

Thunderbolt vs. USB 3.0

by: Michael Dushkoff and Irtaza Ahmed

Agenda

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

USB



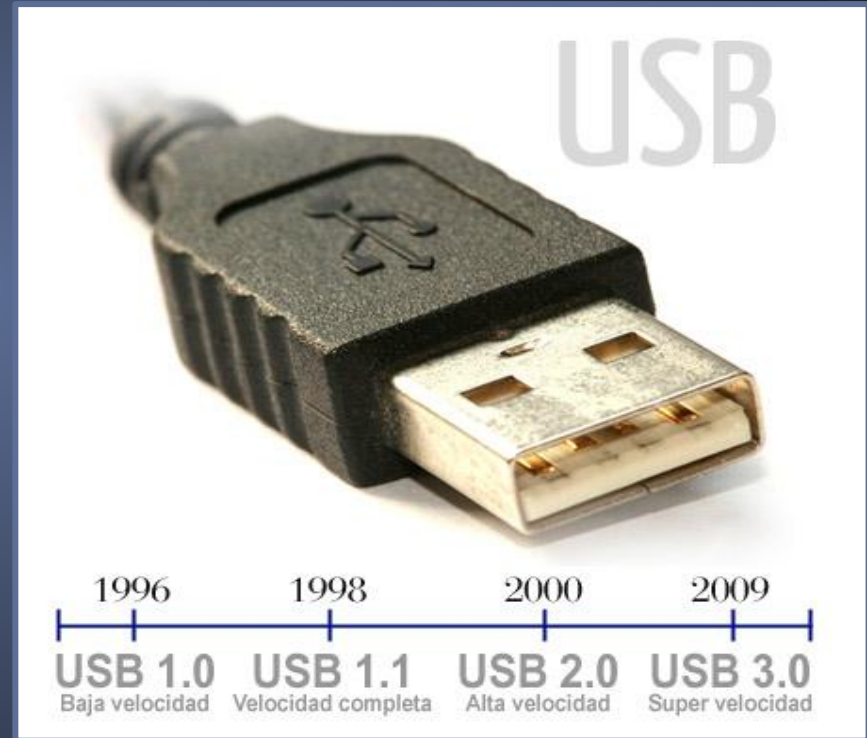
History of USB

- **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.

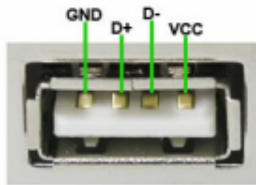


USB Specifications

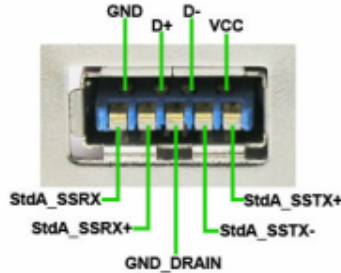
- Communication is based on a series of “Pipes” or logical channels that transfer data at a fixed rate.
- Three types of data transfers:
 - Isochronous - Real-time Audio/Video
 - Interrupt - Keyboard / Mouse
 - Bulk - File Transfers
- Class codes determine device driver utilization
- Twisted-pair copper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

