THUNDERBOLT™

Thunderbolt™ 4

July 8, 2020

A decade of Thunderbolt innovation

2010
Combined high-speed **video and data** onto a single connector **(10Gb/s)**

2013
Speed increase **(20Gb/s)**

2015
Combined high-speed video and data with power onto a **USB-C connector (40Gb/s)**

2017
Native Windows support for Thunderbolt

2019
Thunderbolt protocol **specification contributed** by Intel to be used in USB4

Ice Lake with **integrated** Thunderbolt 3

2020
Tiger Lake with integrated Thunderbolt 4 **NEW**

Thunderbolt 4 offers the **most complete** version of USB-C **NEW**

Thunderbolt 4 **certification includes** USB4 testing **NEW**

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Thunderbolt momentum

- **Hundreds of millions** of Thunderbolt 3 computers and accessories shipped
  - Windows computers with Thunderbolt 3 starting at **$679**[1]
  - Intel NUC with Thunderbolt 3 starting at **$399**[2]

- **High demand** for Tiger Lake-based consumer and commercial products

- Thunderbolt required for code name **Project Athena** Intel innovation program

- **Broad OS** platform **support** – Windows, MacOS, and Linux

- Dock market growing ~10% a year with **Thunderbolt docks growing at ~20%**[3]

- **Thunderbolt dock mix** expected to **grow from ~25-40%** over next few years[3]

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Thunderbolt 4 and USB4 products

- **Thunderbolt** is a high-speed protocol that can dynamically adjust data and video bandwidth depending on the device and/or application. It's now the **basis of the USB4 protocol specification**.

- Thunderbolt 4 and USB 4 products will **use the same underlying protocol specification** to improve compatibility for USB-C based products.

Improved Compatibility
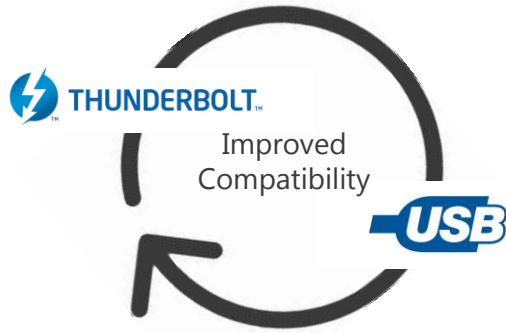
Thunderbolt 4 will offer the **most complete** version of USB-C with a required superset of capabilities not required by USB4

What's new in Thunderbolt™ 4
Same industry leading 40Gb/s performance and more

Double the minimum video and data requirements of Thunderbolt 3

- Video: Support for two 4K displays or one 8K display

- Data: PCIe at 32 Gb/s for storage speeds up to 3,000 MB/s

Expanded End-to-End Solution Capabilities

- Accessories with four Thunderbolt ports

- Universal 40Gb/s cables up to 2 meters in length

- Required PC charging on at least one computer port[1]

- Required PC wake from sleep when computer is connected to a Thunderbolt dock

- Required Intel VT-d based direct memory access (DMA) protection

USB4 Specification Compliant

[1]For thin and light notebooks that require less than 100W to charge

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How Thunderbolt 4 is different than Thunderbolt 3

