

September 23, 2003

USB Uncovered

Breakthroughs, bottlenecks, and bits on the move

by Julie Govan

First, there was USB. And it was good! Especially when everyone had gotten rid of the old printers and mice that used serial and parallel connections. (Yes, for you arcane parallel fans — there *are* advantages to that type of connection, but right now we're focusing on USB.) People started making MP3 players and digital cameras that used USB to connect to computers, and they were nice and speedy.



USB 1.1 or USB 2.0? The jacks are the same, but the specifications are different. (Type A connector shown)

Then there was USB 2.0. And everyone (metaphorically) cheered, because original USB's data transfer rate had been outperformed by FireWire (IEEE 1394) for several years, and it was about time for a meaningful upgrade. Manufacturers were especially excited and a whole host of A/V peripherals — digital cameras, MP3 portables, and the like — appeared with the proud claim "USB 2.0 compatible!"

And then the questions began. Were those products USB 2.0-compatible, in that they took advantage of the faster transfer rates offered by USB 2.0? Or were they USB 2.0-compatible only in that USB 2.0 was backwards-compatible with *all* original USB devices?

As customers became puzzled, manufacturers tried to clarify, labeling gear as offering "Full-speed USB" — which sounded like USB 2.0, until you realized that "Hi-speed USB" was intended to mean 2.0.

Add into all this the fact that, unlike desktop PCs and laptops, "USB 2.0-compatible" peripherals aren't *required* to support the full specifications of the USB 2.0 standard, and you've got a lot of confusion.

Now, it's time to take a quick look at where USB started, what it does, and just what a USB 2.0-compatible portable or camera can reasonably be expected to offer.

Universal Serial Bus

That's what USB stands for. The first widely used USB standard, USB 1.1, was created by Compaq, IBM, Microsoft, NEC, Intel, DEC, and Northern Telecom to replace the existing serial and parallel connections used by the computer world. In 1996, manufacturers began offering systems that were USB-ready. The trend continued, and was solidified with the release of Windows 98 and the Macintosh release of Mac OS 8.6. Today, all Windows OSes, from 98 through XP, are USB-ready, as are all Macintosh OSes from 8.6 up.

A large part of USB's success lies in its support for "hot-swappable" operation (you can safely plug and unplug devices without turning off the devices or the computer) and the "Plug 'n' Play" feature that lets a computer intelligently query a connected device, see what type it is, and load the appropriate drivers. What all this means is that you can attach a new peripheral to a computer and have it work immediately, without puzzling over cryptic installation manuals or restarting the computer multiple times.

Original USB also has a top transfer speed of 12Mbps, making it significantly faster than a 115

Kbps serial connection, and generally much faster than parallel. Other benefits, more meaningful to PC gurus than to the average home user, are USB's ability to send along small amounts of electrical power to peripherals, and the capacity for running over 120 devices through a single USB port simultaneously.

However, the IEEE 1394 standard (also known as FireWire, or i.LINK™) was also present, and it offered what was considered a lightning-fast data transfer rate of 400 Mbps. That kind of speed made it possible to transfer full-motion video from a camcorder, which USB couldn't do. It was just a matter of time before a faster USB standard was created.

April 2000: USB 2.0 arrives on the scene

If the PC world is a Western movie, USB 2.0 didn't really bust through the saloon doors with guns blazing. Not only did the townsfolk know it was coming, they also knew there wasn't much they could do with it — yet. True, computer and motherboard manufacturers started using USB 2.0 right away within their computers, but the trickle-down to peripherals was much slower. There's a major reason for that, which, at the suggestion of a very knowledgeable co-worker, I'm going to sum up as "bottleneck."

Basically, any computer process (for example, moving photos from the flash memory of a digital camera to the hard drive of your computer) will have one step that's the slowest link in the chain. If you remove that bottleneck by speeding up that link, then something else becomes the *new* limiting factor. The planning that went into creating the USB 2.0 standard was not necessarily immediately echoed by the makers of computers, portables, cameras, and the like. So it might be that your current computer's processing just isn't fast enough to make full use of that increased transfer speed. It might be that your player's hardware is the holdup. Regardless, it's factors like these that made USB 2.0 slower to appear in its full glory.

