

WP 08-63

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Before the
Federal Communications Commission
Washington DC 20554

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Federal Communications Commission
Bureau / Office

In the Matter of)
ReconRobotics Inc.,)
Request for Waiver of Part 90 of the)
Commission's Rules to Provide for)
Limited Operation of a Public Safety)
and Security Device at 430-448 MHz)

No. _____

TO: Chief, Wireless Telecommunications Bureau

FILED/ACCEPTED

MAY - 6 2008

Federal Communications Commission
Office of the Secretary

WAIVER -- EXPEDITED ACTION REQUESTED

REQUEST FOR WAIVER

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January 11, 2008

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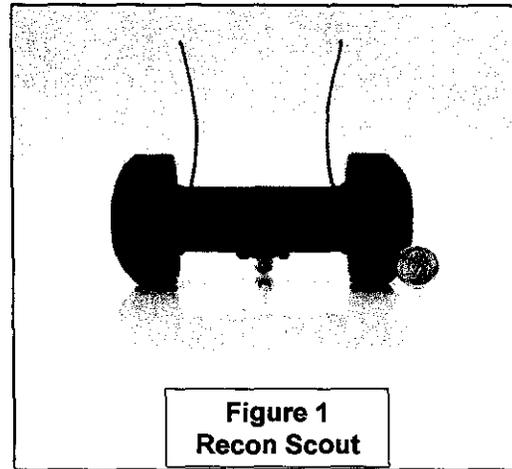
Pursuant to Sections 1.3 and 1.925 of the Commission's Rules, ReconRobotics Inc. requests a waiver of Part 90 of the Commission's Rules, subject to the conditions and limitations set out below, to permit certification and customer licensing of a small, remote-controlled, maneuverable surveillance robot for emergency use by state and local law enforcement and firefighting agencies, and by infrastructure security personnel in areas that may be too hazardous for human entry.¹

ReconRobotics requests an outcome that permits it to certify the device and allows an eligible user to license the device, without further proceedings.

¹ The Commission's Rules provide: "Requests for waiver of rules associated with licenses or applications in the Wireless Radio Services must be filed on FCC Form 601, 603, or 605." 47 C.F.R. Sec. 1.925(b)(1). If the Bureau deems that rule applicable to this request, then ReconRobotics seeks leave to file in the present pleading form so as to better address the multiple issues raised.

A. SUMMARY

ReconRobotics has developed a remote-controlled, maneuverable robot (see photo) capable of providing an operator located a safe distance away with video and audio, along with infrared, biological, chemical, heat, radiation, or other needed data. Called the Recon Scout®, the device is small enough -- and strong enough -- to



be thrown, dropped, or launched into hazardous areas. The U.S. military uses the Recon Scout in Iraq for IED inspection, forced entry reconnaissance, vehicle undercarriage inspection, rooftop searches, and other high-risk missions. The Recon Scout has been credited with saving the lives of military personnel in theater.

ReconRobotics is now preparing a civilian version for law enforcement officers and firefighters, and for investigating environmentally dangerous areas. Typical applications will include checking a building prior to forced entry; searching vehicle undercarriages for explosives; locating hostages, hostiles, officers, and bystanders before a rescue attempt; searching for survivors in a burning building; and inspecting the site of a chemical or nuclear release.

The military version delivers video to the operator in the 420-450 MHz radiolocation band. Performance is excellent. ReconRobotics has spent the past year trying to adapt the device to a Part 15 band for civilian use, but without success. The Part 15 bands that permit relatively high power -- 902-928 MHz, 2.4 GHz, and 5.8 GHz -- do not propagate well through building materials. Use of these frequencies would require additional power for building

penetration, and which in turn would require batteries that are too big and heavy for a throwable device. The ReconRobotics engineers have reluctantly concluded that a workable unit for non-Federal first responders must use frequencies below about 450 MHz.

Specifically, ReconRobotics requests a waiver to certify and license the Recon Scout at 430-448 MHz. The power level of 1 Watt peak (1/4 Watt average) is orders of magnitude below that of radiolocation devices currently licensed in the band. We show below why operation will not cause harmful interference to others.

