



This document is scheduled to be published in the Federal Register on 05/01/2014 and available online at <http://federalregister.gov/a/2014-09279>, and on [FDsys.gov](http://FDsys.gov)

**6712-01**

**FEDERAL COMMUNICATIONS COMMISSION**

**47 CFR Parts 2 and 15**

**[ET Docket No. 13-49; FCC 14-30]**

**Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band**

**AGENCY:** Federal Communications Commission.

**ACTION:** Final rule.

**SUMMARY:** This document amends the Commission rules governing the operation of unlicensed National Information Infrastructure (U-NII) devices in the 5 GHz band to make broadband technologies more widely available for consumers and businesses by increasing power and permitting outdoor use in the U-NII-1 band and by adding 25 megahertz to the U-NII-3 band; it also takes steps to reduce the potential for harmful interference to incumbent operations. The proceeding satisfies the requirements of the Spectrum Act, by which Congress required that the Commission begin a proceeding regarding U-NII devices in the 5 GHz band within a year if it determined, after consultation with NTIA, that incumbents will be protected and their missions will not be compromised.

**DATES:** Effective [**INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER**] except for §15.407(j), which contains information collection requirements that have not been approved by OMB. The Commission will publish a document in the Federal Register announcing the effective date.

**FOR FURTHER INFORMATION CONTACT:** Aole Wilkins, Office of Engineering and Technology, 202-418-2406, [Aole.Wilkins@fcc.gov](mailto:Aole.Wilkins@fcc.gov).

**SUPPLEMENTARY INFORMATION:** This is a summary of the Commission's First Report and Order, ET Docket No. 13-49, FCC 14-30 adopted March 31, 2014, and released April 1, 2014. The full text of this document is available for inspection and copying during normal business hours in the FCC Reference Center (Room CY-A257), 445 12th Street, SW., Washington, DC 20554. The complete text of this document also may be purchased from the Commission's copy contractor, Best Copy and Printing, Inc., 445 12<sup>th</sup> Street, SW., Room, CY-B402, Washington, DC 20554. The full text may also be downloaded at: [www.fcc.gov](http://www.fcc.gov). People with Disabilities: To request materials in accessible formats for people with disabilities (braille, large print, electronic files, audio format), send an e-mail to [fcc504@fcc.gov](mailto:fcc504@fcc.gov) or call the Consumer & Governmental Affairs Bureau at 202-418-0530 (voice), 202-418-0432 (tty).

**Summary of First Report and Order**

1. In 2013, the Commission issued the Notice of Proposed Rule Making, 78 FR 21320, April 10, 2013, that initiated this proceeding, with the goal of supporting the growing needs of businesses and consumers for fixed and mobile broadband communications using Unlicensed National Information Infrastructure (U-NII) devices in the 5.15-5.35 GHz and 5.47-5.85 GHz bands. At the same time, it recognized the need to modify its rules to better ensure that these devices do not cause harmful interference to authorized Federal and non-Federal users in these bands. U-NII devices are unlicensed intentional radiators, which use wideband digital modulation techniques to provide a wide array of high-data-rate mobile and fixed communications used by individuals, businesses, and institutions, particularly for wireless local area networking – including Wi-Fi – and broadband access.

2. U-NII devices already play an important role in meeting public demand for wireless broadband service, particularly wireless local area networking and broadband access. This foundation, coupled with increasing demand for wireless broadband applications and new Wi-Fi technology, signals a bright future for unlicensed operations in the 5 GHz band. To meet continuing demand, in this First R&O the Commission takes a number of actions to increase the utility of the 550 megahertz of the 5 GHz band already available for U-NII operations, while protecting incumbent users from harmful interference.

3. In this First R&O, the Commission modified the Part 15 rules for the U-NII-1 band by removing the indoor-only restriction and increasing the permitted power level. These changes provide more flexibility for providing broadband service, whether indoors or outdoors, and take advantage of the new 802.11ac standard to achieve higher data rate transmissions across multiple U-NII segments of the 5 GHz band. To protect Mobile Satellite Service in the U-NII-1 band from harmful interference, the Commission also created certain technical rules for U-NII-1 devices, principally requiring directionality in the antennas to limit emissions in the upward direction and requiring operators with more than 1000 outdoor access points to register information regarding their systems with the Commission.

4. The Commission described circumstances which would facilitate waivers under its rules for converting existing U-NII-3 devices to incorporate the U-NII-1 band without having to comply with the new antenna rules.

5. The Commission also modified its rules to require manufacturers to secure the software in all U-NII devices to prevent modifications that would allow the device to

operate in a manner inconsistent with the equipment certification. This change will reduce the likelihood of harmful interference not only to Terminal Doppler Weather Radar (TDWR) systems, but to all authorized services in the 5 GHz bands.

6. The Commission consolidated the provisions in § 15.247 of the rules (applicable to digitally modulated devices for this band) with the rules in § 15.407 (applicable to U-NII devices) so that all the digitally modulated devices operating in the 5 GHz band will operate under the combined rules and be subject to the new device security requirement. This change addresses a major cause of harmful interference to the TDWR: in which users have illegally modified devices certified to operate under §15.247 to operate in the 5.47-5.725 GHz band without implementing Dynamic Frequency Selection (DFS). This rule consolidation also will reduce complexity and costs in authorizing technically similar devices under different rules.

#### **Increasing the Utility of the U-NII-1 Band**

7. The majority of commenters support allowing outdoor operations in the U-NII-1 band, and some level of harmonization across the U-NII bands. The Commission concluded that it is in the public interest to permit outdoor operation of U-NII devices in the U-NII-1 band, and that it can do so while appropriately protecting MSS services from harmful interference. Specifically, the Commission revised its rules to permit transmitter power levels up to 1 W, as permitted in the U-NII-3 band, with safeguards to minimize the likelihood of harmful interference to Globalstar's MSS system.

8. The Commission observed that NCTA's and Globalstar's initial analyses of the likelihood of harmful interference to Globalstar's system were based on fundamentally different assumptions about future factors such as the extent of

deployments, the technical characteristics of the equipment, and the extent of the communications traffic, and that these assumptions are inherently uncertain. The Commission determined that it can minimize the significance of these assumptions with a technical resolution which restricts a device's emissions when operating above a certain elevation angle, coupled with a reporting requirement directed at large scale deployments, which will facilitate corrective measures should they become necessary.

9. Since the noise floor increase seen by the satellite will be a function of the aggregated energy from U-NII-1 emissions at elevation angles above 30 degrees, the Commission addressed the likelihood of interference to the satellite by restricting upward emissions to sharply reduce the energy that will be received by the satellite from each individual access point. As a result, it is far less likely that harmful interference will occur, even for proliferation of access points greater than that presumed in either party's earlier analysis, making moot to a large degree the disagreements as to the number of access points that might be deployed.

10. The Commission has concluded that generally allowing fixed access point outdoor operations at a conducted power level of up to 1 W (30 dBm), and a PSD of 17 dBm/MHz with an allowance for a 6 dBi antenna gain (i.e., a total 36 dBm EIRP), and limiting the maximum EIRP above 30 degrees elevation to 125 mW ( 21 dBm) EIRP, provides reasonable protection from harmful interference to Globalstar's system. Both NCTA and Globalstar agree that this protocol would provide interference protection to Globalstar, while permitting access to the spectrum for U-NII users. The Commission believes that expressing a limit in terms of EIRP will provide U-NII manufacturers and operators with flexibility regarding how to design their equipment, while still achieving

the required levels of protection. Manufacturers will be able to demonstrate compliance with the EIRP limit by reducing antenna gain in the upward direction, or by limiting the transmitter power, or a combination of the two, as best suits their particular purpose.

