Will Ultrawideband Technology Connect in the Marketplace?

Linda Dailey Paulson

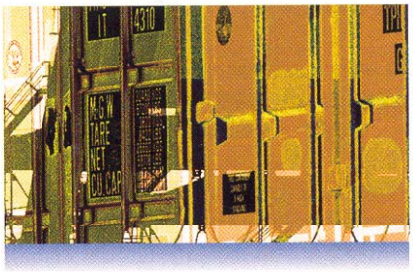
Companies and individuals are using an increasing number of computers, peripherals, mobile devices, consumer electronics, and other machines in their offices or houses. For convenience, many users want to network these devices. Bluetooth radio-based, short-range, wireless-networking technology has received considerable attention as a means for accomplishing this.

However, ultrawideband, a 30-year-old military communications technology, is now being revitalized for wirelessly connecting devices over short distances. Many industry observers say UWB could prove more successful than Bluetooth because it is faster, less expensive, and uses less power.

Companies such as Intel, Time Domain, and XtremeSpectrum are researching and investing in UWB technology, which could be used for networking computers and peripherals and for linking elements of home entertainment systems.

John McCorkle, XtremeSpectrum's chief technology officer, noted that UWB has other uses besides short-range device connectivity. For example, the technology can be used in ground-penetrating radar for tasks such as bridge inspection or archaeological use and in public-safety devices that can capture images through walls.

However, before UWB can become widely popular, it must overcome several important hurdles, including regulatory restrictions in most countries and a heated standardization battle.



UWB PRIMER

The US military developed UWB in the 1970s for various uses including low-power communications capable of evading mainstream eavesdropping techniques. Ben Manny, Intel's director of wireless technology development, said fundamental UWB patents are based on the military research.

Today, many vendors are developing UWB products. For example, XtremeSpectrum has shipped UWB chips to manufacturers, and consumer-electronics makers such as Samsung have announced UWB-capable home entertainment products.

How it works

"UWB is an impulse radio as opposed to carrier-based radio," explained Intel's Manny. Carrier-based radio transmits data continuously. UWB, on the other hand, typically transmits signals via subnanosecond pulses of energy operating at about 0.0001 milliwatt per MHz of transmission bandwidth. Under the IEEE's proposed UWB standard, the pulse duration would increase to 4 nanoseconds, noted Alan Petroff, Time Domain's chief technologist.

UWB uses different techniques for modulating and transferring information. The simplest method assigns binary data's ones and zeros to the absence or presence of pulses, explained Manny.

Spectrum usage

As Figure 1 shows, UWB sends the various pulses of a single transmission over a relatively large part of the radio spectrum, not just at a specific frequency or narrow frequency range, as is the case with cellular-phone and other radio-based technologies.

The US Federal Communications Commission (FCC) has allocated UWB the spectrum between 3.1 and 10.6 GHz, currently used by satellite-based telecommunications providers. This was done to avoid potential interference with radio-based technologies that use other parts of the spectrum.

Some providers of satellite-based telecommunications have expressed concern about UWB interference. XtremeSpectrum's McCorkle said it is important for UWB to avoid interference problems to encourage people to adopt the technology right away.

Unlike the US, many countries don't permit commercial UWB use because their regulations address only technologies that operate at a fixed frequency or a narrow frequency range. Many nations, including Japan, rarely license UWB even for experimental use because of interference-related concerns.

Data rate

UWB's data rate is typically between 200 and 400 Mbits per second, said Time Domain CEO Ralph Petroff. However, proposed IEEE standards would let UWB run anywhere from 110 Mbits per second over 10 meters to 480 Mbits per second over 1 meter. Bluetooth runs at 700 Kbits per second.

