Ultra Wideband: Quiet, fast, struggling

Wireless data transmission is at the heart of many of the advanced wireless services we've become accustomed to, including cellular telephony, Wi-Fi, and Bluetooth. WiMAX, which promises to offer high bandwidth over longer distances than Wi-Fi, appears ready for prime time. At least one major carrier, Sprint Nextel, has announced that they will spend billions of dollars deploying WiMAX infrastructure nationwide.

Another extremely interesting technology, Ultra Wideband (UWB), is slowly emerging from the shadows and offers unique advantages that will likely have a major impact on consumer, commercial, and military wireless communications.

In their new book, *Ultra Wideband Systems* (Oxford, UK, Newness Press, 2006, 315 pages), authors Roberto Aiello and Anuj Batra explore UWB technology, including ultra wideband origins, spectrum issues, antenna design, different data encoding methods, standards development efforts, and commercial applications.

Beyond personal area networks

The book is intended for students, engineers, and marketing professionals, and it covers the subject in depth. It's a very interesting read for anyone involved in embedded system design, as ultra wideband can be used for more than personal area networks, connecting PC's, digital cameras, printers, and the like. With data rates in excess of 1 gigabit per second over distances of up to tens of meters, UWB opens up interesting possibilities for wireless board-to-board and system-to-system communications in embedded systems.

From its beginnings more than 50 years ago, UWB technology has moved from the lab, to the military, back to the lab, in and out of the standards process, and finally into commercial implementations (Figure 1). Unlike normal radio communications, which depend on modulating a specific carrier frequency, UWB works by transmitting and receiving very low power signals over a wide range of frequencies – sometimes several gigahertz – essentially simultaneously. Unlike Wi-Fi or Bluetooth, UWB doesn't require any particular piece of spectrum, licensed or unlicensed. It works on top of existing spectrum space, but the power levels are so low that interference doesn't occur. The Federal Communications Commission currently regulates UWB signals to be below 100 nanowatts per megahertz. UWB is permitted in the United States over the frequency range of 3.1 gigahertz to 10.6 gigahertz. It is this low power in any individual frequency band that allows it to coexist with licensed spectrum. This low power also makes eavesdropping and hacking very difficult, which is one of the reasons for early military interest.

Today, as we all know, industry standards are required to enable widespread technology acceptance and mass-market opportunities. Standards create confidence, reduce the importance of any single vendor, create competition in price and performance, and create critical mass. Standards tend to emerge either from the promotion and opening up of proprietary standards or from ground-up efforts intended to best meet market requirements. Often the process

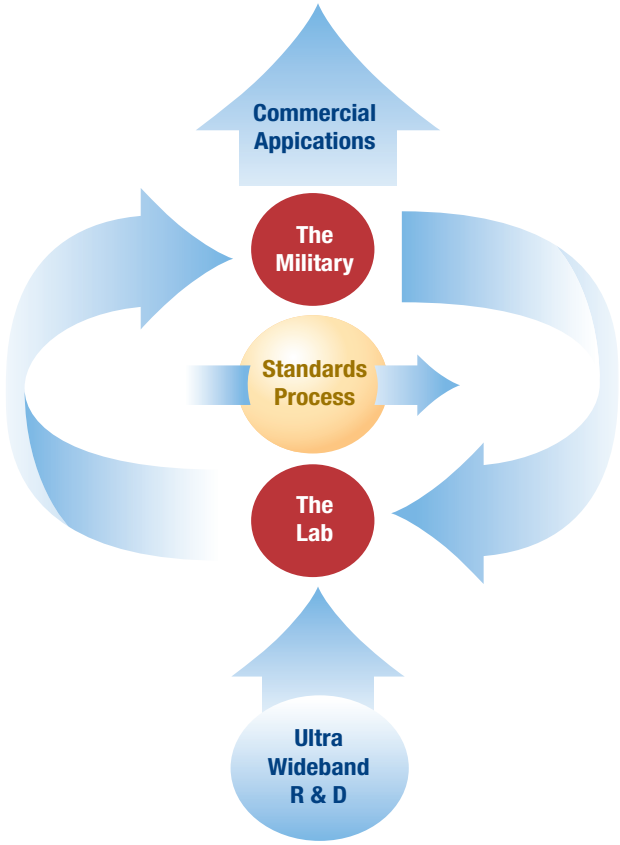

Figure 1

is iterative, including technology experts, market experts, and solution providers. The standards efforts surrounding UWB began in the IEEE in 2001 as IEEE 802.15.3a. Things began to go downhill sometime thereafter. Although the complete story reads like a Raymond Chandler novel, with intrigue, vested interests, shifting coalitions, and bad faith, it is sufficient to say that the standards efforts around UWB are currently in tatters and no single de facto or agreed upon approach has emerged. While commercial products began to be introduced in 2005, they are not completely interoperable and therefore have not yet achieved broad market acceptance. The original IEEE committee has failed to reach consensus, and several splinter groups, including the WiMedia Alliance (wimedia.org) and the UWB Forum (www.uwbforum.org) have come into existence. It's really a shame, as this technology is very fast, extremely low power, robust, essentially interference free, and can be cheap. UWB is applicable to a host of embedded computing applications where its attributes of high bandwidth, very low power, robustness, and low cost can be put to use in ways that one can only begin to imagine. It may be that the technology is simply too useful and compelling to languish. I hope that the current standards woes are only temporary. UWB is really good stuff.

Joe Pavlat, Editorial Director