September 9, 2000

Magalie Roman Salas
Office of the Secretary
Federal Communications Commission
TW-A325
445 12th Street, S.W.
Washington, D.C. 20554

Ref: NPRM Regarding Ultra-Wideband Transmission, ET Docket 98-153

Dear Commissioners:

I am the former Commander of the Air Force's Electronic Systems Center and currently an ad hoc member of the Air Force Scientific Advisory Board. From my perception, recent developments in ultra-wideband (UWB) technologies show promise in being a breakthrough in capability for our national defense.

The second sentence in the Notice Of Proposed Rulemaking (NPRM) states: "UWB devices may have the capability to provide for significant benefits for public safety, business and consumers." Lacking from the NPRM is a discussion of the significant benefits UWB devices may have for the national defense. I would like to bring some of these benefits to your attention. I recognize that the Commission does not serve as the spectrum manager for federal users. I am also aware that technology developments for defense applications may have beneficial non-defense uses. Moreover, refinement of UWB technology for non-government applications can yield substantial benefits to both civilian and military users within and outside of government. Since UWB devices offer capabilities in communications, radar, and positioning, this letter discusses each of these categories separately.

I. UWB's Communications Capabilities

A. In today's operational Air Force, there is no way an aircraft can make radio contact with another aircraft or with the ground without providing an adversary with an opportunity to detect the position of the aircraft. Advances in time-modulated UWB devices have enabled aircraft-to-aircraft communications using only microwatts of power. Such low amounts of RF radiation are essentially undetectable by a potential adversary. The potential benefits from covert communications using UWB devices, in terms of aircraft survivability and mission effectiveness, could be enormous.

B. One of the greatest hazards for airmen is being shot down over enemy territory. In Vietnam, and more recently Bosnia, downed airmen faced the Hobson's choice of using a radio to signal to a rescuing aircraft yet knowing that the same signal might alert the enemy to the airman's position. Time modulated UWB devices, however,

have a low probability of detection by an enemy because the devices only emit microwatts of energy. An added benefit of time modulated UWB, as described more fully below, is its positioning capability. Hence, not only could the rescuing helicopter communicate with the downed airman without detection by hostile forces, but also the helicopter could be able to locate the airman to within inches of his position.

C. During hostilities, perhaps nothing is more tragic than casualties from friendly fire. The Gulf War demonstrated the need for a better "friend or foe" identification system. The covert nature of low powered UWB devices seems ideal for such systems, especially in light of the positioning capabilities of time-modulated, UWB technology.

D. The need for sensors on future aircraft has increased exponentially. Unfortunately, today most sensors have to be "hardwired" throughout the frame of the aircraft. Not only does the cumulative weight of the wiring significantly add to the load of the aircraft, but also the life cycle cost, in terms of maintenance (including depot-level replacement of the wire after several years) is enormous. Furthermore, electrical wiring (especially in the vicinity of fuel) is a safety hazard. UWB devices—no larger than the size of penny--can be embedded in the sensor and transmit the information to the cockpit. Similarly, UWB devices could replace other existing wiring such as to actuators. The bottom line is that UWB devices offer radical improvements to existing aircraft to include more lift capability. Additionally, UWB devices have potential to improve the survivability of aircraft. A frequent cause of aircraft loss in combat involves a projectile severing vital wiring which enables the pilot to control the aircraft. If the wiring were replaced with UWB devices, the risk of wiring being severed by projectiles could be greatly reduced.

E. Today's Air Force must be able to deploy to remote locations on very short notice. The command center at such locations needs to be made operational as soon as possible. A wireless solution is preferred for two reasons. First, wireless is faster than "stringing cables." Second, a wireless solution allows the Air Force to deploy without having to transport cable and a military team to install the cable. Recently, at *Roving Sands 2000,* the Time Domain Corporation successful demonstrated that UWB devices could reduce the number of cables needed to set up a command post.

II. UWB's Radar Capabilities

It would be inappropriate for me to comment upon the full potential of time modulated, UWB radar technology in terms of providing a technical advantage over an adversary. Consequently, my comments are intentionally broad.

A. Recently, a company that specializes in UWB technology, MSSI, was awarded a research and development contract by the Army to use UWB for a collision avoidance system for unmanned aerial vehicles (UAVs).

B. Time modulated, UWB radar essentially allows an electronic fence to be placed around the aircraft. When the aircraft is in flight, an alarm can be sounded to alert the pilot of the impending danger. When the aircraft is on the ground, the fence can be a security fence. If the perimeter of the fence is breached, security police can be dispatched.

