for 2 MHz channel spacing From 1.350 to 80.000 Mbit/s for 4 MHz channel spacing From 2.925 to 173.3333 Mbit/s for 8 MHz channel spacing From 5.850 to 346.6667 Mbit/s for 16 MHz channel spacing	From 0.4 to 117.6 Mbit/s for 26-tone RU From 0.8 to 235.3 Mbit/s for 52-tone RU From 1.6 to 500.0 Mbit/s for 106-tone RU From 3.6 to 1 147.1 Mbit/s for 242-tone RU and 20 MHz non-OFDMA channel spacing From 7.3 to 2 294.1 Mbit/s for 484-tone RU and non-OFDMA 40 MHz channel spacing From 15.3 to 4 803.9 Mbit/s for 996-tone RU and non-OFDMA 80 MHz channel spacing From 30.6 to 9 607.8 Mbit/s for 2×996-tone RU and 160 MHz and 80+80 MHz channel spacing	From 630.00 to 8 316.00 Mbit/s for 2.16 GHz From 1 376.25 to 18 166.50 Mbit/s for 3.32 GHz From 2 126.25 to 28 066.50 Mbit/s for 6.48 GHz From 2 872.50 to 37 917.00 Mbit/s for 8.64 GHz	Up to 453 Mbit/s for 20 MHz channel Up to 907 Mbit/s for 40 MHz channel Up to 1 386 Mbit/s for 60 MHz channel Up to 1 857 Mbit/s for 80 MHz channel

TABLE 1 (*continued*)

Characteristics	IEEE Std 802.11-2020 (Clause 16, commonly known as 802.11b)	IEEE Std 802.11-2020 (Clause 17, commonly known as 802.11a(1))	IEEE Std 802.11-2020 (Clause 18, commonly known as 802.11g(1))	IEEE Std 802.11-2020 (Clause 17, Annex D and Annex E, commonly known as 802.11j)	IEEE Std 802.11-2020 (Clause 19, commonly known as 802.11n)	IEEE Std 802.11-2020- (Clause 20, commonly known as 802.11ad)	IEEE Std 802.11-2020 (Clause 21, commonly known as 802.11ac)	IEEE Std 802.11-2020 (Clause 23, commonly known as 802.11ah)	IEEE Std 802.11ax-2021	IEEE Std 802.11ay-2021	ATIS RLAN (2)
Frequency band (3)	2 400-2 483.5 MHz	5 150-5 250 MHz 5 250-5 350 MHz 5 470-5 725 MHz 5 725-5 825 MHz	2 400-2 483.5 MHz	4 940-4 990 MHz 5 150-5 250 MHz 5 250-5 350 MHz 5 470-5 725 MHz 5 725-5 825 MHz	2 400-2 483.5 MHz 5 150-5 250 MHz 5 250-5 350 MHz 5 470-5 725 MHz 5 725-5 825 MHz	57-71 GHz	5 150-5 250 MHz 5 250-5 350 MHz 5 470-5 725 MHz 5 725-5 825 MHz	755-787 MHz 779-787 MHz 863-868.6 MHz 902-928 MHz 916.5-927.5 MHz 917.5-923.5 MHz	2 400-2 483.5 MHz 5 150-5 250 MHz 5 250-5 350 MHz 5 470-5 725 MHz 5 725-5 825 MHz 5 825-5 850 MHz 5 850-5 895 MHz 5 925-7 125 MHz 5 945–6 425 MHz	57-71 GHz	5 150-5 925 MHz
Channel indexing	5 MHz				5 MHz in 2.4 GHz 20 MHz in 5 GHz	2 160 MHz	20 MHz	1 MHz	20 MHz	2 160 MHz	20 MHz
Spectrum mask	802.11b mask (Fig. 4)	OFDM mask (Fig. 1)			OFDM mask (Figs. 2a, 2b for 20 MHz and Figs. 3a, 3b for 40 MHz)	802.11ad mask (Fig. 5)	OFDM mask (Fig. 2b for 20 MHz, Fig. 3b for 40 MHz, Fig. 3c for 80 MHz, Fig. 3d for 160 MHz, and Fig. 3e for 80+80 MHz)	802.11ah mask (Fig. 6a for 1 MHz, Fig. 6b for 2 MHz, Fig. 6c for 4 MHz, Fig. 6d for 8 MHz and Fig. 6e for 16 MHz)	Spectrum Mask (Fig. 7a for 20 MHz, Fig. 7b for 40 MHz, Fig. 7c for 80 MHz, Fig. 7d for 160 MHz and Fig. 7e for 80+80 MHz)	802.11ay mask (Fig .8a for 2.16 GHz, Fig. 8b for 4.32 GHz, Fig. 8c for 6.48 GHz, Fig. 8d for 8.64 GHz and Fig. 8e for 2.16+2.16 GHz) Fig. 8f for 4.32+4.32 GHz)	Fig. 9a for 20 MHz, Fig. 9b for 40 MHz, Fig. 9c for 60 MHz, Fig. 9d for 80 MHz
Transmitter											

TABLE 1 (*end*)

Characteristics	IEEE Std 802.11-2020 (Clause 16, commonly known as 802.11b)	IEEE Std 802.11-2020 (Clause 17, commonly known as 802.11a[(1)])	IEEE Std 802.11-2020 (Clause 18, commonly known as 802.11g[(1)])	IEEE Std 802.11-2020 (Clause 17, Annex D and Annex E, commonly known as 802.11j)	IEEE Std 802.11-2020 (Clause 19, commonly known as 802.11n)	IEEE Std 802.11-2020- (Clause 20, commonly known as 802.11ad)	IEEE Std 802.11-2020 (Clause 21, commonly known as 802.11ac)	IEEE Std 802.11-2020 (Clause 23, commonly known as 802.11ah)	IEEE Std 802.11ax-2021	IEEE Std 802.11ay-2021	ATIS RLAN [(2)]
Interference mitigation	LBT	LBT/DFS/ TPC	LBT		LBT/DFS/TPC	Entergy Detect, Frequency, Time and Spatial sharing	LBT/DFS/TP C	Entergy Detect CCA, Frequency, Time and Spatial sharing	LBT/DFS/TP C/AFC*	Entergy Detect, Frequency, Time and Spatial sharing	LBT/DFS/TPC
Receiver											
Sensitivity	Listed in Standard	Listed in Standard	Listed in Standard		Listed in Standard	Listed in Standard	Listed in Standard	Listed in Standard	Listed in Standard	Listed in Standard	Listed in Standard

Notes to Table 1:

(1) Parameters for the physical layer are common between IEEE 802.11a and ARIB HiSWANa.

(2) See 3GPP TS 37.213 Release 16 and related ATIS Standards.

- TTA also issued RLAN standards as identical as the IEEE Std 801.11-2020, IEEE Std 802.11ax-2021 and IEEE Std 802.11ay-2021 listed in the Table.

(3) The frequency bands in this Table are those that are supported by the respective broadband RLAN standards and are presented here for information. The frequency bands for the use of broadband RLANs may vary depending on each administration's regulation, which may use portions, none or all of the bands supported by the respective broadband RLAN standards.

TABLE 2

Characteristics including technical parameters associated with broadband RLAN standards: ETSI, ARIB and CCSA

Characteristics	ETSI EN 300 328[(1)]	ETSI EN 301 893 (V2.1.1)[(1)]	ARIB HiSWANa[(2)]	ETSI EN 302 567 (V2.2.1)[(1)]	ETSI EN 303 722 (V1.2.1)	ETSI EN 303 687 (V1.1.1)[(1)]	YD/T 4007 (commonly known as SparkLink Basic, SLB)
Access method	Unspecified	**See clause 4.2.7 of the standard**	**TDMA/TDD**	**See clause 4.2.5 of the standard**	**See clause 4.2.5 of the standard**	**See clause 4.3.6 of the standard**	OFDMA
Modulation	No restriction on the type of modulation	Unspecified	64-QAM-OFDM 16-QAM-OFDM QPSK-OFDM BPSK-OFDM 52 subcarriers (see Fig. 1)	Unspecified	Unspecified	Unspecified	1024-QAM-OFDM 256-QAM-OFDM 64-QAM-OFDM 16-QAM-OFDM QPSK-OFDM

TABLE 2 (*end*)

Characteristics	ETSI EN 300 328[(1)]	ETSI EN 301 893 (V2.1.1)[(1)]	ARIB HiSWANa[(2)]	ETSI EN 302 567 (V2.2.1)[(1)]	ETSI EN 303 722 (V1.2.1)	ETSI EN 303 687 (V1.1.1)[(1)]	YD/T 4007 (commonly known as SparkLink Basic, SLB)
Data rate	Unspecified	Unspecified	6, 9, 12, 18, 27, 36 and 54 Mbit/s	Unspecified	Unspecified	Unspecified	From 4.3 to 1249.0 Mbit/s for 20 MHz channel spacing From 34.6 to 9992.3 Mbit/s for max 160 MHz channel spacing (8 CC carrier aggregation)
Frequency band [(3)]	2 400-2 483.5 MHz	5 150-5 350 MHz and 5 470-5 725 MHz [(4)]	4 900 to 5 000 MHz[(5)] 5 150 to 5 250 MHz[(6)]	57-71 GHz	57-71 GHz	5 945-6 425 MHz	2 400-2 483.5 MHz 5 150-5 350 MHz and 5 725-5 850 MHz
Channel indexing	Unspecified	20 MHz	20 MHz channel spacing 4 channels in 100 MHz	Unspecified	Unspecified	20 MHz	20 MHz
Spectrum mask	Figs. 1 and 3	Fig. 1x	OFDM mask (Fig. 1)	Fig. 2x	Fig. 3x	Fig. 1x [(7)]	Fig. 11
Transmitter							
Interference mitigation	DAA/LBT, DAA/non-LBT, MU	See standard	LBT	See standard	See standard	See standard	FISA (Fast Interference Sensing and Avoidance). See standard
Receiver							
Sensitivity	Unspecified	See standard		See standard	See standard	See standard	See standard

Notes to Table 2

(1) These Harmonized Standards (HS) are not technology standards, but rather are used to demonstrate that products, services, or processes comply with relevant EU legislation.

(2) Parameters for the physical layer are common between IEEE 802.11a and ARIB HiSWANa.

(3) The frequency bands in this Table are those that are supported by the respective broadband RLAN standards and are presented here for information. The frequency bands for the use of broadband RLANs may vary depending on each administration's regulation, which may use portions, none or all of the bands supported by the respective broadband RLAN standards.

(4) DFS rules apply in the 5 250-5 350 and 5 470-5 725 MHz bands in many administrations and administrations must be consulted.

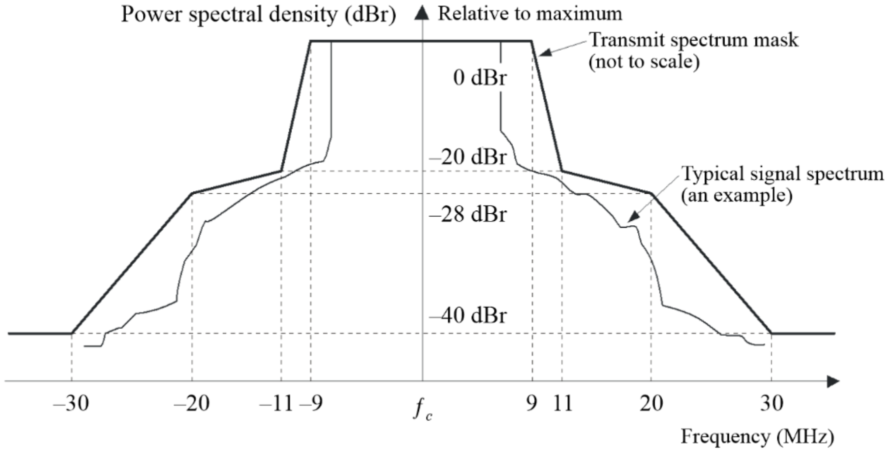
(5) See IEEE 802.11j-2004 and JAPAN MIC ordinance for Regulating Radio Equipment, Articles 49-20 and 49-21.

(6) Resolution **229 (Rev.WRC-23)** applies.

(7) Additional masks are specified for multi-channel use cases.

FIGURE 1a

OFDM transmit spectrum mask for 802.11a, 11g, 11j, and HiSWANa systems



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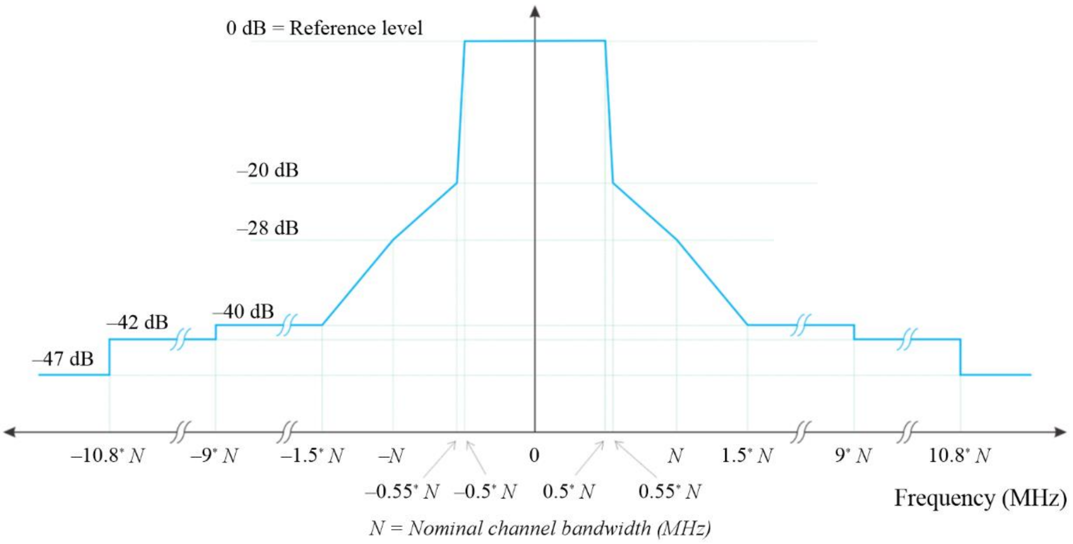
NOTE 1 – The outer heavy line is the spectrum mask for 802.11a, 11g, 11j, HiSWANa and the inner thin line is the envelope spectrum of OFDM signals with 52 subcarriers.