Several user categories currently occupy 420-450 MHz. To minimize impact, ReconRobotics proposes to manufacture the device in three versions, corresponding to these operating frequencies:

Channel A: 442-448 MHz
Channel B: 436-442 MHz
Channel C: 430-436 MHz

All versions fully protect private land mobile operations at 422-430 MHz and wind profile radars at 448-450 MHz. Version A protects earth exploration satellite service operations and all amateur satellite downlinks. Both versions A and B protect the amateur satellite downlinks above 436 MHz. Only version C shares spectrum with the amateur satellite downlinks below 436 MHz.

ReconRobotics will ship the channel A version first to any customer, or to an operating sub-unit of a customer. Versions B and C will ship only as the second and third units, respectively. Similarly, the channel A version will always be the first (or only) device used at the site of an emergency. Version B will be deployed only if a channel A unit is in use on the scene, and so on for version C. All training will use channel A.

Amateur licensees who use the 435-438 MHz segment for satellite downlinks should not experience harmful interference from the Recon Scout. An earth station antenna, although highly sensitive along its main axis, is correspondingly *insensitive* to incoming signals from other directions. Since these antennas are angled high, to point at the satellite, they should not receive interference from a low power device near ground level. The Recon Scout shares spectrum with terrestrial amateur use, but its operation at a given site will be brief and, once completed, unlikely to recur at the same place. Combined with low-power operation, this effectively eliminates any realistic likelihood of harmful interference to amateur radio.

ReconRobotics proposes several conditions on the requested waiver to further minimize any risk of harmful interference to amateurs and other users of the band.

The very high public interest in making the Recon Scout available to first responders, and the very low risk of harmful interference, justify a grant of the waiver.

B. ABOUT RECONROBOTICS

ReconRobotics is a start-up company headquartered in Minneapolis, Minnesota. Its primary mission is to pursue the research, development, manufacturing, and sale of robotic unmanned systems within federal, state and local government, and commercial markets. The company's products include miniature robotic systems and distributed robotic teams designed specifically to provide real time information in hazardous or restricted space areas, for the military and emergency first-responders such as law enforcement and firefighters, and for use in environmentally hazardous areas, such as those contaminated by nuclear or chemical toxins.

ReconRobotics was originally formed to commercialize patented, field-proven technology developed in the University of Minnesota Distributed Robotics Laboratory under grants from DARPA and the National Science Foundation. The company also leverages its

patented miniature robotics technology to potentially produce an educational/research platform product for use by other universities and research facilities.

C. ABOUT RECON SCOUT

The requested waiver will permit certification and limited licensing of the Recon Scout -- a miniature robot designed specifically to perform reconnaissance and surveillance tasks in a variety of environments, including police actions, fires, urban warfare, hazardous material searches, hostage situations, and chemical or nuclear incidents. It can be maneuvered by remote control.

The Recon Scout qualifies as a "throwbot": small and lightweight for ease of portability, but rugged enough to survive deployment via mechanical launching or a drop from a low flying unmanned aerial vehicle. It can also be hand tossed into a building (even upper floors), tunnel, and other structures and spaces to provide reconnaissance back to the operator. Actual size is about that of a soup can: 17.8 cm (7 inches) long and 7.6 cm (3 inches) high at the wheel. Weight is 0.5 kg (just over one pound).

Packed into this small device are a video camera, microphones, and other sensors tailored to the application, short-range radio transmitter for conveying video and audio to the operator, and 75 MHz receiver for remote-control signals,² along with batteries, motors, and all necessary video, audio, and control circuitry. The engineering challenge is to fit all the necessary components into a small package that is strong enough, and has adequate shock absorption, to deliver the durability, reliability, and robustness needed to survive the inevitable rough treatment in the field, and still function perfectly every time.

² The 75 MHz operations comply with Part 95, Subpart C (Radio Control [R/C] Radio Service), and are not part of this request.

