Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

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

REPLY COMMENTS OF BARON SERVICES, INC.

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REPLY COMMENTS OF BARON SERVICES, INC.

Baron Services, Inc. ("Baron") submits these reply comments in response to the Notice of Proposed Rulemaking ("NPRM") released February 20, 2013 in the above-captioned proceeding and the comments filed in response to the NPRM.[1] In its initial comments, Baron detailed the critical public safety services provided by broadcast weather radar systems, and explained how weather radars are extremely susceptible to interference from communication-type transmissions. Baron therefore strongly urged the Commission to ensure that Unlicensed National Information Infrastructure ("U-NII") operations in the 5 GHz band fully protect broadcast weather radar systems from harmful interference. Baron has a significant interest in this proceeding because it designs and develops C-band weather radar systems for the broadcast industry that are authorized to operate within the 5.35-5.47 GHz ("U-NII-2B") and 5.6-5.65 GHz ("U-NII-2C") bands[2] and that would, absent adequate interference protections, suffer severe and irreparable interference, thereby endangering the public safety.[3]

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[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). All comments cited herein are those filed on May 28, 2013 in ET Docket No. 13-49 in response to the NPRM.

[2] *See* Equipment Authorization Identification Nos. NX5XDD-350C, NX5XDD-250C, NX5DSSR-250C, NX5KHDD-1000C, and NX5XDD-1000C.

[3] *See* Comments of Advanced Designs Corporation ("ADC") at 2 ("ADC is deeply concerned about interference to DOPRAD radars from the proposed unlicensed use. The apprehension arises from the history of interference into TDWR radars at 5.6-5.65 GHz from unlicensed users, at least some of which arose from compliant equipment.") (internal citation omitted).

I. INTRODUCTION AND SUMMARY

Baron again strongly urges the Commission to continue to prohibit U-NII operations in the 5.35-5.47 GHz band. Based on the demonstrated potential for U-NII devices, including those in compliance with the Commission's current rules, to cause harmful interference to weather radar systems, as well as the substantial risks identified by the National Telecommunications and Information Administration ("NTIA") regarding the Commission's proposal to permit U-NII operations to expand into the 5.35-5.47 GHz band, retaining this prohibition is the only way to ensure adequate interference protection for broadcast weather radar systems.

If, however, the Commission permits U-NII operations to expand into the 5.35-5.47 GHz band despite this likelihood of harmful interference and the "significant technical challenges surrounding the potential introduction of U-NII devices" into this band,[4] the Commission must implement every reasonable interference protection mechanism in order to mitigate, to the maximum extent possible, the likelihood of interference to broadcast weather radars. For instance, not only should the Commission require that U-NII devices incorporate dynamic frequency selection ("DFS") capabilities, it should require that devices sense for radar signals exceeding their occupied bandwidth. Clearly, the current rule, which requires sensing across only 80 percent of a device's occupied bandwidth, is wholly insufficient because it fails to even prevent co-channel operations with weather radars. Moreover, the NTIA's investigations regarding interference to Terminal Doppler Weather Radar ("TDWR") systems demonstrated that U-NII devices also can cause harmful interference to adjacent-channel weather radars.

In addition, because spectrum sensing, by itself, cannot ensure adequate interference protection for weather radars, Baron strongly urges the Commission to also implement a geo-location/database approach. Further, Baron supports the Commission's proposal to require

[4] Dep't 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*, p. 6-2 (Jan. 2013) ("NTIA 5 GHz Report").

manufacturers to include security features in U-NII devices that prevent third parties from reprogramming the devices to operate outside of their certified parameters. For instance, these security features would prevent end users from modifying a device to operate in unauthorized spectrum bands or without DFS spectrum sensing. If users nevertheless attempt to modify a U-NII device, the device should be rendered inoperable. Baron also continues to support a requirement that U-NII devices transmit identifying information so that the Commission and incumbent licensees have the ability to locate, and thus address, any sources of interference.

Finally, Baron again stresses the need for the Commission to proceed with extreme caution as it considers permitting U-NII operations in the 5.35-5.47 GHz band. At a minimum, the Commission must delay any action in this proceeding pending the completion of further tests and studies by the NTIA, the release of the NTIA's final recommendations regarding the feasibility of allowing U-NII operations in the 5.35-5.47 GHz band, and a public comment period regarding the NTIA's recommendations. Given the stakes involved in terms of life and property, the Commission should not allow new unlicensed uses of this spectrum without actual proof – in the form of detailed engineering studies and field tests – that such uses will not cause harmful interference to broadcast weather radar systems. In fact, the Spectrum Act prohibits the Commission from expanding U-NII operations into the 5.35-5.47 GHz band absent such proof.

II. BROADCAST WEATHER RADARS PROVIDE CRITICAL PUBLIC SAFETY SERVICES, SO MUST BE FULLY PROTECTED FROM INTERFERENCE

Commenters agree that broadcast weather radar systems provide a crucial public safety service, protecting viewers' lives and property.[5] For instance, the NAB stressed that "[w]eather radar systems play a central role in a broadcaster's public service mission and provide critical,

[5] *See* Comments of Baron at 6-7; NPRM, 28 FCC Rcd at 1796 (noting that weather radars permit broadcasters to "inform[] the public on a range of local and regional weather warnings," including "supercell storms capable of developing tornados and severe weather.").

timely and potentially life-saving data on severe weather."[6] Similarly, Hubbard Broadcasting noted how its "weather radar systems provide live and immediate sources of information about tornadoes, thunderstorms, hurricanes and severe snow events."[7] As a result, "[g]enerations of viewers have come to rely on local television weather reports for emergency information."[8] Given the critical public safety services provided by broadcast weather radars, proponents of expanded U-NII operations must unequivocally demonstrate that solutions exist to fully protect weather radars from harmful interference,[9] and, if so, the Commission must adopt rules that ensure interference protection for weather radars.[10]

As Baron detailed in its initial comments, permitting unlicensed operations in the 5.35-5.47 GHz band, even if possible, will be extremely difficult and require stringent U-NII technical and service rules.[11] This is because the same technical characteristics that permit weather radars to accurately forecast severe weather events "make[] them very vulnerable to interference."[12] As summarized by the NTIA, "[l]ow interference thresholds for communication-type signals, insidious behavior of target losses, and potential loss of targets at any range all combine to make

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[6] Comments of the National Association of Broadcasters ("NAB") at 8.

[7] Comments of Hubbard Broadcasting, Inc. at 8.

[8] *Id.* at 10; *see id.* at 8-9 ("Stations often are on-air with tornado warnings when conditions are threatening, but before tornadoes touch down. This advance news coverage is made possible by weather radars, and it saves lives.").

[9] *See* Comments of Savari Networks at ii ("The proposal to share spectrum allocated for safety of life services with unlicensed devices must face a high burden…").

[10] *See* Comments of Cambium Networks Ltd. at 1 ("TDWR installations must be protected from interference, and we consider that manufacturers, regulators, distributers, installers and operators all share a responsibility to ensure that unlicensed wireless devices do not cause interference to TDWRs.").