NOTE 2 – The measurements shall be made using a 100 kHz resolution bandwidth and a 30 kHz video bandwidth.

NOTE 3 – In the case of the 10 MHz channel spacing in 802.11j, the frequency scale shall be half.

FIGURE 1b

Transmit spectrum mask for EN 301 893



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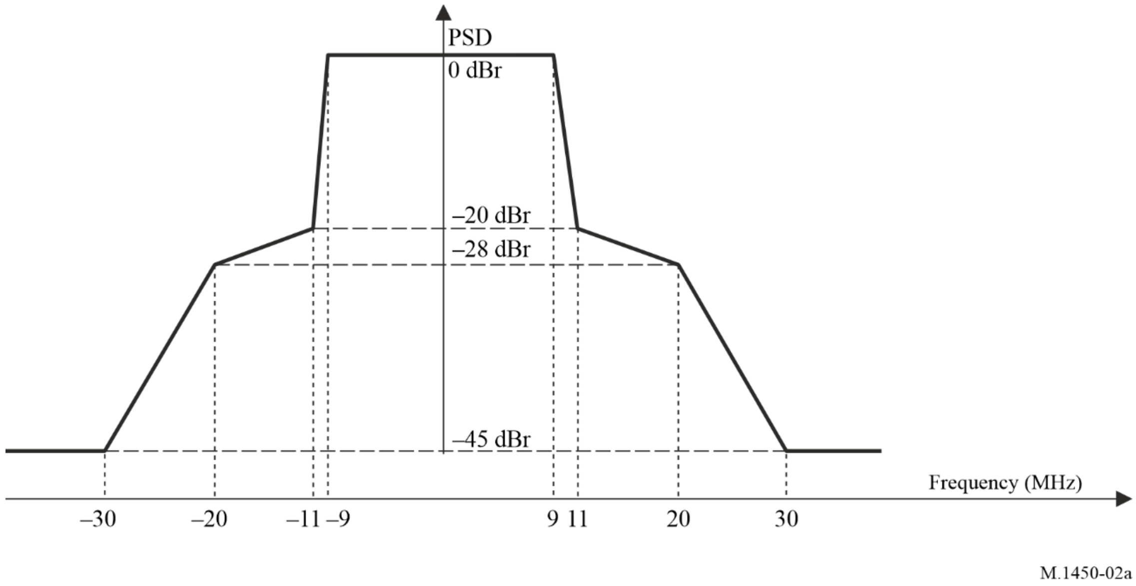
NOTE – dBc is the spectral density relative to the maximum spectral power density of the transmitted signal.

FIGURE 2a

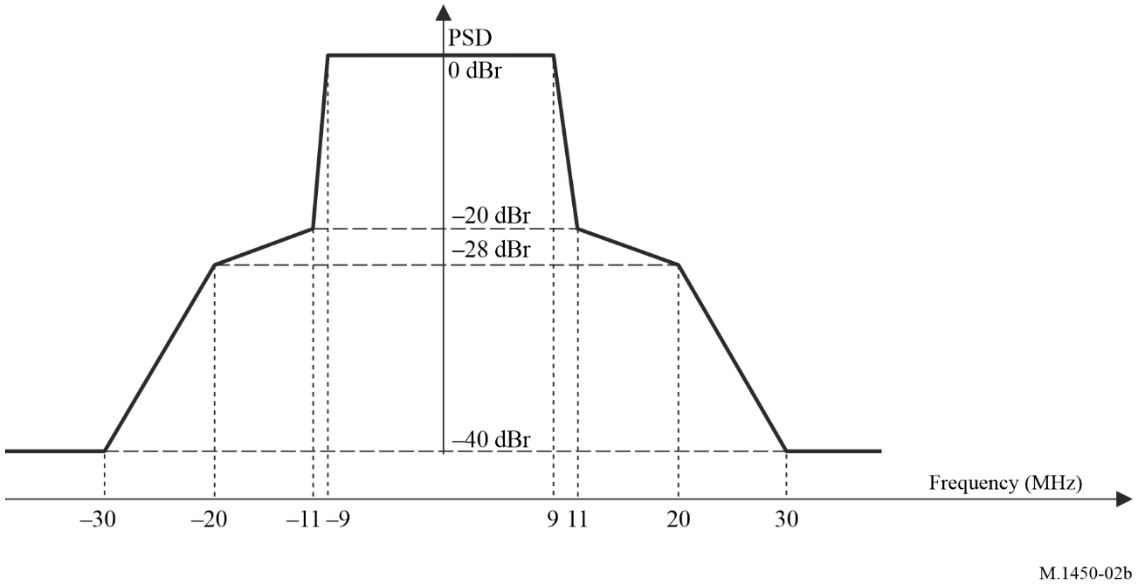
Transmit spectral mask for 20 MHz 802.11n transmission in 2.4 GHz band



NOTE – Maximum of −45 dBr and −53 dBm/MHz at 30 MHz frequency offset and above.

FIGURE 2b

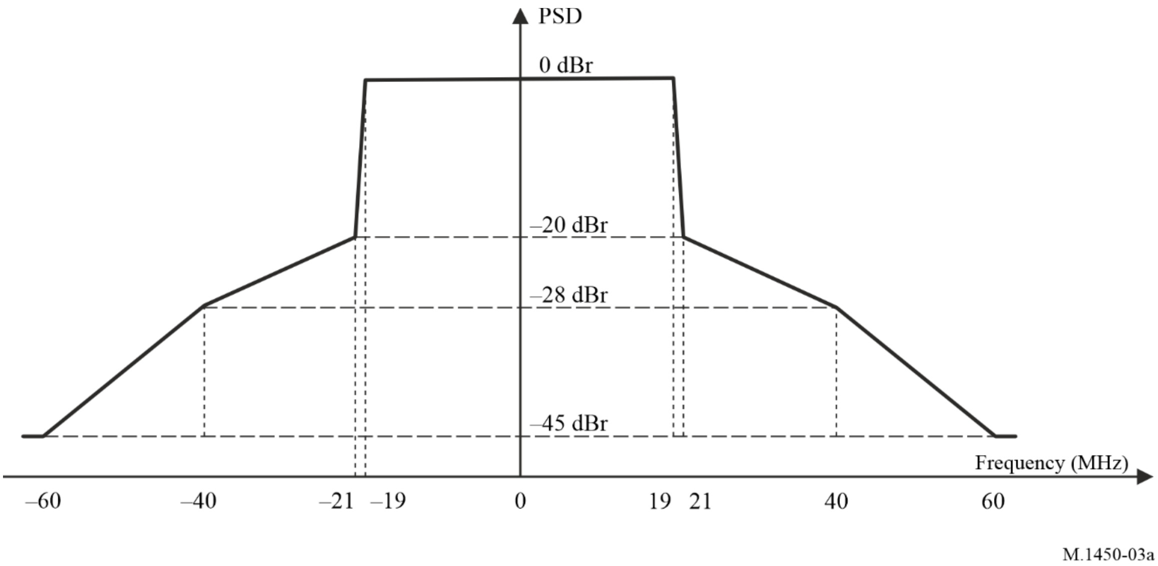
Transmit spectral mask for a 20 MHz 802.11n transmission in 5 GHz band and transmit spectral mask for 802.11ac



NOTE – For 802.11n, the maximum of −40 dBr and −53 dBm/MHz at 30 MHz frequency offset and above. For 802.11ac, the transmit spectrum shall not exceed the maximum of the transmit spectral mask and −53 dBm/MHz at any frequency offset.

FIGURE 3a

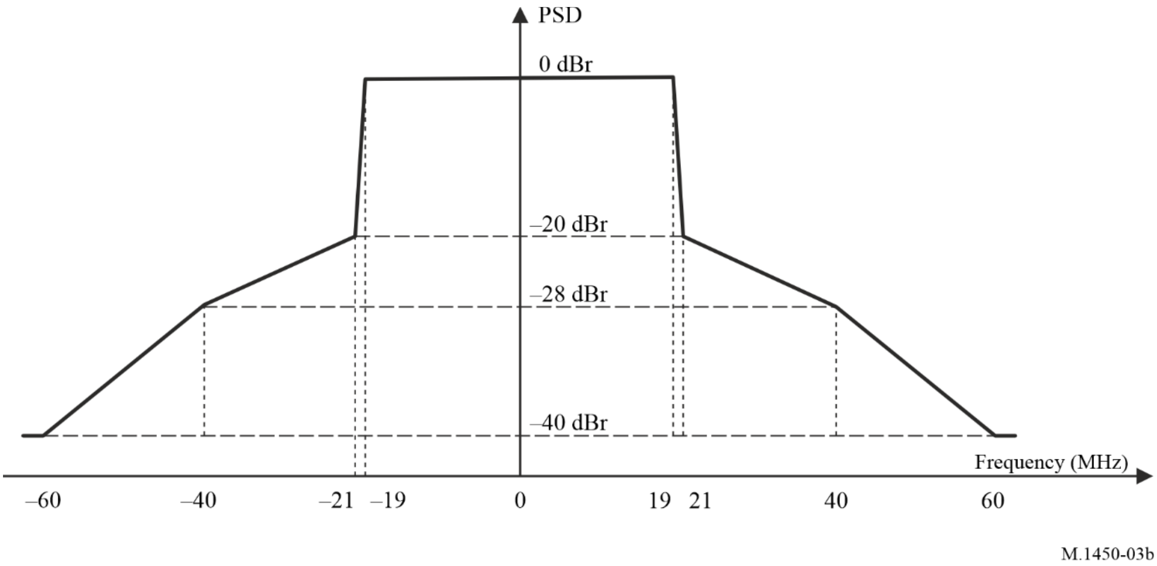
Transmit spectral mask for a 40 MHz 802.11n channel in 2.4 GHz band



NOTE – Maximum of −45 dBr and −56 dBm/MHz at 60 MHz frequency offset and above.

FIGURE 3b

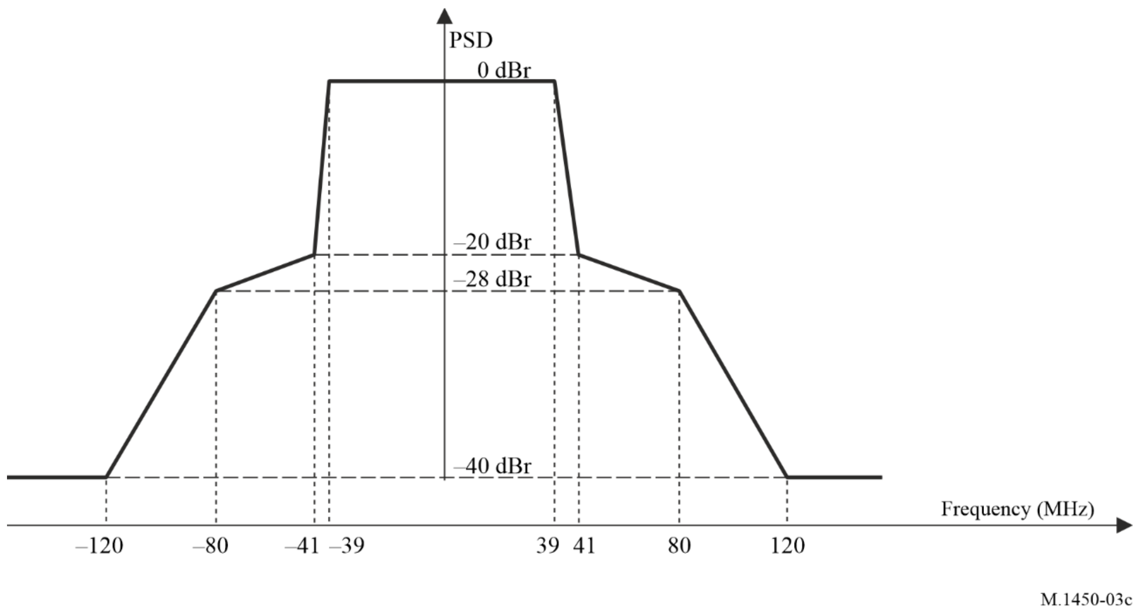
Transmit spectral mask for a 40 MHz 802.11n channel in 5 GHz band and transmit spectral mask for 802.11ac



NOTE – For 802.11n, maximum of −40 dBr and −56 dBm/MHz at 60 MHz frequency offset and above. For 802.11ac, the transmit spectrum shall not exceed the maximum of the transmit spectral mask and −56 dBm/MHz at any frequency offset.

