

# Thunderbolt™ 3 Brings New Storage Performance Levels to Client Computers

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Sr. Business Development Manager

# Agenda

- Thunderbolt™ momentum
- Thunderbolt and USB4
- Thunderbolt storage benefits for key segments
- Wrap Up

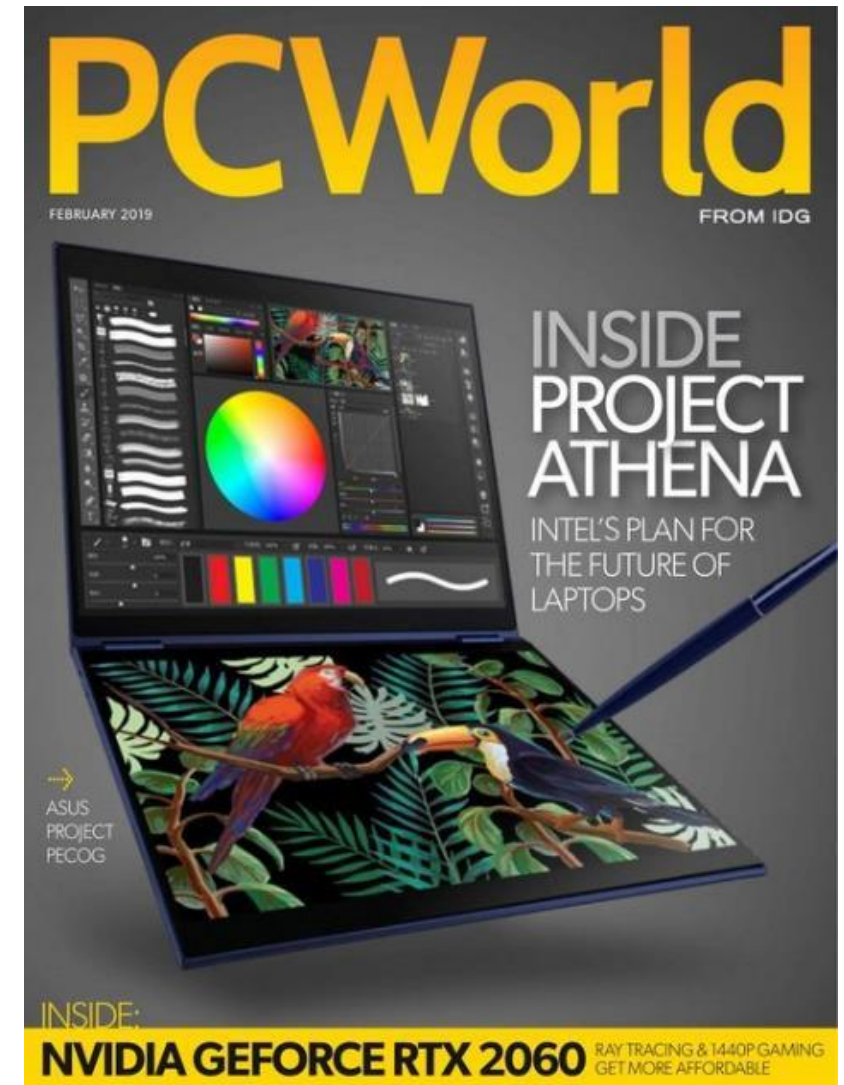


# COMPACT THUNDERBOLT™ 3 SSD STORAGE AS FAST AS INTERNAL SSDs

[Click Here to Play Video](#)

