

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554**

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

COMMENTS OF WI-FI ALLIANCE

May 28, 2013

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SUMMARY

The use of Wi-Fi technologies is rapidly expanding, providing benefits to consumers, businesses and wireless carriers. In addition, Wi-Fi technology is itself changing to accommodate how Wi-Fi will be used in the future. New technology with much larger bandwidths – up to 160 MHz per channel – requires a contiguous block of spectrum for maximum efficiency. In order for Wi-Fi technology to continue to be a critical component of the wireless ecosystem, the Notice of Proposed Rulemaking (“NPRM”) addresses two issues that are important to ensuring the future growth of Unlicensed National Information Infrastructure (“U-NII”) devices, including Wi-Fi products. First, it proposes changes to the rules governing the existing 5 GHz spectrum used for Wi-Fi operations. Second, it proposes to make additional spectrum available for unlicensed operations in the 5 GHz band on a shared basis. Wi-Fi Alliance appreciates the Commission’s focus on making the 5 GHz band even more useful for Wi-Fi operations and encourages the Commission to act swiftly on those matters for which there is general consensus and agreement among commenting parties.

In order to address interference concerns that have surfaced in the U-NII-2C (5470-5725 MHz) band and improve the operating environment for incumbents, Wi-Fi Alliance encourages the Commission to make the following group of proposed rule changes: adopt a unified set of equipment authorization rules under Section 15.407 for the U-NII-2C and the expanded U-NII-3 (5725-5850 MHz) bands; adopt improved security features in order to ensure that U-NII devices operate only in the bands for which they are certified; adopt the improved “Bin 1” testing requirements for devices with dynamic frequency selection (“DFS”); and codify the requirements previously announced in staff guidance to eliminate users’ abilities to initiate transmissions in a mode that does not include DFS in bands where DFS use is required. With these changes, the Commission will directly address the reasons why interference occurred to

certain radar systems in the U-NII-2C band while permitting complete use of the U-NII-2C band, which has been restricted since 2010. These changes would likewise render unnecessary alternative proposals for restrictive emissions limits and frequency separation requirements outlined in the NPRM.

Wi-Fi Alliance also recommends that the Commission adopt the proposed changes to the rules governing the U-NII-1 band (5150-5250 MHz), which will put the U-NII-1 rules on par with those governing the U-NII-2A (5250-5350 MHz) band, including the ability to use the band for outdoor operations, enabling wideband transmissions throughout the 200 megahertz of the two bands. Wi-Fi Alliance further agrees with the proposal to extend the U-NII-3 by 25 megahertz from 5825 MHz to 5850 MHz, thereby ensuring that U-NII rules are applicable throughout the band.

Finally, the Commission should make the U-NII-4 (5850-5925 MHz) and U-NII-2B (5350-5470 MHz) bands available. Wi-Fi Alliance recognizes that opening these bands requires sharing technology to ensure that there is no harmful interference to incumbent use, and testing of that technology to properly evaluate the co-existence ability of U-NII devices with existing operations.

Wi-Fi Alliance suggests the Commission complete its work on the issues raised in segments or modules. Simpler issues or ones that have a significantly developed record could be resolved first, while other issues, such as the use of additional bands for U-NII operations, may take longer. The Commission should not wait until all issues can be resolved to issue a final decision.

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Wi-Fi Alliance hereby submits its comments in the above-referenced proceeding designed to amend the Commission’s rules governing Unlicensed National Information Infrastructure (“U-NII”) devices operating in the 5 GHz band.^{1/} Wi-Fi devices are among the principal users of the current 5 GHz U-NII band, and Wi-Fi devices and technology are critical drivers to the United States economy by providing countless services to consumers, businesses and wireless carriers. The proliferation of Wi-Fi will help the Commission realize its goals of bringing broadband to all Americans, and will help ensure that Wi-Fi technologies can meet the challenges of evolving uses – in particular, transmission of multiple video streams. The public will therefore benefit from the Commission making additional spectrum available for Wi-Fi and modifying its rules governing the 5 GHz band to ensure more complete use of existing U-NII spectrum.

I. BACKGROUND

Wi-Fi Alliance is a global, non-profit industry association of more than 500 leading companies devoted to seamless interoperability. With technology development, market building, and regulatory programs, Wi-Fi Alliance has enabled widespread adoption of Wi-Fi worldwide,

^{1/} *Revision of Part 15 of the Commission’s Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band*, Notice of Proposed Rulemaking, 28 FCC Rcd 1769 (2013) (“NPRM”).

certifying more than 3,600 new products last year alone. The mission of Wi-Fi Alliance is to provide a highly effective collaboration forum for Wi-Fi matters, grow the Wi-Fi industry, lead industry growth with new technology specifications and programs, support industry-agreed standards, and deliver greater product connectivity through testing and certification.

Accordingly, this proceeding is critical to Wi-Fi Alliance and its members. Wi-Fi Alliance appreciates the Commission's focus on the important needs that Wi-Fi meets and is pleased to have the opportunity to submit the following comments in this proceeding.

II. INTRODUCTION

A. Making More Spectrum Available for Wi-Fi and Improving Access to Existing Spectrum is in the Public Interest.

Wi-Fi technology has been an unqualified success and a driving force in the U.S. economy. As former FCC Chairman Genachowski has stated, Wi-Fi is “an essential part of the mobile ecosystem and our overall economy” and “a key complement to licensed spectrum technologies in bridging the supply/demand gap in a sustainable way.”^{2/} In order to meet the skyrocketing demand that has resulted from increasing adoption of Wi-Fi technologies in a variety of sectors, and in order to facilitate the goal of providing ubiquitous broadband access across the U.S., the Commission appropriately proposes to make additional spectrum available for Wi-Fi technology and to permit more complete use of spectrum already designated for Wi-Fi operations in the 5 GHz band.

Wi-Fi is a critical component of the mobile wireless ecosystem, and the use of Wi-Fi technology in a variety of sectors has improved American businesses and provided added

^{2/} See FCC Chairman Julius Genachowski, *Winning the Global Bandwidth Race: Opportunities and Challenges for Mobile Broadband*, Prepared Remarks to University of Pennsylvania – Wharton, at 10 (Oct. 4, 2012), available at <http://www.fcc.gov/document/chairman-genachowski-winning-global-bandwidth-race>.

convenience and connectivity for U.S. consumers. Today, consumers can access Wi-Fi networks with a wide variety of Wi-Fi enabled devices, such as wireless handsets, notebook and netbook computers, tablets, portable electronic games, media players, e-readers, televisions, and cameras.^{3/} Further, Wi-Fi hotspots have proliferated in public spaces, including restaurants, convention centers, parks and airplanes, just to name a few.^{4/} Without Wi-Fi, the value of fixed broadband would be lower because consumers and businesses would not benefit from ubiquitous and simultaneous access throughout a home or office.^{5/} Likewise, the Commission recognizes that Wi-Fi can provide a better mobile experience for consumers using smartphones, tablets, and other connected devices, noting that the “availability of unlicensed Wi-Fi networks in many locations enables licensed wireless providers to take data traffic off of their networks, thus reducing network congestion and delivering a better overall quality of service.”^{6/} In fact, the Commission cited surveys in the recently released Sixteenth Wireless Competition Report indicating that tablet users prefer Wi-Fi over cellular networks for connectivity, and Consumer Reports and some wireless providers recommend that consumers use the rising number of Wi-Fi

^{3/} See *Implementation of Section 6002(b) of the Omnibus Budget Reconciliation Act of 1993; Annual Report and Analysis of Competitive Market Conditions With Respect to Mobile Wireless, Including Commercial Mobile Services*, Sixteenth Report, WT Docket No. 11-186 (Terminated), FCC 13-34, ¶ 376 (rel. March 21, 2013) (“Sixteenth Wireless Competition Report”).

^{4/} Sixteenth Wireless Competition Report ¶ 377.

^{5/} See Richard Thanki, *The Economic Significance of License-Exempt Spectrum to the Future of the Internet*, at 32-37 (June 2012) (“Thanki Report”).

^{6/} NPRM ¶ 79; see also Sixteenth Competition Report ¶ 380 (“WLANs are also increasingly being used to off-load traffic from mobile wireless networks by mobile wireless service providers”); Stuart Taylor, Andy Young & Andy Noronha, *What do Consumers Want from Wi-Fi?*, CISCO, at 1 (2012), available at http://www.cisco.com/web/about/ac79/docs/sp/SP_Wi-Fi_Consumers.pdf (“Cisco Consumer Report”) (“Most mobile operators now realize that offloading data traffic to Wi-Fi can, and must, play a significant role in helping them avoid clogged networks and unhappy customers.”); Connecting America: The National Broadband Plan, at 95, available at <http://www.broadband.gov/download-plan/> (“National Broadband Plan”) (“[W]ith the availability of Wi-Fi networks in many locations that enable users to take much of their data off of a licensed network, users benefit by obtaining much faster service while licensed providers have less congestion and can deliver a better overall quality of service.”).

networks as a way of keeping data costs down, particularly for data applications like streaming video, downloading files, or surfing the web.^{7/}

Additionally, Wi-Fi technology has positively affected American consumers and businesses beyond the scope of phones, personal computers and consumer electronics by reaching a variety of new sectors, including health and fitness, automotive, and smart energy.^{8/} For example, Wi-Fi use in automobiles is on the rise, with primary uses including network-connected navigation, vehicle analytics and safety features, Internet-based radio, and wireless connections for Internet audio/video download and streaming.^{9/} Wi-Fi technology is likewise serving an important public role in the medical field, with new technologies including vital sign monitoring devices that can monitor adult and pediatric patients with one portable, compact device.^{10/}

The Obama Administration and the Commission have appropriately recognized that Wi-Fi deployment is an integral factor in their goal to create seamless broadband connectivity across the country.^{11/} Although the deployment of fixed and mobile broadband networks requires large investments, technologies that use unlicensed spectrum – including Wi-Fi – are cost-effective and can be widely deployed, thereby decreasing the overall costs of broadband

^{7/} See Sixteenth Wireless Competition Report ¶¶ 157, 301, 381.

^{8/} Wi-Fi Alliance, 2012 Annual Report, *available at* <http://www.wi-fi.org/about/organization> (“2012 Wi-Fi Alliance Report”).

^{9/} Jim Lansford, Automotive Applications for Unlicensed Spectrum (July 2012).

^{10/} See generally Wi-Fi Alliance, Certified Products, Medical/Fitness Device, http://certifications.wi-fi.org/search_products.php?search=1&lang=en&filter_category_id=46&listmode=1 (last visited May 8, 2013).