FIGURE 3c

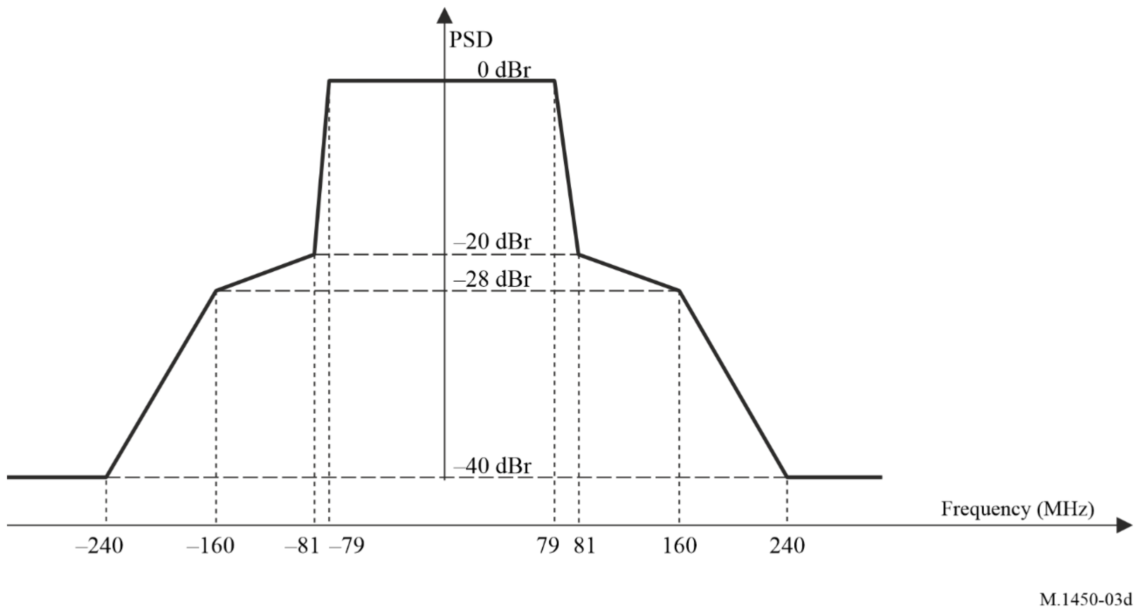
Transmit spectral mask for an 80 MHz 802.11ac channel



NOTE – The transmit spectrum shall not exceed the maximum of the transmit spectral mask and −59 dBm/MHz at any frequency offset.

FIGURE 3d

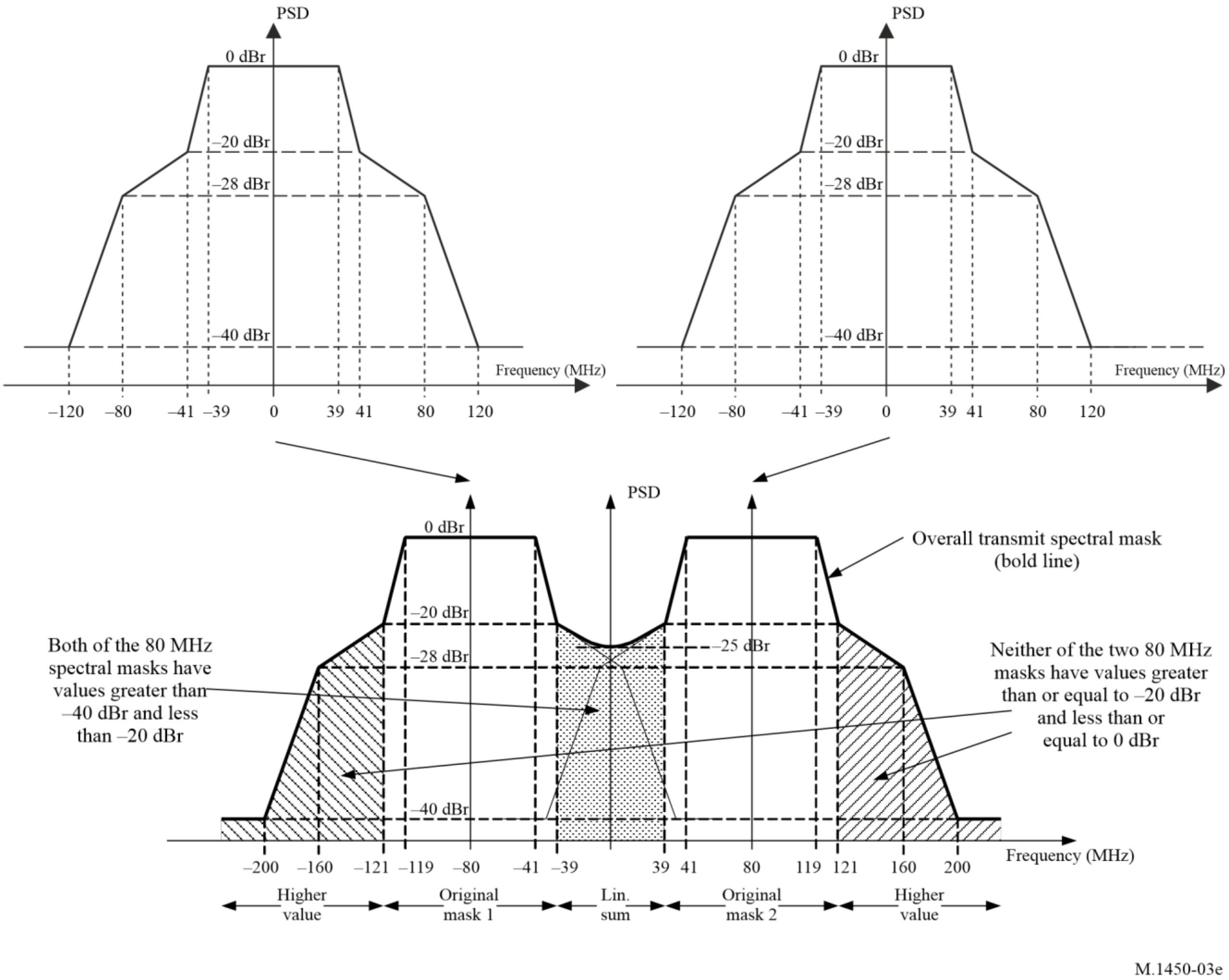
Transmit spectral mask for a 160 MHz 802.11ac channel



NOTE – The transmit spectrum shall not exceed the maximum of the transmit spectral mask and −59 dBm/MHz at any frequency offset.

FIGURE 3e

Transmit spectral mask for a 80+80 MHz 802.11ac channel



NOTE – The transmit spectrum shall not exceed the maximum of the transmit spectral mask and −59 dBm/MHz at any frequency offset.

FIGURE 4

Transmit spectrum mask for 802.11b

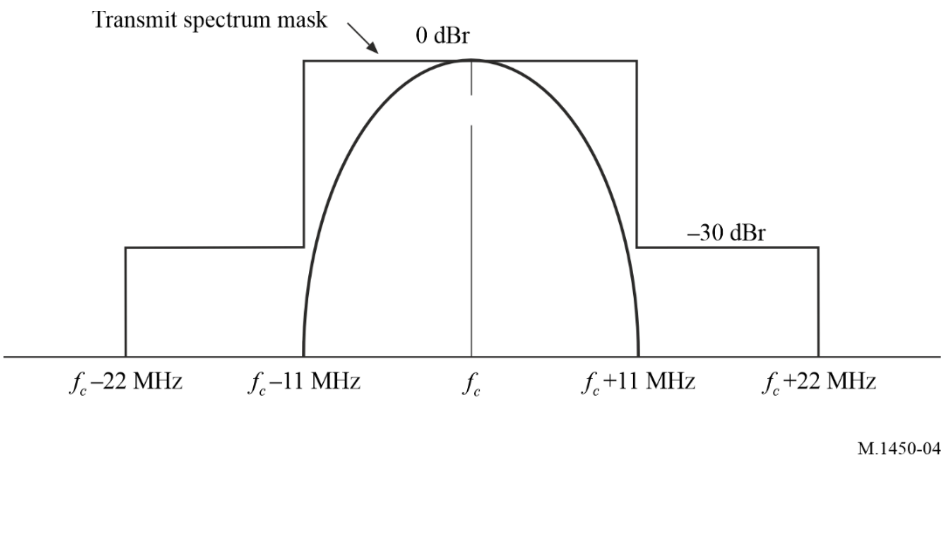


FIGURE 5

Transmit spectrum mask for 802.11ad

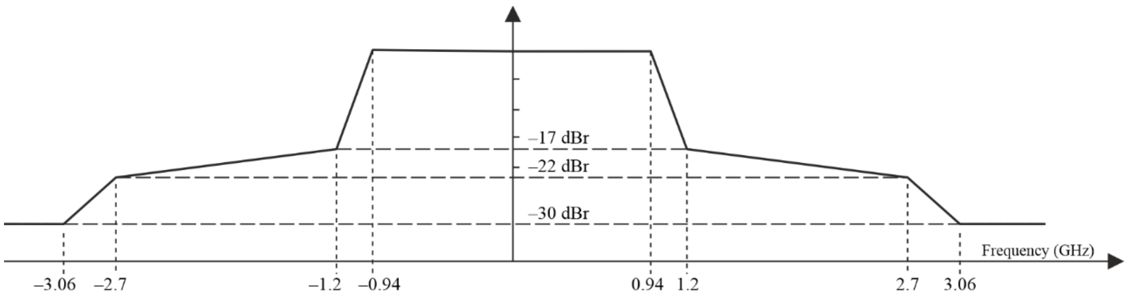


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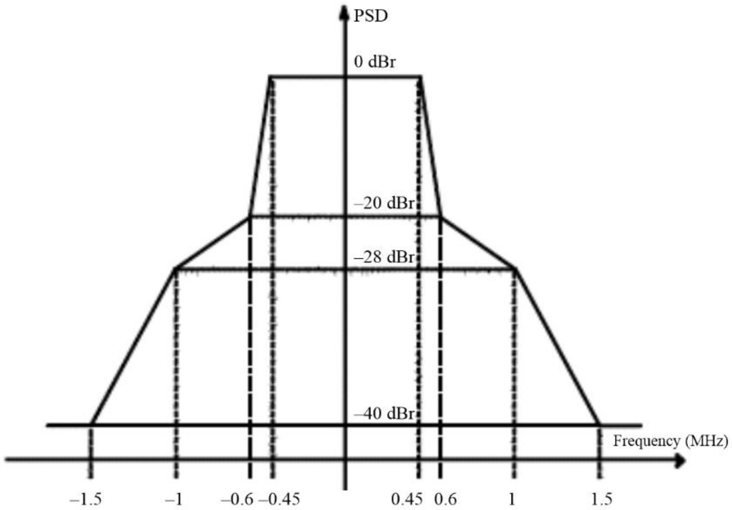
FIGURE 6a

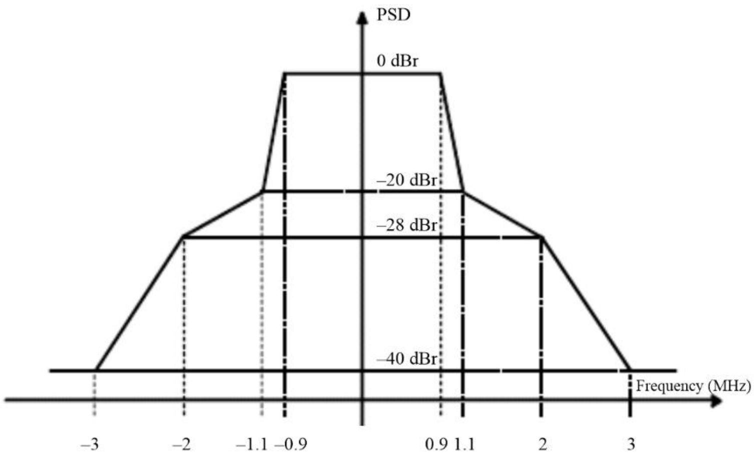
Transmit spectrum mask for 1 MHz 802.11ah channel



M.1450-06a

FIGURE 6b

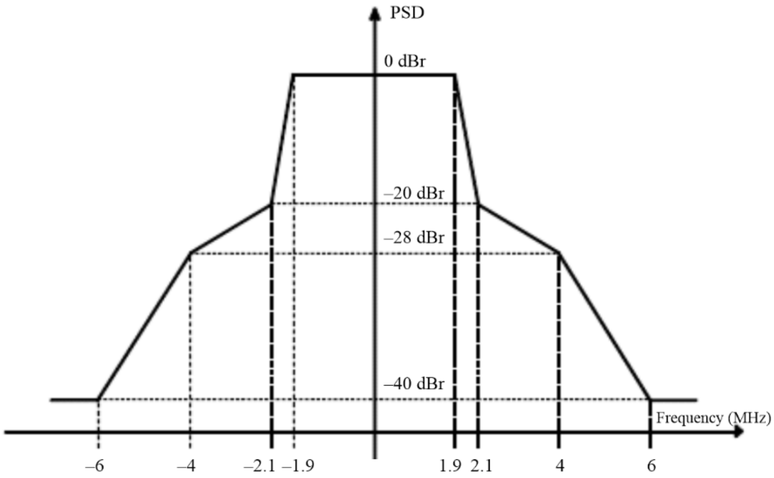
Transmit spectrum mask for 2 MHz 802.11ah channel



M.1450-06b

FIGURE 6c

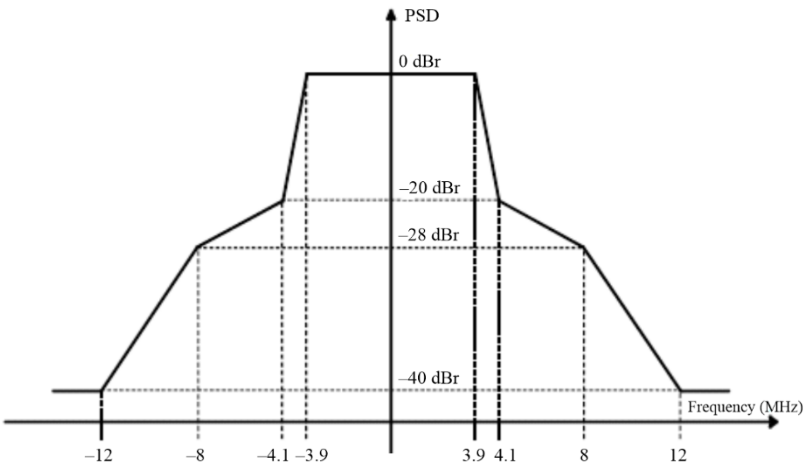
Transmit spectrum mask for 4 MHz 802.11ah channel



