



TAKE CONTROL OF

Untangling Connections

SOLVE PROBLEMS WITH
USB • Thunderbolt
HDMI • DisplayPort
Ethernet • Audio

by **GLENN FLEISHMAN**

\$12.99

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EDITION

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Read Me First

Welcome to *Take Control of Untangling Connections, Third Edition*, version 3.0, published in December 2024 by alt concepts. This book was written by Glenn Fleishman and edited by Joe Kissell.

Learn how to understand the capabilities of your devices' peripherals connections for storage, video, networking, scanning, printing, and input; learn how to find the right cables, hubs, switches, docks, and adapters; and gain expertise in troubleshooting mismatched connections and performance issues.

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What's New in the Third Edition

Since the previous edition of the book was first released, the computer and mobile device industry leapt forward into shipping devices with new standards: USB4 2.0 (80 Gbps), Thunderbolt 5, HDMI 2.1, and DisplayPort 2.1. Some of these “new” standards appeared as long ago as 2019, but only filtered into hardware updates in the last year or so; others made their debuts in 2024.

Integrating all the intricate and extensive changes across those four standards into the book required a revised edition.

Here's a full list of what's new in this edition:

- **Thunderbolt 5 ships in Apple products:** Apple released the first hardware and cable that supports the Thunderbolt 5 specification. The book has been updated throughout to note that Thunderbolt 5 is now shipping, plus a few tweaks about the standard that have been clear since it was released.
- **New Thunderbolt 5/USB4 cables:** These new cables, shipping in late 2024, provide support for the full 80 Gbps rate required for Thunderbolt 5 and the optional 80 Gbps for USB4 2.0. They can also split into 120 Gbps video/40 Gbps data. See throughout the book and particularly across [Link Devices with Cables](#).
- **Updating DisplayPort:** With more cables and higher-resolution/high-refresh rate displays on the market, I provide more detail and all the latest information about DisplayPort 2.1 and Ultra High Bit Rate standards; see [DisplayPort and HDMI Capabilities](#) and [DisplayPort](#), as well as [Video and Audio](#) more generally.
- **HDMI 2.1 becomes standard:** HDMI seemed stuck at version 1.4 in computers for far too long. In 2024, we can finally put a fork in it and talk at length about HDMI 2.1. See [DisplayPort and HDMI Capabilities](#) and [HDMI](#).
- **USB-C mandates:** More countries have joined or may join the European Union's mandate for mobile devices and laptops to use

USB-C. The first deadline hits at the end of 2024. See [Mandates for USB-C for Mobile Devices and Laptops](#).

- **Apple sticks to slow USB 2.0 for low-end iPhones:** Apple added USB-C to the iPhone 15 model series in 2023, but split the line that year and with the iPhone 16s in 2024 between the two lower-end phones (USB 2.0 or 480 Mbps) and higher end Pro models (USB 3.2 or 10 Gbps). The company also introduced a 240 W charging cable. See [Beware the USB-C Charging Cable: It's Slow](#).

Untangling Quick Start

This book teaches you how to identify connection standards used between computers and mobile devices and peripherals. You'll learn the capabilities of standards, as well as how to identify which connection methods are available via ports, plugs, cables, and adapters.

Identify parts of the ports and plugs puzzle:

- Learn about peripherals; see [Connect and Extend](#).
- Understand the role of a cable; see [Attach a Cable or Interpose an Adapter](#).
- Become familiar with different jacks and plugs; see [Identify Jacks and Plugs](#).
- Employ cables to their best effect; see [Link Devices with Cables](#).
- Learn how to test your cables; see [Testing USB and Thunderbolt](#).

Dig into how to work best with major standards:

- Uncover the secrets of USB and Thunderbolt; see [USB and Thunderbolt](#).
- Learn how to get the fastest, best connection every time; see [USB and Thunderbolt Data](#).
- Discover the limits of power over USB and Thunderbolt; see [USB and Thunderbolt Power](#).
- Explore video, audio, and networking; see [Video and Audio](#) and [Networking](#).

Unclutter your cables:

- Find tips to better organize your physical cable clutter; see [Cable Organization](#).

Quick Links for Common Questions

From my experience answering questions people have about technology, I've predicted some of the most common you might raise and note below where to find the answers quickly.

Fastest connection:

- **How do I ensure I have the fastest connection between any combination of USB and Thunderbolt?** Check your ports and get the right cable: at least a Thunderbolt 4/USB4 certified one. See [Thunderbolt Capabilities](#) and [Match Rates with Standards, Jacks, and Cables](#).
- **What's the fastest computer-to-computer connection?** Use Thunderbolt 3, 4, or 5 over a Thunderbolt cable. Just plug the jacks together. See [Use Peer-to-Peer 10 Gbps Thunderbolt](#).
- **What's the fastest generally available computer-to-Ethernet connection?** A 1 Gbps Ethernet connection with the appropriate cable (Category 5E or higher). See [Ethernet Capabilities](#) and [Networking](#).
- **Why is my USB-C cable handling data very slowly—only at 480 Mbps (USB 2.0 speed)?** A small number of cables with USB-C on one or both ends are designed for low-wattage or high-wattage charging, not high-speed data. You may own one! This even includes some Thunderbolt 5 cables that can charge at 240 W. See [Beware the USB-C Charging Cable: It's Slow](#).
- **How do I get 40 Gbps between two USB4 ports?** While a Thunderbolt 4/USB4 is the way to go, you need one that's 80 cm (31.5 inches) or shorter to achieve the top USB4 speed. See [USB Capabilities](#).