^{11/} See National Broadband Plan, *supra* note 6, at xii; White House Office of the Press Secretary, Presidential Memorandum: Unleashing the Wireless Broadband Revolution, § 1 (June 28, 2010), *available at* <http://www.whitehouse.gov/the-press-office/presidential-memorandum-unleashing-wireless-broadband-revolution>.

access and extending broadband to places that are not covered by fixed and mobile networks.^{12/}

As noted in the National Broadband Plan, “[u]nlicensed services such as Wi-Fi and Bluetooth are important complements to licensed mobile networks and to fixed wireline networks.”^{13/}

As a result of its varied uses and deployment, Wi-Fi has become a significant economic engine. Since 2001, Wi-Fi device shipments have experienced double-digit yearly growth, and today, one in six people around the world use Wi-Fi at home, at work, and on the move.^{14/} Last year, Wi-Fi carried 69 percent of total traffic generated by smartphones and tablets and was responsible for carrying 57 percent of total traffic for personal computers and laptops.

According to one study, this level of connectivity has resulted in a total economic gain for all households of around \$52 to \$99 billion annually.^{15/}

In addition to rapid growth, Wi-Fi has enjoyed technological advancement, and new generations of Wi-Fi technology are routinely introduced, which will fuel continued growth. As the Commission notes, three primary sets of Wi-Fi standards are used in the 5 GHz U-NII bands: Institute of Electrical and Electronics Engineers (“IEEE”) standards 802.11a, 802.11n and 802.11ac.^{16/} The latest of these Wi-Fi standards – 802.11ac – will provide even faster transmission speeds and other advancements. As the Commission notes, the 802.11ac standard has a link data rate of approximately 1 Gbit/s, compared to 54 Mbit/s for the 802.11a standard and 54 Mbit/s to 600 Mbit/s for the 802.11n standard.^{17/} The 802.11ac standard results in significant improvements for wireless LAN sites, including a better experience for each client

^{12/} See Thanki Report, *supra* note 5, at 31.

^{13/} National Broadband Plan, *supra* note 6, at 77.

^{14/} See 2012 Wi-Fi Alliance Report, *supra* note 8.

^{15/} See Thanki Report, *supra* note 5, at 8.

^{16/} NPRM ¶ 18.

^{17/} NPRM ¶ 18.

and more available bandwidth for a higher number of parallel video streams.^{18/} However, in order to realize the maximum benefits that 802.11ac technology will provide, large contiguous blocks of unlicensed spectrum are required. As the Commission notes, the 802.11ac standard specifies bandwidths of 20, 40, 80 and 160 megahertz,^{19/} and deployment of wide channel bandwidths with higher data rates in the 5 GHz band can help meet the challenges posed for the rapidly growing wireless industry.^{20/} Today's U-NII bands do not easily accommodate the efficiencies that can be realized by using an 80 or 160 megahertz bandwidth.^{21/} Accordingly, the NPRM's goal of making the entire 5150-5925 MHz available for unlicensed U-NII operations so that Wi-Fi devices can operate across different U-NII bands is key. A contiguous block of spectrum can help industry meet the needs of the latest generation of Wi-Fi technology, thereby continuing to benefit American consumers, businesses and wireless service providers.

B. The Commission Should Take a Sequenced Approach to Amending its Rules Governing U-NII Devices Operating in the 5 GHz Band.

The NPRM raises many important issues in three general categories – (1) modification of rules governing spectrum that is already designated for unlicensed operations so that as much spectrum as possible is subject to consistent rules; (2) amendment of rules designed to ensure that U-NII operations do not interfere with incumbent operations; and (3) adoption of rules governing spectrum that is being made available for unlicensed use. Wi-Fi Alliance expects that the Commission will receive extensive feedback on all of these issues. However, as noted above,

^{18/} *802.11ac: The Fifth Generation of Wi-Fi*, CISCO, at 3 (Aug. 2012), available at http://www.cisco.com/en/US/prod/collateral/wireless/ps5678/ps11983/white_paper_c11-713103.html.

^{19/} NPRM ¶ 18.

^{20/} NPRM ¶ 80.

^{21/} As the Commission notes, Wi-Fi spectrum blocks using the 802.11ac standard need not be contiguous. NPRM ¶ 19. Nevertheless, the rules applicable to the blocks used must be consistent. This proceeding is intended, in part, to make the rules consistent across as much bandwidth as possible.

the public interest dictates that the Commission act as soon as possible to make the maximum Wi-Fi capacity available to support the advancement in Wi-Fi technology and the growth in Wi-Fi use by consumers, businesses and wireless carriers.

Therefore, Wi-Fi Alliance urges the Commission to adopt decisions in this proceeding on matters as they can be resolved, without waiting for resolution of all issues. That is, the Commission should resolve the issues presented in this proceeding in modules by adopting rules sooner on matters for which the record is well developed and/or for which there is general agreement among the commenting parties. In this way, the Commission may be in a position to release a decision on some matters no later than the first calendar quarter of 2014. For remaining issues that raise new and novel questions for which further technical evaluation is required, the Commission may take action later. In taking this sequenced approach, the Commission can quickly act on new rules and modifications where possible that will allow for the immediate growth of Wi-Fi – benefitting consumers and businesses – while allowing sufficient time for the agency, the public, and industry stakeholders to consider issues that require additional development.

Wi-Fi Alliance therefore proposes that the Commission consider adopting a series of decisions that address the issues presented in the following general groupings. First, the Commission should adopt rules governing its treatment of devices that operate in the expanded U-NII-3 (5725-5850) and U-NII-2C (5470-5725 MHz) bands so that devices in those bands can operate across 380 megahertz of contiguous spectrum and can be governed by a single set of modified regulations at Section 15.407 of the rules instead of those in Section 15.247. As the NPRM notes, there is already a significant record regarding the use of the U-NII-2C and U-NII-3

bands, including how they affect Terminal Doppler Weather Radar (“TDWR”).^{22/} At the same time, the Commission should expand the U-NII-3 band to include the 25 megahertz between 5825-5850 MHz. By addressing these matters, the Commission will bring 25 megahertz that is otherwise not subject to U-NII rules under the same regulations as adjacent spectrum, create a contiguous block of 380 megahertz of spectrum generally subject to the same set of rules, promote the use of 802.11ac technology, and ensure adequate protection for incumbents. Second, the Commission should adopt additional changes to the rules governing the existing 5 GHz U-NII band, such as the proposed changes designed to improve the utility of dynamic frequency selection (“DFS”) in the U-NII-2A (5250-5350 MHz) and U-NII-2C bands and the proposed changes to the U-NII-1 (5150-5250 MHz) band. Third, the Commission should adopt rules governing the new U-NII-4 (5850-5925 MHz) band. The band presents new and novel questions and requires additional study with regard to how U-NII devices might share spectrum with Dedicated Short Range Communications Services (“DSRC”) operating in the Intelligent Transportation radio service. Finally, the Commission should consider adoption of rules governing the new U-NII-2B (5350-5470 MHz) band, which also raises new and novel issues concerning the sharing technology that will need to be deployed.

III. IMPROVING THE OPERATIONAL ENVIRONMENT FOR INCUMBENTS AND U-NII OPERATIONS: U-NII-3, U-NII-2C AND U-NII-2A

Although additional spectrum and modified rules governing existing spectrum are required to meet the rapidly expanding needs for Wi-Fi services, Wi-Fi Alliance acknowledges that all spectrum available for U-NII operations in the 5 GHz band today is shared both with other unlicensed services and with incumbent and/or allocated uses.^{23/} Wi-Fi Alliance therefore

^{22/} See, e.g., NPRM ¶¶ 42-48.

^{23/} See NPRM ¶ 3; see also 47 C.F.R. §§ 15.5(b), (c).

recognizes that, in order for the Commission to further promote the use of the 5 GHz band, it must be satisfied that, among other things, incumbent users are adequately protected. Rules that inadequately protect incumbent operations waste valuable Commission resources and potentially jeopardize existing operations, and in the case of federal operations, could affect federal agency missions that require spectrum resources.^{24/} The NPRM addresses these requirements by proposing rules that will further protect incumbents while also allowing for the more complete use of spectrum already designated for U-NII operations.

A. The Commission Should Adopt Its Proposed Changes to the U-NII-2C and U-NII-3 Bands That Address Interference Concerns.

First, the Commission proposes a group of rule changes that together are effectively targeted to resolve the interference concerns affecting the U-NII-2C band and to improve the operating environment for incumbents.^{25/} The proposed changes to the rules, which Wi-Fi Alliance agrees should be adopted, include: a unified set of equipment authorization regulations under Section 15.407 for the U-NII-2C and the expanded U-NII-3 bands; improved security features in order to ensure that U-NII devices operate only in the bands for which they are certified; improved “Bin 1” testing requirements; and codification of previous staff guidance intended to eliminate the ability of users to choose to initiate transmissions in a mode that does not include DFS in bands where DFS is required. With these changes, the Commission will directly address the causes of interference to certain radar systems in the U-NII-2C band specified by the National Telecommunications and Information Administration (“NTIA”), while

^{24/} NPRM ¶¶ 9, 42-50.

^{25/} In addition to the interference concerns outlined in the NPRM, NTIA specified what it believes to be the causes of harmful interference to TDWR operations in a recent letter to the FCC. *See* Letter from Lawrence E. Strickling, Administrator, NTIA, to Julius Genachowski, Chairman, FCC, ET Docket No. 13-49 (Feb. 19, 2013) (“NTIA Letter”).

permitting complete use of the U-NII-2C band, which has been restricted since 2010.^{26/} These changes render unnecessary the restrictive emissions limit and frequency separation requirements proposals outlined in the NPRM.

1. Apply Section 15.407 to Devices That Operate in the Expanded U-NII-3 Band.

Today, U-NII-3 band devices may be certified under Section 15.247 of the rules in addition to Section 15.407. Therefore, as the Commission points out, its rules permit manufacturers of products in the U-NII-3 band to elect the rules under which they will operate.^{27/} The result of the rule disparity is that manufacturers often opt to certify devices in the U-NII-3 band under Section 15.247, which permits the use of more spectrum and higher Power Spectral Density (“PSD”) levels.^{28/}

The rule disparity governing this band also introduces complexity in the equipment authorization process and creates a hazard for incumbent operations in the U-NII-2C band. As the NPRM notes, there is already a significant record developed around TDWR matters, and the Commission has worked cooperatively with the FAA and NTIA to resolve interference issues and conduct studies to evaluate the interference from U-NII devices operating in frequencies occupied by or adjacent to radar systems.^{29/} Through such testing and investigation, the published decisions make clear that most of the interference cases associated with TDWR

^{26/} See OFFICE OF ENGINEERING AND TECH., FEDERAL COMMUNICATIONS COMMISSION, INTERIM PLANS TO APPROVE UNII DEVICES OPERATING IN THE 5470-5725 MHZ BAND WITH RADAR DETECTION AND DFS CAPABILITIES, KDB 443999 (2010).

