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January 3, 2002

Ms. Magalie Salas, Secretary
Federal Communications Commission
445 12th Street SW
Washington DC 20554

**Re: ET Docket No. 98-153 -- Revision of Part 15 of the Commission's Rules Regarding
Ultra-Wideband Transmission Systems
*Ex Parte Communication***

Dear Ms. Salas:

Pursuant to Section 1.1206(a)(1) of the Commission's Rules, on behalf of XtremeSpectrum, Inc., I am electronically filing this written ex parte communication in the above-referenced proceeding.¹

RESPONSE TO PCS FILINGS

XtremeSpectrum responds to four recent filings by the PCS industry.² These generally allege that ultra-wideband (UWB) threatens interference to PCS communications, and request that UWB be excluded from the 1-6 GHz region of the spectrum pending further testing. The filings also question the need for UWB, in light of other technologies.

¹ XtremeSpectrum, with 67 employees, conducts research in ultra-wideband communications systems as its sole business. XtremeSpectrum intends to become a ultra-wideband communications manufacturer once the Commission authorizes certification of such systems. XtremeSpectrum takes no position on ultra-wideband radar applications.

² Qualcomm, Verizon Wireless, AT&T Wireless, and Cingular Wireless (filed Dec. 5, 2001) ("December 5 Joint Filing"); Verizon Wireless, on behalf of AT&T Wireless, Cingular Wireless, Qualcomm, Sprint PCS, and Verizon Wireless (filed Dec. 4, 2001) ("December 4 Joint Filing"); Sprint (filed Nov 16. and Dec. 4, 2001) ("Sprint Filings") (these filings are substantively identical); and Cingular (Filed Nov. 13, 2001) ("Cingular Filing").

UWB WILL NOT CAUSE INTERFERENCE TO PCS COMMUNICATIONS.

A. SUMMARY

The recent PCS filings present no new evidence, but merely refer back to data filed months ago. XtremeSpectrum earlier pointed out the shortcomings in those data. The new PCS filings do not respond to XtremeSpectrum's technical critique, but reiterate the old conclusions as if they had never been challenged.

XtremeSpectrum responds to the PCS filings as follows:

- ***UWB will not interfere.*** XtremeSpectrum has submitted a compromise proposal that resolves all interference concerns documented in the proceeding. (Our proposed rule text is attached as an appendix.) Earlier, we showed that a less stringent proposal provides PCS with complete protection.³ The present proposal offers an additional (albeit unnecessary) margin of safety.

Under all proposals, UWB presents a far lower interference threat to PCS than does any other device in the Commission's Rules. For example, personal computers, laptops, and other digital devices are allowed 16 times more power in the PCS band than is UWB. Microwave ovens are permitted 400 times more power than UWB. Wireless LANs, up to 2800 times more power. The presence of UWB is completely negligible.

- ***PCS industry studies misstate the risk of interference.*** The small handful of studies relied on by the PCS industry greatly overstate the risk of interference. Although the studies are otherwise well carried out, they rely on starting assumptions that are seriously at odds with reality. The wrong assumptions lead to unfounded predictions of interference. With the assumptions corrected, the predicted interference disappears.

For example: The PCS studies assume ten times more operating UWB networks in an area the size of the New York City than the number of people there. And they ignore the effects of other PCS companies' handsets, whose leakage across PCS frequency blocks can run 10,000 times higher than the maximum proposed for UWB. See Part B below, for details.

³ See "XtremeSpectrum, Inc. Technical Reply to Comments on Potential GPS and PCS Interference from UWB Transmitters" at 3-12, filed with *Reply Comments of XtremeSpectrum, Inc. on Issues of Interference Into GPS and PCS* (filed May 10, 2001). See also "XtremeSpectrum, Inc. Technical Statement on Reports Addressing Potential PCS Interference from UWB Transmitters," filed with *Comments of XtremeSpectrum, Inc. on UWB/PCS Interference Issues* (filed April 25, 2001).

