

Before the
Federal Communications Commission
Washington DC 20554

In the Matter of	)	
	)	
L-3 CyTerra, a Division of L-3	)	No. _____
Communications Corporation,	)	
Request for Waiver of Part 90	)	
of the Commission's Rules	)	

TO: Chief, Wireless Telecommunications Bureau

WAIVER – EXPEDITED ACTION REQUESTED

REQUEST FOR WAIVER

February 22, 2008

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Pursuant to Sections 1.3 and 1.925 of the Commission's Rules, L-3 CyTerra ("CyTerra"), a division of L-3 Communications Corporation, 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 the "EMMDAR II" device for public safety and homeland security.¹

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

A. SUMMARY

CyTerra manufactures the EMMDAR II, a handheld radar capable of sensing motion through walls. The device can detect not only someone walking, but even the minimal breathing movements of an unconscious person. A graphic display reports the ranges and directions of multiple targets.

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 CyTerra seeks leave to file in the present pleading form so as to better address the multiple issues raised.

Police will use the EMMDAR II to locate suspects or hostages prior to attempting a forced entry. Prison personnel can scan behind walls and inside trucks to detect escapees. Firefighters can locate victims of a fire or a building collapse, even under a foot of rubble. EMMDAR II will save lives.

Most radars transmit and receive on a single frequency. EMMDAR II is different. Operating at low power, about 1/8 milliwatt average, it steps through 200 equally spaced frequencies, spaced 2 MHz apart from 3101 to 3499 MHz, one at a time. The multiplicity of frequencies allows unambiguous readings in the presence of reflected signals. Reliability and precision of target location improve as the number and spacing of frequency steps increase. The use of 200 steps over 3100-3500 MHz is a compromise among range, precision, battery drain, and spectrum use.

Dwell time on each frequency is 75 μ s, with an "off time" between steps of 17.5 μ s. The complete cycle repeats every 18.5 ms, yielding a duty cycle on any one frequency of 0.41%. The average power is -8.9 dBm (130 microwatts). Peak instantaneous power is +15 dBm (32 milliwatts).

The unit can accurately locate moving targets in one second and immobile (breathing) targets in less than three seconds. Each activation during a search may last upwards of 10 seconds, but can never exceed one minute, due to an automatic cut-off.

The 3100-3500 MHz band is allocated for private radiolocation, secondary to federal radiolocation. Other secondary uses are amateur and amateur satellite operations at 3300-3500 MHz, and federal and private earth-exploration satellite and space research at 3100-3300 MHz. (This last category includes seldom-used radio astronomy bands.) Despite the appropriate

allocation, a waiver is needed because the EMMDAR II's innovative frequency usage is inconsistent with the Commission's technical rules.

The EMMDAR II's low power, low duty cycle, and very sparse deployment (see below) eliminate any realistic likelihood of harmful interference to other users. Considering that large numbers of amateur stations coexist successfully with federal radiolocation, a few EMMDAR II units doubtless can do so as well. If necessary, CyTerra will coordinate around specific sites, such as radio astronomy telescopes that observe in the 3100-3500 MHz band.

Harmful interference into amateur facilities should not occur. The most sensitive amateur receivers in the band are satellite downlink earth stations. But these necessarily use high-gain, narrow-beam antennas angled upward, while EMMDAR II will be at or near ground level, and so should always be well below the earth station boresight. Although in principle terrestrial amateur receivers close to an active EMMDAR II operation may detect brief and fleeting signals, this is unlikely in practice. Spaced 2 MHz apart, EMMDAR II signals have a low probability of falling in the passband of a given amateur receiver. Moreover, only a small number of EMMDAR II units will be sold. Each will be operated infrequently, for short time periods, and rarely (if ever) at the same place twice. Any signals that amateur receivers do pick up will not rise to the level of harmful interference.

