
Before the
Federal Communications Commission
Washington, D.C. 20554

In re Application of)
)
Revision of Part 15 of the Commission's Rules) ET Docket No. 98-153
Regarding Ultra-Wideband Transmission)
Systems)

To: The Commission

**REPLY COMMENTS
OF CINGULAR WIRELESS LLC
REGARDING UWB TEST REPORTS**

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SUMMARY

Cingular agrees with the serious concern expressed by a wide variety of commenters about permitting the proliferation of UWB transmitters, based on the testing data. The Commission should not allow radio services on which all Americans depend, including for safety-related communications, to be put at risk merely due to the *potential* benefits of a new and untried technology. Many different services are endangered by UWB, including not only GPS but many wireless services. The Qualcomm Report showed that UWB poses interference concerns for CDMA PCS, confirming the results of a previous test. Interference concerns have also been voiced as to other wireless technologies, including GSM, W-CDMA, TDMA, and other technologies used in the cellular and PCS bands, as well as the range of 3G technologies. Likewise, the Commission must consider the effect of UWB on the many unlicensed Part 15 applications on which consumers and businesses have become increasingly reliant.

While the reports and comments address the need to protect GPS, there is no discussion about Assisted-GPS, which will be used by many wireless carriers to provide accurate location information complying with the Commission's E-911 Phase II requirements. Assisted-GPS requires greater protection from interference than GPS in general because it operates well below the noise floor in order to permit use in locations where the direct GPS signal is too attenuated. The Commission must not make this technology less effective by allowing UWB to cause interference.

There is clearly a need for further study of the effect of a variety of different UWB technologies on wireless services using various technologies and frequencies. The amount of protection needed for these services remains to be determined.

The wide variety of envisioned UWB devices and technologies makes it difficult to characterize or measure the interference effects of UWB, given the enormous number of open issues. There needs to be additional work on characterizing the application and operating spectrum band of UWB devices, as well as further testing, before the Commission proceeds to adopt rules.

Cingular notes, in response to XtremeSpectrum's comments proposing that UWB communications devices be restricted to indoor use, that its proposal assumes that the wireless receivers that would receive interference from such devices would principally be outdoors. This is not a valid assumption, because wireless phones are commonly used indoors, and there are also indoor microcells and wireless office systems that could receive interference as well. In addition, XtremeSpectrum's proposal does not address the potential interference to wireless receivers from non-communications UWB devices outdoors. Further study is warranted.

TABLE OF CONTENTS

SUMMARY	i
TABLE OF CONTENTS.....	iii
I. THE COMMENTS SHOW THE NEED FOR CAUTION REGARDING WIDESPREAD USE OF UWB.....	1
II. PROTECTION OF ASSISTED-GPS	3
III. NEED FOR FURTHER STUDY OF EFFECT OF UWB ON WIRELESS SERVICES.....	4
IV. CONCERN OVER DIFFERENT UWB CHARACTERISTICS	6
V. REPLY TO XTREMESPECTRUM COMMENTS ADDRESSING ISSUES RELATING TO PCS INTERFERENCE.....	7

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Cingular Wireless LLC ("Cingular") hereby replies to the April 25, 2001 comments responding to five test reports on Ultra-Wideband ("UWB") interference issues.¹

**I. THE COMMENTS SHOW THE NEED FOR CAUTION
REGARDING WIDESPREAD USE OF UWB**

Commenters from all sectors of the telecommunications community expressed serious concern about permitting the proliferation of UWB transmitters, based on the testing data in the five reports.² Cingular shares these concerns. While Cingular believes that the innovative UWB technology holds promise, the Commission must not put at risk existing radio services on which all Americans depend for communications related to safety and business, as well as

¹ See Public Notice, *Comments Requested on Reports Addressing Potential Interference from Ultra-Wideband Transmission Systems*, DA 01-753 (Mar. 26, 2001). The five reports listed in that public notice will be referred to as the "Qualcomm Report" (filed March 5, 2001), the "Hopkins Report" (filed March 9, 2001), the "NTIA Report" (filed March 9, 2001), the "DOT Report II" (filed March 21, 2001), and the "DOT Report I" (filed October 30, 2000).

² See Comments filed April 25, 2001 by Aeronautical Radio, Inc./Air Transport Association of America, Inc. ("ARINC/ATA"), Conexant Systems Inc., Lockheed Martin Corporation, Sprint Corporation, Motorola, Inc., Sirius Satellite Radio Inc., U.S. GPS Industry Council, AARL/National Association for Amateur Radio; Letter filed April 25, 2001 by Nokia Inc.; Comments filed April 23, 2001 by Boeing Corporation.

personal convenience, merely because of the *potential* benefits of a new and untried technology. The comments and test data demonstrate the need for a cautious approach.

