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HOWARD M. WEISS
ZHAO XIAOHUA*

* NOT ADMITTED IN VIRGINIA

FLETCHER, HEALD & HILDRETH, P.L.C.

ATTORNEYS AT LAW

11th FLOOR, 1300 NORTH 17th STREET

ARLINGTON, VIRGINIA 22209-3801

(703) 812-0400

TELECOPIER

(703) 812-0486

INTERNET

www.fhh-telcomlaw.com

RETIRED MEMBERS
RICHARD HILDRETH
GEORGE PETRUTSAS

CONSULTANT FOR INTERNATIONAL AND INTERGOVERNMENTAL AFFAIRS
SHELDON J. KRYS
U. S. AMBASSADOR (ret.)

OF COUNSEL
EDWARD A. CAINE*
DONALD J. EVANS*
MITCHELL LAZARUS
EDWARD S. O'NEILL*

WRITER'S DIRECT

703-812-0440
lazarus@fhh-telcomlaw.com

September 12, 2000

HAND DELIVERED
Magalie R. Salas, Esq.
Secretary
Federal Communications Commission
445 12th Street, SW, Room TW-B204
Washington, D.C. 20554

Re: Revision of Part 15 of the Commission's Rules
ET Docket 98-153

Dear Ms. Salas:

Enclosed are the original and nine copies of the Comments of XtremeSpectrum, Inc., for filing in the above-referenced docket.

Kindly date stamp and return the enclosed extra copy of the Comments.

If there are any questions about this filing, please call me at the number above.

Respectfully submitted,

Mitchell Lazarus
Counsel for XtremeSpectrum, Inc.

ML:deb

Enclosures

cc: Service List
Martin Rofheart, XtremeSpectrum, Inc.

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ORIGINAL

Before the
Federal Communications Commission
Washington DC 20554

In the Matter of	)	
	)	
Revision of Part 15 of the Commission's Rules	)	ET Docket 98-153
Regarding Ultra-Wideband Transmission	)	
Systems	)	
	)	

Comments of XtremeSpectrum, Inc.

Mitchell Lazarus
FLETCHER, HEALD & HILDRETH, P.L.C.
1300 North 17th Street, 11th Floor
Arlington, VA 22209
703-812-0440

September 12, 2000

Counsel for XtremeSpectrum, Inc.

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SUMMARY

Ultra-wideband communications systems will provide short-range, highly mobile, indoor data communications in the 10-100 megabit/sec range. In commercial environments, this technology will connect PCs not only with Internet access, but also with other PCs, printers, scanners, and network servers. In the home, ultra-wideband will facilitate the sharing of computer resources, and can distribute video and music programming from cable, satellite, Internet, or DVD to TVs and MP3 players anywhere in the house. Other foreseeable applications include wireless voice, health care, retail, baggage and package handling, factory and warehouse operations, and education. In both office and home, ultra-wideband links will connect PDAs to desktops and the Internet, and pass data to and from digital still cameras, digital camcorders, digital projectors, and web pads. Ultra-wideband will also -- finally! -- eliminate the tangle of wires behind everyone's desk.

The Commission should carry its policy of technology-neutral regulation into this proceeding, and must resist being drawn into disputes over technical rules that would unnecessarily favor one implementation over another. The Commission should remain particularly alert to proposals that claim to be necessary for avoiding interference, but which have the side-effect of hindering competing technologies.

The Commission's proposed rules are fully practical. XtremeSpectrum's technology will comply in full, yet achieves reliable communications at 100 megabit/sec at practical ranges with very low battery consumption, and at projected costs in the single-digit dollar range.

Nonetheless, XtremeSpectrum suggests relaxing the proposed technical rules in some respects. None of these changes is needed to implement XtremeSpectrum's own technology, or to protect other users, but they will give ultra-wideband manufacturers added flexibility to compete for the best possible technology.

Before the
Federal Communications Commission
Washington DC 20554

In the Matter of	)	
	)	
Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems	)	ET Docket 98-153

Comments of XtremeSpectrum, Inc.