Thunderbolt™ 4

INCREASES MINIMUM PERFORMANCE REQUIREMENTS

EXPANDS END-TO-END SOLUTION CAPABILITIES

USB4 SPECIFICATION COMPLIANT

Thunderbolt™ 3

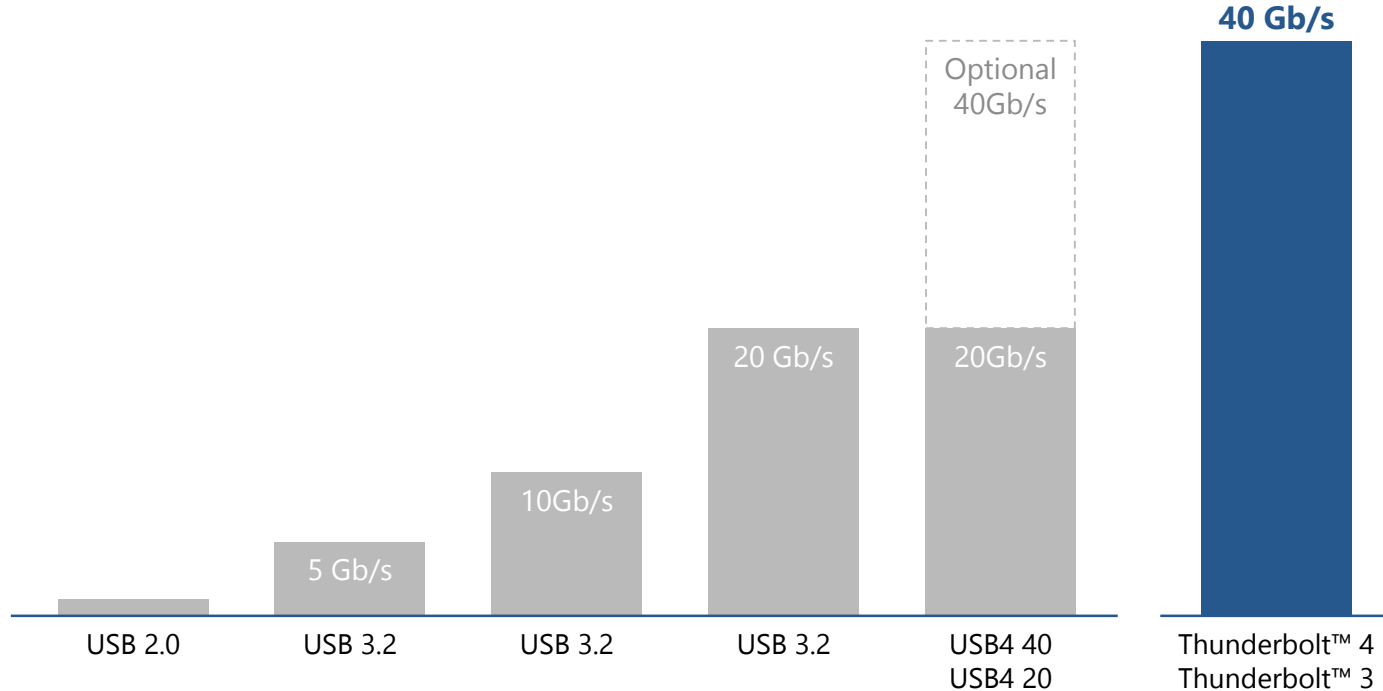| USB 2.0 | USB 3.2 | USB4 compatible | DisplayPort | PCIe |