USB Specifications Cont'd

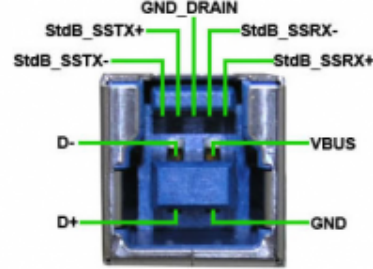
Hi-Speed USB 2.0 A plug pinout



SuperSpeed standard A plug pinout



SuperSpeed standard B plug pinout



BY: AIR T



USB 2.0 A
plug pinout



USB 3.0 A
plug pinout



USB 3.0 micro-B
plug pinout



USB 3.0 B
plug pinout

Thunderbolt



THUNDERBOLT™



History of Thunderbolt

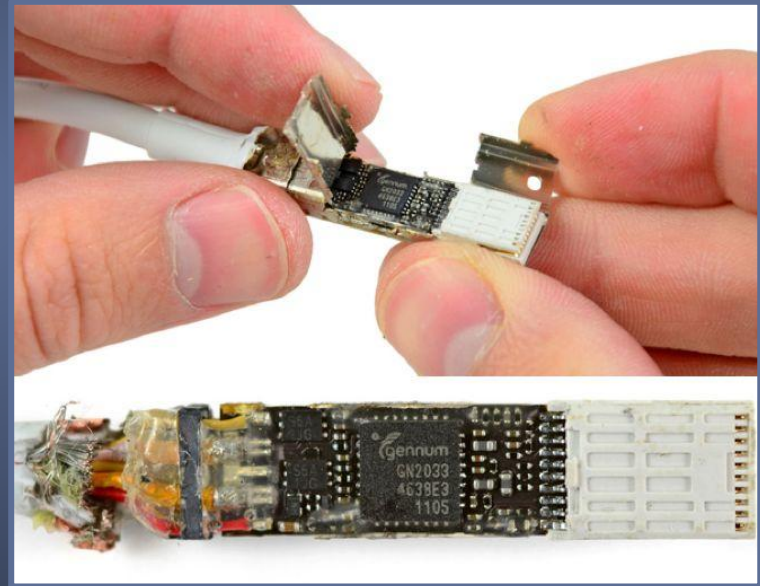
- Thunderbolt is a hardware interface that allows for the connection of external peripherals to a computer. It uses the same connector as Mini DisplayPort (MDP).
- Introduced by Intel in 2009 codenamed: “Light Peak.”
- Early prototypes were shown at Intel Developer Forum in 2010.

History of Thunderbolt Cont'd

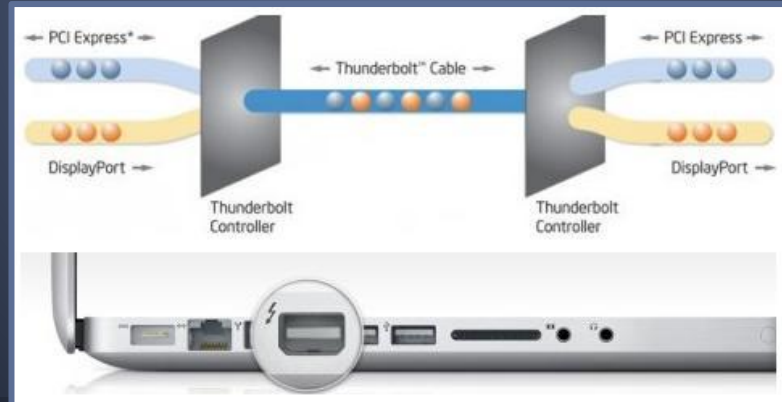
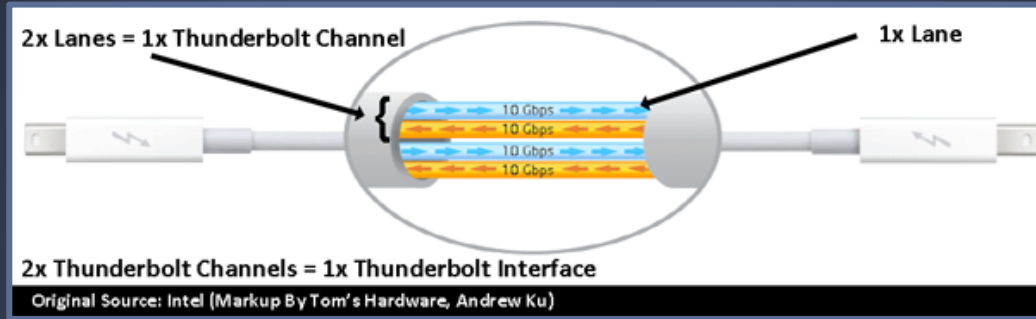
- Released in Feb 24, 2011.
- Thunderbolt 1 was developed by Intel. It was commercially introduced on Apple's 2011 MacBook Pro.
- Thunderbolt 2 released on Apple's Retina Display MacBook Pro in late 2013.

