

# **WIRELESS USB**

## **WHITE PAPER**

**September 2004**

### **USB JOINS THE WIRELESS REVOLUTION**

Since its debut in 1996, the universal serial bus (USB) has conquered the PC and PC peripheral markets and captured a significant share of the consumer electronics market. Now USB is going wireless—a move that will add the convenience of mobility to its unrivalled low-cost performance and ease of use.

The Wireless USB Promoter Group is crafting a specification for a Wireless USB standard that will provide high-speed connectivity over a distance of 10 meters. The target data rate is 480 Mbps—comparable to the speed of wired USB 2.0 and much higher than the speed of other short-range wireless interconnects such as Bluetooth. That means Wireless USB will be the first wireless technology capable of high-bandwidth multimedia streaming and data transfers. Additionally, Wireless USB will maintain the host-to-device architecture, usage models, and simplicity of wired USB to enable easy migration from wired to wireless USB solutions.

### **UWB: THE UNDERLYING TECHNOLOGY**

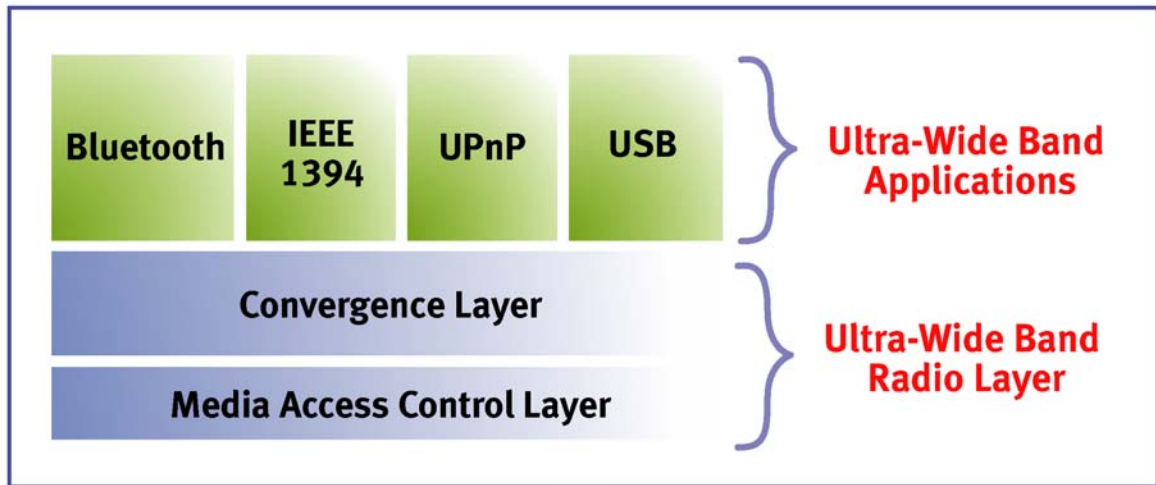
The basic transport mechanism for Wireless USB is the ultra-wide band (UWB) radio platform, which has been the focus of recent efforts by the Multiband OFDM Alliance (MBOA) and the WiMedia Alliance. The platform consists of two core layers: the UWB radio layer and the convergence layer (Figure 1).

#### **UWB RADIO LAYER**

UWB technology is fundamentally different from conventional narrow-band radio frequency (RF) and spread-spectrum technologies (SS) such as Bluetooth and 802.11a/g. Conventional radios transmit a single continuous carrier wave over a specified frequency. In contrast, UWB transmits short, fast, low-power wavelets of energy over a very wide band of frequencies.

In 2002, the Federal Communications Commission (FCC) legalized commercial use of UWB communications in the 3.10 to 10.6 GHz slice of the radio spectrum. At the same time, the FCC imposed stringent limitations on UWB power emissions to enable the co-existence of UWB and other services that operate in this spectrum. This combination of a very broad band

and restricted power provides the high speed and limited range of UWB-based applications. It also enables spectrum reuse: unlike narrow-band RF wireless technologies, a wireless USB cluster can communicate on the same channel as another cluster in proximity. An additional advantage of UWB technology is that the radio circuitry can be implemented in cost-effective CMOS.



**Figure 1. UWB radio platform and emerging UWB applications**

### THE CONVERGENCE LAYER

The convergence layer serves as an interface between the UWB radio layer and UWB-based applications. It allows multiple applications to share a single radio. Wireless USB is the first of several wireless applications that will run on the UWB platform.

