

March 23, 2015

Marlene H. Dortch, Secretary
Federal Communications Commission
445 12th Street, SW
Washington, DC 20554

Re: *Revision of Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band*, ET Docket No. 13-49

Dear Ms. Dortch:

The undersigned organizations and companies hereby present the attached consensus plan as an alternative to the Commission's replacement of the out-of-band emission ("OOBE") limits in the 5.725-5.85 GHz ISM band. These OOBE limits were previously specified in Section 15.247 of the Commission's Rules and were replaced by the more stringent limits described in Section 15.407. The signatories believe that the attached proposal, which would amend Section 15.407, will successfully address both the Commission's concerns about the potential for harmful interference to Terminal Doppler Weather Radar ("TDWR") facilities and the industry's desire to continue to be able to deploy viable and cost-effective broadband delivery networks and backhaul services in the 5.725-5.85 GHz band to traditionally underserved markets including rural broadband consumers, competitive mobile operators, utilities and first responders. The proposal also recommends changes relevant to operation in the 5.15-5.25 GHz band to address these same traditionally underserved markets with similar viable and cost-effective broadband delivery networks and backhaul services.

Over the past several months, representatives from the WISP industry and the critical infrastructure industry met multiple times and worked to create a unified plan that would mitigate the serious threats created by the replacement of the Section 15.247 OOBE emission limits. The industry participants, which include those parties that filed petitions for reconsideration of the Commission's *Order*¹ and others,² understood that any consensus plan would require compromises from equipment manufacturers and users of Part 15 equipment operating in the 5.725-5.85 GHz band. After numerous meetings involving detailed discussions of technical, operating and policy issues, the industry participants developed and finalized the attached proposal. The industry participants respectfully request adoption of this proposal.

The attached proposal shows the changes to Section 15.407 that are requested. Following is a brief summary of each proposed rule amendment:

¹ *Revision of Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band*, First Report and Order, 29 FCC Rcd 4127 (2014) ("*Order*"). Petitions for reconsideration were filed by Cambium Networks, Inc.; JAB Wireless, Inc.; Mimosa Networks, Inc.; Motorola Solutions, Inc.; and the Wireless Internet Service Providers Association.

² The proponents of the consensus plan are listed in the signature block.

Section 15.407(b)(1) – Proposes relaxing the OOB limit between 5.091 GHz and 5.15 GHz by 1 dB for every dB that the antenna gain exceeds 6 dBi provided that the antenna is oriented at 30 degrees or less above the horizon.

Section 15.407(b)(4) – Proposes adding three new OOB certification options to the existing requirement. Allows current Section 15.407 equipment to continue to be certified under the current rules while providing three new options that provide guaranteed TDWR protection. The current rule becomes (b)(4)(i) and the three new options are described in new subsections (b)(4)(ii), (b)(4)(iii) and (b)(4)(iv).

Section 15.407(b)(5) – Proposes measuring OOB levels using average power.

Section 15.407(b)(7) – Proposes relaxing the Section 15.205 provisions between 5.091 GHz and 5.15 GHz by 1 dB for every dB that the antenna gain exceeds 6 dBi provided that the antenna is oriented at 30 degrees or less above the horizon.

Section 15.407(k) – Proposes adding a new section that establishes a 5 km exclusion zone around each TDWR site and specifies two methods by which each operator of a point-to-point 5.725-5.85 GHz system must verify that transmissions from their installation will be below the receiving threshold of TDWR receivers.

The undersigned industry participants strongly believe that adoption of the attached proposal will serve the public interest by continuing to allow the robust use of unlicensed devices in the 5 GHz band, including 5.725-5.85 GHz, for the benefit of rural broadband consumers and other remote location users that rely on long-range connections to access the Internet or other vital communications services. Industry also believes that the proposed rule changes can effectively ensure that TDWR facilities will be free from harmful interference. We urge the Commission to adopt the proposed rule changes.

