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October 27, 2000

HAND DELIVERED

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

Re: Ultra-Wideband Transmission Systems
ET Docket 98-153

Dear Ms. Salas:

Enclosed are the original and nine copies of the Reply 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
John McCorkle, XtremeSpectrum, Inc.
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ORIGINAL

Before the
Federal Communications Commission
Washington DC 20554

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

Reply Comments of XtremeSpectrum, Inc.

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October 27, 2000

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SUMMARY

Public interest. The first-round comments amply demonstrate the need for ultra-wideband products and services. Scores of filings set out dozens of applications, many of them life-critical, in public safety, industrial and personal safety, military, health care, recreation, and several other categories. Even the opponents of ultra-wideband do not dispute its public interest. Moreover, ultra-wideband can deliver these needed services without any additional spectrum allocation.

Bifurcation. It may take considerable time to sort out the susceptibility of different types receivers to various ultra-wideband implementations, under differing combinations of limits and restrictions. To help the public benefit from this technology in the meantime, XtremeSpectrum urges the Commission to identify and promptly authorize a subset of ultra-wideband implementations that pose no realistic threat of interference to other users. We propose the following "safe" parameters for communications devices.

1. Field strength limits to protect the services indicated. (At boundaries, the lower limit applies).

above 2.7 GHz:	500 uV/m at 3m
2-2.7 GHz (WCS, DARS, MMDS):	6 dB below 500 uV/m
1.6-2 GHz (PCS):	12 dB below 500 uV/m
at and below 1.6 GHz (GPS):	18 dB below 500 uV/m
2. Peak-to-average ratio: 20 dB maximum across any bandwidth.
3. Indoor operation only.

Low interference potential. XtremeSpectrum agrees with the need to protect all other radio services, not just those that are critical to safety. Some parties, however, greatly overstate

the risk of interference. Most, for example, fail to recognize that interference effects decay very quickly with distance. This not only curtails the radius of interference from a single device, but also limits the cumulative effect of multiple units. In combination with the field strength and peak-to-average limits suggested above -- considerably more stringent than the Commission's -- the intermittent character of ultra-wideband communications transmissions and the limitation to indoor-only operation should adequately protect other services while the Commission gains experience.

Testing. Some of the parties express an unrealistic level of faith in the ability of testing to resolve the interference issues in this proceeding. Any test is vulnerable to challenge from parties who would have preferred a different result. While well designed tests that can be modeled and explained on a theoretical basis may help to define the scope of reasonable rules, decisions in the end will have to rest primarily on the Commission's best judgment as it seeks to benefit the public interest by adding new services while protecting those already in place.

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Washington DC 20554

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Systems)	

Reply Comments of XtremeSpectrum, Inc.

Pursuant to Section 1.415 of the Commission's Rules, XtremeSpectrum, Inc. hereby files these Reply 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. The Filed Comments Show How Ultra-Wideband Technology Can Make a Much-Needed Contribution to the Nation's Communications Requirements.

Scores of first-round comments strongly support the authorization of ultra-wideband services. Even the opponents of ultra-wideband do not dispute the benefits of this technology. The supporting comments identify dozens of services that cannot be offered satisfactorily -- and some that cannot be offered at all -- except via ultra-wideband. Many of the services listed are life-critical. Most exploit the unique properties of ultra-wideband transmission. Examples of proposed services include the following.

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.

- **Public safety:** covert police communications; protection of law enforcement personnel (*e.g.*, in high-risk tactical situations); law-enforcement surveillance; detection of concealed weapons and contraband; locating victims of fire and smoke; on-scene communications with firefighters; protecting the safety of firefighters;³ fighting wildfires; locating disaster victims in rubble.
- **Industrial and personal safety:** preventing injury to workers in construction, renovation, and demolition by locating rebar, pipes, and wiring in walls; locating underground utilities before excavation; locating industrial wastes, underground nuclear facilities, and unexploded ordinance; highway collision avoidance; advanced cruise control; airbag deployment; residential and commercial security systems.
- **Military:** locating buried land mines; non-interceptible aircraft-to-aircraft communications; covert signaling by airmen downed in enemy territory; friend-or-foe identification; man-overboard detection and rescue.
- **Health care:** aid to persons with physical and mental disabilities; aid to senior citizens and Alzheimer's patients; locating patients prone to disorientation; alerting caregivers to patients in distress; patient monitoring; remotely programmable pacemakers; remote medical imaging; record-keeping and transfer of patient records.
- **Recreation:** television news coverage; multiple camera coverage at sporting events; golfing accessories; systems for evaluating racehorses.
- **Other:** industrial test and measurement equipment; communications networks for commercial facilities; Internet access for classrooms; positioning of persons, animals, small objects (*e.g.*, cell phones), large objects (*e.g.*, automatic lawn mowers), and vehicles; controls for bathroom ventilation; measurement of liquid levels in tanks.