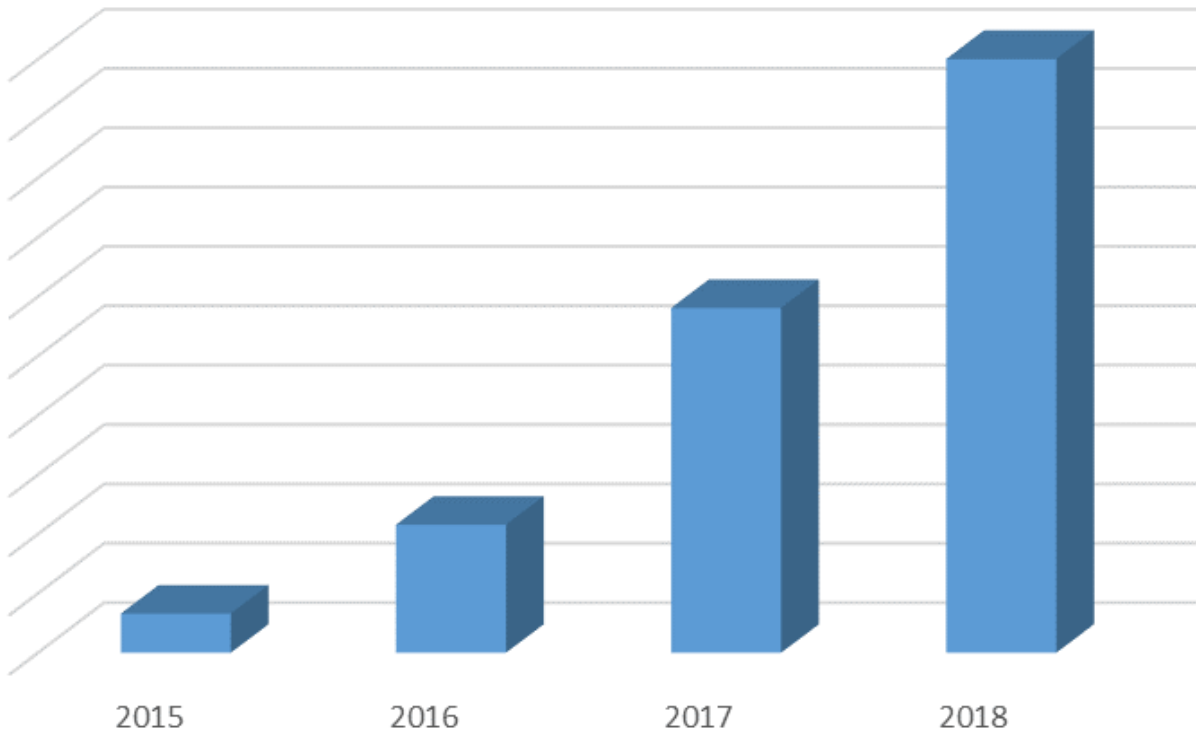
# Thunderbolt™ 3 Continuing to Gain Momentum

- 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 (10<sup>th</sup> gen core processor)
- New Innovations such as hub and low cost and longer cables coming