UWB transmissions have the potential to interfere with numerous radio services on which the public currently relies, as well as services currently in the early stages of deployment. The radio application of greatest concern in the reports and comments is GPS, the Global Positioning System, which is safety-critical. Wireless services will also be affected, both directly and through the reliance of many wireless operators on GPS for providing E-911 Phase II location information.

One of the reports is a Qualcomm study that demonstrates that additional study is needed due to the considerable potential for UWB interference with wireless services using code division multiple access (“CDMA”) technology. As Sprint points out, the Qualcomm tests show under some circumstances UWB operation will not only have the *potential* to cause harm to CDMA wireless services; it “*will have a harmful impact on the normal operation of CDMA wireless devices in the voice, data and GPS modes,*” . . . thus independently confirm[ing] the data obtained in the Sprint PCS/Time Domain tests.”³

CDMA is not unique in its susceptibility to interference from UWB transmissions. Wireless equipment manufacturer Nokia expressed concern about the effect on systems using GSM and W-CDMA technology, as well as all cellular/PCS systems in the 800 and 1900 MHz bands. It also expressed concern about the effect of UWB on third-generation (“3G”) wireless systems “and beyond,” and other emerging services such as wireless local area networks

³ Sprint Comments at 1, *quoting* Qualcomm Report at 25 (emphasis added).

(“WLANs”), digital video broadcasting (“DVB”), digital audio broadcasting (“DAB”), and broadband software defined radios (“SDRs”).⁴

Cingular notes that any number of other services may also be susceptible to UWB interference, such as the Wireless Communications Service (“WCS”) and Multichannel Multipoint Distribution Service (“MMDS”). Moreover, Nokia’s mention of WLANs points up the need for study of the effect UWB may have on this and other unlicensed Part 15 services. While Part 15 devices are “secondary” and are required to accept interference from licensed uses, the Commission needs to take these into account in determining whether to authorize a new service, whether licensed or unlicensed, that has the potential to impair communications on which members of the public rely. For example, many wireless devices used in homes and businesses use spectrum on an unlicensed basis under Part 15, including not only the ubiquitous cordless phone but also wireless data/audio/video distribution systems for the home. Emerging technologies such as Bluetooth will be used for short-range transmissions with many different applications, from WLAN to point-of-sale. Moreover, unlicensed low-power fixed wireless microwave links at 900 MHz, 2.4 GHz, or other ISM frequencies are commonly relied upon by many businesses, including some common carriers.

II. PROTECTION OF ASSISTED-GPS

While the reports focused on interference to conventional GPS, neither the reports nor the comments directly addressed the need to expand the GPS category to include Assisted-GPS. Assisted-GPS is one of the technologies being considered by wireless network operators for meeting the location accuracy specifications mandated by the FCC for providing Phase II E-911 location information. A recent Department of Transportation report pointed out that E-911 will

⁴ See Nokia Letter at 2.

in many cases require “hybrid” systems, such as Assisted-GPS, to provide the location information needed in places unsuited to conventional GPS reception, such as indoors, under trees, or in urban “canyons.”⁵ Assisted-GPS requires greater protection from potential sources of interference than GPS because it can operate at power levels that are below the noise floor in order to provide location information in these difficult locations.⁶

Given the need of many wireless providers to use Assisted-GPS in carrying out their Commission-mandated public safety obligations, there must be careful consideration of the effect of UWB on Assisted-GPS before establishing the technical standards for UWB transmissions on GPS frequencies. The Commission must not risk making Assisted-GPS a less effective technology by introducing additional interference. Moreover, *any* interference (not just “harmful” interference) to the location systems that will be deployed has the potential to make these extremely expensive systems even more expensive to the wireless network operator and less useful as a tool for public safety.

III. NEED FOR FURTHER STUDY OF EFFECT OF UWB ON WIRELESS SERVICES

In today’s cellular and PCS networks, the radio link margins have been optimized to provide acceptable performance over a wide variety of conditions. The addition of interference from UWB would have a severe impact on quality and capacity. At this point, there has been

⁵ See *Second Interim Report to the Department of Transportation: Ultra-Wideband Technology Radio Frequency Interference Effects to Global Positioning System Receivers and Interference Encounter Scenario Development*, at 53-54 (Mar. 27, 2001) (“DOT Report IIP”), submitted as attachment to Letter from Kathy D. Smith, National Telecommunications and Information Administration, Department of Commerce, to the Secretary (filed May 3, 2001).