C. Time modulated, UWB radar has demonstrated remarkable capability to penetrate thick vegetation such as a jungle canopy. Hence, the technology offers significant "look down" capability to detect movement of enemy forces that are operating in a jungle environment.

III. Positioning, Locating, Tracking Capabilities

It would be inappropriate for me to comment upon the full potential of time modulated, UWB positioning technology in terms of benefiting "smart" weapons. However, based on work in the technology conducted by Lawrence Livermore National Laboratory, I have gleaned from public sources that another service is using the technology in proximity fuses for large munitions.

A. Previously, the example was given of being able to locate a downed pilot in enemy territory. Conceivably, the technology can be hardened such that an UWB RF tag can withstand the impact of a crash and thus enable the downed aircraft to be quickly located.

B. Time modulated, UWB involves the transmission of ten million pulses per second. Each pulse allows the receiver to position the transmitter to within a few centimeters. The technology has the potential to evolve into a system in which an autopilot can land an aircraft with almost absolute precision in terms of the aircraft "touching down" within inches of the start of the runway. The safety ramifications of such all-weather systems, for both military and civilian aircraft, are enormous. Moreover, being able to land larger aircraft on smaller runways has significant advantages in terms of deployment of forces in remote locations.

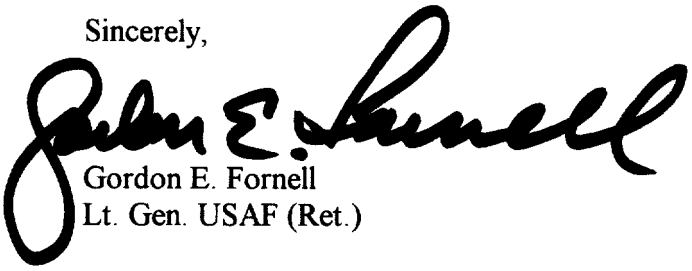
C. Finally, I observed the following observation in the NPRM: "GPS will be increasingly relied upon for air navigation and safety...." Id. at 13. While this observation is certainly correct, it is also important to note that GPS will likely always be somewhat frail. [*See* the attachment to this letter for substantiation of the vulnerability of GPS.] This inherent frailty is exactly why I believe the implementation of beneficial alternative technologies, such as UWB, should be fully supported. UWB has the potential for working with GPS in an augmentation role (urban environments, for example) or in providing positioning information in places where GPS simply will not work (indoors, underground, in the hulls of ships).

Comments

Currently, there are hundreds of millions of devices within the United States that emit power within the thresholds of FCC Part 15 into the spectrum. It is my understanding that this rulemaking is necessitated because these myriads of existing devices are "unintentional" emitters whereas low power UWB devices are "intentional." The logic for the distinction strikes me as fundamentally flawed. UWB devices should be treated like any other device regardless of whether the emission is intentional or unintentional. UWB devices should not be held to any higher standard than laptop computers or "Walkman" CD players.

In summary, UWB is one of the most promising technologies of the first decade of the Twenty-First Century. I urge the Commissioners to complete expeditiously the rulemaking. UWB offers tremendous potential benefit for our national defense.

Sincerely,



Gordon E. Fornell
Lt. Gen. USAF (Ret.)

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ATTACHMENT

National Defense Requires An Alternative Technology

- GPS signals were designed to be very low power relative to the vast distance that the signal must travel to the receivers. Specifically, at this time the signal is only 10 watts of transmitter power at the satellite.

- Through my affiliation with the Air Force Scientific Advisory Board, I am aware that GPS signals are easily interfered with, both from intentional and unintentional sources.

- GPS receiver robustness varies greatly amongst receiver manufacturers and models. Antenna selection can also significantly affect robustness. No real robustness standard exists.

- GPS was designed primarily for military use. Widespread civilian use was not engineered into the system. The system is not sufficiently robust (*i.e.*, more power and different frequency required) for widespread civilian use.

- The GPS frequencies are not totally sacrosanct. Within the United States there are hundreds of millions of consumer devices that knowingly emit minor amounts of energy into GPS frequencies at levels no greater than those which would allow for effective UWB operations in a wide variety of applications. These devices are referred to as "unintentional" or "incidental" radiators under FCC Part 15 Regulations.

- GPS is frequently inadvertently impacted by numerous commercial devices such as television stations, mobile and portable transmitters, and laptop computers when they operate too closely to GPS receivers.