The Easy Way to Plug & Play

Anything. Anytime. Anyone.

*An Overview
of Universal
Serial Bus
Technology*

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INTRODUCTION

For computer users, adding functionality to their PCs has been a frustrating, time-consuming and often inherently risky process. From the outset, users who wish to connect multiple peripherals face difficult choices imposed by the limited number of standard serial and parallel ports built in to most PCs. Once PC users open the box to install expansion cards, things become even more complicated. Nontechnical users face a complex and bewildering array of dip switches, jumper cables, software drivers, IRQ settings, DMA channels and I/O addresses that must be configured—and often reconfigured. To make matters worse, expanding PC functionality can often make system crashes more likely, costing both time and money. For any PC user who has ever guessed about which port to select, or fretted over a dip switch, Universal Serial Bus (USB) is the solution.

USB brings true Plug and Play convenience to the PC desktop for the first time, making the process of adding new peripherals literally as easy as plugging in a table lamp. Instead of opening the case to install expansion cards, set switches and configure jumpers, USB users can now plug in and remove peripherals without ever opening the box. To make the process even easier, USB features hot insertion and removal, a capability that allows users to plug and unplug peripherals while leaving their PC up and running.

USB is an open, royalty-free, Plug and Play standard for PC peripheral connectivity, supported by leading computer, telecommunications and software companies. USB not only makes it easy to add existing peripherals, it also paves the way for exciting new applications including digital peripherals, telephony devices and multi-user games.

As a charter member of the USB Implementers Forum, Intel now offers a complete USB solution in silicon, including PCI chip sets, peripheral controllers and a full array of design tools. With widespread industry support now a reality, PC designers now have available all the resources they need to make USB technology a key selling feature of PCs shipping in the second half of 1996.

> **"…what's going to drive the implementation of USB is the volume of the PC industry. If we can get a modest part of the PC industry focused on USB, we're talking about tens of millions of units per year."**
>
> **Michael Slater**
> **USB Developers Conference**
> **September 1995**

USB ADVANTAGES

The USB specification offers numerous significant advantages for original equipment manufacturers (OEMs) and independent hardware vendors (IHVs):

- USB provides one industrywide plug and play specification that takes the guesswork out of expanding PC functionality.

- It allows virtually unlimited PC expansion "outside the box."

- Peripherals are now simpler to design and manufacture, because system intelligence resides in the PC host.

- Without the investment in expansion cards, the net cost of implementing new peripheral products can be substantially lower. Universal compatibility eliminates much of the cost of testing and validation of varying PC-peripheral-software combinations, while accelerating time-to-market.

- USB is the direct connection to a world of exciting new multi-user game applications.

- The elimination of proprietary add-in cards provides a single standard for telephony application developers to build on.

- Because USB is a universal industry standard, it allows OEMs, IHVs and software suppliers to eliminate many of the marketing risks traditionally associated with bundled combinations of peripherals, software and PCs.

HOW USB WORKS

USB derives its intelligence from the Pentium® processor or Pentium Pro processor-equipped host PC, which enables the bus to sense when peripheral devices are attached or detached.

When a peripheral is added, the USB controller automatically determines the needed driver software and bus bandwidth resources and then makes them available, all without user intervention. Because USB employs a "one-size-fits-all" industry-standard connector and socket interface, users no longer need to worry about matching cables and expansion ports. For manufacturers, the hardware standard saves system real estate, while helping to reduce the desktop footprint of the PC.

The USB standard breaks the traditional logjam associated with the limited number of serial and parallel expansion connectors or PC card slots available for port expansion. With USB, peripherals can act as hub devices so only one peripheral device must be plugged directly into the host PC. Selected peripherals, or a stand-alone USB box, can be used as an expansion hub.

- Users can simultaneously connect as many as 127 daisy-chained devices. Peripheral connections may be up to five meters in length.

- USB cable distributes power to low-power devices.

- Built-in +5-volt power distribution eliminates the need for AC power supply boxes for low/bus-powered devices.

- Data transfer rate of 12Mbits/second supports a wide variety of desktop peripherals, from modems, printers, microphones and speakers to graphics tablets, game controls, joysticks, scanners, monitors and digital cameras.

