Before the
Federal Communications Commission
Washington, DC 20554

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

Reply Comments of the Ultra-Wideband Working Group

February 3, 1999

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ATTACHMENT A - ULTRA-WIDEBAND WORKING GROUP MEMBERS

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Reply Comments of the Ultra-Wideband Working Group

The Ultra-Wideband Working Group (UWBWG) submits these comments in reply to certain comments filed in response to the *Notice of Inquiry* (NOI) released in this proceeding.[1] For the reasons set forth below, the UWBWG urges the Commission to move forward to issue a notice of proposed rule making (NPRM) proposing to modify the Commission's rules to allow for the introduction of a variety of ultra-wideband (UWB) technologies and applications.

Summary

The UWBWG urges the Commission to:

- Note the high degree of interest expressed in UWB by a large number of technology developers and potential users;
- Consider the experience to date with ground penetrating radar as instructive of both the beneficial uses of UWB and the low probability of interference from UWB operations;

[1] The UWBWG is a committee of developers, potential customers, and test engineers of UWB technologies. In addition to the Comments of the UWBWG, many UWBWG members submitted comments of their own addressing the various questions raised in the NOI. See the membership list set forth in Attachment A hereto.

- Realize that UWB technology can be used for relatively inexpensive wireless LANs to meet pressing public needs for better high capacity data links in schools and rural areas;

- Focus on the large amount of agreement expressed in the comments on certain key technical issues such as the need to refrain from using a pulse desensitization factor in measurements, the lack of applicability of the damped sine wave argument, the commonality expressed on the definition of UWB, the inappropriateness of bandlimiting UWB signals, the lack of serious interference potential from the cumulative emissions of UWB devices, and the need to employ a power spectral density concept in regulating UWB signals; and

- Take into account the fact that some systems promoted as "wideband" do not offer the same public benefits as ultra-wideband technologies.

. In these Reply Comments, the UWBWG focuses on the various applications of UWB technology revealed in the comments to the NOI and on certain areas of agreement among UWB technology developers. After reviewing the record in this Inquiry, the UWBWG urges the Commission to move forward with the issuance of an NPRM to implement UWB technology.

I. The unusually large number of comments showed great interest in UWB among a wide number of technology developers and potential users.

Over seventy filings have been made in this proceeding to date.[2] More are expected to be submitted. As such, the NOI has attracted an unusually large number of comments from a widely diverse community of developers, users, and a few who – unjustifiably in the judgment of the UWBWG – view UWB technologies as a threat to existing radio services.

[2] The NOI even drew more of a response than did the first two notices issued in connection with the amendment of the Rules to implement spread spectrum technologies. The first two spread spectrum notices attracted only 16 comments in the first round and 12 in the second. Authorization of Spread Spectrum, 98 FCC 2d 380 (1984).

The comments show that low powered, short range applications of UWB technologies offer the prospect of meeting many publicly beneficial needs. These include, but are not limited to:[3]

- high capacity short range secure wireless data links
- asset tracking and identification devices
- sensors for automobiles
    - air bag deployment control, reverse assist systems, collision avoidance systems, remote keyless entry, intelligent highway applications
- ground penetrating radars to locate
    - victims lost in rubble
    - mineral deposits
    - soil contamination
    - non-metallic pipes
    - archeological sites
    - flaws in bridges, highways, and airport runways
    - unexploded ordnance including plastic land mines
    - suspected crime scenes
        - clandestine burials
        - drug caches
- devices to locate rebar and conduits in walls and floors at construction sites
- radar level gauges
- local position determination devices
- systems to assist the blind and those with mobility disabilities
- monitors to measure heart rate, breathing, and inner body fluctuations
- see through the walls radars for police and fire departments
- covert communications systems for law enforcement
- virtual electronic fences for security applications

While the responses to the NOI may not answer, without debate, every question surrounding UWB technologies, the filings offer a strong knowledge base for the Commission as it determines whether the public interest would be served by proposing rules to regulate various

[3] Obviously, there are military applications that are not listed above. These include, but are not limited to, covert communications systems that are extremely difficult to intercept and virtually impossible to decode and precision navigation systems.

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UWB operations. The UWBWG submits that the interest in and obvious beneficial applications of UWB technologies warrant an expeditious decision by the Commission to issue an NPRM that would call for changes in the Commission's Rules (primarily Part 15) to afford a framework within which UWB technology can be fielded on a regular basis.

