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 Infrastructure (U-NII) Devices in the 5 GHz Band	)	ET Docket No. 13-49
	)	
	)	

REPLY COMMENTS OF CISCO SYSTEMS, INC.

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EXECUTIVE SUMMARY

The comments submitted in response to the *Notice* evidence substantial support for proposals advanced by Cisco both to improve the rules governing the current 5 GHz U-NII allocation and to explore opportunities for expansion of that allocation to support the exploding demand for connectivity via the IEEE 802.11 family of Wi-Fi standards. The record before the Commission establishes that Wi-Fi, one of the great American technology success stories, is straining under the weight of the recent exponential growth in demand and soon will be unable to meet the projected needs of the American public. It also demonstrates that 5 GHz band presents the best available alternative for addressing the exploding demand for Wi-Fi connectivity, but only if the Commission expands unlicensed access to additional 5 GHz spectrum and implements a 5 GHz unlicensed regulatory environment tailored to IEEE 802.11ac, which will deliver gigabit Wi-Fi speeds and make more efficient use of unlicensed spectrum if it can be fully implemented on contiguous spectrum.

Although there is substantial agreement on many of the issues raised by the *Notice*, others are sufficiently new or novel that they require additional record development on technical issues. Like Cisco, many of those commenting have urged the Commission to move rapidly to make those rule changes on which there is substantial agreement, while embarking on the systematic, phased approach that Cisco and many other commenters have suggested for successful navigation of the more difficult issues presented by the *Notice*.

To address the well-document causes of interference to TDWR, the record supports quick and targeted measures by the Commission. Specifically, the Commission should: (i) revise the Bin 1 Waveforms as proposed; (ii) require improved security features in all 5 GHz U-NII devices; (iii) retain the more stringent mandate that a fixed point-to-point system operating in the U-NII-3 band reduce peak transmitter power and peak power spectral density by 1 dB for every 1 dB that antenna gain exceeds 23 dBi when combining Sections 14.407 and 15.247 of the Rules; (iv) require that every U-NII devices include DFS functionality if it is capable of initiating a network in a U-NII band that is subject to a DFS requirement; and (v) modify Section 15.407(h)(2) of the Rules to limit the relaxed -62 dBm DFS detection threshold to those U-NII devices that not only operate with an EIRP of less than 200 mW (23 dBm), but also have an EIRP spectral density of less than 10 dBm/MHz (10 mW/MHz).. However, those commenting overwhelmingly agree with Cisco that other proposals advanced in the *Notice* in the name of protecting TDWR, such as requiring a geo-location database or mandating adjacent channel sensing or imposing more stringent unwanted emissions limits, should be rejected. These additional requirements seek to "fix" problems that have not materialized despite years of experience in U-NII/radar sharing. The record establishes that imposing additional requirements on U-NII devices is unnecessary to protect TDWR and would unnecessarily subject manufacturers to additional costs that ultimately would be borne by the public.

Those commenting on the issues joined Cisco in endorsing proposals advanced in the *Notice* to fine-tune the DFS rules. Thus, the Commission should, concurrent with addressing TDWR protection: (i) eliminate the portion of Section 15.407(h)(2) that mandates that the DFS mechanism "provide a uniform spreading of the loading over all of the available channels"; (ii) allow for either random or manual channel selection (including the maintenance of a list of

available channels within the device that would be used if available) as proposed in the *Notice* and supported by the comments; and (iii) eliminate the current video-centric channel loading requirement applicable during DFS testing and replace it with one based on that employed by ETSI. In addition, the Commission should adopt the proposal by Fastback that would allow a DFS-controlled device to only vacate a portion of a channel if it can isolate the frequencies used by radar and limit the non-occupancy period to that portion of the channel used by the radar.

The record also evidences strong support for the Commission's proposals in the *Notice* to extend the existing U-NII-3 band by 25 megahertz to 5725-5850 MHz and require future certification of digitally modulated devices in that band under a somewhat modified version Section 15.407. Those commenting support limiting the maximum conducted output power to 1 Watt, restricting the peak power spectral density to 8 dBm/3 kHz; imposing a minimum 6-dB bandwidth of 500 kHz on all 5 GHz U-NII devices; eliminating the 26-dB bandwidth requirement from the measurement bandwidth; increasing the measurement bandwidth to 1 megahertz for a single antenna port; retaining the more restrictive emission limits of Section 15.407(b)(4) rather than the limits set forth in Section 15.247, and retaining the maximum 13 dB peak-to-average conducted output power ratio.

Those commenting also agreed with Cisco that at the same time as the Commission adopts the changes identified above, it would adopt the miscellaneous rule changes proposed in Paragraph 113 of the *Notice* and adopt the transition approach outlined by the Commission. Cisco continues to believe that the transition approach should be modified so Class II Permissive Changes to devices certified under the current rules would be permitted after the 2-year transition period proposed in the *Notice* where those changes provide DFS protection to whatever new Bin 1 Waveforms are adopted by the Commission.

The record confirms that to realize the full benefits promised by IEEE 802.11ac, the Commission must harmonize the U-NII-1 power and PSD rules with those of U-NII-2A at a minimum Indeed, Cisco agrees with those who urge a serious exploration of possible harmonization with the U-NII-3 rules. In either case, there is an overwhelming consensus that the restriction preventing outdoor use of the U-NII-1 band should be repealed.

The majority of those commenting agree that the Commission can and should move towards allowing U-NII access to 5850-5925 MHz, while assuring protection to all incumbent users. Sharing between U-NII and DSRC will require work on both sides, and the Commission should facilitate a continuation of the current dialog that is already taking place between U-NII and DSRC stakeholders with a view towards coming to consensus on how sharing can best be implemented in the band. The existing U-NII interference-protection regime should be the logical starting point for analysis of interference to radar systems, with changes only as needed by the particular facts surrounding the band. And, although Cisco is confident that sharing is possible, further studies should be conducted to evaluate the potential for harmful interference to FSS from the introduction of U-NII-4 devices into the 5850-5925 MHz band. Given the success that the unlicensed community has had to date in developing effective approaches to U-NII sharing with other incumbent services, it is far too soon for the Commission to give up on the idea that some or all of this much needed spectrum can be used by U-NII devices.

Those commenting largely agree with NTIA that "further analysis will be required" before the Commission allows greater unlicensed use in the U-NII-2B band. To the extent that broadcasters express concern about potential interference to their weather radar systems, Cisco believes that further analysis will show that the same mitigation techniques used to protect TDWR in other portions of the 5 GHz band are likely to be effective, particularly with the modifications discussed above. At present, there is no reason to believe, as the National Association of Broadcasters and Baron Services, Inc. suggest, that additional burdens like geo-location/database and enhanced software security requirements must be imposed when such restrictions are not necessary to protect Federal TDWR.

Finally, the Commission should expedite its consideration of the issues raised in the *Notice* so the United States can provide leadership at WRC-15.

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REPLY COMMENTS OF CISCO SYSTEMS, INC.

Cisco Systems, Inc. ("Cisco") submits this reply to comments filed in response to the Commission's *Notice of Proposed Rulemaking* soliciting input on a wide range of proposals relating to the usage of the 5 GHz band by Unlicensed National Information Infrastructure ("U-NII") devices (the "*Notice*").[1]

I. INTRODUCTION.

As will be discussed in detail below, the comments submitted in response to the *Notice* evidence substantial support for proposals advanced by Cisco both to improve the rules governing the current 5 GHz U-NII allocation and to explore opportunities for expansion of that allocation to support the exploding demand for connectivity via the Institute of Electronics and Electrical Engineers ("IEEE") 802.11 family of Wi-Fi standards. The record before the Commission is clear – Wi-Fi, one of the great American technology success stories, is straining under the weight of the recent exponential growth in demand and soon will be unable to meet the projected needs of the American public. The 5 GHz band presents the best available alternative for addressing the exploding demand for Wi-Fi connectivity, but only if the Commission

[1] *See* 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) ("*Notice*"). On June 17, 2013, the Office of Engineering and Technology extended the deadline for the submission of reply comments until July 24, 2013. *See* Revision of Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band, *Order*, DA 13-1388 (rel. June 17, 2013).

expands unlicensed access to additional 5 GHz spectrum and implements a 5 GHz unlicensed regulatory environment tailored to today's needs. Although there is substantial agreement on many of the issues raised by the *Notice*, others are sufficiently new or novel that freeing additional 5 GHz band for unlicensed use as proposed by the *Notice* will require additional record development on technical issues. Thus, the Commission can, and should, move rapidly to make those rule changes on which there is substantial agreement, while embarking on the systematic, phased approach that Cisco and many other commenters have suggested for successful navigation of the more difficult issues presented by the *Notice*.

