DOCKET FILE COPY ORIGINAL

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
RECONROBOTICS, INC.	)	**WP Docket 08-63**
	)	
Request for Waiver of Part 90 of the Commission's Rules for a Video and Audio Surveillance System at 430-450 MHz	)	

FILED/ACCEPTED

MAR 24 2010

Federal Communications Commission
Office of the Secretary

To: The Commission

PETITION FOR RECONSIDERATION

ARRL, the national association for Amateur Radio, formally known as the American Radio Relay League, Incorporated (ARRL), by counsel and pursuant to Section 1.429 of the Commission's rules (47 C.F.R. §1.429), hereby respectfully requests that the Commission reconsider and rescind [1] the *Order*, DA 10-291, released February 23, 2010 under the delegated authority of the Deputy Chief, Wireless Telecommunications Bureau, and the Deputy Chief, Public Safety and Homeland Security Bureau.[2] The *Order*, over the objections raised in a substantial number of comments in this proceeding, granted the *Request for Waiver* filed originally on or about January 11, 2008 by ReconRobotics, Inc. (Petitioner). Petitioner developed for use outside the United States a portable, analog, robotic surveillance and data transmission system permitting video and

[1] ARRL also requests that, *pendente lite*, the Wireless Bureau and the Public Safety and Homeland Security Bureau stay the effectiveness of the waiver pursuant to Section 1.102(b)(2) of the Commission's Rules, which, with respect to Commission actions taken under delegated authority, provides: "If a petition for reconsideration of a non-hearing action is filed, the designated authority may, in its discretion stay the effect of its action pending disposition of the petition for reconsideration." The marketing and deployment of the devices under the present waiver, with the inadequate labeling discussed hereinbelow will create interference and place large numbers of devices in the field which are difficult or impossible to recover or relabel after the fact. Therefore, a stay of this waiver is justified and necessary.

[2] This Petition for Reconsideration is being filed within thirty (30) days of the release date of the *Order*. It is therefore timely filed per Section 1.429(d) or, to the extent that this is an adjudicatory matter, Section 1.106 of the Commission's Rules.

No. of Copies rec'd 0+4
List ABCDE

audio surveillance in hazardous areas, called the "Recon Scout." The device allegedly provides audio and video and other sensing circuitry, and would ostensibly be used for law enforcement and firefighting efforts. The device is presently configured by the manufacturer to operate in the 430-450 MHz band, at 1 watt peak power. As good cause for this Petition, ARRL states as follows:

I. Introduction

1. ARRL is of course in favor of the development and use of technology in support of first responders and law enforcement efforts. ARRL has no concern with the deployment by law enforcement personnel and first responders of video and audio surveillance devices *per se*. However, in this instance, the Wireless Bureau and the Public Safety and Homeland Security Bureau have granted the instant waiver precipitously and without due consideration of the interference potential and interference susceptibility of the subject devices. The *Order* in this proceeding failed to address a number of determinative arguments raised timely in comments and as such the Order is arbitrary and capricious. In addition, there are practical errors in the *Order* which under any circumstances require correction immediately, prior to any marketing of this equipment. Finally, there is evidence of illegal marketing of these devices, which should, without more, cause a re-evaluation of this waiver, which was improvidently granted.

2. The *Order* is devoid of any justification for the Petitioner's choice of frequency bands. There is in fact <u>no</u> justification for this waiver because there are alternative frequency bands that would be perfectly suitable for this device and its applications, and which would not suffer the same incompatibilities that the 420-450 MHz band entails. The waiver in this case is sought by the Petitioner not because of the necessity of the use

of the frequency band in question but instead, purely and simply, for the convenience of the manufacturer of the device and that manufacturer's unwillingness to reconfigure the device to operate in a more appropriate frequency band which does not have the interference potential that exists in the 420-450 MHz band. The Commission has made a superficial and erroneous analysis of the interference potential of these devices to the Amateur Service and has made no analysis at all of the susceptibility of the devices to disruption from high power Amateur Radio transmitters. The *Order* establishes labeling requirements that are insufficient to convey to the user the operating conditions that the Commission has placed on the devices, to the detriment of the hundreds of thousands of licensed Amateur users of the 420-450 MHz band. Finally, though the Order establishes certain marketing limitations on these devices, the ineffectiveness of such is demonstrated by *marketing violations which already have occurred* and which inevitably will continue to occur. The deployment of these devices is not subject to any reasonable level of control, given the nature of the devices and the lack of any manufacturer control past point of initial sale.

3. This waiver was improvidently granted and the Commission is respectfully requested to rescind it. The effect of rescission of this waiver would be to cause the manufacturer to modify the product to operate in a more suitable frequency band, and it would permit the device to be operated by eligibles in that different frequency band without the interference potential that the instant waiver inherently creates.

II. The Order Does Not Justify the Manufacturer's Choice of Frequency Band

4. The Recon Scout is a mobile robot for black & white 30 frame-per-second NTSC video surveillance of dangerous environments. It can be thrown or dropped into

the target area and can be maneuvered by an Operator Control Unit ("OCU") operator at safe distance up to about 250 feet. Physically, the robot resembles a barbell of just over 7 inches in length with wheels on each end having a 3-inch diameter. It has two antennas and a stabilizing tail so the image sensor is horizontally oriented. The OCU is a handheld device with transmit and receive antennas. It was developed by the University of Minnesota with funding from the Defense Advanced Projects Agency (DARPA). It was clearly developed for use in Iraq with obvious applications there by the United States military. The choice of frequency band was, also obviously, made as the result of the frequency allocation situation applicable to its use *outside* the United States. The manufacturer in this case, despite its protestations to the contrary, sought the waiver so that it could market the device in the United States without having to reconfigure the device to operate in a more appropriate frequency band, such as 902-928 MHz or 2450-2483.5 MHz, or in the 700 MHz public service allocation.