II. The comments on ground penetrating radar (GPR) offer an instructive view of both the beneficial uses of UWB and the low probability of harmful interference from UWB operations.

The record in this proceeding makes clear that GPR operations have now been conducted in the United States for some twenty-five years.[4] Many of these operations have been carried out at the behest of the federal government, as well as state and local governments.[5] Others have been undertaken on behalf of nongovernmental interests such as public utilities and construction companies. As noted above, GPR is being used to inspect bridges, highways, and runways efficiently and in a noninvasive manner. GPR also has applications in the removal of unexploded ordnance, including plastic land mines that are difficult to detect safely using other methods. GPR and other UWB radar devices can reveal hidden objects at construction sites. GPR is also useful in the exploration for minerals. As a forensic tool, GPR has been used in the subsurface inspection of suspected crime scenes. In this role GPR saves valuable time and other resources by reducing the excavation of such sites.

The record in this proceeding shows that GPR has operated successfully without causing harmful interference to existing radio services, even though these appear to have been operated at

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[4] *See, e.g.* Comments of Geophysical Survey Systems, Inc., and Geo Recovery Systems.
[5] *See, e.g.* Comments of P. Partick Leahy, Chief Geologist, U.S. Geological Survey, and Comments of Dwain K. Butler, PhD, Professor of Geophysics, Texas A & M University,

(Continued...)

power levels in excess of what can be expected of Part 15 devices.[6] Indeed, GPR operators have had to develop techniques for avoiding interference to their operations from high powered narrowband emitters and from certain ultra-wideband signals such as those generated by digital devices. By one count, there are some 2,000 or more GPR systems in operation.[7]

GPR is existing proof of the unique advantages that UWB signals offer by providing bandwidth at low frequencies. The bandwidth gives range resolution, and the low frequencies give penetration, as clearly demonstrated by GPR. However, the same features of UWB signals apply to communication and position location. The low frequencies of UWB signals offer the same penetrating ability as for GPR, but for use inside buildings and urban environments. Moreover, the bandwidth of UWB signals offers multipath immunity, high data rates, and accurate position location.

The record also evinces an interesting split in regulatory philosophy among the proponents of GPR. On the one hand, the view is that of "go away, don't bother us, we're not harming anyone, and we're performing a very useful service."[8] A somewhat different view echoes the themes of useful service and a lack of harmful interference, but recognizes that a regulatory framework that preserves the benefits of GPR, while setting reasonable conditions for GPR operations, would be in the public interest.[9] The UWBWG certainly understands the former view

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Research Physicist, U. S. Army Corps of Engineers.

[6] *See* Comments of Geophysical Survey Systems, Inc., at 3 (peak radiated power of 10 watts with average power of no more than 10 mW).

[7] Comments of Gary R. Olhoeft, PhD, Professor of Geophysics, Colorado School of Mines.

[8] *See, e.g.*, Comments of Radar Solutions International, MALA GeoScience USA, Inc., Ray F. Weston, Inc., Sub-Surface International Surveys, Inc., and Technos Inc.

[9] *See, e.g.*, Comments of Geophysical Survey Systems, Inc., and P. Patrick Leahy, Chief Geologist, U.S. Geological Survey.

and shares the plight of many of its small business proponents. At the same time, the UWBWG endorses the latter view. Thus, the UWBWG encourages the Commission to propose regulations that will not impair the work now being undertaken in the public interest by GPR proponents.

III. The comments also point out how UWB could be used for relatively inexpensive wireless LANs in order to meet pressing public needs for better high capacity data communications in schools and rural areas

While the record shows that there are a myriad of potential applications for UWB technologies as sensors, it also reveals a growing demand for the development of advanced wireless technologies that can be used in schools and rural areas.[10] Certainly, the Commission has already undertaken steps to address these needs in its UNII, unlicensed PCS, and spread spectrum initiatives. Yet, the record in this proceeding reveals that many whom these earlier efforts were designed to help, still find themselves among the "information have nots." High capacity wireless LANS and short range wireless links may well be supported by UWB radio. UWB technology holds the promise of facilitating curb-to-user applications to tie consumers into high capacity fiber optic networks. For schools, it may prove to be the way to implement truly high capacity networks with minimal wiring of buildings. Even in rural areas with comparatively long distances, various UWB technologies could prove very beneficial as another tool for addressing the unique connectivity needs of remote and often sparsely populated areas. Given the potential of UWB technology in such applications, the Commission should move forward with an effort to allow the technology to develop further. The issuance of proposed regulations that, at a minimum, address

