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For Wireless USB, the Future Starts Now

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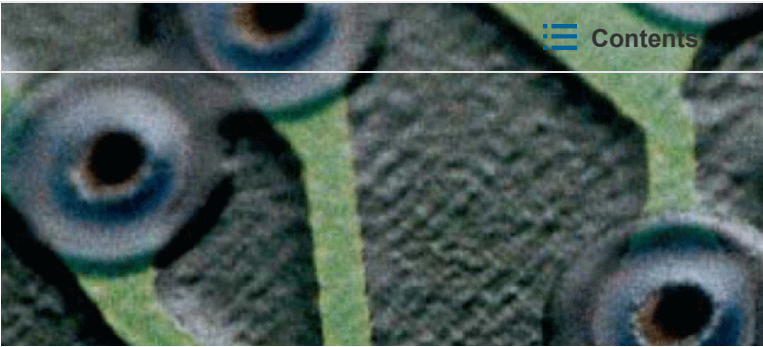
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Universal serial bus technology has made it easier to connect peripherals to PCs than prior methods, such as serial and parallel ports. USB lets users attach peripherals and other devices-such as digital cameras, game controllers, hard drives, printers, and scanners-without having to install individual drivers or use expansion cards, all without rebooting the computer.

However, USB requires connections via cables, which can become a jumble when many devices are involved. And the cables limit the distance over which users can connect devices.

To address this issue, a number of companies-including Alereon, Belkin International, D-Link, Fujitsu, Gemtek Technology, Hewlett-Packard, Icron Technologies, Intel, Lenovo, LSI Corp., Realtek Semi-conductor, Samsung, Staccato Com-munications, Synopsys, and Wisair-are beginning to release products based on wireless USB (WUSB).

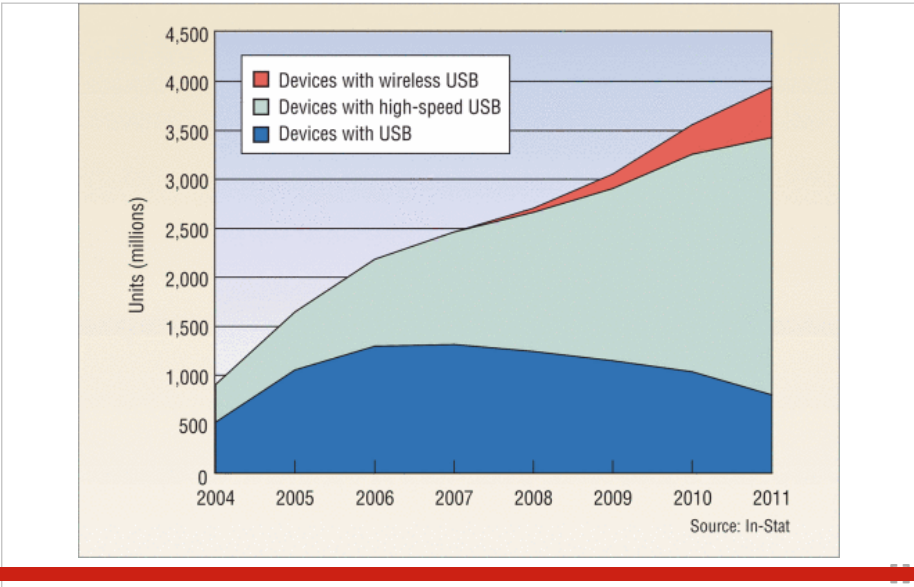
“There is significant interest among both computer and con-sumer-electronic vendors to move from wired to wireless peripheral connections,” said Brian O’Rourke, principal analyst for market-research firm In-Stat.

The use of consumer electronics with computers in home-entertainment systems has created a market for WUSB products, which offer easier implementation and communication of multimedia between devices than wired USB provides, said Synopsys product marketing manager Eric Huang.

Moreover, the technology would let users move around with connected mobile devices beyond the reach of cables.

The initial WUSB products will be dongles and hubs, but vendors will release computers and devices with built-in WUSB capabilities later this year, Huang predicted.

Proponents believe large-scale WUSB sales are just over the hori-zon. As Figure 1 shows, In-Stat estimates there will be 4 billion USB-enabled devices worldwide by 2011, with 503 million, or 12.6 per-cent, using WUSB. This year, In-Stat predicts, out of 2.5 billion USB devices, only 3 million, or 0.1 per-cent, will be WUSB-enabled.



rising percentage of all those that use USB.



