Thunderbolt vs. USB 3.0

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Agenda

- History of USB
- USB Generations
- USB Specifications
- History of Thunderbolt
- Thunderbolt Technology
- Performance Comparison
- Security Issues
USB
History of USB

- Universal Serial Bus (USB) is designed to allow many peripherals to be connected using a single standardized interface.

- A group of seven companies began the development of USB in 1994: Compaq, DEC, IBM, Intel, Microsoft, NEC, and Nortel.
USB Generations

**USB 1.0**

- Released in January 1996. USB 1.0 specified data rates of 1.5 Mbit/s (Low-Bandwidth) and 12 Mbit/s (Full-Bandwidth).
- Did not allow for extension cables or pass-through monitors, due to timing and power limitations.
- These issues were addressed in USB 1.1, which was released in August 1998.
- USB 1.1 was the earliest revision that was widely adopted.
- USB 1.x connectors were usually colored white.
USB Generations cont'd

**USB 2.0**
- Released in April 2000.
- The major feature of revision 2.0 was the addition of a high-speed transfer rate of 480 Mbit/s.
- USB 2.0 connectors were usually colored black.

**USB 3.0**
- Released on November 17, 2008.
- It brought significant performance enhancements to the USB standard while offering backward compatibility with the peripheral devices.
- Signalling speed improved up to 5 Gbit/s.
- Due to encoding overhead, usable data rate moved up to 4 Gbit/s.
- A USB 3.0 port is colored blue and it is also backward compatible with USB 2.0.
USB Generations cont'd

USB 3.1

- Released on 31 July 2013.
- Introduced a faster transfer mode called “SuperSpeed”.
- Signalling rate increased up to 10 Gbit/s.
- The USB 3.1 standard is backward compatible with USB 3.0 and USB 2.0.
USB Specifications

- Communication is based on a series of “Pipes” or logical channels that transfer data at a fixed rate.
- Three types of data transfers:
  - Isochronous - Real-time Audio/Video
  - Interrupt - Keyboard / Mouse
  - Bulk - File Transfers
- Class codes determine device driver utilization
- Twisted-pair copper wire connection up to 5 meters.
USB Specifications Cont’d
Thunderbolt
History of Thunderbolt

- Thunderbolt is a hardware interface that allows for the connection of external peripherals to a computer. It uses the same connector as Mini DisplayPort (MDP).

- Introduced by Intel in 2009 codenamed: “Light Peak.”

- Early prototypes were shown at Intel Developer Forum in 2010.
History of Thunderbolt Cont’d

- Released in Feb 24, 2011.

- Thunderbolt 1 was developed by Intel. It was commercially introduced on Apple's 2011 MacBook Pro.

- Thunderbolt 2 released on Apple’s Retina Display MacBook Pro in late 2013.
Thunderbolt Technology

- Combines PCI Express and Display Port into duplex connection.
- Active cable design improves data speeds with embedded chipset.
- Optical (100m max) vs. Copper medium (10m max)
- Daisy chainable up to 6 devices.
Thunderbolt Technology Cont’d
Thunderbolt Technology Cont’d
Thunderbolt Technology Cont’d

Two ways to interface with Thunderbolt controller on host system. (Markup by Tom’s Hardware, Andrew Ku)
Performance

**USB 3.0**
- 5 Gigabits per second transfer speed
- 10 Watt power dissipation

**Thunderbolt 1**
- 10 Gigabits per second, dual channel
- 10 Watt power dissipation
Performance Cont’d

USB 3.1
- Boasts speeds up to 10 Gigabits per second.

Thunderbolt 2
- Single logical 20 Gigabits per second channel.
Performance Cont’d
## Performance Cont’d

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<thead>
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<th>Write 10GB file</th>
<th>Read 10GB file</th>
<th>Write 10GB folder</th>
<th>Read 10GB folder</th>
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<th>AJA Read</th>
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Best results in **Red**. All results are in MBps (megabytes per second).
Security

USB
● Driver Vulnerabilities
● Buffer Overflow Attacks
● Key Vulnerabilities

Thunderbolt
● DMA Attack vulnerability
● Inception Vulnerability toolkit:
  http://www.breaknenter.org/projects/inception/
Conclusion