5. ARRL's comments in this proceeding noted that *there is **no** domestic allocation for Public Safety land mobile services anywhere in the 420-450 MHz band.*[3] Because the three channels on which the device is proposed to operate in this band [4] are all within that segment, what the Petitioner requested ***in fact*** was not only a waiver of Part 90 service rules, but also a waiver of Section 2.106 of the Commission's Rules, the Table of Allocations. The only allocations in the 420-450 MHz band are for Government Radiolocation (limited to military radars) on a primary basis, and on a secondary basis, the Amateur Service. Per Section 90.273 of the Commission's rules, frequencies above 429.99375 MHz and below 450 MHz are unavailable to stations in the land mobile

---

[3] There is, at Section 90.103(c) an allocation for non-government Part 90 *radiolocation*, but that is limited to N0N emissions only, and there is no mobile allocation in the band at all.

[4] The three channels incorporated in the device are 430-436 MHz, 436-442 MHz, and 442-448 MHz.

service anywhere in the United States. ARRL also noted that the Commission was being asked, in effect, to make spectrum allocations by waiver, without saying so. That process short-circuits the well-established and fully functional procedures for international and domestic frequency allocations and spectrum management, which involve compatibility showings, and detailed consideration of the impact of a new service on incumbent licensees. Spectrum allocation by waiver is manufacturer-specific (which is inherently unfair to other manufacturers of similar equipment) and frustrates competition.[5] ARRL noted that, specifically with respect to the 420-450 MHz band, both NTIA and the Commission have repeatedly found difficulties with adding to incumbent services due to the sensitivity of the 420-450 MHz band, which is used principally for military radars. *See, e.g. Terry Mahn, Esquire,* DA-06-2501, released December 13, 2006 (Part 90 waiver request for indoor positioning system for medical applications at 433 MHz denied).[6] A proposal for a permanent waiver of the Commission's Rules to permit nationwide marketing and use on a licensed basis of land mobile short-range, wideband transmitters at significant power levels, benefiting as it does only one manufacturer to the exclusion of all others, is an inferior method of conducting spectrum allocations and spectrum management.

6. The *Order* in this proceeding did not address any of those arguments. It ignored completely the fundamental issue of the appropriateness of the manufacturer's choice of frequency band. It granted only Part 90 waivers to the Petitioner and it did not address the

---

[5] In this case there are two competitors, at least. See, Octatron, Inc. and Chang Industry, Inc. (*902-928 MHz,* ET Docket 05-356, discussed *infra*) and Remington Arms Company (2400-2483.5 MHz, ET Docket 05-183, Order released November 18, 2005, FCC 05-194, 20 FCC Rcd. 18274; See also, *Remotec, Inc.*, DA 10-454, released March 18, 2010).

[6] In that case, the Commission held that: "we do not believe that the public interest requires grant of a waiver merely to accommodate a manufacturer's choice of a specific frequency when others are available."

necessary, but unrequested waiver of Section 2.106 of the Commission's rules. Nor did it address the availability and suitability of the several alternative frequency bands that would have obviated the need for the waiver. Instead, the Commission relied solely on no data at all, but only on admittedly unsupported assumptions about interference potential to the Amateur Service from the device. It made no analysis of the interference susceptibility of the device to signals from a nearby Amateur Radio transmitter or the effect on first responders from malfunction of the device when it is deployed. The Commission did not take the required "hard look" at this waiver request.[7] Had it done so, the hard look would have revealed an inadequate factual predicate for the requested relief, and available alternatives that would have necessitated denial of the waiver.

7. Alternative available bands exist which would not be inconsistent with the Table of Allocations, which the Commission waived *sub silentio*. Attached hereto as ***Exhibit A*** is a study entitled *Building Penetration and Path Loss at 430 MHz, 900 MHz and 2.4 GHz*, prepared by ARRL Laboratory Manager Ed Hare, which clearly establishes that frequency alone is not at all determinative of building penetration, and therefore the choice of 430-450 MHz for the Recon Scout was not necessary. Thus, the waiver is unsupported and unjustified. ***Exhibit B***, attached, entitled *Analysis of Recon Robotics Testing on 450 and 900 MHz* rebuts the erroneous showing made earlier in this proceeding by Petitioner, which claimed that use of the 430 MHz band was necessary relative to the 900 MHz band. Perhaps the most obvious rebuttal of the Petitioner's allegation that bands higher in frequency than 420-450 MHz are not suitable for the

---

[7] *See WAIT Radio v. FCC*, 418 F.2d 1153, 1158 (D.C. Cir. 1969), *cert. denied*, 409 U.S. 1027 (1972); *see also* Family Stations, Inc. v. DirecTV, Inc., *Order on Reconsideration*, 19 FCC Rcd 14777, 14780 (MB 2004).

