TECH —

The technology inside Apple's $50 Thunderbolt cable

Using Thunderbolt peripherals so far requires a rather expensive cable that is ...

CHRIS FORESMAN - 6/29/2011, 4:00 PM

The first Thunderbolt compatible peripherals—Promise's Pegasus RAIDs—started shipping on Tuesday. Using the RAIDs with a Thunderbolt equipped Mac, though, requires a rather expensive $50 cable that is only available from Apple. We dug into the design of the cable to find out why Apple felt justified in charging $50 for some plastic-wrapped copper wire, and why Thunderbolt may have a hard time gaining traction outside of the higher-end storage and video device market—a fate similar to Apple's FireWire.

Promise's RAIDs do not come supplied with a Thunderbolt cable. Instead, users are directed to buy a Thunderbolt cable directly from Apple, which costs $49 for two-meter length. We contacted Promise to find out why a Mini DisplayPort cable could not be used in its stead, since the Thunderbolt port is based on Mini DisplayPort. A support technician told Ars that Apple's cable is a "smart" cable that "has firmware in it."

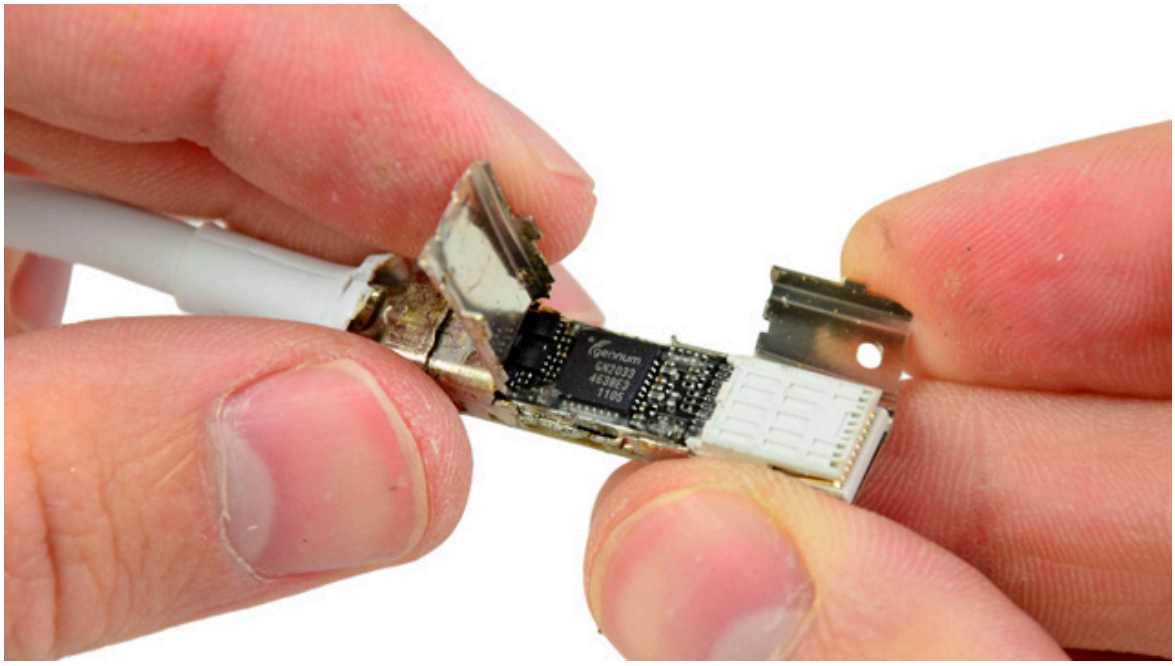
Intel confirmed that Thunderbolt requires specific Thunderbolt cables. "Only Thunderbolt cables can be used to connect Thunderbolt products using Thunderbolt connectors," Intel spokesperson Dave Salvator told Ars. "The cables have been designed for the 10Gbps signaling as well as power delivery that are part of Thunderbolt technology."

Active cabling required

Apple didn't respond to our requests for further information about the "firmware in the cable," but an EETimes article from earlier this year noted that in addition to having different electrical characteristics from Mini DisplayPort, Thunderbolt also uses active cabling to achieve full duplex 10Gbps transmission.