- ***UWB signals do not aggregate.*** The PCS filings continue to insist that UWB signals aggregate to cause interference. In fact, the very short range of UWB devices makes aggregation impossible. UWB emitters more than a few tens of meters away are undetectable, no matter how many there are.⁴ See Part B.3, below.
- ***Long experience with computer noise shows UWB will not interfere.*** Many millions of personal computers, laptops, and other digital devices all emit radio noise with an interference signature very similar to UWB. Each one has permitted emissions in the PCS band many times greater than those proposed for UWB. Yet PCS phones work well around computers, and with no evidence of aggregation. This is a far more realistic form of "testing" than any simulation or laboratory study, and provides persuasive evidence that PCS phones will be unaffected by UWB. See Part C, below.
- ***No further testing is needed.*** The very complete record in this proceeding makes additional testing unnecessary. Calls for more testing are merely a ploy to further delay the introduction of UWB. See Part D.2.
- ***UWB will fill important needs.*** The PCS industry questions whether consumers need UWB, in light of other wireless data technologies. This is a question for the market, not the Commission. In any event, UWB offers competitively decisive advantages in terms of cost, data speed, and battery consumption over all other available technologies. See Part D.3.
- ***The PCS industry's requests overreach its interests.*** Nothing in the record remotely justifies the PCS industry's request to exclude UWB communications systems from 1-6 GHz. Even if it has valid concerns about interference to PCS, the industry cannot raise issues outside the PCS band at 1.85-1.99 GHz. See Part D.4.

In short, the Commission can adopt its NPRM proposal, or the more conservative proposal detailed in the appendix, with no threat of interference to PCS.

⁴ Example: If we could somehow place 100,000 UWB simultaneous emitters 100 meters away from a PCS handset, the "aggregation" would still amount to well under 1% of the signal from a single emitter at 3 meters. At 200 meters away, the same 1% "aggregation" would require 1.7 million operating emitters. *Details:* This assumes same-room propagation losses at $1/R^2$ for the emitter 3 meters away, and $1/R^4$ propagation for emitters 100 or 200 meters away. See Part B.4.

B. THE PCS INDUSTRY CLAIMS OF INTERFERENCE ARE DUE ENTIRELY TO WRONG ASSUMPTIONS IN KEY STUDIES.

The claims of UWB interference into PCS derive from three studies: the Qualcomm Report,⁵ the Telcordia Model,⁶ and the Sprint/Time Domain Study.⁷ (Time Domain later disputed some of the findings in the Sprint/Time Domain Study.⁸)

The recent PCS filings do not provide any new data or other evidence.

All three of the older studies are well designed and carried out, except in one respect: several of their critical starting assumptions are wrong. Assumptions are important, because wrong assumptions yield wrong predictions. In Columbus's day, an assumption that the world is flat yielded the prediction that ships would fall off the edge. With the assumption corrected, the wrong prediction disappears. The issues here are more complex, of course, but the principle holds nonetheless. An accurate prediction can emerge only if the starting assumptions match reality.

XtremeSpectrum has previously challenged the assumptions underlying the earlier studies. We showed that the same analyses, but with wrong assumptions corrected, yields a finding of no interference into PCS handsets from UWB devices.⁹

Five assumptions are at issue. We address them individually.

⁵ Report of Qualcomm Incorporated (filed March 5, 2001).

⁶ Jay Padgett, *A Model for Calculating the Effect of UWB Interference on a CDMA PCS System*, filed as an attachment to Letter from Charles W. McKee, Sprint PCS to Magalie Roman Salas, FCC (filed Sept. 12, 2000).

⁷ *Summary of Testing Performed by Sprint PCS and Time Domain to Characterize the Effect of Ultra Wideband (UWB) Devices on an IS-95 PCS System*, filed as an attachment to Letter from Charles W. McKee, Sprint PCS to Magalie Roman Salas, FCC (filed Sept. 12, 2000). Sprint PCS submitted further commentary in *Sprint PCS Supplemental Comments* (filed Oct. 6, 2000).

⁸ *Reply Comments of Time Domain Corporation at Appendix A, "Analysis of the Impact of UWB Emissions on a 1.9 GHz CDMA PCS System"* (filed Oct. 27, 2000).

⁹ See note 3.

1. Emissions limits.

Most of the PCS studies were based on UWB emissions levels much higher than any proposals before the Commission. The Commission's NPRM specified a 94% reduction below Class B in the PCS band.¹⁰ XtremeSpectrum has proposed that same level for non-peer-to-peer operations, and a more stringent 98% reduction for peer-to-peer operations.¹¹ These levels offer substantial protection to PCS, compared to the Class B levels used in the studies.¹²

Sprint PCS followed up the Sprint/Time Domain Study with a filing that predicts harmful interference into PCS from UWB devices operating at the NPRM level (12 dB below Class B).¹³ But the prediction in that filing continues to depend on several other incorrect assumptions, discussed below. The interference goes to zero when those assumptions are properly adjusted.

