Understanding The Applications Of Ultra Wideband And WiMAX Technologies

Can New Wireless Technologies Be The Answer For The Delivery Of HDTV, Networking And More?

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In the realm of broadband, we face an increasingly complex range of technologies such as Ultra Wideband (UWB), WiMax, 3G, EDGE, GPRS, WiFi, Bluetooth, Zigbee and more. This complexity recently hit home when I was asked the question "What is the difference between UWB and WiMax?" The quick answer is "Everything," but a better appreciation is gained by understanding what each is intended to do, which also requires a brief understanding of where the UWB industry is today.

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At a high level, if we leave aside questions of how these two technologies differ in technical foundation, WiMax and UWB are intended to do entirely separate things and serve entirely separate markets. Simply, WiMax is intended to serve applications requiring wireless high data rate connectivity over miles, whereas UWB is generally intended to serve wireless high data rate connectivity over distances up to 100 meters.

WiMax:

For those familiar with the fixed broadband wireless technology of LMDS, WiMax essentially began life as a way to bring some form of standardization to an industry that was struggling from a wide variety of proprietary approaches. Hence, the technology is at first a fixed broadband wireless technology that is intended to deliver tens of megabits over transmission ranges of several miles—some say up to thirty miles, but somewhat far less is likely for most operating scenarios.

WiMax usage scenarios can typically be summarized as 1) outdoor; 2) great when and where traditional broadband wired infrastructures such as Cable Television, Fiber, xDSL, T1, T3 or similar technologies aren't in place and/or the cost of such wiring is prohibitive; and 3) not necessarily an "end-all, be-all" replacement for wired broadband due to challenges with "atmospherics" such as rain, snow, heavy fog, etc. Work on "mobile" WiMax is reportedly progressing, but some suggest that power and antenna requirements may keep WiMax out of things like cell phones, PDA's and similar applications for the foreseeable future.

All of this, while compelling, has nothing to do with the applications that UWB is being pursued to serve. While there are a number of "non-communications" applications being developed for UWB, the "communications" applications of UWB are broadly shaping up into the categories of "wireless USB", "wireless HDTV and multimedia" in Personal Area Network and Local Area Network settings, "in-home power line networking" and "Cable Television network enhancements".

UWB Wireless PAN:

For the past year, much of the focus on UWB has been centered on standards debates inside of the IEEE 802.15.3a group for UWB Wireless Personal Area Network applications—generally defined as transmission ranges of less than thirty feet. Two competing proposals, one championed by Texas Instruments, Intel and dozens of other members of the Multiband OFDM Alliance (MBOA) and the other championed by Motorola and other members of the UWB Forum, have been deadlocked for almost a year in the standards debate. The popular consensus is that both technologies are about a year away from commercial availability.

Interestingly enough, from an application and usage standpoint, both proposals started out with the same application and markets in mind. As the technology of each evolves, it is beginning to appear that the differences in these two approaches to UWB wireless may actually end up defining differing markets and usage applications for each.

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a technology approach that is increasingly being branded "Wireless USB;" which appears to be the application that it is best suited for. From the standpoint of providing broadband connectivity to properties, it may not seem that compelling, but anyone that has purchased a PC or related peripheral in the past three years or so likely has two or three USB ports in each of those devices. PC's and their related peripherals are increasingly connected by and sharing data through USB cables plugged into those USB ports, and an unsightly and somewhat confusing tangle of cables results. The connection distances are seldom more than five feet and the connected devices are seldom mobile. The data rate required for USB is up to 480 Megabits.

The MBOA approach to UWB makes it perfect as a USB cable replacement. (Be certain not to confuse UWB, Ultra Wideband, with USB, Universal Serial Bus). Anybody that is familiar with the number of USB data ports and cables being employed by the PC/peripheral market today would agree that replacing all of those cables with a comparably priced wireless technology is a huge potential market.

The UWB Forum, on the other hand, champions a Direct Sequence CDMA approach to UWB that appears to make it better suited for high-quality multimedia networking of things like High Definition Television, DVD/CD entertainment systems and the like. The transmission ranges remain relatively short, but certainly provide enough range to wirelessly deliver an HDTV signal from your cable or satellite set top box across a good sized living room to your Plasma display. Despite presently high prices, sales of large screen HDTV capable appliances have been strong. With the price of flat screen HDTV's dropping dramatically—and the FCC's federal mandate that all broadcasts and TV's be digital format by 2006/2007—wireless HDTV distribution also has the potential to be a tremendous market. Not many people will foresee wanting their "flat screen piece of art" hung in their living room with a coax cable running up the wall. Not if there is a wireless alternative. The ability to have the HDTV signal networked wirelessly from the TV to the set-top-box has a tremendous obvious appeal.

