What are Thunderbolt 3 and Thunderbolt 4? Features, speeds and future of USB-C port technology

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- Thunderbolt ports are extremely versatile and essential for modern laptops, allowing for multiple device connections, fast data transfer, and different external accessories.
- Thunderbolt 4 is the current standard, offering improved video support, a wake-from-sleep function, faster data speeds, and added security.
- Thunderbolt 5, announced in September 2023, will triple maximum data transfer speeds and bring additional improvements for multi-display and high refresh rate gaming.

The ports on the side of your laptop are important. They decide what you can do on your device and how quickly you can do it.

In 2018 when Apple introduced a new style MacBook Pro, it ditched every single port of its old machines and replaced it with just Thunderbolt 3. Many PC makers followed suit. Now it's fairly normal to have at least one USB-C or Thunderbolt port on a device.

Even though more specialized ports still have their place (they even returned to newer MacBooks), the versatility of USB-C and Thunderbolt is hard to beat, especially when newer versions keep improving the standard, making it capable of so much more. The upcoming Thunderbolt 5 standard is gearing up to be yet another massive change, bringing huge improvements to gamers and professionals alike.

What is Thunderbolt?

Intel introduced the Thunderbolt platform in 2011 at a time when USB 3.0 was all the rage and could transfer data at speeds up to 5Gbps. Thunderbolt was capable of twice that, 10Gbps, plus it could transfer multiple types of data - not just serial data to storage devices.

It could, for instance, pipe video data to displays. It could also daisy-chain devices together, such as your hard drive to your computer and a display to your hard drive. It was the connector of the future, as a single cable (and a single plug) could do it all.

The first two Thunderbolt standards used miniDisplayPort connectors. They did not become very popular, but many MacBook owners should recognize them, as they were a mainstay on Apple's laptops.

The big step forward when it comes to Thunderbolt was Thunderbolt 3. It uses the same design as the familiar USB Type-C connector, making it much more versatile and hardy, but it was also the only connector on Apple's Pro laptops for a few years. It showed that only one port can do it all - even if you sometimes need to use quite a few dongles.

What can Thunderbolt do?

Thunderbolt is so popular nowadays because it allows you to use multiple devices with completely different functions using only one port on your laptop or PC. Because of the wide range of protocols that it supports, you can expect almost everything to work with it - from your regular thumb drive to your external GPU and more.

Here are some of the standards that Thunderbolt supports:

- USB
- DisplayPort
- HDMI
- PCI Express
- Ethernet

Of course, depending on the Thunderbolt generation, the speeds of these will vary, but having all of those standards contained in a single cable is a huge deal. Plus, Thunderbolt is also backward compatible to sweeten the deal, so you don't have to worry about your accessories not working with a newer laptop or the other way around.

These accessories use Thunderbolt

What's the newest Thunderbolt?

Even though Thunderbolt 3 was (so far) probably the biggest step for that technology, it has already been replaced. Right now, the newest standard is Thunderbolt 4, which was introduced in July 2020. It brought some considerable improvements to the platform, but it also kept the old 40 Gbps maximum transfer speed from Thunderbolt 3.

So what does Thunderbolt 4 add? Several useful things:

- It increased video data support. Thunderbolt 4 can support a single monitor to 8K resolution or two 4K monitors - doubling the capability of Thunderbolt 3.
- Adds a wake-from-sleep function, allowing for a quick start with connected peripherals.
- PCIe data speeds have doubled to 32 Gbps. This is handy if you connect an external graphics card to your PC.
- It adds security - with VT-d protection restricting direct memory access.

However, the days of Thunderbolt 4 are already nearing their end. Intel already announced Thunderbolt 5 with many new improvements, and we should see machines supporting it, maybe even next year.

Is Thunderbolt 4 just USB4?

The confusion between the name USB and every other cable that uses the same port is quite real. You have DisplayPort cables, Thunderbolt cables, and normal USB cables, all of which use the same plug.