^{27/} NPRM ¶ 23.

^{28/} NPRM ¶ 24.

^{29/} See, e.g., NPRM ¶ 42-48.

installations were a result of devices approved under Section 15.247 unlawfully operating in the U-NII-2C band.^{30/}

In order to address this issue, the Commission has proposed to consolidate all equipment authorizations for digitally modulated devices in the expanded U-NII-3 band under the U-NII-2C rules (and not Section 15.247) and to impose the security requirements discussed below.^{31/} At the same time, the Commission would enhance the utility of the U-NII-3 band by extending the current upper edge of the U-NII-3 band to conform to the edge of the band (5725-5850 MHz) now governed by Section 15.247 of the rules.^{32/}

Wi-Fi Alliance supports this approach and believes it, along with the other changes discussed below, will alleviate incumbent interference concerns, allowing the Commission to lift current restrictions on the use of the U-NII-2C band. These rule modifications will facilitate the development of devices that operate using more bandwidth – which is critical to the development of products using the IEEE 802.11ac standard – while limiting the possibility of harmful interference to government operations. The NPRM notes the following changes designed to unify the rules for all devices that will now operate in the U-NII-3 band.^{33/}

Frequency Band – Wi-Fi Alliance agrees that the addition of the 25 megahertz to the U-NII-3 band will help promote use of devices using the 802.11ac standard under a clear and consistent set of equipment authorization rules.^{34/} The Commission should also conform the definition of U-NII in Section 15.403(s) of its rules to include the newly expanded U-NII-3 band.

^{30/} NPRM ¶ 9.

^{31/} NPRM ¶ 28.

^{32/} NPRM ¶ 27.

^{33/} See NPRM ¶¶ 28-35.

^{34/} NPRM ¶ 29.

Power – In order to accommodate devices that were previously permitted under Section 15.247, the Commission proposes to remove the bandwidth dependent term ($17+10 \log B$) from Section 15.407, so that the power limits of Section 15.247 would apply.^{35/} Wi-Fi Alliance agrees that the 1 watt power limit without the bandwidth-dependent term should apply to the U-NII-3 band. Because current devices use the Section 15.247 power limits, applying those to the entire U-NII-3 band will not contribute to the interference environment.

Power Spectral Density – Because there is a minor difference in the PSD limit for devices authorized under Section 15.247 and those permitted under Section 15.407, the Commission proposes to modify Section 15.407, under which U-NII-3 devices will be permitted in the future, to require the PSD limit currently used under Section 15.247 (8 dBm/3 kHz or 33 dBm/MHz).^{36/} This represents a higher PSD limit when the device emission bandwidth is between 0.5 and 20 megahertz. Above 20 megahertz, the 1 watt power limit contained in both Sections 15.407 and 15.247 would continue to apply. Wi-Fi Alliance agrees with this approach and the Commission’s recognition that requiring devices that employ wider bandwidths to utilize a measurement bandwidth of 3 kilohertz may unnecessarily increase the time necessary to complete measurement tests. Therefore, it concurs with the Commission’s suggestion that the measurement bandwidth be increased to 1 megahertz to reduce the complexity in measurement tests.^{37/}

Emission Bandwidth – Because the Commission proposes to eliminate the bandwidth dependent limit on total power that currently exists in Section 15.407, it also proposes to

^{35/} NPRM ¶ 30.

^{36/} NPRM ¶ 31.

^{37/} NPRM ¶ 31.

eliminate the 26 dB bandwidth requirement and to add the minimum 6 dB bandwidth requirement from Section 15.247 of the rules.^{38/} Wi-Fi Alliance agrees.

Antenna Gain – The only difference between Sections 15.407 and 15.247 today is that the maximum antenna gain of 23 dBi can be deployed without a penalty in transmitter power under Section 15.247. As a result, the Commission proposes to apply the more restrictive 23 dBi maximum antenna gain in Section 15.407 to all U-NII-3 devices.^{39/} Wi-Fi Alliance agrees that using the more restrictive antenna gain will help ensure that there is no increase in interference potential from U-NII devices.

Unwanted Emissions – Wi-Fi Alliance supports the proposal to apply the more restrictive unwanted emissions requirements from 15.407 to the U-NII-3 band, as compared to the unwanted emission requirements in Section 15.247. Wi-Fi Alliance agrees that unwanted emissions can be reduced without affecting the utility of Wi-Fi devices and the more restrictive limits will help ensure that there is no increase in potential interference.^{40/} Wi-Fi Alliance also presumes that the general test procedures for measuring the emissions compliance of U-NII devices to Section 15.407 requirements will continue to apply.^{41/}

Peak to Average Ratio – The Commission notes that Section 15.407 contains a requirement to maintain a peak-to-average ratio of no more than 13 dB across any 1 megahertz band. Section 15.247 has no such requirement. The Commission proposes to maintain the

^{38/} NPRM ¶ 32.

^{39/} NPRM ¶ 33.

^{40/} NPRM ¶ 34.

^{41/} See OFFICE OF ENGINEERING AND TECH., FEDERAL COMMUNICATIONS COMMISSION, GUIDELINES FOR COMPLIANCE TESTING OF UNLICENSED NATIONAL INFORMATION INFRASTRUCTURE (U-NII) DEVICES, PART 15, SUBPART E, KDB 789033 (2013) (outlining the acceptable procedures for measuring emission bandwidth, maximum conducted output power, power spectral density, peak excursion, and unwanted emissions both in and out of the restricted bands).

Section 15.407 requirement for all devices operating across the new U-NII-3 band.^{42/} The existing rule will continue to guard against interference.

2. Improved Security for U-NII Devices.

In addition to requiring the certification of U-NII-3 devices under Section 15.407 of the rules, the Commission also proposes to require that manufacturers implement security features in any digitally modulated devices capable of operating in the U-NII bands so that third parties are not able to reprogram them to operate outside the parameters for which the devices were certified.^{43/} This requirement is designed to ensure that incumbent and co-channel use of the 5 GHz band is protected from user manipulation of devices, such as retuning devices authorized to operate in specific bands to bands in which they are not certified to operate. In particular, the Commission notes that devices may be susceptible to manipulation of the country code, frequency range, modulation type, maximum output power or the circumstances under which the transmitter has been approved.^{44/} Accordingly, the Commission seeks comment on whether it should require manufacturers to make it difficult for third parties to reprogram the embedded chip in certified devices.^{45/}

Specifically, the Commission asks whether it should require that manufacturers ensure that modifying or reconfiguring firmware or software will make a device inoperable in certain bands.^{46/} Wi-Alliance agrees that manufacturers should ensure that reconfiguring firmware or software which affects regulatory compliance, by someone other than the manufacturer or authorized by the manufacturer, is made very difficult.

^{42/} NPRM ¶ 35.

^{43/} NPRM ¶¶ 51-52.

^{44/} NPRM ¶ 51.

^{45/} NPRM ¶ 51.

^{46/} NPRM ¶ 51.

A significant number of enforcement cases to date have involved post-manufacture retuning of the U-NII-3 band radios (which lack DFS) into U-NII-2C radios (which require DFS), resulting in unlawful operation in the U-NII-2C band. The interference cases made public demonstrate that users have repeatedly retuned devices approved in the U-NII-3 band under Section 15.247 to operate in the U-NII-2C band, even though those devices do not meet emissions requirements or operate with dynamic frequency selection. The emissions characteristics of these devices approved under Section 15.247 systems produced interference into TDWR systems in the U-NII-2C band. As the Commission recognizes, interference in many of the cases investigated by the Enforcement Bureau was caused by third-party modifications that enabled operation by the device in bands other than those for which the device was certified.^{47/} Had an improved security showing been in effect for those devices, it would have eliminated most interference cases, based on the record of cases resolved to date.^{48/} Adoption of the proposed rule along with the creation of a unified set of technical rules across the U-NII-3 and U-NII-2C bands will, therefore, address the majority of the compliance issues that the Commission has identified.

Indeed, the Commission and industry stakeholders already have experience with similar improved security rules through the use of Software Defined Radio (“SDR”) certifications, which have been available for years. The FCC rules require that any radio for which the software is designed or expected to be modified by a party other than the manufacturer, the modification of which would affect the operating parameters of the device, must be certified as a

^{47/} NPRM ¶¶ 9, 43.

^{48/} See NPRM ¶ 9, n.13 (citing recent Enforcement Bureau cases resulting in Letters of Inquiry and Notices of Apparent Liability for Forfeitures to operators found to be causing interference due to non-compliance with device certifications).

SDR.^{49/} As part of this certification, an applicant must describe the security measures and systems that ensure that only authenticated, legal (as-granted) software is loaded on and operating the device. The Office of Engineering and Technology's SDR Application Guide was designed to facilitate this process by providing questions to which applicants could respond in order to show that their systems meet the security requirements required by the rules.^{50/} These include (1) a description of the procedure that ensures that third parties cannot operate U.S.-sold devices on non-U.S. frequencies; (2) an explanation of any third parties that have the ability to change and operate a device to non-U.S. frequencies; (3) a description of how software updates are distributed and what procedures are in place to ensure that a product sold in the U.S. can only operate under U.S. rules; (4) an explanation, if applicable, of how a product can only be operated per U.S. rules; (5) a description of how third parties are prevented from loading non-U.S. versions of software onto the device; and (6) a statement of whether third parties can make factory-level changes to reload non-U.S. domain codes. Similar requirements for descriptions and explanations can be used to implement proposed Section 15.407(j).

Finally, as part of its security proposals, the Commission seeks comment on whether it should require U-NII devices to transmit identifying information so that, in the event interference to authorized users occurs, the Commission can identify the source of the interference and its location.^{51/} Wi-Fi Alliance believes that implementing stronger protections for security as outlined above (along with the other changes the Commission proposes) should be more than sufficient to prevent harmful interference to government systems.

^{49/} See 47 C.F.R. § 2.944.

^{50/} See OFFICE OF ENGINEERING AND TECH., FEDERAL COMMUNICATIONS COMMISSION, SOFTWARE DEFINED RADIO APPLICATION GUIDE, KDB 442812 (2012).