CyTerra proposes several conditions on the waiver to ensure that any interference potential remains minimal. These include limiting sales to state and local police and firefighters; limiting use to safety-of-life emergencies and training for same; prohibiting use outdoors above ground level or on fixed outdoor infrastructure; delivering a maximum of 5,000 units during the

first year and 10,000 units during the second year; and coordinating with the Federal government for particular sites, if necessary.

The very high public interest in the EMMDAR II's life-saving potential, combined with the remote likelihood of harmful interference, amply justifies a grant of the waiver.

B. ABOUT CYTERRA

CyTerra specializes in threat detection for military, commercial, and homeland security applications. Its products locate concealed threats in a variety of landscapes, providing users with enhanced awareness of the environment and greater confidence in their security. For more than twenty years, CyTerra engineers have pioneered trace explosive detection technologies, land mine detectors, and counter-terrorism products and, additionally, are seasoned experts in ground-penetrating radar, signal processing, and systems engineering. Among CyTerra's clients are the United States Army, United States Marine Corps, Defense Advanced Research Projects Agency, and Department of Homeland Security.

L-3 CyTerra is part of L-3 Communications Homeland Security Group, which also includes L-3 divisions Security and Detection Systems, and SafeView.² The group develops solutions in support of airport, cargo, and facility security; deepwater and port security; U.S. Customs and Border Protection; law enforcement and first responders; crisis management planning and exercises; and protection of U.S. airspace. Major products include explosives detection systems, maritime radars and monitoring systems, cargo screeners, mine detectors,

² The Commission granted a Part 15 waiver to CyTerra's sister division SafeView on August 4, 2006, in DA 06-1589. That waiver bears no relation to the one requested here.

video surveillance systems, thermal imaging cameras, weapon sights for law enforcement, and infrared defense systems.

C. ABOUT THE EMMDAR II DEVICE

The EMMDAR II (ElectroMagnetic Motion Detection And Ranging) device is a compact (10.5"L x 3.6"W x 3.5"H), light-weight (1.5 lbs) handheld sensing device able to "see through walls" into structures. It can detect both fast movement, such as a person walking or running, and very small movement, such as the breathing of an unconscious victim or the slight sway of a person trying to stand still.

In use, the operator places the device against the wall of a structure and depresses the scan buttons. Within one second for moving targets, or three seconds for near-stationary targets, the graphic display shows the ranges and directions of multiple targets. A rear-looking receive antenna eliminates false targets due to reflections.³



1. Potential applications

The EMMDAR II device delivers information critical to public safety and homeland security operations that is not available in any other way. It has two broad categories of applications: accurately locating hostile persons or hostages prior to a forced entry; and

³ Although the descriptions here focus on the EMMDAR II, the requested waiver will also cover a simpler version called the EMMDAR (without the "II" suffix). This model has transmission characteristics identical to the EMMDAR II. The only differences lie in the receive circuitry and user interface. The EMMDAR can locate only one target at a time, and indicates its range but not its direction.

accurately locating unconscious or restrained persons. These capabilities greatly increase the probabilities for survival of hostages, victims, and rescuers alike.

Police S.W.A.T. or fugitive teams will use the EMMDAR II prior to entry to confirm that subjects are inside a dwelling, and to locate the room they are in. Police can observe and record the pattern of suspects' movements to gain entry at the safest time. Where a site has multiple structures, the EMMDAR II can expedite the search by identifying those that are empty.

In a hostage situation, law enforcement authorities can scan a structure from different positions for "breathers" and "movers," exploiting the assumption that hostages are generally kept from moving about.

The EMMDAR II can aid searches in cases of suspected prison escapes by scanning hidden passages behind walls, and can scan outbound vehicles or trucks to ensure that convicts have not hidden in the cargo.

Fire departments can use the EMMDAR II to quickly locate incapacitated victims at the scene of a fire or accident. Current practice has firefighters follow the "right hand rule" on entering a building: a room-by-room search in a counter-clockwise direction. While thorough, this procedure consumes precious time not needed when searching with the EMMDAR II. The device can also help locate downed firefighters after a structural collapse. Current firefighter tracking devices give locations only to within about 6 meters, which could place the victim in any of multiple rooms. The EMMDAR II, in conjunction with current equipment, can pinpoint locations much more precisely.