[11] *See* Comments of Cisco Systems, Inc. at 65 ("[O]pening the 5350-5470 MHz band to U-NII devices will not be easy…"); NTIA 5 GHz Report at 6-2 (noting the "<u>significant technical challenges</u> surrounding the potential introduction of U-NII devices in these bands") (emphasis added); *id.* at ii ("[T]his report identifies a number of risk elements due to the <u>likelihood of harmful interference</u> from large numbers of U-NII devices to protected federal systems in the 5350-5470 MHz and 5850-5925 MHz bands.") (emphasis added).

[12] Dep't of Commerce, *Effects of RF Interference on Radar Receivers*, NTIA Technical Report TR-06-444, p. 82 (Sept. 2006) ("NTIA 2006 Report"); *see id.* at xx ("[R]adar receivers are not generally robust against low-level interference from non-radar (communication-type) radio signals."); Comments of Hubbard at 8 ("[T]he signals reflected from the atmosphere are weak, so weather radars have to be very sensitive to receive and interpret them.").

low-level interference to radar receivers a *very serious problem*."[13] It therefore should come as no surprise that "U-NII devices have a history of causing harmful adjacent channel and co-channel interference to incumbent services in the 5 GHz band."[14] Nor that, although the "interference problem to TDWR was first discovered in early 2009," a resolution to that problem "remains pending some four years later."[15]

In fact, since the initial round of comments in this proceeding, a customer informed Baron of harmful interference being caused to its weather radar. This interference, which is ongoing, is displayed in the attached screen shot. Its appearance is strikingly similar to a severe weather event, and its effect is to prevent the radar from detecting desired targets within an expanding radial that extends to the edge of the radar's service contour. Notably, this radar is licensed to a television station located in Oklahoma City, Oklahoma, which is less than 10 miles from Moore, Oklahoma, where a devastating tornado touched down only two months ago.

For these reasons, Baron joins broadcasters and weather radar manufacturers in strongly urging the Commission to continue to prohibit U-NII operations in the 5.35-5.47 GHz band.[16] Baron continues to believe that the only way to ensure adequate interference protection for broadcast weather radar systems is for the Commission to prohibit U-NII operations in this band and, as detailed below, adopt new regulations that sufficiently protect radars from U-NII devices' harmful out-of-band emissions. Not only is this approach necessary to allow broadcasters to

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[13] NTIA 2006 Report at 1 (emphasis added).

[14] Comments of NAB at 2; *see* Comments of Hubbard at 10 ("The NTIA has made it abundantly clear that U-NII device operations are an interference threat to licensed users in the 5 GHz band, including weather radar systems.").

[15] Comments of Savari Networks at 33 (internal citation omitted); *see* NTIA 5 GHz Report at 3-5 (noting that "instances of interference to TDWRs continue").

[16] *See* Comments of ADC at 4 ("The Commission can best protect DOPRAD radars by declining to authorize unlicensed operation at 5.35-5.47 GHz."); Comments of Hubbard at 2-3 ("HBI urges the FCC to abandon its consideration of expanded U-NII device operations in the 5.35-5.47 GHz band…").

continue to provide unimpaired coverage of severe weather events,[17] it would be consistent with Commission precedent regarding weather radars.[18]

Given the critical public safety services provided by broadcast weather radar systems, if the Commission permits U-NII operations in the 5.35-5.47 GHz band despite the great potential for interference, Baron joins the NAB in emphasizing that "the Commission must take every reasonable step necessary to ensure these important weather radar systems are fully protected from interference."[19] Specifically, as detailed below, the Commission should strengthen its current DFS requirements in order to prevent both co- and adjacent-channel interference; adopt a geo-location/database approach; and require manufacturers to implement security measures to prevent end users from modifying U-NII devices' operating parameters. The combination of these interference mitigation techniques is necessary because, as NAB stressed, "it is imperative that if unlicensed devices are approved for operation in the U-NII-2B band, they cannot interfere with incumbent radar systems in any circumstance."[20]

III. THE COMMISSION SHOULD ADOPT ENHANCED DFS REQUIREMENTS TO MITIGATE THE LIKELIHOOD OF INTERFERENCE TO WEATHER RADARS

As noted, if the Commission permits U-NII operations in the 5.35-5.47 GHz band, it should require that devices incorporate DFS capabilities because, as the Commission previously concluded, "DFS is a key element in enabling unlicensed U-NII devices to share spectrum with

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[17] *See* Comments of Hubbard at 2 ("U-NII device operations in the 5.35-5.47 GHz band clearly would threaten the integrity of television weather radar stations, and jeopardize their health, safety and news-gathering value."); Comments of ADC at 3 ("Because of the high public interest in DOPRAD operation, we ask the Commission to rethink its proposal to allow unlicensed operation at 5.35-5.47 GHz.").

[18] *See Revision of Parts 2 and 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) devices in the 5 GHz band*, Report and Order, 18 FCC Rcd 24484, 24487, n. 17 (2003) ("*5 GHz U-NII R&O*") ("The 5.350-5.460 GHz band is used for aeronautical radionavigiation. Because it is used for a critical safety communication service, it is a restricted band under Part 15, *i.e.* unlicensed devices are not allowed to transmit in this band."); NTIA 2006 Report at 1 ("The technical characteristics of radars … have usually resulted in exclusive, or at least primary, spectrum allocations for their operations.").

[19] Comments of NAB at 2; *see* Comments of Hubbard at 10 ("Interference to television stations' local weather radar operations would strike a blow against their ability to serve viewers' needs" and "could threaten viewers' health, safety, and property.").

[20] Comments of NAB at 8.

… radar operations."[21] In recognition of this fact, most commenters that addressed this issue support a DFS requirement for U-NII devices capable of operating in the 5.35-5.47 GHz band.[22]

The Commission must, however, do more than simply apply its current DFS requirements. The ongoing instances of harmful interference clearly demonstrate that the existing requirements fail to adequately protect weather radars. For instance, the current DFS mechanism, which is designed only to avoid co-channel interference, is insufficient even in that respect because a U-NII device is only required to "sense for radar across 80 percent of its occupied bandwidth."[23] As a result, compliance with the current DFS requirements can "result in simultaneous and overlapping transmissions from the U-NII device and the [weather radar], which would increase the potential for harmful interference."[24]

Baron therefore joins other commenters[25] in strongly urging the Commission to adopt its proposal to "implement a rule requiring that U-NII devices sense for radar signals at or exceeding 100 percent of its occupied bandwidth…"[26] Specifically, the Commission should require U-NII devices to sense for weather radars in channels adjacent to their occupied bandwidth.[27] Otherwise, given the demonstrated potential for U-NII devices to interfere with spectrally-adjacent weather radars, the DFS mechanism would be insufficient to prevent harmful

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[21] *5 GHz U-NII R&O*, 18 FCC Rcd at 24497.

[22] *See*, *e.g.*, Comments of NAB at 5 ("As existing U-NII devices already are required to employ radar avoidance spectrum sensing technology, it is uncontroversial that new U-NII devices operating in the U-NII-2B band should also employ a DFS mechanism."); Comments of the Wireless Internet Service Providers Association ("WISPA") at 7 ("[T]he Commission should require unlicensed U-NII-2B devices to employ DFS technology."); Comments of Motorola Solutions, Inc. at 9 ("[T]he U-NII-2B band should be subject to a DFS obligation…"); Comments of Fastback Networks at 8.