^{51/} NPRM ¶ 51.

3. Additional Rule Changes For the U-NII-2C and U-NII-2A Bands.

In addition to proposing to impose Section 15.407 requirements to devices operating in the U-NII-3 band and requiring additional security features, the Commission proposes changes to the rules governing the U-NII-2A and U-NII-2C bands to ensure protection of incumbent services from interference.^{52/} Currently, devices in those bands must deploy DFS to protect incumbent radar operations.

New Bin 1 - Wi-Fi Alliance supports adoption of the revised so-called Bin 1 test proposed by NTIA for certifying compliance with DFS requirements.^{53/} The revised test now includes test patterns that reflect actual TDWR operation. While Wi-Fi Alliance is unaware of any enforcement case illustrating that properly functioning DFS failed to detect TDWR, it appreciates that this critical test, which all U-NII devices must pass to operate in the U-NII-2A and U-NII-2C bands, must reflect the operational parameters of government systems. The revised Bin 1 test does so, and the new test will address concerns about future interference to TDWR. Wi-Fi Alliance also agrees with the Commission that future adjustments to measurement procedures should not require a rulemaking proceeding, and could be updated by the Office of Engineering and Technology on delegated authority with appropriate notice to affected parties.^{54/}

DFS Functionality – The Commission has found that, in certain non-Wi-Fi devices, the DFS mechanism could be deactivated or “de-selected” by users. It therefore proposes that manufacturers prevent the DFS mechanism from being disabled in devices certified to operate in the U-NII-2A and U-NII-2C bands and that devices in these bands operate with the DFS function

^{52/} NPRM ¶ 67.

^{53/} NPRM ¶¶ 73-74; *see also* NTIA Letter, *supra* note 25.

^{54/} NPRM ¶ 73.

on.^{55/} The Commission notes that it has clarified the type of devices to which this obligation applies using the usual master-client distinction.^{56/} The Commission proposes to incorporate that clarification in the rules by amending Section 15.407 to require that any device subject to DFS requirements that is capable of *initiating a network* must have DFS capability and be approved with that capability.^{57/} Wi-Fi Alliance agrees that “responsible operation of U-NII devices in these [2A and 2C] bands is a joint responsibility of both manufacturers and users”^{58/} and supports the Commission’s proposals for master devices. This proposal will effectively codify requirements previously developed by the Office of Engineering and Technology.

The Commission also asks whether the DFS requirement has limited the types of applications that have been or could be implemented in the U-NII-2A and U-NII-2C bands. Historically, an access point would establish an infrastructure Basic Service Set (“BSS”) in the U-NII-2A and U-NII-2C bands by assuming the role of DFS master. As part of the process to establish the BSS, the access point performs the 60 second channel availability check (“CAC”) to detect whether there is radar activity on the channel. Then, during BSS operation, the access point periodically scans for radar to ensure compliance with in-service monitoring regulations. With new Wi-Fi Direct mobile applications, the Group Owner (“GO”) is required to act as the DFS master in the U-NII-2A and U-NII-2C bands. These new Wi-Fi Direct applications are

^{55/} NPRM ¶ 68.

^{56/} NPRM ¶ 69; *see also* 47 C.F.R. § 15.202 (defining “master device” as “a device operating in a mode in which it has the capability to transmit without receiving an enabling signal,” defining “client device” as a device “not able to initiate a network,” and stating that “client devices that can also act as master devices must meet the requirements of a master device”); OFFICE OF ENGINEERING AND TECH., FEDERAL COMMUNICATIONS COMMISSION, RESTRICTIONS ON SOFTWARE CONFIGURATION FOR DEVICES NOT APPROVED AS SOFTWARE DEFINED RADIOS, KDB 594280 (2012) (“To qualify as a Section 15.202 client, a device cannot initiate, or be configured to initiate, any transmission including probes, beacons, or ad-hoc mode transmissions.”).

^{57/} NPRM ¶ 69.

^{58/} NPRM ¶ 70.

typically short range connections between two nearby devices. The 60 second CAC and in-service monitoring regulations have limited the use of these bands by these short-range mobile devices. **Appendix 1** illustrates such restrictions. Accordingly, Wi-Fi Alliance believes that many applications for Wi-Fi Direct and other short-range Wi-Fi links can be enabled in the U-NII-2A and U-NII-2C bands by defining a low-power profile, one that permits devices without DFS functionality to operate in these bands with transmit characteristics that pose no threat to incumbent radar systems. Wi-Fi Alliance will be pleased to collaborate with the FCC, the NTIA, and other interested parties to develop such a satisfactory low-power profile.^{59/}

Sensing Threshold for Co-Channel Operations – The Commission notes that the current rules permit two levels of sensing thresholds, depending on the power level of the device.^{60/} It proposes to modify its rules to require that devices must operate with both an equivalent isotropically radiated power (“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. Devices that do not meet these standards would be required to meet the more rigorous -64 dBm sensing threshold.^{61/}

Wi-Fi Alliance agrees that these changes, which would be consistent with the European Telecommunications Standards Institute (“ETSI”), will further enhance protection for radars from co-channel interference by reducing both the range and the in-band spectral density emissions of U-NII devices. Because most manufacturers produce equipment for European markets and already meet these standards, there should be little additional cost to comply with the proposed rules.

^{59/} NPRM ¶ 70.

^{60/} NPRM ¶ 71.

^{61/} NPRM ¶¶ 71-72.

Uniform channel spreading – The NPRM also asks if the Commission should eliminate the uniform channel spreading rule.^{62/} Wi-Fi Alliance urges adoption of this change. The original purpose of the rule was to prevent a large number of devices from initiating transmissions on a common channel. Since that time, and with the introduction of 40, 80, and eventually 160 megahertz channels, the rule no longer serves a meaningful purpose. Wi-Fi Alliance further agrees that either random channel selection or manual selection of channels on start-up should be allowed.

Channel loading test – Wi-Fi Alliance also supports the Commission’s proposal to revise the channel loading measurement approach now used with DFS testing – namely, the Moving Picture Experts Group (“MPEG”) test file.^{63/} This test has become outmoded with the development of 802.11 technologies. Wi-Fi Alliance recommends that the current channel loading file approach be replaced with a test that consists of packet transmissions which together exceed the transmitter minimum activity ratio of 30 percent measured over an interval of 100 ms. The required traffic loading can be generated via audio or video streaming, data file transfer, or by using network testing tools that can generate data streams (*e.g.*, iperf, Chariot, etc.). Wi-Fi Alliance notes that this change would make the testing method consistent with recent ETSI rules.^{64/}

Emission Bandwidth – In addition, within the U-NII-2A and U-NII-2C bands, the minimum 6 dB bandwidth of U-NII devices should be at least 500 kilohertz.

^{62/} NPRM ¶ 74.

^{63/} NPRM ¶ 74.

^{64/} See BROADBAND RADIO ACCESS NETWORKS (BRAN); 5 GHz HIGH PERFORMANCE RLAN; HARMONIZED EN COVERING THE ESSENTIAL REQUIREMENTS OF ARTICLE 3.2 OF THE R&TTE DIRECTIVE, ETSI, V1.7.0 (2012).

B. The Alternative Security Measures the Commission Proposes are Impractical and Unnecessary.

The Commission notes that the proposals to modify the technical rules in the U-NII-3 band, along with its proposals to enhance the security requirements of all U-NII devices, would have prevented most of the interference cases it has observed to date.^{65/} Wi-Fi Alliance agrees. The NPRM nevertheless seeks comment on whether additional techniques (*i.e.*, establishing a database registration process combined with geo-location technology; limiting unwanted emission levels; or increasing the sensing frequency range of devices operating in the U-NII-2A and U-NII-2C bands) should be imposed to further limit the potential for interference from U-NII devices.^{66/}

Wi-Fi Alliance strongly opposes the mandatory imposition of these alternative measures. To the contrary, it agrees that by subjecting U-NII-3 devices to Section 15.407 of the rules, imposing the security requirements noted above, and improving the DFS rules applicable to the U-NII-2A and U-NII-2C bands, the potential for interference from U-NII devices will be sufficiently addressed. Given that there is no record of legally operating Wi-Fi devices causing interference, strengthening TDWR protection is best accomplished by rule changes that address the problems that have been identified – retuning devices into unauthorized bands, operating unlawful equipment with emissions characteristics at odds with band requirements, and operating without DFS. The rules proposed in the NPRM, and recommended for adoption by Wi-Fi Alliance, above, squarely address these issues.

^{65/} NPRM ¶¶ 9, 43.

^{66/} NPRM ¶ 53.

The Commission particularly asks if the imposition of geo-location and database systems would aid in the protection of TDWR devices.^{67/} If U-NII devices operate with DFS capabilities across the U-NII-2A and U-NII-2C bands, then geo-location and database requirements are unnecessary. DFS technology, which is designed to avoid co-channel interference to TDWR by detecting radar signals and avoiding co-channel operation with those systems,^{68/} effectively protects against interference when it is operating. Likewise, the rule changes addressed above – which will improve the security of U-NII devices – will further address interference concerns. Therefore, DFS is sufficient and no mandatory geo-location or database obligation should be imposed.^{69/}

Similarly, the Commission’s alternative proposal to impose lower emissions limits to protect TDWR operations is unnecessary.^{70/} The NPRM recites that the implicitly allowed maximum EIRP in the U-NII-2C band is 17 dBm/MHz, that U-NII-2C devices can produce out-of-band emissions of no more than -27 dBm/MHz, and that NTIA has calculated that these limits “may not be sufficient” to protect TDWR from adjacent channel emissions from U-NII devices.^{71/} The NPRM therefore suggests retaining the existing rule with respect to “indoor” devices while tightening the out-of-band emissions to no more than -41dBm/MHz for “outdoor” devices.^{72/}

^{67/} NPRM ¶¶ 54-56.

^{68/} NPRM ¶ 63.

^{69/} If the Commission finds that its security proposal is insufficient for certain classes of devices – outdoor fixed point to point systems, for example, which it has found to be most problematic for TDWR systems – then it should apply the geo-location and database obligations to those devices only.

^{70/} NPRM ¶¶ 57-61.

^{71/} NPRM ¶ 59.

^{72/} NPRM ¶ 60.