Similarly, Search and Rescue teams can use the EMMDAR II to detect surviving victims under non-metallic piles of rubble, through up to 12 inches of concrete or similar material. The

wide beam angle of the EMMDAR II can efficiently search a large area, and then pinpoint victims by moving the device in a systematic pattern while tracking distances to the target.

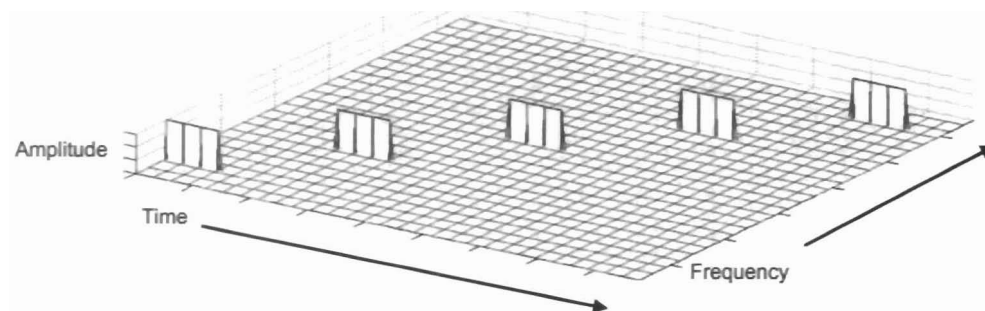
The EMMDAR II is invaluable in any emergency situation that requires the prompt location of either adversaries or victims.

2. *Technical description*

The EMMDAR II is an unconventional radar device. Like any other radar, it emits short pulses of radio-frequency energy, receives reflected signals, and processes the received signal to derive information about the reflecting body's distance, location, and other characteristics.

The EMMDAR II is unusual in employing stepped frequencies. It emits brief pulses successively on 200 different frequencies at equally spaced steps, 2 MHz apart, from 3101 to 3499 MHz. Dwell time on each frequency is 75 μ s, with an "off time" between steps of 17.5 μ s. The complete cycle repeats every 18.5 ms, yielding a duty cycle on any one frequency of 0.41%.⁴

The average power is -8.9 dBm. Peak instantaneous power is +15 dBm.



⁴ Duty cycle is the proportion of time that a device is operating on a given frequency.

EMMDAR II's unique software algorithms provide filtering that allows detection of even very slight movement, such as the chest motions of a person breathing.

The stepped-frequency signal offers important advantages over more conventional methods. Stepping vastly improves both resolution and sensitivity, allowing detection and discrimination of very small movements. This is essential for detecting injured or unconscious individuals. Equally important, stepped frequencies allow rapid calculation of velocity, direction, and range of the target, important for identifying and locating either injured victims or hostile persons. But the device emits a only single frequency at a time, which provides for the use of economical, high-precision hardware.

The number of frequencies needed is dictated by the environments in which the device must operate. Traditional radar systems use line-of-sight over long distances, so that reflection and multipath effects are inconsequential.⁵ The EMMDAR II, in contrast, typically radiates its signal into structures consisting of multiple rooms. The combined multipath effects become extremely complex. If the EMMDAR II used just a single frequency, the multiple reflected waves would have a high probability of showing destructive interference -- *i.e.*, of combining so as to cancel each other out. The solution is to increase the number of frequencies, with an adequate step size between them. The various frequencies have different wavelengths that cancel at different distances. In consequence, as the frequency steps become wider and more numerous,

⁵ "Multipath" refers to radio waves reaching the receive antenna by reflecting from objects in the environment. Because they travel over different distances, the reflected signals tend to arrive at different times, which obscures or even destroys the information they carry. A once-familiar example of multipath effects is the "ghosting" of TV images. This occurs when a TV signal reflected from a building arrives a fraction of a second after the main signal. In areas where multiple buildings cause complex reflections, the picture may be indecipherable.