Mandatory Certification for All Shipping Computers, Accessories and Cables to Offer a Consistent User Experience Across a Wide Range of Product Types and Manufacturers
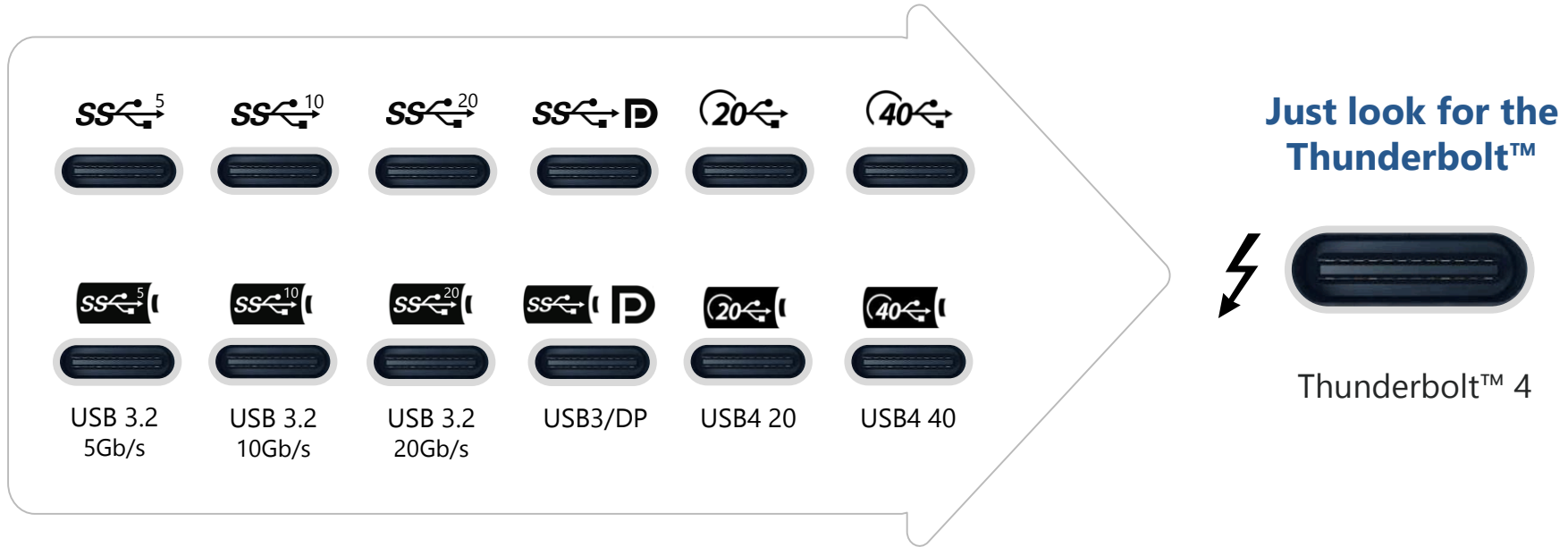
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Thunderbolt is Always 40Gb/s

Consistent performance keeps you fast

40 Gb/s

Optional
40Gb/s

20 Gb/s

20Gb/s

10Gb/s

5 Gb/s

| USB 2.0 | USB 3.2 | USB 3.2 | USB 3.2 | USB4 40 USB4 20 | Thunderbolt™ 4 Thunderbolt™ 3 |

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Computer port simplification

One Thunderbolt 4 universal computer port can replace these other ports for hassle-free connectivity to any of your favorite accessories

USB 3.2 5Gb/s	USB 3.2 10Gb/s	USB 3.2 20Gb/s	USB3/DP	USB4 20	USB4 40

Just look for the Thunderbolt™

Thunderbolt™ 4

Cable simplification

One Thunderbolt 4 universal cable can replace these other cables to make cable selection fast and easy

| USB 2.0 | USB 3.2 5Gbs/s | USB 3.2 10Gb/s | USB 3.2 20Gb/s | USB3/DP | USB4 20 | USB4 40 |

