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THE PULSE OF THE FUTURE

Time Domain Corporation
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Washington, D.C. 20006

April 27, 2001

Ms. Magalie Roman Salas
Secretary
Federal Communications Commission
445 12th St., S.W.
Washington, DC 20554

Re: ***Ex Parte* Notification**
ET Docket No. 98-153
Ultra-Wideband (UWB)

Dear Ms. Salas:

This is to note that on April 26, 2001, Ralph Petroff and Larry Fullerton of Time Domain Corporation, Richard Wiley and Robert Pettit of Wiley, Rein and Fielding, and I met with Chairman Michael Powell and his Senior Legal Advisor Peter Tenhula.

We provided a short demonstration of Time Domain's technology and discussed the issues raised in Time Domain's comments and reply comments filed in this proceeding and the results of the UWB compatibility testing programs. We noted the need to come to a timely resolution of this proceeding and expressed a willingness and flexibility to work for solutions that would facilitate bringing the benefits of short-range, low powered UWB devices to the American public.

We left a copy of a May 2001 Discover magazine article (copy attached) that profiled Larry Fullerton. We noted that the article overstated the transmit power of UWB at 500 rather than 50 microwatts, and that the cell phone reference in the article referred to the use of dual-mode cell phones indoors.

In accordance with the Commission's rules, an original and one copy of this are being filed. Please contact me with any questions concerning this matter.

Respectfully,

Jeffrey L. Ross
Vice President
Corporate Development & Strategy

cc: The Honorable Michael Powell and Peter Tenhula, Esq.

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A TENACIOUS LONE INVENTOR REVOLUTIONIZES WIRELESS

Picosecond timing is the key to Larry Fullerton's radio pulse technology, the fruit of 25 years of inspired, dogged experimenting.

CAN A TENACIOUS LONE INVENTOR REVOLUTIONIZE WIRELESS COMMUNICATIONS WITH A CHIP HE INVENTED IN HIS GARAGE?

Radio flyer

BY STEPHEN FENICHELL
PHOTOGRAPH BY JUSTINE PARSONS

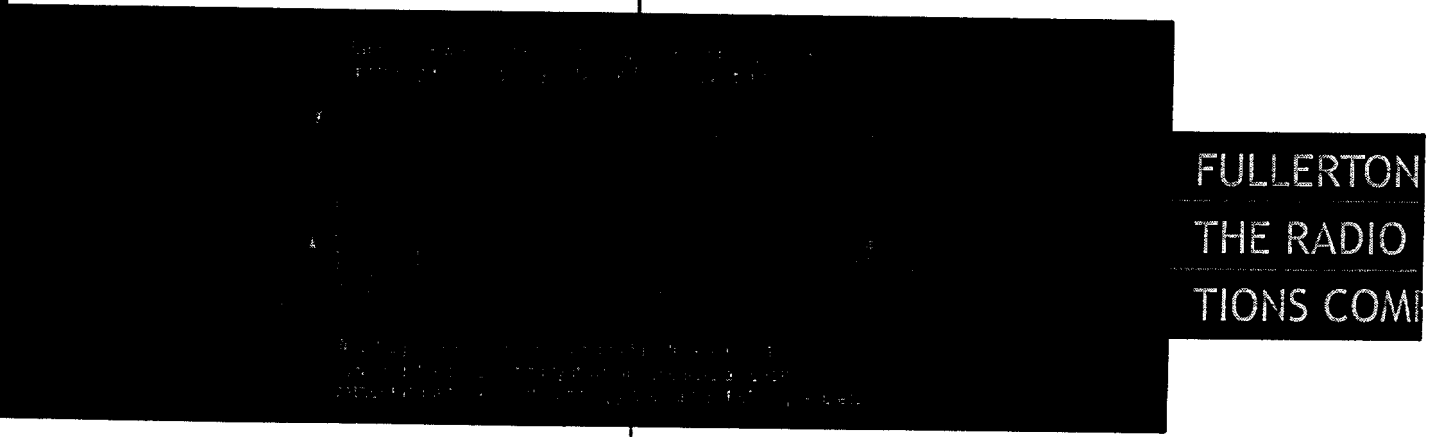
areas where there are large obstructions, such as canyons or skyscrapers.