[23] NPRM, 28 FCC Rcd at 1789.

[24] *Id.*

[25] *See*, *e.g.*, Comments of Shared Spectrum Company at 5; Comments of NAB at 5.

[26] NPRM, 28 FCC Rcd at 1790; *see id.* ("[E]xpanding the sensing bandwidth will prevent co-channel operations between the U-NII devices and radar receivers and thus will reduce the potential for harmful interference.").

[27] *See* Comments of NAB at 5 ("[A] U-NII device should sense for radar not only on 100 percent of its occupied bandwidth but also on frequencies immediately adjacent to its occupied bandwidth.").

interference with an "extremely high degree of reliability" – a threshold the Commission has previously found necessary.[28] On the other hand, expanding U-NII devices' sensing range would ensure that their unwanted emissions are "placed far enough away in frequency from the [radar's] fundamental frequency to preclude harmful interference."[29] Baron continues to believe that requiring 30 megahertz separation will be sufficient for U-NII devices employing a 20 megahertz bandwidth, but that greater frequency separations will be required for U-NII devices with wider bandwidths.[30]

The few commenters who oppose expanding the spectrum sensing range of U-NII devices incorrectly claim that no factual basis exists for the Commission to require sensing for adjacent-channel radars. These commenters base this argument primarily on the fact that the Commission's enforcement actions have not involved interference to weather radars from adjacent-channel U-NII operations.[31] But the fact that a limited number of enforcement actions did not involve adjacent-channel interference is irrelevant. For instance, the NTIA has noted that, "[e]ven when radars experience serious performance degradation due to low-level interference, it is very unlikely that such interference will be identifiable" or "result in reports to spectrum management authorities even when it causes loss of desired targets."[32] Consequently, the "lack of such reports *cannot* be taken to mean that such interference does not occur."[33]

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[28] *See Unlicensed Operation in the TV Broadcast Bands*, Second Report and Order and Memorandum Opinion and Order, 23 FCC Rcd 16807, 16811 (2008) ("*White Spaces Order*") ("[W]hether to certify the device will be based on a demonstrated ability to avoid causing harmful interference with an extremely high degree of reliability.").

[29] NPRM, 28 FCC Rcd at 1789.

[30] *See* Comments of Baron at 11; NPRM, 28 FCC Rcd at 1789, n. 81 ("Requiring 30 megahertz separation … is specific to a U-NII device employing a 20 megahertz bandwidth. For devices with wider bandwidths, the frequency separation will have to be greater than 30 megahertz…").

[31] *See* Comments of IEEE 802 at 21; Comments of Cisco at 38; Comments of Wi-Fi Alliance at 23.

[32] NTIA 2006 Report at 137.

[33] *Id.* (emphasis in original).

These commenters' claim also directly contradicts the results of NTIA investigations and testing. For instance, as part of its TDWR investigation, the NTIA discovered a U-NII device which "still caused interference" even though its "DFS functionality performed properly, causing the device to move to an adjacent channel."[34] Moreover, the likelihood of adjacent-channel interference will become far more likely if the Commission permits expanded U-NII operations in the 5 GHz band. As the NTIA found, "[g]iven the anticipated increase in U-NII device density, adjacent channel interference to radar systems must be taken into account."[35]

Comcast and Cablevision also claim that any DFS requirement would unnecessarily increase the cost and complexity of devices,[36] while Cisco and IEEE 802 focus their opposition on the Commission's proposal that U-NII devices be required to sense for radar signals at or exceeding 100% of their occupied bandwidth. Cisco contends that such a requirement would require a "fundamental change" to U-NII devices,[37] while IEEE 802 described the proposed requirement as "burdensome."[38] However, Fastback Networks explained that a DFS requirement would not "add[] any cost for manufacturers or users of these bands…"[39] Moreover, regarding the proposal to expand U-NII devices' required sensing range, Shared Spectrum Company noted

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[34] NTIA 5 GHz Report at 3-4; *see id*. at 4-10 ("Based on the TDWR interference investigation NTIA determined that some devices were not moving far enough away in frequency and their out-of-channel emissions were causing interference to TDWR."); Memorandum from Julius Knapp, Chief, OET, FCC, and P. Michele Ellison, EB, FCC, to Manufacturers and Operators of Unlicensed 5 GHz Outdoor Network Equipment Re: Elimination of Interference to Terminal Doppler Weather Radar, p. 1 (July 27, 2010) ("*Knapp Memo*") ("[T]here are some instances where the interference is caused by adjacent band emissions."). These numerous mentions of adjacent-channel interference clearly demonstrate that, in particular, Cisco's claims are wholly without merit. *See* Comments of Cisco at 38 ("NTIA has not cited to a single instance in which OOBE, as opposed to co-channel emissions, has been responsible for interference to a TDWR.").

[35] NTIA 5 GHz Report at 4-10; *see* CSMAC Unlicensed Subcommittee, *Draft Recommendations on Enforcement*, Submitted for Adoption: CSMAC Meeting, p. 3 (July 24, 2012) ("*CSMAC Recommendations*") ("[G]iven the widespread – and growing – consumer adoption of these wireless systems, the problem of interference and performance degradation will only worsen.").

[36] *See* Comments of Cablevision Systems Corporation at 7; Comments of Comcast Corporation at 26.

[37] *See* Comments of Cisco at 38.

[38] *See* Comments of IEEE 802 at 22.

[39] Comments of Fastback Networks at 8.

that it "offers technology today that could achieve such capability," and that the cost for this technology "is in line with similar technologies which are in the marketplace today…"[40] Further, even if a DFS requirement would marginally increase the cost of a U-NII device, that added cost would be dwarfed by the value of free access to additional spectrum bands.[41]

Baron also urges the Commission to amend its DFS rules to require that U-NII devices are capable of detecting the sub-microsecond pulsewidths used by some weather radars.[42] This revision is necessary because, as the Commission noted, a "narrower radar pulsewidth used in conjunction with the higher data rates associated with the 802.11ac standard could affect a device's ability to detect pulsed radar signals."[43] If the necessary technology for detecting sub-microsecond pulsewidths currently does not exist, that fact would further support Baron's argument below that other interference mitigation techniques – in particular, a geo-location/ database approach – are needed to ensure adequate protection for weather radars.

With regard to the required DFS sensing threshold, Baron generally supports the Commission's proposal "that devices must operate with both an EIRP of less than 200 mW (23 dBm), and an EIRP spectral density of less than 10 dBm/MHz (10 mW/MHz), in order to use the relaxed sensing detection threshold of -62 dBm."[44] All other U-NII devices would be required to use the -64 dBm sensing threshold.[45] As the Commission noted, this approach will help "to ensure that interference potential does not increase with the use of the relaxed threshold…"[46]

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[40] Comments of Shared Spectrum Company at 6.

[41] *See CSMAC Recommendations* at 6 ("While prophylactic technology solutions can increase the cost of devices at the margin, unlicensed devices and users typically benefit from zero or low costs for spectrum access…").

[42] *See* NPRM, 28 FCC Rcd at 1799; Comments of Cisco at 59 ("[S]ome radar systems … employ a shorter pulse width than was considered in developing the existing U-NII DFS 1 microsecond specification.").

[43] NPRM, 28 FCC Rcd at 1799.