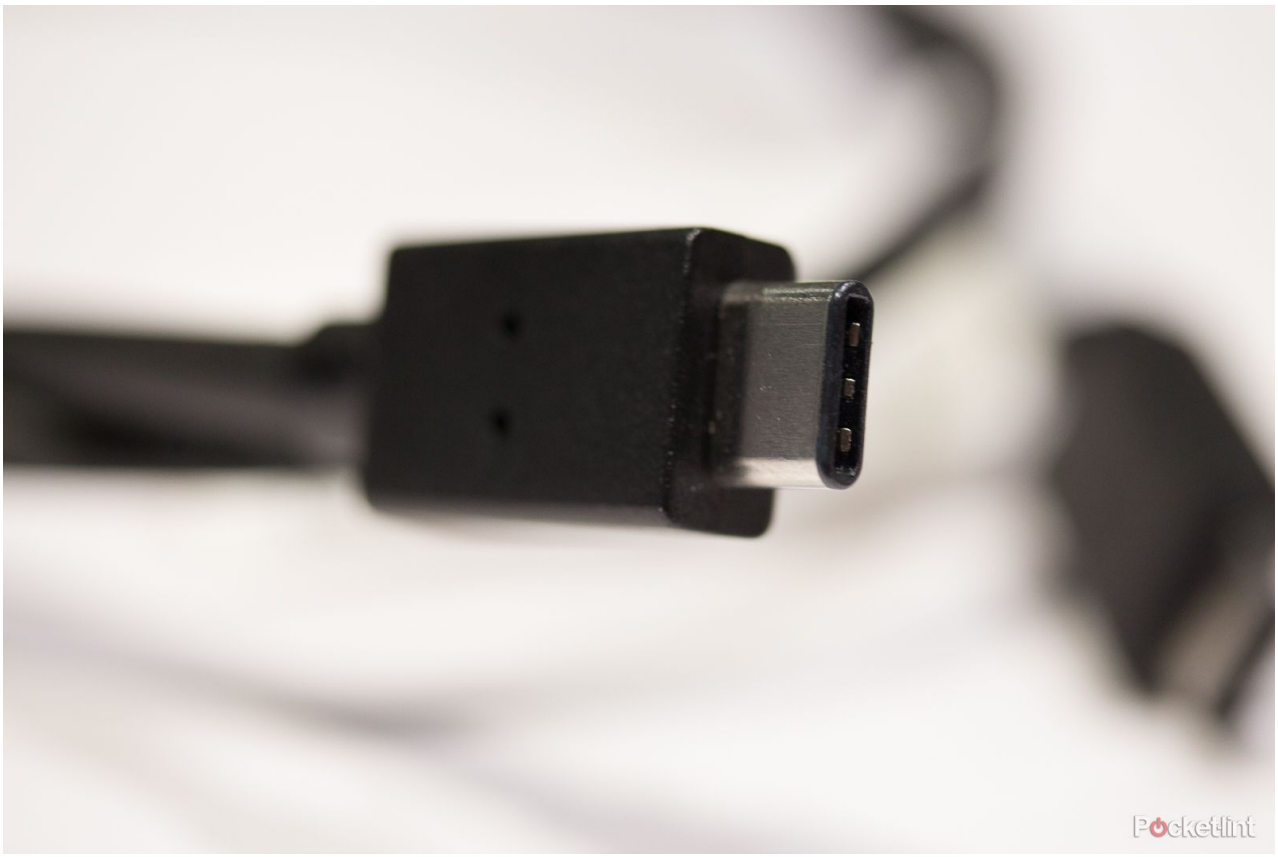
The connector looks the same, being USB Type-C, but Thunderbolt 4 assures you're getting the top-spec USB4.

Because USB4 has various layers: there's a 20Gbps version, for example, despite it being capable of 40Gbps. Thunderbolt 4 ensures that top speed happens.

USB4 also doesn't guarantee the ability to run dual 4K monitors, while there's no mandatory wake-from-sleep requirement - all of which you get with Thunderbolt 4.

So what is USB-C?

USB Type-C - or USB-C for short - is a physical USB connector. It replaced Micro-USB connectors previously used by most Android phones. It will eventually even replace USB Type-A, which is the standard larger-scale USB connector that everyone probably thinks of when they hear "USB." Even Apple has added USB-C to the latest iPhone 15 models.



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USB Type-C is a versatile, backward-compatible, and future-proof connector. While the standard doesn't necessarily reflect speed increase, it is capable of much quicker data transfer.

USB Type-C also allows charging a wider range of devices because it can transmit up to 240W of power, which is enough to charge most laptops and ridiculously quick charging of smartphones.

That means you can use a single cable with a USB Type-C connector to quickly transfer data to your device while you charge it.

But the most interesting thing about USB-C is that the connector is reversible: there is no "right way up." You can blindly stick it into a port on a device, and it'll smoothly go in and work without the never-ending hassle of searching for the correct side.

It's important to remember that USB-C does not denote the cable's speed or capabilities; it is just the name of the plug. That's why USB-C cables can vary greatly in transfer and charging speeds. That's why you'll hear about USB4 2.0 or USB 3.2 - these are the data transfer standards.