Recon Scout, however, is the *Order*, DA 10-454, released March 18, 2010, in *In the Matter of Remotec, Inc.*, in which the Commission extended to Remotec, Inc, a subsidiary of Northrop Grumman Corporation, a waiver previously granted to Remington Arms Company [8] to permit the certification and marketing under the Part 15 rules of a video and audio imaging device which is functionally identical to the Recon Scout, but which operates (apparently effectively) in the 2400-2483.5 MHz band. The Commission did not address the alternative band availability anywhere in the *Order*, but the appropriateness of use of the 420-450 MHz band is a basic element of the good cause showing necessary to justify the instant waiver. Petitioner failed to justify it and the Commission ignored it completely. Since use of another band such as 902-928 MHz, 2400-2483.5 MHz, or the new 700 MHz public safety band would have obviated the need for this waiver and eliminated the incompatibility between the device and incumbent users, the failure of the Commission to evaluate such is sufficient to justify the rescission and reconsideration of the waiver.

8. The Chief, Office of Engineering and Technology (OET), on March 22, 2010, dismissed a long-pending waiver request for a video and audio surveillance device functionally similar to the Recon Scout, but which would operate at 902-928 MHz at a power level of 750 mW. OET dismissed this petition because the petitioner had not provided sufficient information to demonstrate that harmful interference would not be caused to licensed users of the 902-928 MHz band, including Amateur Radio operators. See the *Order, Octatron and Chang Industry, Inc. Waiver of the Part 15 Regulations,* DA 10-453, ET Docket No. 05-356, released March 22, 2010. What the Commission did in

[8] See, Docket 05-183, 20 FCC Rcd. 18724 (2005). The Remington Arms waiver was subsequently extended to the successor-in-interest relative to this device. See, *Optronics, Inc.*, 23 FCC Rcd. 6823 (OET, 2008). Since then the rights to the product were assigned apparently to Remotec, Inc.

this case was to deny a petition for waiver for an analog device similar in function and purpose to the Recon Scout and with similar limited deployment. The device for which the wavier was denied operates at considerably lower power than the Recon Scout, in a band where high power, unlicensed operation is normally permitted. The basis for the denial was potential interference to, among other uses, Amateur Radio operation at 902-928 MHz. That recent OET decision stands in stark contrast to the instant proceeding, in which a *higher power* device was permitted to operate in a band where such high power devices are normally *not* permitted to operate, and where interaction with licensed Amateur operation is far more likely than at 902-928 MHz. In the *Octatron and Chang* Order, OET in Paragraph 7 held, in relevant part, as follows:

> It is a well established principle that the Commission will waive its rules if it determines, after careful consideration, that such a grant would not undermine the policy which the rule in question is intended to serve. As discussed below, in this case Octatron / Chang have not provided information to demonstrate that the policy which the rules in question are intended to serve, *i.e.*, to protect licensed users from harmful interference, would not be undermined by a grant of their waiver request. Specifically, Octatron / Chang have not provided information to demonstrate that operation of their surveillance systems at the requested power levels would not cause harmful interference to licensed users in the 915 MHz band. Octatron / Chang merely assert that the interference would be minimal because of the limited use of the devices as to time and place. Also, Octatron / Chang have not provided any justification for the specific power level increase they have requested. Octatron / Chang merely claim that the increased power is needed so their surveillance systems are "effective for law enforcement purposes."

In the same Order, OET compared the interference potential of the Octatron and Chang surveillance device to a surveillance device for which a waiver had been granted to Remington Arms Company in the 2400-2483.5 MHz band:

> Significantly, assuming free-space loss, and taking into account the higher power Octatron / Chang request, a 60-100 feet interference range in the 2450 MHz band for Remington's device is much less than the 230-370 feet interference range in the 915 MHz band that we calculated for Octatron /

> Chang's devices. The greater interference potential of Octatron / Chang's devices would impact other devices over roughly 4 times the range and almost 16 times the area compared to Remington's device. Moreover, transmissions in the 915 MHz band exhibit different propagation characteristics than the 2450 MHz band, such as greater penetration of walls, foliage, and other obstacles in the propagation path with less attenuation. It is important to note that although these propagation phenomena would allow a greater operating range for Octatron/Chang's surveillance systems, at the same time they also would contribute to a significantly increased interference range for these devices, thereby substantially increasing their interference potential to licensed users in the 915 MHz band.

In the instant case, the Commission never inquired of ReconRobotics what the interference range of its device was toward potential licensed radio services. Yet, it granted a waiver for the device, which uses higher power than the Octatron and Chang device. The Recon Scout would operate in a lower-frequency band than that used by the Octatron and Chang device. The 430-450 MHz band is normally not available for high-power unlicensed devices; signals in that range have an even larger interference contour than do similarly powered devices at 902-928 MHz; and the Recon Scout would be used in a band heavily occupied by a licensed service which uses extremely sensitive receivers. Octatron and Chang were denied a waiver because they made no showing that their device would not cause interference to incumbent services in the 902-928 MHz band. ReconRobotics made no such showing, but were given a grant anyway. In short, all of the reasons for denial of the Octatron and Chang surveillance device apply to the ReconRobotics device, but the Commission denied the former and granted the latter. The grant of the ReconRobotics waiver was arbitrary and capricious and must be reconsidered and reversed.

III. The Commission's Interference Analysis is Flawed and Unsupported.

9. In granting this waiver, the Commission relied solely on the first half of Section 1.925 of the Commission's Rules, which provides that the Commission can grant a waiver if it is shown that (a) the underlying purpose of the rule(s) would not be served or would be frustrated by application to the instant case, and grant of the requested waiver would be in the public interest. The underlying purpose of the Table of Allocations is to insure compatibility among different types of users. The table is modified from time to time in light of compatibility showings and following notice and comment rulemaking applicable to all. This proceeding constitutes spectrum allocations by rule waiver, benefiting one manufacturer to the exclusion of others, without admitting as much. The purpose of the Table of Allocations is quite obviously frustrated by *ad hoc* exceptions to it that are unnecessary or which will result in interference potential to or from incumbent services.