M.1450-06c

FIGURE 6d

Transmit spectrum mask for 8 MHz 802.11ah channel



M.1450-06d

FIGURE 6e

Transmit spectrum mask for 16 MHz 802.11ah channel

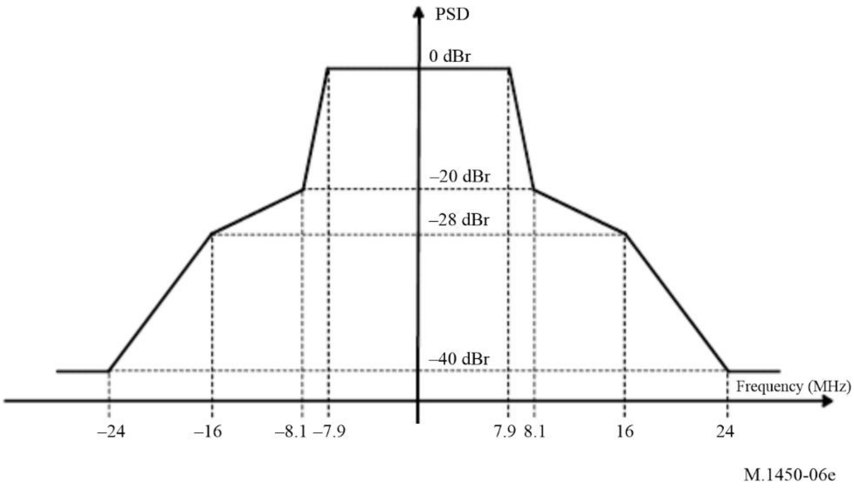


FIGURE 7a

Transmit spectrum mask for 20 MHz 802.11ax channel

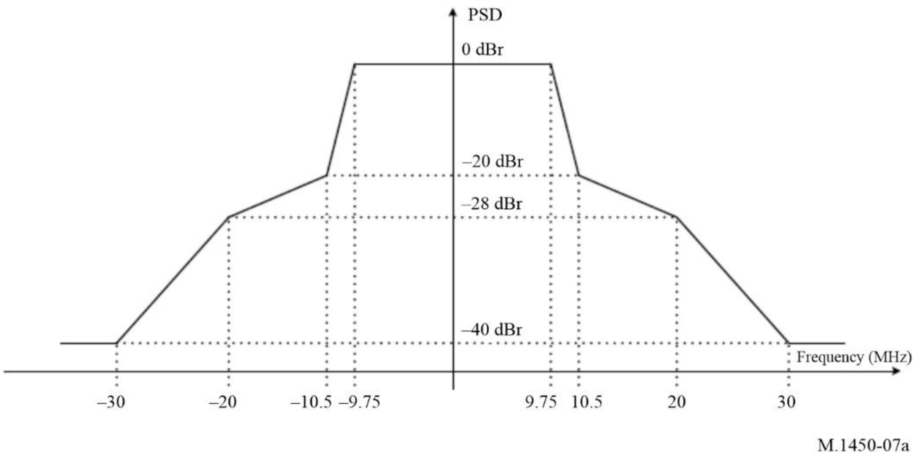


FIGURE 7b

Transmit spectrum mask for 40 MHz 802.11ax channel

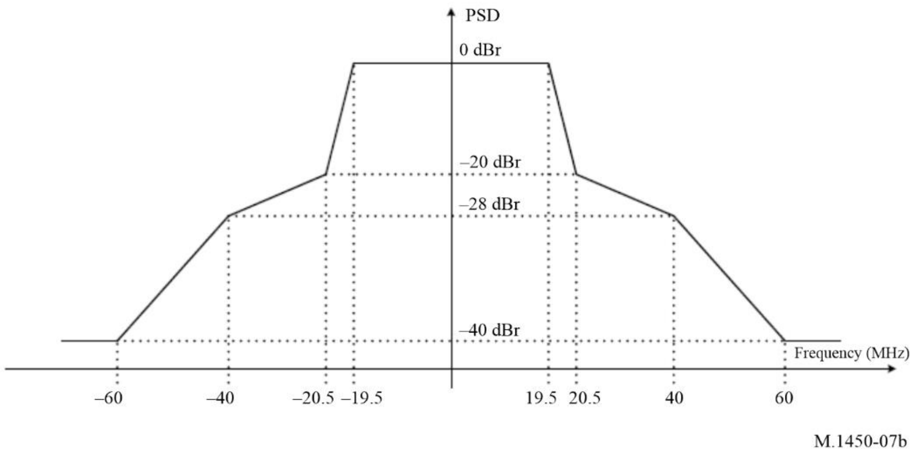
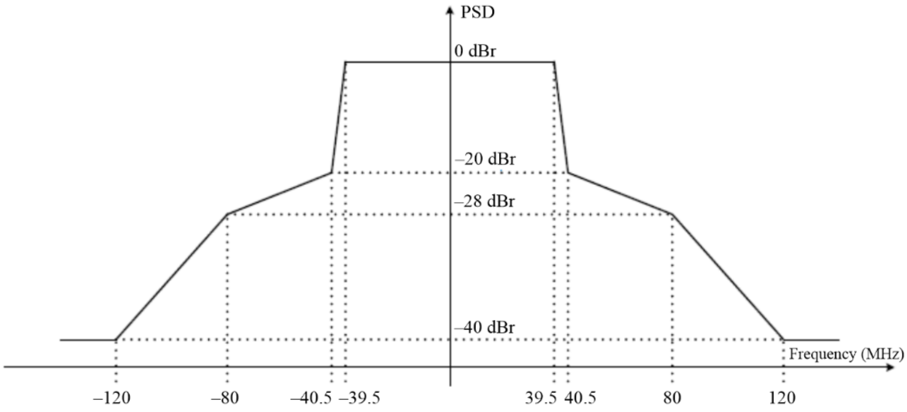


FIGURE 7c

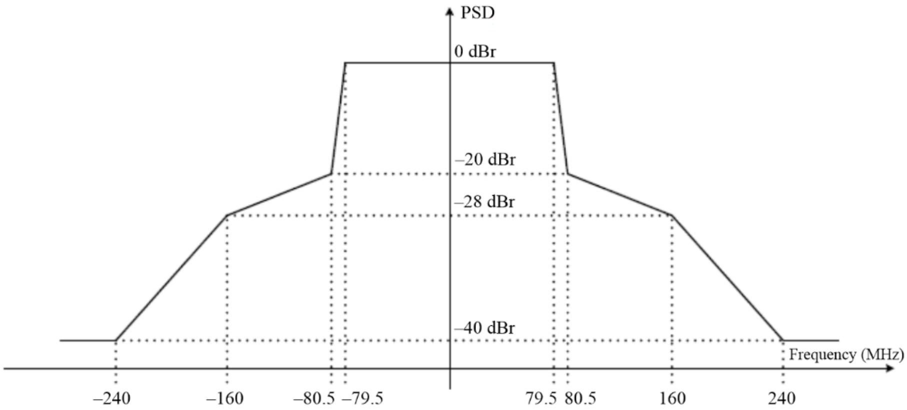
Transmit spectrum mask for 80 MHz 802.11ax channel



M.1450-07c

FIGURE 7d

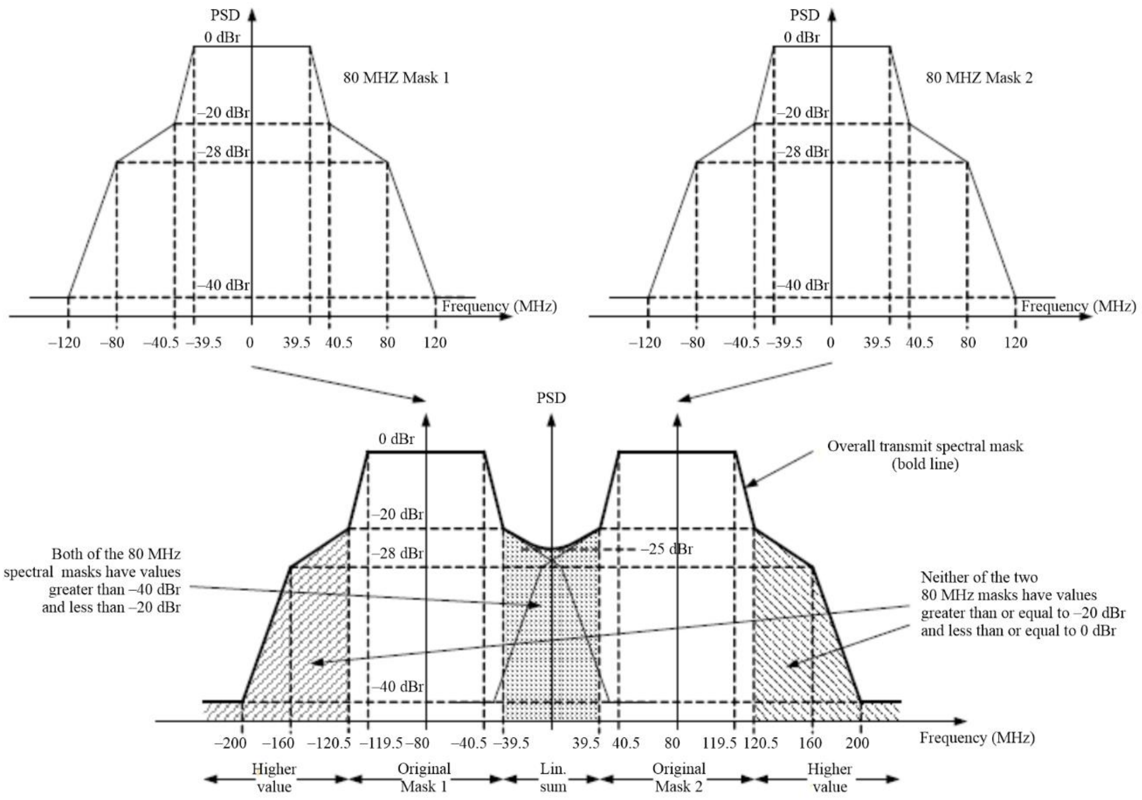
Transmit spectrum mask for 160 MHz 802.11ax channel



M.1450-07d

FIGURE 7e

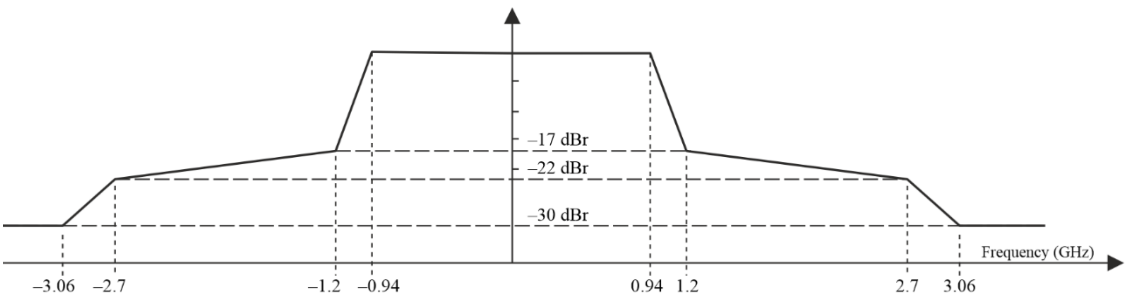
Transmit spectrum mask for 80+80 MHz 802.11ax channel