Wi-Fi Alliance disagrees with this approach. It is aware of no enforcement case that indicates there is an adjacent-channel issue for U-NII devices (in addition to the absence of any enforcement cases against Wi-Fi devices). Moreover, the analysis relied upon in the NPRM is an NTIA analysis that has not been borne out by how 802.11 equipment is used and operates in the real world. For example, the NPRM states that some of the TDWR interference cases were caused by adjacent interference.^{73/} However, none of the enforcement cases made public by the Commission to date shows evidence of adjacent-channel interference. The equipment at issue in those cases was operating on channels that included the center frequency of the radar; therefore, the interference caused was co-channel and attributable to other causes (*i.e.*, no DFS operating; operating outside lawful parameters; user tampering, etc.).^{74/} Given the importance of 802.11 equipment for deploying broadband, the Commission should not impose a new regulation unless there is clear evidence that the cost of the regulation does not outweigh the benefit. In this case, the benefits of new emissions limits are speculative, but the costs of restricting the equipment according to the proposed rule are very real and will result in significant degradation of the utility of equipment subject to the new out-of-band emissions limit.

Finally, the Commission should decline to adopt its alternative sensing proposal to protect TDWR.^{75/} Specifically, the Commission asks whether – if it requires that a U-NII device move more than 30 megahertz in frequency from the TDWR – it should also require that the

^{73/} See NPRM ¶ 42 (“[T]here are some instances where the interference is caused by adjacent channel emissions.”); NPRM ¶ 44 (“[I]nterference studies conducted by NTIA and FAA indicate that there may be some potential for interference from U-NII devices operating in frequencies . . . adjacent to radar systems.”).

^{74/} The Wi-Fi Alliance therefore disagrees with the finding in its January 2013 evaluation report to Congress, that adjacent-channel interference is a concern. NPRM ¶ 110.

^{75/} NPRM ¶¶ 62-65.

U-NII device sense for radar in the channels adjacent to its occupied bandwidth.^{76/} There is no evidence that requiring sensing over 100 percent of the U-NII device’s occupied bandwidth will provide materially better protection than the current 80 percent requirement. Like the alternative geo-location and database proposals, a more rigorous sensing requirement is unnecessary if the Commission adopts its primary security proposal and modifies Section 15.407 of the rules governing the U-NII-3 band.

IV. RULES FOR THE U-NII-1 BAND

As the Commission notes, the rules governing the U-NII-1 band were intended to allow for use of devices in localized indoor settings.^{77/} Based on the passage of time and the change in use of the band by U-NII devices, the Commission seeks comment on whether to modify the rules for the U-NII-1 band.^{78/} It presents two alternatives – modifying the U-NII-1 rules so that they mirror those applicable to the U-NII-2A band or amending them to conform to the less restrictive U-NII-3 rules.^{79/}

Wi-Fi Alliance supports the Commission’s proposal to amend the U-NII-1 rules to conform to those governing the U-NII-2A band.^{80/} As the Commission notes, the U-NII-1 band was made available on a primary basis for federal and non-federal Aeronautical Radionavigation and non-federal Fixed Satellite Services (“FSS”) to provide feeder links for non-geostationary orbit (“NGSO”) satellite systems in the Mobile Satellite Service (“MSS”).^{81/} The band today is

^{76/} NPRM ¶ 62.

^{77/} NPRM ¶ 37.

^{78/} NPRM ¶ 37.

^{79/} NPRM ¶¶ 39-40.

^{80/} NPRM ¶ 39.

^{81/} NPRM ¶ 36.

utilized by the NGSO/MSS industry, including by Globalstar, as the Commission recognizes.^{82/}

Wi-Fi Alliance believes that the U-NII-1 band is currently being underutilized and can, therefore, be more intensely used by U-NII devices if the rules proposed in the NPRM are adopted.

Consistent rules across the U-NII-1 and U-NII-2A bands will facilitate the use of 80 and 160 megahertz wide channels supported by the 802.11ac standards and, as the Commission notes, would permit the development of new wireless devices in the U-NII bands.^{83/} Therefore, the Commission should, as proposed, increase the power limits to 250 mW with a maximum EIRP of 30 dBm with 6 dBi antenna gain, increase the PSD limits to 11 dBm/MHz, and eliminate the restriction on outdoor operation.

Outdoor operation would permit the band to be used by public hotspot and service provider Wi-Fi networks, helping to address the explosion of mobile data traffic via offloading. In addition, the indoor restriction blocks new consumer applications using Wi-Fi Direct. Specifically, this indoor restriction blocks new applications where a Wi-Fi Direct device could associate directly to a Wi-Fi client device. Today, because the Wi-Fi Direct device may be outdoors, the use of the band is restricted. Wi-Fi Alliance therefore recommends that the Commission remove the indoor restriction in the U-NII-1 band in order to enable all peer-to-peer applications that are currently blocked even when all peers are indoors. Examples of specific cases are provided in **Appendix 2**, including diagrams of the issues confronting Wi-Fi Direct devices in the U-NII-1 band. Adopting the rules governing the U-NII-2A band would facilitate outdoor use of Wi-Fi devices when they operate both indoors and outdoors.

In addition, within the U-NII-1 band, the minimum 6 dB bandwidth of U-NII devices should be at least 500 kilohertz.

^{82/} NPRM ¶ 38, n.47.

^{83/} NPRM ¶ 39.

V. RULES FOR THE U-NII-4 BAND

As the Commission notes, the Wi-Fi 802.11ac standard takes advantage of greater channel bandwidths and “has the potential to create new avenues for opportunistic use of spectrum in diverse broadband services.”^{84/} The Commission’s proposal to designate the U-NII-4 band for unlicensed operations will expand by 75 megahertz the amount of spectrum that can be used by Wi-Fi devices, allowing the entire 5150-5925 MHz band (assuming the designation of the U-NII-2B band for unlicensed operations) to be used by various types of Wi-Fi devices.^{85/} Before imposing rules on this band, however, the Commission must consider the operations that will be permitted in this band and the measures necessary to protect incumbent operations therein.

A. U-NII-4 Sharing Environment Raises New Issues.

The use of the U-NII-4 band must for the first time protect future DSRC operations in the Intelligent Transportation radio service. Both Wi-Fi and DSRC are IEEE 802.11 technologies: Wi-Fi technology is based on the IEEE specification 802.11 and subsequent amendments such as 802.11a, 802.11g, 802.11n and others, while DSRC technology is based on an amendment to the base 802.11 standard – 802.11p. Many companies, including silicon vendors, are active in both industry segments, which will promote cooperation and allow the band to support both Wi-Fi and DSRC operations.

Wi-Fi Alliance does not view the formality of this rulemaking proceeding as the most useful mechanism to shape a sharing proposal. In its extensive experience in helping to develop and maintain the DFS technology, there should be a more interactive dialogue of industry

^{84/} NPRM ¶ 80.

^{85/} NPRM ¶ 96.

experts, as well as government stakeholders, to resolve sharing problems.^{86/} Sharing is technically complex, and those designing sharing technologies need to deeply understand what is being asked of the technology.

Accordingly, as noted above, Wi-Fi Alliance recommends that the Commission further develop the record regarding the use of the band for U-NII operations in other ways. Among other things, Wi-Fi Alliance proposes that the Commission facilitate meetings, beginning at the earliest possible time, among all stakeholders to: (1) exchange information on respective requirements; (2) discuss possible mitigation solutions prepared by the technical experts from the IEEE 802.11 community; and (3) come to an agreement on a mutually acceptable solution for testing and implementation. The process will involve the development and testing of DSRC prototype devices designed to ultimately lead to a co-existence mechanism between Wi-Fi and DSRC technologies.

Pending completion of the evaluation and testing noted above, Wi-Fi Alliance tentatively agrees that the U-NII-3 rules should apply across the entire 200 megahertz of spectrum that will comprise the (expanded) U-NII-3 and U-NII-4 bands.^{87/} In particular, U-NII-4 devices would be permitted to operate with: (1) a maximum output power that is the lower of 1 watt and $17 \text{ dBm} + 10 \log(B)$ where B is 26 dB emission bandwidth; (2) an antenna gain of 6 dBi for non-point-to-point and 23 dBi for point-to-point (with power and spectral density reduced if the antenna gain exceeds these values); and (3) a maximum power and spectral density not to exceed 17 dBm in any 1 megahertz band, with out-of-band emission (“OOBE”) from the band edge to 10 megahertz above or below the band edge not to exceed an EIRP of -17 dBm/MHz and, for frequencies 10 megahertz or greater, emissions should not exceed an EIRP of -27 dBm/MHz.

^{86/} NPRM ¶ 101.

^{87/} See NPRM ¶ 97.

However, Wi-Fi Alliance does not agree that imposing adjacent-channel sensing is necessary for the protection of DSRC or of radar in the band.^{88/} As stated above, it believes the case for adjacent-channel sensing is speculative, not borne out by real world examples, and is very costly in terms of degrading the operation of commercial Wi-Fi equipment that would operate in the band.

B. Additional Evaluation is Required to Determine the Need for DFS Requirements.

The Commission notes that it requires devices operating in the U-NII-2A and U-NII-2C bands to incorporate DFS and asks if that requirement should be incorporated in the U-NII-4 (and U-NII-2B) rules.^{89/} It asks in particular about the ability of signal sensing spectrum-sharing technologies to detect sub-microsecond pulses and whether the current DFS mechanism would protect current and future radars that employ these sub-microsecond pulses.^{90/} As the Commission notes, there are existing services in the U-NII-4 band, some of which may be protected by the same type of mechanisms used to limit interference in other U-NII bands – *e.g.*, DFS.^{91/} However, radar operations in the U-NII-4 band may be different than in other bands requiring protection from U-NII devices. Accordingly, there must be further evaluation of how U-NII devices should protect incumbent operations in the U-NII-4 band. If DFS is required, it is not clear whether the existing DFS testing requirements must be modified to protect U-NII-4 radars. In response to the NPRM’s question about pulsewidth detection capability, ETSI requires detection of 0.5 microsecond pulsewidths, which represents industry’s present

^{88/} NPRM ¶¶ 98-99.

^{89/} NPRM ¶ 98.

^{90/} NPRM ¶¶ 98-99.

^{91/} See NPRM ¶¶ 88-94 (discussing incumbent services in the U-NII-4 band, including federal military surveillance and test range instrumentation systems, as well as non-federal systems such as fixed satellite services, intelligent transportation services, and amateur radio).

capability. The issue is not, of course, detection of one pulsewidth, but detection of the radar bursts over a test pattern to a measured probability of detection.

In addition, within the U-NII-4 band, the minimum 6 dB bandwidth of U-NII devices should be at least 500 kilohertz.