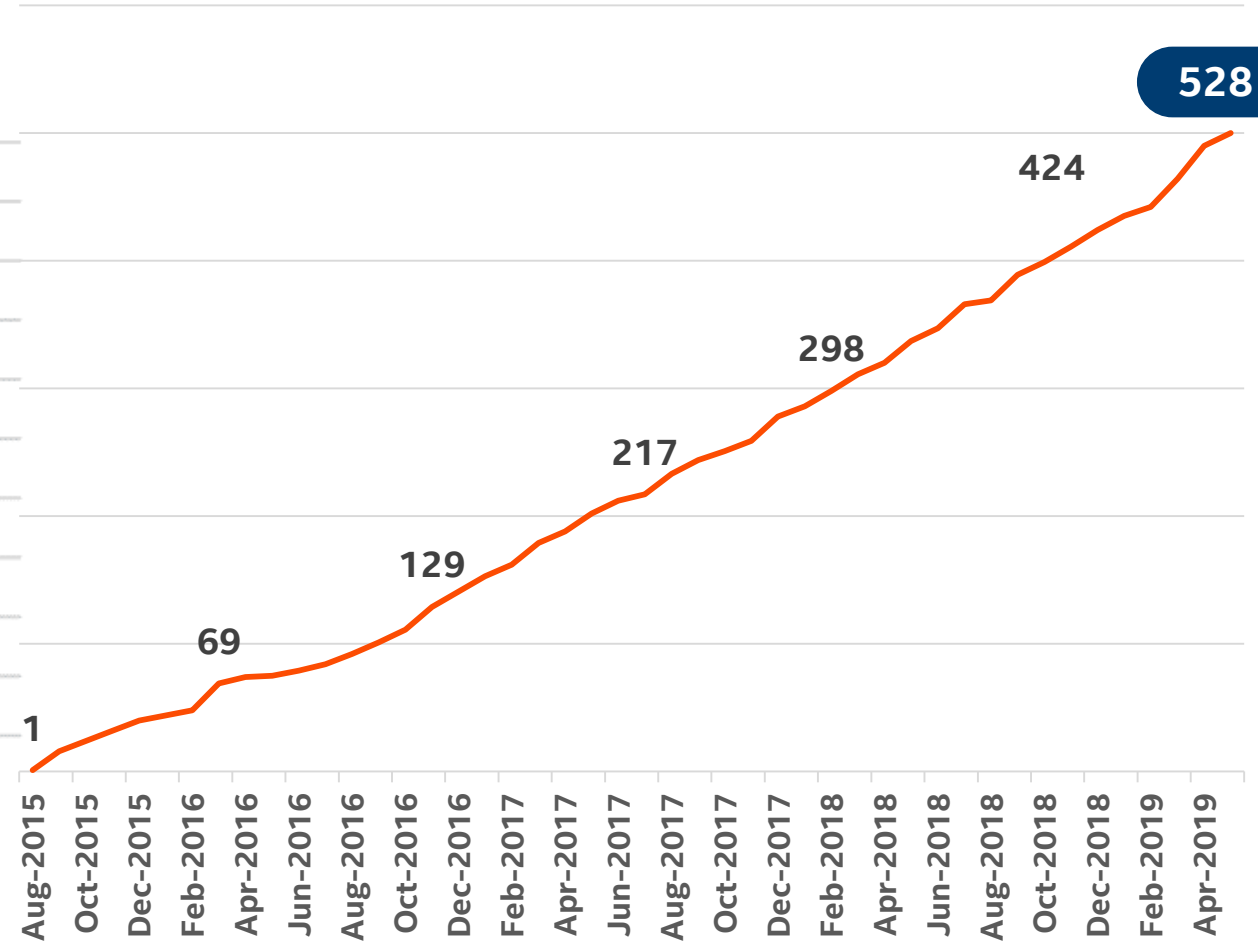
# Significant PC Growth

Thunderbolt™ 3 volume (Windows PCs)