II. THE RECORD ESTABLISHES THE PUBLIC INTEREST IMPERATIVE FOR IMPROVING THE USABILITY OF 5 GHZ FOR FIFTH GENERATION WI-FI.

In its comments, Cisco addresses at length the marketplace developments that have spurred the need for improved unlicensed access to the 5 GHz band.[2] And Cisco is hardly alone in that regard – a wide range of manufacturers, service providers and trade associations have made the case that it is imperative for the Commission to both free the 5 GHz band for unlicensed use and modify the Part 15 regulatory regime to meet the growing demand for Wi-Fi connectivity in the United States.

The comments submitted in response to the *Notice* establish not only that the sheer volume of information traversing the Internet is growing at an unprecedented rate,[3] but also that

[2] *See* Comments of Cisco Systems Inc., ET Docket No. 13-49, at 7-23 (filed May 28, 2013) ("Cisco Comments").

[3] *See id*. at 7 ("Driven by more users, more devices, faster broadband speeds and more rich media content, Internet Protocol ('IP') traffic in the United States is expected to more than triple over the period from 2011-2016, growing from 9.4 Exabytes per month in 2011 to 24.7 Exabytes in 2016."); Comments of Consumer Electronics Ass'n, ET Docket No. 13-49, at 4 (filed May 28, 2013) ("CEA Comments") ("Americans consume broadband capacity at a massive and increasing rate . . . .").

connectivity to the Internet increasingly is occurring wirelessly via Wi-Fi.[4] Indeed, many filers note that Wi-Fi is rapidly becoming the most prevalent vehicle for Internet connectivity in the United States and around the globe.[5] This trend is being driven by the proliferation of Wi-Fi equipped portable devices, including smartphones, tablets, laptops and a growing array of other Internet-enabled devices.[6] In addition, the record confirms that with the growth in smartphones, tablets and other broadband devices used on mobile networks, the spectrum crunch is accelerating, and the allocation of additional licensed spectrum will not alone be a panacea. Indeed, the record establishes that Wi-Fi is already being used by mobile network carriers to off-load a significant share of their traffic from licensed spectrum, and that this trend will only accelerate as more consumers demand greater bandwidth from their mobile devices.[7]

There is no doubt that industry is making tremendous strides to accommodate American consumers' insatiable demand for Wi-Fi connectivity. The comments confirm that Wi-Fi

[4] *See, e.g.*, Comments of the Telecommunications Industry Ass'n, ET Docket No. 13-49, at 4 (filed May 28, 2013) ("TIA Comments"); Comments of Wi-Fi Alliance, ET Docket No. 13-49, at 2-4 (filed May 28, 2013) ("WFA Comments").

[5] *See* Cisco Comments at 8; Comments of the National Cable and Telecommunications Ass'n, ET Docket No. 13-49, at 8 (filed May 28, 2013) ("NCTA Comments") ("In the United States, more data is carried over Wi-Fi than any other Internet source.").

[6] *See* Cisco Comments at 9-11; CEA Comments at 6-7; Comments of the Information Technology Industry Council, ET Docket No. 13-49, at 2 (filed May 28, 2013) ("ITIC Comments"); NCTA Comments at 9; WFA Comments at 3; Comments of the Ass'n for the Advancement of Medical Instrumentation, ET Docket No. 13-49, at 2-3 (filed May 28, 2013).

[7] *See, e.g.*, Cisco Comments at 11-17; CEA Comments at 8 ("Indeed, in early 2012, three of the four major wireless carriers offloaded more than 50% of their smartphone data traffic to Wi-Fi networks."); ITIC Comments at 2-4; TIA Comments at 4-5 ("[c]ommercial wireless networks are already offloading 47% of all traffic to fixed wireline networks and project that offloading will grow to 66% by 2017."). *See also* Comments of Motorola Mobility, LLC, ET Docket No. 13-49, at 9 (filed May 28, 2013) ("Motorola Mobility Comments") (noting that adoption of rule changes proposed in *Notice* could "promote a wave of technological innovation while also alleviating congestion from the commercial mobile broadband networks.").

capabilities are increasingly being incorporated into a wide range of devices,[8] and that new public hotspots are aggressively being deployed.[9] Perhaps most importantly for purposes of this proceeding, many of those commenting emphasize industry's development of the fifth generation IEEE 802.11 Wi-Fi standard, IEEE 802.11ac, which will deliver gigabit Wi-Fi speeds and make more efficient use of unlicensed spectrum if it can be fully implemented on contiguous spectrum.[10]

Yet, the record also confirms Cisco's initial assessment that industry alone cannot meet the escalating demands for unlicensed connectivity. There is no disagreement that the current unlicensed allocation is insufficient to meet demand, and that absent regulatory action by the Commission, demand for unlicensed spectrum will soon overwhelm supply.[11] As Google, Inc.

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[8] *See* Cisco Comments at 9; CEA Comments at 6-7 ("WiFi Alliance has approved more than 14,000 different products for use on WiFi networks.").

[9] *See* Comments of Comcast Corp., ET Docket No. 13-49, at 4-9 (filed May 28, 2013) ("Comcast Comments"); NCTA Comments at 4 ("In less than two years, cable operators have deployed more than 150,000 Wi-Fi access points throughout the country in both urban and rural areas, and more access points are being deployed every day."); WFA Comments at 3 ("Wi-Fi hotspots have proliferated in public spaces, including restaurants, convention centers, parks and airplanes, just to name a few.").

[10] *See* CTIA Comments at 17-21; TIA Comments at 5-6; Comments of Google, Inc. and Microsoft Corp., ET Docket No. 13-49, at 4 (filed May 28, 2013) ("Google/Microsoft Comments"); ITIC Comments at 5; NCTA Comments at 11-12; WFA Comments at 5-6.

[11] *See, e.g.*, NCTA Comments at 8 ("Indeed, the 2.4 GHz band, the primary band used for Wi-Fi, is already reaching exhaustion in larger, high-penetration markets."), *citing* Rob Alderfer, WiFi Spectrum: Exhaust Looms, CableLabs at 7 (May 2013); Comcast Comments at 15 (noting that the 2.4 GHz band is reaching capacity in larger markets today and that even in smaller markets, congestion may occur by 2015); Comments of Cablevision Systems Corp., ET Docket No. 13-49, at 4 (filed May 28, 2013) ("Cablevision Comments") ("Because of congestion in the 2.4 GHz band, Cablevision has already come to rely heavily on that part of the 5 GHz band not encumbered by outdated restrictions such as prohibitions on outdoor use, insufficient power levels, and DFS requirements."). These views were confirmed by a recent submission by the United States to Working Party 5A in conjunction with preparations for WRC-15, "the spectrum requirement for broadband RLANs using the 5 GHz frequency range in the year 2018 [is estimated] to be a minimum of 880 MHz: this figure includes spectrum already utilized by broadband RLANs operating in the 5 GHz frequency range." United States of America,

and Microsoft Corporation note, "[u]nlicensed networks and users . . . face a congestion challenge akin to the network congestion experienced by licensed network operators and their customers."[12]

The comments filed in response to the *Notice* leave no doubt that the Commission has an important role to play in assuring that the demand for Wi-Fi can be met in coming years. And, they establish that freeing the majority of the 5 GHz band for unlicensed use is the best hope for addressing the unlicensed spectrum shortage. Not only can additional spectrum be made available in the band by designating the U-NII-2B and U-NII-4 bands for unlicensed use, but the creation of a 775 MHz block of contiguous unlicensed spectrum under appropriate rules can unleash the full power of IEEE 802.11ac by maximizing the number of very wide channels that can be deployed and thus promoting the most efficient use of the spectrum.[13] The National Cable and Telecommunications Association ("NCTA"), among others, describes how the 5 GHz band is well-suited for accommodating the expanding demand for Wi-Fi because it is already incorporated within 802.11 standards, vendors of devices area already incorporating it into their offerings, much of the band is globally harmonized, and it provides a substantial amount of

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Spectrum Requirements of Terrestrial Mobile Broadband Applications (excluding IMT), R12-WIPSA AR-C-0312!!MSW-E.

[12] Google/Microsoft Comments at 3.

[13] *See, e.g.*, Cisco Comments at 19-20; NCTA Comments at 7-10 (establishing that IEEE 802.11 ac will promote efficiency by enabling use of more advanced modulation and coding schemes and increase throughput capacity through the use of wider channels, leading to higher Wi-Fi air interface capacity, lower battery consumption and a better overall customer experience); TIA Comments at i; Comments of the Wireless Internet Service Providers Ass'n, ET Docket No. 13-49, at ii (filed May 28, 2013) ("WISPA Comments"); Comments of Shared Spectrum Company, ET Docket No. 13-49, at 3 (filed May 28, 2013) ("SSC Comments"). The 5 GHz band also has the benefit of being internationally harmonized for unlicensed use. *See, e.g.*, NCTA Comments at 10; Motorola Mobility Comments at 1; Comcast Comments at 17-19.

spectrum.[14] Clearly, the Wi-Fi Alliance ("WFA") had it right when it notes that "[i]n 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."[15]

As discussed in more detail below, the *Notice* has raised a wide variety of issues, some easily resolved but others that are far more thorny. As the Commission starts to balance the equities in resolving these difficult issues, it cannot lose sight of the incredible technological success story that IEEE 802.11 has become, the increasing reliance by the American public on Wi-Fi connectivity, and the dramatic adverse consequences for the American economy if the feared Wi-Fi spectrum crunch becomes a reality.

