Thunderbolt™ 3 Brings New Storage Performance Levels to Client Computers

Shailendra Sinha
Sr. Business Development Manager
Agenda

- Thunderbolt™ momentum
- Thunderbolt and USB4
- Thunderbolt storage benefits for key segments
- Wrap Up
Thunderbolt™ 3 Continuing to Gain Momentum

• Thunderbolt™ 3 continuing to accelerate across various product segments
  • Required in the Project Athena specification
  • Strongly recommended in Intel’s Creator PC initiative
  • Thunderbolt integrated into Ice Lake -Y/U (10th gen core processor)
• New Innovations such as hub and low cost and longer cables coming
Significant PC Growth

Thunderbolt™ 3 volume (Windows PCs)

Certified Thunderbolt™ 3 Hosts (Cumulative)

Tens of Millions of PCs shipping with Thunderbolt™ 3

Certified Hosts Steadily Growing
Great momentum continues
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Thunderbolt™ 3 GROWTH

THUNDERBOLT™ 3
Simply connect to any Thunderbolt, DisplayPort, USB-C, or USB peripheral device at up to 40Gb/s

OS SUPPORT
Windows 10
macOS
LINUX

INDUSTRY ADOPTION
PC and peripheral volumes continue to double every year

BRIGHT FUTURE
Intel is making today's Thunderbolt 3 available to everyone by releasing the protocol specification

Intel's upcoming "Ice Lake" CPU will be the first to integrate Thunderbolt 3

Announced Q1'19
Intel takes steps to release Thunderbolt™ everywhere, releases protocol
Press announcement on March 4, 2019

Intel is well on its way to making the innovation delivered with Thunderbolt™ 3 available to everyone.

Today, Intel announced that it contributed the Intel Thunderbolt protocol specification to the USB Promoter Group, enabling other chip makers to build Thunderbolt compatible silicon, royalty-free.

In addition, the USB Promoter Group announced the pending release of the USB4 specification, based on the Thunderbolt protocol.

The convergence of the underlying Thunderbolt and USB protocols will increase compatibility among USB Type-C connector-based products, simplifying how people connect their devices.
Thunderbolt™ Protocol Overview

Thunderbolt protocol is a high-speed transport that transfers data and video simultaneously:
- Bandwidth varies dynamically depending on the devices and applications
- Supports both daisy chain (up to 6 devices) and hub topologies

Intel contributed the Thunderbolt protocol to the USB Promoter Group as an open standard:
- The new standard is called USB4
Thunderbolt™ & USB4

- Many configurations of USB exist today on the USB-C connector - USB4 is expected to add to this list.

- USB4 will offer a menu of feature options that could span from phones to PCs to embedded applications.

- Thunderbolt will offer end-to-end solution capabilities, validation testing, and certification requirements focused on PC and peripheral device applications.

- Thunderbolt™ and USB4 are complementary and compatible since they share the same underlying CIO protocol.

1 USB4 branding is still under discussion, examples listed are possible branding options for USB4 specification.
Going Forward

Intel will continue to develop Thunderbolt™, even after the USB4 spec is released

- Intel and other industry leaders continue to innovate on Thunderbolt technology to deliver a leading connectivity solution, from silicon and cables to PCs and peripheral devices.
- Maintain higher bar for Thunderbolt product capabilities, ease-of-use, and quality; which is good for customers and their businesses.
- Thunderbolt end-to-end solution validation
  - Just-works interoperability
  - Solution enabling for computers, devices, cables vs. just ingredient.
- We expect Thunderbolt and USB to continue to co-exist as they do today.
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# Thunderbolt™ 3 Storage Benefits for Key Segments

<table>
<thead>
<tr>
<th>Category</th>
<th>Business</th>
<th>Media</th>
<th>Gaming</th>
<th>On the Go</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed</td>
<td>Speed up to <strong>2,850MB/s</strong> (PCIe Gen 3x4)</td>
<td></td>
<td></td>
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<tr>
<td>Capacity</td>
<td><strong>Standard 15W</strong> of bus power for larger capacity drives</td>
<td>Thunderbolt SSDs offer real-time extension to capacity limited PC</td>
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<tr>
<td>Compatibility</td>
<td><strong>Hundreds of millions</strong> of Thunderbolt™ 3 PCs in the next 1-2 years</td>
<td>Pro level quality - due to <strong>required</strong> host, device, and cable cert</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost</td>
<td>USB PD controllers and 40Gb/s cable <strong>costs continue to drop</strong></td>
<td><strong>Small cost adder</strong> when compared to the SSD cost</td>
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</tbody>
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*Based on Intel Internal Projections*
Thunderbolt™ 3 to 10GbE adapter ~$149 may accelerate 10GbE transition

Mainstream 10GbE for thin-and-light laptops can drive client and data center refresh for faster SSDs
Media Creation

Portable, desktop, compact flash, and NAS storage innovation is happening on Thunderbolt™ 3 and PCIe.

Manage large photo library created by widely available 4K phone cameras.

Quickly ingest and edit multi-stream uncompressed HD and 4K video.
Gaming

Keep entire gaming library on Thunderbolt™ 3 external SSD

Expand capacity of PC or Mac with Thunderbolt 3 external SSD, while maintaining the same performance as an internal SSD.

Record game play in 4K then post to Twitch or YouTube
On the Go

Offer Thunderbolt™ products using lower bin SSDs focused at mainstream segment, offering 3x SATA performance (1,500MB/s)

Drive brand awareness for your SSDs in mainstream channels

Convenient small form factor
Edge Computing

Large amount of sensor / video data at the edge can be quickly captured and accessed over Thunderbolt™

Verticals include consumers, healthcare, industrial, enterprise.
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Next Steps

- Become a Thunderbolt™ developer
  - Contact Shailendra Sinha at Intel shailendra.sinha@intel.com

- Work with existing Thunderbolt 3 ODM to improve time to market
  https://thunderbolttechnology.net/tech/odms

- Collaborate with industry on optimal M.2 configurations
  - Performance up to PCIe Gen 3 x 4 and Bus Power up to 15W
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