11. In conjunction with this requirement, the Commission will continue to monitor developments in this band. Globalstar has expressed strong concerns in this proceeding that proposed unchecked, widespread deployments of outdoor access points may disrupt licensed services in the band. To provide a safeguard and require accountability for such large deployments, the Commission adopted the following filing requirement. Before deploying an aggregate total of more than one thousand outdoor access points within the U-NII-1 band, companies 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.

12. The Commission will permit current UN-II-3 devices to operate under the new U-NII-1 rules under two potential scenarios, but in both cases, the equipment must comply with the software security requirements that it adopted to prevent unauthorized device modifications. First, at any time manufacturers or equipment operators may file a request for a permissive change to their current equipment authorizations demonstrating compliance with the rules adopted. If manufacturers of the previously deployed equipment are able to demonstrate compliance with the EIRP requirement described, the Commission will allow a permissive change with up to 1 W of conducted power.

13. Second, for outdoor U-NII 3 band systems installed prior to the effective date of the rules adopted are not able to comply with the new EIRP requirement, , the Commission suggested the kind of information that could be submitted to expedite consideration and grant of a waiver of the new antenna rules for existing devices. The Commission determined that providing the following about the waiver petitioner's

existing deployments will be important to its ability to assess waiver requests: the number of devices installed, general location of each deployment, ability to reprogram the devices, and ability to adjust operating power from a central network management system. The Commission concluded that waiver requests meeting these parameters and made within 30 days of the effective date of its rules are likely to serve the public interest because granting them is highly unlikely to create any risk of harmful interference, given the small numbers involved and the limited departure from the new technical requirements for the U-NII-1 band. Moreover, having such waiver petitioners provide information about the numbers of installed devices that would be covered by the grant, as well as their general location, will help the Commission monitor the accuracy of its predictions in these regards and allow the Commission to alter course or take effective corrective action if necessary. The Commission has specifically delegated to the Office of Engineering and Technology the authority to grant waivers under these favorable conditions. Following the 30-day window, operators and manufacturers may continue to file petitions for waiver, but the Commission will decide such petitions without the assurances of good cause provided by the described approach.

14. All parties receiving a waiver must then demonstrate compliance with the technical requirements through the equipment certification process by filing a permissive change request including the approved waiver. There is no deadline for filing for such a permissive change.

15. The Commission will permit fixed point-to-point devices operating in the U-NII-1 band to employ transmitting antennas with directional gain up to 23 dBi without any corresponding reduction in the transmitter maximum output power or maximum

power spectral density, and with no reduction of power in the vertical direction. It will not require these devices to reduce the antenna gain in the vertical direction. Such point-to-point operations are typically highly directional and aim their signals along the earth, and therefore are less likely to contribute significant energy to that received by the satellite. They are also relatively few in numbers as compared to the widespread distribution of access points examined by Globalstar and NCTA.

16. The Commission will permit indoor access points operating in the U-NII 1 band at 1 W of conducted power with a 6 dBi antenna gain and no reduction in vertical antenna gain coupled with a requirement for a 1 dB reduction in conducted power for every 1 dB that the antenna gain exceeds 6 dBi. These types of consumer-oriented devices should not contribute to interference concerns, as the building materials used in indoor environments should sufficiently attenuate energy transmitted from indoor devices to prevent any significant contribution to any noise rise seen by Globalstar's satellite.

17. The Commission will permit any client device which operates under control of an access point in the U-NII-1 band to operate at conducted power levels up to 250 mW and a PSD of 11 dBm/MHz with a 6 dBi gain antenna without distinction to whether devices are located indoor or outdoor; power must be reduced by 1 dB for every dB that the antenna gain exceeds 6 dBi. These devices will not cause interference to Globalstar's MSS because of their nature of operation. A client device operates with an access point in a very asymmetric nature, in that very little data is transmitted in the uplink direction (i.e. transmitted from the client device) as compared to data transmitted in the downlink direction (i.e. transmitted from the access point). Client devices are typically mobile or portable, such as handsets or laptops and tablets. These devices are not typically installed



in permanent outdoor locations, and due to their mobile nature the antenna gain in any particular direction cannot be guaranteed. Because client devices will most often be used in indoor locations with very low antenna heights any emissions will be shielded to some extent by buildings, foliage or other obstructions. While many such devices are able to operate in either a client mode, hotspot mode or a peer-peer mode, the Commission does not believe that such peer-to-peer modes will be used frequently or deployed as part of an outdoor network; and thus, it will permit mobile or portable client devices to operate in either mode without changing maximum power levels. Finally, many client devices incorporate power control features that cause the device to use as little power necessary to provide necessary communications. These factors compound each other and point to a very low impact from client devices and the Commission does not find a need to impose the antenna requirements described for access points.

18. The Commission notes that Globalstar has the capability to monitor increases in noise levels at its satellites, and anticipates that Globalstar will report any significant changes in the noise levels and provide specific details as to how it is affecting its operations. The Commission also encourages all interested parties to continue to communicate regularly among each other and with Commission staff regarding developments in this band.

#### **Security Features for All U-NII Bands**

19. Because the current and future use of the 5 GHz U-NII bands is heavily reliant on the successful implementation of the Commission's technical rules, the Commission proposed to require that manufacturers implement security features in any digitally modulated device 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.

20. Because 5 GHz U-NII devices are able to operate across such a wide swath of spectrum, any device could potentially be reprogrammed to operate outside of its certified frequency range. Accordingly, the Commission adopted its proposal in the NPRM that manufacturers must take steps to prevent unauthorized software changes to their equipment in all of the U-NII bands. It leaves the precise methods of ensuring the integrity of the software in a radio to the manufacturer, but requires the manufacturer to document those methods in its application for equipment authorization and declines to set specific security protocol or authentication requirements at this time, so as not to hinder the development of the technology used to provide such security, or to be unduly burdensome on manufacturers.

21. The Commission acknowledges that it may have to specify more detailed security requirements at a later date as software driven radio technology develops. The Commission directed OET to provide guidance, through the Knowledge Data Base (KDB) on what types of security measures work effectively, and what types do not, as well as on the level of detail the FCC will typically need to evaluate the authorization request.

22. The Commission reiterated its observation in the NPRM that some radios are designed so that they can communicate directly with each other, rather than through a control point, and thus they could function as either a “master” that initiates a network or as a “client” device within the network. The Commission also believes that it is important to ensure that client devices cannot be unlawfully reprogrammed to perform

the functions of an access point. Thus, the Commission concludes that all devices that operate under the U-NII rules must be subject to the device security requirements.

23. The Commission believes the enhanced security measures will be effective, and conclude that there is no need for a reactive scheme such as disabling devices that are modified or tampered with, as urged by some commenters. The Commission intends to enforce its security protocol requirement carefully and vigorously.