Thunderbolt Technology

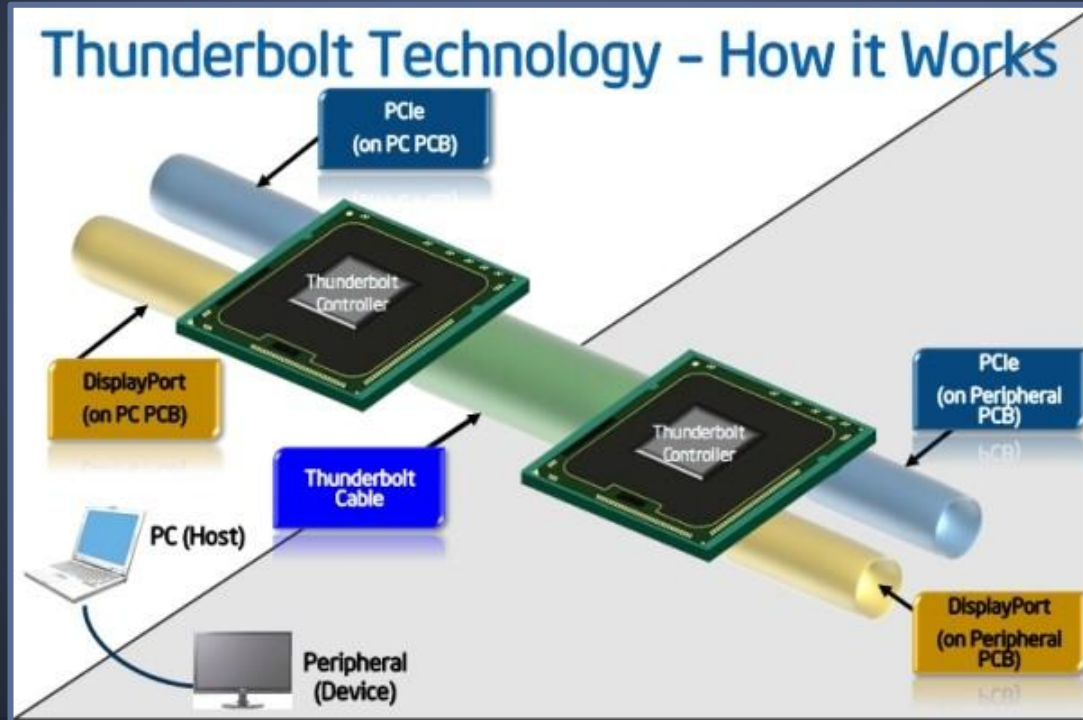
- Combines PCI Express and Display Port into duplex connection.
- Active cable design improves data speeds with embedded chipset.
- Optical (100m max) vs. Copper medium (10m max)
- Daisy chainable up to 6 devices.