2. Numbers of UWB devices.

The PCS studies assume extremely large numbers of UWB devices, ranging up to 5,000 to 100,000 active emitters per square kilometer. Even for a population-dense region such as metropolitan New York City, this works out to *ten operating UWB transmitters for every man, woman, and child*.¹⁴ These figures are unrealistic, to say the least. (NTIA's worst case was only

¹⁰ The Class B limit is the maximum level of stray noise permitted from personal computers and other consumer digital devices. This is only *75 billionths* of a watt. The NPRM level for the PCS bands is *5 billionths* of a watt, equivalent to 12 dB below Class B. See *Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems*, 15 FCC Rcd 12086 at para. 39 (2000) ("NPRM"). *Detail*: All power levels in this filing are specified for a minimum resolution bandwidth of 1 MHz, in accordance with the Commission's measurement procedures. See 47 C.F.R. Sec. 15.35(b).

¹¹ This is equivalent to 16 dB below Class B, less than 2 billionths of a watt. Peer-to-peer communications are communications between two battery-operated devices. As detailed in the appendix, XtremeSpectrum proposes lower limits for peer-to-peer operations to allow for the possibility that they may occasionally occur outdoors. The lower peer-to-peer limit is offered to protect outdoor receivers, and is unnecessary for PCS. See Part D.1, below, on protecting indoor PCS operations.

¹² See also Part C, below, for a discussion of UWB peak emissions.

¹³ *Sprint PCS Supplemental Comments* (filed Oct. 6, 2000).

¹⁴ *Details*: The 2000 census put the population of New York City at 8,008,278. The area is 320 square miles, or 828 square kilometers. This yields an average population density of 9672 people per square kilometer, less than 1/10 the UWB density in the PCS studies.

1-10,000 devices per square kilometer.¹⁵ Much of its analysis assumed a value of 200 devices per square kilometer.¹⁶)

Still, in the end, all of this is irrelevant. The number of units in an area would be significant only if their signals aggregated. We show below that a victim receiver is affected only by the nearest emitter (or the nearest few, at most). The other 99,999 devices make no difference whatsoever.

3. Noise floor.

The PCS studies assume that the UWB emitters and PCS handset exist alone, unaffected by any other sources of radio-frequency energy. This is never the case. Populated areas always have a background level of ambient radio noise.

Some of the background noise into a PCS handset comes from other people's PCS calls. Signals from a competing provider's handset, with its main signal in some other PCS frequency block, are permitted to reach 50 millionths of a watt.¹⁷ Although a small number, this is still *10,000 times higher than the maximum proposed for UWB*.¹⁸ Other noise comes from same-provider PCS base stations serving other cell sites nearby. The PCS studies fail to account even for this unavoidable self-generated interference.

The Sprint/Time Domain Study tested PCS interference from UWB by isolating both devices inside a radio-opaque chamber. The results of such a study are interesting, but academic, because they say little about interference in the real world. The more important question, for regulatory purposes, is whether UWB interferes with PCS in a world populated by ubiquitous noise-emitting devices, all of them authorized at far higher power than UWB.

¹⁵ Lawrence K. Brunson *et al.*, *Assessment of Compatibility Between Ultrawideband Devices and Selected Federal Systems*, NTIA Special Publication 01-43 at 5.1-5.2 (U.S. Dep't of Commerce January 2001).

¹⁶ National Telecommunications and Information Administration Special Publication 01-45 at page 3-48 (filed March 9, 2001).

¹⁷ *Details*: Competing PCS providers operate their handsets on six contiguous frequency blocks within the PCS band. 47 C.F.R. Sec. 24.229. Any emission outside a provider's own block must be attenuated by $43 + 10 \log(P)$, where P is the power within the provider's own block. 47 C.F.R. Sec. 24.238(a). This yields a maximum out-of-block power of 50 uW, regardless of the in-block power.

¹⁸ *Details*: Class B is equivalent to 75 nW. See 47 C.F.R. Sec. 15.109(a). The proposed UWB limit of 12 dB below that is equivalent to 5 nW, which is 10,000 times less than 50 uW.