III. THE COMMISSION SHOULD SEQUENCE ITS DECISIONS IN RESPONSE TO THE NOTICE TO PROVIDE THE MAXIMUM PUBLIC BENEFIT AS QUICKLY AS POSSIBLE.

Cisco, along with several other parties, establish in their initial comments that while some of the issues presented by the *Notice* are relatively simple and straightforward, or have become such after years of work by stakeholders, others are relatively novel, quite complex and will require extensive analysis beyond what has taken place to date. Given this disparity, the Commission is urged to approach this proceeding with an eye towards issuing a series of reports

[14] NCTA Comments at 9-11. *See also* Comments of Time Warner Cable Inc., ET Docket No. 13-49, at 2 (filed May 28, 2013) ("Time Warner Comments") ("the 5 GHz band offers the best and likely only path for providing such additional unlicensed spectrum for Wi-Fi services at this time, most notably because it has the capacity to enable large channels of contiguous spectrum that could accommodate the newly-developed 802.11ac standard and its promise of gigabit Wi-Fi.").

[15] WFA Comments at 2.

and orders, addressing the low hanging fruit quickly while at the same time starting down the path towards resolving the more complex questions presented by the *Notice*.[16]

The record developed during the comment round confirms that there are issues raised in the *Notice* that are ripe for prompt resolution. As is discussed in more detail below, the Commission can and should rapidly address:

- *Protection of TDWR.* There is substantial agreement on a range of steps that the Commission should take, and should not take, to permanently address potential interference to Terminal Doppler Weather Radar ("TDWR") systems and lift the interim restrictions on use of the 5600-5650 MHz band by unlicensed devices. These issues are discussed in Section IV below.

- *Extension of the U-NII-3 Band.* There is unanimous support in the record for adoption of the Commission's proposal to extend by 25 megahertz the current U-NII-3 band to include the entire 5725-5850 MHz band and substantial support for consolidating all equipment authorizations for digitally modulated devices operable in that band under a modified version of the U-NII rule – Section 15.407.[17]

- *Harmonization of Section 15.407 and 15.247.* Although not without some disagreement, the record is sufficiently well-developed for the Commission to quickly resolve the issues raised in the *Notice* regarding the current disparities between Sections 15.407 and 15.247 of the Rules as the two rules are consolidated into a revised Section 15.407. The specific issues regarding the resolution of the inconsistencies between the two rules are discussed in Section V below.

- *Miscellaneous Rule Changes.* Paragraph 113 of the *Notice* sets forth a series of existing 5 GHz U-NII rules that reference procedures or provisions that either are no longer in use and should be deleted or otherwise need to be updated with

[16] *See, e.g.*, Cisco Comments at 24-25; Comments of IEEE 802, ET Docket No. 13-49, at 3, 11-12 (filed May 28, 2013) ("IEEE 802 Comments"); TIA Comments at 2-3, 8-9; NCTA Comments at 13, 24-26; Time Warner Comments at 3; WFA Comments at 6-8.

[17] *See, e.g.*, Cisco Comments at 42-43; WFA Comments at 11; Comcast Comments at 22; TIA Comments at 11; Comments of Ericsson, ET Docket No. 13-49, at 4 (filed May 28, 2013) ("Ericsson Comments"); Comments of Fastback Networks, ET Docket No. 13-49, at 2 (filed May 28, 2013) ("Fastback Comments"); IEEE 802 Comments at 17, 26; NCTA Comments at 17; Motorola Mobility Comments at 2, 3. *But see* Comments of First Step Internet, LLC, ET Docket No. 13-49, at 3-4 (filed May 28, 2013) (supporting expansion of U-NII-3 band but opposing elimination of Section 15.247); WISPA Comments at 12-13 (supporting extension of the band to 5850 MHz but opposing consolidating all equipment authorizations).

minor revisions. Cisco and all other commenting parties addressing the proposal support adoption of these changes.[18]

- *Transition Plan*. The *Notice* proposes a phased approach to transitioning to whatever new or modified equipment certification rules are adopted in this proceeding. That proposal was generally supported by those commenting upon it.[19] The Commission should also adopt Cisco's non-controversial suggestion that the transition timeframes commence with the effective date of the new rules, that manufacturers would also be afforded the option to certify equipment under the new or modified rules during this transitional period as soon as test procedures are ready, and that Class II Permissive Changes to devices certified under the current rules should be permitted after the 2-year transition period where those changes are designed to provide appropriate Dynamic Frequency Selection ("DFS") protection to whatever new Bin 1 Waveforms are adopted by the Office of Engineering and Technology ("OET") as a result of the comments filed in this proceeding.[20]

Citing the importance of the issues presented in the *Notice* to meeting the growing demand for Wi-Fi connectivity, others join with Cisco in urging the Commission to begin addressing the issues raised by the *Notice* on an expedited basis as early as the fourth quarter of 2013.[21] While this timeline is aggressive, it will yield substantial benefits by providing manufacturers of 5 GHz U-NII equipment with a measure of regulatory certainty as they move aggressively to implement IEEE 802.11ac.[22]

In addition, the Commission should implement the suggestion advanced by the Telecommunications Industry Association ("TIA") and "provide industry with reasonable and

[18] *See, e.g.*, Cisco Comments at 51-52; WFA Comments at 30-31; Ericsson Comments at 12; IEEE 802 Comments at 24-25; TIA Comments at 11.

[19] *See* Cisco Comments at 52-54; WFA Comments at 31-32; Ericsson Comments at 12; IEEE 802 Comments at 25-26; NCTA Comments at 24 (supporting a transition period of between 12 months and 3 years depending on what other obligations are adopted).

[20] *See* Cisco Comments at 52-54.

[21] *See id*. at 25; TIA Comments at 11.

[22] See TIA Comments at 16; WFA Comments at 6-7; IEEE 802 Comments at 11-13.

reliable expectations for the time frames for final decisions in this modular process."[23] As TIA points out, NTIA has provided the public with specific deadlines for its completion of its process for quantitative evaluation of sharing and the submission of recommendation to the Commission and an international task group.[24] A similar schedule from the Commission will provide industry with beneficial clarity as to when various decisions will be made, so that product development and roll-out can be scheduled in an appropriate manner.

IV. THE COMMISSION CAN AND SHOULD MOVE QUICKLY TO ADOPT ITS PROPOSED RULES TO IMPROVE PROTECTION OF TDWR FROM U-NII INTERFERENCE.

The comments submitted in response to the *Notice* reflect a widespread recognition by Part 15 stakeholders that the problem of interference to TDWRs is a serious one that must be addressed and addressed quickly. However, it is equally important that the Commission take a measured approach, modifying its rules to fix what is known to be broken, while rejecting calls for unnecessary "belt and suspenders" limits on unlicensed operations.

In its initial comments, Cisco establishes that to the extent there has been actual interference from unlicensed operations to TDWR, that interference can be traced to four fundamental issues with respect to outdoor deployments by wireless internet service providers ("WISPs") of transmission antennas at locations high above ground with clear line-of-sight to TDWRs: (1) the Bin 1 Waveforms used for evaluating compliance with the Dynamic Frequency Selection ("DFS") requirements requirement do not accurately represent all of the TDWR modes

[23] TIA Comments at 9.

[24] *See id.* at 9 n.21, *citing* U.S. Department of Commerce, National Telecommunications and Information Administration, *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*, at 6-4 (Table 6-2 – Tentative Schedule and Milestones for Completing Quantitative Evaluation) (Jan. 2013), *available at* http://www.ntia.doc.gov/files/ntia/publications/ntia_5_ghz_report_01-25-2013.pdf.

of operations; (2) U-NII devices that do not include DFS and thus are not certified for use in the U-NII-2A and U-NII-2C bands are being modified illegally to operate in those bands; (3) U-NII devices that do include DFS and are certified for use in the U-NII-2C band are being modified illegally to disable DFS or otherwise employ technical parameters other than those authorized; and (4) devices certified under Section 15.247 of the Rules are operating at power levels in excess of that permitted under Section 15.407.[25] The *Notice* proposed, and there is widespread support for, specific rule changes designed to target each of these issues.