10. Even if the question here was reducible, as the Commission seems to have assumed, to a determination of whether the ReconRobotics device can be operated at the high power levels permitted by the waiver without (1) creating a very substantial interference potential to licensed Amateur Radio operations, including weak-signal communications at 432 MHz and repeater input frequencies; and (2) being subject to malfunction in the presence of nearby Amateur Radio transmissions (the effect of which would obviously be to endanger the lives of First Responders) the Commission's analysis of these factors is superficial and flawed, or not addressed at all.

11. The Commission claims that the Recon Scout will be used infrequently and will be limited in numbers deployed, significantly reducing the possibility of interference. In addition, the *Order* stated that it is unlikely that Recon Scout would have a significant

effect on the ability of even an Amateur Earth station operating near the horizon to receive a low-level satellite signal, given the variety of natural and man-made interference sources such as terrain, trees, buildings, and other obstacles and ground level interferers having a greater effect on reception. So, the Commission claimed that grant of a waiver to permit authorization and licensing of the device on 436-442 MHz is appropriate, because the device is unlikely to cause interference to Amateur Satellite communications in the 435-438 MHz segment. At the same time, however, the Commission prohibited training exercises using the device within thirty kilometers of certain Government radar and earth station antennas. The difference in regulatory treatment, and the obviously different assumptions underlying them, is not explained. The simple fact is that there is no way for an operator of the Recon Scout on Channel C (430-436 MHz) to avoid interference to Amateur Satellite Service downlinks because the operator of the device cannot determine in advance where or when the Recon Scout will be deployed; where Amateur-Satellite receivers will be in use; or when. The Recon Scout is a "deaf transmitter" with respect to 430-450 MHz and it will cause unpredictable and potentially substantial interference to ongoing Amateur Radio and Amateur-Satellite operations. Scarcity is not an interference avoidance mechanism where there are ten thousand units of the device authorized throughout the United States and where the interference cannot be predicted or detected by the operator of the device. Operating conditions are meaningless in that environment.

12. There is predictable interference to weak-signal terrestrial, point-to-point Amateur operations between 432 and 433 MHz; auxiliary and repeater links between 433 and 435 MHz, and international satellite operations above that range. The band 442-448

MHz is used for FM repeater inputs and Amateur television repeater inputs. These repeater input antennas, both for voice and video, are at high locations where line-of-sight to the Petitioner's devices should be expected anywhere in the United States at unpredictable times. [9] Repeaters in this band are routinely used for emergency communications via Amateur Radio for numerous served agencies including FEMA. Therefore, at times when the Recon Scout may be expected to be used, the Amateur repeaters may be expected to be in operation in the same areas. As to the 430-436 MHz channel and 442-448 MHz segments, the Commission admits that whether the device "can operate without causing harmful interference *is not as clear*." The only compatibility analysis made, however, was the casual statement that deployment of the Recon Scout on multiple channels is "expected to be rare," and that the Commission "believes" that interference to these amateur operations can "largely be avoided" by requiring deployment first in the 436-442 MHz segment, then in the 442-448 MHz segment, and in the 430-436 MHz segment only if the other two channels already are in use. There is no RF sensing mechanism here, however; no advance coordination requirement; no limit on the number of units that can be deployed in a given area at the same time; and no database to be consulted by radio Amateurs to determine the source of interference. The Commission's non-empirical assumptions are an abdication of its spectrum management obligation, and more is surely required to justify this waiver than what is contained in the *Order*. There is a worst-case, obvious and substantial interference potential from these devices to Amateur operations in the 432 MHz band

[9] Though the Commission notes that Amateur television transmitters often transmit at high power levels to the repeaters relative to the signal level of the Recon Scout, that is a static analysis which fails to recognize the fact that Recon Scout devices are mobile and may well be far closer to an ATV repeater input than is the source of the intended input signal from an Amateur station, thus blocking the Amateur input transmission.

which involve exceptionally weak signals. Reliance for interference avoidance in this frequency range on a completely unenforceable, tiered channel deployment plan by the ReconRobotics devices is simply insufficient. *The devices should have been prohibited completely from operation at 432 MHz, because there is never a situation where the deployment of a Recon Scout device in geographic proximity to an Amateur receiver operating at 432 MHz will be compatible, and where that proximity is completely unpredictable.* Similarly, the devices should not have been permitted in the 442-448 MHz range, because triggering and blocking Amateur voice repeater inputs is a *very* likely event when the Scout devices are deployed. If, as the Commission wants to assume, the devices are unlikely to be deployed on more than one channel at once, there is no reason to allow more than one device on one channel to be deployed in a given area at once. No need is established for allowing more than one device to be deployed in a given area at once.

13. Assumed scarcity of interaction between or among incompatible spectrum uses, and assumed infrequent deployment of interfering transmitters are not reliable interference avoidance mechanisms, and the conditions on this waiver will not produce the degree of scarcity that the Commission would like to rely on in any case. The Commission has permitted an initial run of *ten thousand* Recon Scout devices to be marketed legally in the United States in only two years. It has authorized them not only for state and local police and firefighters, but also for "security personnel in critical infrastructure industries." [10] That is a very large group of eligible users and a very large

[10] "Critical Infrastructure Industries" include Private internal radio services operated by State, local governments and non-government entities, including utilities, railroads, metropolitan transit systems, pipelines, private ambulances, volunteer fire departments, and not-for-profit organizations that offer

number of deaf transmitters in a heavily occupied frequency band. The fact that any offer for sale or lease must state eligibility limitations is, as will be shown below, a completely ineffective means of regulating the use of such devices, or restricting the distribution of the devices, and the class of eligible users is overbroad.