VI. RULES FOR THE U-NII-2B BAND

As the Commission notes, designation of the U-NII-2B band for unlicensed use will create 475 megahertz of contiguous spectrum in which U-NII devices, including Wi-Fi stations, may operate.^{92/} However, substantial technical analysis is required before this band can be used, and the Commission should allow sufficient time for industry and other stakeholders to evaluate the proposed rules for governing operations in this band. Today, there are a number of federal and non-federal incumbent operations in the U-NII-2B band that must be considered when devising rules governing this band. Specifically, as the Commission notes, the U-NII-2B band is allocated on a primary basis to federal operations – including radar systems (*i.e.*, spaceborne altimeter radar systems), earth exploration satellite systems, and unmanned aircraft systems – and on a secondary basis to non-federal operations – including broadcast and media entities and weather radars.^{93/} Wi-Fi Alliance agrees with the NTIA Report that additional study is needed^{94/} and agrees with NTIA’s characterization of mitigation techniques known today.^{95/} More information is necessary in order for the commercial Wi-Fi industry to present potential sharing ideas. We look forward to reviewing the NTIA Report on this issue.

^{92/} NPRM ¶¶ 96.

^{93/} See NPRM ¶¶ 82-86; *see also* 47 C.F.R. § 2.106.

^{94/} NPRM ¶¶ 103.

^{95/} NPRM ¶¶ 106-108.

The Commission proposes to impose the rules that otherwise apply to the U-NII-2A and U-NII-2C bands to the new U-NII-2B band.^{96/} Specifically, the Commission proposes to allow U-NII devices to operate with (1) a maximum power output limit of the lesser of 250 milliwatts or $11\text{dBm} + 10 \text{ Log (B)}$ (where B is 26 dB emission bandwidth); (2) an antenna gain of 6 dBi for non-point-to-point systems and 23 dBi for point-to-point systems; (3) a power and PSD reductions if the antenna gain exceeds the aforesaid values; (4) a maximum PSD of 11 dBm in any 1 megahertz band; (5) an out-of-band emissions limit of EIRP -27 dBm/MHz; and (6) an out-of-channel emissions limit for outdoor devices of -41 dBm/MHz.^{97/}

With one exception, Wi-Fi Alliance agrees with this approach. Wi-Fi Alliance does not believe it is necessary for the Commission to impose an out-of-channel emissions limit to outdoor devices in the band. There is no similar rule for the U-NII-2A and U-NII-2C bands and the Commission has not suggested that there is any more likelihood of interference from outdoor devices in the U-NII-2B band than there is in the U-NII-2A or U-NII-2C bands. Accordingly, the Commission should delete the proposed out-of-channel emissions limit that would apply to outdoor devices in the U-NII-2B band.

In addition within the U-NII-2B GHz band, the minimum 6 dB bandwidth of U-NII devices should be at least 500 kilohertz.

VII. ADDITIONAL PART 15 RULE CHANGES

In order to simplify and clarify Part 15 of its rules, the Commission proposes to make miscellaneous revisions and updates to various sections.^{98/} In particular, the Commission seeks to replace the phrase “Peak Power Spectral Density” with “Maximum Power Spectrum Density”

^{96/} NPRM ¶ 96.

^{97/} See 47 C.F.R. § 15.407(b)(2).

^{98/} See NPRM ¶ 113.

in Section 15.403, a revision which Wi-Fi Alliance supports. Within this same section, and as noted above, the Commission should also modify subsection(s) to include the 5.825-5.850 MHz spectrum in the definition of U-NII spectrum. In addition to these changes, Wi-Fi Alliance also supports the Commission’s proposal to modify the general technical requirements in Section 15.407, including the deletion of the second sentence in paragraph (a)(4), the replacement of “peak” with “maximum” in paragraph (a)(5), and the clarification in paragraph (a)(6) that all peak excursion measurements are to the highest average rather than to the average in each corresponding 1 megahertz band. Wi-Fi Alliance also supports the Commission’s proposals to fix the typographical error in Section 15.247 and to clarify that the 20 dB bandwidth limitation for ultrawideband devices does not apply to Section 15.407 devices. In addition, Wi-Fi Alliance proposes to change in-band PSD limits from 8 dBm/3 kHz to 23.2 dBm/100 kHz for the below 1 GHz unlicensed bands that are not part of Subpart H of Part 15 of the rules.

VIII. TRANSITION PERIOD FOR COMPLIANCE

The Commission proposes to establish a 12-month deadline after the effective date of any new or modified rules adopted in this proceeding for manufacturers to produce U-NII devices that comply with the new rules.^{99/} The Commission also proposes to adopt a two-year deadline after the effective date of any new or modified rules for requiring that U-NII devices manufactured in or imported into the U.S. for sale comply with the new or modified rules, and seeks to grandfather for the life of the equipment those U-NII devices that are already installed or in use.^{100/} Wi-Fi Alliance supports these proposed transition periods, which will give industry stakeholders a sufficient period of time to comply with the rules. However, the Commission should allow for an exception to the two-year deadline for permissive changes being filed to

^{99/} NPRM ¶ 114.

^{100/} NPRM ¶¶ 114-115.

upgrade existing devices to meet the new DFS Bin 1 test.^{101/} Wi-Fi Alliance supports adoption of the new Bin 1 test to better reflect all federal radar systems, and the Commission should permit transitioning the embedded base with improved DFS capability, whether adopted in this proceeding or otherwise by the Office of Engineering and Technology.

IX. REACTION TO NTIA REPORT

Wi-Fi Alliance appreciates the work of the NTIA in its 5 GHz Report^{102/} and is pleased to see the progress regarding the potential availability of new spectrum in the 5 GHz band. For purposes of this proceeding, the Commission seeks comment on all aspects of the NTIA Report, particularly the spectrum-sharing technologies and risk analysis described therein.^{103/} At the outset and as noted above, Wi-Fi Alliance agrees that additional study is needed in this area in order to determine the feasibility of introducing U-NII devices into the U-NII-2B and U-NII-4 bands.^{104/} Specifically, the Commission should seek input from relevant federal agencies and industry stakeholders in order to better assess whether and how risks may be mitigated and what technical parameters should be developed in order to deploy U-NII devices in these bands.

Wi-Fi Alliance supports determining the optimal technologies to protect incumbent users. As the Commission states, these spectrum sharing technologies may be used as reference models in the U-NII-2B and U-NII-4 bands, and the advantages and disadvantages of each should be considered, consistent with Wi-Fi Alliance's comments in this proceeding. Nevertheless, as noted above, Wi-Fi Alliance does not believe that mandatory use of geo-location, sensing or

^{101/} See NPRM ¶¶ 73-74; see also NTIA Letter, *supra* note 25.

^{102/} See NTIA, Department of Commerce, Evaluation of the 5350-5470 MHz and 5850-5925 MHz Bands Pursuant to Section 6406(b) of the Middle Class Tax Relief and Job Creation Act of 2012, available at http://www.ntia.doc.gov/files/ntia/publications/ntia_5_ghz_report_01-25-2013.pdf ("NTIA Report").

^{103/} NPRM ¶ 104.

^{104/} See NTIA Report at ii; see also NPRM ¶ 103.

database technologies are necessary to protect incumbent users. Wi-Fi Alliance also notes that NTIA models of U-NII device use must be extended to femtocells and vehicles to include new applications and deployment models.

The NTIA Report also contains an assessment of the risks to each type of Federal operation and suggests mitigation strategies.^{105/} In the U-NII-2B band, the NTIA Report indicates that current U-NII regulations may introduce hidden node interference and that changes in existing U-NII DFS detection parameters may not adequately shield current and future radar systems from serious degradation.^{106/} The NTIA Report also cites risks to federal systems associated with allowing U-NII devices to operate in the U-NII-4 band, including that DFS detection parameters may not protect DSRC operations from performance degradation.^{107/} Wi-Fi Alliance stresses that it is currently too early to tell if NTIA has correctly catalogued the risks of each type of federal operation. However, Wi-Fi Alliance disagrees with the assertion contained in the NTIA Report that DFS does not work.^{108/} When properly configured, DFS protects incumbents operating in the U-NII bands, and the Commission has not initiated any enforcement actions which indicate otherwise. Accordingly, DFS must be seriously considered as a primary method for protecting federal users.

X. CONCLUSION

As the Commission has recognized, Wi-Fi is an integral part of the wireless ecosystem and a driving force in the overall economy. Wi-Fi Alliance therefore appreciates the

^{105/} See NTIA Report at 4-1 to 5-12; *see also* NPRM ¶¶ 109-112.

^{106/} See NTIA Report at 4-4 to 4-5; *see also* NPRM ¶ 110.

^{107/} See NTIA Report at 5-4 to 5-5; *see also* NPRM ¶ 110

^{108/} See NTIA Report at 3-4 (stating that instances were observed during NTIA's interference investigation where "U-NII device DFS functionality performed properly, causing the device to move to an adjacent channel, but still caused interference" and where "U-NII device complied with FCC DFS certification requirements but failed to detect TDWR").

Commission's efforts to make additional spectrum available for U-NII operations and to modify current rules governing the 5 GHz band. Although the NPRM raises many important issues, the public interest would be best served if the Commission focuses first on harmonizing the rules governing the U-NII-2C and expanded U-NII-3 bands, increasing security features in order to promote the continued growth of Wi-Fi technologies, and adopting the updated Bin 1 testing requirements for devices requiring DFS. That will unlock the full potential of the U-NII-2C and U-NII-3 bands while protecting incumbent users. The Commission should also focus its efforts on adopting its other proposed modifications, particularly by amending the U-NII-1 rules to conform them to those governing the U-NII-2A band. Finally, the Commission should adopt new rules governing the U-NII-4 and U-NII-2B bands. In so doing, the Commission will allow American consumers and businesses to continue to enjoy the benefits of advances in Wi-Fi technology while protecting incumbent operations.