- Low-speed 1.5 Mbit/second option supports low-end, low-speed devices such as keyboards and mice for further cost reduction.

NEW MARKETING OPPORTUNITIES

Designed with future generations of PCs in mind, USB opens the door to a wide range of new applications including digital audio and high bandwidth telephony. Significantly, the universal compatibility of USB takes much of the risk out of bundled product offerings, enabling OEMs and IHVs to create innovative combinations of PCs, peripherals and software that meet the needs of targeted market segments. The USB specification simplifies the compatibility test and validation process of different hardware and software combinations, so manufacturers can develop early market segment share and more quickly respond to emerging markets.

USB technology will make a particularly valuable contribution in the area of PC telephony. For large business, as well as small office/home office users, USB architecture enables easy connectivity to PBX and digital telephones—without proprietary expansion cards. USB bandwidth can support high-speed interfaces including ISDN, PRI, T1 and E1 and enables flexible compliance with country-specific telephony standards, again without add-in cards.

USB already enjoys wide-ranging and growing support throughout the PC, telecommunications and software industries.

The USB Implementers Forum was founded by Compaq Computer Corp., Digital Equipment Corp., IBM PC Co., Microsoft Corp., NEC, Northern Telecom and Intel Corp. and now includes more than 250 member companies. The Implementers Forum sponsors a variety of developers conferences, meetings and workshops. Details are available on the USB Implementers Forum Web site: **http://www.teleport.com/~usb** .

USB MARKET GROWTH

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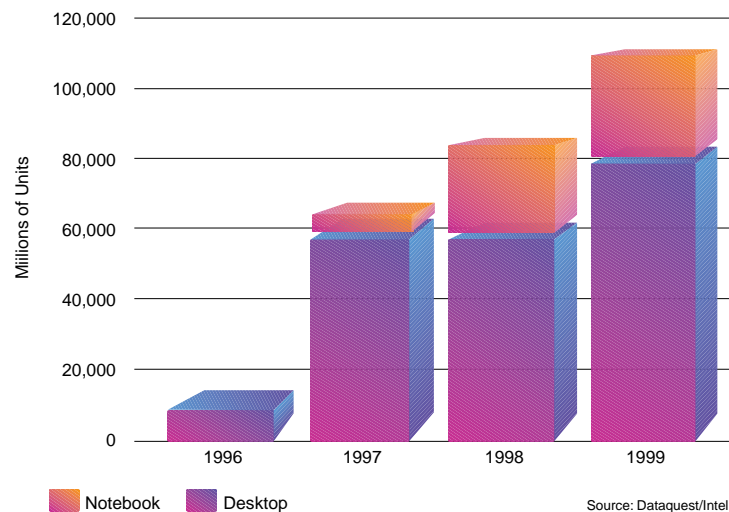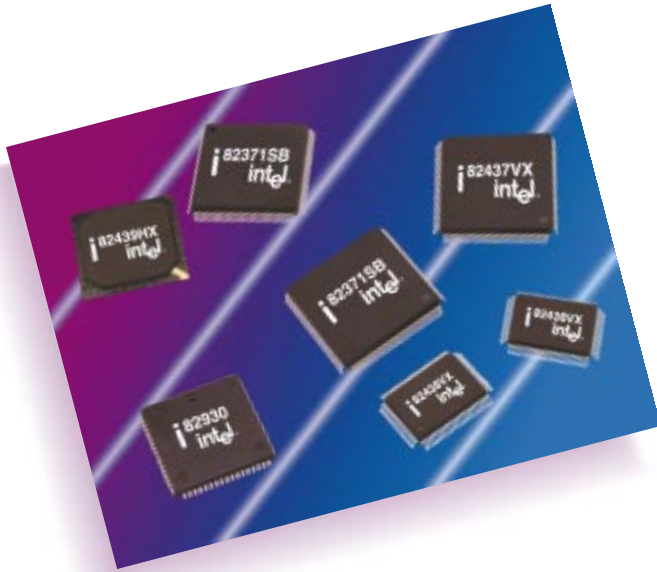
INTEL OFFERS COMPLETE SILICON SOLUTION

Intel is helping customers bring USB-capable PC platforms and peripherals to market quickly by shipping a complete silicon implementation of the USB1.0 specification. The elements include:

• The Intel 930 USB peripheral controller.