Respectfully submitted,

Alcatel-Lucent
American Petroleum Institute
Cambium Networks, Inc.
Fastback Networks
JAB Wireless, Inc.
Mimosa Networks, Inc.
Motorola Solutions, Inc.
Utilities Telecom Council
Wireless Internet Service Providers Association

Enclosure

cc: Julius Knapp
Mark Settle
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§15.407 General technical requirements.

(a) Power limits:

(1) For the band 5.15-5.25 GHz.

(i) For an outdoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

(ii) For an indoor access point operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(iii) For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

(iv) For mobile and portable client devices in the 5.15-5.25 GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250 mW provided the maximum antenna gain does not exceed 6 dBi. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(2) For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or $11 \text{ dBm} + 10 \log B$, where B is the 26 dB emission bandwidth in megahertz. In addition, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(3) For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information. The operator of the U-NII device, or if the equipment is professionally installed, the installer, is responsible for ensuring that systems employing high gain directional antennas are used exclusively for fixed, point-to-point operations.

NOTE TO PARAGRAPH (4)(3): The Commission strongly recommends that parties employing U-NII devices to provide critical communications services should determine if there are any nearby Government radar systems that could affect their operation.

(4) The maximum conducted output power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage.

(5) The maximum power spectral density is measured as a conducted emission by direct connection of a calibrated test instrument to the equipment under test. If the device cannot be connected directly, alternative techniques acceptable to the Commission may be used. Measurements in the 5.725-5.85 GHz band are made over a reference bandwidth of 500 kHz or the 26 dB emission bandwidth of the device, whichever is less. Measurements in the 5.15-5.25 GHz, 5.25-5.35 GHz, and the 5.47-5.725 GHz bands are made over a bandwidth of 1 MHz or the 26 dB emission bandwidth of the device, whichever is less. A narrower resolution bandwidth can be used, provided that the measured power is integrated over the full reference bandwidth.

(b) *Undesirable emission limits.* Except as shown in paragraph (b)(7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

(1) For transmitters operating in the 5.15-5.25 GHz band all emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz **except that if a transmitting antenna with a directional gain greater than 6 dBi is used, the emissions limit between 5.091 GHz and 5.150 GHz shall be increased by the amount in dB that the directional gain of the antenna exceeds 6 dBi, provided that the directional gain above 6 dBi is oriented at 30 degrees or less above the horizon.**

(2) For transmitters operating in the 5.25-5.35 GHz band: All emissions outside of the 5.15-5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.

(3) For transmitters operating in the 5.47-5.725 GHz band: All emissions outside of the 5.47-~~5.855-725~~ GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.

(4) For transmitters operating in the 5.725-5.85 GHz band: ~~All emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an e.i.r.p. of -17 dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, emissions shall not exceed an e.i.r.p. of -27 dBm/MHz~~ Equipment must meet one of the conditions specified in either (b)(4)(i), (b)(4)(ii), (b)(4)(iii) or (b)(4)(iv):

(i) All emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an e.i.r.p. of -17 dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, emissions shall not exceed an e.i.r.p. of -27 dBm/MHz.

(ii) For professionally installed equipment, to be installed such that an arc extended PHI degrees from the extended centerline of the main beam of the antenna does not cross any portion of the horizontal plane geographic area within a 5 km radius of a TDWR station (the "exclusion zone") for the frequency range from the band edge to 75 MHz above or below the band edge, the conducted out of band emissions shall not exceed -13 dBm/MHz; for the frequency range 75 MHz or greater above or below the band edge, conducted out of band emissions shall not exceed T (dBm/MHz) where

$T = \text{minimum of } T(a, i) \text{ for all antennas } (i = 1 \dots n), \text{ angles of azimuth } a = -180 \dots 180$
and -45.6dBm/MHz.

$$T(a, i) = \begin{cases} -45.6 - 20 \log_{10}(\sin(|a|)) - G_i(a), & \text{if } \text{PHI} < |a| \leq 90; \\ -45.6 - G_i(a), & \text{if } 90 < |a| \leq 180. \end{cases}$$

0 <= PHI <= 90 is specified by the manufacturer and communicated in the installation instructions.