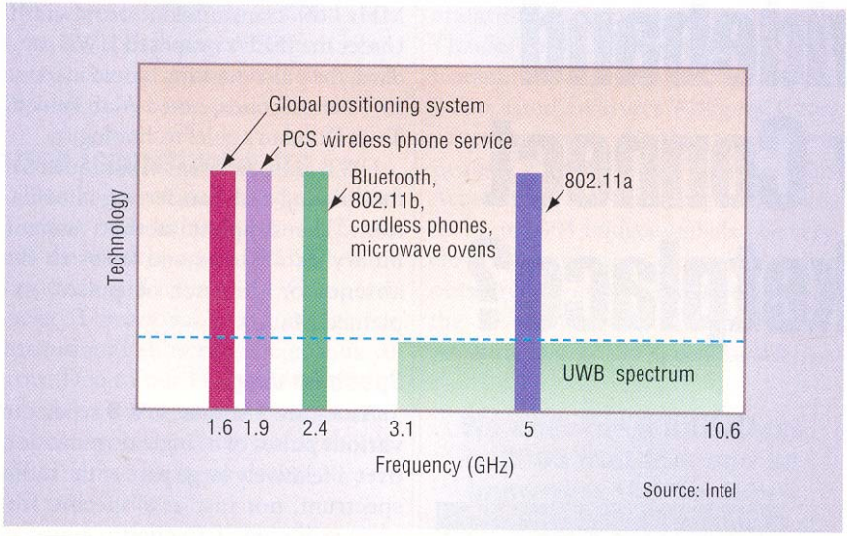


Figure 1. Wireless technology frequencies. While other prominent wireless technologies operate in narrow frequency ranges within the radio spectrum, UWB operates over a very broad section.

UWB is faster largely because it uses a wide spectrum range.

Other advantages

UWB operates over a range of up to 10 meters, as is typically the case with Bluetooth.

In addition, UWB uses less power under current FCC restrictions than Bluetooth or other existing wireless systems. According to Manny, UWB is energy efficient largely because it achieves fast data rates via high bandwidth rather than the power-hungry, high-order, complex modulation methods that some wireless approaches use.

UWB is also more immune than traditional radio systems to the signal degradation that multipath distortion causes. Multipath distortion occurs when a transmitted wireless signal bounces off a building, tree, or other surface, creating copies that arrive at the destination at different times, thereby degrading overall quality. When signal bounces occur, a UWB receiver can receive the main transmitter pulse first and then combine reflected pulses to make the overall signal stronger.

Like other wireless technologies, UWB uses chips with transceivers, antennas, and other radio equipment. Implementing UWB can be relatively inexpensive because all the radio circuitry can be incorporated on a small chip, explained Time Domain's Alan Petroff.

Although initial chips that comply with the proposed IEEE standard for UWB could cost about $20, the price will fall as companies produce them in higher volumes. Bluetooth chips currently cost a bit less than $5.

USING UWB

UWB will primarily compete with Bluetooth technology for short-range device connectivity, said Vamsi Sistla, director of broadband research for ABI Research.

The first big UWB market will be home networking, including the provision of links between computers and elements of home entertainment systems, said Steve Turner, Texas Instruments' (TI's) UWB business development manager. The technology could transfer audio or video from camcorders to televisions and PCs, from a set-top box in one room to a TV in another, from a VCR or DVD player to multiple TVs, or from a stereo or DVD player to remote speakers.

UWB's fast transfer speeds could make the technology ideal for home theater systems because the high data rates would contribute to the smooth, uninterrupted viewing of data-intensive video presentations.

According to Ralph Petroff, many vendors are also excited about using UWB's connectivity capabilities to replace universal serial bus 2, the latest version of the USB plug-and-play interface between computers and add-on devices.

STANDARDS CONTROVERSY

The IEEE is developing the 802.15.3a standard for UWB, with participation from companies such as Intel, Motorola, and Philips.

The IEEE is winding up its work prior to adopting a standard, said Robert Heile, chair of the IEEE 802.15 Working Group on Wireless Personal Area Networks and chief technology officer of Appairent Technologies, a wireless multimedia systems and solutions company. The working group's Task Group 3a is studying the UWB standard.

Ralph Petroff said the goal of the standards effort is resolving interoperability issues right away to assure consumers that different UWB devices will be compatible from the start.

Divided spectrum

One UWB approach uses orthogonal frequency-division multiplexing, a method of digital modulation that increases channel capacity by splitting a signal into several narrowband channels at different frequencies.

The Multiband OFDM Alliance (MBOA), a group of about 30 companies led by Intel and TI, advocates a standard that would divide the recently authorized UWB radio spectrum into three or seven bands. The alliance says it chose three or seven bands because they offer the best performance-related tradeoffs.

An individual UWB transmission would operate within one of the narrower bands, rather than over the entire permissible spectrum. In addi-

tion, the bands would fill only the spectrum between 3.1 and 4.9 GHz, to avoid interference with wireless technologies operating above 4.9 GHz.