First, those parties commenting on the issue, including Cisco, are unanimous in support of the Commission's proposal to fix the flaw in the current Bin 1 test used for certifying DFS compliance by replacing the current test with an alternative proposed by the National Telecommunications and Information Administration ("NTIA").[26]

Second, to address what appears to be the most common source of TDWR interference – operation of illegally modified frame-based (non-Wi-Fi) devices in the U-NII-2A and U-NII-2C bands that either do not have DFS or have DFS illegally disabled – there is widespread support for the *Notice*'s proposal "to require that manufacturers implement security features in any digitally modulated device capable of operating in the U-NII bands, so that third parties are not able to reprogram the devices to operate outside the parameters for which the device was certified."[27]

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[25] *See* Cisco Comments at 26-27.

[26] *See, e.g.*, Cisco Comments at 28-29; WFA Comments at 9, 17; IEEE 802 Comments at 23; TIA Comments at 10; WISPA Comments at 18-19.

[27] *See* Cisco Comments at 29-34, *quoting Notice*, 28 FCC Rcd at 1785 ¶ 51. *See also* WFA Comments at 14-16; NCTA Comments at 23-24; WISPA Comments at 16-17; Fastback Comments at 7; Comments of Cambium Networks, ET Docket No. 13-49, at 1-2 (filed May 28, 2013) ("Cambium Comments"); Comments of National Ass'n of Broadcasters, ET Docket No. 13-49, at 7-8 (filed May 28, 2013) ("NAB Comments").

Third, as the Commission consolidates Sections 15.407 and 15.247, most commenters support the *Notice*'s proposal to retain the requirement of Section 15.407 that those using high gain antennas reduce their transmitter output power.[28] By retaining the provisions of Section 15.407(a)(3) requiring reductions in power when high-gain point-to-point antennas are deployed, the Commission can mitigate the potential for interference to TDWR that has been found to be caused by the use of high-gain antennas. While the Commission's proposal to retain the more stringent antenna gain requirement is predictably opposed by a small subset of commenting parties that make use of unlicensed equipment for point-to-point service,[29] they fail to consider that the Commission and NTIA have both concluded that high-gain antennas are part of the TDWR interference problem.[30] Contrary to their assertions, adoption of the Commission's proposal will not preclude broadband service in rural areas – retention of the current Section 15.407 approach still permits all but the most lengthy point-to-point uses of the 5 GHz band, and does not prevent those who require longer lengths from using 5 GHz with multiple hops or

[28] *See* Cisco Comments at 34-35; IEEE 802 Comments at 18-19; Ericsson Comments at 5; TIA Comments at 11; WFA at 13; Comments of Motorola Solutions, Inc., ET Docket No. 13-49, at 3 (filed May 28, 2013) ("MSI Comments") (proposing absolute maximum antenna gain of 23 dBi for fixed point-to-point systems).

[29] *See, e.g.*, Cambium Comments at 4 ("We encourage the Commission to permit the continued use of higher gain antennas without an output power penalty in areas where interference is unlikely to be a problem"); Fastback Comments at 3-4; WISPA Comments at 12-15.

[30] *See, e.g.*, Memorandum from Julius Knapp, Chief, OET, FCC and P. Michele Ellison, Chief, Enforcement Bureau, FCC to Manufacturers and Operators of Unlicensed 5 GHz Outdoor Network Equipment, at 1 (July 27, 2010), *available at* http://transition.fcc.gov/eb/uniitdwr.pdf ("We have found that the interference [to TDWR] at each location has generally been caused by a few fixed wireless transmitters used by wireless internet service providers (WISPs) and operating outdoors in the vicinity of airports at high elevations that are line-of-sight to TDWR installations . . ."); U.S. Department of Commerce, National Telecommunications and Information Administration, *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*, at 3-5 (Jan. 2013) ("*NTIA 5 GHz Report*"), *available at* http://www.ntia.-doc.gov/files/ntia/publications/ntia_5_ghz_report_01-25-2013.pdf.

moving to the unlicensed TV white spaces or 2.4 GHz band, the "licensed light" 3.65 GHz band or any of the myriad licensed bands available without auction for point-to-point usage. Given the importance of TDWR and the clear linkage between high-gain equipment and interference, the prudent approach is to limit the equivalent isotropic radiated power ("EIRP") consistent with current Section 15.407, even if that means that WISPs and others will have to turn to other available spectrum alternatives to meet their longest link requirements.

Fourth, the Commission should immediately adopt the proposal in the *Notice* to incorporate into Part 15 the guidance previously provided by OET via KDB 594280 as to what constitutes a client device exempt from the DFS requirement – guidance that assures that the non-DFS devices deployed in the U.S. for use in the U-NII-2A and U-NII-2C bands can only be used under the control of a master device that does includes such functionality and controls the frequency selection of associated clients.[31] While some urge the Commission to permit "low power" devices to operate in the band without DFS and without being under the control of a master device, the record to date does not fully address the implications of such usage for TDWR. For example, while Motorola Mobility, LLC suggests that "eliminating the DFS requirement for U-NII devices operating at no greater than 50 mW may present little to no increase in potential harmful interference to radar," no technical analysis is submitted to validate the assertion.[32] While further exploration of the issue may be appropriate in light of the comments filed by others, until it can be demonstrated that TDWR is not jeopardized by low power, non-DFS devices, the rule should be clarified to conform to the OET guidance.

[31] *See* Cisco Comments at 31-33.

[32] *See* Motorola Mobility Comments at 7. *See also* IEEE 802 Comments at 26-27 (suggesting a "low-power" exemptions from DFS but not proposing any specific power limit or establishing the lack of an impact on TDWR); WFA Comments at 18-19 (suggesting that the Commission establish a "low power" exemption from the DFS requirement, but recognizing the need for further work among the Commission, NTIA and other interested parties to develop a profile.).

Fifth, consistent with the record developed in response to the *Notice*, the Commission should adopt its proposed changes to the DFS sensing rules and testing procedures. There is wide-spread support for the Commission's proposal[33] to modify Section 15.407(h)(2) of the Rules to limit the relaxed -62 dBm DFS detection threshold to those U-NII devices that not only operate with an EIRP of less than 200 mW (23 dBm), but also have an EIRP spectral density of less than 10 dBm/MHz (10 mW/MHz).[34] The record shows that the Commission properly concluded that doing so will "further enhance protection for radars from co-channel interference by reducing both the range and the in-band spectral density emissions of the U NII device."[35]

As Cisco notes in its initial comments,[36] it agrees with the Commission's assessment that adoption of its proposals to modify the measurement procedures and technical rules applicable to the U-NII-3 band, along with its proposals to enhance the security requirements of all U-NII devices, will be effective in avoiding TDWR interference.[37] The causes of interference to TDWR are, at this point, well known and the steps outlined above are narrowly targeted to mitigate those causes of interference. Like Cisco, other commenters stress that imposing additional requirements on U-NII devices is unnecessary to protect TDWR and would unnecessarily subject manufacturers to additional costs that ultimately would be borne by the

[33] *See Notice*, 28 FCC Rcd at 1791-92 ¶¶ 71-72.

[34] *See* Cisco Comments at 48-50; IEEE 802 Comments at 23; WFA Comments at 19; Ericsson Comments at 8; Fastback Comments at 9.

[35] *Notice*, 28 FCC Rcd at 1791-92 ¶ 72.

[36] *See* Cisco Comments at 26-28.

[37] *See Notice*, 28 FCC Rcd at 1785-86 ¶ 53.

public.[38] Thus, the Commission should reject arguments to the effect that even with the modification discussed above, additional protection is necessary for TDWR.

For example, the only comments submitted in response to the *Notice*'s solicitation of comment on "whether requiring new unwanted emission limits for U-NII devices operating in the U-NII-2A and U-NII-2C bands is appropriate" [39] opposed that approach, noting that the enforcement record establishes co-channel emissions as the culprit behind TDWR interference.[40] Similarly, the record does not support an obligation to relocate a transmission at least 30 megahertz in frequency away from a TDWR[41] or bandwidth sensing over 100% of bandwidth instead of the current 80% requirement, another proposal that unrelated to any instance of actual TDWR interference.[42]

Although there was some support for the concept of using a mandatory geo-location database as a tool for addressing TDWR interference,[43] there is substantial opposition to the

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[38] *See, e.g.*, Cisco Comments at 37-41; IEEE 802 Comments at 19-21; WFA Comments at 21-24. Thus, for example, there is no reason for the Commission to give serious consideration to Ericsson's proposal that 5 GHz unlicensed devices be required to transmit a "beacon" that would include identifying information. *See* Ericsson Comments at 7. As Cisco demonstrated in its comments, requiring U-NII devices to transmit identifying information is both unnecessary and raises a host of practical and economic concerns. *See* Cisco Comments at 39-40.

[39] *See Notice*, 28 FCC Rcd at 1787-89 ¶¶ 57-61.