And it *is* glorious. USB 2.0 offers a top speed of 480 Mbps — that's 80 megabits per second faster than its rival, IEEE 1394, and *forty times faster* than USB 1.1.

USB 2.0 is also backwards-compatible with USB 1.1 — it has the same kind of plug, and can transmit at 1.5 Mbps and 12 Mbps as well as 480 Mbps. It means, among other things, that you will be able to plug a new USB 2.0-capable MP3 player into your computer's old USB 1.1 port, and it'll operate without a hitch. You won't get transfer speeds of 480 Mbps, of course, but you'll be able to use that new portable with your old computer — and when you decide to upgrade your PC, you'll be able to get the full benefits!

An important clarification

USB-IF, the forum that maintains the USB standard, went ahead and officially changed the names of both USB 1.1 and USB 2.0 to, respectively, "Full-speed USB" and "Hi-speed USB." In fact, USB-IF prefers that only those designations are used. However, perhaps because everyone had already heard of "USB 2.0," manufacturers have been slow to switch to the new naming convention, and inconsistent in their use of it. For the sake of simplicity, I'll stick with the numerical designations for the remainder of my discussion, obsolete though they may be.

So, everything has USB 2.0 now, right?

Well. Sort of. Let's put it this way: if your computer is USB 2.0-capable, and you buy a new digital music player or digital camera that claims to be USB 2.0-capable, you may start to see faster transfer rates than you used to. However, you may not see that much-touted transfer speed of 480 Mbps. And here's why.



Above, you'll see the logo for what most people call USB 1.1. Below, the logo for fancy new USB 2.0 (officially called "Hi-speed USB").



Take the 20GB Nomad Jukebox Zen hard-drive MP3 player, by Creative Labs. On the front of the box, it says "USB 2.0!" On the back of the box, it says, "Use the blazing fast transfer rate of USB 2.0, 10X faster than USB 1.1, to transfer your entire music collection and data files!" Isn't that great?

But wait, you say, something's wrong. Didn't I just read that USB 2.0 was forty, not ten, times faster than old USB 1.1?

Yes, you did. And it is. *Potentially*. But that's where the looseness of the requirements for peripherals comes in. Back on the first page, I commented on how "USB 2.0-compatible" peripherals don't always support the USB 2.0 standard fully. Because of this flexibility, you and I — average-Joe users of fun gadgets — both lose and win.

We lose because we are unlikely, at this moment in time, to buy an MP3 portable that can zoom data in and out at 480 Mbps. But we win because we can get portables that are noticeably faster than old USB 1.1, even if they don't live up to the full standard of USB 2.0. Ten times faster, for example, is a lot faster.

Looking ahead

So, does USB 2.0 look to be the undisputed king of high-speed connections for the foreseeable future? Actually, it's already got a challenger for the throne — FireWire 800 (IEEE 1394b). As the name suggests, FireWire 800 doubles the speed of old IEEE 1394, going from 400 Mbps to 800 Mbps (that's a transfer rate of about 100 MB, or megabytes, per second). That's pretty exciting, and very, very fast. But you don't need to go running out to replace all your gear with FireWire 800 gear just yet. Here's why:

- FireWire 800 is still quite expensive
- It's mostly available on external DVD drives
- It's not yet available on many peripherals, not even most DV gear
- It's not backwards-compatible with existing IEEE 1394 jacks

Realistically, PC users, with their traditional reliance on USB, and Mac users, with their tendency to embrace FireWire, will all be using *both* USB 2.0 and IEEE 1394b for the next several years. This really won't be another case of the Beta vs. VHS wars.

When it's time to buy gear

If you have a USB 2.0-capable computer, and want to make sure your next MP3 player or digital camera can transfer tunes or photos in seconds, how will you know just what the USB 2.0 capability of your new gear is? There's no one answer.

Some manufacturers abide strictly by the recommendations of USB-IF, and list all specifications carefully, while also including the appropriate logo on both the box and the product itself. Some have the information available if you call and ask. Some have tucked that info inside the manual, but clarified it nowhere on the box. The bottom line: it can be tough to tell, but even some USB 2.0-capability can make a noticeable difference in speed. And don't forget — even if your gear has full 2.0-compatibility, the speed you see may be affected by limitations in your computer's processing!

Julie Govan is the Home A/V Editor of CrutchfieldAdvisor.com