Unlicensed operation. As a practical matter, most of these services can be offered only on an unlicensed basis. Most cover only a very short range, and some transmit on very low duty cycles. Thus, despite a wide occupied bandwidth, their overall demand on the spectrum remains

³ Several commenters believe that the availability of ultra-wideband technology might have averted the 1999 deaths of six firefighters in Worcester, MA.

light. In consequence, these services would be impracticably expensive if they had to use dedicated spectrum.

In a time of chronic and worsening spectrum shortage, the Commission should seize this opportunity to make new, badly needed services available to the public without any need for additional spectrum allocation.

B. The Commission Should Bifurcate This Proceeding So As To Authorize Promptly Those Ultra-Wideband Implementations That Pose No Realistic Threat of Interference.

The Notice contemplates several differing ultra-wideband technologies. Even within the proposed technical rules, these vary widely in their interference potential. The process of evaluating the possible interference hazards of all these technologies into a variety of victim devices, at various limits and under various restrictions, may take considerable time, during which the public is denied the benefits of all the technologies under review -- including those whose safety is not in serious doubt.

To expedite benefits to the public, while continuing to protect the spectrum, XtremeSpectrum proposes that the Commission identify a subset of ultra-wideband implementations that pose no realistic threat of interference to other users. A rule authorizing such devices can be promulgated almost immediately, while the Commission continues to evaluate the more controversial aspects of the rulemaking.

XtremeSpectrum suggests the following "safe" parameters for communications devices. These are generally lower than the Commission's proposals at and below 2.7 GHz.

1. **Field strength** (at boundaries, the lower limit applies).

- above 2.7 GHz: 500 uV/m at 3m (⁴)
- 2-2.7 GHz: 6 dB below 500 uV/M
- 1.6-2 GHz: 12 dB below 500 uV/m
- at and below 1.6 GHz: 18 dB below 500 uV/m.

The proposed attenuations are intended to protect the following services, among others:

- 2-2.7 GHz: WCS and DARS at 2305-2360 MHz;
MMDS at 2150-2162 & 2500-2690 MHz
- 1.6-2 GHz: PCS at 1850-1990 MHz
- below 1.6 GHz: GPS at 1227.6, 1381.05, and 1575.42 MHz.

2. **Peak-to-average ratio:** 20 dB maximum across any bandwidth. This value is more conservative than those in the Commission's proposal, which range up to 60 dB.⁵ XtremeSpectrum's opening comments noted that even the Commission's numbers could be safely relaxed for systems whose pulse repetition frequency is significantly higher than the highest service bandwidth in the occupied frequency range. Nevertheless, some commenters caution that the pulse-train waveform of typical ultra-wideband systems concentrates more energy into

⁴ 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.

⁵ The Commission proposed these limits:

- (1) over a bandwidth of 50 MHz: 20 dB
- (2) over the entire occupied bandwidth: $[20 + 20\log_{10}(\text{occupied bandwidth in Hertz}/50 \text{ MHz})]$ dB, but not to exceed 60 dB. The 60 dB limit will control for any occupied bandwidth over 5 GHz.

Notice at para. 43.

shorter time periods than other modulations, and hence may generate more interference, even at comparable average emissions.⁶ To accommodate these concerns, XtremeSpectrum proposes a lower limit for the purpose of bifurcating the proceeding. XtremeSpectrum is confident that experience will ultimately permit the peak-to-average limits to be relaxed.

XtremeSpectrum's own implementation has a peak-to-average ratio of only 5 dB. The proposed 20 dB cut-off is intended to promote competition among manufacturers, while still protecting other users.

3. ***Indoor operation only.*** This additional constraint is offered to provide further protection to other users, at least until the Commission has developed a full technical record.

C. XtremeSpectrum Agrees With the Need to Protect Other Users of the Spectrum.

Several commenters argue at length for the need to protect certain radio services that are important to the protection of life and property, or which play a vital role in fueling the economy. Among the services mentioned in the first-round comments are GPS, PCS, DARS, WCS, and MMDS.