24. Transmitter ID. The Commission declines to require U-NII devices to transmit identifying information. While the Commission's experience in the field has indicated that a transmitter ID requirement would help to more quickly identify and locate devices that cause harmful interference, the Commission is not persuaded that the benefits accrued from such a requirement would outweigh the costs to implement it at this time. One of its primary goals throughout this proceeding is to prioritize eliminating the occurrence of harmful interference in the first instance. The Commission's adoption of enhanced security requirements, directly addresses this priority, whereas a transmitter identification requirement does not. However, if harmful interference continues to be a problem the Commission will reevaluate the costs and benefits associated with a transmitter ID requirement, recognizing that it may be necessary to implement more costly solutions to eliminate the harmful interference if devices operating in the band continue to cause harmful interference.

#### **U-NII-2 Bands**

25. In addition to the security requirements applicable to all U-NII devices operating in the 5 GHz band described, the Commission revised the technical rules for operation in the U-NII-2A and U-NII-2C bands to further mitigate potential harmful

interference to TDWR and other radar systems that operate in those bands. It also modified the rules and updated its U-NII compliance measurement procedures to improve testing for radar detection and eliminate certain outdated performance tests.

**Interference Mitigation Techniques.**

26. To be certified for operation in the U-NII-2A and U-NII-2C bands, devices must include a DFS radar detection function. In its field investigations, the Commission's Enforcement Bureau found that certain models of devices certified for use in these bands were designed in a way that users were able to disable the DFS mechanism. With the DFS mechanism inactive, the device could transmit on an active radar channel and cause harmful interference. In the NPRM the Commission therefore proposed that manufacturers prevent the DFS mechanism from being disabled in devices certified to operate in the U-NII-2A and U-NII-2C bands. It also proposed that U-NII devices certified to operate in these bands must be operated with the DFS function on. The Commission also noted in the NPRM that the NTIA Third Technical Report and its own discussions with NTIA, FAA and industry representatives have identified additional techniques that could mitigate in-band and adjacent band interference to incumbents. These include increasing the sensing frequency range (e.g., detection bandwidth) of U-NII devices operating in the U-NII-2A and U-NII-2C bands; using a database registration process combined with geo-location technology to determine whether there is any potential harmful interference to radar systems such as the TDWR; and limiting the unwanted emission levels of the U-NII devices.

27. DFS Functionality. No commenters opposed the Commission's proposal that DFS must be active for any devices operating in the U-NII-2A and U-NII-2C bands. The

technical rules for equipment authorized to operate in the U-NII-2A and U-NII-2C bands already require the implementation of DFS. The requirement to preclude software changes that would allow devices to operate outside of their authorized parameters includes the DFS functionality. That is, the devices must be designed to prohibit software changes that would disable the DFS functionality. The Commission also modified its rules to explicitly prohibit operators from using equipment without operational DFS in the U-NII-2 bands, and to require the DFS function to be turned on when operating in these bands. This explicit requirement will help the Commission's Enforcement Bureau eliminate harmful interference should they encounter modified equipment in the field.

28. DFS Sensing Bandwidth. The Commission modified its rules to require U-NII devices to sense for radar signals at 100 percent of their emissions bandwidth in U-NII-2A and U-NII-2C bands, as proposed in the NPRM. The current rule for sensing bandwidth ensures co-channel interference protection only when the radar signal falls within 80 percent of the U-NII device's occupied bandwidth, and it is thus possible for the U-NII device to transmit on the same frequency as the radar when the radar signal falls within the 20 percent of occupied bandwidth that does not require sensing. This could result in transmissions from the U-NII devices that fall within the TDWR receiver bandwidth, which would increase the potential for harmful interference. Expanding the sensing requirement to the entire occupied bandwidth will prevent any and all co-channel operations between U-NII-2A, U-NII-2C band devices and radars

29. Geolocation/Database. The Commission declines to adopt a geo-location database requirement that I proposed in the NPRM for several reasons. First, it is taking

several actions in this First R&O that would have prevented most of the harmful interference cases that it has observed to date, and which will prevent future interference cases. Second, the Commission is making several changes to its part 15 rules and compliance measurement procedures to improve the DFS functionality, thus further reducing the harmful interference risk to TDWR and other radar systems, e.g. increasing the sensing bandwidth, modifying the sensing threshold, and testing DFS functions against a new radar waveform. These changes will be sufficient for U-NII devices to avoid radar systems operating in these bands. Given these considerations, the Commission agrees with commenters that the incremental benefit provided by implementing a geo-location/database approach as a supplement to DFS is not sufficient to justify the expense of doing so. Additionally, permitting a geo-location/database approach as an alternative to requiring DFS functionality would also present some practical concerns in overall management of the interference environment, since two different types of devices would be operating under different authorization procedures and operating rules.

30. The Commission notes that although it is not adopting a database requirement, WISPA maintains a database accessible to the public which contains TDWR system locations and the Commission actions in this First R&O will not prevent the use of any voluntary databases such as the one implemented by WISPA.

31. Out-of-Band Emissions in the U-NII-2 Bands. In the NPRM, the Commission noted that emissions outside of the U-NII device's occupied bandwidth may have the potential to cause harmful interference to TDWRs. Aside from increasing frequency separation or distance separation, U-NII devices may avoid causing harmful

interference by lowering the emissions on the radar's fundamental frequency. This equates to lowering all emissions from U-NII devices at the frequencies outside of the device's operating bandwidth. The Commission sought comment on whether requiring lower unwanted emission limits for U-NII devices operating in the U-NII-2A and UNII-2C bands was appropriate, and whether it should modify the emission limits based on findings in NTIA Third Technical Report.

32. The Commission also sought comment on modifying its rules to adopt out-of-channel limits for indoor versus outdoor U-NII devices, including how it should define the terms "indoor" and "outdoor," and how different operating requirements for indoor versus outdoor operations can be accommodated through its equipment authorization and enforcement procedures.

33. The Commission declined to adopt the proposals in the NPRM that would have required reductions in out-of-band emissions below the levels currently allowed under §15.407. In the harmful interference cases that it has investigated, it has not seen evidence that problems are being caused by unwanted emissions from properly certified and properly functioning equipment. Instead, the majority of cases have been caused by devices that have been modified to operate in frequency bands in which they are not certified to operate, or by devices in which DFS had been disabled. Consolidating the technical rules in the U-NII-3 band, along with enhancing the software security requirements of all U-NII devices, would have prevented most of the harmful interference cases that has been observed to date. Accordingly, the Commission agrees with commenters that a reduction in unwanted emissions from properly certified and properly functioning equipment would be overly restrictive and would not provide any

long-term interference mitigation and that the benefits of applying reduced emission limits would be speculative, while the costs imposed on manufacturers and users are real and would result in decreased equipment capabilities.

#### **Other U-NII-2 Rules and Measurement Procedures**

34. Sensing Threshold. The current rules require that the DFS mechanism continuously monitor the device's environment for the presence of radar, both prior to and during operation, using two detection thresholds to ascertain whether radar signals were present. The required threshold levels are: (a) -62 dBm for lower power devices with a maximum EIRP less than 200 mW (23 dBm), and (b) -64 dBm for higher power devices with a maximum EIRP between 200 mW (23 dBm) and 1 W (30 dBm), averaged over 1  $\mu$ s. The difference is due to the lesser range at which the lower power devices can potentially cause harmful interference. In order to ensure that the potential for harmful interference does not increase with the use of the relaxed sensing threshold, the Commission proposed in the NPRM to apply a reduction in EIRP spectral density for devices that use the -62 dBm sensing threshold.