M.1450-07e

FIGURE 8a

Transmit spectrum mask for 2.16 GHz P802.11ay channel



M.1450-08a

FIGURE 8b

Transmit spectrum mask for 4.32 GHz P802.11ay channel

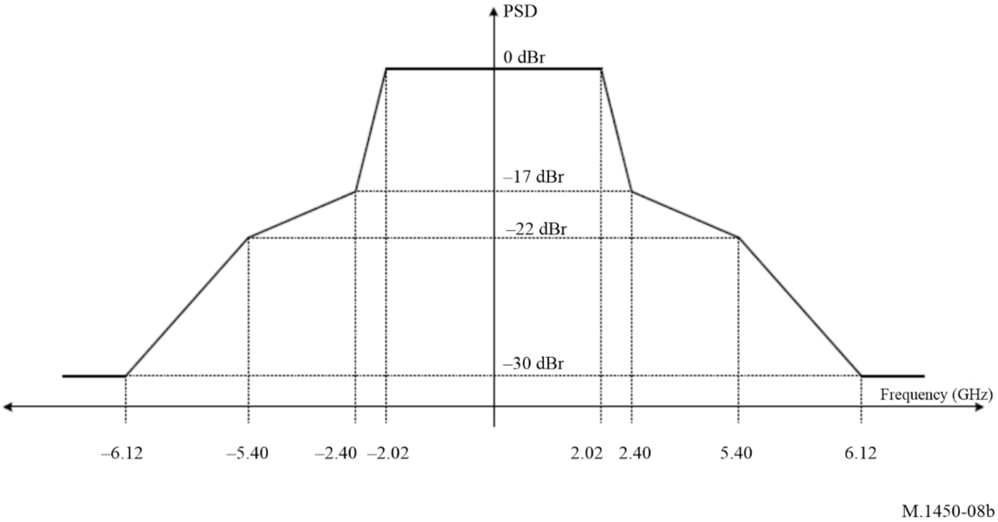


FIGURE 8c

Transmit spectrum mask for 6.48 GHz P802.11ay channel

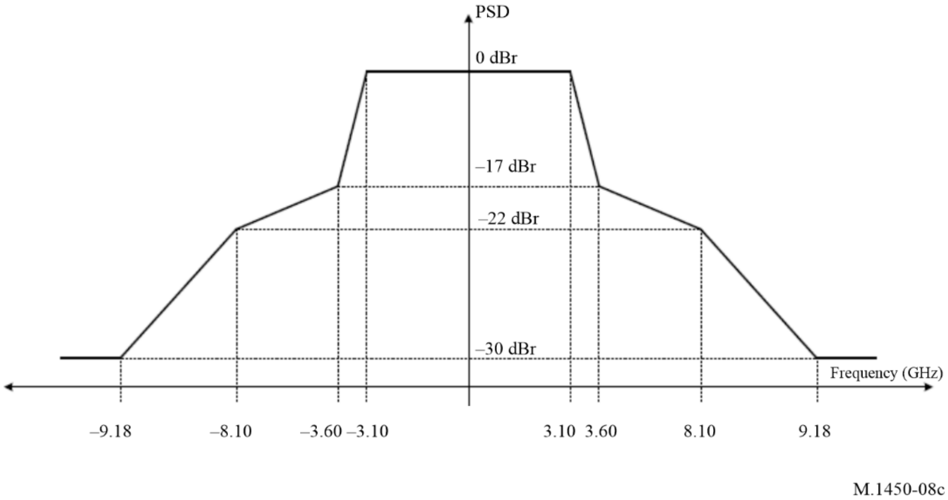
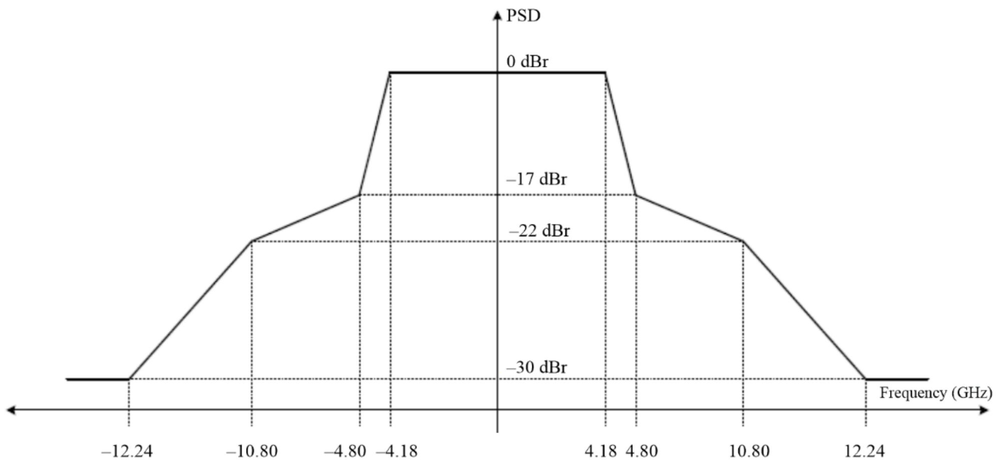


FIGURE 8d

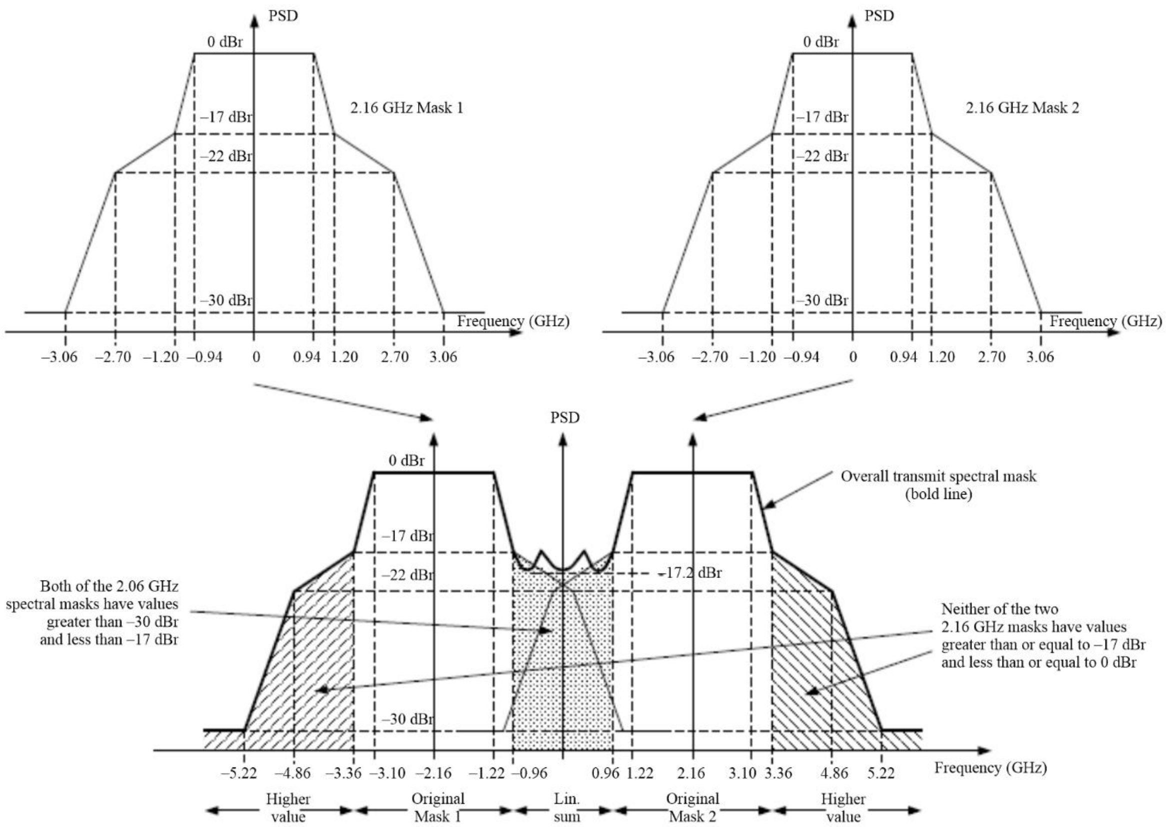
Transmit spectrum mask for 8.64 GHz P802.11ay channel



M.1450-08d

FIGURE 8e

Transmit spectrum mask for 2.16+2.16 GHz P802.11ay channel



M.1450-08e

FIGURE 8f

Transmit spectrum mask for 4.32+4.32 GHz P802.11ay channel

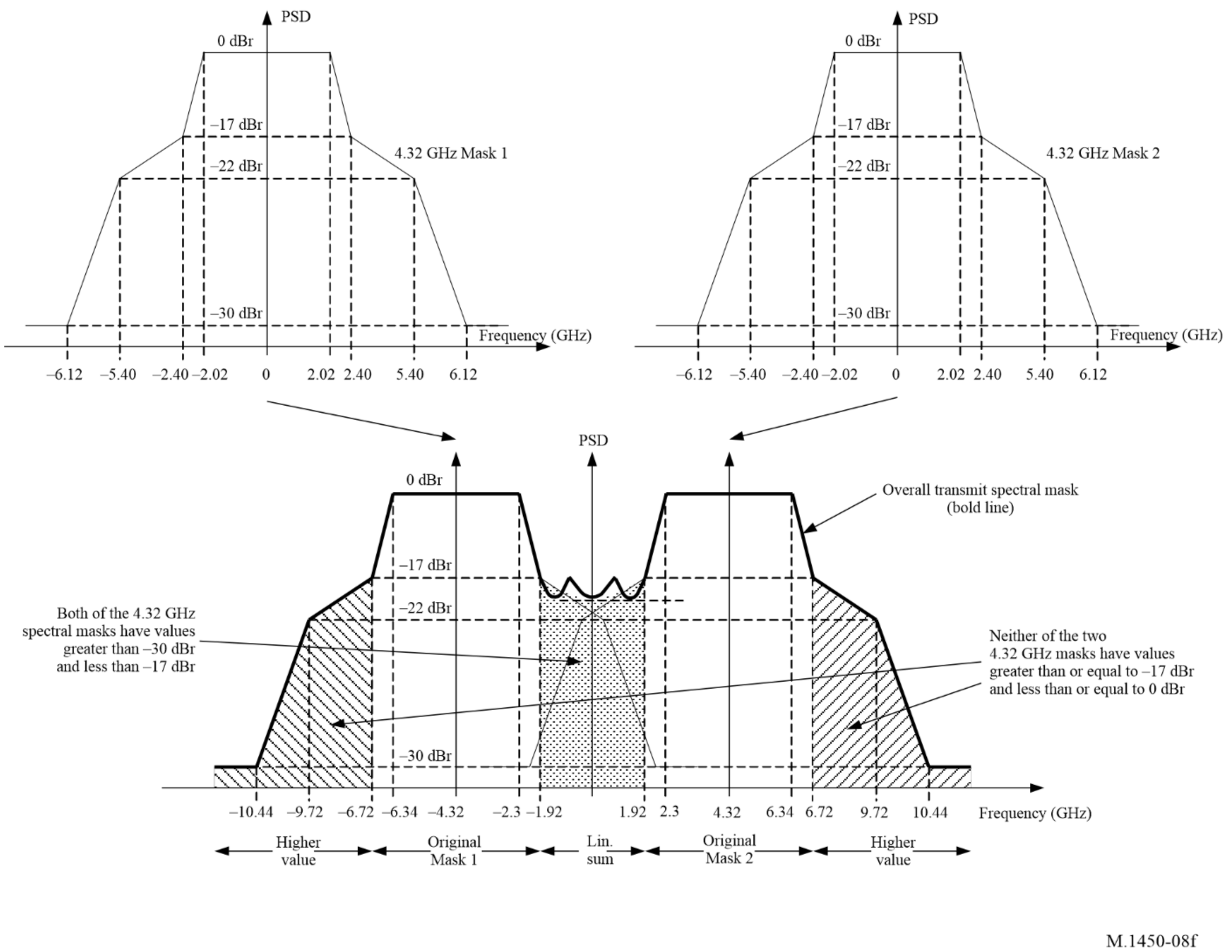
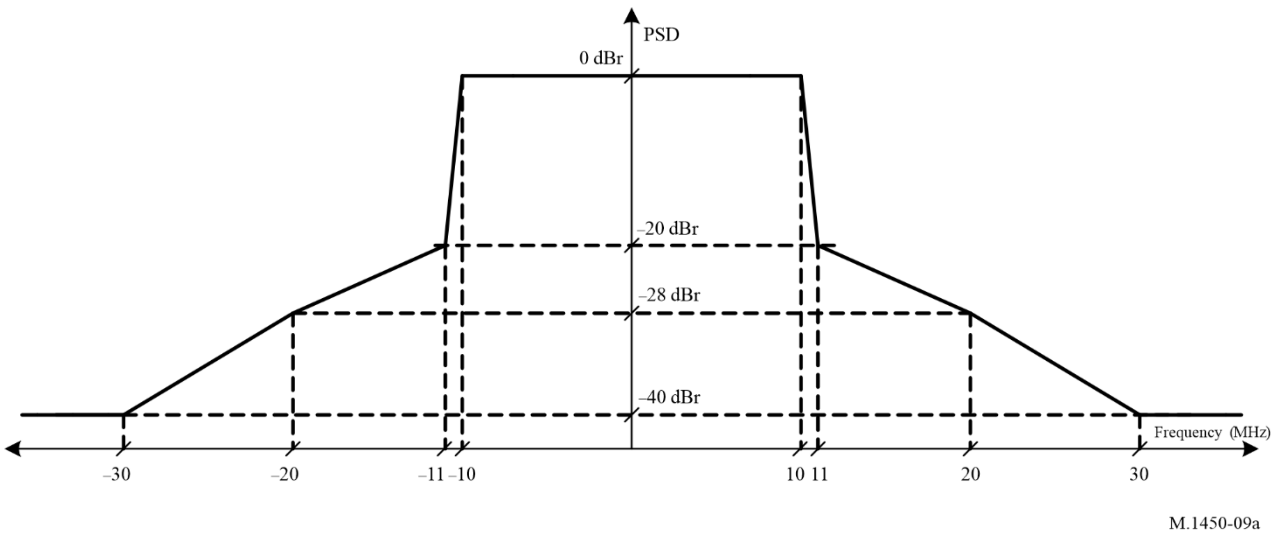


FIGURE 9a

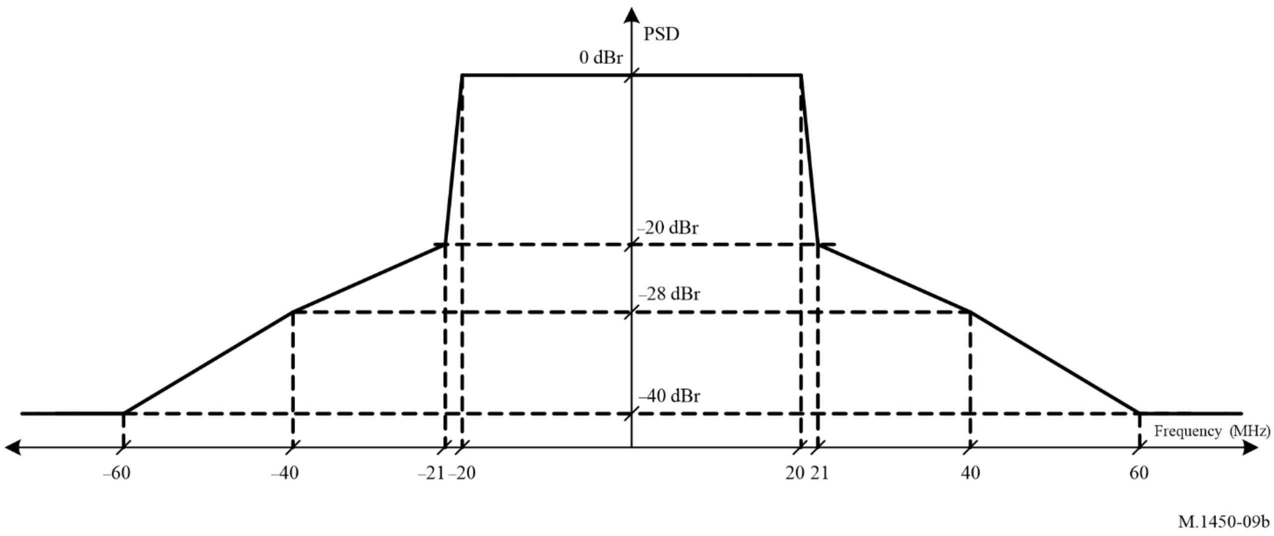
Transmit spectrum mask for 20 MHz ATIS RLAN



NOTE – The spectrum emission mask is defined relative to the maximum power density in a 1 MHz measurement bandwidth within the channel bandwidth. The relative power of any transmitter emission shall not exceed the levels indicated by the mask or −30 dBm/MHz whichever is the greatest.

