



USB 3.0 Technology

Performance Advantage on HP Workstations

Purpose

This white paper is an introduction to USB 3.0 technology, and illustrates USB 3.0's capability to deliver the throughput needed for high bandwidth external I/O applications. USB 3.0 builds upon the USB ecosystem that is pervasive in the industry today, is extremely flexible, provides a robust Plug & Play experience, and can provide high data throughput to non-USB 3.0 devices thanks to interface adapters.

Introduction

As technology continues to evolve, the need for more bandwidth is becoming a requirement. High speed external storage devices, video capture, and high definition multimedia are prevalent in today's market. USB has become the dominating Plug & Play interconnect for PCs and it continues to grow. USB 3.0 "SuperSpeed" provides a significant performance increase over previous USB generations, making it the ideal solution for external connectivity. Unlike the single duplex USB 2.0 interface, USB 3.0 supports 5Gb/s full duplex. It also provides higher power, and is backwards compatible with USB 2.0.

USB 3.0 Benefits and Features

- Up to 10 times greater performance over USB 2.0.
 - 5Gb/s full-duplex providing up to 350MB/s throughput in current implementations
- More power for devices
 - 900mA per port (configured)
- Significantly improved power management.
 - Reduced active power during data transfers
 - Improved idle power management allows devices to drive the bus to lower power states.
- Backwards compatible with USB 2.0
 - USB 3.0 connectors are supersets of USB 2.0, containing both USB 3.0 and USB 2.0 signals
 - Robust Plug and Play operation. User can connect/disconnect devices without shutting down/restarting the system
 - Builds on existing USB 2.0 market ecosystem
- Up to 10 times faster than 1394a(400Mb/s), 6 times faster than 1394b (800Mb/s), and 1.5 times faster than eSATA (3Gb/s), making it the fastest industry standard external Plug & Play I/O available for personal computers