14. Of at least equal concern is the fact that interference ***to*** the Recon Scout may be expected on a regular basis from Amateur Radio operations, and the Commission has not evaluated that potential at all; nor has the Petitioner addressed it. Radio Amateurs will be perceived to be, or held responsible for the failure or malfunction of these analog devices in a given application and the danger to public safety officers who are relying on them. The Commission has decided to rely solely on labeling as a means of dealing with this, and it has done so erroneously, as will be discussed below. There is, simply stated, no compatibility demonstrated whatsoever between unwanted but perfectly legal Amateur Radio transmissions at high effective radiated power levels, and ReconRobotics receivers attempting to receive desired video signals through varying obstructions. The Commission cannot and most certainly should not in this context be content to rely on the public safety officer's obligation to accept interference from other licensed users in the band, and it hasn't even required the provision of that much information to the public safety officer using the device, given the labeling inadequacies in the *Order*.

IV. The Commission's Labeling Requirements are Flawed

15. Among the conditions attached to the waiver grant in the *Order* is a requirement that Recon Scout transmitters be labeled, and bear the following statement in a conspicuous location on the device: "This device may not interfere with Federal

---

emergency road services, provided these private internal radio services are used to protect safety of life, health, or property; and are not made commercially available to the public.

stations (sic) operating in the 420-450 MHz band and must accept any interference received." The problem with the non-interference requirement language is that it is inconsistent with, and under inclusive of the obligations imposed on the waiver in the text of the *Order*. Those conditions include a specific statement that the device is on a secondary basis to all Federal users ***and licensed non-Federal users.***[11] The Commission apparently took the label language directly from that suggested by NTIA, but it is incomplete. The label must be modified [12] to state that the device "may not interfere with Federal and non-federal stations operating in the 420-450 MHz band and must accept any interference received." In addition, the *Order* requires [13] that the following statement be placed in the instruction manual: "Although this transmitter has been approved by the Federal Communications Commission, there is no guarantee that it will not receive interference." The manual language is insufficient: it should be modified to explain the conditions of operation more clearly. There is nothing in that language that explains to the user who experiences interference what that user's expectations should be. Instead, the notice in the manual should read: "Although this transmitter has been approved by the Federal Communications Commission, it must accept any interference received from Federal or non-federal stations, including interference that may cause undesired operation."

V. There Has Already Been Illegal Marketing of Recon Scout Devices

16. As recently as March 4, 2010, ARRL members spotted a listing on eBay ® of two Recon Scout devices for sale to the general public. This was "eBay auction #

[11] See, the *Order*, at paragraph 11, page 6.
[12] ARRL strongly urges that the Commission correct this error in an Erratum *immediately*, prior to any adjudication of the remainder of this Petition.
[13] See, the *Order*, at paragraph 11, pages 6 and 7.

180455347338 –Recon Scout Throwbot-Remote Control Camera Robot." ARRL staff wrote that day to Michael Jacobson, Esq., Senior Vice President and General Counsel of eBay in San Jose, California; reported this marketing violation to him, and provided him with a copy of the *Order* in this proceeding. The items were subsequently removed from eBay (apparently by eBay), but the marketing violation was reported to the Commission's Enforcement Bureau by ARRL as well. This is a clear illustration of the utter lack of control of these devices exercised by the manufacturer, and the futility of the conditions on grant of the waiver in order to avoid illegal marketing and deployment of these devices in the subject band. It is unclear to what extent ReconRobotics participated in this illegal marketing or other instances which may have occurred (though ARRL expects the Commission's Enforcement Bureau to investigate this matter and ascertain that information), but what is quite apparent is that there is not going to be any effective control of the deployment of these devices going forward. [14]

---

[14] ReconRobotics is also using a large number of resellers, making enforcement of the waiver and use limitations difficult or impossible. See Exhibit C, attached, taken from: http://www.reconrobotics.com/contact/resellers.cfm (site last visited March 23, 2010). As well, there is ample evidence that ReconRobotics has been actively marketing, selling and delivering this device to large numbers of end users well before the grant of this waiver, and they have been deployed without licenses. The following quote is from:

http://www.hendonpub.com/publications/article/?mag=TR&articleId=207607&articleLoc=Other+Featured+Articles

> "As of the time this article was written, over 100 police and security agencies use the Recon Scout and Recon Scout IR for tactical reconnaissance and high-risk operations…
>
> The Huntington Park, CA, Police Department is one of the many law enforcement agencies now employing the Recon Scout. In May 2007, then-Assistant Chief Paul Wadley purchased the department's first tactical reconnaissance robot, the Recon Scout. Wadley introduced the robot to the tactical team during its monthly training session.
>
> ****
>
> Over the next couple of months, the entire tactical team became very familiar with the operation of the Recon Scout and its control unit. The Recon Scout was used in a variety of training scenarios. When the time came to actually put it to the test, the team was ready to go…"