Respectfully submitted,

THE WI-FI ALLIANCE



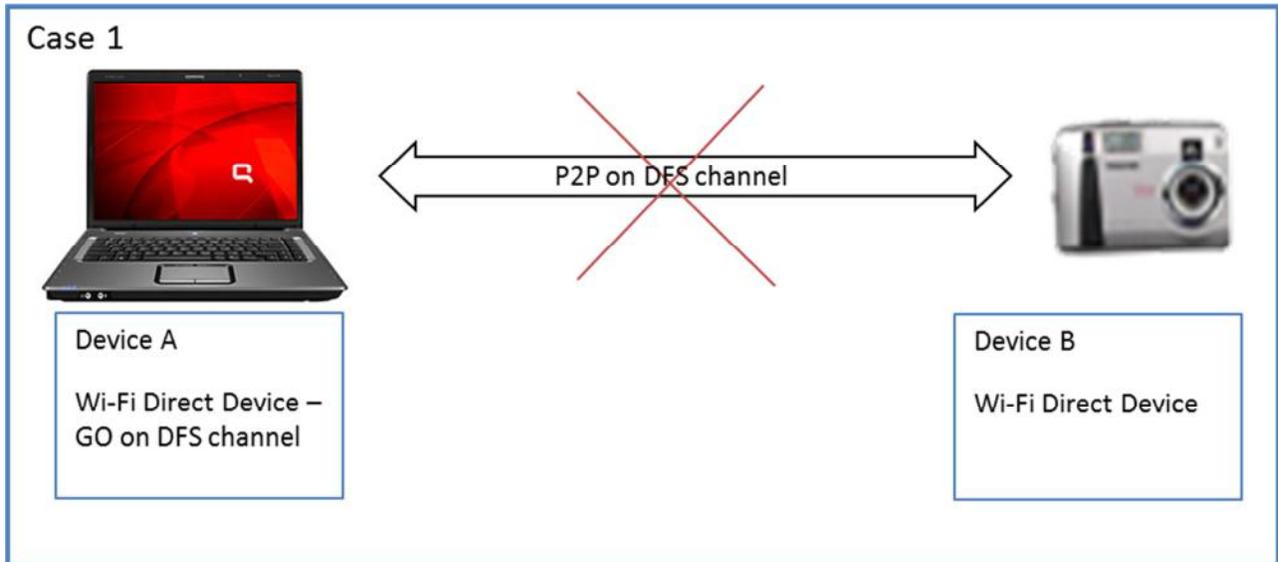
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APPENDIX 1

Case 1: Temporary, short-term Wi-Fi Direct connections

Bands that use Dynamic Frequency Selection (“DFS”) are not conducive to temporary, short-term Wi-Fi Direct connections. For example, a quick file transfer of photos between a laptop and camera would have to wait for the 60 sec. initial radar scan, significantly increasing transfer time.



Case 2: Interruption of service during Wi-Fi Direct connection

When an active Wi-Fi Direct connection is in place, *e.g.*, file transfer, radar detection might trigger in the Wi-Fi Direct group owner (DFS master device) either due to false detect or due to an actual radar. In this case, the Group Owner (“GO”) needs to switch to another channel, which might be a DFS channel because of the uniform spreading rule, and do a new channel availability check. The channel availability check interrupts the Wi-Fi Direct service for at least 60 seconds.

Case 3: Simultaneous connection to AP and Wi-Fi Direct peer

Use Case:

- Access Point (“AP”) established Basic Service Set (“BSS”) in the 2.4GHz band
- Device A
 - associated with AP for Local Area Network (“LAN”)/Internet connectivity
 - capable of Wi-Fi Direct GO
 - DFS Master Capability
- Device B:
 - Wi-Fi Direct Device with DFS client capability
- Device A wishes to establish a direct peer-to-peer link with Device B for file transfer

Assumptions:

- Device A supports DFS master capability and can operate as a GO on DFS channel

Cost effective implementation:

The most cost effective way for a mobile device to support a simultaneous connection to an AP and Wi-Fi Direct peer is with multi-virtual MACs (support virtually several MACs with only one HW) and to time multiplex RF/baseband hardware between different channels. However “different channel” support is problematic, as a Wi-Fi Direct GO on a DFS channel must stay on the channel to perform in-service monitoring. If the GO leaves the channel (power save, other channel activity, scanning for Wi-Fi discovery, etc.), when returning to the channel the GO is required to re-do CAC and scan the channel for radar activity for 60 seconds.

Therefore performing channel availability check (“CAC”) before any transition to the DFS band, while a GO is connected with Wi-Fi Direct clients, and also has an active BSS connection to the AP on a different channel, will have several negative effects:

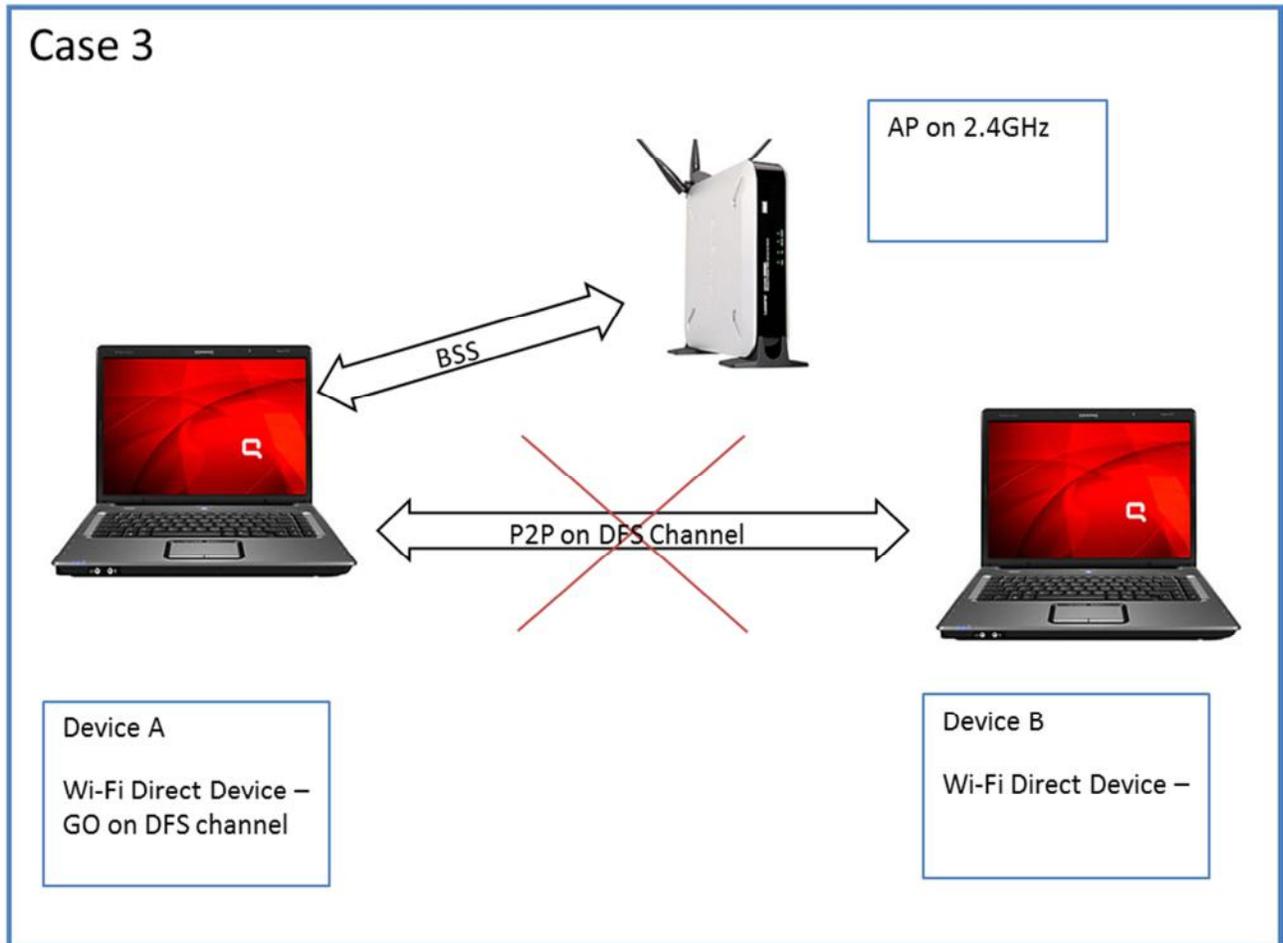
1. The GO is not allowed to transmit anything (including beacons) until the CAC is over, therefore, all Wi-Fi Direct clients that are connected to the GO will probably get disconnected since they would not have received a beacon for at least 60 seconds.
2. The connection to the AP on the other channel (other MAC) will probably get disconnected as well since the device disappeared for at least 60 seconds.

This means that devices that support DFS as such are not really capable of supporting multiple virtual MACs on different channels on DFS channels.

Resulting use case restrictions:

To avoid congestion and interference in the 2.4 GHz band, Device A desires to establish a GO on a DFS channel to perform the file transfer. However according to the description above, if it does so, both connections will be lost.

The restrictions on DFS channels blocks valid low range usages since, even where Device A supports DFS as a GO, it is not effective to operate as such due to the disconnection implications, and they must communicate on other non-DFS bands.



An alternative implementation to time multiplex RF/baseband hardware is to implement dual-band/channel simultaneous support. This adds substantial hardware cost and battery consumption to mobile devices and severely limits commercial acceptability.

APPENDIX 2

Case 1: Legacy client (without Wi-Fi Direct capability) may not connect to a Wi-Fi Direct GO on UNII-1 band

Use Case:

- Indoor AP established BSS on UNII-1
- Device A
 - associated with AP
 - capable of Wi-Fi Direct
- Device B:
 - not associated with AP
 - legacy device not capable of Wi-Fi Direct
- Device A wishes to establish a direct peer-to-peer link with Device B for file transfer

Assumptions:

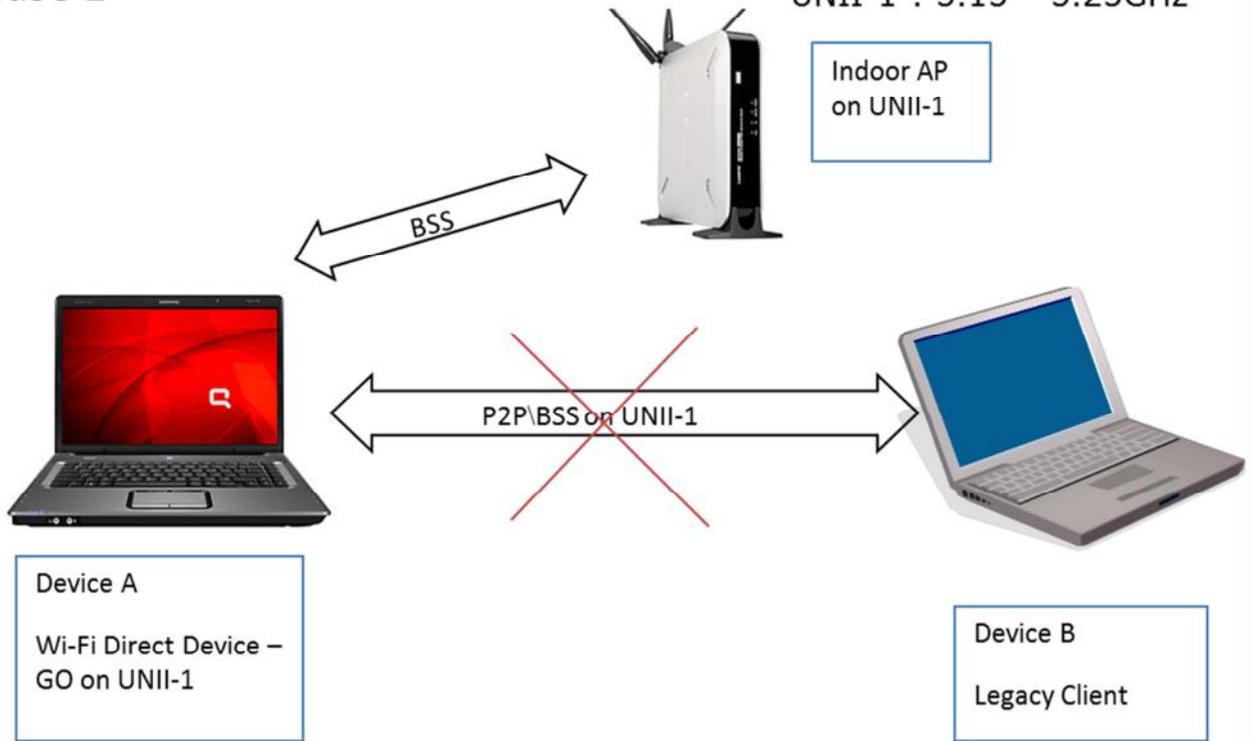
- Device A is allowed to establish a peer to peer (“P2P”) BSS on UNII-1 if it is connected to an AP on UNII-1 band, ensuring it is indoors.
- Device A, operating as a Wi-Fi Direct GO, will appear to Device B (legacy client) as an indoor fixed AP.
- Device A does not know whether Device B is indoors or outdoors.

Resulting use case restrictions:

- Since Device B may be twice as far from the AP as Device A, the probability of it being outdoors is increased. As such, Device A must refuse a connection attempt from Device B to ensure that outdoor devices are not allowed to operate on the indoor band.
- The restriction on outdoor operation blocks valid indoor usages since, even where both Device A and Device B are indoors, Device A must refuse a connection attempt from Device B.

Case 1

UNII-1 : 5.15 – 5.25GHz



Case 2: P2P Device that is Battery powered and doesn't support concurrent connection (or doesn't support BSS connection at all)

Use Case:

- Indoor AP established BSS on UNII-1
- Device A
 - associated with AP
 - capable of Wi-Fi Direct
- Device B:
 - not associated with AP
 - Capable of Wi-Fi Direct and not connected to the AP
- Device B wishes to establish a direct P2P link with Device A for file transfer

Assumptions:

- Device A is allowed to establish a P2P BSS on UNII-1 if it is connected to an AP on UNII-1 band, ensuring it is indoors.
- Device A, operating as a Wi-Fi Direct GO, will appear to Device B as a P2P GO
- Device A does not know whether Device B is indoors or outdoors.
- Device B cannot be the GO on indoor band since it is not AC powered and not connected to indoor AP.

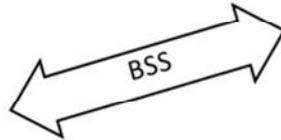
Resulting use case restrictions:

- Since Device B may be twice as far from the AP as Device A, the probability of it being outdoors is increased. As such, Device A must refuse a connection attempt from Device B to ensure that outdoor devices are not allowed to operate on the indoor band.
- The restriction on outdoor operation blocks valid indoor usages since, even where both Device A and Device B are indoors, Device A must refuse a connection attempt from Device B.
- For example: a camera that supports only P2P connection to a computer for downloading pictures.

Case 2

UNII-1 : 5.15 – 5.25GHz

Indoor AP
on UNII-1



Device A
Wi-Fi Direct Device –
GO on UNII-1



Device B
Battery powered
Wi-Fi Direct Device

Case 3: Cannot establish a GO on UNII-1 band if the BSS connection is on a different band, even if indoors

Use Case:

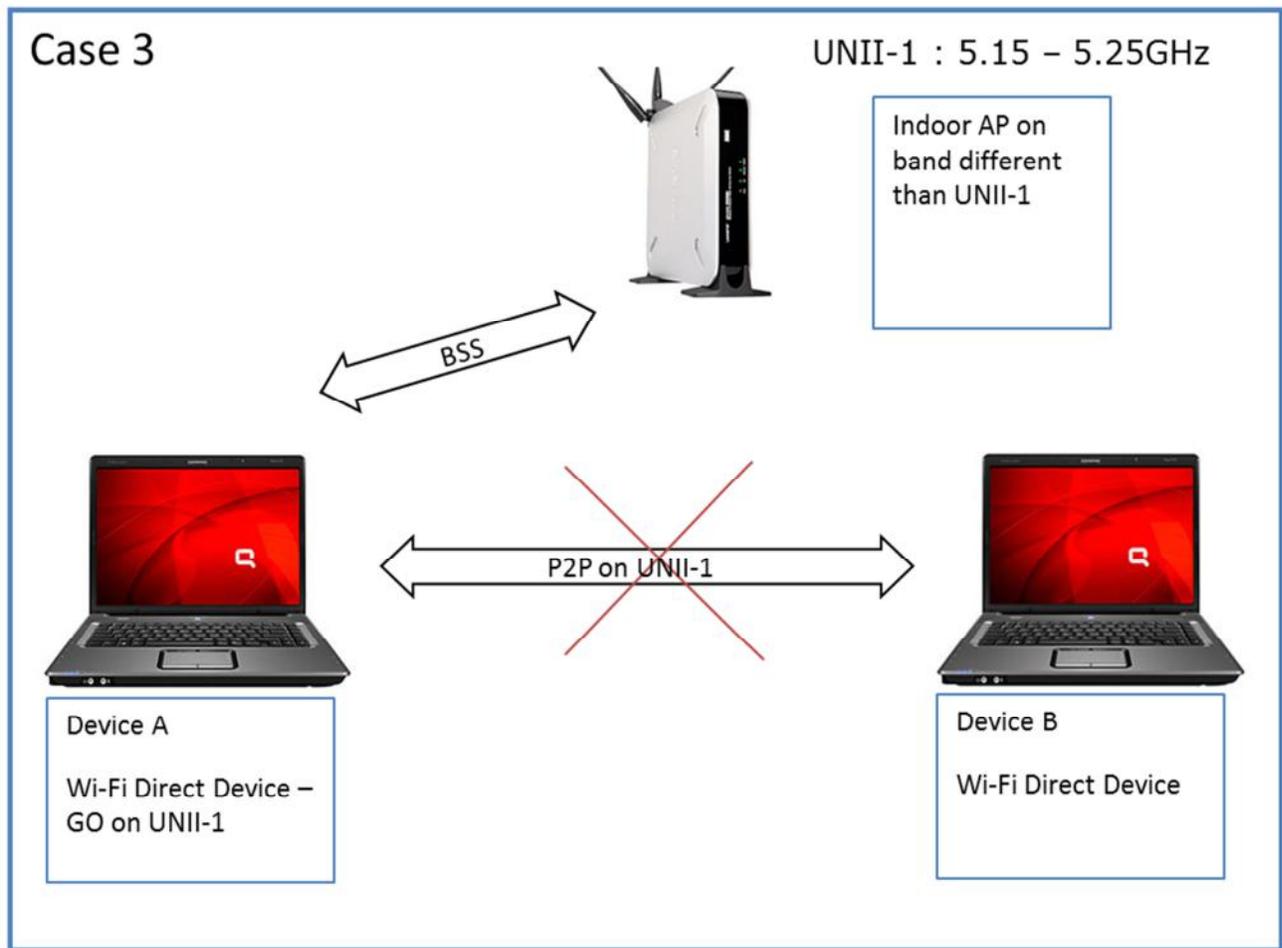
- Indoor AP established BSS on the low band 2.4GHz or any non-UNII-1 band
- Device A
 - associated with AP
 - capable of Wi-Fi Direct
- Device B:
 - Wi-Fi Direct Device not connected to UNII-1 band AP
- Device B wishes to establish a direct P2P link with Device A for file transfer

Assumptions:

- Device A HW support UNII-1
- It is unknown if Device A and Device B are indoor or outdoor

Resulting use case restrictions:

- Since Device A and B are not connected to AP on UNII-1 band they may be outdoor. As such they cannot establish a connection on UNII-1 band and can only communicate on the low band channels or UNII-3 on specific regions.
- Since 2.4GHz band is usually very busy with other Wi-Fi communication and other technologies (BT, microwave...) the communication may be slow and not stable.
- The restriction on outdoor operation blocks valid indoor usages since, even where both Device A and Device B are indoors, none of them can establish a GO on the indoor band and they must communicate on other bands.



Case 4: Media center cannot establish a GO on UNII-1 band due to any of the reasons described in previous use cases, even though indoors

Use Case:

- Indoor AP established BSS on UNII-1
- Device A
 - associated with AP
 - capable of Wi-Fi Direct
- Device B:
 - Battery powered device that support Wi-Fi Direct and is not connected to the AP
- Device B wishes to establish a direct P2P link with Device A for file transfer (pictures)
- Device C:
 - AC Powered TV that is not connected to the AP
- Device A wishes to establish a direct P2P link with Device C for wireless display
- Device D

- capable of Wi-Fi Direct
- Device A wishes to establish a direct P2P link with Device D for file transfer

Assumptions:

- Device A,B,C,D HW support UNII-1
- It is unknown if Device A,B,C,D are indoor or outdoor

Resulting use case restrictions:

- Since Device A has several P2P connections simultaneously, it is optional only if device A is the GO and devices B,C and D are connected to the same group. Since Device B,C,D are not connected to AP on UNII-1 band they may be outdoor. As such they cannot establish a connection on UNII-1 band and can only communicate on the low band channels or UNII-3 on specific regions.
- Since 2.4GHz band is usually very busy with other Wi-Fi communication and other technologies (BT, microwave...) the communication may be slow and not stable.
- The restriction on outdoor operation blocks valid indoor usages since, even where all 4 devices A,B,C and D are indoors, They cannot be on the same group and have simultaneous connection on UNII-1 band.
- Since the TV is AC powered it is allowed to activate a GO on UNII-1 band, but if that will happen then Device A will be a Wi-Fi Direct client and the other devices (B and D) will not be able to connect to it, or they will be able to connect to it on a different group (that will probably be on the low band) causing a non-optimal connection that is both on the low band and use different channels operation that split each channel time.

Case 4