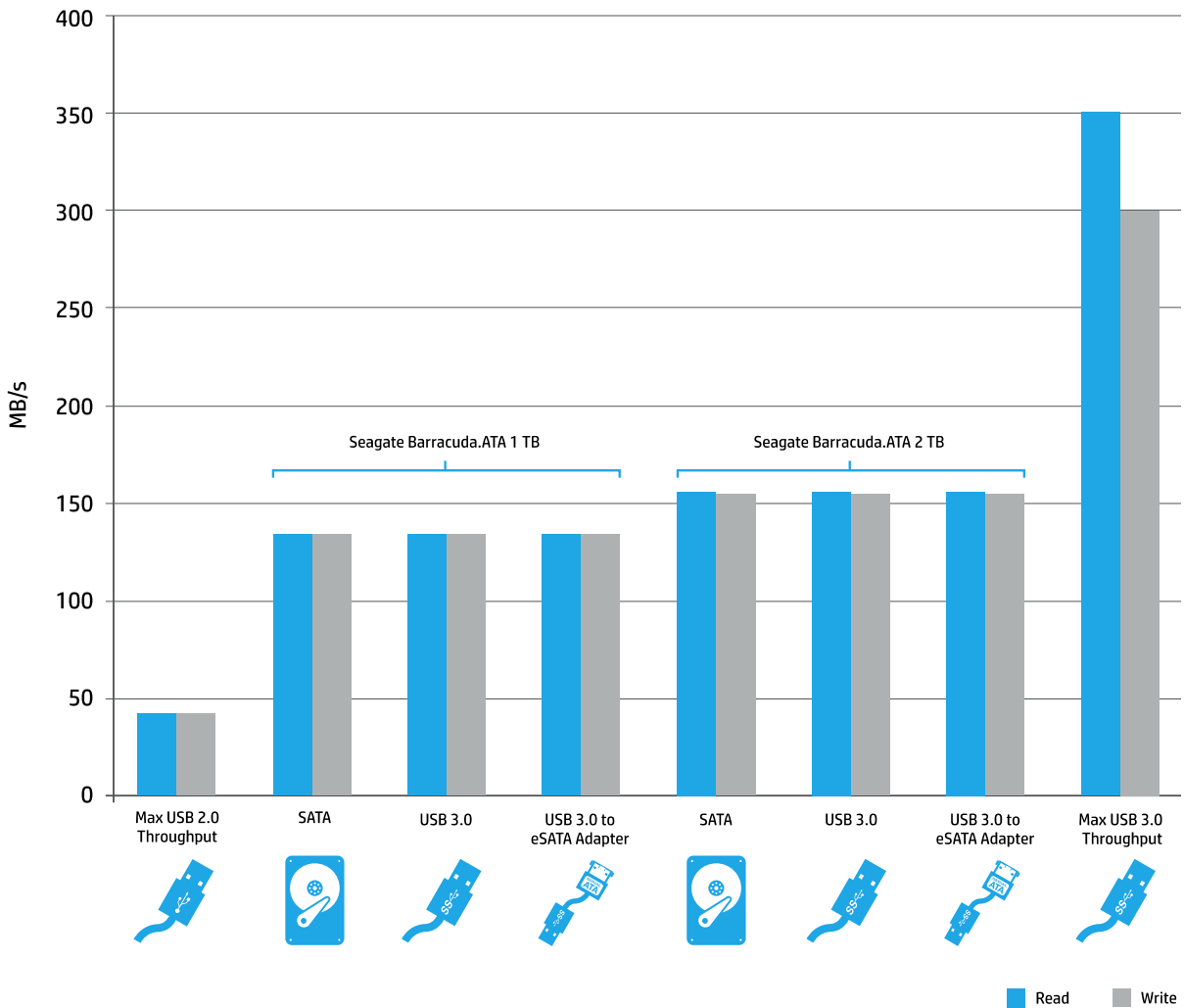
Performance

First generation USB 3.0 capable systems did not perform to USB 3.0's potential due to non-optimal implementations that limited the maximum throughput achievable. Current HP Workstations have been designed with at least a PCI-Express lane at 2.0 speed (5Gb/s) connected to the USB 3.0 controller, allowing it to perform at it's maximum throughput.

The chart below demonstrates how a typical SATA HDD (7200 RPM drive) will perform when connected to a native SATA port, a USB 3.0 port (external USB 3.0 enclosure), and a USB 3.0 to eSATA interface (external eSATA enclosure).

Performance testing illustrates that USB 3.0 can provide equivalent bandwidth when compared to current SATA and eSATA technologies. USB 3.0 can be used as an alternate interface to eSATA devices by using a USB 3.0 to eSATA adapter, and still preserve the device's data throughput. Actually, USB 3.0 can even provide greater bandwidth and scalability beyond eSATA's, with up to 350MB/s throughput on current systems. As USB 3.0 matures, further gains in overall performance and bandwidth should be expected.

File Transfer Results Comparison*



* Performance experiments were measured in 2012 HP Workstations.

Characteristics	USB 3.0	USB 2.0
Data Rate	SuperSpeed (5.0 Gbps)	Low-speed (1.5 Mbps), full-speed (12 Mbps), and high-speed (480 Mbps)
Data Interface	Dual-simplex, four-wire differential signaling separate from USB 2.0 signals. Simultaneous bi-directional data flows, i.e. full duplex	Half-duplex two-wire differential signaling Unidirectional data flow with negotiated directional bus transitions
Cable Signal Count	Six: Four for SuperSpeed data path Two for non-SuperSpeed data path	Two: Two for low-speed / full-speed / high-speed data path
Bus Transaction Protocol	Host directed, asynchronous traffic flow. Packet traffic is explicitly routed.	Host directed, polled traffic flow. Packet traffic is broadcast to all devices.
Power Management	Multi-level power management supporting idle, sleep, and suspend states. Link-, Device-, and Function-level power management.	Port-level suspend with two levels of entry/exit latency. Device-level power management
Bus Power	Same as for USB 2.0 with a 50% increase for unconfigured power and an 80% increase for configured power. Up to 900mA/port	Support for bus-powered devices with lower power limits for un-configured and suspended devices. Up to 500mA/port
Data Transfer Types	All legacy USB 2.0 transaction types (Control, Bulk Interrupt, Isochronous). With USB 3.0 bulk transactions support streaming (improved throughput).	Four data transfer types: control, bulk, interrupt, and Isochronous

Summary

As demonstrated herein, USB 3.0 is a compelling external I/O interface for high speed needs. It is up to 10 times faster than USB 2.0, provides more power, and also builds upon the already existing USB 2.0 ecosystem. Its full support on several generations of Windows and Linux operating systems, and its Plug and Play compatibility, make it a robust external solution across applications, markets and usage models.

USB 3.0 is substantially faster than other industry standard Plug & Play interfaces. SATA and eSATA devices can be supported without impacting performance by utilizing externals HDD enclosures and USB 3.0 to eSATA adapters. Other adapters, to such interfaces like 1394, Ethernet, Wireless, for instance, are also available.

It is expected that USB 3.0 will become a dominant device interface as it:

- provides up to 10 times the throughput of USB 2.0
- provides more power for self-powered USB devices
- is backward compatible with USB 2.0, thereby leveraging the large ecosystem of existing USB 2.0 devices. Many external hard drives now support both USB 2.0 and USB 3.0
- a robust Plug and Play interface, just like USB 2.0
- is supported on both Windows and Linux
- is ubiquitously available in 2012 personal computers
- and as USB 3.0 devices are becoming plentiful and readily available

Additional resources

hp.com/go/whitepapers