VI Conclusions

17. ARRL is not seeking to deprive the public safety community of a device that will benefit their difficult, admirable and important tasks. Amateur Radio operators are proud of their work in support of public safety, and Amateur Radio is allied closely at all levels with public safety entities. But the regulatory paradigms that the Commission has established for both allocated services and under Part 15 are workable ones, and manufacturer-specific waivers should not be substituted for reasoned allocation decisionmaking, or as a substitute for use of modern Part 15 technologies that in their deployment or in training applications will not cause interference to licensed services. The bands, 2400-2483.5 MHz, 700 MHz or 902-928 MHz are considerably better alternatives for these applications for public safety use than is 430-450 MHz, for the reasons discussed herein. In addition to the Commission's failure to evaluate alternative frequency bands for this application, it was not satisfactorily established in the *Order*

See also, for ample evidence of illegal marketing (copies of the ReconRobotics web sites referenced below are attached hereto in Exhibit C):

http://www.recon-scout.com/pdfs/Recon_Scout_Marietta_Profile.pdf

http://www.recon-scout.com/pdfs/Recon-Scout_Huntington_Park_Profile.pdf

http://www.recon-scout.com/pdfs/Recon_Scout_Burnsville_Profile.pdf

http://www.recon-scout.com/pdfs/Recon-Scout_Orlando_Profile.pdf

http://74.125.95.132/search?q=cache:iQFRkS_89OQJ:www.allbusiness.com/crime-law-enforcement-corrections/law-police-forces/13959848-1.html+reconrobotics+scout&cd=13&hl=en&ct=clnk&gl=us

http://www.popularmechanics.com/technology/military_law/4289576.html

why digital alternatives are inadequate, or why analog emissions are necessary. Digital emissions are not any less robust than analog emissions for the proposed application. Perhaps the simple explanation is that it costs the manufacturer less to make analog devices than digital ones, or that the devices had already been configured as analog devices when originally developed for use outside the United States.

18. The Commission should not have conducted spectrum allocations for licensed services by waiver as it has done here. It should not have merely presumed, without requiring a compatibility showing from ReconRobotics, that there would be no interference to Amateur Radio to the Scout devices. The Scout devices should have been shown to be capable of rejecting co-channel interference from Amateur stations nearby, some of which transmit effective radiated powers in the megawatt range. The Commission should not have granted a waiver merely to placate a manufacturer which chose its operating parameters and frequency band in terms of its own commercial advantages and because it did not want to incur the expense of re-engineering its product to operate in an appropriate and available band, be it 2400-2483.5 MHz, 700 MHz, 902-928 MHz, or elsewhere. The Commission failed to give this request the "hard look" that it is obligated to give it. It did not address arguments fairly and timely made in the record. An effort to achieve compatible use merely by creating an unenforceable sequence of band segment occupancy by a fundamentally incompatible device is ineffective. It should not have served to replace careful technical analysis of interference potential as a spectrum management tool. Nor is a limitation on rollout of the device – allocation by scarcity – an appropriate method where the interfering service and the victim service are

both itinerant, mobile services. [15] Finally, the Commission must correct the rather obvious errors in the labeling requirements for these devices, and it should do so by erratum immediately. Pending resolution of this Petition, the Commission should address the effect of the apparent marketing violations and the participation of ReconRobotics in those instances prior to making any final decision on the waiver; and it should stay this waiver pursuant to Section 1.102 of the Commission's rules pending ultimate resolution of the matters raised herein.

Therefore, for all of the above reasons, ARRL, the National Association for Amateur Radio, respectfully requests that the Commission reconsider, rescind and stay the ReconRobotics waiver and the effectiveness of the *Order* in accordance with the foregoing.

Respectfully submitted,

ARRL, THE NATIONAL ASSOCIATION FOR AMATEUR RADIO

225 Main Street
Newington, CT 06111-1494

By: _____
Christopher D. Imlay
Its General Counsel

BOOTH, FRERET, IMLAY & TEPPER, P.C.
14356 Cape May Road
Silver Spring, MD 20904-6011
(301) 384-5525

March 24, 2010

[15] As discussed above, the assumption that there will not be interaction between Recon Scout devices and incompatible Amateur receivers and transmitters because of scarcity of the Scout devices is completely unsupported. Ten thousand of these devices is an absurdly large number given the acknowledged interference potential of the devices to and from Amateur Radio.

EXHIBIT A

Building Penetration and Path Loss at 430 MHz, 900 MHz and 2.4 GHz

Ed Hare
ARRL Laboratory Manager
225 Main St
Newington, CT 06111
Email: w1rfi@arrl.org

ReconRobotics asserts that their proposed Recon Scout device must use 430-448 MHz because of inadequate building penetration.[16] This assertion is made without detailed engineering support and fails to consider how propagation varies with building structure, claiming only an incorrect general principle that "[b]uilding penetration drops as frequency increases."

In fact, literature indicates that when building apertures, such as windows, are in the path to the receiver, building penetration actually tends to *increase* at 900 MHz compared to 440 MHz. (Recon Scout devices necessarily operate in a building with an aperture—otherwise, the device could not be thrown or maneuvered into the building.)

The following is a compilation of quotes from various studies, published books, peer-reviewed literature and published reports by industry and government. Although these citations do indicate that building penetration is generally somewhat better with increasing frequency, actual penetration and propagation within a building vary significantly (plus or minus) with distance, frequency, building structure, placement of devices being tested, radiation angles and polarization of transmit/receive antennas. This variation is on the whole greater than the modest difference in loss versus frequency.

Path Loss versus Building Penetration:

This cited literature generally reports building losses in of two ways: as a path loss or as a building penetration loss.