35. The Commission adopted the proposal it advanced in the NPRM to revise the DFS sensing rules by introducing a Power Spectral Density (PSD) limit for devices that meet the requirements for this relaxed sensing threshold. It modified the rules to require that devices operate with both an EIRP of less than 200 mW (23 dBm), and an EIRP spectral density of less than 10 dBm/MHz (10 mW/MHz), in order to use the relaxed sensing detection threshold of -62 dBm. Devices that do not meet the proposed EIRP and EIRP spectral density requirements must use the -64 dBm sensing threshold. The Commission also noted that a reduction in the EIRP spectral density limit would be



consistent with recent actions taken by European Telecommunications Standards Institute (ETSI). Specifically, ETSI chose to restrict a device's use of the relaxed sensing threshold by reducing both the EIRP and the EIRP spectral density to 23 dBm (200 mW) and 10 dBm/MHz (10 mW/MHz), respectively. This change will further enhance protection for radars from co-channel interference by reducing both the range and the in-band spectral density of the U-NII devices that use the relaxed sensing threshold.

36. Bin 1 Waveforms. U-NII devices that operate in the U-NII-2A and the U-NII-2C bands are certified using a testing regime that considers how the U-NII equipment responds to sample waveforms that simulate typical parameters that are used by radars that operate in these bands. The radar parameters are divided up into several "bins," each representing a different category of radar system. The Commission is adopting its proposals from the NPRM, to use an updated set of "Bin-1" radar waveforms to be used in certifying U-NII equipment. The new waveforms are expected to account for current and, to the extent possible, future TDWR characteristics, and the modifications in the Bin-1 radar simulating waveform used in its measurement procedures will reduce the potential for co-channel interference to the TDWR and other radar systems. The Commission believes that these changes will reduce the potential for co-channel interference to the TDWR and other radar systems, and directed OET to modify the Bin-1 radar simulating waveform used in the 2006 DFS Compliance Measurement Procedures. Based on the reported co-channel interference to TDWR, and its investigations into complaints, the Commission believes the modifications to the test waveforms in the measurement procedures are required. The test waveforms proposed in the NPRM were created by NTIA with input from a number of agencies and with the industry

stakeholders after a long evaluation period. The tests are a generalized procedure and are not intended to cover every radar device exactly. In fact, all the test waveforms were created by “mixing” a number of radar types. Thus, they are not exact representations, but a generalized view of pulse types to be detected. In practice, a U-NII device is expected to detect any radar types and not just the parameters used for test purposes and thus, the Commission does not need to include the specific parameters requested by Baron Services.

37. Channel Spreading. With the support of all commenters addressing the issue, the Commission modified its rules, as proposed in the NPRM, to eliminate the last portion of §15.407(h)(2) that requires that the DFS process provide a uniform spreading of the loading over all of the available channels, and directed OET to update the 2006 DFS Compliance Measurement Procedures to remove the channel spreading requirement. The Uniform Channel Spreading requirement on DFS is outdated and does not reflect the current state and trajectory of wireless technology, which is turning toward U-NII devices which operate with ever wider bandwidths such as contained in the new 802.11ac standard. Operation over wider bandwidths causes U-NII energy to be spread throughout the frequency band in which the device is operating, rather than concentrated in a narrow bandwidth, reducing the utility of uniform channel-spreading requirement. This rule modification will give U-NII equipment manufacturers significant flexibility to design and develop radar avoidance methods, while increasing effective use of the spectrum.

38. Channel Loading. With the support of all parties that commented on channel loading, the Commission determined to remove the requirement for using the MPEG test file (streaming full motion video at 30 frames per second) for testing of channel loading.

Given that there are a number of affected devices that are not designed for video use and therefore cannot be effectively tested with a video-based process, the Commission concluded that a more flexible approach is warranted, which permits channel-loading testing to be performed using means appropriate to the data types that are used by the unlicensed device at issue.

### **U-NII-3 Band Features**

39. The Commission's rules permit the certification of devices that operate in 5.725-5.85 GHz band under two different rule sections. Section 15.247 was originally adopted in 1985 to govern spread spectrum operations. The U-NII rules were adopted in 1997 and were designed to accommodate new digital modulation technologies. In 2002, the Commission modified the original spread spectrum rules to allow digitally-modulated devices under §15.247, but were not fully aligned with the U-NII rules. The differences in these rules has persisted and led to the situation where devices were authorized under the frequencies permitted under §15.247 and then illegally modified to operate on frequencies permitted only for U-NII devices without complying with the rules designed to prevent interference to other radio services, resulting in harmful interference to TDWRs.

40. To provide for simplicity and clarity in the rules and to eliminate the scheme whereby unlicensed devices authorized under the unlicensed rules rather than the U-NII rules could then be (illegally) modified to operate on U-NII bands without U-NII compliance and protection protocols, the Commission adopted the NRPM proposals for the U-NII-3 band with one exception, it did not adopt an antenna gain limit for point-to-point devices. It adopted a single set of rules for all devices in the U-NII-3 band, it

adopted the provisions from each respective rule regimen which provides for the most effective and efficient use of spectrum while protecting incumbents.

41. First, the Commission extended the upper edge of the U-NII-3 band from 5.825 GHz to 5.85 GHz to match the amount of spectrum available for digitally-modulated devices under §15.247. Second, it consolidated §15.247 technical rules for digitally-modulated devices in the 5.725-5.85 GHz band with §15.407 U-NII rules, while maintaining many of the technical rules that currently make equipment authorization under §15.247 more attractive for equipment manufacturers. It removed the 5.725-5.85 GHz band for digital modulation devices from §15.247 to ensure that all digitally modulated equipment that are technically similar operate under a single set of technical rules in this band.

42. The Commission also adjusted the rules for technical parameters such as the frequency band of operation, the power and power spectral density limits, emission bandwidth, antenna gain, unwanted emission limits, and the peak to average ratio permitted in its rules. It adopted a modified version of its proposed rule for antenna gain to retain the provisions for high-gain point-to-point operations.

43. The Commission adopted its proposal to consolidate the provisions for operation in the 5.725-5.85 GHz band into the U-NII rules under §15.407. It expects this rule change to decrease unnecessary complexity in the equipment authorization process and eliminate the incentives for gaming the rules. More importantly, this change, combined with the software security changes the Commission adopted, should help eliminate potential harmful interference from unlicensed devices to other spectrum users.

## **Power**

44. Section 15.247 allows 1 Watt of total peak conducted power whereas §15.407 limits maximum conducted output power to the lesser of 1 Watt or  $17 \text{ dBm} + 10 \log B$  (where B is bandwidth in MHz). In addition to the 1 Watt power limit, there are different PSD limits in §§15.247 and 15.407 such that 1 Watt of total power is available only when the 6-dB bandwidth is 500 kilohertz or more under §15.247 and when the 26-dB bandwidth is 20 megahertz or more under § 15.407. Because the Commission is trying to accommodate digitally modulated devices that are currently permitted under both rules, it proposed in the NPRM to remove the bandwidth dependent term (i.e., remove  $17 + 10 \log B$ ) from §15.407, so that the power limit would be 1 Watt.

45. The Commission modified its rules to remove the bandwidth-dependent term from §15.407(a)(3) of its rules, as proposed. As the Commission initially suggested and the majority of commenters agreed, utilizing the 1 Watt power limit will not increase the potential for harmful interference because unlicensed devices are already allowed to operate without the bandwidth-dependent term under §15.247.