Thunderbolt™ 4
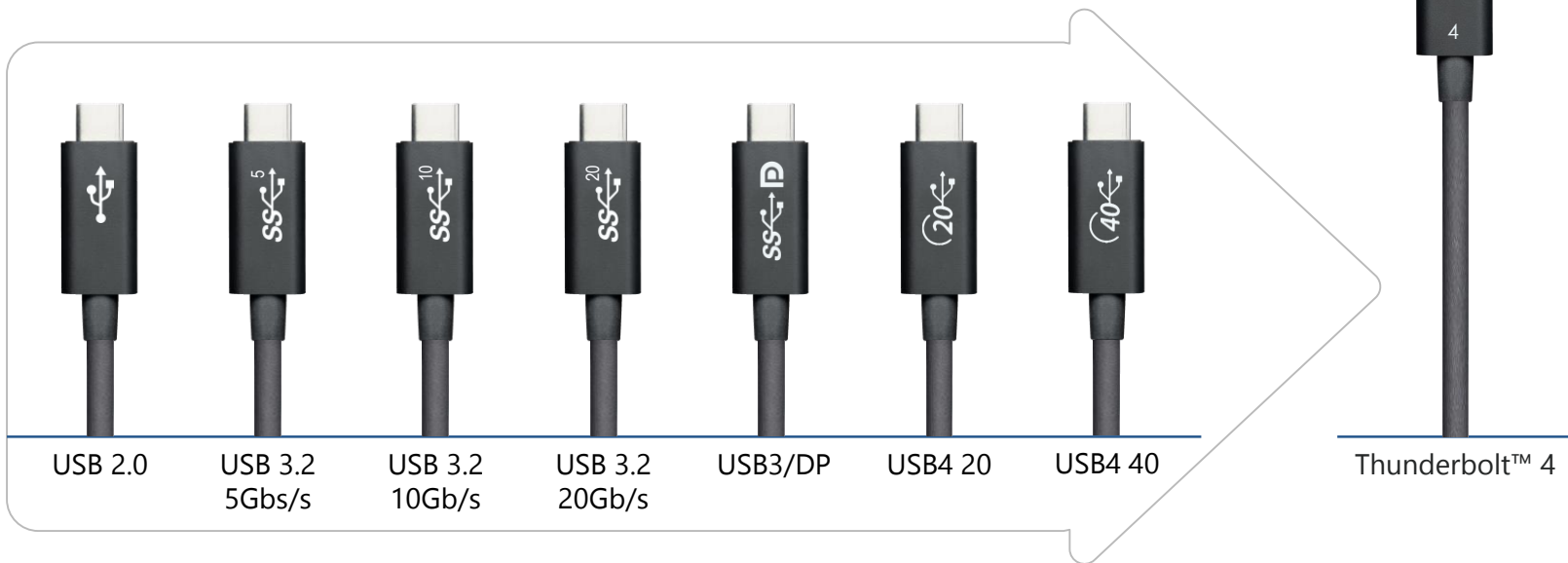
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Brand simplification
Thunderbolt brand continues to be simple

Name	Logo	Icon	Port	Cable
Thunderbolt™ 4	THUNDERBOLT™			

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Intel® Virtualization Technology for Directed I/O
Committed to continuously improving security over the Thunderbolt port

Thunderbolt™ 4 computer ports will be required to support Intel VT-d based DMA protection solutions

Thunderbolt 4

Truly universal cable connectivity solution for work and play

Truly Universal
Most complete and future proof version of USB-C

Effortless Connectivity
More ways to connect accessories than ever before

Secure & Manageable
Intel VT-d based DMA protection

Unrivaled
Simplicity

Maximum
Performance

Reliable
Connectivity

Always Fast
40Gb/s for connecting to powerful Thunderbolt docks, monitors, fast storage and more

Notebook Charging
Required on at least one computer port[1]

Mandatory Certification
Consistent user experience across a wide range of product types and manufacturers

[1]For thin and light notebooks that require less than 100W to charge

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How Thunderbolt 4 is different than other solutions
Based on minimum solution requirements so people know what they are getting

		Thunderbolt™ 4	Thunderbolt™ 3	USB4	USB3/DP
Unrivaled Simplicity	One universal computer port	●	●		
	Universal 40Gb/s cables up to 2 meters in length	●			
	Accessories with four Thunderbolt ports	●			
Maximum Performance	Minimum PC speed requirements	40Gb/s	40Gb/s	20Gb/s	10Gb/s
	Minimum PC video requirements	Two 4K displays	One 4K display	One display (No Minimum)	One display (No Minimum)
	Minimum PC data requirements	PCIe 32 Gb/s USB 3.2 - 10Gb/s	PCIe 16 Gb/s USB 3.2 - 10Gb/s	USB 3.2 - 10Gb/s	USB 3.2 - 5Gb/s
	Required PC charging on at least one computer port[1]	●			
	Required PC wake from sleep when computer is connected to a Thunderbolt dock	●			
	Minimum PC port power for accessories	15W	15W	7.5W	4.5W
	Thunderbolt Networking	●	●		
Reliable Connectivity	Mandatory certification for all shipping computers, accessories and cables	●	●		
	Cable testing and cable quality audits for Thunderbolt cable manufacturers	●	●		
	Required Intel VT-d based DMA protection	●			
	USB4 Specification	Compliant	Compatible	Compliant	Compatible

