

## FireWire and Thunderbolt a Natural Fit

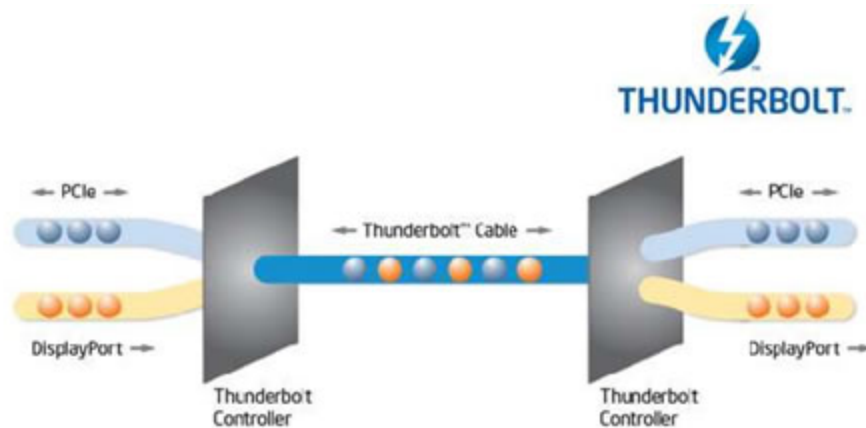
By Richard Mourn, Director Systems Engineering, Dap USA Inc.

FireWire™ and Thunderbolt™ have much in common, IEEE-1394 (FireWire) was the brainchild of Apple Computer and provided a revolutionary new I/O technology. Originally designed to consolidate I/Os like Apple's Desktop Bus (ADB) and Small Computer System Interface (SCSI), FireWire provided unprecedented speed and complete power, along with a plug-and-play, memory mapped and peer-to-peer architectures. FireWire connectivity enabled the consumer external hard disk drive market including the now famous iPod. Additionally, FireWire was the first high-speed real-time digital I/O enabling the transition from analog to digital audio/video with products like DV camcorders, Set Top Boxes and IIDC cameras.

Similarly, Thunderbolt as an emerging new technology is targeted at I/O consolidation. In the case of Thunderbolt Apple wasn't the primary inventor, Intel Labs was, however Apple was the first to deploy Thunderbolt via Mac computers.

While Thunderbolt isn't the first technology to make I/O consolidation claims, Thunderbolt appears to have the bandwidth and plug-and-play features to make a go of it. At the same time the laptop, tablet and smart phone markets appear ripe for a standardized high speed I/O and with external expansion interfaces such as ExpressCard and eSATA quickly disappearing Thunderbolt's timing may just be perfect.

Providing 10 Gbps of full-duplex bandwidth per channel Thunderbolt concurrently supports PCI Express and DisplayPort connectivity over a single cable. Combining two existing technologies (PCI Express and DisplayPort) through the Thunderbolt transport layer allows for quick adoption of this technology by enabling the use of native protocol software driver support.



*Picture courtesy of Intel Corporation*

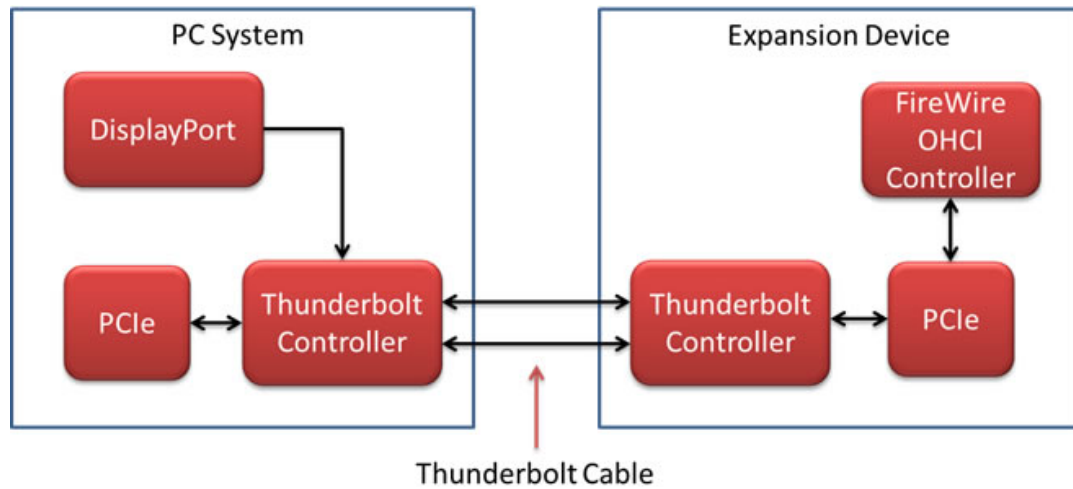
With more than two billion FireWire devices already shipped by 2011<sup>1</sup> and more shipping and being developed each day, it is important to understand how FireWire devices will connection via Thunderbolt if its promise of I/O consolidation takes place; currently all Macs, except for the MacBook Air, support both FireWire and Thunderbolt.