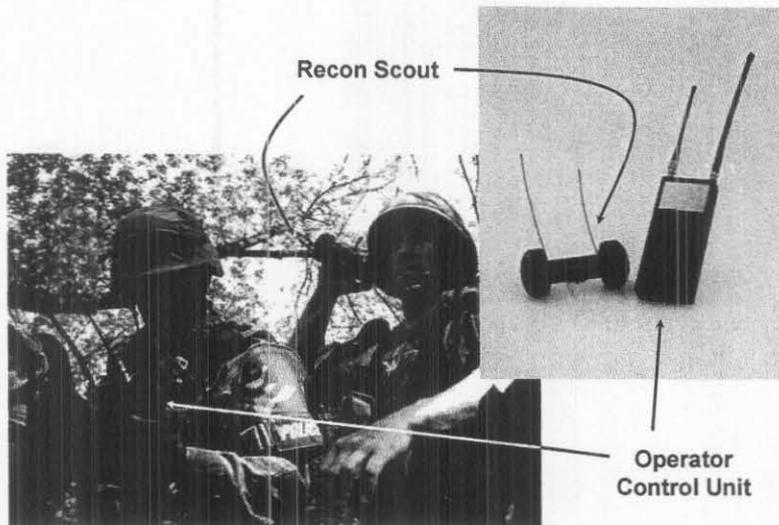


Figure 2
Field Testing the Recon Scout

For specialized applications, the robot is designed to carry, in addition to the video, sensors to provide infrared, biological, chemical, heat, radiation, or other data as needed.

An Operator Control Unit (OCU) sends maneuvering commands to the Recon Scout and receives video and audio back.

A third system aspect consists of a recharger for the Recon Scout and the OCU to support the lithium polymer batteries used to power the equipment.³

A military version of the Recon Scout has been experimentally deployed in Iraq for the past four years. During military testing, word of the device spread to domestic police forces,

³ The only FCC compliance issues raised by the recharger are its digital emissions, which comply with applicable limits.

S.W.A.T. and emergency response teams, and homeland security officials, who now see an important role for the device in reducing the exposure of their own people to harm.

D. NEED FOR WAIVER

The Recon Scout operates in part of the 420-450 MHz band. Extensive testing by the military shows the performance in this band to be excellent. The device is able to achieve adequate propagation through walls and other barriers at power levels low enough both to maintain a useful battery life and to minimize any threat of interference.

ReconRobotics has labored for the past year to develop a civilian version that could operate under Part 15 in the ISM bands. A waiver would still have been needed: the Part 15 rules require digital operation at the necessary power levels, while the Recon Scout must use analog modulation.⁴ Our first choice was 2400-2483.5 MHz, because the Commission previously issued a waiver in that band for analog video transmission.⁵ Second choice was 902-928 MHz. But after extensive testing, the company was forced to conclude that neither band yields adequate propagation at acceptable power levels. Many Recon Scout applications require

⁴ Analog is needed for three reasons. First, making the Recon Scout small and light enough to throw allows only five cubic centimeters and 15 grams for the transmitter. Use of a digital system and necessary peripherals would increase the size and weight beyond those limits; and that increase in turn would require further additions to the shock absorption system and the external housing, adding yet more size and weight. Second, digital video is prone to sudden cut-off at the edge of its range, which can be catastrophic in a law enforcement or hazmat emergency. Once the cut-off occurs, lack of video makes it impossible for the operator even to guide the robot back into range. A weak analog signal, in contrast, may produce a snowy or degraded image, but under the circumstances that is vastly more useful than no picture at all. Third, state and local law enforcement must often maintain a level of service incommensurate with their financial support. Despite grant funding (see Part B), the need for a digital transmitter would push the cost of the device beyond a price point accessible to all but the most affluent state and local emergency responders.