<b>Key Players in the Development of Wireless USB Technology</b>	
Multiband OFDM Alliance (MBOA)	MBOA, an organization representing over 170 companies, is defining standards for the UWB radio layer and creating specifications for the UWB PHY and MAC.
WiMedia Alliance	WiMedia Alliance is developing a convergence layer and IP stack that will run on the UWB radio layer specification produced by MBOA and IEEE. The alliance also plans to administer certification for UWB-based products to ensure multivendor interoperability.
Wireless USB Promoter Group	The Wireless USB Promoter Group is developing a Wireless USB specification based on UWB technology. The group, which consists of Intel, NEC, Agere Systems, HP, Microsoft Corporation, Philips Semiconductors and Samsung Electronics, is expected to have a standard by the end of 2004.

## **WUSB CLUSTER TOPOLOGY**

Wireless USB clusters use a simple hub and spoke topology, with point-to-point connections between the host and the devices connected to it. The host—which can logically connect to as many as 127 devices—initiates and schedules data transfers to the devices in the cluster, allotting time slots and bandwidth to each connected device. Clusters will be able to physically overlap with minimal interference.

## **FEATURES**

Wireless USB will build on the success of Wired USB. An important goal of the WUSB Promoter Group is to ensure that wireless USB offers users the experience they have come to expect from wired USB. Toward that end, the Wireless USB standard is being designed to support the following features.

- **Backward compatibility**

Wireless USB will be fully backward compatible with the one billion wired USB connections already in operation. Moreover, Wireless USB will be compatible with current USB drivers and firmware and provide bridging from wired USB devices and hosts.

- **High performance**

At launch, Wireless USB will provide speeds up to 480 Mbps, a performance comparable to the wired USB 2.0 standard and high enough to provide wireless transfer of rich digital multimedia formats. As UWB technology and process technologies evolve, bandwidth may exceed 1 Gbps.

- **Simple, low-cost implementation**

Implementation will follow the wired USB connectivity models as closely as possible to reduce development time and preserve the low-cost, ease-of-use model that has made wired USB the interconnect of choice.

- **An easy migration path**

To enable an easy migration path from wired USB, Wireless USB will maintain the same usage models and architecture as wired USB.

■ **Security**

Wireless USB will provide the same level of security as wired USB. All certified Wireless USB devices will incorporate standard, non-removable security features. Connection-level security will be designed to ensure that devices are associated and that both hosts and devices are authenticated before operation. Higher levels of security involving encryption will be implemented at the application level. At the same time, an important goal of the specification is to ensure that security requirements do not impact the performance or cost of Wireless USB applications.

■ **Host-to-device architecture**

Wireless USB will use a point-to-point connection topology similar to the host-to-device architecture used for wired USB. For ease of use, Wireless USB will employ an asymmetric host-centric model that confines complexity to the host.