[44] *Id.* at 1791.

[45] *See id.*

[46] *Id.*

However, if the Commission does not also implement a geo-location database approach, as detailed below, Baron believes a sensing threshold of -87 dBm is needed because U-NII devices complying only with the stringent thresholds discussed above likely would not detect a radar signal if the radar is facing away from the device at the time.[47] Weather radars typically take 4-5 minutes to complete a Volumetric Scan, while the Commission proposes to retain its current requirement that a U-NII device may begin transmitting if a 60-second channel availability check does not indicate the presence of a radar signal. Consequently, it is more likely than not that a U-NII device's entire channel availability check would take place without the radar ever directly facing towards the device. Because the less stringent sensing thresholds would not be sufficient to detect radar signals when the radar is facing away from the U-NII device, the use of these sensing thresholds would permit a U-NII device to begin transmitting on spectrum occupied by a weather radar system, and thereby interfere with the radar.[48]

With respect to U-NII device certification testing, Baron generally agrees with the modified measurement procedures set forth in Appendix B to the NPRM as a method to enhance protection for TDWR.[49] However, Baron believes that additional certification tests are needed to ensure that U-NII devices adequately protect broadcast weather radar systems. Baron designed these additional tests, which are detailed in the Attachment hereto, to account for the fact that broadcast weather radars use different waveforms than TDWRs. Finally, Baron agrees with

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[47] Baron notes that manufacturers could improve a U-NII device's sensitivity from -67 dBm to -87 dBm simply by adding a 160 MHz receive filter. Such a filter could be added through software alone, so would not increase production costs, and its size (160 MHz) would permit a U-NII device to utilize the widest bandwidth permitted by the new IEEE 802.11ac Wi-Fi standard.

[48] Another approach the Commission should take that would help to address this situation is to require 10 minutes of continuous monitoring by a U-NII device prior to transmitting on, or within 30 MHz of, spectrum on which the device had detected a radar signal. *See* International Telecommunication Union, *Dynamic frequency selection in wireless access systems including radio local area networks for the purposes of protecting the radiodetermination service in the 5 GHz band*, Recommendation ITU-R M.1652-1, p. 4, Annex 1 (May 2011).

[49] *See* NPRM, 28 FCC Rcd at 1810-12, Appendix B.

Cisco that "[a]nyone seeking an exemption from the DFS or other rules designed to protect radar systems should bear a heavy burden to establish that interference will not result."[50]

IV. THE COMMISSION SHOULD IMPLEMENT A GEO-LOCATION/DATABASE APPROACH BECAUSE SPECTRUM SENSING ALONE WOULD NOT ADEQUATELY PROTECT WEATHER RADARS

Baron joins other commenters and again stresses that, in addition to spectrum sensing requirements, a geo-location/database approach will be critical if the Commission permits U-NII operations in the 5.35-5.47 GHz band.[51] Even with improvements to the current DFS mechanism, spectrum sensing, by itself, cannot ensure adequate interference protection for weather radar systems.[52] In recognition of this fact, last year the NTIA's Commercial Spectrum Management Advisory Committee ("CSMAC") recommended that the NTIA, in coordination with the Commission, only permit "connected devices" to operate in any new unlicensed bands. Such devices would be required to periodically connect to a database in order to "[r]enew the authorization to operate in the band," "[o]btain a firmware update, to be remotely disabled in a particular frequency," and/or "[r]eceive direction to move to another frequency band when necessary."[53] In making this recommendation, CSMAC observed that "database-enabled devices allow for much more robust and real-time spectrum sharing…"[54]

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[50] Comments of Cisco at 37, n. 93.

[51] *See*, *e.g.*, Comments of NAB at 6 ("Given the critical nature of incumbent radar systems in the 5 GHz band, we believe the Commission should implement, in addition to enhanced spectrum sensing requirements, a geo-location/database solution…"); Comments of Motorola Mobility LLC at 7 ("One promising approach … would be a geo-location/database solution…"); Comments of ADC at 3-4.

[52] *See* Comments of NAB at 6 ("As evidenced by the numerous interference problems that plagued TDWR systems, spectrum sensing alone – even if it performs as designed – does not always prevent harmful interference…"); *White Spaces Order*, 23 FCC Rcd at 16836 ("[S]pectrum sensing with capabilities as presented in the record of this proceeding would not, by itself, be sufficient to adequately protect from interference…").

[53] *CSMAC Recommendations* at 1; *see* NPRM, 28 FCC Rcd at 1787 ("CSMAC, for example, recommends implementing a Dynamic Database approach to device authorization."). Although Cisco claims that CSMAC failed to adopt this recommendation of its Unlicensed Subcommittee, *see* Comments of Cisco at 39, n. 97, a motion made during CSMAC's July 24, 2012 meeting to adopt all of the Subcommittee's recommendations passed unanimously.

[54] *CSMAC Recommendations* at 7.

A few commenters oppose a geo-location/database sharing solution, claiming that this approach is unnecessary because DFS alone would effectively protect licensed incumbents from harmful interference. In support of this claim, they allege that "there has been no case to date where functioning DFS has not detected radar."[55] They are mistaken. For instance, during its TDWR investigation, the NTIA determined that one of the interference sources was a U-NII device that "complied with FCC DFS certification requirements but failed to detect TDWR."[56]

Baron also previously detailed the results of NTIA laboratory testing which demonstrate that DFS capabilities are, at best, unreliable. Specifically, the DFS-equipped U-NII devices tested by the NTIA failed to detect weather radar signals in a variety of scenarios despite the fact that, based on their FCC certifications, these devices should have detected the radar signals under the conditions being tested.[57] Further, as the Commission observed in finding that spectrum sensing alone would be insufficient to protect broadcasters from unlicensed TV white spaces operations, "the facts that personal/portable devices have antennas that are less efficient for sensing and may be in a less advantageous position for sensing incumbent signals … increases the difficulty of reliably detecting incumbent transmissions."[58]

Baron therefore continues to believe that a geo-location/database approach would best ensure that U-NII devices consistently operate outside of weather radars' interference zones.[59]

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[55] Comments of IEEE 802 at 10; *see* Comments of Motorola Solutions, Inc. at 6 ("[T]here is no evidence that DFS, where used correctly, has been ineffective at protecting incumbent users from harmful interference."); Comments of Wi-Fi Alliance at 21 ("[T]here is no record of legally operating Wi-Fi devices causing interference…").

[56] NTIA 5 GHz Report at 3-4; *see Knapp Memo* at 1-2 ("[E]quipment that met the FCC's certification standards nonetheless caused interference, due to a variety of factors such as … the device's failure to detect and avoid the radar signal."); NPRM, 28 FCC Rcd at 1782 ("In some cases, equipment that met the Commission's certification standards nonetheless caused interference…").

[57] *See* Comments of Baron at 12-13 (quoting from and citing to Dep't of Commerce, *Case Study: Investigation of Interference into 5 GHz Weather Radars from Unlicensed National Information Infrastructure Devices, Part I*, NTIA Technical Report TR-11-473, pp. 19-20 (Nov. 2010)).

[58] *White Spaces Order*, 23 FCC Rcd at 16836.

[59] *See id.* ("[T]he geolocation/database approach appears best able to reliably identify unoccupied TV channels.").