There is no controversy about the need to protect such services -- indeed, all radio services. No ultra-wideband proponent seeks to deploy its products at the expense of vital communications. To the contrary, ultra-wideband technology generates great interest because it can be deployed *without* causing harmful interference to other services.

Some of the comments, however, deliberately exaggerate the threat of interference from ultra-wideband. This does not advance an informed debate. One GPS pleading, for example,

⁶ 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.

implies that peak power from ultra-wideband will reach megawatt levels.⁷ The pleading assumes not only average power levels far higher than those proposed by the Commission, but also a hopelessly impractical pulse rate of one per second.⁸ A more realistic calculation of peak power under the Commission's proposal is 15 *nanowatts*⁹ -- 14 orders of magnitude below megawatt levels, and harmless to other users.

In a similar vein: "*Any* increase in the basic noise floor will *significantly* reduce the ability of the receiver to acquire or maintain tracking of a GPS signal, or will cause errors in position or time accuracy."¹⁰ Depending on local conditions, however, including other equipment operating in the vicinity, an ultra-wideband device may not have any discernable effect on the preexisting noise floor. Moreover, any increase that does occur will be limited to a small area. It is well known that RF energy falls off as $1/R^N$ in realistic indoor and outdoor environments, where N is typically in the range 3-6. Conservatively taking N=4, the effect at 10 meters (say) is only 0.01% of (*i.e.*, 40 dB less than) the effect at 1 meter. No matter how

⁷ U.S. GPS Industry Council at 42.

⁸ The pleading states that an average power of 1 milliwatt in a 1 nanosecond pulse yields one megawatt. *Id.* The math is right, but is irrelevant. The assumed one-milliwatt average level is 50 dB higher than the Commission proposed for the GPS bands, and the calculation then assumes just one nanosecond pulse every second. This is 30 dB higher than the 60 dB proposed by the Commission for absolute maximum peak-to-average limits. Equally irrelevant is a reference in the same pleading to an optical laser producing pulses 100 femtoseconds wide, *id.* -- orders of magnitude shorter than any ultra-wideband system, and operating in a very different part of the spectrum.

⁹ Sec. 15.209 permits 500 uV/m at 3m, which is 75 nanowatts EIRP. The Commission proposes 12 dB below that level at all frequencies under 2 GHz, which yields 5 nanowatts maximum average power. XtremeSpectrum operates with a peak-to-average ratio of 5 dB, for a peak power of 15 nanowatts.

¹⁰ U.S. GPS Industry Council at 12 (emphasis added). See also *id.* at 25.

sensitive a GPS receiver may be, an ultra-wideband device cannot affect it beyond a short distance.

One last example of rhetorical overstatement: "Increasing the noise floor in this area of the spectrum [below 3 GHz] will potentially have a very large destabilizing effect on the economic engine driven by information technology."¹¹ It is true the economy depends increasingly on information-carrying radio links. But those are not susceptible to interference from ultra-wideband, because they operate at far greater powers. The licensed services typically operate at multiple watts or kilowatts. Unlicensed spread spectrum is authorized at a full watt; but even operating at more typical levels at tens of milliwatts, this equipment is still fully three orders of magnitude above the ultra-wideband proposals. Harmful interference from ultra-wideband into any of these services is unlikely to happen at all, and if it does, will be an exceedingly rare occurrence resulting from chance proximity and alignment that can be remedied by the user. This will not destabilize the economy.

D. Under Appropriate Constraints, Ultra-Wideband Will Not Cause Significant Harmful Interference.

Some parties that make a more realistic effort to calculate the likelihood and severity of interference from ultra-wideband systems nonetheless greatly overestimate the probable harm. In part the discrepancies may stem from a shortage of information about the ultra-wideband systems likely to be deployed. In the absence of specifics, other spectrum users understandably assume the worst case. Actual ultra-wideband systems -- at least, that proposed by XtremeSpectrum, and doubtless others as well -- pose far less threat of interference.

¹¹ U.S. GPS Industry Council at 4.

1. Ultra-wideband devices produce a very small area of interference.

The incidence of actual interference depends in large part on how fast the interference effect of an ultra-wideband transmitter falls off at increasing distances. In practice, this consideration is just as important as the device's output power.