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Thunderbolt family of accessories

Thunderbolt 4 computers and cables are a fully compatible extension to existing Thunderbolt 3 accessories and cables

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Two Port Docks

Two Port Monitors

Portable Storage, Enclosures

Four Port Compact Docks **NEW**

Power Supply Docks

Adapters

Desktop Storage

Four Port Docks **NEW**

Audio Interfaces

4K

Video Interfaces

External Graphics

Multi-Port Monitors **NEW**

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Thunderbolt 4 modern docks

Thunderbolt 4 docks offer up to four Thunderbolt 4 ports
to simplify connectivity and redefine the modern workspace
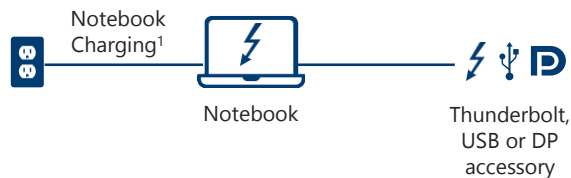
Thunderbolt™ 4 Compact Dock
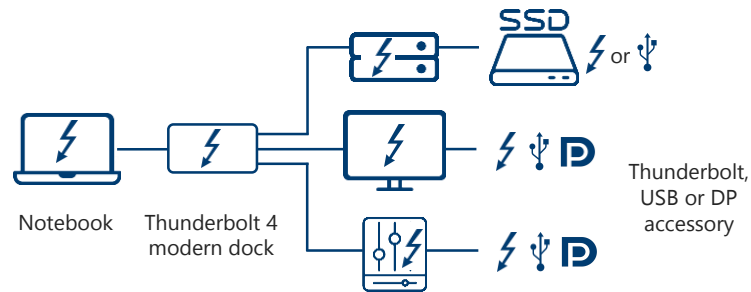
Thunderbolt™ 4 Dock

Thunderbolt accessory configurations

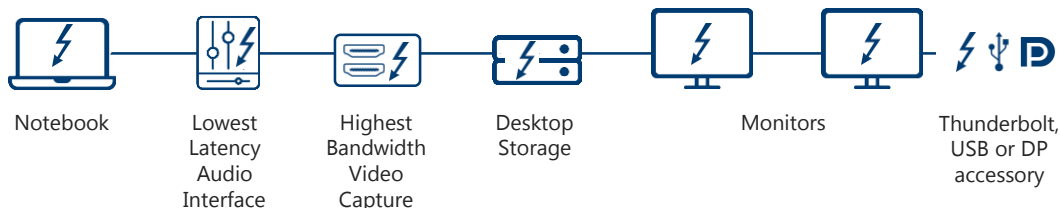More Thunderbolt ports and more ways to connect than ever before

More Thunderbolt Computer Ports

Notebook Charging[1]

Notebook

Thunderbolt, USB or DP accessory

Multi-port Accessory Architecture NEW

SSD

⚡ or ⌁

Notebook

Thunderbolt 4 modern dock

Thunderbolt, USB or DP accessory

Daisy Chain Accessory Architecture

Notebook

Lowest Latency Audio Interface

Highest Bandwidth Video Capture

Desktop Storage

Monitors

Thunderbolt, USB or DP accessory

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Thunderbolt 4 cable innovation
World's first universal cable line-up from top to bottom