[40] *See* Cisco Comments at 38; IEEE 802 Comments at 21-22; WFA Comments at 21-23. Indeed, there appears to have been only one case, involving a non-Wi-Fi, frame-based radio, that arguably could have been a case of adjacent channel interference, and there have been no subsequent adjacent channel interference cases since the Commission issued a consent decree against that manufacturer in 2010. *See* Motorola, Inc., *Order*, 25 FCC Rcd 3601 (EB 2010).

[41] *See* Cisco Comments at 39; WFA Comments at 23-24. As Cisco notes, adoption of this proposal would require a fundamental change in the way U-NII devices equipped with DFS functionality currently operate, either adding unnecessary costs or resulting in inefficient spectrum utilization. *See* Cisco Comments at 38.

[42] *See* Cisco Comments at 40; IEEE 802 Comments at 22; WFA Comments at 23-24.

[43] SSC Comments at 2-3, WISPA Comments at 17 (noting its voluntary database should not be mandated).

concept.[44] Given that the causes of interference are known, and will be addressed by adoption of the proposals addressed above, geo-location databases at 5 GHz U-NII-2C are a solution in search of a problem.[45] IEEE 802 correctly notes in its comments that imposing a geo-location database requirement on 5 GHz:

> significantly alters equipment design, increases complexity, raises questions about database maintenance, and introduces significant uncertainty to an industry that today is delivering a wireless broadband access platform that by some measures will account for over half of all IP traffic in the United States. This is a far different proposition than when a device ecosystem is new, and there are no consumer expectations in terms of quality and price points yet built around it.[46]

As Cisco emphasizes in its own comments, questions abound as to how a geo-location database can work, how it will operate, and whether it can be effective given the predominantly indoor nature of Wi-Fi use.[47] None of those supporting a geo-location database have even begun to address these questions.[48] Now, when time is of the essence if this country's demand for Wi-Fi

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[44] IEEE 802 Comments at 3, 20-22, Cisco Comments at 40, WFA Comments at 22; Ericsson Comments at 7 (stating that a geo-location database could be further studied, but "may not be worth the effort").

[45] While NAB supports a mandatory geo-location database requirement, its position appears to be based on the mistake view that even when properly operating, DFS has failed to properly identify radar. *See* NAB Comments at 6 n.12. Yet, that flaw will be corrected by the adoption of the new Bin 1 waveforms proposed by NTIA. Fixing the specific problem is a far superior approach than introducing a new set of requirements that undoubtedly will come with their own problems.

[46] IEEE 802 Comments at 20-21. *See also* Cisco Comments at 39-40; WFA Comments at 22.

[47] *See* Cisco Comments at 39-40.

[48] *See, e.g.*, NAB Comments at 6; Cambium Comments at 2-3. Indeed, Cambium's filing raises more questions than it answers. Although it "would support introduction of a mandatory database and registration scheme" for devices "close to TDWRs", it opposes requiring a wireless terminal to consult a database "on a continuous or regular basis, or at every restart." Although Cambium does not specify how close a device would have to be to be required to register, how the database process would operate, or how it could be policed, it is clear that adopting such a regime is unnecessary because the specific steps proposed in the *Notice* should alleviate the risk of TDWR interference.

connectivity is to be met in coming years, is not the time for the Commission to inject regulatory uncertainty into the industry by considering the imposition of a material new regulatory paradigm on 5 GHz unlicensed use. Rather, now is the time to be providing regulatory certainty by quickly addressing the issues raised in the *Notice* and limiting regulatory burdens to those absolutely necessary.

In short, we know why TDWR has suffered interference, and there is general agreement that the problem can be solved by adopting a relatively few rule and policy changes that can be implemented without threatening the viability of Wi-Fi in the 5 GHz band. Additional measures to hamstring Wi-Fi are unnecessary, and could prove extraordinarily harmful at a time when America can ill-afford self-imposed regulatory harm to its scarce reserve of unlicensed spectrum.

Although not directly related to the use of DFS to provide TDWR protection, the Commission should, concurrent with the steps outlined above, make several changes to the DFS rules that are proposed in the *Notice* and supported unanimously by those commenting on the specific proposals. Specifically, the Commission should:

- Eliminate the portion of Section 15.407(h)(2) that mandates that the DFS mechanism "provide a uniform spreading of the loading over all of the available channels," as proposed in the *Notice*[49] and supported by the comments.[50]

- Allow for either random or manual channel selection (including the maintenance of a list of available channels within the device that would be used if available) as proposed in the *Notice*[51] and supported by the comments.[52]

- Eliminate the current video-centric channel loading requirement applicable during DFS testing as proposed in the *Notice*[53] and supported by the comments.[54] Cisco

[49] *See Notice*, 28 FCC Rcd at 1792 ¶ 74 (citation omitted).

[50] *See* Cisco Comments at 50; IEEE 802 Comments at 24; WFA Comments at 20; Ericsson Comments at 9; Fastback Comments at 10.

[51] *See Notice*, 28 FCC Rcd at 1792 ¶ 74.

[52] Cisco Comments at 50; IEEE 802 Comments at 24; Fastback Comments at 10.

> continues to recommend that, at least for IEEE 802.11 devices, the current approach be replaced by one based on that employed by ETSI,[55] as recommended by IEEE 802 and by WFA.[56]

In addition, although not proposed in the *Notice*, the Commission should adopt a suggestion advanced by Fastback Networks ("Fastback"). Fastback proposes that:

> "…DFS detection within a channel should not require the device to vacate the entire channel to the extent that the manufacturer can optionally certify to the Commission that its DFS detection capability can identify the specific frequency range at which the detected radar is operating with sufficient accuracy. Similarly, to the extent that such a DFS detector identifies the specific frequency range of the detected radar, the Non-occupancy period should apply only to that range and not to the entire channel that the device had been operating in."[57]

Cisco agrees with Fastback that implementation of this approach will provide for even more efficient use of the 5 GHz band, particularly as IEEE 802.11ac is implemented. Since that standard supports varying channel bandwidths, devices often will be able to automatically shift to a smaller channel when the DFS identifies radar using a portion of a larger channel.

V. THE RECORD IS SUFFICIENTLY DEVELOPED FOR THE COMMISSION QUICKLY TO EXPAND THE U-NII-3 BAND AND CONSOLIDATE SECTIONS 15.247 AND 15.407.

As noted above, the comments submitted in response to the *Notice* addressing the issue unanimously agree with Cisco that the public interest will be well-served by adoption of the

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[53] *See* Cisco Comments at 50-51; IEEE 802 Comments at 24; WFA Comments at 20; Fastback Comments at 10.

[54] *See Notice*, 28 FCC Rcd at 1792 ¶ 74.

[55] *See* Cisco Comments at 51, *citing* ETSI, *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*, Final Draft ETSI EN 301 893 V1.7.0, at 27, Sec. 5.1.2.2 (Jan. 2012), *available at* http://www.etsi.org/-deliver/etsien/301800_301899/301893/01.07.00_40/-en_301893v010700o.pdf.

[56] IEEE 802 Comments at 24; WFA Comments at 20. *See also* Cisco Comments at 51.

[57] Fastback Comments at 9.

Commission's proposals to extend the current U-NII-3 band by 25 megahertz to include the entire 5725-5850 MHz band, and overwhelmingly supported requiring all equipment authorizations for digitally modulated devices operable in that band to be governed by a modified version of the U-NII rule – Section 15.407.[58] While there is some disagreement regarding the specific proposals for a modified Section 15.407, the issues are relatively simple and straightforward and, on most, there is substantial consensus. Thus, the Commission can and should move quickly to expand the U-NII-3 band and adopt revisions to Section 15.407 to govern equipment authorization for all 5 GHz digitally modulated devices.

A. THE COMMISSION SHOULD AMEND SECTION 15.407(A)(3) TO PROVIDE THAT THE MAXIMUM CONDUCTED OUTPUT POWER IS LIMITED TO 1 WATT.

The comments unanimously support the *Notice*'s proposal[59] to resolve the conflict between present Section 15.247(b)(3) of the Rules, which allows 1 Watt of total peak conducted power, and Section 15.407(a)(3), which limits the maximum conducted output power to the lesser of 1 Watt or 17 dBm + 10 log B where B is the 26-dB emission bandwidth in MHz, by modifying Section 15.407 to simply limit the maximum conducted output power to 1 Watt.[60] As the Commission has recognized, conforming Section 15.407 to current Section 15.247 by removing the bandwidth dependent term should not increase any potential for interference.[61] Thus, the proposed modification should be adopted.

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[58] *See supra* note 17.

[59] *See Notice*, 28 FCC Rcd at 1779 ¶ 30.

[60] *See, e.g.*, Cisco Comments at 43; IEEE 802 Comments at 17-18; Motorola Mobility Comments at 4-5; MSI Comments at 3; WFA Comments at 12.