• The Intel 430HX and 430VX PCIsets for the Pentium processor.

• The Intel 440FX PCIset for the Pentium Pro processor.

• The USB Host System, USB 930 Evaluation Kit and USB Reference Designs.

The 930 USB controller is the industry's first USB-compliant controller chip and supports a wide range of peripherals with four data transfer modes:

• Control transfers for configuration, command and status information.

• Isochronous transfers for telephony and other time-critical data.

• Interrupt transfers to support joysticks, mice and keyboards.

• Bulk transfers for printers, scanners, and digital cameras.

The 930 USB controller is a high-performance 12MHz device with low power consumption, inherently low noise and a mix of onboard ROM and RAM. Onboard memory enables the chip to carry resident firmware for fast data access and minimal board space requirements. The device features four transmit FIFOs and four receive FIFOs to support higher-speed devices like telephony and imaging. In addition to the 12 Mbits/second primary data rate, the 930 controller supports a USB sub-channel rate of 1.5 Mbits/second for input devices such as keyboards and game pads. To make product development fast and easy, the 930 controller uses the same high-level programming and development tools as the Intel MCS® 51 and MCS 251 microcontrollers.

Intel further supports the USB standard with the first PCI chip sets to bring USB compliance to a host PC platform. System designers can choose from the two latest additions to the Intel 430 PCIset family—the Intel 430HX PCIset for business PCs, and the Intel 430VX PCIset for value-priced home and small business multimedia PCs. Both new PCIsets support the 100 MB/second performance of the PCI 2.1 standard and feature Intel's Concurrent PCI Architecture for enhanced multimedia performance, as well as built-in scalability for high-performance PC design.

Both the two-chip Intel 430HX PCIset and the four-chip Intel 430VX PCIset include a PCI USB host controller interface. Each PCIset also includes two USB ports connecting directly to two USB connectors

on the PC chassis without intermediate hardware. PCIset host controller circuits execute all host functions needed to connect USB peripherals, including supporting the 12Mbit/second data rate for each of the four transfer modes, as well as detecting and interrogating peripherals as they are connected with the bus.

For Pentium Pro processor-based applications, the Intel 440FX PCIset delivers a highly integrated 3-chip solution enabling cost-effective performance for mainstream desktop systems. What's more, USB will be supported by Intel's next-generation PCIsets, including enhanced multimedia performance and high-volume Pentium Pro processor designs.

END-TO-END DESIGN SUPPORT

Intel USB design tools and prototyping hardware offer design engineers the support they need to accelerate the time-to-market for USB-compliant PCs and peripherals. Tools for fast time-to-market include the USB Host System, USB 930 Evaluation Kit and Reference Designs for Intel 430HX, 430VX and 440FX PCIset-based systems.

The USB Host Platform offers developers a USB-compliant host platform including:

- A Pentium processor-based Intel 430HX PCIset system
- De-bug driver stack
- Software utilities
- Intel technical support

The USB 930 Evaluation Kit includes tools to speed the development of USB-compliant peripherals, including an evaluation board, schematics and *Ap*Builder software. USB platform Reference Designs help accelerate the design cycle. Components include:

- "Baby AT" design based on the Intel 430HX/VX PCIset
- USB connectors
- Reference schematics
- Gerber files

Information on Intel USB-compliant products and design tools is available on the Intel Web site: **http://www.intel.com.**

THE TIME IS RIGHT TO PLUG IN TO USB

Thanks to the functionality, flexibility and ease of use of the Universal Serial Bus, plug and play functionality "outside the box" is already a key selling feature for PCs due to ship in the second half of 1996. At the same time, USB is opening the door to significant new marketing opportunities for OEMs and IHVs. Industrywide momentum is now firmly established, and design tools and technical support are in place to help designers quickly implement USB-compliant products. Now is the right time to plug in to the benefits of USB.

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