FIGURE 9b

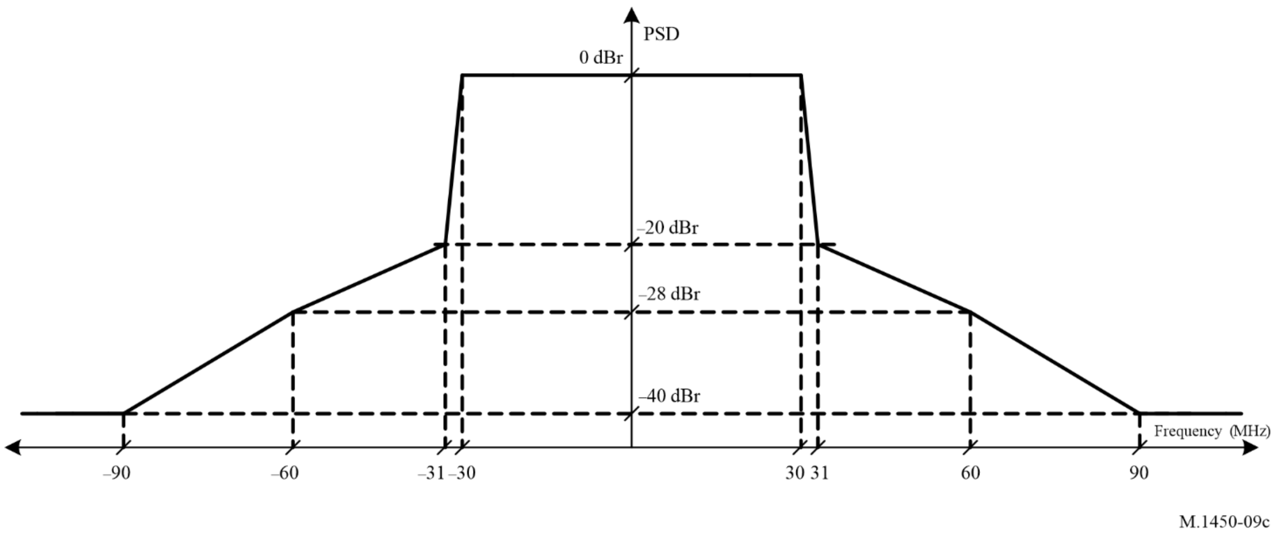
Transmit spectrum mask for 40 MHz ATIS RLAN



NOTE – The spectrum emission mask is defined relative to the maximum power density in a 1 MHz measurement bandwidth within the channel bandwidth. The relative power of any transmitter emission shall not exceed the levels indicated by the mask or −30 dBm/MHz whichever is the greatest.

FIGURE 9c

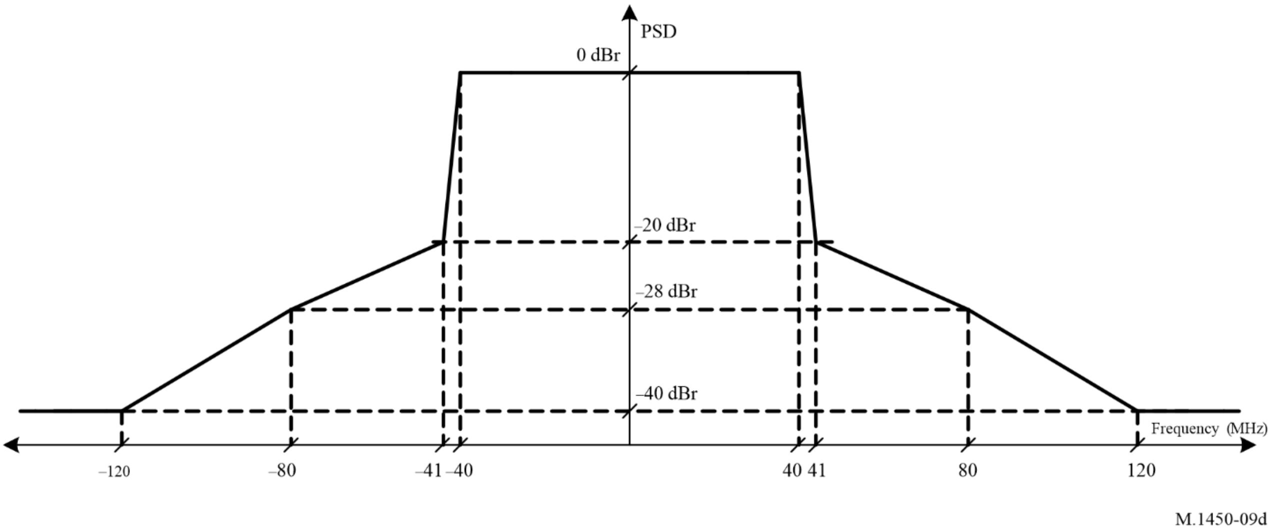
Transmit spectrum mask for 60 MHz ATIS RLAN



NOTE – The spectrum emission mask is defined relative to the maximum power density in a 1 MHz measurement bandwidth within the channel bandwidth. The relative power of any transmitter emission shall not exceed the levels indicated by the mask or −30 dBm/MHz whichever is the greatest.

FIGURE 9d

Transmit spectrum mask for 80 MHz ATIS RLAN



NOTE – The spectrum emission mask is defined relative to the maximum power density in a 1 MHz measurement bandwidth within the channel bandwidth. The relative power of any transmitter emission shall not exceed the levels indicated by the mask or −30 dBm/MHz whichever is the greatest.

FIGURE 10a

Transmit Mask for EN 302 567

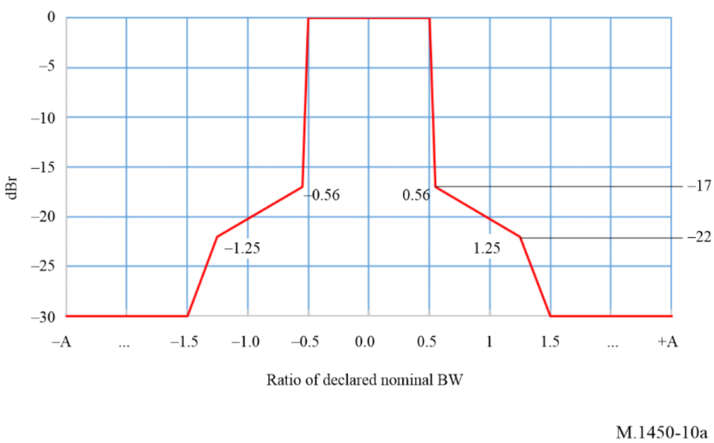
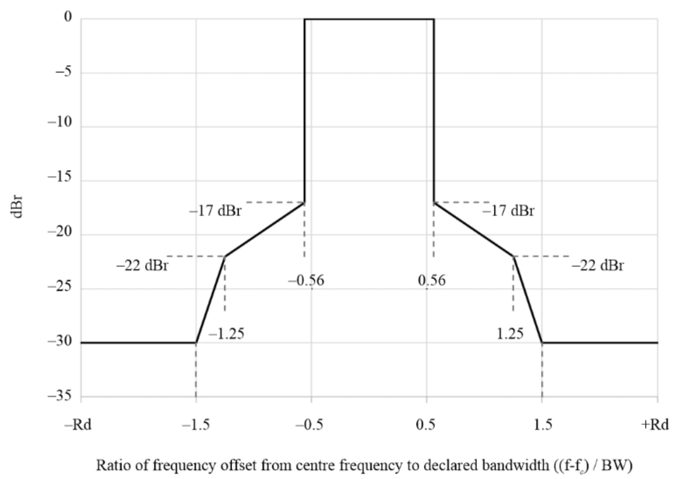


FIGURE 10b

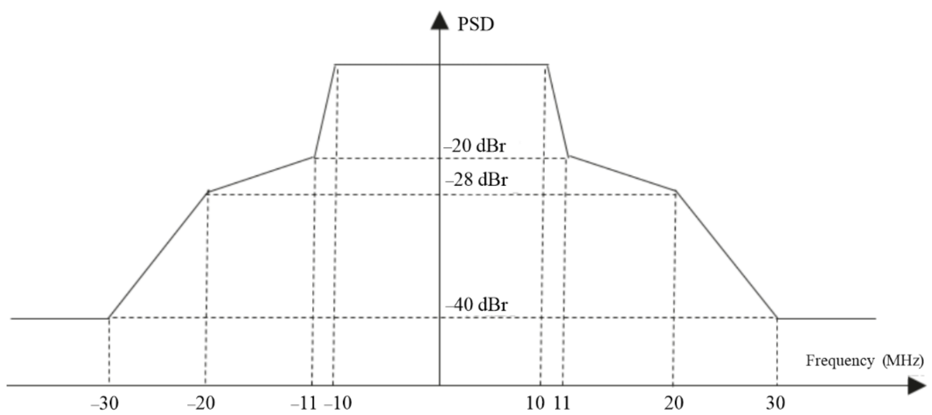
Transmit Mask for EN 303 722



M.1450-10b

FIGURE 11

Transmit spectrum mask for 20 MHz CCSA SLB channel



M.1450-11

NOTE – The relative power of any transmitter emission shall not exceed the levels indicated by the mask or −53 dBm/MHz whichever is the greatest.

Annex 2

Obtaining additional information on RLAN standards

The ETSI EN 300 328, EN 301 893 and EN 302 567 standards can be downloaded from http://pda.etsi.org/pda/queryform.asp. In addition to these standards, the Hiperlan type 2 standards can still be downloaded from the above link.

The IEEE 802.11 standards can be downloaded from: http://standards.ieee.org.

IEEE 802.11 has developed a set of standards for RLANs, IEEE Std 802.11 – 2020, which has been adopted by ISO as ISO/IEC/IEEE 8802-11:2022[2]. The medium access control (MAC) and physical characteristics for wireless local area networks (LANs) are specified in ISO/IEC/IEEE 8802-11:2022, which is part of a series of standards for local and metropolitan area networks. The medium access control unit in ISO/IEC/IEEE 8802-11:2022 is designed to support physical layer units as they may be adopted dependent on the availability of spectrum. Approved amendments to the IEEE Std 802.11-2020 base standard include IEEE Std 802.11ax-2021, IEEE Std 802.11ay-2021, IEEE Std 802.11ba-2021, IEEE Std 802.11az-2022, and IEEE 802.11bd-2022. This ISO/IEC/IEEE 8802-11:2022 standard can be downloaded from https://ieeexplore.ieee.org/document/9930960

The ATIS RLAN standards can be downloaded from: https://atis.org/wp-content/uploads/3gpp-documents/Rel16/

The CCSA SLB standard can be accessed from: https://hbba.sacinfo.org.cn/attachment/onlineRead/198120e63978b9bd9868adac9c4a71a450859b17efd1e82a14c5be02f823fe24

Annex 3

Basic characteristics of broadband RLANs and information for deployment and system design

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[2] Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications.

1 Introduction

Broadband RLAN standards have been designed to allow compatibility with wired LANs such as IEEE 802.3 and ATM at comparable data rates. Some broadband RLANs have been developed to be compatible with current wired LANs and are intended to function as a wireless extension of wired LANs using TCP/IP and ATM protocols. License-exempt use of spectrum allocations globally further promoted development of broadband RLANs allowing many applications such as cellular offload, voice/video over RLAN, audio/video streaming, mobile hotspot, real-time gaming, AR/VR to be supported in various segments including enterprise and residential connectivity, health, education, retail, leisure/hospitality, smart cities, transportation, IoT and Industrial IoT.

Portability is a feature provided by broadband RLANs but not wired LANs. Laptop computers and palmtop are portable and have the ability, when connected to a wired LAN, to provide interactive services. However, when they are connected to wired LANs they are no longer portable. Broadband RLANs allow portable computing devices such as notebooks, tablets, smartphones and wearable devices to remain portable and operate at maximum potential.

Advanced applications such as cellular offload, voice/video over RLAN, audio/video streaming, mobile hotspot, real-time gaming, AR/VR require higher level of performance characteristics of RLAN such as throughput and latency.

2 Mobility

Broadband RLAN technology is primarily designed for and is capable of supporting fixed and nomadic/portable devices.

Broadband RLANs may be either pseudo fixed as in the case of a desktop computer that may be transported from place to place or portable as in the case of battery operated notebooks, tablets, smartphones and wearable devices with integrated wireless LAN connectivity.

The latest broadband RLAN technology is capable to support not only fixed devices, but also portable/mobile devices indoors and outdoors. In some RLAN technologies, the relative velocity between these devices and an RLAN wireless access point remains low. In warehousing applications, RLANs may be used to maintain contact with lift trucks at speeds of up to 6 m/s. RLAN devices are generally not designed to be used at automotive or higher speeds.

3 Operational environment and considerations of interface

Broadband RLANs are predominantly deployed inside buildings, in offices, factories, warehouses, etc. For RLAN devices deployed inside buildings, emissions are attenuated by the structure. In order to better support the outdoor operations, broadband RLAN has developed various features including longer Orthogonal Frequency Division Multiple (OFDM) symbol, preamble including repeated Legacy Signal field (L-SIG), extended range preamble including repeated High Efficiency Signal A field (HE-SIG-A), dual carrier modulation improving robustness in the data field. Some administrations have used mitigation techniques for the use of broadband RLAN operating in the outdoor environment in certain frequency bands under the condition of not causing interference nor claiming protection from others and the provisions of the RR are fully observed. Mitigation techniques are described in section 5 below. The technical requirements as described in § 6 include information from administrations on use of mitigation techniques of broadband RLAN outdoor use, for information purposes only. Resolution **229 (Rev.WRC-23)** defines the use conditions for 5 GHz broadband RLAN, including the conditions for outdoor use.