⁵ *Remington Arms Company, Inc.*, 20 FCC Rcd 18724 (2005).

transmission from within a building, such a structure on fire or the site of criminal activity. Because building walls attenuate more at higher frequencies, operation in the Part 15 ISM bands would require greater power for the same performance. Higher power in turn, together with the need for an adequate battery life, would call for bigger, heavier batteries. But the same design criteria that keep the device small and light enough to be dropped or thrown put severe limits on battery's physical properties. It has proved impossible to construct a device capable of transmitting from deep within a building on ISM frequencies, at power levels compatible with batteries of acceptable size and weight.⁶

In order to make the device available to law enforcement, public safety, and environmental hazard personnel, ReconRobotics requests permission to license the civilian device in the same part of the spectrum as its military counterpart, in the 420-450 MHz band. In particular, we seek to use 430-448 MHz, prioritized as described below, to communicate video and audio to the operator.

The 420-450 MHz band has an allocation for private land mobile radio service.⁷ The Commission has adopted service and technical rules for radiolocation systems,⁸ but these do not accommodate the Recon Scout device.

⁶ The Remington device (see preceding footnote) is able to use 2.4 GHz because it operates in a less demanding environment. The Remington device is not maneuverable. "[T]hrown like a baseball," *id.* at para. 2, it transmits from wherever it lands. The worst case for the Remington device (from a propagation standpoint) arises when is thrown through a door or window, where the signal may have to penetrate one building wall at most. The Recon Scout, in contrast, can be remotely driven deep into a structure, or even down a stairwell into a basement. The signal may have to pass through several walls to reach the operator. Successful operation at 2.4 GHz, or even 902-928 MHz, would require higher power, resulting in either batteries that are too big or a battery life that is too short.

⁷ 47 C.F.R. Sec. 2.106.

At these frequencies, an average power of 1 Watt peak (1/4 Watt average⁹) is enough to allow the Recon Scout to penetrate structural walls and, where necessary, to permit the operator to stand off at a safe distance. This is far below the radiolocation power levels used in this band.¹⁰

E. SPECTRUM USAGE

There is no vacant UHF spectrum. Any new operations must share frequencies with incumbents. The 420-450 MHz band is already successfully shared among several categories of users. With the precautions described below, ReconRobotics is confident that it can add to the mix without significantly increasing the risk of harmful interference. In all events, ReconRobotics recognizes its obligation to frame its waiver request and constrain its products' operation so as reduce any interference threat to negligible levels.

Figure 3 shows the present incumbents and the sub-bands where ReconRobotics proposes to operate.¹¹

⁸ 47 C.F.R. Sec. 90.103. Two-way radio operation is permitted at 422-430 MHz in three Great Lakes cities. 47 C.F.R. Sec. 90.273.

⁹ The maximum peak power is measured at 1 Watt. The peak-to-average ratio of analog video modulation is 6 dB, yielding an average power of 0.25 Watt.

¹⁰ A review of active radiolocation licenses in the Commission's ULS database shows 420-450 MHz transmitter powers ranging from 320 to 10,000 Watts.

¹¹ For clarity, the diagram omits some sub-categories of Federal usage.