Moreover, UWB communications signals can never appear in isolation. Every XtremeSpectrum UWB transmitter unit will be embedded in a host digital device such as a laptop, DVD player, etc. The host digital device is always allowed at least 16 times the power of the UWB unit, in the PCS band. We know the digital signals are harmless to PCS, because PCS phones work well near computers. (See Part C, below.) It follows that UWB, at far lower levels, must be harmless as well.

In any imaginable environment, all UWB emissions combined will always be well below ambient radio noise in the PCS band. No accumulation of UWB emitters can have any detectable effect on interference to PCS.¹⁹

4. Propagation.

The PCS studies assume that interfering UWB signals propagate indoors as they would in outer space. In fact, however, the effects of interior walls, furniture, and within-the-room reflections all diminish the UWB signal strength. One widely accepted technical study shows that a typical indoor environment provides a 94% reduction (12 dB) relative to free space, over a 10 meter range.²⁰ This greatly reduces the effect of UWB on PCS (and other systems).

5. Aggregation.

The PCS studies assume that signals from multiple UWB units aggregate to form stronger signals.²¹ This is incorrect.

UWB aggregation has taken on the status of an urban myth. Many filings in the docket state with great conviction that aggregation occurs, although none cites any evidence. UWB emissions add, as do other radio-frequency signals, but nonetheless they do not aggregate at a victim receiver. The reason is simple: UWB signals cannot travel far. As they propagate, the already small signals fall off much faster than they can add up. As a result, only the nearest UWB emitter can be significant. The signals from all others are so weak as to be negligible.

Suppose we could somehow arrange for 100,000 UWB emitters to be distributed through a building, each one of them 100 meters away from a PCS handset. The total signal received at

¹⁹ See note 27.

²⁰ Robert J.C. Bultitude, Samy Mahoud, and William Sullivan, *A Comparison of Indoor Radio Propagation Characteristics at 910 MHz and 1.75 GHz*, 7 IEEE Journal on Selected Areas in Communications No. 1 at 20 (Jan. 1989).

²¹ *E.g.*, Cingular Filing at 1st page after cover letter; Sprint Filings at 1 (after cover letter).

the handset from all 100,000 units would be well under 1% of the signal from *one* UWB emitter, placed 3 meters away.²² Only the nearest emitter matters.²³

Some parties have pointed to an NTIA *simulation* (not an actual experiment) and erroneously concluded that it predicted aggregation.²⁴ That outcome resulted solely from a manipulation of assumptions. The study calculated the cumulative effects of UWB emitters scattered randomly over a target-like pattern of concentric rings, with the "victim receiver" at the center. But in every case where it made a difference, the authors "forced" an extra UWB emitter onto the innermost ring, nearest to the receiver. The effects attributed to aggregation in fact arose from that extra emitter. With the extra emitter removed, the supposed aggregation disappeared.²⁵

Rather than predict aggregation, the NTIA study actually demonstrates the reverse: there is no aggregation, and only the closest emitter counts. This same conclusion emerges from other analyses. The NPRM cites the Commission's own Technology Advisory Council as concluding that UWB would cause "no significant rise in the [radio-frequency] noise floor." Instead, the

²² *Details:* As noted above, this assumes same-room propagation losses at $1/R^2$ for the emitter 3 meters away, and $1/R^4$ for emitters 100 or 200 meters away.

²³ An analogy may help to explain this effect. Suppose a hotel has a TV playing in every room. A guest in the hotel hears the TV in that room, and might barely hear the immediate neighbors' TVs, but no others. Someone outside the hotel hears nothing at all. In just the same way, a receiver is potentially affected by the nearest UWB emitter, but no others.

²⁴ Lawrence K. Brunson *et al.*, *Assessment of Compatibility Between Ultrawideband Devices and Selected Federal Systems*, NTIA Special Publication 01-43 at Chapter 5 and Appendix B (U.S. Dep't of Commerce January 2001).

²⁵ For details, see "XtremeSpectrum, Inc. Technical Statement on Reports Addressing Potential GPS Interference from UWB Transmitters" at 16-18, filed with *Comments of XtremeSpectrum, Inc. On Issues of Interference Into Global Positioning System Receivers* (filed April 25, 2001).

TAC concluded, the "noise floor would be set by the closest UWB transmitters."²⁶
XtremeSpectrum does not know of *any* study that shows *any* evidence for aggregation.