At typical ultra-wideband wavelengths, both indoor and outdoor environments exhibit propagation characteristics very different from free space. Rappaport and others¹² show that losses due to reflection, scattering, absorption in indoor walls, floors, and ceilings, and diffraction around ordinary office furniture and objects cause RF interference to fall off much faster than $1/R^2$ -- more typically between $1/R^3$ and $1/R^6$. Even outdoors, in a populated area, the attenuation is typically between $1/R^3$ and $1/R^5$.

Rappaport provides these estimates of path loss exponent N, for attenuation as $1/R^N$:

Environment	Path Loss Exponent, N
Free space	2
Urban area cellular radio	2.7-3.5
Shadowed urban cellular radio	3-5
Line-of-site in building	1.6-1.8
Obstructed in building	4-6
Obstructed in factory	2-3

¹² Theodore S. Rappaport, *Wireless Communications, Principles and Practice*, Prentice Hall PTR, Upper Saddle River, NJ, pp85-90, 1996; Aurand, J.F., "Measurements of Short-Pulse Propagation through Concrete Walls" in *Ultra-Wideband Short-Pulse Electromagnetics 3*, ed. Baum, et al., Plenum Press, New York, pp 239-246, 1997; Turkmani, A.M.D., et al., "Propagation into and within Buildings at 900, 1800 and 2300 MHz," IEEE Vehicular Technology Conference, 1992.

The Ericsson radio system model, empirically derived from measurements, shows similar results.¹³ That model yields attenuations that vary from $1/R^2$, very close to the device, to $1/R^{12}$ beyond 40m.

The path loss exponent has a strong effect on a device's potential for causing interference. To illustrate the principle, suppose one device emits 10 nanowatts, interferes within 1 meter, and falls off as $1/R^2$ with distance. Another device emits five times the power (50nW), but falls off as $1/R^4$. The higher-power device actually causes less interference beyond 1.5m, and its interference potential drops off very sharply beyond that. At 10m, for example, the energy density from the 50 nW device using $1/R^4$ is only 5% of (*i.e.*, 13 dB lower than) the 10 nW device using $1/R^2$.

Thus, the behavior of average and peak emissions over distance is just as important as their absolute magnitude. The steep attenuations typical of RF interference signals in realistic indoor environments should help to reassure other users of the spectrum that even relatively small separations between these devices and victim receivers will help to mitigate interference.

2. Ultra-wideband devices have a small cumulative effect.

The Commission suggested the cumulative effect of ultra-wideband devices would be negligible, so that only the device closest to a victim receiver need be considered.¹⁴ Several commenters disagreed, claiming the cumulative effect would be substantial.¹⁵

¹³ Akerberg, D., "Properties of a TDMA Picocellular Office Communication System," IEEE Globecom, pp. 1343-1349, December 1988.

¹⁴ Notice at para. 47.

¹⁵ *E.g.*, National Business Aviation Ass'n at 14, 16; Satellite Industry Ass'n at 5-6; Cisco Systems, Inc. at 7.

But the Commission is right. Thanks to the steep decay of energy over distance, more distant ultra-wideband emitters have very little effect, relative to the nearest. As an illustration, suppose ultra-wideband transmitters are scattered randomly around an area that includes a victim receiver.¹⁶ As distance R from the receiver increases, the number of ultra-wideband devices tends to increase linearly with R. But the interference effect of each device tends to fall off as $1/R^N$, where N is in the range 3-6. The net effect of all the ultra-wideband devices taken together therefore falls off as $1/R^{N-1}$, or $1/R^2$ to $1/R^5$. For example, at four times the distance of the nearest interferer, there will tend to be four times as many of them, but the *total* interference effect of them all will be only 1/16 to 1/1000 as much as the nearest. Only the nearest need be considered, in the ordinary case, because the combined contribution of all the others is negligible.

In actual practice, moreover, ultra-wideband devices (at least, those used for communications) use time domain duplex (TDD) and are not likely to transmit continuously, but rather will send packets only as needed. Indeed, local ultra-wideband devices often communicate using time division multiple access (TDMA), so only one unit will transmit at a time. Thus, even if a receiver were positioned closely enough to be affected by more than one ultra-wideband device, there is a diminished probability of more than one impinging on the receiver at the same time.

¹⁶ Motorola, Inc. (at 20) offered a model along these lines, although Motorola analyzed it differently.

3. Other factors, including indoor-only operation, will further reduce the threat of interference.

As noted above, XtremeSpectrum proposes that operation of ultra-wideband communications devices be permitted only indoors, at least until the Commission has gained additional experience.

Among the major potential interference victims -- GPS, PCS, WCS, DARS, and MMDS -- this requirement alone will greatly reduce the threat of harm.