Notably, even though IEEE 802 generally opposes geo-location/database requirements, it withheld judgment on whether this approach could be a useful sharing mechanism for the U-NII-2B band, noting "that the sharing issues associated with the 5350-5470 MHz band are difficult ones, the details of which NTIA is only now bringing to light."[60] Moreover, even those commenters who generally oppose a geo-location/database approach acknowledged that such a requirement could be appropriate in a spectrum band, like the U-NII-2B band, that is made available for sharing by unlicensed devices for the first time.[61] In addition, because weather radar "locations are known and somewhat limited in number, implementation of geo-location and database registration might be very straightforward and easy to accomplish."[62]

Baron again stresses that a geo-location/database approach would only truly be effective if the Commission requires that U-NII devices include a built-in geo-location capability rather than simply requiring that U-NII transmitters be professionally installed.[63] Absent a built-in geo-location feature, the Commission and weather radar licensees could not adequately determine the location of a mobile U-NII device in order to address interference issues, and a professional installation requirement would not prevent the operator of a fixed U-NII transmitter from subsequently changing locations.

Cambium Networks argues against a built-in geo-location requirement, claiming that "not all wireless terminals include GPS receivers."[64] Motorola Mobility, however, noted that "[m]any

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[60] Comments of IEEE 802 at 20, n. 35.

[61] *See* Comments of Cisco at 40 (contrasting 5 GHz U-NII operations to "the greenfield TV white space situation where the entire service has been predicated from the beginning on location awareness in devices…"); Comments of IEEE 802 at 21 ("This is a far different proposition than when a device ecosystem is new…").

[62] NPRM, 28 FCC Rcd at 1787; *see* Comments of NAB at 7 ("[B]roadcast weather radar systems are limited in number and stationary. Therefore, a geo-location/database solution should work very well as a supplement to existing sensing requirements.").

[63] *See* Comments of NAB at 6 ("[A] device's location should be determined by an installed GPS or other geo-location mechanism built into the device…").

[64] Comments of Cambium Networks at 3,

devices, especially mobile devices, increasingly have built in geo-location capabilities."[65] CSMAC also recognized that, "[l]ooking forward, the vast majority of sharing opportunities are likely to involve devices that are inherently connected to the Internet…"[66] As a result, CSMAC found that, "[o]n a going-forward basis, a requirement that devices and systems sharing a band on an unlicensed basis should be 'connected' devices seems particularly feasible…"[67] Consequently, CSMAC "recommend[ed] that in the future 'unconnected' devices should be restricted to legacy bands of spectrum where they are already prevalent…"[68] Notably, CSMAC also recommended that "[p]olicymakers should consider whether such devices should even be further restricted in the future, phasing out their access to very high-quality bands over an appropriate time period."[69] Given these findings and recommendations, it certainly would be reasonable for the Commission to require U-NII devices to include a built-in geo-location feature and to connect to a database in exchange for free access to additional valuable spectrum.

While the opponents of a geo-location/database requirement also claim that this approach would add complexity and expense to U-NII devices,[70] Motorola Mobility noted that a "geo-location database lookup solution would incur little additional cost or design challenges…"[71] Similarly, CSMAC explained how the "continued decrease in product costs makes [a geo-location/database] approach feasible even for very low end or low cost devices."[72] Moreover, WISPA, one of the commenters opposing a geo-location/database requirement, "has already

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[65] Comments of Motorola Mobility at 7.

[66] *CSMAC Recommendations* at 4; *see id.* at 5 ("[S]ince the demand for spectrum is arising from the explosion of smart devices that need to communicate, we should use those same 'smarts' to enable safer sharing scenarios.").

[67] *Id.* at 6.

[68] *Id.* at 2.

[69] *Id.*

[70] *See* Comments of Cisco at 40; Comments of IEEE 802 at 16; Comments of WISPA at 17.

[71] Comments of Motorola Mobility at 7.

[72] *CSMAC Recommendations* at 5; *see id.* at 6 ("While prophylactic technology solutions can increase the cost of devices at the margin, unlicensed devices and users typically benefit from zero or low costs for spectrum access…").

implemented a database solution for TDWR systems."[73] This fact undercuts WISPA's opposition because, as ADC noted, "[t]he incremental cost, above that of providing protection to TDWR, should be negligible."[74]

With respect to the required U-NII device frequency and distance separations that should be included in the database to protect broadcast weather radars operating in the 5.35-5.47 GHz and 5.6-5.65 GHz bands, broadcasters and radar manufacturers agree that these separation requirements should be based on those ultimately adopted for TDWR systems.[75] Baron generally supports the NTIA's tentative conclusions in this respect,[76] except Baron believes it is necessary for the distance separations regarding broadcast weather radars to be calculated using the waveforms in the Attachment hereto, which include 0.4 and 4.5 microsecond pulsewidths and different PRI's when compared to TDWR. Finally, Baron stresses that the Commission should not adopt any frequency or distance separation requirements until the NTIA completes its additional testing and the results have been fully vetted by the Commission and the industry.

V. THE COMMISSION SHOULD REQUIRE THAT MANUFACTURERS IMPLEMENT SECURITY MEASURES TO PREVENT END USERS FROM MODIFYING THE OPERATING PARAMETERS OF U-NII DEVICES

An overwhelming majority of commenters joined Baron in supporting the Commission's proposal to require that manufacturers implement security features in U-NII devices "so that third parties are not able to reprogram the devices to operate outside the parameters for which the

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[73] Comments of NAB at 7; *see* Comments of WISPA at 16 ("WISPA agreed to establish a voluntary database by which users of U-NII-2C devices could register their operations.").

[74] Comments of ADC at 4.

[75] *See* Comments of NAB at 7 ("NAB suggests that broadcast weather radar systems be added to [the TDWR] database."); Comments of ADC at 3 ("[I]f the Commission goes ahead with its plans, it should include DOPRAD locations in the proposed database for TDWR, and should require geographic and frequency separations from DOPRAD in the same way as it proposes for TDWR.").

[76] *See* Dep't of Commerce, *Case Study: Investigation of Interference into 5 GHz Weather Radars from Unlicensed National Information Infrastructure Devices, Part III*, NTIA Technical Report TR-12-486, Appendix A (June 2012).

device was certified."[77] Baron agrees with the NAB that such a requirement is necessary because "[u]ser manipulated devices are often the source of the most offending interference issues, and could create major problems for incumbent radar systems."[78] Notably, in addition to the past interference to TDWRs,[79] the Commission has "seen an increase in interference incidences in U-NII bands that are caused by users unlawfully modifying and operating unlicensed devices…"[80] As the Commission explained, "[t]his type of conduct occurs mainly because … only the software configuration of these devices limits their operation to permissible bands or operational parameters that comply with the Commission's rules."[81]

Absent such a requirement, the Commission would be jeopardizing the efficacy of any interference protection measures adopted in this proceeding. As noted by the NAB, "[e]ven a well-designed and properly adjusted U-NII device can cause harmful interference if that device is reconfigured by a user to function outside the device's intended operational parameters."[82] The proposed requirement also is necessary because simply prohibiting end users from modifying a device has proved insufficient. As IEEE 802 observed, "[a]lthough the FCC has

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[77] NPRM, 28 FCC Rcd at 1785; *see, e.g.*, Comments of Cisco at 31; Comments of NAB at 7; Comments of Wi-Fi-Alliance at 14; Comments of Motorola Solutions at 5; Comments of Cambium Networks at 2; Comments of Fastback Networks at 7; Comments of Ericsson at 6; Comments of IEEE 802 at 16; Comments of the National Cable & Telecommunications Association ("NCTA") at 23.