* * * *

In short, the PCS industry's predictions of UWB interference arose entirely from five wrong assumptions: higher-than-proposed emissions limits; impossibly high numbers of UWB devices; no other sources of radio noise; free-space propagation indoors; and aggregation of UWB signals. Under those conditions, some level of interference would hardly be surprising. But none of these assumptions is true. At proposed emissions levels, realistic numbers of operating units, a real-life noise environment, actual propagation characteristics, and negligible aggregation of signals, the same methods of analysis used by the PCS industry show that interference will *not* occur.

C. DECADES OF EXPERIENCE WITH DIGITAL DEVICES SHOW THAT UWB WILL NOT CAUSE INTERFERENCE.

UWB opponents routinely call for further testing of UWB. In addition to the tests already reported in the docket, however, a real-life, large-scale "natural experiment" has been running for several years, using the countless millions of products that contain digital circuitry -- everything from personal computers and laptops to the processors that run wireless phones, microwave ovens, stereo systems, and alarm clocks. Yet everyday experience tells us that PCS handsets work perfectly well around all types of digital devices. This vast "study" is persuasive evidence that PCS phones will likewise be unaffected by UWB devices, because the interference signature of stray radio noise from digital equipment is similar to that of a UWB transmitter. The Commission can take this result as added evidence that UWB is fully compatible with all other uses of the spectrum.

Although all UWB manufacturers' signals are not identical, the main difference between digital noise and UWB emissions is their relative signal strength: UWB signals are far weaker. The proposed rules would limit UWB emissions in the PCS band to just 6% of the energy

²⁶ NPRM at para. 24, *citing* "Cumulative Issues and Ultra-Wideband," TAC White Paper, Spectrum Management Focus Group, (undated). This paper drew on the following studies: "Cumulative Electromagnetic Radiation from Multiple UWB Transmitters," Time Domain Systems, Inc. (Dec. 4, 1998); "An Analysis of Noise Aggregation from Multiple Distributed RF Emitters," Interval Research Corporation (Dec. 6, 1998); "Short Analysis on the Effects of a Large Number of UWB Systems," XtremeSpectrum, Inc., Technical Report TR-98-1 (Fall 1998); "The Effect of Proliferation of Wideband Devices," A. D. Little Corporation, C5803-R-001a (Feb. 3, 1999); "Cumulative Impact of Large Numbers of TM-UWB Users," Time Domain (date not given).

permitted for digital devices. This assures that interference into PCS from UWB will be far less than the interference caused by digital products -- *i.e.*, none at all.²⁷

Digital devices and aggregation. It is hard to imagine a better experiment on aggregation than a crowded office suite equipped with scores of computers, printers, scanners, copiers, etc., all operating simultaneously. If the PCS industry were correct about signal aggregation, a PCS handset would not stand a chance in that environment. But in fact they work fine, which is powerful evidence that digital noise (and UWB signals) do not aggregate.

Digital devices and peak emissions. We understand that some in the PCS industry have expressed concern about the effects of UWB *peak* emissions. Again, the experience with digital devices shows that any such fears are unfounded. The proposed peak-to-average ratio limit for UWB is 20 dB²⁸ -- the same as the limit for all consumer digital devices.²⁹ Measurements show that the peak-to-average properties of a UWB signal complying with the proposed rules are very similar to those of noise from a digital device. In other words, PCS handsets are just as safe from UWB peak emissions as from digital-device peak emissions -- safer, in fact, because peak (and average) UWB emissions in the PCS band will be much lower than the corresponding digital device emissions.

Digital devices and other systems. The PCS filings suggest that UWB "could interfere" with a miscellany of other services and devices: public safety communications systems, entertainment systems, mobile satellite, military systems, and also hearing aids, pacemakers, implanted defibrillators, and "other hospital equipment."³⁰ To imply life-threatening interference without citing any evidence, as the PCS filings have done, borders on the irresponsible.

²⁷ We do not dispute that a PCS handset operating too close to a personal computer may have to request more power from its base station. *See* Sprint Filings at 1 (after cover letter). That is a cost of PCS's doing business in a technologically rich environment. However, because UWB operates at a far lower permitted power level than a personal computer, it will have a far smaller effect on a PCS handset's power demands, most typically none at all.

²⁸ NPRM at para. 43. *Detail:* Twenty dB is the proposed UWB peak-to-average ratio across a 50 MHz measurement bandwidth. Although higher maximum ratios are proposed for higher measurement bandwidths, these can have no effect on PCS, whose bandwidths are much smaller than 50 MHz.