the reliability and precision of detection go up. The use of 200 frequencies at 2 MHz spacing is an engineering compromise that provides satisfactory performance at minimum power, while encroaching on minimum spectrum.⁶

The need for multiple, well-spaced frequencies rules out unlicensed operation in the Part 15 band at 2.4 GHz. The 83.5 MHz of bandwidth available there would limit resolution to about 6 feet, which is too coarse for reliably locating a target in a particular room. The reduced resolution would also impair the ability to detect unconscious persons. The 902-928 MHz band is worse, with only 26 MHz. Although more bandwidth is available in the 5.8 GHz unlicensed band, poor propagation and building penetration make those frequencies unworkable for the EMMDAR II.

3. *Limitations on deployment*

Section F, below, proposes conditions on the waiver to minimize any realistic likelihood of harmful interference. Some of those derive from the practical considerations described here.

At the outset, CyTerra will limit the availability of EMMDAR II devices under the waiver to state and local governmental law enforcement and firefighting authorities. There will be no private owners.

⁶ **TECHNICAL NOTE.** The EMMDAR II unit functions by emitting a controlled power stepped-frequency pulse at nominal 54 Hertz rate. Due to the inherently narrowband instantaneous transmission, the receiver employs an economical superheterodyne input down converter design along with a very narrow band filter to provide the essentially DC input to the data processing portion. The data processor accepts the digitized quadrature DC levels and applies Fourier analysis to convert time-delay into range and received signal phase into Doppler shift. This formulation is a computationally efficient method of matched filtering for simultaneous range-Doppler hypotheses. These range-Doppler representations form the basis for signal detection and discrimination across the multiple repeats of the received reflections of the stepped-frequency transmissions.

The EMMDAR II device is useful primarily in emergency situations. Users will have every incentive to finish with the device and resolve the emergency as quickly as possible. Unnecessarily prolonged use is against everyone's interest.

We expect police S.W.A.T. teams to use the device prior to entry of a building, typically about 2-3 activations lasting approximately 45-60 seconds each. Once inside, if circumstances warrant, police might use the device again to search for hidden suspects. In the worst case, this might entail 15-20 shorter activations of 10-15 seconds each, partially shielded by external building walls.

Patrol officers arriving on the scene of a suspected burglary can use the device to determine if the suspect is still inside before attempting entry -- perhaps four activations, each in the 45-60 second range.

We expect firefighters to use the device on arrival at the scene for initial search of a building, in conjunction with thermal imaging cameras. This application would require 10-15 activations for approximately 15 seconds at a time.

Although the unit detects moving targets in approximately one second and immobile (breathing) targets in about 2.5 seconds, our studies show that users tend to scan for longer intervals (as above) to increase confidence. We expect that more experienced users will use shorter scan times.

Typical applications will have only one unit at the scene. As a practical matter, only one device can operate at a time at a given site, as they otherwise tend to interfere with one another.

Training in use of the device will track the above scenarios. Only one unit will be available to each training group, to eliminate any chance of multiple simultaneous operation.

CyTerra will provide a specific training manual and course with the units, including a briefing on operation to minimize interference to other users.

D. REQUEST FOR WAIVER

Part 90 of the Commission's Rules does not anticipate the stepped-frequency signal used by the EMMDAR II. For that reason, CyTerra requests a waiver of the rules as needed to permit certification and operation as described here. Affected rules might include the applicable technical provisions on modulation and bandwidth.⁷

1. Power considerations

The Commission's Rules have no measurement procedure for stepped frequency equipment such as the EMMDAR II.⁸ When EMMDAR II emissions are observed using the Commission's prescribed 1 MHz minimum measurement bandwidth,⁹ no stepping is apparent. The stepping frequencies are 2 MHz apart -- wider than the measurement bandwidth -- so that only one EMMDAR II frequency is visible during a measurement. The instrument sees brief, intermittent emissions at a single frequency, silent 99.6% of the time.