Pursuant to Section 1.415 of the Commission's Rules, XtremeSpectrum, Inc. hereby files these Comments in the above-captioned proceeding.[1] XtremeSpectrum conducts research in ultra-wideband communications systems, and intends to become a manufacturer once the Commission authorizes certification of such systems.[2]

A. Introduction: Solving the Last-10-Meter Problem

Telecommunications providers spent the last two decades crisscrossing the country with long-haul fiber optic systems. These carry huge amounts of data at low cost from one central facility to another. They do not, however, solve the problem of delivering the data economically over the "last mile" to the customer's premises. That problem has begun to yield only in the last few years. Cable and DSL use pre-existing copper facilities to deliver data at megabit speeds to office and home. Where available, MMDS facilities can serve the same purpose. Some service providers now use unlicensed spread spectrum transmission and, increasingly, licensed spectrum

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[1] Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems, ET Docket 98-153, Notice of Proposed Rule Making, FCC 00-163 (released May 11, 2000) (Notice).

[2] These comments address only communications systems. XtremeSpectrum takes no position on ultra-wideband radar applications.

as well for last-mile delivery. Satellite systems will soon be available for service where other facilities do not penetrate.

Solving the last-mile problem still leaves a gap, however, albeit a smaller one. DSL, cable, and the various radio technologies terminate at a network interface, cable outlet, or antenna installation that usually lies at the periphery of the home or workplace, typically several meters from the end user's desk or armchair. In addition, user devices often must communicate with one another over comparable distances. In the office, PCs communicate not only with the Internet, but also with other PCs, printers, scanners, and network servers. In the home, a DVD player or Internet computer may serve a TV or game-playing station in another room, while a nursery camera puts a picture of a sleeping baby in a corner of the screen. Although wire-in-the-wall networks can handle all such functions, they have serious disadvantages. Older types of wiring are limited in speed, but rewiring an existing building, or wiring one for the first time, is very expensive. Moreover, all wired systems are inherently inflexible, as they literally chain end-user devices to the wall.

Existing radio technologies can serve some of these needs, but have limitations of their own. Today the most popular solution for wireless LANs is unlicensed spread spectrum devices in the 2.4 GHz band. But those systems are limited in speed to about 11 megabits/sec. The U-NII bands at 5.15-5.35 and 5.725-5.825 GHz have no inherent speed restrictions, but the equipment has proved too expensive for widespread use, particularly in the home, and the power requirements are too high for a hand-held device. Similarly, although the Commission permits using auctioned spectrum for short-range communications, no provider has yet found a way to achieve adequate returns on the cost.

Ultra-wideband communications systems will solve the ubiquitous last-10-meter problem. They are ideal for short-range, highly mobile, indoor data communications in the 10-100 megabit/sec range. Near-term commercial applications are likely to include wireless LANs and PBXs, retail cash registers and inventory control, baggage and package handling, warehouse operations, and automated meter reading and alarm connections. Health care facilities will find the technology ideal for patient telemetry, inventory and billing, and bedside record keeping. Educators will distribute Internet access and other resources inexpensively to classrooms. In the home, ultra-wideband will facilitate sharing of computer resources such as printers and Internet connections, and can distribute video and music programming from cable, satellite, Internet, or DVD to TVs and MP3 players anywhere in the house. In both office and home, ultra-wideband links will connect PDAs to desktops and the Internet, and pass data to and from digital still cameras, digital camcorders, digital projectors, and web pads. The low cost of ultra-wideband will bring wireless keyboards, mice, and speakers within easy reach of the consumer, and help to untangle the wires behind everyone's desk. Ultra-wideband is especially suitable for voice applications such as PBX and cordless phone, including voice-over-IP, because its signal is nearly impossible to detect, much less intercept.

In short, the technology is promising. Moreover, ultra-wideband will greatly increase the Nation's communications capacity without any need for dedicated bandwidth. XtremeSpectrum urges the Commission to promulgate rules expeditiously so the public can enjoy the benefits of ultra-wideband at the earliest possible date.

B. Ultra-Wideband Rules Should Be Technology-Neutral.

The term "ultra-wideband" does not connote a single communications technology, but rather covers several different implementations. Each generates some sort of pulse train, and they all occupy a relatively high bandwidth, but in other respects they can differ substantially.