²⁹ 47 C.F.R. Sec. 15.35(b).

³⁰ Cingular Filing at 2nd page after cover letter; December 5 Joint Filing at 3.

Considering that all of these systems routinely operate in close proximity to computers, they are in no danger from UWB.³¹

Conclusion. The "additional testing" demanded by the PCS industry has already been carried out, over many years and on a huge scale. We know that digital devices do not interfere with PCS, and we know UWB is safer for PCS than digital devices. As a result, we can be fully confident that UWB will not cause interference to PCS.

D. OTHER MATTERS

XtremeSpectrum responds briefly to other issues raised by the PCS industry. None of these points is seriously in issue.

1. XtremeSpectrum does not rely on indoor-only operation to protect PCS.

The PCS industry continues to assert that XtremeSpectrum's proposed indoor-only restriction on UWB will not protect PCS handsets, which are also used indoors.³²

XtremeSpectrum long ago made clear that its indoor-only proposal was intended to expedite the proceeding by offering extra protection for outdoor receivers, such as certain radar systems.³³ UWB does not require an intervening building wall to protect PCS. We have shown in detail that the Commission's proposed emissions limits are adequate to prevent indoor-to-

³¹ The reference to hospital equipment is particularly surprising, because hospitals tend to exhibit a high level of radio noise. In addition to an unusually dense installation of computers, monitors, printers, and other commercial equipment, the environment includes a variety of specialized medical equipment that is permitted to emit digital energy at *any* level. 47 C.F.R. Sec. 15.103(e). At the same time, however, many hospitals ban cell and PCS phones, out of concerns about interference into their equipment. A UWB device puts out *100 million times less power* in the PCS band than a PCS handset. (*Details:* This compares a UWB device at 12 dB below Class B to a 600 mW PCS handset, both operating across a 1.25 MHz PCS CDMA channel.)

³² *E.g.*, Sprint Filings at 2 (after cover letter).

³³ See "Detailed Technical Analysis of Systems Studied in NTIA Reports," *filed with* Letter from Mitchell Lazarus to Magalie Salas, Secretary, FCC (filed Nov. 14, 2001); *Reply Comments of XtremeSpectrum, Inc.* and attached "XtremeSpectrum, Inc. Technical Statement on NTIA Report" (filed March 12, 2001).

indoor UWB interference into PCS handsets.³⁴ Our compromise proposal (attached) is still more conservative.

2. No further testing is needed.

UWB opponents demand additional testing, on the ground that not every type or combination of UWB devices has been specifically tested for PCS interference.³⁵

Further testing is unnecessary, for several reasons. First, no laboratory tests can approach the ongoing, large-scale field experiment using billions of products containing digital devices, all of them allowed to radiate at far more power in the PCS band than UWB. The results of this experiment are completely unambiguous, and need no follow-up. Second, the rules will define certification tests that limit the potential for harmful interference, regardless of how any particular device is implemented. (The rules proposed in the appendix do just that.) The product-by-product testing requested by the PCS industry in fact will take place -- but as part of the certification process, not prior to the adoption of rules. Third, no analysis suggests that further testing will change the outcome. The worst-case analyses already conducted show that no interference occurs (once counterfactual assumptions are corrected).

Although it is immaterial, in view of the above, we note that testing all types and combinations of UWB devices is neither feasible nor desirable. It is not possible to list all UWB product types, and may never be possible, because competition will force the continuing development of new and better UWB products. One benefit of adopting certification tests that are independent of particular products is precisely the fostering of such competition and continuing innovation.

The administrative record in this forty-month-long proceeding is more than adequate for Commission action. Additional testing can add nothing useful. Calls for more testing are only a transparent effort at delay.

³⁴ See "XtremeSpectrum, Inc. Technical Reply to Comments on Potential GPS and PCS Interference from UWB Transmitters" at 3-12, filed with *Reply Comments of XtremeSpectrum, Inc. on Issues of Interference Into GPS and PCS* (filed May 10, 2001). See also "XtremeSpectrum, Inc. Technical Statement on Reports Addressing Potential PCS Interference from UWB Transmitters," filed with *Comments of XtremeSpectrum, Inc. on UWB/PCS Interference Issues* (filed April 25, 2001).

³⁵ Cingular filing at 1st page after cover letter. See also "December 4 Joint Filing at 2.