[78] Comments of NAB at 7.

[79] *See* NPRM, 28 FCC Rcd at 1772 ("In many cases, the [TDWR] interference was caused by third parties modifying software configurations to enable operation in frequency bands other than those for which the device had been certified…"); *see* NTIA 5 GHz Report at 3-4 (noting that some of the TDWR interference occurred when the "U-NII device DFS functionality was available but was disabled by the operator").

[80] NPRM, 28 FCC Rcd at 1775.

[81] *Id.*; *see* Comments of NAB at 7 ("[E]xisting U-NII devices can be modified easily by the user through software changes.").

[82] Comments of NAB at 7; *see* NPRM, 28 FCC Rcd at 1785 ("[O]ne of the difficulties in ensuring compliance with our current rules comes from the fact that these devices can easily be re-configured by operators modifying the software that controls the device's operational parameters, such as frequency band.").

specifically stated that modifying radios to operate outside of their authorized bands is illegal, that did not stop the activity that caused interference to TDWRs."[83]

Baron, like other commenters, also supports the Commission's proposals "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 "U-NII devices certified to operate in these bands must be operated with the DFS function on."[84] Without these requirements, U-NII device end users would be a significant interference threat to weather radars.[85] As Cisco explained, regardless of why a U-NII device is operating in one of these bands without active DFS capabilities, "the end result is the same – an increased threat of interference to TDWR and other radar systems that DFS is intended to protect."[86] In addition, if the Commission permits U-NII operations in the U-NII-2B band, Baron strongly urges it to apply these same requirements to any devices certified to operate in that band. Because broadcast weather radars have very similar technical characteristics as TDWRs, there is no reason to not also adopt this requirement for U-NII devices capable of operating in the U-NII-2B band.

Significantly, the record reveals a consensus that these enhanced security proposals would not materially increase the cost or complexity of U-NII devices. For instance, with regard to preventing U-NII devices from being modified to operate outside of their certified parameters, WISPA believes these "security features can be incorporated into U-NII devices with little technical difficulty."[87] WISPA also noted that "any incremental cost to 'harden' devices will be

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[83] Comments of IEEE 802 at 15 (internal citation omitted).

[84] NPRM, 28 FCC Rcd at 1790; *see* Comments of Motorola Solutions at 5; Comments of Ericsson at 8; Comments of Comcast at 27; Comments of WISPA at 15; Comments of NCTA at 23.

[85] *See* NPRM, 28 FCC Rcd at 1790 ("[T]he deactivation of DFS in certain devices caused harmful interference to the TDWR."); *id.* ("If the DFS mechanism is not active, the device could transmit on an active radar channel and cause harmful interference.").

[86] Comments of Cisco at 23.

[87] Comments of WISPA at 17.

more than offset by increased sale and production of U-NII devices…"[88] Similarly, although Cambium Networks recognized that "there may be some additional development costs for manufacturers that do not presently implement software security," it found it "unlikely that there will be any additional manufacturing costs."[89] Commenters also noted that manufacturers already have the ability to prevent the deactivation of a device's DFS capabilities.[90]

In addition, Baron joins NAB and others in again supporting "rules requiring that a device should become inoperable if a user tries to modify the software or firmware."[91] Although Ericsson argued against this proposal, contending that it would "excessively complex,"[92] it also noted that "no technology is guaranteed to be 'unhackable.'"[93] Ericsson therefore undermined its own argument. If manufacturers cannot guarantee that users will not be able to modify a device, the device should become inoperable if a user in fact does so. Moreover, at least with respect to the U-NII-2 sub-bands, Cisco noted that including a mechanism to disable operations if a device is modified "should not be particularly difficult or costly for manufacturers to implement."[94]

Finally, Baron agrees with NAB "that U-NII devices should be required … to transmit identifying information so that each device can easily be identified in the event of harmful

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[88] *Id.*

[89] Comments of Cambium Networks at 2.

[90] *See* Comments of NCTA at 23 ("[M]anufacturers can take measures to prevent DFS from being disabled for devices operating in the U-NII-2 bands…"); Comments of WISPA at 15 ("[E]quipment manufacturers can produce equipment that will make it impossible for users to illegally modify equipment to enable non-DFS operations…").

[91] Comments of NAB at 7; *see* Comments of Fastback Networks at 7; NPRM, 28 FCC Rcd at 1785.

[92] *See* Comments of Ericsson at 7.

[93] *Id.* at 6.

[94] Comments of Cisco at 34.

interference."[95] As noted in the NPRM, without such a requirement, it would be "difficult for the Commission not only to ensure compliance with its rules but also to enforce those rules."[96]

VI. AT A MINIMUM, THE COMMISSION MUST DELAY ANY ACTION IN THIS PROCEEDING PENDING COMPLETION AND PUBLIC ANALYSIS OF THE NTIA'S STUDIES AND FINAL RECOMMENDATIONS

The critical public safety services provided by broadcast weather radars require the Commission to proceed with extreme caution as it considers permitting U-NII operations in the 5.35-5.47 GHz band. This is especially so given the NTIA's recognition of the "significant technical challenges surrounding the potential introduction of U-NII devices" into this band.[97] The NTIA 5 GHz Report clearly demonstrates the full extent of the complexity involved with the Commission's proposal. Specifically, the NTIA identified eight separate risk factors for weather radar operations if the Commission permits U-NII operations in the 5.35-5.47 GHz band, and for each risk factor, the NTIA emphasized the need for further testing.[98] As IEEE 802 observed, "the challenges identified in the NTIA report raise new and novel sharing issues."[99]

In recognition of this fact, the record overwhelmingly supports additional study, testing, and other due diligence by the Commission, in cooperation with the NTIA and the industry, prior to any additional action regarding the expansion of U-NII operations into the 5.35-5.47 GHz

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[95] Comments of NAB at 7-8; *see* NPRM, 28 FCC Rcd at 1785 (seeking comment on whether to "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 interference and its location.").

[96] NPRM, 28 FCC Rcd at 1785; *see* Comments of the Alliance of Automobile Manufacturers, Inc. and the Association of Global Automakers, Inc. ("Alliance/Global") at 30 ("[T]he Commission will have no control over unlicensed users of the 5.9 GHz band (or even a mechanism for reliably tracking those users), which could result in instances of user misbehavior and disregard for the Commission's rules, causing further harmful interference.").

[97] NTIA 5 GHz Report at 6-2; *see id.* ("This analysis will be more complex than that used to develop the existing U-NII DFS/TPC regulations…").

[98] *Id.* at 4-7 to 4-11; *see id.* at 6-2 (concluding "that further analysis is required to determine whether and how the risk factors can be mitigated…"); NPRM, 28 FCC Rcd at 1800 ("The report concludes that additional analysis is needed to determine the feasibility of introducing U-NII devices into these two bands…").