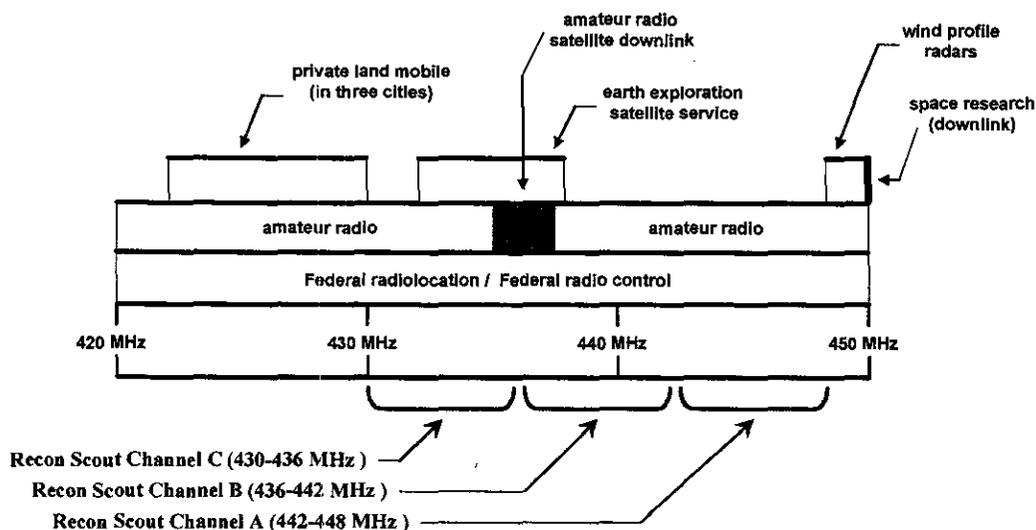


Figure 3
420-450 MHz incumbents and Recon Scout spectrum usage

The stringent size and cost limitations on the Recon Scout require that frequency usage be wired into each unit. Three different versions of the device will operate respectively on Channels A, B, and C:

- Channel A: 442-448 MHz
- Channel B: 436-442 MHz
- Channel C: 430-436 MHz

This arrangement allows a channel priority structure for the protection of other spectrum users, as described below.

All three versions fully protect the private land mobile operations at 422-430 MHz in Detroit MI, Cleveland OH, and Buffalo NY,¹² and also the federal wind profile radars at 448-450 MHz.¹³ The channel A version completely protects the earth exploration satellite service

¹² 47 C.F.R. Sec. 90.273.

¹³ 47 C.F.R. Sec. 2.106 note G129.

operations at 432-438 MHz and all amateur satellite downlinks.¹⁴ Both versions A and B protect the amateur satellite downlinks above 436 MHz. Only Version C shares spectrum with the amateur satellite downlinks below 436 MHz.

Even where operation is co-channel, interference into amateur earth stations is extremely unlikely. The earth stations require high-gain antennas to receive weak signals from satellites, and nearly always operate at angles of elevation well above the horizontal. Such antennas are highly sensitive along the main axis, but are necessarily *insensitive* to sources well away from the main axis. The Recon Scout will be used most often at or near ground level, at inherently low power levels. Even in the very unlikely event that an amateur earth station azimuth happens to point directly toward an operating Recon Scout unit, the antenna will be aimed well above the unit, and so will not detect it. Harmful interference into an amateur earth station is all but impossible.

The entire 420-450 MHz band is allocated for terrestrial amateur operations. Amateur transmitters operate at powers higher than the Recon Scout by tens of dB, so that any interference should be rare. Still, we cannot absolutely rule out occasional, brief interference into an amateur receiver that is straining to pick up a distant signal. And we recognize that the Part 90 allocation in this band is secondary to amateur radio,¹⁵ obligating ReconRobotics to avoid causing harmful interference.

¹⁴ 47 C.F.R. Sec. 2.106 note US397 (EESS); 47 C.F.R. Sec. 97.207(c)(2) (amateur downlinks at 435-438 MHz).

¹⁵ 47 C.F.R. Sec. 90.103(c)(21).

The Commission defines harmful interference as "[i]nterference which . . . seriously degrades, obstructs, or repeatedly interrupts" licensed radio communications.¹⁶ The low power of the Recon Scout and the short-term, emergency-only nature of its operation together ensure that any interference that does occur will be transitory and brief, well below the threshold for harmful interference.

The amateur radio community is known and respected for its tradition of working closely with first responders in times of crisis. Amateurs are well positioned to recognize the importance of technology that improves the odds for first responders, and to balance that public-interest benefit against a realistic assessment of the interference threat to receivers.

Channel priorities. The first unit sold to a responding organization -- often the only unit -- will always be on channel A. Subsequent units may be sold on all three channels.

Operationally, however, channel A will always be the primary channel deployed when responding to an emergency. Channel B will be used only where interference from another Recon Scout eliminates channel A; and similarly, channel C will be used only where nearby units eliminate channels A and B. Use of channel B, and especially channel C, should be rare.

All training will use channel A, unless circumstances on the ground make it unavailable. We expect this likewise to be rare.

Multiple organizations operating under the same umbrella will be issued multiple channel A units before receiving any on channels B or C. For example, a municipality equipping four S.W.A.T. teams will receive four units on channel A. Only if a particular team orders a second

¹⁶ 47 C.F.R. Sec. 2.1(c).

unit would it receive one on channel B, and only on a third order would the company ship a channel C unit.