Tens of Millions of PCs shipping with Thunderbolt™ 3

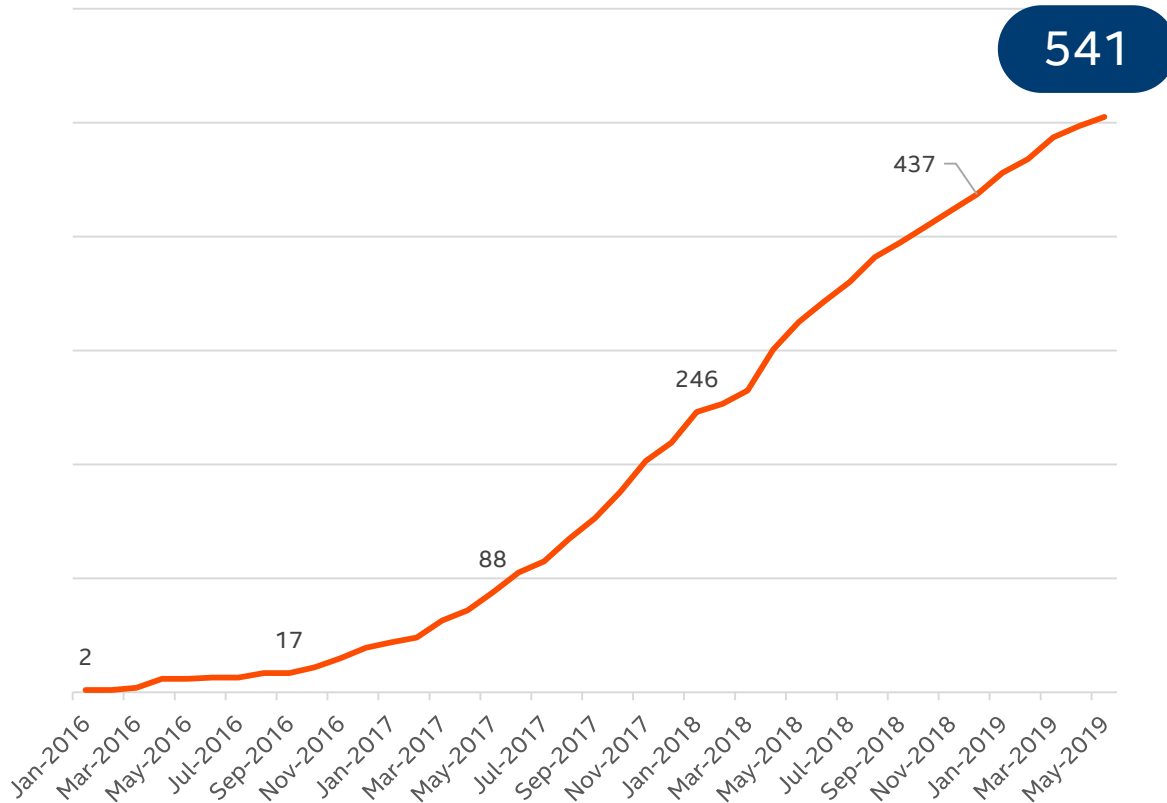
Certified Thunderbolt™ 3 Hosts (Cumulative)



Certified Hosts Steadily Growing

# Thunderbolt™ 3 Ecosystem Snapshot

Certified Thunderbolt™ 3 Device (Cumulative)



Great momentum continues



Adapters (87)



Networking (32)



Display (17)



AV (19)



Docks (127)



PCI Expansion (34)



Card Reader, Hub (18)



Storage (148)



eGfx (49)



Other (10)

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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

Fully supported in Windows 10 and macOS



macOS

LINUX

## INDUSTRY ADOPTION

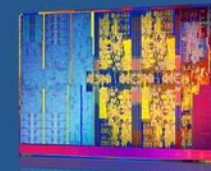
PC and peripheral volumes continue to double every year