[99] Comments of IEEE 802 at 31; *see* Comments of the Telecommunications Industry Association ("TIA") at 13 ("Those processes will not be easy – NTIA has noted that the analysis will be more complex than that which led to existing 5 GHz sharing…").

band.[100] Before this necessary work takes place, sufficient information regarding the potential for the spectrum-sharing technologies and approaches under consideration to adequately protect weather radars from harmful interference cannot be known. As IEEE 802 noted, "[m]ore information will need to be known in order for the commercial industry to put forward potential sharing ideas."[101] In turn, "[a]bsent a specific sharing proposal that can be tested, the Commission cannot meaningfully reach a decision on acceptable radio emissions parameters."[102]

The Commission, therefore, should not take any additional steps toward expanding U-NII operations into the 5.35-5.47 GHz band until the NTIA completes its further testing and analyses and releases its final recommendations.[103] Commission action even at that point, however, would be premature. Rather, the Commission should first publicize the NTIA's findings and provide an opportunity for interested parties to comment.[104] Given the complex issues raised and the substantial public interest involved, the Commission cannot, as either a practical or legal

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[100] *See*, *e.g.*, Comments of Wi-Fi Alliance at 29 ("[S]ubstantial technical analysis is required before this band can be used…"); Comments of Cisco at 67 ("Cisco agrees with NTIA that 'further analysis will be required' before the FCC allows greater unlicensed use in the UNII-2B band."); Comments of the Information Technology Industry Council at 9 ("Industry supports all technical due diligence to ensure that incumbents' services in the proposed new bands are protected…"); Comments of IEEE 802 at 31 ("IEEE 802 agrees with the NTIA report that additional study is needed…"); Comments of Ericsson ("Further study should be undertaken…"); Comments of Time Warner Cable Inc. at 3 ("Undoubtedly, some aspects of the Commission's 5 GHz reforms will require additional study…"); Comments of the Consumer Electronics Association ("CEA") at 15 ("Where the impact on incumbent users of unlicensed operations in these new portions of the 5 GHz band is unclear, additional research and analysis should be performed.").

[101] Comments of IEEE 802 at 31; *see* Comments of Wi-Fi Alliance at 29 ("More information is necessary in order for the commercial Wi-Fi industry to present potential sharing ideas."); Comments of Intelligent Transportation Society of America ("ITS America") at 40 ("[C]ommenters do not currently have a means to analyze the potential for band sharing since there is no specific proposal or proposals.").

[102] Comments of ITS America at 39-40.

[103] *See* Comments of Hubbard at 7 ("[T]he NTIA makes it clear that the FCC should not permit any additional use of the 5 GHz band by U-NII devices until after the NTIA completes thorough additional testing and finalizes its recommendations."); Comments of NAB at 3 ("As an initial matter, the Commission should wait for the results of this further study before it finalizes any new rules for these bands.").

[104] *See* Comments of Wi-Fi Alliance at 29 ("[T]he Commission should allow sufficient time for industry and other stakeholders to evaluate the proposed rules for governing operations in this band."); Comments of American Ass'n of State Highway & Transportation Officials at 12 ("The work presently being conducted by NTIA should be permitted to finish and be thoroughly vetted by all concerned parties before any decision is made by the FCC.") (although these comments focused on the 5.9 GHz band, the reasoning applies equally to the U-NII-2B band).

matter, consider expanded U-NII operations in the 5 GHz band based upon the record established in response to the NPRM alone.[105]

Baron also urges the Commission to make a commitment not to take any additional steps toward expanding U-NII operations until after the close of that comment period, regardless of when the NTIA releases its recommendations. In other words, the Commission should not establish an arbitrary date upon which it will pursue its spectrum sharing proposals despite the lack of a fully-developed record, which could take some time. For instance, although the NTIA hopes to finalize its recommendations by the second half of 2014, it does not anticipate doing so prior to that time, and it expressly recognized the potential for delays.[106] Experience also demonstrates the likelihood that the NTIA cannot feasibly finish its work within a truncated timeframe. For instance, the TDWR situation shows how difficult and time-consuming it can be to sufficiently address interference to weather radars by U-NII devices. Specifically, although the "FCC has continued to work with industry, the FAA, and NTIA to address interference to TDWR systems" since 2009, "instances of interference to TDWRs continue."[107]

The Commission's prior 5 GHz U-NII proceeding further demonstrates the substantial time required to develop mechanisms to prevent harmful interference to weather radars. When the Commission decided to permit U-NII operations in the 5.47-5.725 GHz band in November 2003, it adopted new rules for U-NII devices capable of operating in either the 5.25-5.35 GHz or

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[105] *See* Comments of Savari Networks at 35; Comments of Alliance/Global at 33 ("Once a proposed course of action has been developed, and consistent with the Administrative Procedure Act ('Act'), the Commission should seek formal public comment on such proposal, including any U-NII rules or restrictions that might be envisioned."). Although these comments focused on the 5.9 GHz band, the reasoning applies equally to the U-NII-2B band.

[106] *See* NTIA 5 GHz Report at 6-4, Note a ("The dates in this schedule are tentative because delays can occur during the different stages of the review and coordination process and can impact completing the milestones. Equipment availability is beyond the control of NTIA and would also impact completing the milestones.").

[107] NTIA 5 GHz Report at 3-5; *see* Comments of Alliance/Global at 22 ("While the interference from U-NII devices was first discovered in 2009, a resolution to the problem has not yet been reached."); Comments of ITS America at 38 ("The interference problem to TDWR was first discovered in early 2009; resolution via revised compliance and measurement procedures for U-NII devices remains pending, some four years later.") (internal citation omitted).

5.47-5.725 GHz band. Any U-NII device capable of operating in the 5.47-5.725 GHz band had to immediately comply with these rules. With respect to devices designed only for the 5.25-5.35 GHz band, the Commission implemented a one-year transition period, until January 20, 2005, after which time all certification applications had to comply with the new rules.[108] However, as of that date, the "measurement procedures for certifying U-NII devices containing DFS capabilities ha[d] not yet been finalized" because the "industry and the Federal Government [] found the implementation of DFS to be more complex than originally envisioned."[109] The Commission therefore extended the deadline by a full year.[110] Then, in February 2006, the Commission had to further extend the deadline by 180 days because the NTIA was still working "to develop test procedures to ensure that DFS adequately protects most [] radar systems…"[111]

Not only would it be premature for the Commission to take any further action prior to the release of, and public comment on, the NTIA's final recommendations,[112] it would violate the Spectrum Act. Although Congress required the Commission to initiate this proceeding,[113] it expressly prohibited expanded U-NII operations unless the Commission, in consultation with the NTIA, concludes that "licensed users *will be protected*."[114] In other words, the Commission

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[108] *See 5 GHz U-NII R&O*, 18 FCC Rcd at 24501.

[109] *Revision of Parts 2 and 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) devices in the 5 GHz band*, Order, 20 FCC Rcd 4883, 4886 (2005).

[110] *See id.*

[111] *Revision of Parts 2 and 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) devices in the 5 GHz band*, Order, 21 FCC Rcd 1816, 1818 (2006).