So, you can get a USB 2 USB-C cable which supports data transfer of up to 480 Mbps, or you can get a USB4 2.0 USB-C cable - it supports up to 80 Gbps speeds. The difference is quite massive.

Why are more laptops using Thunderbolt?

Manufacturers have embraced Thunderbolt because of its features - mostly the fast data transfer for storing large files. The fact it uses the now-common USB-C connector is a welcome bonus.

You can use it to connect your Mac or PC to displays, transfer data quickly between computers and hard drives, daisy chain external devices, and power up - all with just one physical connection.

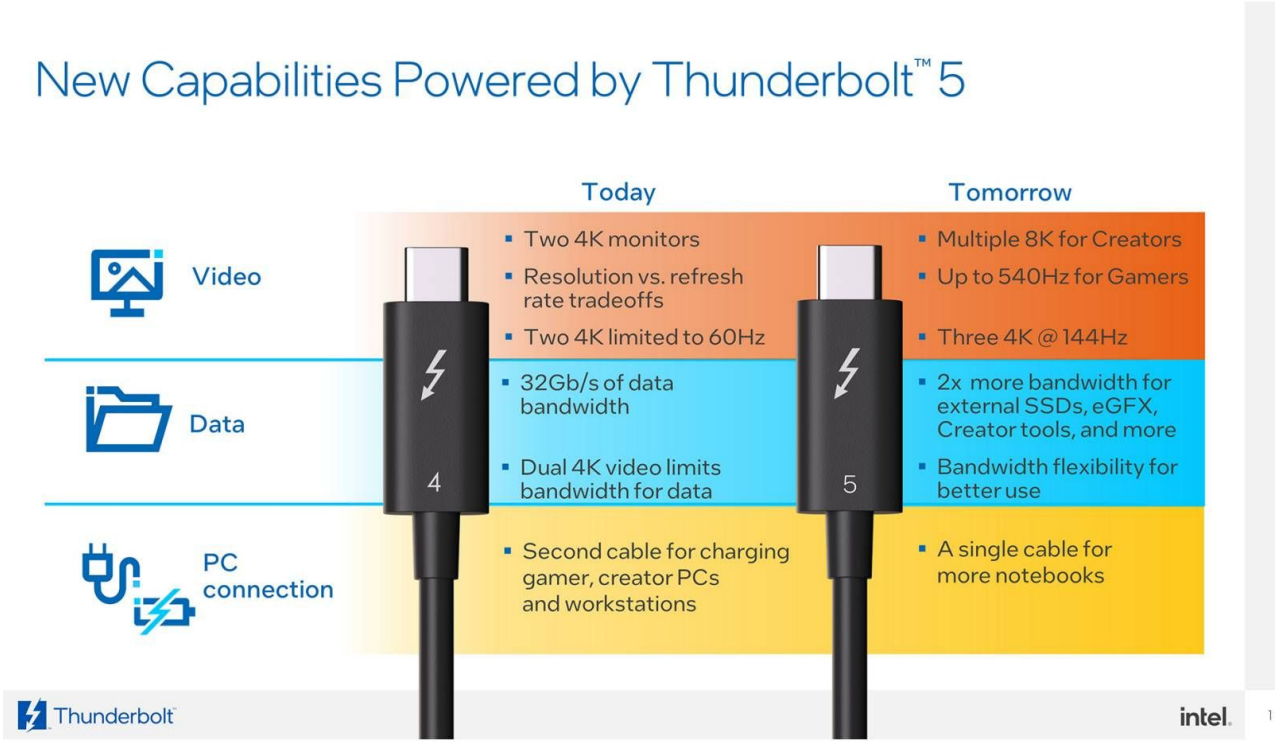
It's also much more convenient than having all of these ports available, as most laptop manufacturers aim to make their machines as thin and light as possible. A small USB-C connector fits this kind of chassis much better than a bulky HDMI or Ethernet port. Plus, you only need to make space for one small connector instead of four big ones.

A big step towards more widespread adoption of Thunderbolt came with the USB4 standard. This port includes Thunderbolt 3 functionality, making it available for every machine with USB4, not just specific Thunderbolt 3-certified devices. This is important because Thunderbolt is an Intel technology, meaning that it's reserved to work only with Intel processors. Both AMD, with its Ryzen, and Apple, with the M-series chips, became much more competitive, and they can now also use Thunderbolt functionality thanks to the USB4 standard.