## 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.

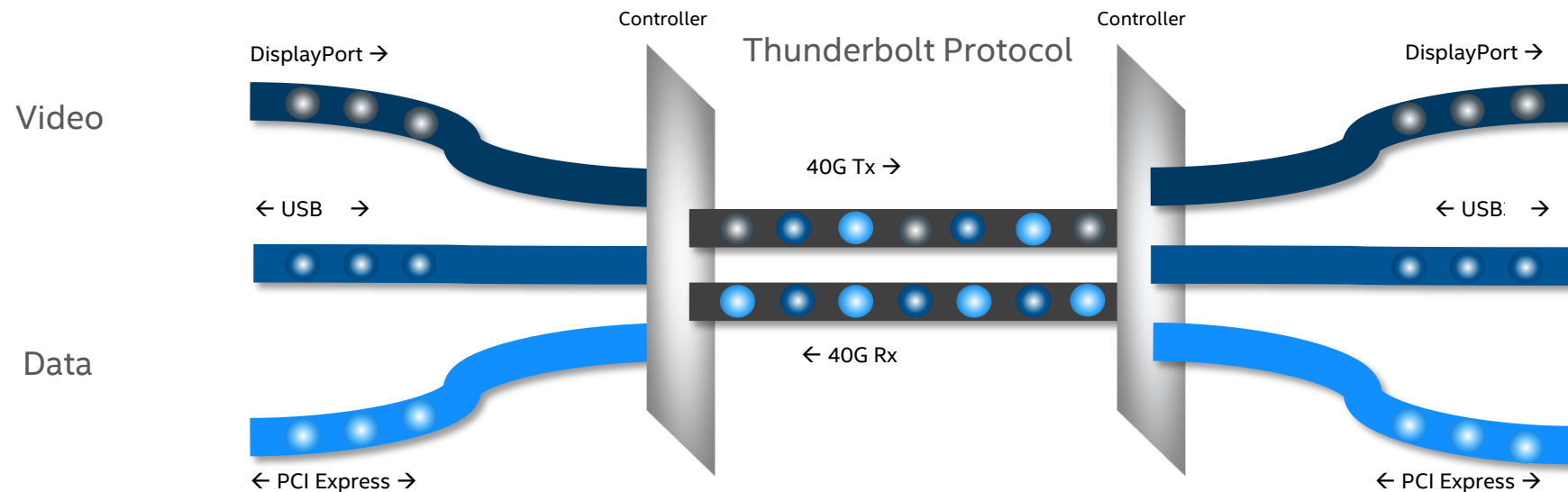
# Thunderbolt™ Protocol Overview

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.



<b>USB2.0</b> 480 Mb/s	<b>USB3.1 Gen 1</b> <b>USB3.2 Gen 1</b> 5 Gb/s	<b>USB3.1 Gen 2</b> <b>USB3.2 Gen 2</b> 10 Gb/s
<b>USB3.2 Gen 2 x 2</b> 20 Gb/s	<b>USB-C</b> x4 lanes DP + USB 2.0	<b>USB-C</b> x2 lanes DP + USB 3.1
<b>USB4<sup>1</sup></b>		

<sup>1</sup> 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

**Business**

**Media**

**Gaming**

**On the Go**

Speed

Speed up to **2,850MB/s** (PCIe Gen 3x4)

Capacity

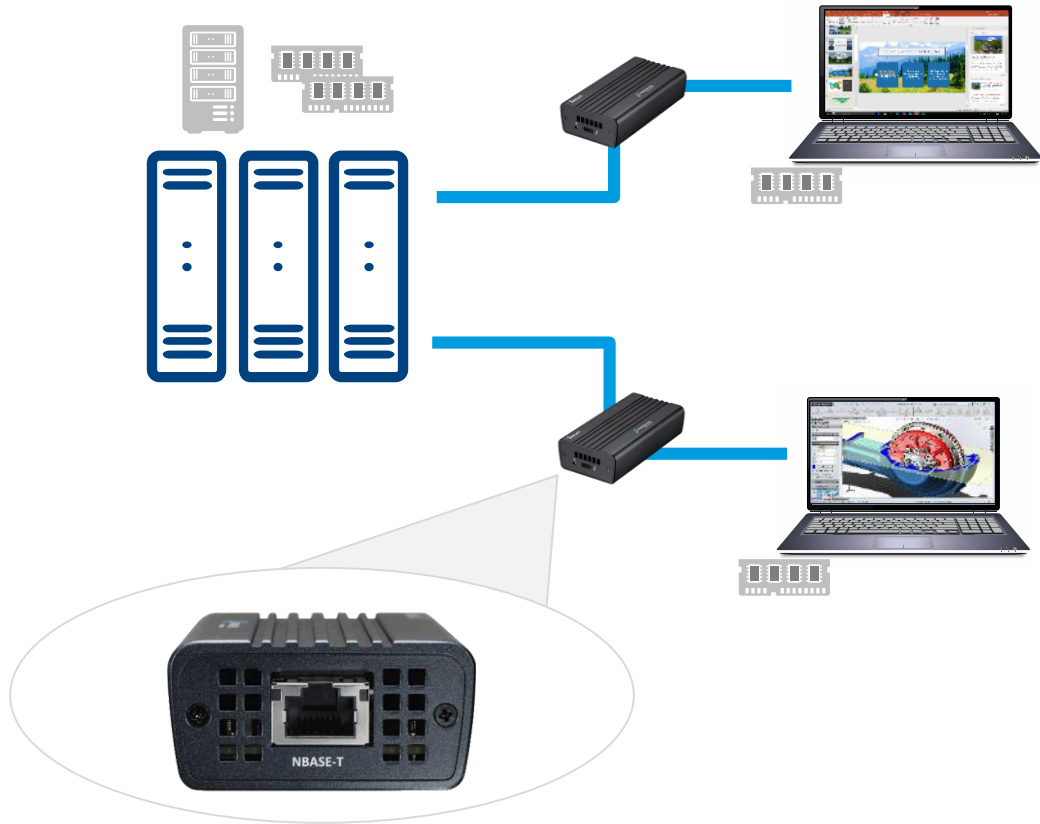
**Standard 15W** of bus power for larger capacity drives  
Thunderbolt SSDs offer real-time extension to capacity limited PC

