

Connecting Thunderbolt Devices

Connecting external devices to a computer has always suffered from two problems: speed (or lack thereof) and convenience (or lack thereof). The speed issue is an ancient one, and interface designers have been slowly increasing the pace at which various technologies transfer data. For example, USB has gone from a pokey transfer rate of 12 megabits per second (Mbps) in version 1.0, to 480 Mbps in 2.0, and 5 gigabits per second (Gbps) in 3.0. Similarly, FireWire has gone from 400 Mbps in FireWire 400 to 800 Mbps in FireWire 800.

The convenience issue is more complex:

- **Compatibility.** Although newer interface standards are usually backward-compatible with earlier standards, devices designed for the old standard often require an adapter. For example, adding a FireWire 400 device to a FireWire 800 port requires a FireWire 800-to-400 adapter cable.
- **Connections.** Interface connections can be maddeningly inconsistent. USB is the main villain here, with legions of different device-side connectors, including Micro, Mini, Standard-A, Standard-B, and so on.
- **Driver support.** Device driver support can be shaky, particularly with newer technologies. For example, USB 3.0 devices often lack the drivers required to take full advantage of the interface's new features.
- **Port availability.** This can be problematic, depending on the computer. This is particularly true on the MacBook Air, which includes just two USB ports and no FireWire ports. On many computers, particularly notebooks, if you need to connect multiple external devices, you often need to use a hub.

Compare all this with the current state of the art in *internal* device connections: PCI Express. This interface is widely used (all Macs, including MacBook Air, use PCI Express internally), it's blazingly fast (up to 16 Gbps), and device drivers are easy to come by.

The performance and convenience gap between internal and external connections has never been more of a concern because nowadays we're not just connecting keyboards and mice: We're adding peripherals such as external hard drives, RAID arrays, Ethernet cards, and video capture devices that scream for as much throughput as you can give them. What the world needs is an external device interface that's both super fast and super convenient.

Welcome, then, to the new world of Thunderbolt. Developed by both Intel and Apple, Thunderbolt effectively combines both PCI Express and Apple's Mini DisplayPort display technology (which I discuss in more detail in the next section):

- **Speed.** Thunderbolt offers two data channels, each of which supports 10 Gbps throughput.
- **Flexibility.** Thunderbolt supports not only data transfer components such as hard drives and video capture devices, but also high-resolution displays.
- **Compatibility.** A Thunderbolt port is the same size and shape as a Mini DisplayPort (see Figure 1.1), so devices designed for Mini DisplayPort, such as the Apple LED Cinema Display, can plug right in. Similarly, adapters designed to work with Mini DisplayPort, such as adapters for DVI and VGA displays, will still work with Thunderbolt ports. Unfortunately, devices designed for Thunderbolt will not work with Mini DisplayPort connectors.
- **Connections.** Thunderbolt supports *daisy-chaining*, which means a single port can support multiple devices, up to six at a time. This works because many Thunderbolt-compatible devices come with multiple Thunderbolt ports. For example, take a look at the rear of the Promise Pegasus R4 RAID storage unit, shown in Figure 1.2. As you can see, it includes two Thunderbolt ports. This means you can run a Thunderbolt cable from your Mac to the device, and then run a second cable from the other Thunderbolt port to another device.



Thunderbolt port

1.1 The latest version of the MacBook Air comes with a Thunderbolt port for connections to external displays and other devices.



1.2 Many Thunderbolt devices come with two ports, so you can daisy-chain multiple Thunderbolt devices to your MacBook Air without requiring a hub.