## **Power Spectral Density**

46. Section 15.247(e) permits a maximum PSD of 8 dBm/3 kHz (33 dBm/MHz), whereas §15.407(a)(3) permits a maximum PSD of 17 dBm/MHz. The difference between these two PSD limits is the bandwidth at which the device reaches the 1-Watt total power limit. Specifically, §15.247(e) allows a higher PSD when the device emission bandwidth is between 0.5 and 20 megahertz. Whenever devices use an emission bandwidth above 20 megahertz, the 1 Watt power limit becomes the limiting parameter, and the effective PSD at which the device operates is the same under both

§15.247 and 15.407. A PSD of 8dBm/3kHz (33dBm/MHz) is equivalent to a PSD that is higher than a total power limit of 1 Watt (30dBm).

47. The Commission did not adopt the proposed PSD limit of 33dBm/MHz because it would exceed the conducted power limit of 1 Watt specified in §15.247(b)(3), which it is incorporating into the consolidated rule; the Commission instead calculates a PSD limit that can be practically measured and would not be higher than the conducted power limit of 30 dBm. The Commission adjusts the 33 dBm/MHz proposed in the NPRM by simply converting the PSD into a smaller bandwidth such that the power allowed in that bandwidth does not exceed 30 dBm. The Commission modifies the PSD limit by decreasing the power by 3 dB, and at the same time reduces the bandwidth by half, making the PSD that it adopted 30 dBm/500 kHz. Assuming that emission levels are evenly distributed throughout the bandwidth, this is equivalent to the 8 dBm/3 kHz (33 dBm/MHz) that was proposed in the NPRM.

48. The Commission continues to believe that the 3 kilohertz measurement bandwidth is unnecessary, as it creates an exceedingly long time for labs to complete the measurements for devices that use 20 megahertz or even wider channels. With the introduction of 80 and 160 megahertz channels with the IEEE 802.11 ac standard, the time to complete a single measure would increase significantly. Because the Commission adopted a PSD limit in a 500 kHz bandwidth, it modified the measurement procedures to correspondingly be performed using a 500 kHz reference bandwidth. Likewise, the Commission modified §15.407(a)(5) to specify a 500 kHz reference bandwidth for the U-NII-3 band. This will allow measurements of unlicensed devices being certified for operation in the U-NII-3 band to be performed in a timely manner,

resulting in efficiencies and cost savings for manufacturers, test facilities, and ultimately to consumers.

### **Emission Bandwidth**

49. Section 15.247(a)(2) requires a minimum 6 dB bandwidth of 500 kilohertz. Section 15.407 has no minimum or maximum bandwidth, but the emission bandwidth is defined and measured at the 26 dB down points of the U-NII signal and is used to determine the total power allowed under that rule.

50. The Commission concludes that using a minimum 6 dB bandwidth of 500 kilohertz will continue to provide sufficient flexibility to foster development, frequency sharing and frequency reuse in the band, and it modified §15.407 to include that minimum-bandwidth requirement, in order to help ensure that the band does not become congested with narrow-bandwidth applications for which other spectrum could be available.

### **Antenna Gain**

51. Under the antenna gain requirements in §15.247, a 1 dB reduction in power is required for every 1 dB that the antenna gain exceeds 6 dBi, except for fixed point-to-point systems, for which no power reduction is required. Under §15.407, a 1 dB reduction in power is similarly required for every 1 dB that the antenna gain exceeds 6 dBi, but for fixed point-to-point systems, a 1 dB reduction in power is required for every 1 dB that the antenna gain exceeds 23 dBi.

52. The Commission declined to adopt its initial proposal to conform to the provisions of §15.407 which restrict require reduced power for high-gain antennas, and instead will conform the rules for U-NII-3 devices to those presently in §15.247 to

continue to permit the use of unlicensed high-gain point-to-point antennas. This will allow service providers to deploy cost-effective wireless links in what would otherwise be considered high cost areas, and allow for the quick setup and transitioning of unlicensed and licensed microwave links.

53. The Commission finds that Fastback's proposal to permit higher antenna gain for point-to-multipoint systems would be an expansion of usage in the U-NII-3 band, and is beyond the scope of the rulemaking.

### **Unwanted Emissions**

54. Section 15.247(d) requires 20 dB of attenuation (30 dB if the alternate measurement procedure detailed in §15.247(b)(3) is used) for unwanted emissions. In restricted bands, emissions must meet the §15.209 general emission limits. Section 15.407 requires unwanted emissions to be below -17 dBm/MHz within 10 megahertz of the band edge, and below -27 dBm/MHz beyond 10 megahertz of the band edge. Also, all emissions below 1 GHz must comply with the §15.209 general emission limits. These unwanted emission limits are somewhat more restrictive than those in §15.247.

55. The Commission adopted the more restrictive unwanted emissions limits in §15.407 for the combined new rule, rather than the more lenient unwanted emissions limit currently in §15.247 for several reasons. The more stringent unwanted emissions requirement will ensure that there is no increase in the potential for harmful interference from unlicensed devices operating under the new combined rule parts. Additionally, this decision is consistent with the determination to apply the §15.407 out-of-band emission levels in the U-NII-2 bands, and having a single limit for devices that operate in any U-NII band will provide clarity and simplicity. The record shows broad support for



adopting the tighter unwanted-emissions limits of §15.407 limits. The Commission recognizes that high gain point-to-point system certified under §15.247 may have to be modified to comply with the lower out-of-band emissions limit from §15.407.

Manufacturers have the flexibility to determine how they should meet the lower out-of-band emissions limit.

### **Peak-to-Average Power Ratio**

56. Section 15.407 contains a requirement to maintain a peak-to-average power ratio of no more than 13 dB across any 1 megahertz band, whereas §15.247 contain no peak-to-average ratio requirement. The Commission did not adopt the proposal in the NPRM to keep the peak-to-average ratio requirement, agreeing with commenters that this measurement is no longer necessary.

### **Hybrid Devices**

57. The Commission will continue to authorize under §15.247 frequency hopping spread spectrum devices and the frequency hopping spread spectrum portion of hybrid devices in the 5725-5850 MHz band. The digitally modulated portion of hybrid devices will have to meet the modified U-NII rules for this band.

### **Adoption of Miscellaneous Rule Modifications**

58. The NPRM proposed several rule modifications to simplify and clarify various Part 15 rules. The Commission determines that several sections of the rules referenced procedures or provisions that are no longer in use and therefore, are no longer necessary and others with inconsistent terminology. In §15.403(m) the Commission replaced “Peak Power Spectral Density” with “Maximum Power Spectral Density.” In addition, the Commission deleted “peak or” from §15.403(o) for clarity. It also deleted

“peak or” from §15.403(o) for clarity. The Commission also deleted §15.247(b)(4)(i) through (b)(4)(ii) to eliminate repetitive language that was found in §15.247(c)(1)(i) through (c)(1)(iii)

59. In § 15.407 the Commission deleted the second sentence in paragraph (a)(4) because it contains language that is no longer relevant. It also corrected the wording in paragraphs (a)(2) and (a)(5) by replacing “peak” with “maximum.” The Commission also corrected the wording in paragraph (b)(8) by replacing “block edges” with “band edges.” The Commission also clarified rule §15.215(c) to allow the operation of a U-NII device over multiple channels/bands. U-NII Band straddling in the 5 GHz region of U-NII spectrum is allowed and applies to 802.11ac bonded 80 megahertz and 160 megahertz channels. It also modified §15.407(h)(2) to clarify the language for DFS requirements once the emission bandwidth of a U-NII device is straddled across multiple U-NII bands.