3. UWB will fill important needs.

The PCS industry questions the need for UWB, in light of other wireless data technologies such as Bluetooth and IEEE 802.11.³⁶

The Commission has always recognized that better and more flexible technology stands to benefit consumers, albeit sometimes in unexpected ways. (For example, no one in the early days of PCS foresaw web browsing on handheld phones.) UWB promises to be no exception. In any event, the Commission's mandate is to prevent interference. Picking technologies is a task for the marketplace.

Furthermore, the PCS industry's argument is factually wrong. Over its 10-meter design range, XtremeSpectrum's implementation of UWB offers competitively decisive advantages in terms of cost, data speed, and battery consumption over Bluetooth, IEEE 802.11, and every other available technology.

4. The PCS industry has no grounds to exclude UWB from 1-6 GHz.

Some PCS companies urge the Commission to exclude UWB communications systems from the entire region covering 1-6 GHz.³⁷ PCS is entitled to protection from harmful interference in the PCS band at 1.85-1.99 GHz. Users of other bands can speak for themselves (and have done so). The PCS industry has no grounds for addressing regions of the spectrum that do not affect its operations.³⁸

5. Licensing is not only unnecessary, but would deprive consumers of UWB.

The PCS industry asks the Commission to require that UWB devices be licensed, "or at least coordinated," so that interference issues can be examined.³⁹ As we have shown in detail above, however, UWB does not raise any interference issues. Licensing and coordination are therefore unnecessary.

³⁶ Cingular Filing at 2nd page after cover letter; Sprint Filings at 2 (after cover letter)

³⁷ Cingular Filing at 1st page after cover letter; December 4 Joint Filing at 2

³⁸ Even if the PCS industry wants to take into account possible future allocations for 3G services, this would still justify its concern only below 2.5 GHz. The PCS industry has no conceivable interest in the vast region of spectrum between 2.5 and 6 GHz.

³⁹ Cingular Filing at 1st page after cover letter; December 5 Joint Filing at 4.

Worse, licensing would make it impossible for manufacturers of consumer devices to incorporate UWB capability. A licensing scheme intended to control interference depends on a database that shows the location of every user. Yet the PCS industry cannot expect each purchaser of a UWB-equipped laptop, digital camera, or Palm-type PDA to file a license application with the Commission, and then refile every time the product is moved to a new location. A call for licensing amounts to a call for banning UWB communications devices.

The Commission long ago determined that the public interest is well served by allowing low-power, non-interfering devices to operate on an unlicensed basis. *The power limits proposed for UWB are lower than those for than any other device, licensed or unlicensed, in the Commission's Rules.* The PCS band will receive at least 12 dB more protection from UWB than from any other type of device.⁴⁰ As discussed above, these levels fully protect PCS. UWB licensing would be completely superfluous.

6. Authorizing UWB will not violate any contract between the Government and the PCS licensees.

Sprint alleges that the Commission's "modify[ing] the [PCS] licenses" to authorize "additional use and interference" in the band would put the Government in breach of contract, and make it liable for the PCS licensees' costs incurred in overcoming interference.⁴¹

Sprint offers no legal support for this argument. Indeed, there is none. First, authorizing UWB is not a modification of the PCS licenses, either in letter or in spirit. Sprint bid on its spectrum knowing that the Commission's Rules allow Part 15 devices to operate in the PCS bands. Second, the Government has no contract with Sprint that would bar authorization of UWB. Accordingly, there can be no breach, and no damages. Finally, because UWB does not cause interference, PCS licensees will not incur any costs in overcoming it.

A licensee such as Sprint nonetheless has another, non-contractual form of protection. Sprint can rely on the Commission's decades-old commitment not to authorize Part 15 devices that threaten harmful interference to licensed services. The three-year pendency of this proceeding is telling evidence (if any were needed) that the Commission takes that responsibility seriously. No one who has followed the proceeding can seriously believe the Commission would authorize UWB unless there were no significant risk of interference to PCS and other critical services.

⁴⁰ See NPRM at para. 39 and Appendix hereto.

⁴¹ Sprint Filings at 2 (after cover letter).

CONCLUSION

XtremeSpectrum respects the PCS industry's interest in safeguarding its spectrum, and acknowledges its right to challenge Part 15 uses that would cause harmful interference to its operations. But that is not the case here. All of the evidence in this very thorough proceeding shows that interference will *not* occur.