**WUSB APPLICATIONS**

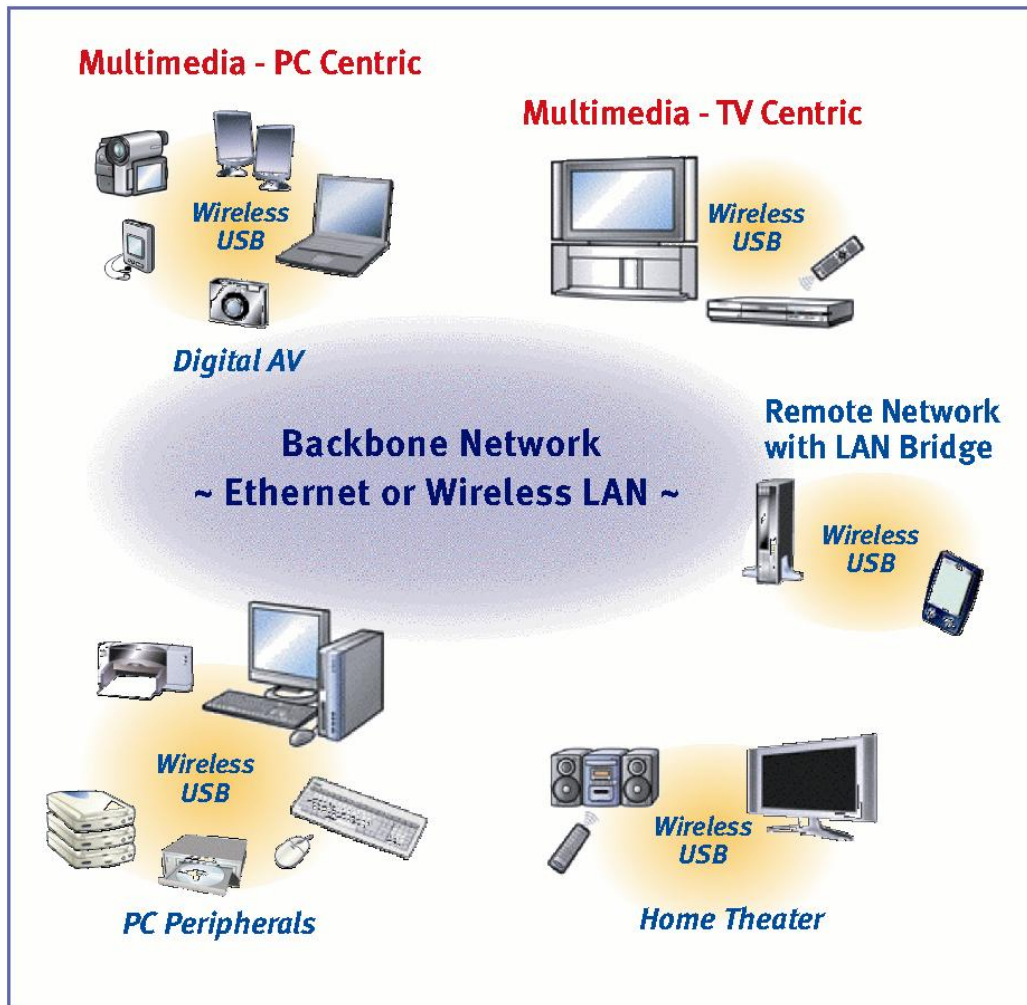
Wireless USB will benefit both from the success of wired USB in the PC market and from the growing demand for wireless technologies in the booming consumer electronics market. The shift to wireless will revitalize existing markets and contribute to the creation of new markets, particularly for multimedia devices that can take advantage of the high data rate. For example, Wireless USB will make possible next-generation notebook PCs with fewer I/O connectors and a more compact design, as well as digital AV equipment that can wirelessly transmit high-definition video.

**HOME USAGE MODELS**

In the home environment, Wireless USB will eliminate the tangle of cables connecting PCs and peripherals such as printers, scanners, monitors, and digital cameras. In addition, it will wirelessly connect myriad home products, including PCs, stereos, HDTVs, STBs, DVD players, video recorders, digital AV equipment, and the growing class of devices with rich functionality and multimedia capabilities. The home of the not-too-distant wireless future will support individual high-speed wireless personal area networks (WPANs) for entertainment, home office equipment, gaming, and audio devices. Wireless USB will introduce a standard wireless interconnect that supports multiple devices and usage models.

**Typical Home Applications**

- PCs and peripherals
- PDAs
- External storage devices (HDDs)
- HDTVs and STBs
- Game consoles
- Digital cameras
- Digital camcorders
- DVD players
- MP3 players
- CD players
- Wireless speakers



**Figure 2. Wireless USB home usage model**

### OFFICE USAGE MODELS

In the office environment, Wireless USB will offer a broad range of time-saving and productivity-enhancing applications. Users of portable devices such as notebook PCs, PDAs, and cell phones will be able to connect to printers and scanners quickly and easily. Employees will be able to share printers, scanners and storage devices, back up files quickly, exchange large files without sending them through e-mail, and synchronize their PDAs to a network—all without a single wire.

#### Typical Office Applications

- Laptop and notebooks computers
- Printers
- Scanners
- Projectors
- Mass storages devices (HDDs)
- PDAs
- Cell phones