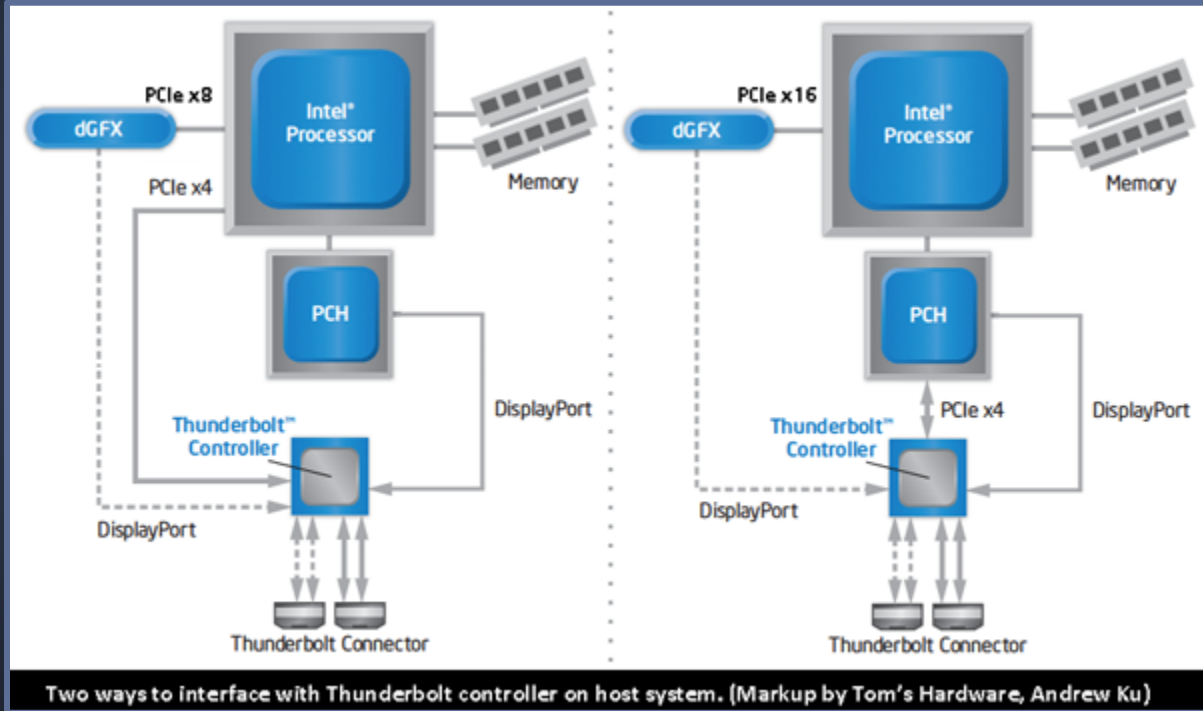
Thunderbolt Technology Cont'd



Thunderbolt Technology Cont'd



Thunderbolt Technology Cont'd



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

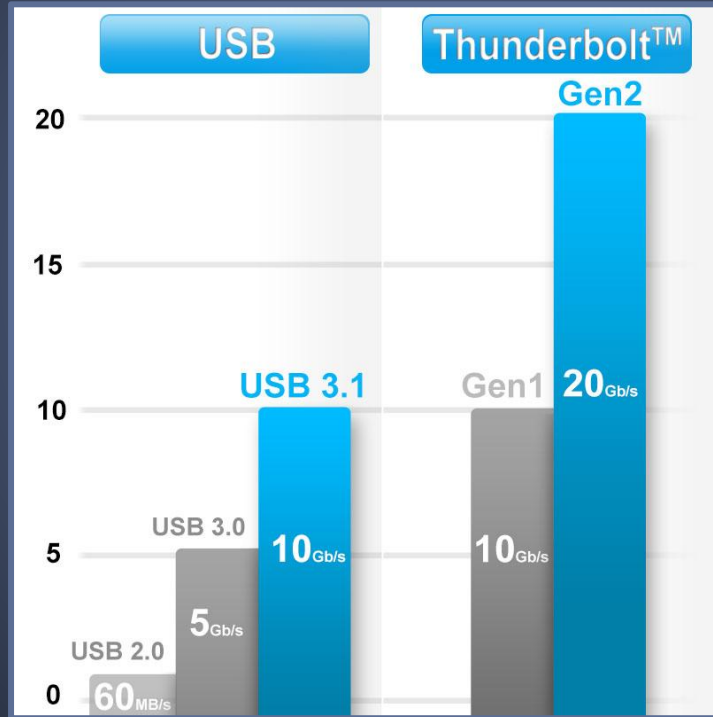
USB 3.1

- Boasts speeds up to 10 Gigabits per second.

Thunderbolt 2

- Single logical 20 Gigabits per second channel.

Performance Cont'd



Performance Cont'd

Hitachi 750GB 7200 RPM HDD	Write 10GB file	Read 10GB file	Write 10GB folder	Read 10GB folder	AJA Write	AJA Read
USB 2.0	35.4	40.6	35.1	39.5	38.2	39.8
USB 2.0 w/ Belkin hub	41	40.6	40.5	39.6	39.3	39.1
USB 2.0 w/ StarTech hub	41	40.6	40.6	39.7	38.9	38.7
USB 3.0	114.2	115	112.4	112.3	107.2	111.6
USB 3.0 w/ Belkin hub	114.2	114.5	112.7	112.3	106.1	111.6
USB 3.0 w/ StarTech hub	113.2	115.8	111.9	112.9	102.5	111.6
FireWire 800	58.3	74.5	55.12	72.3	59.5	72.3
Thunderbolt	112.9	115	110.8	111.9	105.6	110.6

Best results in Red. All results are in MBps (megabytes per second).

Macworld

Security

USB

- Driver Vulnerabilities
- Buffer Overflow Attacks
- Key Vulnerabilities

Thunderbolt

- DMA Attack vulnerability
- Inception Vulnerability toolkit:

<http://www.breaknenter.org/projects/inception/>

Conclusion