Anuj Batra, manager of the mobile wireless branch of TI's Digital Signal Processing Solutions Research and Development Center, said many companies support this strategy and thus could work together to get UWB products to market quickly. Other proponents contend that dividing the spectrum could facilitate adoption outside the US by letting UWB work within smaller spectrum ranges, as required by most other countries' telecommunications regulations.

Continuous spectrum

A group of vendors that includes Motorola and XtremeSpectrum favors a standard that calls for UWB transmission to use the entire spectrum the FCC permits, not narrower bands. According to XtremeSpectrum's McCorkle, this approach will offer higher performance and better scaling because it could make use of the entire 3.1 to 10.6 GHz spectrum range.

Continuous-spectrum proponents say the divided-spectrum approach won't offer enough performance for UWB to remain a useful technology for long.

Concerns

A recent vote by the Task Group 3a failed to yield the 75 percent approval necessary to adopt one of the UWB proposals.

Ongoing fighting over the standard concerns industry observers who say that adoption delays could hold back the technology's development and marketing. Intel has said that unless an agreement is reached soon, the company would consider creating a special interest group outside the IEEE to set a standard.

"We don't have a formal deadline," said Intel's Manny. "We think the IEEE is a good venue. [The standards process] tries to be fair, but it doesn't always work out that way."

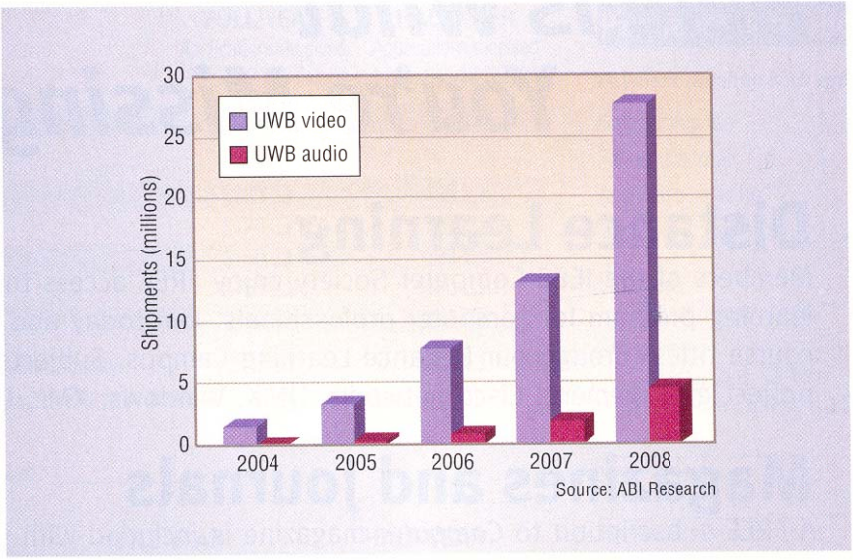


Figure 2. UWB sales. ABI Research predicts that the sale of UWB equipment for multimedia applications will increase rapidly during the next few years.

"We'll work the issues until we can get consensus around one proposal," explained Heile. He said there won't be a big marketplace for UWB until 2006 or 2007, so there is no hurry.

ADOPTION

According to McCorkle, UWB acceptance has been slow because many users don't understand how effective it can be. Time Domain's Ralph Petroff said UWB acceptance in the US has been delayed because, until recently, the FCC generally permitted only government users to work with the technology.

Outside the US, the European Union and the European Telecommunications Standards Institute have decided to wait to see what the IEEE does with the proposed standard.

Once standards issues are resolved, stated TI's Turner, "2005 is going to be the prime-time year." Kurt Scherf, vice president of research for Parks Associates, a market research and consulting firm, said he expects commercial UWB development to begin by 2006. ABI Research's Sistla predicted that UWB sales will take off quickly, as Figure 2 shows, and that the technology will generate $1.39 billion in revenue by 2007.

According to Jeff Foerster, technology strategist for Intel's radio communications lab, "There are still a lot of technical challenges to be overcome with the design of these systems to yield a low-cost, low-power device that achieves good, reliable performance. The main challenge will be coming up with a proper balance between cost and performance that meets application requirements."

But when all is said and done, predicted Time Domain's Ralph Petroff, "UWB will be ubiquitous. There are things UWB can do that no other technology can do." ■

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