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December 3, 1998

Federal Communications Commission
The Portals TW-A325
445 12th St., S.W.
Washington, DC 20554

School of Engineering
Electrical Engineering-Systems

Re: Revision of the Commission's Rules Regarding Ultra Wideband Transmission Systems: ET Docket No. 98-153

Dear Sirs:

I am a Professor of Electrical Engineering and currently am Chairman of the Systems Division of the Electrical Engineering Department at the University of Southern California. I founded the Ultra-Wideband Communications Laboratory at the University of Southern California in 1996 after having learned of the technology while consulting for Pulson Communications (now Time Domain Corporation). I was the organizer and general chairman of the UWB Radio Workshop held in May 1998 in Solvang CA. The views that I present here are my own, and not those of either USC or the Time Domain Corporation.

Ultra-Wideband (UWB) radiation is characterized by wide bandwidth relative to the center frequency of the radiated spectrum. I've seen UWB radiation defined as any radiation in which the 3 dB bandwidth is at least 25% of the center frequency of the radiation.

So there are two factors that drive the UWB concept: (1) very wide bandwidth at (2) a relatively low center frequency. The wide bandwidth leads to fine time resolution and a measure of covertness in a well-designed system. The low center frequency, if low enough, will give UWB radiation a chance to penetrate many materials, providing a functionality that would not be present in a system of comparable bandwidth at a significantly higher center frequency.

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These characteristics point to the niche markets where UWB systems will most likely make significant inroads. I believe that possible applications fall into two distinct categories: (1) those in which penetration of materials is paramount and size and weight is a secondary issue, and (2) applications in which size and portability (i.e., hand-held) is a major constraint. The first category includes ground-penetrating radar. The second category includes short-range devices like cordless phones, cordless microphones, some types of intrusion detectors, personal localizers for law enforcement, radio control and location devices for the home, stud finders, etc.

It seems to me that the regulatory issues for these two categories are quite different. Henceforth I will address my comments to the second category with which I have some familiarity. I believe that UWB antenna and battery technology are the driving forces in these designs and that the center frequencies of these UWB designs will likely be in the range of a few hundred megahertz to a few gigahertz. I believe that many of these applications can be made operable with radiated power densities on the order of tens of microwatts per megahertz or less. Most will use spread-spectrum technology to reduce their peak power spectral density (and hence interference to others), to provide a measure of narrowband interference immunity, and to enable multiple access techniques. With appropriate constraints on power densities, I believe that this technology is viable for many applications and can coexist operationally with other radio systems.

The rationale for using UWB technology, rather than more conventional narrow-band technology at the same center frequency, for these applications is superior range resolution (i.e., in some cases down to an inch or less). Equivalently that implies the capability to resolve time-of-arrival of signals down to a fraction of a nanosecond for some designs. Properly designed radios in many situations will not undergo the severe multipath fading present in narrowband systems (even in the indoor environment) because signal propagation paths with differential delays on the order of the reciprocal bandwidth can be resolved by a well-designed receiver. This implies that potentially significant reductions in transmitted average power can be achieved by reducing fading margins in radio link budgets.

The effect of large aggregates of UWB emitters can be answered definitively only for specific geometries. There is evidence that indicates that with reasonably homogeneous distributions of emitters, the interference power in a receiver is dominated by a few of the closest emitters. It is hard to imagine a practical operational geometry that would occur in the above mentioned applications in which interference power (a) would increase linearly with significant increases in the numbers of emitters and (b) would not be dominated by the closest emitters.

While I am not involved in any commercial ventures involving UWB radio, I am a strong proponent of UWB research. My lab, primarily funded by the National Science Foundation and with added support from the Army Research Office and Advanced Micro Devices, is aimed at understanding the performance properties of UWB radio and its interaction with (or isolation from) other radio systems in its frequency spectrum.

If I can be of any further assistance, please let me know.

Sincerely,

Robert A. Scholtz
Professor and Chair
Electrical Engineering - Systems Department
University of Southern California