RLANs utilize low power levels because of the short distances inside buildings. Power spectral density requirements are based on the basic service area of a single RLAN, defined by a circle with a radius from 10 to 50 m. When larger networks are required, RLANS may be logically concatenated via bridge or router function to form larger networks without increasing their composite power spectral density.

One of the most useful RLAN features is the connection of mobile computer users to a wireless LAN network. In other words, a mobile user can be connected to his own LAN subnetwork anywhere within the RLAN service area. The service area may expand to other locations under different LAN subnetworks, enhancing the mobile user's convenience.

There are several remote access network techniques to enable the RLAN service area to extend to other RLANs under different subnetworks. The Internet Engineering Task Force (IETF) has developed a number of the protocol standards on this subject.

To achieve the coverage areas specified above, it is assumed that RLANs require a peak power spectral density of e.g. approximately 10 mW/MHz in the 5 GHz operating frequency range (see Table 3). For data transmission, some standards use higher power spectral density for initialization and control the transmit power according to evaluation of the RF link quality. This technique is referred to as transmit power control (TPC). The required power spectral density is proportional to the square of the operating frequency. The large scale, average power spectral density will be substantially lower than the peak value. RLAN devices share the frequency spectrum on a time basis. Activity Factor will vary depending on the usage, in terms of application and period of the day.

Broadband RLAN devices are normally deployed in high-density configurations and may use an etiquette such as listen before talk and dynamic channel selection (referred to here as dynamic frequency selection, DFS) or TPC to facilitate spectrum sharing between devices.

4 System architecture including fixed applications

Broadband RLANs are often point-to-multipoint architecture. Point-to-multipoint applications commonly use omnidirectional, down-looking antennas. The multipoint architecture employs several system configurations:

– point-to-multipoint centralized system (multiple devices connecting to a central device or access point via a radio interface);
– point-to-multipoint non-centralized system (multiple devices communicating in a small area on an ad hoc basis);
– RLAN technology is sometimes used to implement fixed applications, which provide point-to-multipoint (P-MP) or point-to-point (P-P) links, e.g. between buildings in a campus environment. P-MP systems usually adopt cellular deployment using frequency reuse schemes similar to mobile applications. Technical examples of such schemes are given in Report ITU-R F.2086 (see § 6.6). Point-to-point systems commonly use directional antennas that allow greater distance between devices with a narrow lobe angle. This allows band sharing via channel and spatial reuse with a minimum of interference with other applications;
– RLAN technology is sometimes used for multipoint-to-multipoint (fixed and/or mobile mesh network topology, in which multiple nodes relay a message to its destination). Omnidirectional and/or directional antennas are used for links between the nodes of the mesh network. These links may use one or multiple RF channels. The mesh topology enhances the overall reliability of the network by enabling multiple redundant communications paths throughout the network. If one link fails for any reason (including the introduction of strong RF interference), the network automatically routes messages through alternate paths.

5 Interference mitigation techniques under frequency sharing environments

RLANs are generally intended to operate in unlicensed or license-exempt spectrum and must allow adjacent uncoordinated networks to coexist whilst providing high service quality to users. In the 5 GHz bands, sharing with primary services must also be possible. Whilst multiple access techniques might allow a single frequency channel to be used by several nodes, support of many users with high service quality requires that enough channels are available to ensure access to the radio resource is not limited through queuing, etc. One technique that achieves a flexible sharing of the radio resource is DFS.

Dynamic frequency selection (DFS) is an interference mitigation technique, usable in frequency sharing environments, that dynamically detects presence of signals from priority systems, such as radar systems, and avoids co-channel operation. In DFS all radio resources are available at all RLAN nodes. A node (usually a controller node or access point (AP)) can temporarily allocate a channel and the selection of a suitable channel is performed based on interference detected or certain quality criteria, e.g. received signal strength, C/I. To obtain relevant quality criteria both the mobile terminals and the access point make measurements at regular intervals and report this to the entity making the selection.

In the 5 250-5 350 MHz and 5 470-5 725 MHz frequency bands, DFS must be implemented to ensure compatible operation with systems in the co-primary services, i.e. the radiolocation service.

DFS can also be implemented to ensure that all available frequency channels are utilized with equal probability. This maximizes the availability of a channel to node when it is ready to transmit, and it also ensures that the RF energy is spread uniformly over all channels when integrated over a large number of users. The latter effect facilitates sharing with other services that may be sensitive to the aggregated interference in any particular channel, such as satellite-borne receivers.

TPC is intended to reduce unnecessary device power consumption, but also aids in spectrum reuse by reducing the interference range of RLAN nodes, the RF link quality and/or extend the battery life.

Some administrations have authorized broadband RLANs to share spectrum with incumbent services under rules that are carefully crafted to enable both RLANs and incumbent operations to co-exist.

Administrations may consider some of the following RLAN mitigation techniques: requiring RLANs to implement contention-based protocol, limiting RLAN e.i.r.p., adopting exclusion zones around specific sites, restricting operation to indoor locations only, restricting the use of access points on oil platforms and aboard ships, allowing higher power fixed RLAN access points to operate subject to an antenna pointing restriction, and/or specifically for the 6 GHz band, the use of an Automatic Frequency Coordination (AFC) system, etc. Administrations may consider the need to use mitigation techniques in order to facilitate coexistence with other services, e.g. RAS, electronic news gathering (ENG), EESS, satellite services, fixed service.

Some administrations have considered broadband RLAN operation on an unlicensed or license-exempt and a non-interference, non-protected basis as outlined in their national regulation and without engaging with other administrations in this regard.

Antenna Pointing Restriction is a form of a more stringent limit on maximum e.i.r.p. at angles above a specified elevation in degrees, relative to near horizon direction, for outdoor devices to protect satellite operations in the band.

For fixed RLAN access points outdoor use, Automated Frequency Coordination (AFC) is a geolocation aware spectrum use coordination system that uses databases of registered terrestrial incumbent services/links to determine frequency/channel availability and maximum permissible power level for RLAN Access Points based on their reported 3D locations. AFC System is intended to protect incumbent Fixed Services from harmful interference from RLAN license-exempt operation.

AFC Systems may be used to enforce exclusion zones around radio observatories for protection of Radio Astronomy Services. AFC System is used for Wi-Fi Standard Power mode at 6 GHz band.

Contention-Based Protocol (CBP) is a protocol that allows multiple wireless communication devices to use the same frequency/channel, without pre-coordination, by specifying the events that must occur when two or more transmitters attempt to simultaneously access the same channel and establishing rules by which various devices will have reasonable transmit opportunities to use the spectrum. Listen Before Talk protocol in IEEE 802.11 is one example of CBP. Contention Based Protocol may also be used to detect presence of incumbent services in close proximity of RLAN as an interference mitigation technique.

6 General technical characteristics

Table 3 summarizes technical characteristics applicable to operation of RLANs in certain frequency bands and in certain geographic areas. Operation in the 5 150-5 250 MHz, 5 250-5 350 MHz and 5 470-5 725 MHz frequency bands are in accordance with Resolution **229 (Rev.WRC-23)**. Administrations allow RLAN use in the 2 400-2 500 MHz and 5 725-5 850 MHz frequency bands, which are designated in the RR for industrial, scientific and medical applications under No. **5.150**.

TABLE 3

General technical requirements applied by certain administrations and/or regions

General band designation	Administration or region	Specific frequency band (MHz)	Transmitter output power (mW) (except as noted)	Antenna gain (dBi)	Other use conditions
2.4 GHz band	USA	2 400-2 483.5	1 000	0-6 (Omni)	
	Canada	2 400-2 483.5	4 W e.i.r.p.	N/A	Canada permits point-to-point systems in this band with e.i.r.p. > 4 W provided that the higher e.i.r.p. is achieved by employing higher gain antenna, but not higher transmitter output power.
	CEPT	2 400-2 483.5	100 mW (e.i.r.p.)	N/A	The transmitter output power requirement refers to ETSI EN 300 328
	China	2 400-2 483.5	20 dBm (e.i.r.p. for integrated antenna gain < 10 dBi) 10 dBm/MHz (e.i.r.p. for Integrated antenna gain < 10 dBi) 27 dBm (e.i.r.p. for antenna gain ≥ 10 dBi) 17 dBm/MHz (e.i.r.p. for Integrated antenna gain ≥ 10 dBi)		Interference Avoidance mechanism is mandatory Additional out of band emission limit applies in order to protect the service in the adjacent band and in specific bands.
	Japan	2 471-2 497 2 400-2 483.5	10 mW/MHz 10 mW/MHz	0-6 (Omni) 0-6 (Omni)	See Japan MIC ordinance for Regulating Radio Equipment, Articles 49-20, 49-20-2 and 49-21 for details.
	Republic of Korea	2 400-2 483.5	10 mW/MHz at OBW 0.5-26 MHz 5 mW/MHz at OBW 26-40 MHz 2.5 mW/MHz at OBW 60-80 MHz	6 max 6 max 6 max	In the Republic of Korea, for RLANs operating in the 2.4 GHz band, for antenna gains greater than 6 dBi, some reduction in output power required.
	Brazil	2 400-2 483.5	1 000	0-6 (Omni)	For antenna gains greater than 6 dBi, some reduction in output power is required.
	Mexico	2 400-2 483.5	1 000	6	For antenna gains greater than 6 dBi, some reduction in output power is required.
	Colombia	2 400-2 483.5	Maximum conducted output power: 1 W for devices using at least 75 non-overlapping frequency-hopping channels and 0.125 W for other devices using frequency-hopping. 1 W for devices using digital modulation		See section 3.6 of Resolution ANE 105 of 2020 about specific operation conditions for frequency-hopping devices, digital modulation or hybrid https://ane.gov.co/SitePages/normatividad/index.aspx?p=741 Have to complain the specific operation conditions defined at section 3.6 of Resolution ANE 105 of 2020
	Argentina	2 400-2 483.5	1 000 4 W (e.i.r.p.)	6	Point-to-point systems: for antenna gains greater than 6 dBi, some reduction in output power is required.

TABLE 3 (*cont.*)

General band designation	Administration or region	Specific frequency band (MHz)	Transmitter output power (mW) (except as noted)	Antenna gain (dBi)	Other use conditions
	Nigeria	2 400-2 483.5	• 1 000 mW e.i.r.p. • FHSS: ≤ 100 mW/100 kHz e.i.r.p. • DSSS/OFDM: ≤ 10 mW/MHz e.i.r.p.	0–6 (omni)	• Peak PSD ≤ 17 dBm in any 1 MHz • ATPC (automatic transmit power control) mandatory • Dynamic frequency selection (≥ 75 hops; max dwell 0.4 s/30 s) • BW ≤ 1 MHz; channel sep ≥ 25 kHz • Max coverage ≤ 200 m (indoor/outdoor)
5 GHz band	USA	5 150-5 250 5 250-5 350 5 470-5 725 5 725-5 850 5 850-5 895	50 2.5 mW/MHz 250 12.5 mW/MHz 250 12.5 mW/MHz 1 000 50.1 mW/MHz	0-6 (Omni) 0-6 (Omni) 0-6 (Omni) 0-6 (Omni)	In the United States of America, providers deploying more than 1 000 outdoor access points in the 5 150-5 250 MHz band must notify the FCC and ensure that the maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon shall not exceed 125 mW. In the United States of America, for RLANs operating in the 5 GHz band, for antenna gains greater than 6 dBi, some reduction in output power required. See sections 15.407 and 15.247 of the FCC's rules for details.
	Canada	5 150-5 250 5 250-5 350 5 470-5 725 5 725-5 850	200 mW e.i.r.p. 10 dBm/MHz e.i.r.p. 250 12.5 mW/MHz (11 dBm/MHz) 1 000 mW e.i.r.p. 250 12.5 mW/MHz (11 dBm/MHz) 1 000 mW e.i.r.p. 1 000 50.1 mW/MHz		See RSS-247 section 6.2 for the detailed rules on devices with maximum e.i.r.p. greater than 200 mW
	CEPT	5 150-5 250 5 250-5 350 5 470-5 725	200 mW (e.i.r.p.) 10 mW/MHz (e.i.r.p.) 200 mW (e.i.r.p.) 10 mW/MHz (e.i.r.p.) 1 000 mW (e.i.r.p.) 50 mW/MHz (e.i.r.p.)	N/A	Operation in the 5 150-5 250 MHz band: no fixed outdoor use. Operation in the 5 250-5 350 MHz band is limited to indoor use. See ECC Decision (04)08.

TABLE 3 (*cont.*)

General band designation	Administration or region	Specific frequency band (MHz)	Transmitter output power (mW) (except as noted)	Antenna gain (dBi)	Other use conditions
5 GHz band	China	5 150-5 350	23 dBm (e.i.r.p.) 10 dBm/MHz (e.i.r.p.)		Indoor use only (use within vehicle is prohibited). 5 250-5 350 MHz, TPC and DFS are mandatory. Interference Avoidance mechanism is mandatory Additional out of band emission limit applies in order to protect the service in the adjacent band and in specific bands.
		5 725-5 850	33 dBm (e.i.r.p.) 19 dBm/MHz (e.i.r.p.)		Interference Avoidance mechanism is mandatory Additional out of band emission limit applies in order to protect the service in the adjacent band and in specific bands
	Japan	4 900-5 000 5 150-5 250 5 250-5 350 5 470-5 730	250 mW 50 mW/MHz 1 W (e.i.r.p.) 200 mW (e.i.r.p.) 1 W (e.i.r.p.)	13 N/A N/A N/A	4 900-5 000 MHz is for fixed wireless access, registered. For 5 150-5 250 MHz, registration is required for RLAN access points with a maximum e.i.r.p. greater than 200 mW, and operations inside automobiles are allowed with a maximum e.i.r.p. of 40 mW. Operation in the 5 250-5 350 MHz band is limited to indoor use
	Republic of Korea	5 150-5 350 and 5 470-5 850	10 mW/MHz at OBW 0.5-20 MHz 5 mW/MHz at OBW 20-40 MHz 2.5 mW/MHz at OBW 40-80 MHz 1.25 mW/MHz at OBW 80-160 MHz	7 max 7 max 7 max 7 max	In the Republic of Korea, for the device using OBW 40 MHz in 5 230-5 250 MHz, power density is limited to 2.5 mW/MHz or less. In the Republic of Korea, for RLANs operating in 5 150-5 350 MHz, 5 470-5 850 MHz, for antenna gains greater than 7 dBi, some reduction in output power required. And in this case OBW can use maximum 160 MHz, power density is limited to 1.25 mW/MHz or less.
	Brazil	5 150-5 250 5 250-5 350 5 470-5 725 5.725-5.850	1 000 250 1 000 (e.i.r.p.) 1 000	6 6 N/A N/A	For 5 150-5 350 MHz, limited to indoor use only.