The regulatory issues in this proceeding turn largely on the need to avoid harmful interference to other radio services, particularly those such as GPS that are vital to safety.[3] No one in the ultra-wideband community disputes the need to protect other users. But there may be disagreement within the industry on how best to accomplish that.

The Commission should be alert for technical proposals that claim to be necessary for avoiding interference, but which have the side-effect of hindering competing technologies. The Commission has wisely tried to avoid picking technologies in the past, leaving those decisions to the marketplace instead. It should maintain that policy here, and resist being drawn into disputes over technical rules that would favor one technology over another. Instead, the Commission should maintain its policy of promulgating rules that are technology neutral to the maximum extent possible, leaving the industry free to compete in the marketplace instead of the Commission's offices.

Specifically, the Commission should set "boundary conditions" for its technical rules along the following lines:

- specify a background or "default" value for the maximum average signal level;
- identify any particular bands for which the default level is too high;

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[3] *E.g.*, Notice at para. 23.

- specify maximum levels for those bands needing special protection; and
- specify appropriate peak-to-average limits.

This approach allows industry the widest possible latitude for ultra-wideband product design, while still affording all needed protection to other users of the spectrum.

We are pleased that the rules proposed in the Notice largely adhere to this plan, with only two significant exceptions. First is the proposal to require 12 dB attenuation at all frequencies below 2 GHz.[4] Although the Commission has identified other relatively sensitive services below 2 GHz,[5] this measure seems to be intended primarily for the benefit of GPS. Rather than apply a blanket rule below 2 GHz, XtremeSpectrum suggests the Commission be specific in identifying the bands requiring special protection, and set maximum emissions for each. Second, as explained in Part D below, XtremeSpectrum believes the proposed peak-to-average limits can safely be relaxed for systems whose pulse repetition frequency significantly exceeds the highest bandwidth used by potential victim receivers.

Technology-neutral rules that state the minimum conditions needed to assure adequate interference protection will ultimately yield the best possible ultra-wideband products, and will help eliminate regulatory distortions in the marketplace.

C. About XtremeSpectrum's Technology

The products currently under design by XtremeSpectrum comply in full with the rules proposed in the Notice. Occupied bandwidth (at the -12 dB points) is 2-10 GHz. Maximum field strength is 500 uV/m at 3m into 1 MHz bandwidth, in compliance with Section 15.209.

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[4] Notice at para. 39.

[5] Notice at paras. 28-29.

The maximum occurs at about 4 GHz. Average field strength across the occupied bandwidth is approximately half the maximum. Total transmit power is 375 uW into a 0 dBi antenna. Radiated emissions at all frequencies below 2 GHz are less than 125 uV/m at 3m into a 1 MHz bandwidth.

XtremeSpectrum's technology uses the same materials and fabrication techniques as conventional CMOS computer chips. This provides extremely low unit costs in quantity production, and should allow the sale of complete radios in the single-digit dollar range. Moreover, because XtremeSpectrum's data throughput is proportional to the density of elements on the chip, its data rates should double every 18-24 months in accordance with Moore's Law.

The Notice assumes throughout that ultra-wideband systems necessarily transmit a train of very brief pulses, yielding a "spiky" waveform with a high peak-to-average ratio. Most ultra-wideband systems (other than XtremeSpectrum's) use a pulse repetition frequency (PRF) in the 0.1-100 MHz range and indeed have high peak-to-average ratios, usually well in excess of 20 dB. Theses systems raise concerns that victim receivers sensitive to peak values may experience interference even from ultra-wideband transmitters whose average power remains low. As a rule, receivers with bandwidths higher than the PRF will be sensitive to the relatively high peak energy in a single pulse, while narrower-band receivers will respond to the lower average energy over the pulse train.[6]

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[6] *See* Notice at para. 35.