Taken together, the combination of emergency-only infrequent usage, low power, limitations on numbers of units in the field, and low probability of channel B or C operation will minimize any risk of harmful interference to other users.

F. REQUEST FOR WAIVER

No one section of the Commission's Rules prohibits operation of the Recon Scout at the requested frequencies. But neither does any provision in Part 90 specifically authorize such operation.¹⁷ ReconRobotics therefore requests a waiver of the Part 90 rules as necessary to permit operation as described here. Affected rules might include Sections 90.20 and 90.35 on frequency usage, and the applicable technical rules on power, modulation, and bandwidth.¹⁸

We note that amateur radio operations are permitted throughout the 420-450 MHz band at either 1500 Watts or 50 Watts PEP, depending on location.¹⁹ In principle these operations are secondary to Federal radiolocation.²⁰ In practice, however, the ubiquity of amateur stations, both fixed and mobile, would make it difficult to locate and shut down a station that causes harmful interference. The general success of the sharing arrangement suggests that actual harmful interference from amateur stations to Federal radiolocation systems must be very rare. We

¹⁷ As noted, the only private land mobile radio service in this band contemplated under the rules is radiolocation. *See* 47 C.F.R. Sec. 90.103.

¹⁸ *See* 47 C.F.R. Secs. 90.205(q) (power), 90.207 (modulation), 90.209 (bandwidth).

¹⁹ 47 C.F.R. Secs. 97.313(b), (f).

²⁰ 47 C.F.R. Sec. 97.303(b).

submit that harmful interference from the Recon Scout devices, at far lower power and in far fewer numbers, should be rarer still.

Similarly, the Recon Scout uses much less power than radiolocation transmitters in the same band operating at hundreds or thousands of Watts.²¹ If those can coexist with the primary users, then the Recon Scout certainly can as well.

G. PUBLIC INTEREST CONSIDERATIONS

The public interest benefits of the requested waiver need no elaboration. By providing real-time information about hidden threats in dangerous environments, Recon Scout will save lives of first responders, hostages, and bystanders. Examples:

- checking the interior of a building prior to forced entry by police;
- active shooter identification;
- remote undercarriage inspection for explosives;
- S.W.A.T. team ascertaining the positioning of hostages, hostiles, officers, and bystanders prior to a rescue attempt or forced entry;
- firefighters checking for survivors in a burning building before risking their own safety;
- hazmat workers seeking to secure the site of a chemical or nuclear release, while minimizing exposure to their personnel.

We respectfully submit that the near-negligible risk of harmful interference to other users, coupled with the undeniable benefits to first responders and security personnel, justify a grant of the requested waiver.

²¹ See ULS database entries for call signs KNIQ269, KNCL880.

H. PROPOSED WAIVER CONDITIONS

To further limit any risk of interference, ReconRobotics proposes to abide by the following waiver conditions:

- ReconRobotics will limit availability of the Recon Scout to (1) state and local law enforcement and firefighting agencies (but not others) eligible for licensing under the provisions of Section 90.20(a)(1) of the Commission's Rules; and (2) security personnel in critical infrastructure industries, limited to use in areas that are hazardous for entry by human personnel, such as those contaminated by nuclear, chemical, or other environmental toxins.
- Any offer for sale or lease of the device will include the following statement: "This device has been authorized by the Federal Communications Commission for use only by state and local law enforcement and firefighting agencies eligible for licensing under the provisions of Section 90.20(a)(1) of the Commission's Rules, or for use by security personnel in areas that are environmentally hazardous to humans, and for training of these users. This device has not been authorized and may not be used by other entities or for other purposes."
- The Recon Scout will be used only in actual emergencies involving threats to safety of life and for necessary training. All operation will use the minimum number of units and the minimum duration consistent with human safety. The device will not be used for permanent or fixed operations. These restrictions will be clearly and conspicuously noted in all instructions and training materials for the Recon Scout. Such materials will also carry a clear and conspicuous warning that failure to comply with the restrictions could result in harmful interference to other spectrum users and to withdrawal of operating authority by the FCC.
- ReconRobotics will ship versions of the Recon Scout that use channels A, B, and C in that order of priority to each customer, and similarly to each operating sub-unit of a customer. Users will be instructed to deploy units in the same order of priority, and to conduct training only on channel A.
- The Recon Scout will operate secondary to Federal users, secondary to the Amateur Radio Service, and on a co-equal basis with other non-Federal users, except that the Recon Scout does not seek interference protection from any licensed user.
- ReconRobotics will limit marketing under the waiver to not more than 2,000 Recon Scout units during the first twelve months following