Each application relies on a set of silicon-germanium chips that send out an electromagnetic stream of coded (and thus encrypted) pulses at the speed of light. It works like this: A timer chip—accurate to 12 trillionths of a second—tells the transmitter precisely when to send out each pulse. It also modifies the precise intervals at which the pulses are released to create a uniquely randomized pattern that can be recognized only by a similarly coded receiver. Another chip digitizes these pulses by inducing an infinitesimally short delay or advance in the signal's departure from the transmitter: If the pulse arrives at the receiver slightly early, it's a one; if it arrives slightly late, it's a zero. The receiver contains several chips too. One of them tells it when to "listen" for incoming pulses. Fullerton compares this to a camera shutter, which opens and shuts at precisely the right fraction of a second to receive an incoming signal. Another chip inside the receiver synchronizes its "shutter" with the transmitter's coded pulses.

sweet vindication. "I knew if this ever panned out," says Fullerton, "it would be a big part of my future."

FULLERTON'S CORE IDEA GERMINATED IN 1973 WHILE HE WAS STILL A student at the University of Arkansas. His basic hunch was that engineers assumed radio transmissions had to be sinusoidal–in the form of sine waves–mostly because the tools employed to analyze them were limited. To detect the transmission of an infinitesimal burst of electromagnetic radiation required exotic equipment most labs didn't possess–a pulse generator and a sampling oscilloscope capable of registering superfast broadband pulses.

In 1975 Fullerton came across just the sort of rare oscilloscope he needed in advertisement in the back of an electronics magazine. Even secondhand, the tool's $1,000 price tag was beyond his means. But he persuaded the dealer to take $100 instead, then immediately drove to Dallas to retrieve it before the man changed his mind. Fullerton also picked up a used Hewlett-Packard pulse generator,



Fullerton hopes ultra-wideband's future will include tracking devices for personal items like keys and eyeglasses; smarter air bags that precisely locate a seat occupant in order to reduce the risk of injury; dual-mode cell phones that improve efficiency and capacity indoors; hospital communications systems that can locate and transmit data between medical devices; and security nets that spread out like an invisible dome over a home or a car, warning of intruders. Fullerton's company, Time Domain, is releasing its first product, RadarVision 2000, this winter. The device will be marketed to police and rescue services to detect suspects concealed behind walls and doorways and find rescue workers such as firefighters trapped inside buildings.

Some of the world's largest telecommunications companies–Siemens, Sony, Qwest, Marconi, GE, WorldCom–have partnered with or invested in Time Domain. For a man who worked alone out of his home laboratory for the better part of 20 years, equipped with little more than ingenuity and tenacity, it is a rather

a machine used in the late 1960s to test solid-state circuits. He arrived back in Conway, Arkansas, emptied the trunk of his car, and got to work.

"In those first experiments," says Fullerton, "I used the pulse generator as my transmitter and the oscilloscope as my receiver." He attached the pulse generator to a coaxial cable that sent pulses to a copper loop antenna. The antenna transmitted these pulses through the air to an identical antenna connected to the oscilloscope. Fullerton detected only a blob on his screen–not a clear pulse–but he was on the right track.

One problem was the antenna: It generated too much electrical vibration, distorting the pulse detected by the oscilloscope. What he needed was an "a-resonant" antenna–one so exquisitely dampened that it would scarcely vibrate at all. Building one meant more years of searching and innovating. Fullerton's backyard became littered with discarded antennas he'd made, including an 18 foot-long contraption resembling a kite frame with wood struts surrounded by

wire. By 1978, Fullerton's handmade components had become more refined, portable, and integrated. He was finally ready for his Chicago experiment. "It's easy to transmit a tone, but a voice, or better yet, music–that's the real test," Fullerton says. "It was a watershed moment. Getting something to work just changed everything. I immediately started thinking: 'Now where do I go from here? Whom should I take it to?'"