[10] *See e.g.*, Comments of Community Technology Centers Network, George L. Johnson, Lewistown (Montana) Public Library, Chesapeake Computer Consultants, Inc., Brian Zisk, David R. Hughes, Interval Research, and Low Tech Designs.

short range communications applications will be a major step in this direction and will address statutory mandates of the Commission to foster the development of new technologies and to encourage the improvement of telecommunications for schools and rural areas.

IV. The comments show a high degree of agreement on many technical issues

While the comments reflect a variety of approaches to UWB implementation and many different applications, the responses to the NOI also support a general consensus on many technical issues. These include recognition of the fact that pulse desensitization as now employed is not appropriate.[11] Use of the pulse desensitization factor effectively measures far more energy than is seen by any receiver other than another UWB receiver. Thus, the pulse desensitization factor is not needed in measuring compliance of UWB emissions with limits set by the Commission's Rules. In this respect, the emissions from UWB devices should be treated much like those from so-called unintentional radiators, such as digital devices. These UWB emissions, which are often undistinguishable from emissions from digital devices, should not be subject to measurement using a pulse desensitization factor, just as such a factor is not employed in making measurements from unintentional and incidental radiators. Indeed, these latter categories of devices will remain the most ubiquitous sources of broadband emissions.

Similarly, the comments generally reflect agreement to the effect that the prohibition on damped sine waves should not apply to UWB devices.[12] This prohibition, which was implemented in the International Radio Regulations in the 1930s as a means for eliminating spark

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[11] *See, e.g.*, Comments of Rosemount Measurements, M/A Com, WINForum, ANRO Engineering, Interval Research, Lawrence Livermore National Labs, Zircon, Endress + Hauser GmbH & Co., and Time Domain Corporation.

gap transmitters which radiate signals far broader than they use, is not appropriate when applied to low powered devices that utilize the ultra-wideband signals they radiate.

The comments also show a large measure of agreement on the definition of ultra-wideband. Particularly for operation below 10 GHz, most of the comments from UWB interests support a definition that would include a fractional bandwidth of 25% or more.[13] Above 10 GHz some commenters note that the attributes generally associated with UWB signals may be obtained with lesser fractional bandwidths, which would still be in excess of 1 GHz.

Many of the commenters also noted that bandlimiting of UWB signals will have a negative impact on both the performance and the commercial viability of UWB systems.[14] This view arose most often in connection with the feasibility – or lack thereof – of employing filters to notch out emissions within the UWB signal. Thus, it was felt that the adverse effect on the timing and integrity of the UWB signal would be so compromised as to nullify the benefits of the UWB signal.

In addition, many of those filing comments submitted models and expressed agreement that the cumulative effects of numerous UWB emitters in a general area would pose little likelihood of causing harmful interference.[15] In general these commenters noted the low probability that UWB signals from multiple emitters would add coherently. They also explained

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[12] *See, e.g.,* Comments Saab Marine Electronics, ANRO Engineering, Inc., and Interval Research.

[13] *See, e.g.,* Comments of M/A Com, XtremeSpectrum, Inc., Interval Research, Zircon, and Time Domain Corporation.

[14] *See, e.g.,* Comments of Geophysical Survey Systems, Inc., Milltronics, Gary R. Olhoeft, PhD, of the Colorado School of Mines, Arthur D. Little, Lawrence Livermore National Laboratories, Zircon, Endress + Hauser GmbH & Co., and Time Domain Corporation.

[15] *See, e.g.,* Comments of Arthur D. Little, Robert A Sholtz, PhD, of the Univeristy of Southern California, XtremeSpectrum, Inc. (attached Technical Report), Interval Research (attached

(Continued...)

that their simulations showed that the predominant effect on a receiver that would suffer interference would come most likely from the closest UWB emitter.