Path loss is a function that specifies the loss that will occur between two isotropic antennas over a given distance and frequency. It is generally defined with the formula:

$$\text{Pathloss(dB)} = 32.45 + 20 \log_{10}(\text{FMHz}) + 20 \log_{10} (\text{distance_km})$$
$$\text{Pathloss(dB)} = -27.55 + 20 \log_{10}(\text{FMHz}) + 20 \log_{10} (\text{distance_meters})$$

[16] ReconRobotics, Inc., Spectrum Analysis for the "Recon Scout Device, *ex parte* filing in WP Docket 08-63, July 30, 2008.

The function of 20 $\log_{10}$ (distance) accounts for the fact that power density of a far-field wave propagating away from a source decays as the inverse of the distance squared. The function of 20 $\log_{10}$ (FMHz) accounts for the fact that the capture area of the isotropic antennas that are used as the reference in the path loss calculation becomes smaller as frequency increases.

This has often been misinterpreted to suggest losses in propagating a signal from one point to another increase with frequency. In reality, for a given amount of gain over isotropic, an antenna will have a smaller capture area with increasing frequency, thus *receive* less signal from a given propagating wave. When an antenna is used for transmit, however, the resultant power density at a distant point is independent of frequency. For a distant point, the power density of a propagating wave at that point is a function of the distance from the radiating source and the gain of the transmit antenna in the direction of that point. If antennas of equal capture area are used at different frequencies, the received signal levels at each frequency will be the same.

The impact of this on a particular real-world system depends on the antennas involved. If that system were constrained to use antennas of a particular gain over isotropic on different frequencies, the higher frequency will have a larger path loss and a lower received signal level. However, if on different frequencies, receive antennas can be made approximately the same physical size, in general, the capture area of antennas of similar size will be the same, so in that case, there would be no increased loss with increased frequency due to free-space propagation characteristics.

Building Loss

Other studies express propagation losses in terms of building penetration loss. This is a relative figure that compares the path loss between a signal radiating at some distance outside a building to the signal level measured or calculated just outside a building to the signal level inside the building. This calculation or measurement is independent of the capture area of the test antenna, and is thus independent of frequency. It is expressed only as a ratio, typically in dB.

In the far field of the radiating source the difference in distance for point just outside of a building and a point just inside the building is negligible, so the relative difference between a measurement made inside a building compared to the level outside the building is a function only of losses involved in the signal propagating through the building, through openings into and within the building and through and around various scattering objects found in building structures and environments.

Factors Influencing Building Penetration Measurements and Calculations

A study of the available literature on building penetration versus frequency show that there are a number of factors that influence how signals enter buildings and how signals propagate within a building. There is no single way to simply calculate what to expect,

and variations with frequency, building construction, floor level and distance within a building structure.

Most of the studies on this subject do not (and should not) rely on a few spot measurements at various locations within a building. A quick perusal of graphical data from studies that have done measurements at many points within a building – every 0.5 meters along a corridor, for example – show that a change in location of a meter or less can change the measured result by as much as 10-15 dB, as constructive and destructive effects from scatterers add to or decrease the field strength at various points within a building.

A study that measures only a few points inside a building is has not used sufficient points, and there is a very real likelihood of having many of the measurements enhanced or degraded by the scattering effects that impact the signal level at any point within that building. A measurement at a single point within a building is a valid measurement of the signal level at that point, but it is of little use in making decisions about necessary power level, best frequency to use for a particular application and other factors that may have prompted the need for the study in the first place. Even a study that selected a small number of points within a building will generally not have enough of those points be representative of the average propagation characteristics within that building. The variations between those points are generally going to be much greater than any result that may be inferred from the data associated with them.

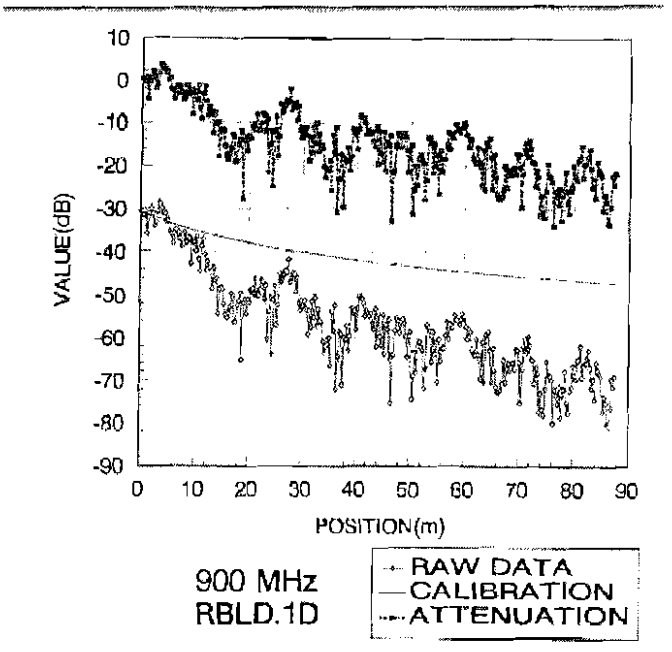

Figure 10. Raw data, free-space correction factor, and penetration attenuation versus distance for a typical 900-MHz measurement in the Radio Building.

Figure 1: These data, taken from NTIA Report 94-306, show that a change in location within a building of as little as 1 meter can change the strength of a measured or calculated signal by as much as 15 dB in this case. It is not possible to determine the characteristics of a building from a small number of data points.