[61] *See Notice*, 28 FCC Rcd at 1779 ¶ 30.

B. THE CHANGES TO THE POWER SPECTRAL DENSITY REQUIREMENTS PROPOSED IN THE NOTICE SHOULD BE ADOPTED.

Similarly, all of those addressing the issue support the Commission's proposal[62] to modify Section 15.407 to incorporate the provision of Section 15.247(e) that limits the peak power spectral density ("PSD") to 8 dBm/3 kHz (33 dBm/MHz).[63] Cisco concurs with the Commission's assessment that doing so, which permits digitally modulated devices designed to comply with Section 15.247 to remain compliant with the new rules, will ease the transition of digitally modulated devices in the 5725-5850 MHz band to the new regulatory regime, without risk of increased interference.[64]

C. A MINIMUM 6-DB BANDWIDTH OF 500 KILOHERTZ SHOULD BE REQUIRED FOR ALL 5 GHZ U-NII BANDS.

In the *Notice*, the Commission recognized that although Section 15.407 does not currently mandate any minimum emission bandwidth, Section 15.247 requires a minimum 6-dB bandwidth of 500 kilohertz, and proposed to amend Section 15.407 to require that U-NII-3 emissions have a minimum 6-dB bandwidth of at least 500 kilohertz.[65] Cisco and all others addressing the issue agree.[66] Indeed, Cisco has urged the Commission to go further by subjecting all 5 GHz U-NII bands to the 500 kilohertz minimum 6-dB bandwidth requirement,

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[62] *See id*. at 1779 ¶ 31.

[63] *See* Cisco Comments at 44; WFA Comments at 12; Ericsson Comments at 5; IEEE 802 Comments at 17-18; Motorola Mobility Comments at 4-5; MSI Comments at 3; TIA Comments at 12 n.29.

[64] As Cisco notes in its comments, it concurs with the *Notice*'s analysis the proposed modification of Section 15.407 will only implicate devices with an emission bandwidth between 0.5 and 20 megahertz and thus with respect to the high-bandwidth devices typically used in U-NII applications, the proposed modification of Section 15.407 will not increase the potential for interference. *See* Cisco Comments at 44, *citing Notice*, 28 FCC Rcd at 1779 ¶ 31.

[65] *See Notice*, 28 FCC Rcd at 1780 ¶ 32.

[66] *See* Cisco Comments at 45; WFA Comments at 12-13; Ericsson Comments at 5; IEEE 802 Comments at 18; MSI Comments at 3.

and nothing submitted in the initial round suggests otherwise.[67] Given the Commission's objective of promoting the 5 GHz U-NII bands to meet the growing demand for high-speed Wi-Fi connectivity, mandating a minimum bandwidth will help ensure that the band does not become congested with narrow bandwidth applications for which other spectrum is available.

D. THE COMMISSION SHOULD MODIFY THE MEASUREMENT BANDWIDTH REQUIREMENT IN SECTIONS 15.407(A)(5) AS PROPOSED.

Cisco and all others addressing the issue endorse the *Notice*'s proposal[68] to modify the measurement bandwidth specified in Section 15.407(a)(5) of the Rules by eliminating the current 26-dB bandwidth requirement.[69] Those addressing the issue also support the *Notice*'s proposal to increase the measurement bandwidth for compliance with the revised Section 15.407 from the 3 kilohertz specified in Section 15.247(e) to 1 megahertz.[70] The record establishes that

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[67] *See* Cisco Comments at 45. To implement this proposal, Cisco suggested the Commission modify proposed Section 15.407(f) to read as follows "(f) Within the 5.15-5.25, 5.25-5.35, 5.47-5.725 and 5.725-5.85 GHz bands, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz." As U-NII devices are authorized to operate in the 5.35-5.47 and 5.85-5.925 GHz bands, Section 15.407(f) should be modified accordingly.

[68] *See Notice*, 28 FCC Rcd at 1780 ¶ 32.

[69] *See* Cisco Comments at 45-46; WFA Comments at 12-13; IEEE 802 Comments at 18; MSI Comments at 3. To avoid any ambiguity, Cisco urges the Commission to confirm that this modification will not impact the ability of manufacturers to demonstrate compliance with the U-NII rules under the provisions of American National Standards Institute, Inc. (ANSI) Accredited Standards Committee (ASC) C63, *American National Standard for Testing Unlicensed Wireless Devices*, ANSI C63.10-2009 (2010). *See* Cisco Comments at 46 n. n.114, *citing* Office of Engineering and Technology Clarifies Use of Recently Published ASC C63 Measurement Standards for Compliance Testing of Intentional and Unintentional Radiators under Part 15, *Public Notice*, 24 FCC Rcd 14134 (OET 2009) and OET, Equipment Authorization Measurement Procedures, http://transition.fcc.gov/oet/ea/-eameasurements.html (last visited July 23, 2013). Cisco noted that the Commission has solicited comment in a separate proceeding regarding incorporation of the C63.10-2009 measurement procedures into the Commission's Rules, and that issue is best resolved in that proceeding. *See* Cisco Comments at 46 n.114, *citing* Amendment of Parts 0, 1, 2, and 15 of the Commission's Rules regarding Authorization of Radiofrequency Equipment, *Notice of Proposed Rulemaking*, 28 FCC Rcd 1606, 1634 ¶ 68 (2013).

[70] *See Notice*, 28 FCC Rcd at 1779 ¶ 31.

increasing the measurement bandwidth to 1 megahertz will reduce the complexity of conducting measurement tests, decreasing the time it takes to complete those tests.[71] Thus, Cisco again urges that the Commission increase the measurement bandwidth to 1 megahertz, provided that the measurement is of a single antenna port.[72]

E. THE MORE RESTRICTIVE UNWANTED EMISSIONS LIMITS OF SECTION 15.407(B) SHOULD REMAIN IN PLACE.

Cisco and all of the other parties commenting on the issue also endorse the Commission's proposal[73] to retain the more restrictive emission limits of Section 15.407(b)(4) rather than the limits set forth in Section 15.247.[74] Thus, the Commission should require, as proposed in the *Notice*, that the EIRP of emissions within 10 megahertz of the band edge must be no greater than -17 dBm/MHz, and no greater than -27 dBm/MHz beyond 10 megahertz of the band edge, while all emissions below 1 GHz must comply with Section 15.209 general emission limits. As Cisco has noted, doing so will ensure that there is no increase in the potential for interference due to out-of-band emissions and, over time, will improve the RF environment as devices certified under Section 15.247 are replaced in the normal course with devices certified under the new regulatory regime.[75]

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[71] *See* Cisco Comments at 46, *citing Notice*, 28 FCC Rcd at 1779 ¶ 31; Motorola Mobility Comments at 4.

[72] As Cisco discusses in its comments, the issues raised by multiple antenna ports in MIMO antenna configurations are being discussed separately from this docket, and should be resolved via a future KDB. *See* Cisco Comments at 46.

[73] *See Notice*, 28 FCC Rcd at 1780 ¶ 34.

[74] *See* Cisco Comments at 47; IEEE 802 Comments at 19; Motorola Mobility Comments at 4; MSI Comments at 3; Ericsson Comments at 5; WFA Comments at 13.

[75] *See* Cisco Comments at 47.

F. THE PEAK-TO-AVERAGE RATIO LIMIT OF SECTION 15.407(A)(6) SHOULD BE RETAINED.

Those commenting on the issue were unanimous in support of the *Notice*'s proposal[76] to retain the requirement of Section 15.407(a)(6) of the Rules that the "ratio of the peak excursion of the modulation envelope . . . to the maximum conducted output power . . . shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth, whichever is less."[77] Retention of the peak-to-average restriction of Section 15.407(a)(6), for which there is no analog in Section 15.247, will help ensure that there is no increase in the potential for interference from unlicensed devices and will improve the RF environment over time as users replace Section 15.247 devices with devices certified under the new regulatory regime.

VI. THE RECORD SUPPORTS HARMONIZATION OF THE U-NII-1 RULES TO THE MAXIMUM EXTENT FEASIBLE.

The record developed in response to the *Notice* supports the Commission's proposal to harmonize its rules for the U-NII-1 band with those for the U-NII-2A or U-NII-3 bands to the greatest extent possible by increasing the U-NII-1 power and PSD limits, and by eliminating the restriction on outdoor U-NII-1 operations.[78]

Cisco and others have demonstrated that to realize the full benefits promised by IEEE 802.11ac, the Commission should at a minimum harmonize the U-NII-1 power and PSD rules with those of U-NII-2A and eliminate the restriction preventing outdoor use.[79] Others have

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[76] *See Notice*, 28 FCC Rcd at 1780 ¶ 35.