The comments also showed widespread support for the use of a power spectral density approach to the regulation of emissions from UWB devices.[16] In fact, the use of peak and average measurements as recommended by the UWBWG also represents a power spectral density approach.[17]

V. The comments also show some divergence on certain technical issues.

Some of the comments voiced concern that no steps be taken that would be likely to disrupt certain critical radio services, including GPS and aeronautical radio navigation.[18] UWB need not be implemented so as to pose a threat to such systems. The UWBWG submits that, while understandable, these concerns are unfounded. Experience with unintentional and incidental radiators as well as ground penetrating radars suggests that it should be possible for low power UWB systems to be deployed without giving rise to the sorts of interference problems that some commenters have suggested could occur.

A few commenters urged that what they termed "wideband" systems be allowed but that use of UWB either be prohibited or restricted greatly.[19] The UWBWG submits that such an approach would greatly impede the development of publicly beneficial technology. Further, most of the

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Exhibit 3), and Time Domain Corporation (attached Appendix C).

[16] *See, e.g.,* Comments of M/A Com and WINForum.

[17] Comments of the UWBWG at 14 - 15.

[18] *See, e.g.,* Comments of the FAA and Comments of the U.S. GPS Industry Council.

[19] Multispectral Solutions, TEM Innovations, and Saab Marine Electronics.

wideband systems proposed in the comments are already allowed under the existing rules and are not encompassed within the spirit of this NOI, which is about a new technology that currently does not fit existing regulations. Wideband systems may be able to address a small subset of the overall potential applications of UWB technologies, but cannot realize the full potential of these UWB systems.

While individual reply comments will address in detail the technical merits of the claims of superiority advanced by wideband proponents, the UWBWG urges the Commission to focus on the implementation of beneficial technologies consistent with its spectrum manager mandate from Congress and not foreclose technologies that can yield great advancements, but which do not fit within the current regulatory framework. The Commission should examine the compatibility of UWB technologies with current users. In so doing, the Commission should not be shackled to prior analysis that led to the current classifications of "intentional," "unintentional," and incidental radiators. If protected restricted band systems function well today in the face of emissions generated by the billions of unintentional and incidental radiators, the systems should also function well if UWB emissions at similar levels are permitted. In short, there is room for both wideband and UWB technologies.

VI. The Commission should move forward to issue an NPRM.

If the promise of UWB technology is to give rise to its reality, the FCC Rules must be revised. The comments illustrate that the current characterization of devices as *intentional radiators, unintentional radiators,* and *incidental radiators* fails to deal appropriately with emissions from UWB devices. From an interference standpoint, it is the level of unwanted emissions that matters, not the intent behind the creation of the emissions. Accordingly, the

regulations for UWB devices should refrain from the semantic models of the past and rely instead on new approaches.

As a general principle, the Commission should apply the Class B digital device emissions limits to UWB systems. Where the marketing and use of equipment focus on commercial and industrial environments, the Commission should propose regulations that permit Class A digital device emissions levels for applications in such locations. As needs are demonstrated that cannot be met under either approach, the Commission should also delegate authority to the Office of Engineering and Technology to permit UWB systems to operate on a licensed basis subject to appropriate conditions designed to minimize interference.

The Commission should also make suitable accommodations in its rules and practices for ground penetrating radar. In so doing, the Commission should endeavor to preserve operational flexibility for GPR operations that are coupled to the ground.

In addition, the NPRM should address measurement techniques. These procedures should be practical and of the sort that can be implemented at most test labs that are likely to evaluate equipment. In developing measurement procedures, the Commission should be cognizant of the problem of sacrificing good repeatable results in favor of overly complex procedures. While the Commission should not adopt simplistic approaches, it should also note the problems that unnecessarily complex procedures could bring as divergent results are obtained from multiple test labs trying to implement the procedures. In addition, the new procedures should avoid the use of the pulse desensitization factor now imposed in the measurement of intentional radiators that employ a pulsed emission. Finally, the NPRM should make clear that UWB signals do not run afoul of the prohibition on damped sine waves.

VII. Conclusion

This proceeding represents an important initial step toward the understanding of UWB technologies and the development of an effective and equitable regulatory framework designed to bring to the public a variety of beneficial applications of UWB signals. Naturally, there has been a learning curve for developers, other spectrum users, and the Commission. Prepared with

the record in this proceeding, the Commission is now poised to take the next step by issuing its notice of proposed rule making. The UWBWG urges the Commission to do so expeditiously.

Respectfully submitted,

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Attachment A

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