### **Transition Periods**

60. The Commission adopted its proposal to require that 12 months after the effective date of this First R&O, applications for certification of devices must meet the new and modified rules adopted. The manufacture, marketing, sale and importation into the United States of devices that do not meet the new or modified rules adopted must cease two years after the effective date of this First R&O. While the Commission is sympathetic to the arguments that the more restrictive unwanted emission limits for digital modulation devices may present design challenges for some manufacturers, the Commission finds that it is in the public interest to implement the changes as soon as possible to eliminate the potential of harmful interference to incumbents.

61. Grandfathered devices must continue to employ DFS as required in §15.407(h)(2). Devices operating in the U-NII-2A or U-NII-2C bands that do not have DFS or that have DFS turned off are not compliant with the part 15 rules, and any operators who use such devices may be subject to a forfeiture. Large numbers of 5 GHz U-NII devices are already in the marketplace and pose no threat of harmful interference unless they are modified in violation of the Commission's rules. However, should these devices be modified and cause harmful interference to TDWR or any other incumbent systems, the FCC Enforcement Bureau will continue its aggressive approach to ensuring compliance with the Commission's rules.

62. Since 2010, the Commission has been certifying U-NII-2C devices under interim procedures which require that the 5.6-5.65 GHz band be notched out, and that certain devices within 35 km of a TDWR location be separated by at least 30 MHz (center-to-center) from the TDWR operating frequency. The Commission will permit U-NII-2C, i.e., devices operating in the 5470-5725 MHz band, to be certified either under these interim procedures or the new rules adopted herein for 12 months after the effective date of this First R&O. After 12 months, all U-NII-2C devices must meet the new rules in order to be certified.

63. The Commission adopted its proposal to no longer allow Class II permissive changes for devices certified under either the old rules, or the U-NII-2C interim procedures, after two years unless they meet the new rules adopted here. Devices may continue to apply for Class II permissive changes that demonstrate compliance with the old rules for only up to two years after the effective date of the new rules. However, the Commission feels that it is in the public interest to continue to allow indefinitely Class II

permissive changes to devices certified under the old rules in some instances. The Commission will therefore allow devices certified under the old rules, or U-NII-2C interim procedures, prior to the 12-month effective date of the new rules, to demonstrate compliance with the new or modified rules through Class II permissive changes.

64. The Commission will continue to allow digital modulation equipment and the digital modulation portion of hybrid devices, i.e., those that can function as either spread spectrum or digitally modulated systems, operating in the 5.725-5.85 GHz band to be certified to meet the §15.247 requirements for 12 months after the effective date of the new rules. After 12 months, digital modulation devices and the digital modulation portion of hybrid devices must meet the new §15.407 U-NII-3 rules in order to be FCC certified. The frequency hopping spread spectrum portion of hybrid devices will continue to be certified under the §15.247 spread spectrum rules. The manufacture, marketing, sale and importation into the United States of digitally modulated and hybrid devices certified under §15.247 operating in the 5.725-5.85 GHz band must cease two years after the effective date of this 1<sup>st</sup> R&O. Additionally, for up to two years after the effective date of these new rules they may apply for Class II permissive changes to demonstrate compliance with the old rules. After two years, these devices must be certified to meet the new rules and Class II permissive changes may only be made if these devices meet the new rules as well.

## **PROCEDURAL MATTERS**

65. Paperwork Reduction Analysis. This document contains modified information collection requirements subject to the Paperwork Reduction Act of 1995 (PRA), Public Law 104-13. It will be submitted to the Office of Management and

Budget (OMB) for review under section 3507(d) of the PRA. OMB, the general public, and other Federal agencies are invited to comment on the new or modified information collection requirements contained in this proceeding. This collection of information will be covered under (OMB 3060-0057 Equipment Authorization).

### **Final Regulatory Flexibility Analysis**

66. As required by the Regulatory Flexibility Act (RFA),<sup>1</sup> an Initial Regulatory Flexibility Analysis (IRFA) was incorporated in the Notice of Proposed Rulemaking (NPRM) in ET Docket No. 13-49.<sup>2</sup> The Commission sought written public comment on the proposals in the NPRM, including comment on the IRFA. This present Final Regulatory Flexibility Analysis (FRFA) conforms to the RFA.

#### **A. Need for, and Objectives of, the Report and Order.**

67. The First Report and Order amends the regulations for Information Unlicensed National Information Infrastructure (U-NII) devices which operate in the 5 GHz band.<sup>3</sup> U-NII devices are unlicensed intentional radiators which use wideband digital modulation techniques to provide a wide array of high data rate mobile and fixed communications used by individuals, businesses, and institutions.<sup>4</sup> As discussed, the Commission modified certain technical requirements in its rules for all U-NII devices to ensure that these devices do not cause harmful interference to Terminal Doppler Weather Radar (TDWR) systems and other radar systems that operate in the 5 GHz band. It is also extending the upper edge of the 5.725-5.825 GHz U-NII band from 5.825 GHz to

---

<sup>1</sup> See 5 U.S.C. 603. The RFA, see 5 U.S.C. 60-612, has been amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), Public Law 104-121, Title II, 110 Stat. 857 (1996), and the Small Business Jobs Act of 2010, Public Law 111-240, 124 Stat. 2504 (2010).

<sup>2</sup> See Revision of part 15 of the Commission's rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band in ET Docket No. 13-49, Notice of Proposed Rulemaking, 28 FCC Rcd. 1769 (2013) (NPRM).

<sup>3</sup> See 47 CFR part 15 Subpart E – Unlicensed National Information Infrastructure Devices.

<sup>4</sup> See 47 CFR 15.403(s).

5.85 GHz and consolidating the provisions formerly applicable to digitally modulated devices under §15.247 of the rules for this band with the U-NII rules in §15.407. This change will eliminate a loophole in the former rules that allowed devices to be certified under the §15.247 rules and then modified to operate as U-NII devices without complying with all of the technical requirements of the U-NII rules - a practice that was shown to be a major source of harmful interference to TDWRs. Finally, the Commission is removing the indoor only restriction and increasing the permitted power for U-NII devices in the 5.15-5.25 GHz band thus increasing the amount of spectrum available for next generation Wi-Fi services by 100 megahertz.

**B. Significant Issues Raised by Public Comments in Response to the IRFA.**

68. There were no public comments filed that specifically addressed the rules and policies proposed in the IRFA.

**C. Response to Comments by the Chief Counsel for Advocacy of the Small Business Administration.**

69. Pursuant to the Small Business Jobs Act of 2010, the Commission is required to respond to any comments filed by the Chief Counsel for Advocacy of the Small Business Administration, and to provide a detailed statement of any change made to the proposed rules as a result of those comments. The Chief Counsel did not file any comments in response to the proposed rules in this proceeding.