[77] *See* Cisco Comments at 48; WFA Comments at 13-14; IEEE 802 Comments at 19; MSI Comments at 4.

[78] *See Notice*, 28 FCC Rcd at 1781-82 ¶¶ 39-40.

[79] *See, e.g.*, Cisco Comments at 54-57; WFA Comments at 24-25; IEEE 802 Comments at 27-28; Motorola Mobility Comments at 4-6; Ericsson Comments at 5. As Cisco noted, because the U-NII-1 band does not include any radar systems, there is no reason to impose a radar detection/DFS requirement upon devices operating in the U-NII-1 band. *See* Cisco Comments at

taken the view that the U-NII-1 rules should be harmonized with the U-NII-3 rules[80] and, as Cisco notes in its comments, this approach has substantial benefits that warrant serious examination.[81] In either case, there is an overwhelming consensus that the restriction preventing outdoor use of the U-NII-1 band is a vestige of a 1990s judgment that a coverage-starved nation should bet on Mobile Satellite Service – a judgment that, in the hindsight of the success of terrestrial wireless and wired broadband in 2013, is flawed.[82]

Despite the overwhelming sentiment for harmonizing the U-NII-1 rules to permit higher power and outdoor use, some have sought to limit power levels or the use of the band for indoor operations. Globalstar, Inc. ("Globalstar"), the incumbent mobile satellite system ("MSS") whose feeder links operates in the U-NII-1 band, agrees that U-NIIs should be permitted to operate in the band with increased power aligned with U-NII-2A rules, but argues for retention of the rule requiring U-NII use of the band to be indoors.[83] As Cisco points out in its initial comments, "[t]he question before the Commission is simple – to what extent will the potential

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54 n.139. *See also* Comcast Comments at 26-27 (urging Commission to impose DFS requirements only where absolutely necessary to avoid service degradation); Cablevision Comments at 7 (urging limited imposition of DFS mandate and identifying costs, including impaired consumer experience, resulting from DFS); Time Warner Comments at 13.

[80] *See, e.g.*, MSI Comments at 4-5; Cablevision Comments at 5-6; Comcast Comments at 24-25; NCTA Comments at 13-17; Time Warner Comments at 9-12.

[81] *See* Cisco Comments at 54.

[82] *See* IEEE 802 Comments at 27-28; Ericsson Comments at 5; Motorola Mobility Comments at 5; Google/Microsoft Comments at 5-6; Comcast Comments at 25-26; Time Warner Comments at 9-11; Cablevision Comments at 6; CEA Comments at 11; WISPA Comments at 6. In addition, it was established that the "indoor only" restriction is blocking the ability of Wi-Fi Direct to be deployed in the band, because there is no way to assure that the portable devices that would employ Wi-Fi Direct are indoors. *See* IEEE 802 Comments at 28 and Appendix 2; WFA Comments at 25 and Appendix 2. *See also* Motorola Mobility Comments at 5-6.

[83] *See* Comments of Globalstar, Inc., ET Docket No. 13-49, at 4-6 (filed May 28, 2013).

benefits of IEEE 802.11ac in meeting the exploding demand for Wi-Fi connectivity be sacrificed for over-protection of Globalstar's MSS feeder links."[84]

Given the overwhelming support in the record for increasing the power levels for the U-NII-1 band to those allowed under the U-NII-2 rules, if not those allowed under the U-NII-3 rules, there is no reason for the Commission to give serious consideration to the overly-complex proposal by Fastback that would repeal the "indoor only" requirement for U-NII-1 devices, but only permit professionally installed fixed devices to operate with the higher-power otherwise permitted under the U-NII-3 rules.[85] All other devices would be restricted to operating at very low power limits similar to those of the current U-NII-1 band rules. While Cisco appreciates that this approach would meet Fastback's business needs, it would unnecessarily preclude efforts to meet the vast majority of the demand for expanded U-NII use of the 5 GHz band. Simply put, there is no reason in the record to limit the power levels of most U-NII-1 operations in the manner Fastback proposes.

VII. THE RECORD SUPPORTS CONTINUATION OF THE COMMISSION'S EFFORT TO ALLOW U-NII ACCESS TO 5850-5925 MHZ WHILE ASSURING PROTECTION TO INCUMBENT USERS.

In its initial comments, Cisco expresses its view that while opening the 5850-5925 MHz band for U-NII devices will play a critical role in meeting the escalating demand for Wi-Fi connectivity, it is imperative that the introduction of U-NII-4 devices not pose a threat of interference to incumbent Federal users protected under the Spectrum Act[86] or to Dedicated

[84] *See* Cisco Comments at 55.

[85] *See* Fastback Comments at 5-6 (proposing that devices not professionally installed be required to operate with a maximum EIRP to a prescribed limit of 200 mW or +23 dBm and a conducted output power limit of 50 mW at a peak power spectral density of 2.5 mW/MHz as per current U-NII-1 band rules, but with higher conducted output power allowed so long as the maximum EIRP of 200 mW is demonstrated).

[86] Spectrum Act § 6406(b)(1), 126 Stat. at 231, *codified at* 47 U.S.C. § 1453(b)(1).

Short Range Communications ("DSRC") anti-collision systems.[87] Cisco was hardly alone in that view – the vast majority of those commenting on the issue agree that while sharing of 5850-5925 MHz may be possible, more work is necessary to assure that incumbents are adequately protected from interference.[88]

The issues that have generated the most comment in response to the *Notice* revolve around the protection of DSRC. While a few DSRC stakeholders are suggesting, prematurely, that the Commission end its consideration of establishing the U-NII-4 band,[89] most recognize that sharing of the band offers significant potential interest benefits and that sharing scenarios should be thoroughly explored. Given the success that the unlicensed community has had to date in developing effective approaches to U-NII sharing with other incumbent services, it is far too soon for the Commission to give up on the idea that some or all of this much needed spectrum can be used by U-NII devices. Rather, consistent with Cisco's initial comments, the Commission should facilitate a continuation of the current dialog that is already taking place between U-NII and DSRC stakeholders with a view towards coming to consensus on how sharing can best be implemented in the band.[90]

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[87] *See* Cisco Comments at 57-65.

[88] *See, e.g.*, CEA Comments at 14-16; TIA Comments at 15-16; IEEE 8022 Comments at 30-31; Comments of the Toyota Motor Corp., ET Docket No. 13-49, at 1-2 (filed May 28, 2013) ("Toyota Comments"). *See generally,* Comments of Qualcomm Inc., ET Docket No. 13-49 (filed May 28, 2013) ("Qualcomm Comments").

[89] *See, e.g.*, Letter from John R. Njord, P.E, Executive Director, Utah Department of Transportation, to Julius Genachowski, Chairman, FCC, ET Docket No. 13-49, at 1-2 (dated Mar. 28, 2013, posted Apr. 16, 2013); Letter from Donald E. Hunt, Executive Director, State of Colorado Department of Transportation, to Marlene H. Dortch, Secretary, FCC, ET Docket No. 13-49, at 1-2 (dated May 16, 2013, posted May 20, 2013); Comments of the European Automobile Manufacturers' Ass'n, ET Docket No. 13-49, at 3 (dated May 24, 2013, posted May 28, 2013).

[90] *See* Cisco Comments at 65. Several commenting parties have noted that NTIA's own analysis of the interference risks associated with introducing U-NII into the band is not due until next

Those discussions can and should examine the possible approaches to sharing that are already being discussed, as well as look to develop innovative new ways in which U-NII and DSRC can co-exist in all or part of the band. For example, as Toyota Motor Corp. recognizes, all Wi-Fi devices incorporate a 20 MHz Clear Channel Assessment ("CCA") function to determine whether a channel is idle or busy, while DSRC devices employ a similar waveform for that function, but using a 10 MHz channel.[91] Discussions are taking place within IEEE 802 examining possible avenues by which CCA could become a part of the solution. For example, by half-clocking the CCA functions on IEEE 802.11ac devices which today perform CCA on multiple 20 MHz preambles, it may be possible to use the native functionality of IEEE 802.11 systems to create sharing capabilities without making any changes to DSRC (IEEE 802.11p) devices. While there are pluses and minuses to this approach, and it is premature for anyone to be identifying it as the best possible solution, the discussions around it illustrate that stakeholders are working together to identify sharing solutions.

Qualcomm, Inc. ("Qualcomm") advances a different sharing solution that seeks to designate a DSRC-only set of channels at the top end of the band that would not be shared, including moving the vehicle-to-vehicle safety channel from channel 172 to the unshared upper part of the band, while calling for further exploration of the potential for sharing for the remaining spectrum and encouraging DSRC adoption of the IEEE-802 CCA approach.[92] While

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year. *See, e.g.*, Comments of the Alliance of Automobile Manufacturers, Inc. and the Association of Global Automakers, Inc., ET Docket No. 13-49, at 7-8 (filed May 28, 2013); Qualcomm Comments at 7; Comments of Savari Networks, ET Docket No. 13-49, at 28 (filed May 28, 2013; Comments of SAE International, ET Docket No. 13-49, at 4 (filed May 28, 2013). However, there is no reason to delay ongoing evaluations and discussions pending completion of NTIA's work. *See* TIA Comments at 7. That said, NTIA should take all steps possible to expedite its consideration of sharing this band.