A source within the telecom industry explained to Ars that active cables are commonly used at data rates above 5Gbps. These cables contain tiny chips at either end that are calibrated to the attenuation and dispersion properties of the wire between them. Compensating for these properties "greatly improves the signal-to-noise ratio" for high-bandwidth data transmission.

Our friends at iFixit made a trip to a local Apple Store to find out what hardware powers Apple's Thunderbolt cable. CEO Kyle Wiens told Ars that Apple's cable contains two Gennum GN2033 Thunderbolt Transceiver chips to facilitate Thunderbolt's blazing speed.



Each Apple Thunderbolt cable includes a Gennum GN2033 Thunderbolt Transceiver inside the plug at each end.

"Unlike ordinary passive cables that can be used at lower data rates, the unprecedented speed of the new Thunderbolt technology places unique demands on the physical transmission media," according to Gennum's website. "The GN2033 provides the sophisticated signal boosting and detection functions required to transfer high-speed data without errors across inexpensive Thunderbolt copper cables."

Our telecom source noted that Intel made an unusual choice in also using active cabling for future optical-based iterations of Thunderbolt. Passive cabling is more common, but active cabling could offer some advantages. For one, active cables could combine fiber optics with electrical cabling for power transmission. Another good reason to use active optical cables, according to our source, "is that your current electrical ports can be forward compatible with future optical cables."

So far, though, Apple is the only supplier for Thunderbolt cables. Though Gennum is already highlighting its Thunderbolt transceiver chips, Intel would not say when official specs would be released to other manufacturers, or when other suppliers might be able to offer compatible cabling.

FireWire II: Thunderbolt Boogaloo?

The unfortunate side affect of all this is that if you are interested in using Thunderbolt-compatible peripherals—including RAIDs, hard drives, and video I/O devices coming soon—you'll have to buy a $50 cable from Apple for each device. Without additional suppliers, that could lead to trouble in gaining wider adoption for the standard in the industry.

The situation is not unlike the one that plagued FireWire in its early days. Designed by Apple and featured on its own computers, the original FireWire 400 standard offered significant speed improvements over USB 1.1, could supply more power to peripherals, and used an architecture that allowed any FireWire device to communicate with another, making it possible to forgo the need to connect both devices to a host computer.

Despite these benefits, FireWire cost more to implement on a device because it required a separate controller chip in each device. And though Apple turned over the FireWire standard to standards body IEEE, the company originally required additional licensing fees to use the FireWire trademark and logo. This made USB a more attractive, less expensive alternative for device makers.

Apple later relaxed the licensing fees, but an alternate 4-pin, non-powered version of FireWire—dubbed "IEEE 1394" and branded as "i.Link" by Sony—had already begun to gain wide adoption. USB 2.0 improved speeds to be more competitive with FireWire 400, while retaining its cost advantage. A faster FireWire 800 standard emerged, but used an entirely new 9-pin connector that required adapters to use with 6-pin FireWire 400 devices or 4-pin IEEE 1394 devices.

The combination of non-compatible plugs and added cost meant that FireWire ended up being largely confined to high-speed storage and the burgeoning digital video and digital audio industries.

As mentioned previously, the devices featuring Thunderbolt that have been announced so far include a variety of high-performance storage and mobile video I/O devices. Thunderbolt's high bandwidth and low latency are perfect for these applications. But Thunderbolt's high cost in terms of the necessary controllers and relatively expensive active cabling could limit its expansion to the broader market.

Furthermore, Intel only mentioned two vendors aside from Apple who were considering adopting Thunderbolt when it announced the technology earlier this year: HP and Sony. HP ultimately decided it wouldn't be adopting Thunderbolt in its computers any time soon. Sony has announced a new Vaio Z laptop that incorporates Thunderbolt controllers from Intel, but uses a proprietary optical connection via a specially modified USB3 port. That port can connect to a special discrete GPU-equipped docking station that won't be compatible with standard Thunderbolt peripherals.

Thunderbolt may be capable of some impressive speeds, but Apple and Intel run the risk of the technology quickly becoming a dead end if Apple remains the only vendor for Thunderbolt-equipped computers as well as Thunderbolt cables. Greater third-party support will be the key to the broad market adoption needed to support Thunderbolt in the years to come.

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