### Connecting FireWire to Thunderbolt

Thunderbolt technology maps both PCI Express and DisplayPort onto a single meta-protocol which allows the information from both to be transmitted and received across a single cable. This mapping architecture allows devices connected through Thunderbolt to appear as though they are directly connected to the host PC through PCI Express or DisplayPort.

PCI Express based FireWire host controllers are widely available today in both standard PCI Express and ExpressCard form factors. Additionally, Mac OS, Windows, Linux and many embedded operating systems as well as multiple proprietary and third-party stacks provide native IEEE-1394 support for many different types of products like HDD, DVD, CDROM and tape drives, flash drives, camcorders, IIDC cameras, industrial controllers, IP1394 plus many more. Thunderbolt preserves the huge software investment made of over the past 15+ years by keeping backward compatibility through PCI Express.

Thunderbolt based expansion devices (docks) provide PCI Express, ExpressCard as well as native FireWire support allowing all devices that typically connect to a FireWire host controller to do so over Thunderbolt without any changes. The figure below shows a block diagram of a Thunderbolt enabled PC host connected to an expansion device with a FireWire OHCI controller connected to a standard PCI Express controller.

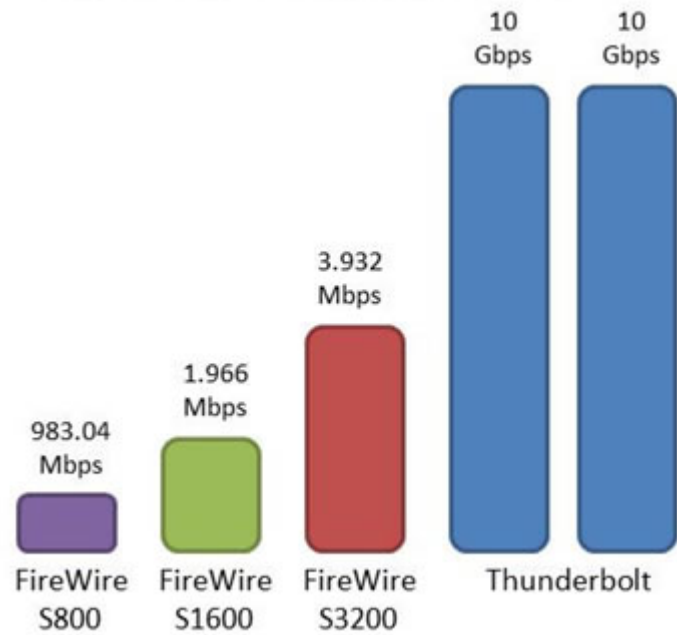


*FireWire connected to PC Host through Thunderbolt expansion device*

### **FireWire and Thunderbolt Performance**

Driven by the industrial vision market, FireWire S1600 (1.966 Gb/s) and S3200 (3.932 Gb/s) host and device implementations became available in the past year. The need for higher resolution imaging and the desire to connect more cameras to a single network make the FireWire and Thunderbolt combination even more attractive. Just like FireWire, Thunderbolt technology was designed with audio and video applications in mind with inherently low latency and highly accurate time synchronization capability.

## FireWire and Thunderbolt Performance



In the past most FireWire hosts implemented parallel PCI or PCIe x1. FireWire S3200 is simply too fast for PCIe x1 therefore PCIe x4 will be required. Fortunately most expansion devices are expected to implement PCIe x4 as it provides roughly the same throughput as a single Thunderbolt channel. This will allow two FireWire S3200 devices to connect to Thunderbolt with both able to realize their full bandwidth capabilities.



*Belkin Thunderbolt Express Dock with FireWire S800*

FireWire and Thunderbolt have much in common; both were developed with I/O consolidation mind, both inherently support real-time audio and video applications and Apple played a strategic role in the development and deployment of both technologies. Thunderbolt combines two fundamental I/Os, PCI Express and DisplayPort over a single cable and as such provides connectivity for legacy

interfaces such as FireWire with no changes required. Therefore it is no wonder that Thunderbolt is ideally suited to support the 2 billion FireWire device already deployed and millions more that will be sold in the years to come.

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FireWire is a trademark of Apple Inc.*

#### REFERENCES:

<sup>1</sup> 1394 Trade Association [Press Release](#), January 10, 2011.