To accommodate concerns about interference into broadband receivers, the Notice proposes peak-to-average limits ranging from 20 dB over a 50 MHz bandwidth to an absolute maximum of 60 dB.[7]

The XtremeSpectrum system uses a pseudo-noise-encoded bi-phase modulated wavelet whose peak-to-average ratio is below 5 dB -- similar to that of a half-rectified sine wave. Thus, high peak-to-average values are not an inevitable characteristic of ultra-wideband systems. Moreover, XtremeSpectrum operates with a PRF above 1 GHz, which is higher than all receiver bandwidths in the 2-10 GHz operating range. Either the low peak-average ratio or the high PRF would alone all but eliminate the risk of interference into broadband receivers. Narrowband receivers are well protected by the low average emissions.

D. XtremeSpectrum Supports the Proposals in the Notice.

XtremeSpectrum believes the Commission has struck almost the right balance between protecting other users of the spectrum and affording ultra-wideband communications manufacturers the flexibility they need to meet the public's need for short-range, high-volume communications.

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[7] The proposed limits are:

(1) over a bandwidth of 50 MHz: 20 dB

(2) over the entire occupied bandwidth: [20 + 20log[10](-10 dB occupied bandwidth in Hertz/50 MHz)] dB, but not to exceed 60 dB. The 60 dB limit will control for any occupied bandwidth over 5 GHz.

Notice at para. 43.

Definition. The Commission's two-prong definition reflects the common understanding of ultra-wideband systems. The alternative criteria of minimum fractional bandwidth and minimum occupied bandwidth are both well reasoned.[8]

The Notice asks whether the definition should include "extremely high speed data systems that comply with the UWB bandwidth requirements only because of the high data rate employed, as opposed to meeting the definition solely from the narrow pulse width."[9] The answer is plainly yes. The regulatory purpose of the definition is to identify systems that qualify for certification despite emissions into the restricted bands. The threat of interference into those bands depends primarily on the average and peak emissions, and the location of any significant spectral lines. It is affected little, if at all, by the nature of the modulating signal. Indeed, an unmodulated pulse train at constant frequency typically presents the most prominent spectral lines, and the worst case for interference. A signal spread by modulation with high-speed data is an improvement. There is no sound regulatory reason to prohibit such signals.

Frequency bands of operation. As explained in Part B above, XtremeSpectrum supports the greatest possible flexibility for ultra-wideband systems so as to encourage competition for the best technology. The Commission should refrain from imposing unnecessary limitations on operating frequencies, among other characteristics. The proposed limitation on communications systems to operation above 2 GHz may be unnecessarily restrictive.[10] Again, XtremeSpectrum urges the Commission to identify the bands that need protection, and let the manufacturers decide

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[8] Notice at para. 21.

[9] Notice at para. 21.

[10] Again, XtremeSpectrum takes no position on radar applications.

how to comply. Some implementations may have to cut off all operation below 2 GHz to satisfy the rules, but more flexible technologies should be permitted maximum freedom, consistent with adequate protection to other services.

Further testing. XtremeSpectrum supports testing, and is participating in ongoing tests. The Commission should not believe, however, that any set of test results will resolve the controversies over interference from ultra-wideband emissions. Any test necessarily relies on simplifying assumptions about the characteristics of ultra-wideband transmitters, the likely conditions of their use, and the properties of victim receivers. Whatever the test results, they are likely to undergo challenge by one or another group of parties in the proceeding.

Nevertheless, testing remains valuable if properly done. Even with their limitations, test results may help to narrow the scope of reasonable rules. But they will not spare the Commission the need to make the hard decisions on how best to accommodate both those who seek to offer valuable new services and those concerned about interference to existing services.

Emission limits. XtremeSpectrum supports adoption of the limits in Section 15.209 for ultra-wideband communications systems. The Commission has extensive experience with these limits, which have proven to be fully satisfactory. Although the Commission has not permitted intentional operation in the restricted bands, these same limits govern spurious emissions in the restricted bands from equipment whose fundamental frequencies lie elsewhere.[11] To the best of our knowledge, such emissions have not caused harmful interference.

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[11] 47 C.F.R. Sec. 15.205(b).

The Commission declined to treat ultra-wideband emissions as equivalent to those from unintentional radiators.[12] XtremeSpectrum does not contest this decision. As a factual matter, however, XtremeSpectrum notes that its equipment generates its signal in precisely the same way that a digital device generates noise. Only an XtremeSpectrum receiver can distinguish the signal from stray PC emissions.