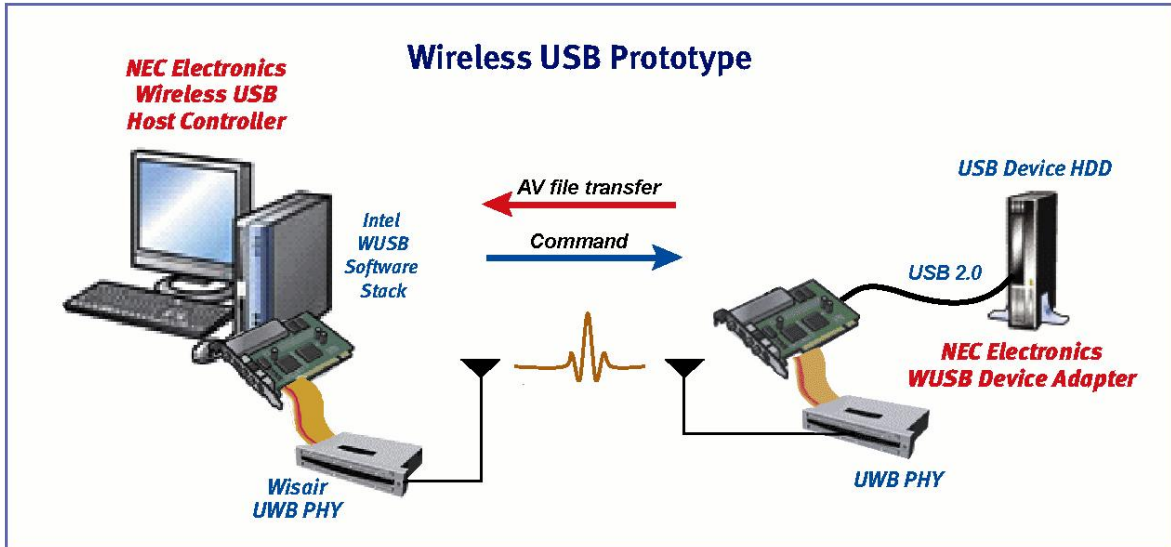
## **NEC ELECTRONICS' COMMITMENT TO WIRELESS USB TECHNOLOGY**

NEC Electronics America is committed to the evolution of USB technology. The company was a driving force in the development of the USB 2.0 standard, working closely with industry-leading companies to make high-speed USB the most successful interface in PC history. Today, NEC Electronics holds fifty percent of the worldwide USB market share and, as an active member of the Wireless USB Promoter Group, MBOA and IEEE, continues to work closely with Intel and other industry leaders to develop a standard Wireless USB specification this year.

### **WIRELESS USB DEMOS**

NEC Electronics America was a lead contributor to the first demonstration of Wireless USB technology at the Intel Developer Forum in Spring 2004. The demo showed two types of wireless transfer: a live video stream and a data file transfer from a USB hard drive.

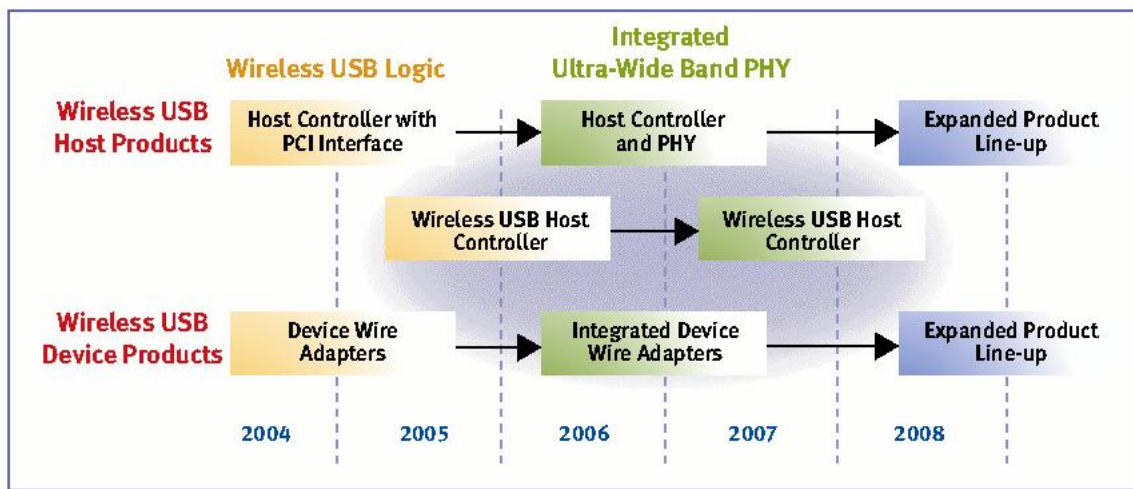
At the Intel Developer Forum Systems Conference in September 2004, NEC Electronics America exhibited an upgraded Wireless USB prototype demo that featured NEC Electronics' Wireless USB host controller board and new single-board device wire adapter.



**Figure 3. NEC Electronics Wireless USB host controller and device wire adapter**

**PRODUCT ROADMAP**

NEC Electronics' experience with USB will enable the company to develop industry-leading products based on the new Wireless USB standard at a very affordable price. Product development efforts are well underway with plans to begin mass production in 2005. The first generation of Wireless USB products will consist of discrete host controllers that connect to the host via a PCI interface and device adapters for existing USB devices. The company will then bring to market single-chip Wireless USB solutions with an integrated controller and PHY.



**Figure 4. NEC Electronics Wireless USB product roadmap**