

Carl: Attached is a replacement exhibit for Experimental application File No. 0189PL2000. Kindly discard the original exhibit and substitute this one in its place. The new exhibit incorporates responses to your questions on number of units (100 maximum nationwide), locations of operation (six are listed), and maximum peak EIRP (38 mW). In response to your question whether the applicant wishes to amend to seek an STA, we prefer to apply for a license.

Other, minor changes in the exhibit reflect the evolution of the applicant's plans since the original was filed. Please let me know if we can provide any further information. Mitchell Lazarus

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XtremeSpectrum, Inc.

Experimental App'n File No. 0189PL2000

Form 442

for 2 years

AMENDED EXHIBIT

XtremeSpectrum, Inc. requests a license in the Experimental Radio Service to refine an ultra-wideband modulation for communications purposes. No radar operations will be conducted.

Operation under this license will conform to the rules proposed for ultra-wideband communications devices in ET Docket No. 98-153.¹

Locations

	Coordinates ²	Radius
Los Angeles CA	34-03-15N, 118-14-28W	40 km
San Francisco CA	37-46-39N, 122-24-40W	40 km ←
San Jose CA	37-20-16N, 121-53-24W	40 km
Washington DC	38-53-51N, 077-00-33W	40 km ←
New York NY	40-45-06N, 073-59-39W	40 km
Dallas TX	32-47-09N, 096-47-37W	40 km

Roston, CA

Technical Characteristics

Bandwidth:	2-10 GHz (at -12 dB points)
Field strength (maximum):	500 uV/m at 3m into 1 MHz bandwidth ³
Field strength (average across 2-10 GHz):	approx. half the maximum
Power spectral density (maximum):	0.075uW/MHz (-71dBW/MHz)

¹ See Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems, ET Docket No. 98-153, Notice of Proposed Rule Making, FCC 00-163 (released May 11, 2000) ("Notice").

² Coordinates are taken from 47 C.F.R. Sec. 76.53.

³ This field strength corresponds to Sections 15.209 (maximum emissions in bands not otherwise specified) and 15.109 (Class B digital devices). See Notice at para. 39. Maximum field strength occurs at about 5 GHz.

Total transmit power: ⁴	$(0.075\text{uW/MHz}) * (\text{approx. } 5 \text{ GHz}) = 375\text{uW}$
Peak/average ratio:	20 dB maximum across any bandwidth (see <i>Note on Modulation</i> , below)
Total peak EIRP across all frequencies:	not to exceed 38 mW
Antenna gain:	0 dBi
Radiated emissions in GPS band:	less than 125 uV/m at 3m into a 1 MHz bandwidth at all frequencies below 2 GHz ⁵
Modulation:	pseudo-noise-encoded bi-phase modulated wavelet

Additional Limitations

1. The aggregate number of units operating simultaneously under this license at all locations will never exceed 100.
2. Indoor operation only. This limitation provides an additional 10-50 dB protection to outdoor receivers.⁶ Considering the minuscule power levels originating from the transmitter, this leaves very little energy to reach a potential interference victim.
3. No operation within 10 km of an airport handling commercial aviation.⁷
4. No operation of more than 10 transmitters simultaneously within a radius of 1km.⁸

⁴ This calculation sums across 5 GHz rather than 8 GHz to allow for the fact that 0.075uW/MHz represents the maximum power density, which is approximately twice the average.

⁵ This level corresponds to the Commission's proposal of a 12 dB reduction below Section 15.209 levels at frequencies less than 2 GHz. See Notice at para. 39.

⁶ The XtremeSpectrum system sees $10 * F$ dB/m attenuation (F in GHz) through rebar concrete. A rebar wall 50 cm thick will impose about 10-50 dB attenuation across the occupied bandwidth.

⁷ Although XtremeSpectrum is confident this condition is wholly redundant, we offer it in hopes of reassuring the aviation community that a grant of this license cannot cause it any conceivable harm. We also expect operation under the license to generate real-world data that helps to confirm this condition is unnecessary.

⁸ This condition likewise is redundant, and offered in a spirit of reassurance as to the cumulative effects of multiple devices. See Notice at 34, 46-47. See also Reply Comments of XtremeSpectrum at 8-10 (filed Oct. 27, 2000) (interference effects decay quickly with distance, rendering cumulative effects negligible).

5. XtremeSpectrum will retain full control over every unit, and will be in a position to cease operation promptly if the Commission requires it.

Note on Modulation

The Notice assumes that ultra-wideband systems necessarily transmit a train of very brief pulses. Accordingly, the Notice anticipates a "spiky" waveform with a high peak-to-average ratio. To accommodate such waveforms, the Notice proposes three distinct peak-to-average limits:⁹

- (1) over a bandwidth of 50 MHz: 20 dB
- (2) over the entire occupied bandwidth: $[20 + 20\log[10](-10 \text{ dB occupied bandwidth in Hertz}/50 \text{ MHz})]$ dB.
- (3) absolute maximum: 60 dB. This limit will control over (2) above for any occupied bandwidth over 5 GHz.

Most ultra-wideband systems other than XtremeSpectrum's produce pulse trains with a pulse repetition frequency (PRF) in the 0.1-100 MHz range. These waveforms have high peak-to-average ratios (>20 dB). Receivers with bandwidths higher than the PRF are sensitive to the relatively high peak energy in a single pulse, as opposed to the much lower average energy over the pulse train.¹⁰ The proposed peak-to-average ratios anticipate this scenario.

Some commenters in ET Docket No. 98-153 caution that pulse-train waveforms concentrate more energy into shorter time periods than other modulations, and hence may generate more interference, even at comparable average emissions.¹¹

XtremeSpectrum's modulation, however, differs from those contemplated in the Notice, and addresses the commenters' concerns. XtremeSpectrum greatly reduces the threat of interference with a modulation having a low peak-to-average ratio, and by operating with a PRF above 1 GHz, which is higher than all receiver bandwidths in the 2-10 GHz operating range. Although XtremeSpectrum expects its production units to achieve a 5 dB peak-to-average ratio, this application requests 20 dB for flexibility in research.

Taking into account the low peak-to-average ratio, low average emissions levels, and limitation to indoor operation, XtremeSpectrum's equipment presents a negligible risk of interference.

⁹ Notice at para. 43.

¹⁰ See Notice at para. 35.

¹¹ Comments of National Business Aviation Ass'n at 13-1; Dep't of Aeronautics and Astronautics, Stanford University; Cisco Systems, Inc. at 7; AT&T Wireless Services, Inc. at 7.

Anticipated Experimental Performance

XtremeSpectrum expects to attain a data throughput of 100 Mbps at 10 meters range, with a bit error rate of 10^{-5} under a 10 dB link margin. The radio is fading immune, so all of the link margin is available for indoors materials penetration.

The system is software programmable as to data rate, scalable from 1-100 Mbps, and is subject to classical trade-offs among output power, range, and data-rate.

Applications

In the long run, XtremeSpectrum's wireless technology will enable high data rate wireless connection of intelligent electronic devices -- Internet music (MP3 and other players), voice over IP cordless phones, digital still cameras, digital camcorders, digital projectors, web pads, and PDA & PDA-cellphone combinations, as well as more traditional LAN-type PC-PC, PC-printer, and PC-Internet connections. XtremeSpectrum will use its experimental license to test several of these applications.

Conclusion

A grant of the requested license will further the development of potentially valuable radio technologies with no realistic prospect of interference, harmful or otherwise, to any other user of the spectrum.