Compatibility

**Hundreds of millions\*** of Thunderbolt™ 3 PCs in the next 1-2 years  
Pro level quality - due to **required** host, device, and cable cert

Cost

USB PD controllers and 40Gb/s cable **costs continue to drop**  
**Small cost adder** when compared to the SSD cost



Thunderbolt™ 3 to 10GbE adapter

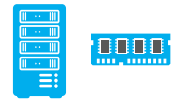
## Business and Large Enterprise

Thunderbolt™ 3 to 10GbE adapter ~\$149 may accelerate 10GbE transition

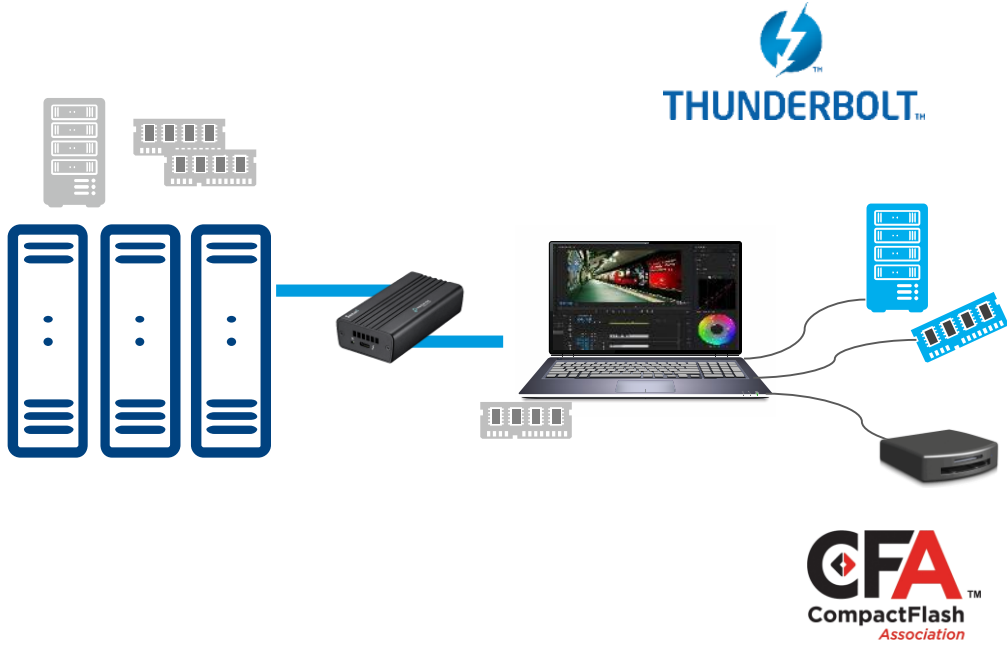
Mainstream 10GbE for thin-and-light laptops can drive client and data center refresh for faster SSDs