$G_i(a)$ is the gain of an antenna at azimuth angle a from center of its main lobe for antenna i in dBi.

For equipment employing more than one transmitter each must be tested separately using the value of T for the associated antenna.

(iii) For professionally installed equipment, for the frequency range from the band edge to 15 MHz above or below the band edge, the conducted out of band emissions shall not exceed -13 dBm/MHz; for the frequency range from 15 MHz to 75 MHz above or below the band edge, emissions shall not exceed an e.i.r.p. of -17 dBm/MHz; for frequencies 75 MHz or greater above or below the band edge, emissions shall not exceed an e.i.r.p. of -60 dBm/MHz.

(iv) A transmitter operating in 5.725 GHz – 5.85 GHz band may employ a DFS radar detection mechanism to detect the presence of radar systems in the 5.47-5.725 GHz band to prevent out of band emissions from transmissions in 5.725 GHz – 5.85 GHz band from interfering with radar systems operating in 5.47-5.725 GHz band. In any part of the 5.47-5.725 GHz band that the DFS radar detection function has verified that there is no radar system operating, the out of band emissions level in that portion of the band, measured in any 100 kHz bandwidth, shall be at least 20 dB below the level in the 100 kHz bandwidth within the 5.725 – 5.85 GHz band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

(5) The **conducted out of band** emission measurements in (b)(1-4) shall be performed using a minimum resolution bandwidth of 1 MHz **and average power**. A resolution bandwidth less than 1 MHz may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 1 MHz. **Average power shall be measured by using a receiver to perform time-domain averaging on the received signal while the transmitter is continuously operating at its maximum power control level. The average power measurement must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level.**

(6) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in §15.207.

(7) The provisions of §15.205 apply to intentional radiators operating under this section, **except that if a transmitting antenna with a directional gain greater than 6 dBi is used, the emissions limit between 5.091 GHz and 5.150 GHz shall be increased by the amount in dB that the directional gain of the antenna exceeds 6 dBi, provided that the antenna is oriented at 30 degrees or less above the horizon.**

(8) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the upper and lower frequency band edges as the design of the equipment permits.

(c) The device shall automatically discontinue transmission in case of either absence of information to transmit or operational failure. These provisions are not intended to preclude the transmission of control or signaling information or the use of repetitive codes used by certain digital technologies to complete frame or burst intervals. Applicants shall include in their application for equipment authorization a description of how this requirement is met.

(d) [Reserved]

(e) Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

(f) U-NII devices are subject to the radio frequency radiation exposure requirements specified in §1.1307(b), §2.1091 and §2.1093 of this chapter, as appropriate. All equipment shall be considered to operate in a “general population/uncontrolled” environment. Applications for equipment authorization of devices operating under this section must contain a statement confirming compliance with these requirements for both fundamental emissions and unwanted emissions. Technical information showing the basis for this statement must be submitted to the Commission upon request.

(g) Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user’s manual.

(h) Transmit Power Control (TPC) and Dynamic Frequency Selection (DFS).

(1) Transmit power control (TPC). U-NII devices operating in the 5.25-5.35 GHz band and the 5.47-5.725 GHz band shall employ a TPC mechanism. The U-NII device is required to have the capability to operate at least 6 dB below the mean EIRP value of 30 dBm. A TPC mechanism is not required for systems with an e.i.r.p. of less than 500 mW.

(2) Radar Detection Function of Dynamic Frequency Selection (DFS). U-NII devices operating with any part of its 26 dB emission bandwidth in the 5.25-5.35 GHz and 5.47-5.725 GHz bands shall employ a DFS radar detection mechanism to detect the presence of radar systems and to avoid co-channel operation with radar systems. Operators shall only use equipment with a DFS mechanism that is turned on when operating in these bands. The device must sense for radar signals at 100 percent of its emission bandwidth. The minimum DFS detection threshold for devices with a maximum e.i.r.p. of 200 mW to 1 W is -64 dBm. For devices that operate with less than 200 mW e.i.r.p. and a power spectral density of less than 10 dBm in a 1 MHz band, the minimum detection threshold is -62 dBm. The detection threshold is the received power averaged over 1 microsecond referenced to a 0 dBi antenna. For the initial channel setting, the manufacturers shall be permitted to provide for either random channel selection or manual channel selection.