See 47 C.F.R. Secs. 90.207(k) (modulation) ("For radiolocation operations . . . any type of emission may be authorized upon a satisfactory showing of need"), 90.209 (bandwidth).

⁸ The Part 15 rules require that *swept* frequency equipment be measured with the sweep stopped, 47 C.F.R. Sec. 15.31(c), but even Part 15 has no corresponding requirement for stepped devices.

⁹ 47 C.F.R. Sec. 15.35(b). Again, this is a Part 15 rule, but the Commission might reasonably apply it in the absence of a specific rule for Part 90 equipment.

Over an integration of time of 18.5 ms or longer, the average power is only 130 microwatts (−8.9 dBm).¹⁰

The EMMDAR II peak instantaneous power of 31.6 mW (+15 dBm) is far below the power limit for the 3300-3500 MHz segment.¹¹ There is no specific peak (or average) limit for the 3100-3300 MHz segment.¹²

2. *Interference Issues*

The band sought to be used by the EMMDAR II has the following allocations and users:

- 3100-3500 MHz: Federal radiolocation (primary);¹³
- 3100-3500 MHz: private radiolocation (secondary);¹⁴
- 3100-3300 MHz: Federal and private earth-exploration satellite, space research (secondary);¹⁵
- 3300-3500 MHz: amateur 9 cm band (secondary).¹⁶

¹⁰ This value results from multiplying the instantaneous peak power of +15 dBm by the single-frequency duty cycle of 0.41%. The applicable integration time under Part 15 is 100 ms, 47 C.F.R. Sec. 15.35(c), longer than the EMMDAR II stepping cycle of 18.5 ms.

¹¹ See 47 C.F.R. Sec. 90.103(c)(13) (5 Watt power limit).

¹² 47 C.F.R. Sec. 90.205(q) (requested transmitted power considered and authorized on case by case basis).

¹³ 47 C.F.R. 2.106.

¹⁴ 47 C.F.R. Sec. 90.103(b). Operations at 3300-3500 MHz are limited to 5 Watts peak power into the antenna. 47 C.F.R. Sec. 90.103(c)(13).

¹⁵ 47 C.F.R. Sec. 2.106. The bands 3260-3267, 3332-3339, 3345.8-3352.2 MHz. are identified for radio astronomy, 47 C.F.R. 2.106 n.US342, but we understand that very few facilities make observations in these bands.

¹⁶ 47 C.F.R. Sec. 97.301. The sub-band 3400-3410 MHz is used for amateur satellite uplink and downlink operations.

The low power and sparse numbers of EMMDAR II devices to be authorized under the waiver (see proposed limits in Part F, below) ensure that any likelihood of harmful interference will be remote.

Concerning interference into Federal operations, we note that amateur radio stations are permitted throughout the 3300-3500 MHz band at 1500 Watts PEP, secondary to Federal radiolocation. The ubiquity of amateur stations 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 submit that harmful interference from the EMMDAR II devices, at far lower power and in far fewer numbers, should be rarer still.

If the Commission requires it, CyTerra will agree to prior coordination with the Federal government for operation within specified distances of particular sites, such as radio astronomy telescopes observing in the 3100-3500 MHz bands.

Interference into amateur receivers should also be rare, considering that amateur transmitters operate at powers higher than the EMMDAR II by tens of dB. 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 co-secondary to amateur radio, obligating CyTerra to avoid causing harmful interference.

The Commission defines harmful interference as "[i]nterference which . . . seriously degrades, obstructs, or repeatedly interrupts" licensed radio communications. The low power of the EMMDAR II 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.

Interference into amateur satellite earth stations should not occur. The earth stations require high-gain antennas to receive weak signals from the 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 in other directions. The EMMDAR II will be used at or near ground level, at low power levels. Even in the very unlikely event that an amateur earth station azimuth happens to point directly toward an operating EMMDAR II, 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.

As others have noted, 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 amateur receivers.