RAID and SSDs



Thunderbolt 3 RAID and 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



RAID and SSDs



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RAID and SSDs





## Gaming

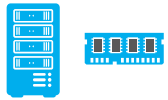
Keep entire gaming library on Thunderbolt™ 3 external SSD

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



RAID and SSDs



Thunderbolt 3  
RAID and SSDs



## On the Go

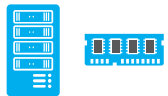
Offer Thunderbolt™ products using lower bin SSDs focused at mainstream segment, offering 3x SATA performance (1,500MB/s)

Drive brand awareness for your SSDs in mainstream channels

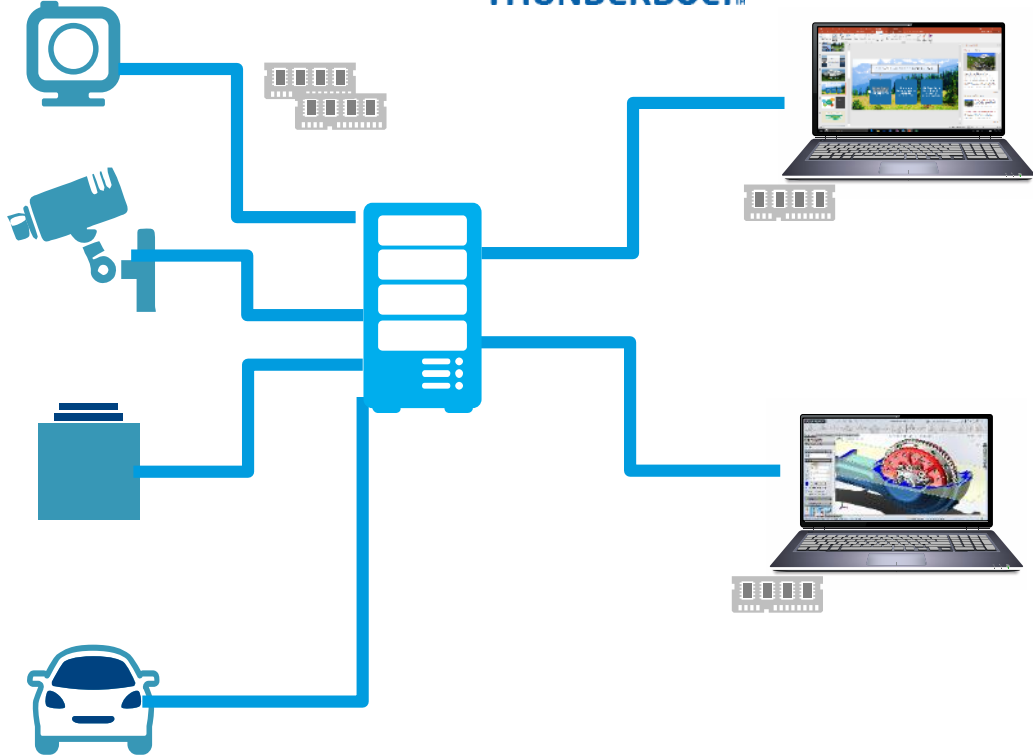
Convenient small form factor



RAID and SSDs



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RAID and SSDs



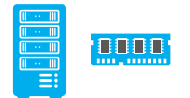
## Edge Computing

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

Verticals include consumers, healthcare, industrial, enterprise.



RAID and SSDs



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RAID and SSDs

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# Next Steps

- Become a Thunderbolt™ developer
  - Contact Shailendra Sinha at Intel [shailendra.sinha@intel.com](mailto: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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