**D. Description and Estimate of the Number of Small Entities to Which the Rules Will Apply.**

70. The RFA directs agencies to provide a description of, and, where feasible, an estimate of the number of small entities that may be affected by the proposed rules, if

adopted.<sup>5</sup> The RFA defines the term “small entity” as having the same meaning as the terms “small business,” “small organization,” and “small business concern” under section 3 of the Small Business Act.<sup>6</sup> Under the Small Business Act, a “small business concern” is one that: (1) is independently owned and operated; (2) is not dominant in its field of operations; and (3) meets may additional criteria established by the Small Business Administration (SBA).<sup>7</sup>

**E. Small Businesses, Small Organizations, and Small Governmental Jurisdictions.**

71. The Commission’s action may, over time, affect small entities that are not easily categorized at present. It therefore describes here, at the outset, three comprehensive, statutory small entity size standards that encompass entities that could be directly affected by the proposals under consideration.<sup>8</sup> As of 2009, small businesses represented 99.9% of the 27.5 million businesses in the United States, according to the SBA.<sup>9</sup> Additionally, a “small organization” is generally “any not-for-profit enterprise which is independently owned and operated and is not dominant in its field.”<sup>10</sup> Nationwide, as of 2007, there were approximately 1,621,315 small organizations.<sup>11</sup> Finally, the term “small governmental jurisdiction” is defined generally as “governments of cities, counties, towns, townships, villages, school districts, or special districts, with a population of less than fifty thousand.”<sup>12</sup> Census Bureau data for 2007 indicate that there

---

<sup>5</sup> See 5 U.S.C. 603(b)(3).

<sup>6</sup> *Id.* 601(3).

<sup>7</sup> *Id.* 632.

<sup>8</sup> See 5 U.S.C. 601(3)–(6).

<sup>9</sup> See SBA, Office of Advocacy, “Frequently Asked Questions,” available at <http://web.sba.gov/faqs/faqindex.cfm?areaID=24> (last visited Aug. 31, 2012).

<sup>10</sup> 5 U.S.C. 601(4).

<sup>11</sup> INDEPENDENT SECTOR, THE NEW NONPROFIT ALMANAC & DESK REFERENCE (2010).

<sup>12</sup> 5 U.S.C. 601(5).

were 89,527 governmental jurisdictions in the United States.<sup>13</sup> The Commission estimates that, of this total, as many as 88,761 entities may qualify as “small governmental jurisdictions.”<sup>14</sup> Thus, the Commission estimates that most governmental jurisdictions are small.

72. The adopted rules pertain to manufacturers of unlicensed communications devices. The appropriate small business size standard is that which the SBA has established for radio and television broadcasting and wireless communications equipment manufacturing. The Census Bureau defines this category as follows: “This industry comprises establishments primarily engaged in manufacturing radio and television broadcast and wireless communications equipment. Examples of products made by these establishments are: transmitting and receiving antennas, cable television equipment, GPS equipment, pagers, cellular phones, mobile communications equipment, and radio and television studio and broadcasting equipment.”<sup>15</sup> The SBA has developed a small business size standard for firms in this category, which is: all such firms having 750 or

---

<sup>13</sup> U.S. CENSUS BUREAU, STATISTICAL ABSTRACT OF THE UNITED STATES: 2011, Table 427 (2007).

<sup>14</sup> The 2007 U.S. Census data for small governmental organizations are not presented based on the size of the population in each such organization. There were 89,476 local governmental organizations in 2007. If the Commission assumes that county, municipal, township, and school district organizations are more likely than larger governmental organizations to have populations of 50,000 or less, the total of these organizations is 52,095. If the Commission makes the same population assumption about special districts, specifically that they are likely to have a population of 50,000 or less, and also assume that special districts are different from county, municipal, township, and school districts, in 2007 there were 37,381 such special districts. Therefore, there are a total of 89,476 local government organizations. As a basis of estimating how many of these 89,476 local government organizations were small, in 2011, the Commission notes that there were a total of 715 cities and towns (incorporated places and minor civil divisions) with populations over 50,000. CITY AND TOWNS TOTALS: VINTAGE 2011 – U.S. Census Bureau, *available at* <http://www.census.gov/popest/data/cities/totals/2011/index.html>. If the Commission subtracts the 715 cities and towns that meet or exceed the 50,000 population threshold, the Commission concludes that approximately 88,761 are small. U.S. CENSUS BUREAU, STATISTICAL ABSTRACT OF THE UNITED STATES 2011, Tables 427, 426 (Data cited therein are from 2007).

<sup>15</sup> U.S. Census Bureau, 2007 NAICS Definitions, “334220 Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing”; <http://www.census.gov/naics/2007/def/ND334220.HTM#N334220>.



fewer employees.<sup>16</sup> According to Census Bureau data for 2007, there were a total of 939 establishments in this category that operated for part or all of the entire year. Of this total, 784 had less than 500 employees and 155 had more than 100 employees.<sup>17</sup> Thus, under this size standard, the majority of firms can be considered small.

**F. Description of Projected Reporting, Record keeping and Other Compliance Requirements.**

73. The Report and Order contains a non-substantial modification to the information collection requirements. The rules adopted in this First Report and Order will apply to small businesses that choose to use, manufacture, design, import, or sell part 15 U-NII devices. There is no requirement, however, for any entity to use, market, or produce these types of products. Small businesses are already subject to the existing rules with regard to reporting, record keeping and other compliance requirements related to U-NII devices. The rules adopted in this First Report and Order do not add substantial additional compliance burden on small businesses.

**G. Steps taken to Minimize Significant Economic Impact on Small Entities and Significant Alternatives Considered.**

74. The RFA requires an agency to describe any significant alternatives that it has considered in reaching its proposed approach, which may include the following four alternatives (among others): (1) the establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities; (2) the clarification, consolidation, or simplification of compliance or reporting requirements under the rule for small entities; (3) the use of performance, rather than

---

<sup>16</sup> 13 CFR 121.201, NAICS code 334220.

<sup>17</sup> [http://factfinder.census.gov/servlet/IBQTable?\\_bm=y&-fds\\_name=EC0700A1&-geo\\_id=&-skip=300&-ds\\_name=EC0731SG2&-lang=en](http://factfinder.census.gov/servlet/IBQTable?_bm=y&-fds_name=EC0700A1&-geo_id=&-skip=300&-ds_name=EC0731SG2&-lang=en).

design, standards; and (4) an exemption from coverage of the rule, or any part thereof, for small entities.<sup>18</sup>

75. In this First Report and Order, the Commission modified its rules for Unlicensed National Information Infrastructure (U-NII) devices which operate in the 5 GHz band.<sup>19</sup> U-NII devices are unlicensed intentional radiators which use wideband digital modulation techniques to provide a wide array of high data rate mobile and fixed communications used by individuals, businesses, and institutions.<sup>20</sup> As discussed, the Commission is modifying certain technical requirements in its rules for all U-NII devices to ensure that these devices do not cause harmful interference to Terminal Doppler Weather Radar (TDWR) systems and other radar systems that operate in the 5 GHz band. The Commission also extends the upper edge of the 5.725-5.825 GHz U-NII band from 5.825 GHz to 5.85 GHz and consolidates the provisions formerly applicable to digitally modulated devices under §15.247 of the rules for this band with the U-NII rules in §15.407. This change will eliminate a loophole in the former rules that allowed devices to be certified under the §15.247 rules and then modified to operate as U-NII devices without complying with all of the technical requirements of the U-NII rules - a practice that was shown to be a major source of harmful interference to TDWRs. Finally, the Commission is removing the indoor only restriction and increasing the permitted power for U-NII devices in the 5.15-5.25 GHz band thus increasing the amount of spectrum available for next generation Wi-Fi services by 100 megahertz.