Admittedly, both of the short-range wireless UWB approaches share significant common applicability for many functions. While the UWB standards debate between these two approaches continues inside the IEEE, however, it may not be entirely outside the realm of possibility that both approaches may evolve to a point where they effectively serve different applications. Wireless USB versus wireless HDTV—or something like that.

UWB wireless LAN and UWB wired over Power Line and CATV networks:

Next, there is also UWB technology for Wireless Local Area Networks (WLANs), UWB for home—Power Line networking and UWB for Cable Television Networks. Each of these technologies, developed by Pulse~LINK, work simultaneously on a single chipset.

Fundamentally, when compared to WiMax, the UWB WLAN and UWB home power line networking are for connectivity within the home or office, not over miles of coverage as served by WiMax. Delivering UWB across Cable Television Networks tremendously increases a Cable Operators network carrying capacity over entire Metropolitan Area Networks, and in that sense is a bit more similar to WiMax than other implementations of UWB technology. It is important to note that UWB-Cable is not a wireless technology at all—it is a new means of modulating wired data on wired networks. The primary difference between WiMax and UWB-cable, is that UWB-cable increases the carrying capacity of existing wired cable television infrastructures, whereas WiMax is an alternative wireless technology to wired CATV networks.

As has been the case with LMDS services, there will most likely be implementations of WiMax designed to deliver digital entertainment and data to consumers as an alternative to wired cable infrastructures. There are, however, notable differences and new limitations that such "would be" wireless cable companies might face versus the traditional Hybrid Fiber Coax Networks that UWB-cable would enhance. For instance, WiMax looks to offer tens of megabits. An HDTV broadcast signal, using MPEG2 compression in 1080i high-resolution format, requires about 19.2 megabits. Therefore, a WiMax-based media delivery service may not be able to handle a compelling variety of programming for consumers accustomed to digital cable or satellite services. Better than nothing if no CATV infrastructure exists—perhaps even a great way for existing CATV operators to augment their networks.

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UWB-Cable, on the other hand, can dramatically increase the capacity of existing CATV networks. Even though CATV serves over 300 million subscribers worldwide, new CATV subscriber growth has flattened due to competition from satellite, fiber to the home, xDSL and others. Revenue growth is now coming from the provisioning of new services such as cable modems and true video-on-demand services—which can mean a requirement for new bandwidth. UWB-cable also has positive implications for property operators that serve commercial tenants, insomuch as commercial tenants tend to have a higher requirement for sending large amounts of data back upstream through the network and current CATV systems currently have a relatively tight upstream carrying capacity per node that can be augmented tremendously by UWB-cable.

UWB-Cable will provide tremendous additional two-way data carrying capacity without the expensive cost of modifying the existing cable infrastructure. In essence, it only requires equipment at the operator's head-end and a microchip at the customer premises, and that same chipset at the customer premises can network appliances and electronics throughout the home either wirelessly or over existing wires. Commercial availability for the Pulse~LINK chipset is anticipatedmid-2005.

Integration of WiMax and UWB

While much more could be said about the differences between WiMax and UWB, an interesting contemplation is how these two technologies might be used in combination with one another. Since each uses differing portions of the radio spectrum and can peacefully coexist, integration of the two could present compelling usage scenarios. WiMax could be used to achieve high data rate connectivity across long ranges, whereas UWB integrated with WiMax at the customer end-point might be used to network a variety of local client devices together at the end-points of the WiMax transmission.

WiMax might one day be used, for example, to connect a desktop or laptop computer at high data rate to an Internet or entertainment service provider, whereas UWB inside that receiving laptop might distribute that data or entertainment wirelessly—or over powerline or cable—to printers, plasma displays, speakers or more in the local operating vicinity of the PC or laptop in question. Understanding the implications of this, Pulse~LINK is pursuing a roadmap for such future integration on its Software Defined Cognitive Radio chipset.

In the end, such integration is what end-users ultimately want. Consumers don't want to care about how their Internet services, entertainment and devices or appliances are networked. They don't want to care about which technologies are involved. They just want to pay as little as possible, turn things on and have them work when and where they want. While such truly seamless integration may be some years away, for now it is important to understand that it is not an issue of one versus the other, but how they might be best leveraged together. ■

About the Author

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