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However, the technology is new and faces potential problems once widely implemented, said Rob Enderle, principal of the Enderle Group, a market-research firm.



Here Comes Wireless USB

HP, Intel, Lucent Technologies (now part of Alcatel-Lucent), Micro-soft, NEC, and Royal Philips Electronics developed USB, which debuted in 1995 as an interface to connect peripherals to computers.

Several companies formed the Wireless USB Promoter Group in February 2004 to define the WUSB 1.0 specification, with the help of about 100 other members. The group completed the work in May 2005.

The USB Implementers Forum (USB-IF; www.usb.org) now supports and promotes wired and one wireless flavor of the technology, whose current versions are USB 2.0 and WUSB 1.0.

The USB-IF has a Certified WUSB (CWUSB) program that verifies computers' and devices' compliance to the WUSB approach that the forum supports.

CWUSB lets systems transmit USB wirelessly via ultrawideband radio technology. However, vendors such as Icron that don't use CWUSB provide a type of wireless USB that works with Wi-Fi as well as UWB.

Delayed development

Competition between the Intel-led WiMedia Alliance and the Freescale Semiconductors-led UWB Forum over which group's version would become the IEEE's UWB standard delayed initial WUSB development.

The IEEE tried but failed to get the two sides to come together. Over time, Freescale left the UWB Forum but still has not been active in the WUSB marketplace. The UWB Forum eventually dropped out of the race. Cypress Semiconductor has a WUSB-like technology used only for low-throughput products like key-boards, mice, and game controllers.

CWUSB is thus currently wireless USB's main focus.

Nonetheless, overall WUSB implementation has been delayed, Icron president Robert Eisses said, "because the radio technology has not been able to replace the performance of a wire at the high speeds necessary for true USB 2.0 applications. With [improved] UWB and Wi-Fi, it is now becoming a viable solution."

WUSB, explained Eisses, will compete mainly with Bluetooth and Wi-Fi for device connectivity.

Driving forces

Ease of use and elimination of cables are WUSB's principal driving factors, noted Stephen Wood, president of the WiMedia Alliance, an industry organization that promotes UWB adoption and standardization.

For example, he said, "Customers want to get rid of the rat's nest of wires and to connect mobile devices without the bother of carrying a cable around," Wood said.

Because of plans to connect consumer-electronics devices to home-entertainment complexes, vendors want systems to have standardized interconnects, a role that WUSB could also fulfill.

Improvements in processor manufacturing, single-chip integration, radio technology, and wireless networks are making WUSB practical, Wood noted.

"Today it's possible to build WUSB radios that are fast enough, have low enough power for mobile applications, and are cheap enough for consumers to buy comfortably," he said.

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In addition to functioning as a freestanding chip, WUSB capabilities can come in the form of circuitry that can be integrated into mother-boards, add-on cards, or devices.

Hubs and dongles are the first products to use CWUSB, according to USB-IF chair and Intel technology strategist Jeff Ravencraft.

"A dongle can be attached to a USB port, allowing the host to communicate with CWUSB devices," Ravencraft said. "Likewise, existing wired USB devices can be connected to a CWUSB hub."

NEC Electronics has released a USB-IF certified host controller, which adds CWUSB support to a PC, usually via peripheral-component-interconnect technology.

Icron has rolled out a WUSB hub, not based on CWUSB, that uses a Wi-Fi radio.

Synopsys, using an Alereon chip-set, recently created two Design-Ware Wireless USB products: a host controller for machines such as PCs, set-top boxes, and digital TVs; and a dual-role device for machines such as mobile phones, digital cameras, and printers.

DRDs let devices not only connect to a host but also function as hosts themselves. This would, for example, let a digital camera act as a connecting device when communicating with a computer and as a host when transferring pictures to a printer.

Inside Wireless USB

WUSB developers' principal technical challenge has been adapting USB so that it works as well wirelessly as it does with wires.

The Technology

WUSB uses much of wired USB's approach, including a host controller that does the work necessary to transfer data to and from peripherals and connected devices.

Details

As is the case with wired USB, CWUSB allows up to 127 devices to connect directly to a host and has a theoretical maximum speed and range of from 480 Mbps at 3 meters to 110 Mbps at 10 meters. The relatively short range lets multiple high-speed CWUSB clusters coexist within a small area without interference.