Factors Within a Building that Influence Penetration Loss

In the studies done on UHF, considerable variation versus frequency was seen. In general, three major factors influence the way signals of different frequencies behave when penetrating a building or propagating within that building:

- Losses of signals passing through building material
- Losses (or gains) of signals passing through openings in that building
- Constructive and destructive reflections caused by scattering of signals by conductors and dielectric boundaries within the building

In general, losses from signals passing through building material increase with frequency. In cases where it is known that the primary propagation path of a particular signal will be through building material, a lower frequency would generally be a slightly better choice.

However, most of the literature on studies that have compared the results on multiple frequencies have determined that there is a slight advantage to higher frequencies in most cases, as these higher frequencies propagate better through building openings such as windows and doors, and propagate better around corners through scattering and reflection. This could offer a slight advantage to the upper part of the UHF range for propagation within a building, especially if signals were expected to propagate within a single floor. In cases where parts of a building may be damaged and partially collapsed, the physical size of openings could be reduced, giving a slight advantage to the upper part of the UHF range in getting signals around and through buildings in a significant state of internal disarray.

There is one natural advantage to higher spectrum for propagation within a building in indeterminate circumstances: As shown in Figure 1 above, the variation in propagation within a building versus distance within that building significantly exceeds any apparent advantage to one frequency versus another within the UHF range. The distance between the peaks and valleys in these data results is directly proportional to the wavelength of the frequency being measured. If a device transmitting within that building is by happenstance located at a null in the propagation, it will need to move a greater distance on the lower part of the frequency range to go from a location with poor propagation to a location where the scattering involved will add in phase and increase the signal strength by 15 dB or more. If that device were transmitting a video image and by happenstance located at a point of poor propagation, it would need to move only a short distance if it were operating on 900 MHz or 2.4 GHz, compared to the greater distance it would have to move on 430 MHz (probably needing to move farther away from the image on which the camera was focused).

In general, with most buildings exhibiting characteristics that encompass all phenomena that can influence propagation within that building, a more realistic conclusion would be that, on average, at least within a broad range that encompasses UHF (300-3000 MHz),

frequency is not the most important criterion to use in determining what is needed to transmit signals within a building.

Excerpts and Quotes from Individual Studies, Reports and Presentations

Planning parameters for hand-held reception — Tech 3317

Table 1.3.8: Building penetration loss

Band	Class B	
	Median value	Standard deviation
Band III	9 dB	3 dB
Bands IV/V	11 dB	6 dB
1.5 GHz Band	11 dB	6 dB

For Band III, the values are taken from the GE06 Final Acts [6].

For Bands IV and V, the values are taken from the ETSI DVB-H implementation guidelines [1], (where further information on building penetration loss can be found.)

Figure 2: This table, excerpted from Report EBU-Tech 3317, "Planning parameters for handheld reception[17]," Geneva, July 2007, show that there is no significant difference in propagation through a building exterior on Band III (200 MHz), Band IV and V (500 MHz and 800 MHz) and 1.5 GHz. Within a building, variations in propagation vs frequency will be determined by the size of the openings through which a signal must pass. In a building with large, open corridors, 200 or 500 MHz may have a slight advantage, but in a building in which that corridor has suffered some degree of compromise (partial collapse or other damage), it is likely that the higher frequencies will propagate better.

[17] This is available on the web at http://www.ebu.ch/CMSimages/en/tec_doc_t3317-2007_tcm6-48865.pdf.

'review this book | **Digital Audio Broadcasting** By Wolfgang

7.2.4 Building Penetration Losses at 230 MHz and 1.5 GHz

Field strength measurements were performed to derive typical figures for the building penetration losses in the frequency bands relevant to DAB.

Around 230 MHz, building penetration loss was measured in the UK [Green, 1992] and Germany [Schramm, 1996]. The UK results show that the building penetration loss varies between 2 dB and 18 dB on the ground floor of domestic buildings. Measurements on the first floor gave about 6 dB more field strength. The average loss was found to be 8 dB ± 1.2 dB. The German results basically support these figures. The penetration loss measured ranged from 3 dB to 20 dB and the median value for typical German buildings was found to be 9 dB at 220 MHz and 8.5 dB at 223 MHz with a standard deviation of 3.5 dB. The attenuation caused by a building located between an outdoor receiver and the transmitter was found to be 13 dB.

At 1.5 GHz, measurements in Australia have shown that the average building penetration loss for DAB in domestic dwellings averages 6.7 dB (ranging from 6.1 dB to 9.4 dB, depending on construction materials used) and is approximately 18.6 dB in reinforced concrete commercial buildings [DSB, 2002]. Measurements in a 1.5 GHz SFN were performed in the DAB pilot project at Dresden, Germany [Michler, 1998]. The field strengths in rooms at different floors of seven different buildings were measured. The buildings were all located in a zone where two or three transmitters contributed to reception. In most buildings the level difference between outdoor and indoor measurements was found to be 0 dB to 5 dB at upper floors and 8 dB to 15 dB at the ground floor. In a modern office building (a concrete-steel construction with metal coated windows), however, the corresponding values were 20 and 30 dB, respectively.

Figure 3: This selection from a book titled, *Digital Audio Broadcasting*[18] (Hoeg, Lauterbach), describes building-loss measurements made at 230 MHz and 1.5 GHz. The losses at 1.5 GHz were a few dB less than the losses at 230 MHz, with a much smaller range of value, indicating better reliability at 1.5 GHz.

[18] http://www.google.com/search?hl=en&safe=off&q=%22Digital+Audio+Broadcasting%22+Wolfgang