0.2m

0.8m

2.0m   NEW

Targeting ~5-50m [Future]
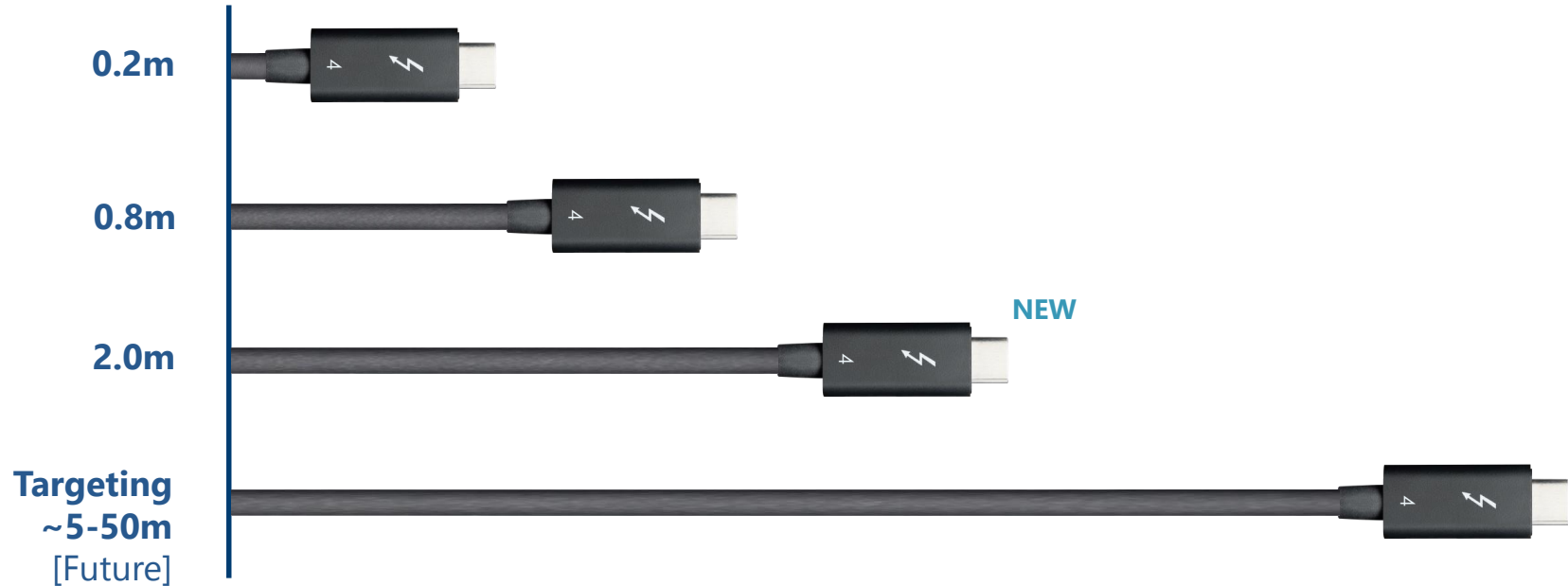
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Thunderbolt Developer Update

- Intel's upcoming mobile PC processors, code-named "Tiger Lake," will be the first to integrate Thunderbolt 4.

- Intel® 8000 series Thunderbolt 4 controllers coming later this year:
  - JHL8540 and JHL8340 host controllers for computer makers
  - JHL8440 device controller for accessory makers

- Thunderbolt 4 developer kits and certification testing are now available.

- The first Thunderbolt 4 computers and accessories are expected to be available later this year, including laptops based on Intel's innovation program code-named "Project Athena."

(intel)

Intel® 8000 Series
Thunderbolt™ 4 Controllers

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Summary

- Intel introduces Thunderbolt 4 and new Thunderbolt controllers, compatible with hundreds of millions of Thunderbolt 3 PCs and accessories already available.

- Thunderbolt 4 builds on Thunderbolt 3 by increasing minimum performance requirements, expanding solution capabilities and adding USB4 compliance.

- For the first time....

  - Thunderbolt 4 docks offer up to four Thunderbolt ports for the modern workspace.

  - Longer Thunderbolt 4 universal cables up to 2 meters for fast and easy cable selection.

- Upcoming "Tiger Lake" mobile processors will be the first to integrate Thunderbolt 4. The first Thunderbolt 4 computers and accessories are expected to be available later this year.

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