Peak/average ratios. As noted above, XtremeSpectrum's peak-to-average ratios are far below those proposed in the Notice. Nevertheless, in keeping with our policy of promoting maximum flexibility and competition, XtremeSpectrum notes that high peak levels affect only receivers whose bandwidths exceed the PFR. The Commission thus can safely consider increasing the peak-to-average limits for systems whose PRF is significantly higher than the highest bandwidth authorized for any service in the occupied frequency range.

Cumulative effect. XtremeSpectrum agrees with the Commission's tentative conclusion that only the ultra-wideband transmitter nearest to the victim receiver need be considered as a significant source of interference, and that the cumulative effect of all others in the vicinity is negligible.[13] In considering this issue (and most others involving ultra-wideband), it is important to keep in mind the extremely low power levels involved. Personal computers are subject to the same emissions limits as those proposed for ultra-wideband devices,[14] and are densely deployed in commercial environments, yet do not appear to cause significant harmful interference. Even relatively dense installations of ultra-wideband equipment should be similarly benign.

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[12] Notice at para. 40.

[13] Notice at para. 47.

[14] *Compare* 47 C.F.R. Sec. 15.109(a) *and* 47 C.F.R. Sec. 15.209(a).

Other -- indoor operation. If the Commission remains concerned about potential interference from ultra-wideband communications systems, it can obtain additional protection by limiting ultra-wideband to indoor operation, at least while the Commission and the industry gain initial experience. The Commission declined to *assume* that ultra-wideband units would be operated indoors.[15] But it can require that result by regulation.[16] XtremeSpectrum estimates that its system sees 10*F dB/m attenuation (F in GHz) through rebar concrete. For example, a rebar wall 50 cm thick will impose about 10-50 dB attenuation across the occupied bandwidth. Considering the minuscule power levels originating from the transmitter, this leaves very little energy to reach a potential interference victim.

CONCLUSION

Ultra-wideband promises short-range, inexpensive, data communications in the 10-100 megabit/sec range. Ultra-wideband offers far higher data rates than other unlicensed radio technologies, and does so without diminishing the spectrum available for other services. Concerns about interference into sensitive safety services such as GPS must be taken seriously,

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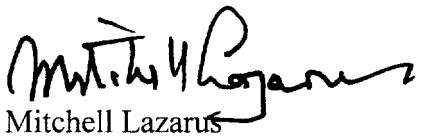
[15] Notice at para. 40.

[16] The Commission has done just that for U-NII operation in the 5.15-5.25 GHz band. *See* 47 C.F.R. Sec. 15.407(e).

but should be addressed on a band-by-band basis, rather than through blanket restrictions. XtremeSpectrum urges the Commission to promulgate technology-neutral regulations, and to do so expeditiously, so the public can enjoy the benefits of ultra-wideband at the earliest possible date.

Respectfully submitted,



Mitchell Lazarus
FLETCHER, HEALD & HILDRETH, P.L.C.
1300 North 17th Street, 11th Floor
Arlington, VA 22209
703-812-0440

September 12, 2000

Counsel for XtremeSpectrum, Inc.

SERVICE LIST

Chairman William E. Kennard
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Commissioner Harold Furchtgott-Roth
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Commissioner Michael Powell
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Commissioner Susan Ness
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Commissioner Gloria Tristani
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Dale N. Hatfield, Bureau Chief
Office of Engineering and Technology
Federal Communications Commission
445 12th Street, S.W., Room 7C-155
Washington, D.C. 20554

Julius P. Knapp, Chief
Policy & Rules Division
Federal Communications Commission
445 12th Street, S.W., Room 7B-133
Washington, D.C. 20554

Karen E. Rackley, Chief
Technical Rules Branch
Federal Communications Commission
445 12th Street, S.W., Room 7A-161
Washington, D.C. 20554

John A. Reed
Senior Engineer
Technical Rules Branch
Office of Engineering and Technology
Federal communications Commission
445 12th Street, S.W., Room 7A-140
Washington, DC 20554