[112] *See* Comments of Alliance/Global at 33 ("The Commission should not take premature action now regarding shared use of 5.9 GHz spectrum, as doing so would involve incomplete, inconclusive data regarding the grave risks posed by 5.9 GHz U-NII use to life-saving DSRC technologies."); Comments of ITS America at 3 ("[T]he proposal to permit sharing of the 5.9 GHz Band with unlicensed devices is at best premature and cannot form the basis for a Report and Order permitting such sharing…"). Although these comments focused on the 5.9 GHz band, the reasoning applies equally to the U-NII-2B band.

[113] *See* Middle Class Tax Relief and Job Creation Act of 2012, Pub. L. No. 112-96, §6406(a)(1) (2012).

[114] *Id.* at §6406(a)(2) ("The Commission may make the modification described in paragraph (1) <u>only if</u> the Commission, <u>in consultation with the Assistant Secretary</u>, determines that – (A) <u>licensed users will be protected</u> by technical solutions...") (emphasis added); *see* NTIA 5 GHz Report at 6-2 ("As the Tax Relief Act requires, the FCC and NTIA must determine that licensed users will be protected…").

cannot permit expanded U-NII operations before the NTIA even determines whether such operations are feasible.[115]

VII. CONCLUSION

The NTIA's TDWR interference investigation and laboratory testing, as well as the harmful interference experienced by Baron's C-band weather radar customers, aptly demonstrate the substantial interference risk U-NII devices pose to both co- and adjacent-channel radar operations. Accordingly, Baron strongly urges the Commission to continue to prohibit U-NII operations in the 5.35-5.47 GHz band, and to adopt adequate technical and service rules to ensure that adjacent-channel U-NII operations do not interfere with weather radar systems. If, however, the Commission permits U-NII operations in the 5.35-5.47 GHz band despite the likelihood of harmful interference to broadcast weather radars, it must implement every reasonable interference protection mechanism in order to mitigate, to the maximum extent possible, this likelihood of interference. Moreover, the Commission must not take any further action toward expanding U-NII operations into the 5.35-5.47 GHz band until the NTIA completes its testing and releases its final recommendations, and interested parties have an opportunity to comment on those recommendations.[116] While Baron understands the importance of identifying additional spectrum for wireless broadband services, this goal must be weighed against the substantial public interest in ensuring broadcast weather radar systems continue to provide viewers with accurate and timely warnings of impending severe weather events.

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[115] *See* Comments of Hubbard at 1 ("Congress required the FCC to initiate this proceeding, but the determinations made must be based on the record, and any FCC decisions must protect licensed users in the 5 GHz band.") (internal citation omitted); Comments of CEA at 14 ("The Spectrum Act requires that, before allowing unlicensed use in the U-NII-2B sub-band, the Commission consult with NTIA and conclude that licensed users will be protected…"); Comments of TIA at 13 ("[T]he Spectrum Act makes clear that sharing of 5350-5470 MHz can only be authorized if the Commission, in consultation with NTIA, concludes that there are technical solutions available that assure that protection to licensed users … are not compromised by the introduction of U-NII devices.").

[116] *See* Comments of Hubbard at 11 ("The FCC should not even consider expanded sharing until, and unless, thoroughly effective mitigation technologies have been proven and deployed.").

Respectfully submitted,

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ATTACHMENT[1]
Dynamic Frequency Selection ("DFS") Compliance Measurement Procedures for Unlicensed National Information Infrastructure ("U-NII") Devices Operating in the 5.25-5.725 GHz Band

PURPOSE

This document proposes additional DFS certification tests designed to ensure that U-NII devices operating in the 5.25-5.725 GHz ("U-NII-2") band will not interfere with incumbent broadcast weather radar systems operating in the 5.35-5.47 GHz and 5.6-5.65 GHz bands.

Overview of Proposals

The certification tests proposed below are modeled after the tests proposed in Appendix B to the 5 GHz U-NII NPRM,[2] which are designed to ensure that U-NII devices' DFS functionalities adequately protect Terminal Doppler Weather Radar ("TDWR") systems from harmful interference.

The additional tests proposed herein are designed to account for the fact that broadcast weather radars use different waveforms than TDWRs. The proposed tests are intended to be in addition to, not in lieu of, the tests the Commission ultimately adopts with respect to TDWRs.

[1] This document is an attachment to the Reply Comments being filed by Baron Services, Inc. ("Baron") on July 24, 2013 in response to a Notice of Proposed Rulemaking adopted by the Federal Communications Commission (the "Commission"). *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) ("5 GHz U-NII NPRM").

[2] *See id.* at 1810-12, Appendix B.

Table 1
Proposed U-NII-2 DFS Broadcast Weather Radar Detection Test Waveforms

Test #	*Radar Mode*[3]	*PRF/PRI pps/µsec*	*Pulse Width µsec*	*Antenna Max Scan Rate RPM/Time Interval (Sec)*	*Pulses per Dwell* $\left[\frac{1}{360}\right] \times \left[\frac{time}{PRI}\right]$	*% Detection Required*[4]	*Number of Trials/Minimum # Detections*
1	Reflectivity Rfl _1	250/4000	2.0	3/20	14	60%	30 Trials 18 Detections
2	Rfl_2	250/4000	3.3	3/10	14	60%	30 Trials 18 Detections
3	Rfl_3	330/3003	3.3	3/20	19	60%	30 Trials 18 Detections
4	Rfl_4	330/3003	4.5	3/10	19	60%	30 Trials 18 Detections
5	Rfl_5[5]	250/4000	4.5	3/20	14	60%	30 trials 18 Detections
6	Velocity (HDD)[6] V_1 Single PRF	1000/1000	1	6/10	28	60%	30 trials 18 Detections
7	V_2 Single PRF	1000/1000	0.8	6/10	28	60%	30 trials 18 Detections
8	V_3 Dual PRF 2:3 Unfolding[7]	Interlaced 800 then1200/ 1250 then 833	0.8	6/10	23 or 34	60%	30 trials 18 Detections
9	V_4 Dual PRF 3:4 Unfolding	Interlaced 900 then1200/ 1111 then 833	0.8	6/10	25 or 34	60%	30 trials 18 Detections
10	V_5 XDD[8] Single PRF	1500/666.6	0.4	6/10	42	60%	30 trials 18 Detections
	Aggregate Detection %					**90% minimum**[9]	**300 Trials 270 Detections**

[3] Baron's weather radar systems can operate in ten different modes.

[4] As per the proposed listen times described in the 5GHz U-NII NPRM.

[5] 2 MHz Non-Linear FM Chirp.

[6] "HDD" stands for High Definition Doppler.

[7] Dual-PRF is used for velocity unfolding. Transmit 1 dwell at Low PRF followed by 1 dwell of High PRF. Unfolding Ratio 2:3, 3:4 and 4:5, such as PPP or DFT processing.

[8] "XDD" stands for Xtreme Definition Doppler.

[9] Baron proposes an aggregate detection percentage of 90% as a compromise between the Commission's proposal of 80%, *see* 5 GHz U-NII NPRM, 28 FCC Rcd at 1811, Appendix B, and the 99.9% detection probability recommended by The Network of European Meteorological Services, which obviously would best ensure adequate interference protection for weather radars. *See* The Network of European Meteorological Services, *Recommendation on C-Band Meteorological radars designed to ensure global and long-term coexistence with 5 GHz RLAN*, p. 13 (Apr. 12, 2008).

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