TABLE 3 (*cont.*)

General band designation	Administration or region	Specific frequency band (MHz)	Transmitter output power (mW) (except as noted)	Antenna gain (dBi)	Other use conditions
	Nigeria	5 250-5 350	200 mW mean e.i.r.p.	N/A	• 5 250-5 350 MHz and 5 725-5 850 MHz are designated for License-exempt, shared, uncoordinated and unprotected use of wireless access system(WAS). • DFS & TPC mandatory (Outdoor) • PSD ≤ 50 mW/MHz • Out of band emissions < −27 dBm/MHz
		5 470-5 725	4 000 mW e.i.r.p.	≤ 6 (point to multipoint)	• 5 470-5 725 MHz is designated as licensable (Exclusive assignment), unshared, coordinated and protected use of Wireless Access System(WAS) • Peak PSD ≤ 17 dBm/MHz • Channel sep ≥ 25 kHz; max hop dwell 0.4 s/30 s • Outdoor/indoor use; elevation mask applies if e.i.r.p.> 200 mW
		5 725-5 850	4 000 mW e.i.r.p. (≤ 1 000 mW TX)	≤ 6 (point to multipoint)	• Same technical conditions as 5.47-5.725 GHz • License exempt; no exclusive assignments • Equipment type approved; site registration required • DFS & TPC mandatory (Outdoor)
	Argentina	5 150-5 250 5 250-5 350 5 470-5 600 5 650-5725 5 725-5 850	50 200 (e.i.r.p.) 250 1 000 (e.i.r.p.) 250 1 000 (e.i.r.p.) 250 1 000 (e.i.r.p.) 1 000 4 W (e.i.r.p.)	6	Point-to-point systems: 5 1250-5 250 MHz: for antenna gains greater than 23 dBi, some reduction in output power is required. 5 250-5 350 MHz, 5 470-5 600 MHz and 5 650-5 725 MHz: for antenna gains greater than 6 dBi, some reduction in output power is required. 5 725-5 850 MHz: for antenna gains greater than 6 dBi, reduction is not required.

TABLE 3 (*cont.*)

General band designation	Administration or region	Specific frequency band (MHz)	Transmitter output power (mW) (except as noted)	Antenna gain (dBi)	Other use conditions
	Colombia	5 150-5 250 5 250-5 350 5470-5 725 5 725-5 850	Maximum conducted output power: 1 W for access devices 250 mW for client devices 1 W for point to point devices Maximum conducted output power: 250 mW Maximum conducted output power: 1 W		See section 3.8 of Resolution ANE 105 of 2020 about specific operation conditions for WAS https://ane.gov.co/SitePages/normatividad/index.aspx?p=741
	Mexico	5 150-5 250 5 250-5 350 5 470-5 600 5 650-5 725 5 725-5 850	50 10 mW/MHz (e.i.r.p.) 250 50 mW/MHz (e.i.r.p.) 250 50 mW/MHz (e.i.r.p.) 250 50 mW/MHz (e.i.r.p.) 1 000 200 mW/MHz (e.i.r.p.)	6 dBi	For antenna gains greater than 6 dBi, some reduction in output power is required. For 5 470-5 600 MHz and 5 650-5 725 MHz subbands, TPC (or e.i.r.p. reduction by 3 dB) and DFS are mandatory.

TABLE 3 (*cont.*)

General band designation	Administration or region	Specific frequency band (MHz)	Transmitter output power (mW) (except as noted)	Antenna gain (dBi)	Other use conditions
6 GHz band	CEPT	5 945-6 425	Low Power Indoor (LPI) 23 dBm (e.i.r.p.) 10 dBm /MHz (e.i.r.p.) Very Low Power (VLP) 14 dBm (e.i.r.p.) 1 dBm/MHz (e.i.r.p.)	N/A	LPI equipment use is limited to indoor only use. No fixed outdoor use is allowed by VLP equipment. Narrowband VLP devices that operate in channels bandwidths below 20 MHz can operate at a higher e.i.r.p. density up to 10 dBm/MHz if they implement a frequency hopping mechanism based on at least 15 hop channels See ECC Decision (20)01
	Republic of Korea	5 925-6 425 5 925-7 125 5 925-6 425	14 dBm (e.i.r.p.) and 1 dBm/MHz (VLP) 2 dBm/MHz (LPI) 2 dBm/MHz (only for subway train)	N/A	In the Republic of Korea, the band 5 925-6 425 MHz is not allowed for using in drone. And for device built in vehicle, only 6 085-6 425 MHz band is allowed. And it is applicable for both indoor and outdoor usage. In the Republic of Korea, the band 5 925-7 125 MHz is only applicable for indoor usage. This band is not allowed for using in moving objects, such as vehicle, aircraft, railway, ship and drone. In the Republic of Korea, the band 5 925-6 425 MHz is only applicable for inside subway train.
	USA	5 925-7 125 5 925-6 425 6 525-6 875	Low Power Indoor (LPI): 30 dBm (max. e.i.r.p.); 5 dBm/MHz and Client Connected to Low Power Access Point (AP): 24 dBm (max e.i.r.p.); –1 dBm/ MHz Very Low Power (VLP – indoor/outdoor): 14 dBm (max. e.i.r.p.); −5 dBm/MHz Standard Power (SP) AP (AFC Controlled): 36 dBm (max. e.i.r.p.); 23 dBm/MHz and Client Connected to SP AP: 30 dBm (max e.i.r.p.); 17 dBm/MHz SP AP (AFC Controlled): 36 dBm (max. e.i.r.p.); 23 dBm/MHz and Client Connected to SP AP: 30 dBm (max. e.i.r.p.); 17 dBm/MHz	N/A	Applicable USA rules can be found: https://www.ecfr.gov/current/title-47/chapter-I/subchapter-A/part-15/subpart-E/section-15.407. Full discussion available: https://docs.fcc.gov/public/attachments/FCC-20-51A1.pdf and https://docs.fcc.gov/public/attachments/FCC-23-86A1.pdf

TABLE 3 (*cont.*)

General band designation	Administration or region	Specific frequency band (MHz)	Transmitter output power (mW) (except as noted)	Antenna gain (dBi)	Other use conditions
	Brazil	5 925-7 125	Indoor access point and subordinate access point 30 dBm (e.i.r.p.) 5 dBm/MHz (e.i.r.p.) Client equipment under control of indoor access point 24 dBm (e.i.r.p.) −1 dBm/MHz (e.i.r.p.) Very Low Power 17 dBm (e.i.r.p.) −5 dBm/MHz (e.i.r.p.)	N/A	Indoor access point and subordinate access point must be directly connected to the power grid
	Japan	5 925-6 425	Low Power Indoor (LPI): 200 mW (e.i.r.p.) Very Low Power (VLP): 25 mW (e.i.r.p.)	N/A	LPI equipment use is limited to indoor only use.
	Canada	5 925-7 125 5 925-6 875	Low-power indoor access-points and indoor subordinate devices 30 dBm (e.i.r.p.) 5 dBm/MHz (e.i.r.p.) Low-power client devices 24 dBm (e.i.r.p.) −1 dBm/MHz (e.i.r.p.) Standard-power access points and fixed client devices (AFC Controlled) 36 dBm (e.i.r.p.) 23 dBm/MHz (e.i.r.p.) Standard client devices 30 dBm (e.i.r.p.) 17 dBm/MHz (e.i.r.p.)	N/A	The maximum e.i.r.p. for a device not enclosed by walls and a ceiling, measured at any elevation angle greater than 30 degrees above the horizon, shall not exceed 21 dBm over the 5 925-6 875 MHz frequency band. For standard client devices, the maximum power limits shall remain at least 6 dB below the power levels authorized for the associated standard-power access point. See RSS-248 for more details

TABLE 3 (*cont.*)

General band designation	Administration or region	Specific frequency band (MHz)	Transmitter output power (mW) (except as noted)	Antenna gain (dBi)	Other use conditions
	Mexico	5 925-6 425	Low Power Indoor (LPI): 30 dBm (e.i.r.p.) 5 dBm /MHz Client Connected to Low Power Access Point: 24 dBm (max e.i.r.p.) −1 dBm/MHz Very Low Power (VLP): 14 dBm (e.i.r.p.) 1 dBm/MHz	N/A	LPI equipment: – Limited to indoor use. – Must have an integrated non-removable antenna and no possibility of connecting external antennas. – The maximum channel bandwidth allowed for transmission is 320 MHz. – The use in communications for unmanned aerial vehicle systems, on ships, oil platforms, automobiles, trains and airplanes is prohibited, unless its operation is within large aircraft that fly at altitudes of more than 10,000 feet. – The use of containment-based protocols is mandatory. – Access Points and Slave Access Points cannot be weather resistant, cannot use batteries, and the power supply must be connected directly to the electrical outlet.
	Russian Federation	5 925-6 425	Low Power DSS: 200 mW (e.i.r.p.) and 10 mW/MHz Very Low Power DSS: 25 mW (e.i.r.p.) and 1.3 mW/MHz Very Low Power FHSS: 10 mW/MHz (e.i.r.p.)	N/A	Limited to indoor use only. For Low Power DSS – Automatic power control shall be implemented. For Very Low Power FHSS - Channel bandwidths shall be below 20 MHz and at least 15 hop channels shall be implemented.
	Argentina	5 925-7 125	Indoor access points and subordinated devices: 30 dBm (e.i.r.p.) 5 dBm/MHz (e.i.r.p.) Indoor client devices: 24 dBm (e.i.r.p.) −1 dBm/MHz (e.i.r.p.)	N/A	Restricted to indoor use only. Use in vehicles (cars, trains, ships and airplanes) is prohibited, unless its operation is within aircraft that fly at altitudes above 10 000 feet.
	Colombia	5 925-7 125	Maximum e.i.r.p. 30 dBm and maximum density spectrum of e.i.r.p. 5 dBm/MHz for access devices Maximum e.i.r.p. 24 dBm and maximum density spectrum of e.i.r.p. −1 dBm/MHz for client devices		For indoor use only (LPI). See section 3.8 of Resolution ANE 105 of 2020 about specific operation conditions for WAS

TABLE 3 (*cont.*)

General band designation	Administration or region	Specific frequency band (MHz)	Transmitter output power (mW) (except as noted)	Antenna gain (dBi)	Other use conditions
	Kenya, South Africa, Uganda, Zimbabwe	5 925-6 425	Low Power Indoor (LPI) 23 dBm (e.i.r.p.) Very Low Power (VLP) 14 dBm (e.i.r.p.)		LPI: • An LPI access point or bridge is a device that is supplied power from a wired connection, has an integrated antenna and is not battery powered. • An LPI client device is a device that is connected to an LPI access point or another LPI client device and may or may not be battery powered. • Restricted to indoor use only. • Low Power Indoor (LPI) use only (including trains where metal coated windows (Note 1) are fitted and aircraft. • Outdoor use (including in road vehicles) is not permitted. • An adequate spectrum sharing mechanism shall be implemented for channel access and occupation. • Mean e.i.r.p. density for in-band emissions −10 dBm/ MHz. VLP: • Very Low Power (VLP) device is a portable device. • Very Low Power (VLP) Indoor and outdoor use. • Use on drones is prohibited. • An adequate spectrum sharing mechanism shall be implemented for channel access and occupation. • Maximum mean e.i.r.p. for in-band emissions (Note 2). • Mean e.i.r.p. density for in-band emissions −1 dBm/MHz (Note 2).

TABLE 3 (*end*)

General band designation	Administration or region	Specific frequency band (MHz)	Transmitter output power (mW) (except as noted)	Antenna gain (dBi)	Other use conditions
60 GHz band	CEPT	57-71 GHz (C1) 57-71 GHz (C2)	40 dBm (e.i.r.p.) 23 dBm/MHz (e.i.r.p.) 40 dBm (e.i.r.p.) 23 dBm/MHz (e.i.r.p.)	N/A Max conducted power 27 dBm	For c1: fixed See ERC Recommendation 70-03 Annex 3 (Table 3) entries c1 and c2
	Brazil	57-71 GHz	40 dBm (e.i.r.p.) average 43 dBm (e.i.r.p.) peak 13 dBm/MHz (e.i.r.p.)	N/A	Point-to-area indoor and outdoor
	Mexico	57-64 GHz 64-71 GHz	40 dBm (e.i.r.p.) average 43 dBm (e.i.r.p.) peak 40 dBm (e.i.r.p.) average 43 dBm (e.i.r.p.) peak	N/A	
	Argentina	57-71 GHz	40 dBm (average e.i.r.p.) 43 dBm (peak e.i.r.p.)	N/A	Point-to-point outdoor systems: Average e.i.r.p.= 82 dBm Peak e.i.r.p.= 85 dBm Some reduction in output power is required for antenna gains lower than 51 dBi.
	Colombia	57-71 GHz	43 dBm (e.i.r.p.) peak 40 dBm (e.i.r.p.) average		See section 3.8 of Resolution ANE 105 of 2020 about specific operation conditions for WAS
	Canada	57-71 GHz	40 dBm (e.i.r.p.) average 43 dBm (e.i.r.p.) peak	N/A	See Annex J of RSS-210 Licence-Exempt Radio Apparatus: Category 1 Equipment