GPS. This equipment is used overwhelmingly outdoors.¹⁷ Potential interference to an outdoor victim receiver, such as a GPS device, from an indoor ultra-wideband transmitter is diminished at least 12 dB by a typical exterior wall. Moreover, the GPS device typically must be several meters from the exterior wall to avoid shadowing and hence function successfully. This added distance further diminishes the energy of the ultra-wideband device, and makes it an unlikely source of interference.¹⁸ As an extra precaution, XtremeSpectrum suggests limits for the GPS bands that are somewhat lower than those proposed by the Commission.

PCS. Although PCS has some indoor application, everyday experience suggests the large majority of use is outdoors, or in vehicles outdoors. Due to the close proximity and unobstructed

¹⁷ There may be occasional indoor applications as well, but these are an exceedingly small fraction of the total, and in any event are not safety-critical.

¹⁸ Some comments suggest that ultra-wideband may in fact enhance GPS services. L-3 Communications suggests using ultra-wideband to implement a Local Area Augmentation System to improve the accuracy, availability, integrity, and continuity of GPS for aviation operations. One comment notes that ultra-wideband may augment GPS for precision takeoff and landing. Bill Armistead, Alabama State Senate.

path required, any interference that might occur would almost certainly come from ultra-wideband devices being used by the same individual that was using the PCS device, allowing the ultra-wideband device to be shut down as desired by the user.

Even indoors, however, the major interfering effect of ultra-wideband will *not* be interruption of service to the nearest handset, as one might expect. Sprint PCS appears to concede the handset will operate successfully within inches of the ultra-wideband device.¹⁹ But Sprint PCS has two other concerns. One is the cumulative effect of multiple ultra-wideband devices.²⁰ We addressed that concern above, and showed it is misplaced because realistic RF path attenuations (i.e. ~12 dB exterior walls, and $1/R^N$ loss) were not used in the analysis. The other issue arises from the system's designed-in tendency to divert resources to the interfered-with handset, thus diminishing the resources, and hence the quality of service, available elsewhere in the system.²¹

Diversion of PCS system resources will become a significant problem only if multiple handsets are interfered with simultaneously. Several considerations diminish the probability of this happening. The calculations submitted by Sprint PCS assume free-space propagation ($1/R^2$),²² where in fact the interference effect of each ultra-wideband device falls off much faster,

¹⁹ Sprint PCS at 4 n.8 (Supplemental, filed Oct. 6, 2000).

²⁰ *Id.* at 6-7.

²¹ *Id.* at 3-4.

²² Jay Padgett, A Model for Calculating the Effect of UWB Interference on a CDMA PCS System at 2, Eq. 2 (Telcordia Technologies, *filed by* Sprint PCS (Sept. 12, 2000).

as explained above. Moreover, Sprint PCS's own filing presents the case that intermittent transmission from ultra-wideband devices make simultaneous interference unlikely.²³

WCS and DARS. These are also predominantly outdoor services with some indoor operation.²⁴ XtremeSpectrum proposes an additional 6 dB of attenuation, below the very low Sec. 15.209 levels, to accommodate these services. They will receive further protection from indoor-only operation of ultra-wideband communications, rapid decay with distance, lack of cumulative effect, and low probability of simultaneous transmission. XM Radio (DARS) and AT&T Wireless (WCS) ask the Commission to limit ultra-wideband operations below 3 GHz and 2600 MHz, respectively. XtremeSpectrum's proposed attenuated levels below 2.7 GHz is offered as an alternative that should help to address the concerns of these providers.

XtremeSpectrum is confident that experience will ultimately permit this limit to be relaxed.

MMDS. An MMDS vendor predicts harmful interference from a ultra-wideband device hundreds of meters away.²⁵ Its calculations, however, assume free-space propagation,²⁶ which considerably extends the interference radius many times beyond that likely to be encountered in practice. An MMDS system must be designed to operate in an environment where it receives Class B emissions from a multitude of computing, networking, and consumer electronics devices, but more importantly, where its own multiuser and multipath interference is often the limiting factor, as opposed to the noise floor.

²³ *Id.* at 1-2.

²⁴ *See* Metricom, Inc.; AT&T Wireless, Inc.; XM Radio, Inc.

²⁵ Cisco Systems, Inc. at 7.

²⁶ *Id.* at A1-4 (equation for *L*).