certification, and not more than 8,000 units during the second twelve months.

I. LEGAL BASIS FOR WAIVER

The Commission assesses waiver requests according to the standards set out in *WAIT Radio v. FCC*.²² In that case, as here, the applicant sought to operate in contravention of the rules while explaining how it would nonetheless accomplish the purpose of the rules.²³ The court required the Commission to consider the request:

[A] general rule, deemed valid because its overall objectives are in the public interest, may not be in the "public interest" if extended to an applicant who proposes a new service that will not undermine the policy, served by the rule, that has been adjudged in the public interest.²⁴

The plain meaning is clear: Waiver is appropriate where the applicant furthers the public interest inherent in the underlying rule. ReconRobotics unquestionably does so here. The waiver is consistent with the purpose of the Part 90 rules as to protecting federal 420-450 MHz users from harmful interference. And, of course, the Recon Scout will directly further the public interest by reducing the risks faced every day by law enforcement and other emergency personnel. The requested waiver fits easily into the boundaries drawn by *WAIT Radio*.

The Court of Appeals emphasized the importance of waiver procedures as part of the regulatory scheme:

²² 418 F.2d 1153 (D.C. Cir. 1969). *E.g.*, 2002 Biennial Regulatory Review, 18 FCC Rcd 13620 at para. 85 n.130 (2003) (citing *WAIT Radio* as "setting out criteria for waivers of Commission rules.")

²³ *WAIT Radio* operated an AM broadcast station. It was limited to daylight hours so as to afford protection to "white areas" that had no local service, and that relied on nighttime skywave propagation from another station. *WAIT Radio* proposed to transmit at night using a directional antenna that would limit its signal in the white areas. *WAIT Radio v. FCC*, 418 F.2d at 1154-55.

²⁴ *WAIT Radio v. FCC*, 418 F.2d at 1157.

The agency's discretion to proceed in difficult areas through general rules is intimately linked to the existence of a safety valve procedure for consideration of an application for exemption based on special circumstances.²⁵

Thus, it said, "allegations such as those made by petitioners, stated with clarity and accompanied by supporting data . . . must be given a 'hard look.'"²⁶

Here, too, the request fully qualifies. The "safety valve" of the waiver procedure is needed to make available an important tool for law enforcement. The requested waiver is in the public interest, not only in terms of great benefits to the public, but also in the absence of any likely increase in harmful interference. The request is entitled not only to the "hard look" mandated in *WAIT Radio*, but to a grant of the waiver.

CONCLUSION

The Recon Scout is unquestionably in the public interest. The device will give police, firefighters, and hazmat personnel the ability to evaluate hazardous situations before risking their own safety. The combination of low power, severely restricted applications, and limited numbers of units in the field will eliminate any realistic likelihood of actual harmful interference.

²⁵ *Id.*

²⁶ *Id.* (citation footnote omitted).

We ask the Commission to grant the requested waiver at the earliest possible time.

Respectfully submitted,

/s/

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703-812-0440
Counsel for ReconRobotics Inc.

January 11, 2008

TECHNICAL CERTIFICATION

I am a technically qualified person who reviewed the foregoing "Request for Waiver" of ReconRobotics Inc.

I certify that the technical statements therein are correct to the best of my knowledge.


(signature) 1/3/2008 (date)

Ian Burt
Senior R&D Engineer
ReconRobotics Inc.

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