E. PUBLIC INTEREST

The Commission has never required a waiver proponent to show an absolute zero probability of interference. Indeed, that would be impossible into today's radio-frequency environment. The proponent does have the burden of framing its request so as to reduce any risk of interference to an acceptable minimum, and further, of showing that the public interest in the waiver justifies any residual risk. CyTerra has amply met both of these burdens.

Although other devices share some of the EMMDAR II's characteristics, its particular combination of capabilities is unique. The device gives first responders an irreplaceable tool that can save lives -- of hostages, accident and fire victims, and of law enforcement and firefighting personnel themselves. First responders risk their personal safety every day to protect the rest of us. There is no more important public interest than in making available the equipment they need to minimize their risk.

Thanks to its choice of frequencies, low power, low duty cycle on each frequency, and restrictions on users and applications, the EMMDAR II device presents an extremely small threat of harmful interference to other users. The enormous public interest in the device easily justifies that very small threat.

F. PROPOSED WAIVER CONDITIONS

CyTerra proposes the following conditions on a waiver grant to help ensure that any threat of harmful interference from waived units remains acceptably small:

- Marketing limited to state and local governmental law enforcement and firefighting authorities. Resale prohibited by contract except within this same category of users.
- Use limited to genuine safety-of-life emergencies and training for same.
- Unit operates only while its activation button is depressed. Unit cannot be locked on.
- Unit automatically disables after one minute of continuous operation (in case button is accidentally jammed in the "on" position).
- Units may not be used outdoors above ground level or on fixed outdoor infrastructure.

- A maximum of 5,000 units marketed under the waiver during the first 12 months following certification, and 10,000 units during the second 12 months.

As noted above, CyTerra will also accept prior coordination with the Federal government for operation within specified distances of particular sites, such as radio astronomy receivers observing in the 3100-3500 MHz bands. Any such requirement should include a reasonable time limit for objections to coordination,¹⁷ and a provision for operating without coordination in emergency situations involving the safety of life or property.¹⁸

G. WAIVER STANDARD

The Commission assesses waiver requests according to the standards set out in *WAIT Radio v. FCC*.¹⁹ In that case, as here, the applicant sought to operate in contravention of the rules while explaining how it would accomplish the purpose of the rules by other means.²⁰ 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

¹⁷ See, e.g., 47 C.F.R. Sec. 15.525(f) (time limit of 15 business days for coordination of ultra-wideband imaging systems).

¹⁸ *Id.*

¹⁹ 418 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.")

²⁰ *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 keep its signal out of the white areas. *WAIT Radio v. FCC*, 418 F.2d at 1154-55.

applicant who proposes a new service that will not undermine the policy, served by the rule, that has been adjudged in the public interest.²¹

The plain meaning of the passage is clear: Waiver is appropriate where the applicant maintains the public interest in the underlying rule. CyTerra does so here. The waiver is consistent with the purpose of the Part 90 rules as to protecting federal 3100-3500 MHz users from harmful interference. Equally important, the EMMDAR II device will directly further the public interest by enhancing the safety of first responders and victims needing rescue. The requested waiver thus fits easily within the boundaries drawn by *WAIT Radio*.

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

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.²²

Thus, it said, "allegations such as those made by petitioners, stated with clarity and accompanied by supporting data . . . must be given a 'hard look.'"²³

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

²¹ *WAIT Radio v. FCC*, 418 F.2d at 1157.

²² *Id.*

²³ *WAIT Radio v. FCC*, 418 F.2d at 1157 (citation footnote omitted).

CONCLUSION

The EMMDAR II offers a badly-needed tool to enhance the safety of first responders and victims. The only obstacle to its prompt deployment is a technical inconsistency with the provisions of Part 90. As shown above, however, the device does not present a significant threat of harmful interference to other spectrum users, thanks to a combination of technical characteristics and operational restrictions. Taking all of the factors into account, the requested waiver is plainly in the public interest, and plainly meets the standard of *WAIT Radio v. FCC*.

In the interest of public safety, and with little realistic possibility of harm, we urge the Commission to grant the waiver promptly.

Respectfully submitted,

/s/

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February 22, 2008

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