Moreover, the same party's calculations also specify an antenna gain of 20 dBi.²⁷ This means an ultra-wideband device is unlikely to act as an interference source unless it is on, or very close to, the antenna axis. Because an MMDS antenna is typically located on the rooftop, or on a window ledge or balcony looking outward, the back and sides of the antenna will almost invariably provide a very high level of attenuation for an ultra-wideband source located inside the building. Even if a roof-mounted antenna is located away from the edge of the building, and so may be impacted closer to the front of the antenna pattern, it will benefit from approximately 12 dB of attenuation from the roof materials. XtremeSpectrum's proposed attenuated levels below 2.7 GHz and indoor-only operation should help to address the concerns of MMDS. They will receive further protection by the rapid decay with distance, lack of cumulative effect, and low probability of simultaneous transmission. XtremeSpectrum is confident that experience will ultimately permit this limit to be relaxed.

E. Testing is Necessary, But Cannot Resolve All Interference Issues.

Several parties concerned about interference from ultra-wideband call on the Commission to take into account the results of well-engineered interference tests. XtremeSpectrum agrees.

Some parties, however, set out test criteria that are simultaneously so broad in scope and so specific in detail as to make the tests impossible to complete within any reasonable time

²⁷ *Id.* at A3-1.

period.²⁸ These proposals seem intended not so much to gather needed data as to delay the implementation of ultra-wideband.²⁹

Still other parties insist that the Commission not permit *any* ultra-wideband operations until test results have proved conclusively that no interference into other services can possibly result.³⁰ Surely these parties understand that the degree of certainty they demand is not achievable in practice. Their request is simply a roundabout way of asking the Commission never to authorize ultra-wideband.

XtremeSpectrum supports testing and is committing its own resources to participation in ongoing tests. But no set of test results, no matter how extensive, can ever resolve all of the controversies over interference from ultra-wideband emissions. Any practical 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. For that reason, any test is vulnerable to challenge from parties who would have preferred a different result.

Nonetheless, results of repeatable, well designed tests that can be modeled and explained on a theoretical basis may help to define the scope of reasonable rules. But they will not spare

²⁸ See, e.g., Aeronautical Radio, Inc. and the Air Transport Ass'n of America, Inc. at 16-17; Garmin Int'l, Inc. at 5-8; Nortel Networks Inc. at 2-5; ARRL, The Nat'l Ass'n for Amateur Radio at 11-12.

²⁹ XM Radio Inc. (at 13) suggests the Commission should not even require submission of test results before 2002.

³⁰ E.g., "The overarching requirement to ensure the protection of safety-of-life applications of GPS and other services dictates that the Commission should wait until the interference implication of UWB applications and services are *all* known and understood." U.S. GPS Industry Council at 40-41 (emphasis added). See also Satellite Industry Ass'n at 3; Qualcomm at 5.

the Commission the need to make the hard decisions on how best to accommodate those who seek to offer valuable new services without causing unacceptable interference to existing services.

CONCLUSION

This proceeding gives the Commission a rare opportunity to bring the public a wide range of badly needed services, without detracting from scarce spectrum resources.

To speed the availability of these services, XtremeSpectrum urges the Commission to bifurcate the proceeding, so as to authorize promptly those ultra-wideband implementations that pose no realistic threat of interference. For the sake of safety in these early rules, XtremeSpectrum suggests the Commission impose additional power limitations on the bands used by GPS, PCS, DARS, WCS, and MMDS, limit peak-to-average ratios to 20 dB, and restrict use to indoors-only. No doubt some or all of these conditions can be relaxed after the Commission and the industry have gained practical experience.

Much of the opposition to ultra-wideband greatly overstates the potential for interference, perhaps in part because commenters, lacking hard information, tend to assume the worst. In particular, most parties fail to appreciate that the interference energy from an ultra-wideband device drops off very quickly with distance. Not only does that make the radius of potential interference very small, but it also minimizes any cumulative effect of multiple ultra-wideband units. Moreover, the intermittent character of ultra-wideband communications transmissions further reduces the likelihood that more than one device will affect a given receiver. Indoor-only operation will further protect most applications of the services concerned about interference.

Finally, although XtremeSpectrum supports testing, we caution the Commission to maintain realistic expectations about the usefulness of test results. No set of tests, no matter how extensive, will ever resolve all of the interference issues to everyone's satisfaction. Decisions in the end will have to rest primarily on the Commission's best judgment as it seeks to benefit the public interest by adding new services while protecting those already in place.

Respectfully submitted,



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October 27, 2000

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