⁶ DOT Report III notes that while “the GPS signal level under clear view of the sky is –130 dBm,” this signal is degraded by more than 20 dB by “building penetration, shadowing, and foliage.” It further notes that hybrid GPS systems such as Qualcomm’s *gpsOne*TM “are able to acquire and track GPS signals as weak as –150 dBm,” but warns that “[a]t such a low signal level . . . , even a small amount of interference can have adverse effects.” *Id.* at 54.

only two reports (the Qualcomm Report and the earlier joint report from Sprint and Time Domain⁷) that addressed interference to PCS, and specifically CDMA. This should be expanded to include TDMA, GSM, and W-CDMA in both the cellular and PCS frequency bands. At least one company has said that it has begun working on simulated results for interference with PCS and GPS and will report the results in the near future.⁸

From the Part 15 specifications, it is clear that the field strength levels allowed in the restricted bands are based on the fact that the only signals expected in these bands are spurious emissions. In this case, there may be “spurs”, or peaks, in these bands that may be as high as the Part 15 limits but over the remaining bandwidth the emissions would be significantly less than this limit. However, in the case of UWB it seems that the emission levels could be at (or, depending on how the Commission ultimately rules on power measurement standards, greater than)⁹ the Part 15 limit across the entire bandwidth of any of the individual restricted bands. This is a much different scenario and should be thoroughly examined through continued testing. The tests should take into account a wide variety of both UWB technologies and victim technologies.

⁷ See Dr. Jay Padgett, Senior Research Scientist, Telcordia Technologies, “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” (Sept. 12, 2000), *appended as Attachment 2* to the September 12, 2000 Sprint PCS and Time Domain letters; *see also* Sprint PCS Supplemental Comments (Oct. 6, 2000).

⁸ See Motorola Comments at 2.

⁹ UWB devices should be studied further to determine the interference characteristics due to conventional signals (*i.e.*, white noise) and also high peak power, transient UWB signals. See generally Terence W. Barrett, *History of Ultra Wideband Communications and Radar: Part 1, UWB Communications*, 44 MICROWAVE J. No. 1, at 22-56 (Jan. 2001) (“These are two separate requirements which are usually assumed to be identical.”).

While the Commission had proposed a 12dB reduction from the current Part 15 emission levels,¹⁰ one of the commenting companies, XtremeSpectrum, Inc., suggested a reduction of 18dB (*i.e.*, an additional 6dB) for the protected bands such as GPS.¹¹ Exactly what amount of protection below the Part 15 specifications that is acceptable must be determined through additional testing and analysis before any ruling can be issued. Also, there may be a need for additional protection for bands other than the protected bands listed in Part 15. The question of whether the 12dB protection proposed by the Commission is enough for other bands, such as PCS and cellular, is still an open question worthy of additional investigation.

IV. CONCERN OVER DIFFERENT UWB CHARACTERISTICS

In the test reports, the various UWB devices have signal characteristics that are very different from one another. At this point, there are no guidelines as to how UWB should be characterized¹² or how interference should be measured.¹³ Many commenters observed that there is not sufficient knowledge about UWB at this time and that the FCC should not make any

¹⁰ *Ultra Wideband Transmission Systems*, ET Docket 98-153, *Notice of Proposed Rulemaking*, 15 F.C.C.R. 12,086, 12,103 (2000).

¹¹ XtremeSpectrum Reply Comments at 4 (Oct. 27, 2000).

¹² There is no generic UWB signal or pulse, pulse repetition frequency, or temporal code. Indeed, there are no accepted standards related to UWB waveforms or pulse rates at all. Every developer or manufacturer pursues different approaches, each using its own unique combination of factors. *See generally* Barrett, *supra*.

¹³ For example, it is difficult to detect individual pulses, and even more difficult to detect “the sporadic combinations of peak powers due to the individual peak powers in aggregated networks of UWB devices,” even when using state-of-the-art spectrum analyzers or fast sample-and-hold oscilloscopes. As a result, the effect of collocating UWB devices is difficult to determine. Moreover, the measurement sampling rate may affect measurement of the effect of dithering a train of UWB signals, resulting in spurious claims that dithering results in a flat power density spectrum. *See* Barrett, *supra*.

rulings that would permit implementation now.¹⁴ Cingular agrees that the wide variety of UWB devices and technologies makes it difficult to characterize the interference effects of UWB, particularly since there is not even a single agreed-upon definition of UWB at this point, and there is no agreement on many fundamental issues.¹⁵ Accordingly, the FCC should proceed with additional work to attempt to characterize the application and operating spectrum band of UWB devices before proceeding to the adoption of rules.

Additional testing and evaluation has to be done, including with respect to the additive effects of interference by multiple UWB devices in close proximity to each other. After this has been accomplished and parties have had a chance to comment on the results, then the Commission could consider adopting rules to permit licensed operation of certain defined UWB devices if there is persuasive proof that no harmful interference will be caused to existing services.