The PCS industry's own studies can reach a prediction of interference only if they first change the facts of both UWB and PCS beyond recognition. We detailed those above: over-powered UWB devices; far more UWB networks operating simultaneously per square mile than there are people, even in New York City; a world that otherwise has no other radio devices (not even PCS, except the victim handset); free-space propagation indoors; and the laws of physics set aside so that UWB signals can aggregate. Without these departures from reality, the analyses show there will be no interference.

Reading the filings of the PCS industry and other UWB opponents, it is easy to forget just how low the UWB power levels will be. Both the NPRM and the XtremeSpectrum proposal limit emissions in the PCS band to less than 5 billionths of a watt. This is lower than any power limit for any device in any band, anywhere in the Commission's rules.

All of this makes the PCS industry's focus on UWB somewhat puzzling. Under all currently proposed rules, *UWB presents a far lower interference threat than any other Part 15 device, whether intentional or unintentional*. Both the Commission's NPRM and XtremeSpectrum's proposal limit UWB emissions in the PCS band to just 6 percent of the power permitted for hundreds of millions of consumer digital devices, not to mention other unlicensed transmitters. Even those devices are permitted far less energy in the PCS band than the harmonics and spurious outputs of several other systems, including wireless LANs, microwave ovens, and several TV channels.⁴² The presence of ultra-low power UWB in this mix cannot make any difference to the performance of PCS handsets.

Finally, XtremeSpectrum must completely protect PCS handsets anyway, no matter what the Commission requires. XtremeSpectrum answers to another authority whose power rivals the Commission's: the law of the marketplace. XtremeSpectrum will sell chips to manufacturers, which in turn will install the chips in consumer products. Many of the end products will include other radio-based capabilities, particularly PCS and GPS. These will have to function correctly while the UWB transmitter operates in the same device, a few centimeters away. The market will ensure that our products are absolutely non-interfering to PCS.

* * * *

⁴² See, e.g., 47 C.F.R. Secs. 15.231(b) (periodic operation above 70 MHz); 15.245(b) (field disturbance sensors); 15.247(c) (spread spectrum systems); 18.305(b) (microwave ovens); 73.687(e) (third harmonic of TV channels 38-46).

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

Respectfully submitted,

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APPENDIX -- Proposed Rule Text

15. ___ Protection of other services.

(a) An ultra-wideband communications device may not be mounted on an outdoor surface or support.

(b)(I) Under no circumstances may the emissions from an ultra-wideband communications device exceed these limits:

Frequency (MHz)	Field strength (microvolts/meter)	<i>[NOTE IN DRAFT]</i>
960-1574.92	125	<i>[Class B - 12 dB]</i>
1574.92-1575.92	45	<i>[Class B - 21 dB]</i>
1575.92-1990	125	<i>[Class B - 12 dB]</i>
above 1990	500	<i>[Class B]</i>

(ii) In the table above, the measurement distance is 3 meters. The tighter limit applies at band edges. Measurements shall be performed using a resolution bandwidth of 1 MHz.

(iii) In addition to the provisions of paragraph (b)(I), emissions limits in the band 1574.92-1575.92 MHz measured using a resolution bandwidth of 10 kHz shall not exceed 15 microvolts/meter measured at 3 meters. *[NOTE IN DRAFT: This represents a 10 dB additional attenuation for spectral lines in the GPS band.]*

©) The provisions of this subsection apply to a battery-powered ultra-wideband device in communication with another battery-powered ultra-wideband device.

(I) The following emissions limits apply in lieu of those set out in section (b):

Frequency (MHz)	Field strength (microvolts/meter)	<i>[NOTE IN DRAFT]</i>
960-1610	10	<i>[Class B - 34 dB]</i>
1610-3100	80	<i>[Class B - 16 dB]</i>
3100-4200	160	<i>[Class B - 10 dB]</i>
above 4200	500	<i>[Class B]</i>

(ii) A battery-powered ultra-wideband device must be designed so that it cannot commence communicating with another battery-powered ultra-wideband device unless the user affirmatively initiates the transmission, as by pressing a button.

(iii) As an alternative to compliance with paragraphs (I) and (ii), a battery-powered ultra-wideband device can be made incapable of communicating with another battery-powered ultra-wideband device outdoors.

[NOTE IN DRAFT: The last provision allows "full power" peer-to-peer operation where the device can establish it is indoors -- e.g., by detecting a nearby AC-powered unit.]