What about Thunderbolt 5?

Thunderbolt 4 is already old news, as Intel has announced a new generation, this time with many more tangible improvements. Thunderbolt 5 will triple the maximum data transfer speeds and bring along several improvements that all will enjoy - both multi-display aficionados and high refresh rate gamers.

Thunderbolt 5 was announced in September 2023 and promises huge improvements in virtually all the important aspects of the standard. Firstly, Thunderbolt 5 will be able to handle up to 120 Gbps of data bandwidth, which is supposed to help your transfer speeds and drive more high-resolution displays.



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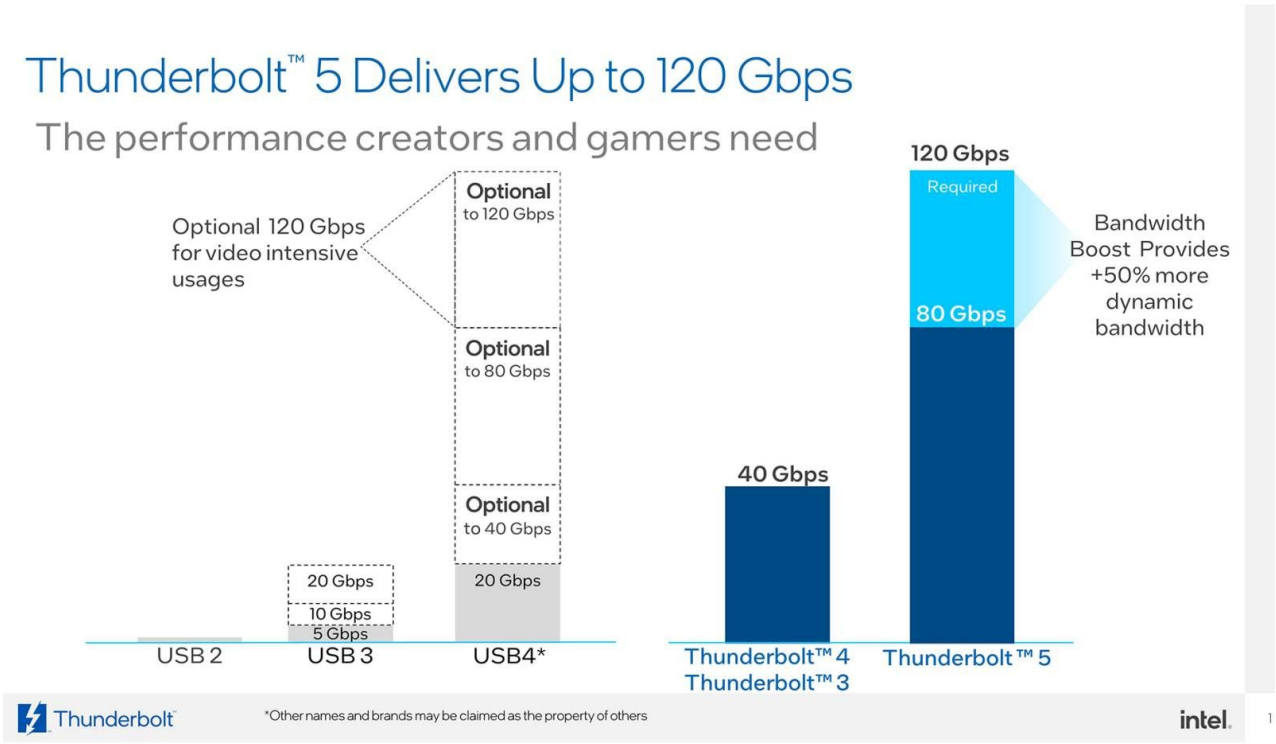
Speaking of the displays, Thunderbolt 5 will be able to drive multiple 8K screens or three 4K displays at 144 Hz. If you're not that into resolution and prefer higher framerates, Thunderbolt 5 will also be able to support up to 540 Hz.

Thunderbolt 5 will also double the PCI-E bandwidth and support PCI-E Gen 4. This means that your PCI-E accessories - for example SSDs or external graphics cards - will have more available bandwidth, allowing for faster transfer speeds or better graphics cards and framerates. Of course, thunderbolt 5 will also support USB4 V2, the newest USB standard.



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When will Thunderbolt 5 be available?

So far, Intel hasn't announced any specific devices that will feature the upcoming standard. However, the company said that we'll see computers and accessories featuring the new standard in 2024. It'll surely be one of the important headlining features, so you surely won't miss it when it comes out.

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