[91] *See* Toyota Comments at 8-9.

[92] *See generally* Qualcomm Comments.

Qualcomm's specific proposal presents its own challenges,[93] the concept of segregating the most critical DSRC channels into a sub-band while using CCA to facilitate sharing is worth further exploration by all stakeholders.

The comments submitted in response to the *Notice* evidence broad agreement with Cisco, that the Commission's existing 5 GHz rules for protecting radar through DFS (as such may be modified in this proceeding) are an appropriate starting point for protection of Federal radar systems operating in the 5850-5925 MHz band.[94] Given the effectiveness of the Commission's DFS requirement (particularly once the rule is fine-tuned as discussed in Section IV above) in preventing interference in the U-NII-2A and U-NII-2C bands, it is premature for the Commission to be considering the use of geo-location databases or other approaches that would radically depart from those used to protect radar against interference from U-NII-2A and U-NII-2B devices. There is nothing in the record to suggest that a geo-location database requirement (and its attendant additional cost and fundamental departure from the architecture of other U-NII devices) is required for U-NII-4.

Similarly, there is no basis for the Commission to summarily reject allowing U-NII devices to operate in the 5850-5925 MHz band to protect the Fixed Satellite Service ("FSS") from interference.[95] SES S.A. and Intelsat S.A (collectively "SES/Intelsat") have not provided any technical analysis suggesting, much less demonstrating, that allowing U-NII-4 operations in

[93] First, there is currently a second higher power public safety channel allocated in that band, raising concerns about how that modification might affect system operations. Secondly, the upper part of the band is adjacent to a band used by high-power satellite uplinks which are widely deployed in the U.S. and there are concerns that these uplinks could significantly impact the performance of the DSRC systems.

[94] *See* Cisco Comments at 59; WISPA Comments at 8; CEA Comments at 15-16.

[95] *See generally* Comments of SES S.A. and Intelstat S.A., ET Docket No. 13-49 (filed May 28, 2013) ("SES/Intelsat Comments").

the 5850-5925 MHz band, which already is allocated for sharing with DSRC, poses a threat of either co-channel interference to FSS use of the Extended C-Band or adjacent channel FSS use of the C-Band. Indeed, with respect to potential co-channel interference into the Extended C-Band, SES/Intelsat acknowledges, "FSS use of the 5.9 GHz spectrum for service to U.S. points is limited due to a restrictive footnote in the U.S. table of allocations,"[96] which confirms Cisco's view that the potential for co-channel interference should not pose a significant obstacle to the creation of U-NII-4. Nonetheless, Cisco agrees with SES/Intelsat that further studies should be conducted to evaluate the potential for harmful interference to FSS from the introduction of U-NII-4 devices into the 5850-5925 MHz band.

Nor is there any basis for denying U-NII access to the 5850-5925 MHz band to protect the secondary Amateur Radio Service allocation at 5650-5925 MHz.[97] While ARRL expresses concern about the potential for interference, it also recognizes that established mitigation techniques likely to be part of the U-NII-4 regulatory regime have resulted in "reasonably positive" sharing between its constituents and unlicensed operations in the U-NII-2C band.[98] As ARRL recognizes, the utility of the 5850-5925 MHz band for secondary amateur use has been "diminished" by virtue of the allocation to DSRC."[99] Given the similarities between U-NII and DSRC, and given that they will both be prevalent in the same geographic areas (where people live and work), the steps that secondary amateurs must take to circumvent DSRC interference should also substantially protect them from interference by U-NII-4 devices.

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[96] *Id.* at 4, *citing* 47 C.F.R. § 2.106 (extended C-band FSS "is limited to international inter-continental systems and is subject to case-by-case electromagnetic compatibility analysis").

[97] *See* Comments of ARRL, the National Association for Amateur Radio, ET Docket No. 13-49, at 11-14 (filed May 28, 2013).

[98] *Id*. at 13.

[99] *Id*.

VIII. FURTHER STUDY IS NECESSARY TO EVALUATE THE APPROPRIATE MEANS TO PROTECT INCUMBENT SYSTEMS IN THE U-NII-2B BAND FROM INTERFERENCE.

Cisco demonstrates in its initial comments that introducing U-NII devices in the 5350-5470 MHz band will require new approaches to U-NII sharing, as incumbent use of the band is unlike that in other U-NII spectrum.[100] Thus, Cisco agrees with NTIA that "further analysis will be required" before the Commission allows greater unlicensed use in the U-NII-2B band.[101] NTIA has performed its initial analysis which is now under review by industry. Cisco notes that NTIA's analysis does not yet contain any study of potential mitigation techniques.

To the extent that broadcasters express concern about potential interference to their weather radar systems, Cisco believes that further analysis will show that the same mitigation techniques used to protect TDWR in other portions of the 5 GHz band are likely to be effective, particularly with the modifications discussed above.[102] At present, there is no reason to believe, as the National Association of Broadcasters and Baron Services, Inc. suggest, that additional burdens like geo-location/database and enhanced software security requirements should be imposed on U-NII to protect broadcast radar systems when such restrictions are not necessary to protect Federal TDWR.[103] As Cisco has suggested, NTIA and the Commission should facilitate

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[100] *See* Cisco Comments at 65-69.

[101] *NTIA 5 GHz Report* at ii. *See also Notice*, 28 FCC Rcd at 1800 ¶ 103.

[102] Certainly, it is incorrect to suggest that the current mitigation techniques have been ineffective. *See* Comments of Hubbard Broadcasting, Inc., ET Docket No. 13-49, at 11-12 (filed May 28, 2013). As discussed above and in Cisco's initial comments, interference to TDWR has largely been the result of illegal device modifications, and can be substantially mitigated by adoption of the steps outlined in the *Notice*. *See* Cisco Comments at 26-27.

[103] *See* Comments of Baron Services, Inc., ET Docket No. 13-49, at 15-17 (filed May 28, 2013); *see also* NAB Comments at 4-7. As Cisco stressed in its initial comments, "[b]efore use of a geo-location database in the U-NII-2B band is seriously considered, there is much work to be done given the differences between the 5350-5470 MHz sharing scenario and that presented by the TV white spaces geo-location approach." Cisco Comments at 67-68.

an open and forthright discussion among stakeholders of the costs and benefits of mitigation approaches, followed by appropriate further analysis and testing is the best way to assure that all stakeholders have input into the decision-making process. That process will provide a vehicle for the U-NII community and broadcasters to further explore the best approach to affording broadcaster weather radar reasonable protection from U-NII interference.

IX. THE COMMISSION SHOULD EXPEDITE ITS CONSIDERATION OF THE ISSUES RAISED IN THE NOTICE SO THE U.S. CAN PROVIDE LEADERSHIP AT WRC-15.

Cisco must take issue with the suggestion by the European Space Agency that the Commission not take action in this proceeding until after WRC-15.[104] TIA correctly observes that "the best way for the Commission to further the U.S. position at WRC-15 is to move this proceeding forward expeditiously; developing domestic approaches to sharing that can be shared at WRC-15 in furtherance of America's global leadership with respect to the 5 GHz band."[105] In the unlikely event that actions taken by the Commission between now and the conclusion of WRC-15 must be revisited, the Commission can do so at that time.

X. CONCLUSION.

Once again, Cisco applauds the Commission for its acknowledgement of the critical importance of identifying additional spectrum to support the introduction of IEEE 802.11ac and for its decision to undertake a holistic look at the current 5 GHz U-NII band regulatory regime. The comments submitted in response to the *Notice* confirm that the best approach to resolving the wide range of issues in this proceeding in a timely manner is for the Commission to group issues based on the Commission's ability to resolve them promptly. This will allow the

[104] *See* Comments of the European Space Agency, ET Docket No. 13-49, at 2 (filed Apr. 19, 2013).

[105] TIA Comments at 7. *See also* Ericsson Comments at 3; NCTA Comments at 13.

Commission to promote U-NII use of the 5 GHz band by issuing its initial report and order in this proceeding, perhaps as early as later this year, on those issues that have been the subject of substantial work by the public and private sectors over the past several years or otherwise can be resolved quickly. At the same time, the Commission should promote ongoing efforts by government and industry stakeholders to reach consensus on the more difficult interference-protection issues posed by the *Notice*. The record confirms that taking a modular approach along these lines will provide timely benefits to the American public as various aspects of this proceeding become ripe for resolution.

Respectfully submitted,

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