V. REPLY TO XTREMESPECTRUM COMMENTS ADDRESSING ISSUES RELATING TO PCS INTERFERENCE

XtremeSpectrum's comments regarding UWB/PCS interference issues are directed in particular to the Qualcomm Report. XtremeSpectrum has proposed that UWB communications be limited to indoor operations because it believes interference from an indoor UWB device to an outdoor PCS device is unlikely.¹⁶

¹⁴ See, e.g., ARINC/ATA Comments at 16; Sirius Comments at 15-16; Sprint Comments at 7; Conexant Comments at 2; Nokia Letter at 2; Motorola Comments at 7; U.S. GPS Industry Council Comments at 10.

¹⁵ "UWB communications systems have yet to be evaluated with respect to both bandwidth efficiency and power efficiency." Barrett, *supra*.

¹⁶ XtremeSpectrum UWB/PCS Comments at 2, *citing* XtremeSpectrum Comments at 11 (Sept. 12, 2000).

In Cingular's earlier comments on an NTIA report, Cingular stated that there is a concern about emissions from a UWB device (presumably outdoors) interfering with operation of an outdoor cellular base station receiver.¹⁷ While permitting UWB *communications* devices to be located only indoors would *lessen* concern about interference with outdoor cellular or PCS base stations, it does not eliminate such concerns, because many *non-communications* applications of UWB have been proposed.

More importantly, however, XtremeSpectrum's proposal appears to assume that under its scenario there will not be any indoor cellular or PCS receivers subject to interference from the indoor UWB devices. This is not the case, however. UWB devices would potentially interfere with base station receivers used in indoor cellular/PCS systems, such as microcells in public or semipublic areas or wireless office systems interfacing cellular or PCS phones with a PBX or other office phone network. While XtremeSpectrum states that additional propagation loss should be used in the indoor environment,¹⁸ the same loss should also be applied to the cellular/PCS signal from the mobile phone to the indoor base station and the addition of interference from the UWB device(s) would certainly have a negative impact on the receiver performance.

Equally important, cellular and PCS handsets are often used indoors.¹⁹ Cingular is concerned that a UWB device could easily cause interference to the receiver in PCS or cellular

¹⁷ Response of Cingular Wireless LLC To NTIA Reports at 2 (Feb. 23, 2001).

¹⁸ XtremeSpectrum UWB/PCS Comments at 2-3 (estimating 12 dB path loss over free space in an indoor environment), *citing* Bultitude, Mahoud, and Sullivan, *A Comparison of Indoor Radio Propagation Characteristics at 910 MHz and 1.75 GHz*, 7 IEEE J. SEL. AREAS IN COMMS. No. 1, at 20 (Jan. 1989).

¹⁹ Sprint points out that XtremeSpectrum's assumption that wireless phone use is principally outdoors is inaccurate. "A growing segment of mobile customers are people who use their wireless service as a replacement for landline service. Another sizable [sic] percentage of customers use their mobile phone at home or at work to make long distance calls, as free long
(continued on next page)

phone. There would be no way to ensure any significant isolation between a cellphone and a UWB device, such as a WLAN, since both would typically need to function at the same locations, such as an office worker's desk or an inventory control point. Accordingly, it is necessary to consider that these devices will be operated in close proximity or, effectively, collocated.

A mobile phone being used indoors to communicate with an outdoor base station will be subject to the normal propagation losses plus an additional penetration loss due to the path through the walls of the building. If the mobile phone is in close proximity to one or more UWB devices, the UWB device has the potential to generate a signal that would cause harmful interference (*e.g.*, cause a dropped call, inject noise making a call unusable, or prevent call origination). For example: Assume the following parameters: thermal noise floor = -114 dBm / MHz, noise figure = 6 dB for the PCS mobile phone, unity gain antennas on the UWB device and the PCS phone. With a UWB device transmitting at -53.2 dBm (*i.e.*, 12 dB below the current Part 15 limit), there is still a requirement for the UWB device and the PCS mobile phone to be separated by at least 13.4 m (approximately 44 ft). In other words, if a UWB device is located in the same room with, or just down the hall from, a PCS phone, there is a likelihood that harmful interference will occur to the PCS phone.

If UWB is widely deployed (*e.g.*, as a wireless LAN technology), there is certainly the possibility for interference with PCS mobile phones, as well as base stations, to occur. The potential for interference would increase even further as the number of UWB devices deployed in an area grows. Further study is clearly warranted.

distance is included in many of the 'bucket' plans that customer purchase. Indeed, some would say that the use of wireless phones has become . . . pervasive" Letter from Charles W. McKee, Sprint, to Bruce A. Franca, Acting Chief, OET, at 4 (February 21, 2000), *appended to Sprint Comments*.

Respectfully submitted,

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