Fullerton, it turns out, wasn't the only person working on transmitting ultra-wideband pulses. The same year that the stood in his backyard listening to Chicago, a prestigious journal of the Institute of Electrical and Electronics Engineers (IEEE) published "Time-Domain Electromagnetics and its applications," an article by two researchers who'd worked for the Sperry-Rand Corporation. Fullerton felt so deflated he almost abandoned his project. He soon decided, however, that the paper, "although mathematically elegant and sound, was not nearly as practical as my own approach." The published method required a lot more power to propagate the electromagnetic pulses. "The device would overwhelm any other radio transmitters in the vicinity," says Fullerton. He also realized the work focused primarily on radar.

Five years later, after relocating to Huntsville, Alabama, Fullerton filed his first patent. During what he now refers to as his "patent pending years"–1983 to 1987–he leapfrogged from one federal research grant to another, straining to keep his innovation alive and his finances afloat. Finally, in 1995, his fortunes took a Cinderella-like turn when a family of Huntsville-based entrepreneurs visited his lab. The Petroff family had recently sold their pollution-monitoring-device company, ADS, for $95 million. "Larry had so many ideas, we figured if even 10 percent of them took off, we were home free," recalls Alan Petroff, Senior VP of engineering. Backed by the family's capital, management skills, and clout, Fullerton was finally able to transform his patents into chips.

Time Domain almost immediately became embroiled in a public dispute with the Lawrence Livermore National Laboratory over patents. The conflict was resolved when the U.S. Patent Office granted both organizations the right to produce and license products based on a similar technology. Ralph Petroff, Time Domain's CEO, describes the company's long-range business plan as "based on the Intel model. We want to design the chips to manufacturers of products." The exception is RadarVision 2000, which the company will produce itself.

The most significant applications for ultra-wideband chips will most likely be in wireless communications. Links between appliances and electronic equipment inside homes, offices, or large institutions could offer higher data-transmission rates (up to 40 megabits per second), lower power requirements (.5 milliwatts), and less interference than the wireless local area networks now available.

Before any product comes to market, however, Time Domain will have to clear a significant hurdle: The FCC's "Part 15" rules regulate low-level electromagnetic radiation–including unintentional emissions from everyday electronic appliances such as computers and VCRs–that could interfere with authorized frequencies. The agency must now grapple with something it never anticipated: a technology that seeks to intentionally transmit low-level emissions across a large part of the radio spectrum, including restricted bands where intentional transmission at any level has never been allowed.

The FCC has yet to issue a final ruling, but John Reed, the engineer charged with drafting the agency's technical guidelines for ultra-wideband, says he "can design a set of standards under which this equipment can operate without interfering with existing radio services." The commission expected the completion of a least one large-scale study in March 2001.

FULLERTON ONCE FEARED THAT HIS INNOVATION WOULD BE DISMISSED as a crank scheme–the radio equivalent of "cold fusion"–but lately he has earned a place at the table where wizards of technology mingle with the captains of commerce. Last year, the IEEE elevated him to senior member, an honor accorded to barely 10 percent of its members. U.S. News and World Report named him one of the "Top Innovators of the New Millennium." But as Time Domain pushes his invention into the marketplace, Fullerton can still be found most evenings past midnight in his home lab, chasing down new hunches in areas that range from astrophysics to quantum physics.

"I have a whole workshop full of projects," he says. "None of them are quite ripe yet. But I've made it my job to find out what the edges of knowledge are, the fringes, and to extend them. It's the edges that are important and interesting."

FEARED HIS INNOVATION WOULD BE DISMISSED AS A CRANK SCHEME-EQUIVALENT OF "COLD FUSION." NOW THE LARGEST COMMUNICA-PANIES IN THE WORLD HAVE BECOME INVESTORS