CWUSB uses wired USB's hub-and-spoke model, in which a single host manages all data traffic, initiating communications and allotting time slots and data bandwidth to each connected device, Ravencraft noted. This eliminates the need to add costly management capabilities to devices.

UWB

The CWUSB standard is built on the WiMedia Alliance's Multiband Orthogonal Frequency Division Multiplexing (MB-OFDM) version of UWB.

UWB works via chip-based radios that modulate signals in the form of high volumes of low-power electromagnetic pulses across the entire available ultrawideband spectrum, which differs depending on the country involved. For example, UWB is permitted in the 3.1 to 10.6 GHz spectrum range in the US, in the 3.4 to 4.8 GHz and 7.25 to 10.25 GHz ranges in Japan, and from a proposed 3.1 to 4.8 GHz in much of Europe.

By working with the entire spectrum, UWB can produce high performance with less energy use. In essence, UWB uses low-energy pulses over a broad frequency range to achieve bandwidth. Most other wireless technologies operate only in a single assigned band within a frequency spectrum and thus achieve performance at the cost of high energy consumption.

MB-OFDM increases bandwidth by dividing a signal into 14 528-MHz-wide bands, which can each simultaneously carry signals. The channels are orthogonal to their neighbors and thus can be packed close together without interfering with one another.

CWUSB's main components can be integrated easily onto a single radio chip, which costs less, uses less power, and is smaller than multichip approaches. The chip's principal elements include the

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A device wire adapter, such as one that NEC recently released, enables wired USB devices to be used wirelessly. A host wire adapter lets current PCs add WUSB capabilities.

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PDF UWB's low power consumption makes WUSB suitable for battery-powered devices.

Wi-Fi

While CWUSB works only with UWB, Icron has developed a WUSB version that also runs on Wi-Fi, which represents a set of Ethernet-based, wireless LAN technologies formalized as an evolving series of IEEE 802.11 standards.

Wi-Fi moves data via radio waves in the 2.4 GHz or 5 GHz spectrum ranges. The technology commonly provides Internet availability, frequently via publicly accessible hotspots, and network connectivity for consumer electronics.

Security

To protect sensitive transmissions from interception, CWUSB provides 128-bit Advanced Encryption Standard cryptography, according to Ravencraft.

CWUSB provides an extra layer of security by enabling the host to randomly generate a one-time secret AES encryption key and transmit it to a device via either a USB cable used only for first-time setup or public-key encryption, in both cases to protect against interception.

CWUSB also utilizes association-in which a user verifies that the devices being connected are the ones the user intends to connect and don't include one belonging to an attacker-in first-time connections.

Barriers to Success

Initially, WUSB will experience some bumps in the road. For example, said Enderle, wireless connections can be unreliable and can be obstructed by physical obstacles or experience interference from other devices' signals.

Another challenge will be keeping costs down and performance up, especially for the consumer market, according to Icron's Eisses.

Generally, he noted, wireless technology is more expensive than comparable wired approaches, so keeping WUSB's costs competitive in the long run could be a challenge. Moreover, he said, "You better make sure its performance is as good or better, or it provides some significant benefit, to justify the added cost."

WUSB also faces competition from other wireless-connectivity technologies, such as Bluetooth, as well as those that may enter the market in the future, he explained.

"WUSB's biggest challenge is to get to market quickly with cost-effective, useful solutions, before next-generation Bluetooth or [Wi-Fi], or other wireless solutions really take off," he said. "So far, [proponents] have not been able to deliver, even after a number of years of saying it is here."

Computer makers Lenovo and Fujitsu say they will offer CWUSB as an option in laptops later this year. Within 18 months, most laptops will have the technology, predicted Synopsys' Huang.

According to Wood, CWUSB will get faster-with data rates up to 2 to 3 gigabits per second-in a couple of years and will thus more effectively support the transfer of video and other large files. He said the technology will also offer lower power consumption and thus work better with mobile devices.

However, all is not rosy.

"If equipment manufacturers don't see cost-effective implementations that can hit the price point demanded by consumers, this technology will never take off in a big way," Eisses predicted. "It also must be easy to use and set up. [Wired] USB has been a great success due to its plug-and-play nature, and device makers are putting a great deal of emphasis on that."

Ease of use and eliminating cables are driving wireless USB popularity.

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Kirsten West, cofounder and principal analyst of West Technology Research Solutions, a market-research firm, said that before WUSB reaches mass adoption levels, “there needs to be a developed market infrastructure, significant consumer education, and training; and the bugs must be worked out of products.” ■

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