(i) Operational Modes. The DFS requirement applies to the following operational modes:

(A) The requirement for channel availability check time applies in the master operational mode.

(B) The requirement for channel move time applies in both the master and slave operational modes.

(ii) Channel Availability Check Time. A U-NII device shall check if there is a radar system already operating on the channel before it can initiate a transmission on a channel and when it

has to move to a new channel. The U-NII device may start using the channel if no radar signal with a power level greater than the interference threshold values listed in paragraph (h)(2) of this section, is detected within 60 seconds.

(iii) Channel Move Time. After a radar's presence is detected, all transmissions shall cease on the operating channel within 10 seconds. Transmissions during this period shall consist of normal traffic for a maximum of 200 ms after detection of the radar signal. In addition, intermittent management and control signals can be sent during the remaining time to facilitate vacating the operating channel.

(iv) Non-occupancy Period. A channel that has been flagged as containing a radar system, either by a channel availability check or in-service monitoring, is subject to a non-occupancy period of at least 30 minutes. The non-occupancy period starts at the time when the radar system is detected.

(i) *Device Security*. All U-NII devices must contain security features to protect against modification of software by unauthorized parties.

(1) Manufacturers must implement security features in any digitally modulated devices capable of operating in any of the U-NII bands, so that third parties are not able to reprogram the device to operate outside the parameters for which the device was certified. The software must prevent the user from operating the transmitter with operating frequencies, output power, modulation types or other radio frequency parameters outside those that were approved for the device. Manufacturers may use means including, but not limited to the use of a private network that allows only authenticated users to download software, electronic signatures in software or coding in hardware that is decoded by software to verify that new software can be legally loaded into a device to meet these requirements and must describe the methods in their application for equipment authorization.

(2) Manufacturers must take steps to ensure that DFS functionality cannot be disabled by the operator of the U-NII device.

(j) *Operator Filing Requirement*: Before deploying an aggregate total of more than one thousand outdoor access points within the 5.15-5.25 GHz band, parties must submit a letter to the Commission acknowledging that, should harmful interference to licensed services in this band occur, they will be required to take corrective action. Corrective actions may include reducing power, turning off devices, changing frequency bands, and/or further reducing power radiated in the vertical direction. This material shall be submitted to Laboratory Division, Office of Engineering and Technology, Federal Communications Commission, 7435 Oakland Mills Road, Columbia, MD 21046. Attn: U-NII Coordination, or via Web site at <https://www.fcc.gov/labhelp> with the SUBJECT LINE: "U-NII-1 Filing".

(k) *Operator Avoidance of Terminal Doppler Weather Radar (TDWR) Facilities*: For the purpose of determining that the arc extended \pm PHI degrees from the antenna centerline does not cross the exclusion zone in (b)(4)(ii), the centerline of the main beam of the antenna shall be

extended from the transmitter by one of the two following methods as determined by the user prior to installation (where the value of PHI is communicated in the installation instructions):

1. The arc extended \pm PHI degrees from the centerline of the main beam of the antenna may be extended by $5 \times 10^{(g/20)}$ km up to a limit of 200 km; g is the maximum gain of the antenna.

2. Use a FCC-approved anonymous website calculator to confirm if any given installation meets the requirements of (b)(4)(ii). Such a website calculation may also allow for the effects of non-line-of-sight (NLOS) propagation from each proposed location to the TDWR station following the calculation in ITU-R P.452-15. Such approved calculation may occasionally allow operation at specific locations within the 5 km exclusion zone.

Your submission has been accepted

ECFS Filing Receipt -
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Proceeding

Name	Subject
13-49	Revision of Part 15 of the Commission's Rules

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