---

<sup>18</sup> 5 U.S.C. 603(c).

<sup>19</sup> See 47 CFR part 15 Subpart E – Unlicensed National Information Infrastructure Devices.

<sup>20</sup> See 47 CFR 15.403(s).

## **Report to Congress.**

76. The Commission will send a copy of the Report and Order, including this FRFA, in a report to be sent to Congress pursuant to the Congressional Review Act.<sup>21</sup> In addition, the Commission will send a copy of the Report and Order, including this FRFA, to the Chief Counsel for Advocacy of the SBA. A copy of the Report and Order and FRFA (or summaries thereof) will also be published in the Federal Register.<sup>22</sup>

## **Congressional Review Act**

77. The Commission will send a copy of this Report and Order to Congress and the Government Accountability Office pursuant to the Congressional Review Act, see 5 U.S.C. 801(a)(1)(A).

## **Ordering Clauses**

78. Pursuant to sections 4(i), 301, 302, 303(e), 303(f), 303(g), and 303(r) of the Communications Act of 1934, as amended, 47 U.S.C. 154(i), 301, 302a, 303(e), 303(f), 303(g), and 303(r), this First Report and Order is hereby ADOPTED and parts 2 and 15 of the Commission's rules ARE AMENDED as set forth in Final rules, effective **[INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER]**, except for §15.407(j), which contains information collection requirements subject to the Paperwork Reduction Act of 1995, Public Law 104-13, that are not effective until approved by the Office of Management and Budget. The Federal Communications Commission will publish a document in the Federal Register announcing OMB approval and the effective date of this rule.

---

<sup>21</sup> See 5 U.S.C. 801(a)(1)(A).

<sup>22</sup> See 5 U.S.C. 604(b).

79. The Office of Engineering and Technology is delegated authority to grant waivers of the antenna requirements adopted herein consistent with the terms of this Order.

80. The Commission's Consumer and Governmental Affairs Bureau, Reference Information Center, SHALL SEND a copy of this First Report and Order, including the Final Regulatory Flexibility Analysis, to the Chief Counsel for Advocacy of the Small Business Administration.

81. The Office of Engineering and Technology shall publish, consistent with the terms of this Report and Order, measurement procedures that will be used for certifying equipment that will operate in the 5.15-5.35 GHz and 5.47-5.85 GHz bands.

**List of Subjects in 47 CFR Parts 2 and 15**

Communications equipment, Radio.

FEDERAL COMMUNICATIONS COMMISSION

Sheryl D. Todd,  
Deputy Secretary.

## Final rules

For the reasons set forth in the preamble, the Federal Communications Commission amends 47 CFR parts 2 and 15 of the Code of Federal Regulations to read as follows:

### **PART 2 – FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS**

1. The authority citation for part 2 continues to read as follows:

**Authority:** 47 U.S.C. 154, 302a, 303, and 336, unless otherwise noted.

2. Section 2.1033 is amended by adding paragraph (b)(13) to read as follows:

#### **§ 2.1033 Application for certification.**

\*\*\*\*\*

(b) \*\*\*\*\*

(13) Applications for certification of U-NII devices in the 5.15-5.35 GHz and the 5.47-5.85 GHz bands must include a high level operational description of the security procedures that control the radio frequency operating parameters and ensure that unauthorized modifications cannot be made.

\*\*\*\*\*

### **PART 15 – RADIO FREQUENCY DEVICES**

3. The authority citation for part 15 continues to read as follows:

**Authority:** 47 U.S.C. 154, 302a, 303, 304, 307, 336, 544a, and 549

4. Section 15.37 is amended by adding new paragraph (h) to read as follows:

#### **§ 15.37 Transition provisions for compliance with the rules.**

\*\*\*\*\*

(h) Effective June 2, 2015 devices using digital modulation techniques in the 5725-5850 MHz bands will no longer be certified under the provisions of §15.247. The technical requirements for obtaining certification after this date for digitally modulated devices and the digitally modulated portion of hybrid devices are found in subpart E of this part. The provisions for the frequency hopping spread spectrum portion of hybrid devices will remain in §15.247. Effective June 2, 2016 systems using digital modulation techniques in the 5725-5850 MHz band certified under the provisions of §15.247 may no longer be imported or marketed within the United States.

5. Section 15.215 is amended by revising paragraph (c) to read as follows:

**§ 15.215 Additional provisions to the general radiated emission limitations.**

\*\*\*\*\*

(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. In the case of intentional radiators operating under the provisions of subpart E, the emission bandwidth may span across multiple contiguous frequency bands identified in that subpart. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in

the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

6. Section 15.247 is amended by removing paragraphs (b)(4)(i), (ii) and (iii), and by revising paragraph (f) to read as follows:

**§ 15.247 Operation within the bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.**

\*\*\*\*\*

(f) For the purposes of this section, hybrid systems are those that employ a combination of both frequency hopping and digital modulation techniques. The frequency hopping operation of the hybrid system, with the direct sequence or digital modulation operation turned-off, shall have an average time of occupancy on any frequency not to exceed 0.4 seconds within a time period in seconds equal to the number of hopping frequencies employed multiplied by 0.4. The power spectral density conducted from the intentional radiator to the antenna due to the digital modulation operation of the hybrid system, with the frequency hopping operation turned off, shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

Note to paragraph (f): The transition provisions found in §15.37(h) will apply to hybrid devices beginning June 2, 2015.

\*\*\*\*\*

7. Section 15.401 is revised to read as follows:

**§ 15.401 Scope.**

This subpart sets out the regulations for unlicensed National Information Infrastructure (U-NII) devices operating in the 5.15-5.35 GHz, 5.47-5.725 GHz and 5.725-5.85 GHz bands.

8. Section 15.403 is amended by revising paragraphs (m), (o) and (s) to read as follows:

**§ 15.403 Definitions.**

\*\*\*\*\*

(m) Maximum Power Spectral Density. The maximum power spectral density is the maximum power spectral density, within the specified measurement bandwidth, within the U-NII device operating band.

\*\*\*\*\*

(o) Power Spectral Density. The power spectral density is the total energy output per unit bandwidth from a pulse or sequence of pulses for which the transmit power is at its maximum level, divided by the total duration of the pulses. This total time does not include the time between pulses during which the transmit power is off or below its maximum level.

\*\*\*\*\*

(s) U-NII devices. Intentional radiators operating in the frequency bands 5.15-5.35 GHz and 5.470-5.85 GHz that use wideband digital modulation techniques and provide a wide array of high data rate mobile and fixed communications for individuals, businesses, and institutions.



9. Section 15.407 is amended by revising paragraphs (a)(1) through (a)(5), (b) introductory text, (b)(1) through (b)(4), (b)(8), (e), and (h)(2), and removing paragraph (a)(6) and by adding new paragraph (i) and (j) to read as follows:

**§ 15.407 General technical requirements.**

(a) \*\*\*

(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. 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 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 ( a )(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.

(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 5.47-5.725 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.

\*\*\*\*\*

(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.

\*\*\*\*\*

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

\*\*\*\*\*

(h)\*\*\*

(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) 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 website at <https://www.fcc.gov/labhelp> with the SUBJECT LINE: "U-NII-1 Filing".

[FR Doc. 2014-09279 Filed 04/30/2014 at 8:45 am; Publication Date: 05/01/2014]