

Intel and USB

Helping make it easier to connect devices to PCs

What is USB?

The Universal Serial Bus (USB) is the most successful interface in the history of personal computing. It has migrated heavily into mobile and consumer electronics (CE) segments and also met with great success there.

A serial bus standard for connecting external and internal devices to a computer, USB is designed to allow many peripherals to be connected using a single standardized interface socket. Intel helped develop the original USB standard and continues to contribute to its advancement.

USB improves "plug and play" capabilities by enabling hot swapping — the connection and disconnection of devices without rebooting the computer or turning off the device. Other convenient USB features include:

- Providing power to low power consumption devices so there's no need for an external power supply or battery charger
- Allowing devices to charge their batteries over USB
- Enabling many devices to be used without the installation of manufacturer-specific device drivers

Today USB is used to connect a wide range of computer peripherals, such as mice, keyboards, gamepads, cell phones, PDAs, printers, scanners, digital cameras and camcorders, personal media players, flash drives, and external hard drives. For these devices, USB is the most common connection method. As of 2008, there are 6 billion USB products in the install base and the industry is shipping more than 2 billion units per year — and this number continues to grow.

The problem

In the early 1990s, peripheral devices — such as scanners, printers, and PDAs — each had their own complicated installation procedure. At the same time, because of the power and popularity of the PC, more and more of these peripherals were being created. People needed a faster, easier, less frustrating way to connect these devices without having to add cards to the PC and reboot the system.

Industry collaboration

Seeing the problem both computer owners and device manufacturers were having because there was no uniform, consistent way to connect to the PC, Intel took action.

- Formed the USB Implementers Forum (USB-IF) in 1995 with other industry players to support and accelerate market and consumer adoption of USB-compliant peripherals. Today, USB-IF has more than 800 member companies, and the Board of Directors is comprised of representatives from Hewlett-Packard Company, Intel Corporation, LSI Corporation, Microsoft Corporation, NEC Corporation, and ST-Ericsson.
- Contributed technology from Intel Research and Development designed to enable higher speed connections and plug and play simplicity.
- Helped develop an open industry specification with a royalty-free intellectual property (IP) licensing obligation.
- Encouraged adoption of the specification by implementing it in Intel products (e.g., Intel released chipsets in May 2002 which integrated Hi-Speed USB 2.0 in the I/O Controller Hub, ICH4, and future versions of the I/O Controller Hub).
- Aided the rapid introduction of USB 2.0 by developing an Enhanced Host Controller Interface specification (EHCI) at Intel's own expense and made it available to the industry through a royalty-free licensing program. This specification provides a standardized method for USB 2.0 controllers to communicate with the USB 2.0 software stack. Using this specification, chipset manufacturers are easily able to develop hardware that can communicate with USB 2.0 system software in a standardized, consistent manner. This helps ensure compatibility among USB device implementations.
- Sped up implementation through "plugfests" — periodic opportunities for vendors to get together to test and demonstrate the compliance and interoperability of their products. The USB-IF currently holds over five plugfests yearly, both within the U.S. and internationally.

A short history of USB

The original USB 1.0 specification was introduced in 1996. In April 2000, an updated specification, USB 2.0, was approved. USB 2.0, also referred to as Hi-Speed USB, provides enhanced performance. With a design data rate of 480 megabits per second (Mbps), it is up to 40 times faster than USB 1.1. Hi-Speed USB won several awards, including PC Magazine's Technical Excellence Award in the specifications category and CNET's Best Emerging Technology Award at PC Expo.

In 2002, USB On-The-Go (OTG), a supplement to the USB 2.0 specification,

was created. USB OTG defines a dual-role device which can act as either a host or peripheral and can connect to a PC or other portable devices through the same connector. This gives portable computing devices such as handhelds, cell phones and digital cameras the additional capability to connect to other USB devices directly. This means users can perform such functions as sending photos from a digital camera to a printer, PDA, cell phone, or sending music files from an MP3 player to another portable player, PDA or cell phone.

Today USB 2.0 is a ubiquitous feature on all PCs and many devices that makes it much easier for users everywhere to connect everything from digital cameras to MP3 players. Devices are easier to install, can be disconnected and plugged back in freely without rebooting the system, and can be powered through their USB connection. Device categories include cell phones, PDAs, digital camcorders and still cameras, MP3 and video players, external DVD-RW's, CD burners, external storage devices, and advanced digital scanners and printers.

USB 3.0

Released in November 2008, the USB 3.0 specification provides performance increases to data transfer speeds and improved power efficiency, while retaining backward compatibility. People can still connect USB 1.0 and 2.0 devices through USB 3.0 ports on upcoming PCs and other devices. Much more exciting though is what happens when USB 3.0 compliant devices are connected to a USB 3.0 port using the new USB 3.0 cable. Performance is up to 10 times faster than USB 2.0. The commercial name for USB 3.0 is "SuperSpeed USB" and PC and devices using this specification should be available by 2010.

To fully appreciate what this speed increase means, consider what it does for common transfer tasks.

- One gigabyte (GB) of data can be transferred from a flash drive to a host device in just 3.3 seconds with USB 3.0. (The same data transfer using USB 2.0 takes 33 seconds — 10 times more time.)
- Transferring a 25GB HD movie from a portable USB device to a PC can be done in just 70 seconds with USB 3.0. (The same transfer takes 13.9 minutes using USB 2.0.)

Why is this speed increase so important? People today are creating and collecting more and larger media files and wanting to transfer them quickly from one device to another. USB 3.0's dramatic time savings on common tasks such as hard drive backups to external drives and off-loading large camcorder memory cards makes this possible.

How fast is SuperSpeed USB? Raw signaling rates of up to 5 gigabits per second (Gbps) are possible, though data overheads can reduce that to from about 3.5 to 4 Gbps. The protocol has been developed with an eye to the future though. It is designed to operate at up to 25 Gbps if the wire supports that data rate. Copper wire won't, but optical interfaces could.

Improved power management

The improved power management features of USB 3.0 are nearly as important as the tenfold speed jump. USB 3.0 drops device polling. This USB 2.0 feature would constantly check the bus to see if devices were attached and doing anything. This used unnecessary power. USB 3.0 uses instead an interrupt-driven architecture that ignores connected devices until they actually do something. This significantly lowers power consumption by allowing attached devices to go into a virtual sleep mode. It can be particularly helpful, for instance, when using a laptop under battery power, helping extend battery life when USB peripherals are attached.

Speeding adoption through an extensible host controller interface specification

To help accelerate the introduction of USB 3.0, Intel developed an extensible host controller interface specification (xHCI) at its own expense and made it available to the industry through a royalty-free licensing program. This specification provides a standardized method for USB 3.0 controllers to communicate with the USB 3.0 software stack. Using this specification, chipset manufacturers will be easily able to develop hardware that can communicate with USB 3.0 system software in a standardized, consistent manner. This will help ensure compatibility among USB device implementations.

Learn more

Find out more about [USB](#) on the [Intel website](#) www.intel.com/technology/usb/index.htm.

Visit the [USB Implementers Forum](#) site at www.usb.org.