- **Can I get 80 Gbps between any two ports?** With two devices that support Thunderbolt 5 or USB4 2.0, ports have 80 Gbps as their top-rated speed. See [USB Capabilities](#) and [Thunderbolt 5 Capabilities](#).

Highest resolution:

- **How can I make sure my display can show its maximum resolution, whether that's 1080p or 16K?** Make sure you're choosing the right video output standard or jack on your device, that your computer or other device and display both offer the parameters you need, and you have the right generation of cable. See [Video Standards](#) and [DisplayPort and HDMI Capabilities](#).
- **Why can't I connect more displays to my computer?** Every device that lets you attach external monitors has hardware limitations on the maximum number (and the maximum resolution and refresh rate). See [Video Questions and Answers](#) and [DisplayLink Isn't Part of DisplayPort](#).

Fastest charging:

- **How do I know how many watts a given port can offer a device I plug into it?** It varies so much that there's no cut-and-dried way to explain it. You are almost always plugged into USB Type-A, which might provide a maximum of between 5 W and 15 W, or USB-C, which has a range from 7.5 W to 240 W. See [USB and Thunderbolt Power](#).
- **My laptop isn't charging from the USB-C port it's plugged into due to insufficient power provided. How can I fix this?** Check the port really delivers the wattage expected. High-wattage output isn't required until Thunderbolt 4, and even a Thunderbolt 4 controller only has to deliver 100 W from a single jack on its host device; see [USB and Thunderbolt Power](#). Most likely, you need a better cable. See [USB Capabilities](#) and [Thunderbolt Capabilities](#).

What Ports You Have

This book aims to help people connect and troubleshoot connections with computers, peripherals, and other hardware purchased in the past 20 years. Despite the seeming profusion of standards, only a handful found wide-scale adoption in that period, and most remain in use. As a second form of quick start, here's what you're likely to find on your hardware, and where to jump to the part of the book that discusses it:

- **USB 2 or 3 or USB4:** Most hardware sold since the early 2000s has at least one USB port. See [USB Capabilities](#) and [USB and Thunderbolt](#).
- **FireWire 400 or 800:** Now outdated technology, it was found widely in Macs and some Windows PC models from the late 1990s through the late 2000s. See [USB, FireWire, and Thunderbolt](#).
- **Thunderbolt (original) and Thunderbolt 2:** From 2010 to 2015, these first two flavors predominantly were built into Macs. See [Thunderbolt Capabilities](#).
- **Thunderbolt 3, 4, or 5:** Thunderbolt 3 showed up mostly built into Macs starting around 2016, while Thunderbolt 4 has become a much more broadly used standard beginning in 2021. Thunderbolt 5 was announced in 2023, and first appeared in hardware in October 2024. See [Thunderbolt Capabilities](#) and [USB and Thunderbolt](#).
- **DisplayPort and HDMI:** Dating back 20 years, DisplayPort and HDMI jacks appear on most computers and, in mini and micro forms, on some mobile devices, cameras, and gaming systems. See [DisplayPort and HDMI Capabilities](#) and [Video and Audio](#).
- **Ethernet:** The same Ethernet plug has been dominant for nearly 30 years, even as the speeds that can pass over the wired networking medium have risen from 10 Mbps to 10 Gbps. See [Ethernet Capabilities](#) and [Networking](#).

Introduction

No computer is an island. Every computer needs to connect to other devices, whether internally or through external ports, to realize its potential fully. Even the original, all-in-one 128K Mac or the latest Apple silicon iMac requires an external keyboard and pointing device.

It's a port-based world—and what wonders run over cables and adapters. You can buy a computer that can run four 6K external displays plus one at 4K, 10 Gbps Ethernet, and 40 Gbps Thunderbolt 4, and output 100 watts of power to connected devices. Even those high limits will increase in the near future—in 2024 and beyond!

Mobile devices were once an exception, as most people only plugged them into a power supply to charge or via a simple USB cable to sync—and less of the latter over time. But in 2022, many models of Apple and Android smartphones and tablets can connect via USB, Ethernet, HDMI, or DisplayPort with a suitable adapter. The switch to USB-C as a universal mobile, laptop, and desktop connector has helped.

The latest DSLR and mirrorless cameras aren't excluded, either: they come with video output, like Micro HDMI, and a USB connection for data, remote control, and webcam input.

I know from over 40 years of working with computers and over 30 writing about them, on the list of the most frustrating situations you can encounter—appearing on the list after an unexpected software or operating system crash—is when you need to connect devices and come up empty.

This book focuses on managing connections by knowing what your device is capable of, what cable or adapter you need, and what peripherals you can attach. I'll help you understand the basics of major standards. But my real goal is to solve problems and provide planning guidance for expansion and upgrades.

Connect and Extend

Even in the earliest days of computing, it was obvious that a computer had to have ways for information to enter and leave the system to connect to other hardware. Devices external to computers that added functionality were *peripheral* to the main system, and that's why we call them peripherals to this day. A computer could also connect to some kind of communication system, like a network or hub.

We use a *port* to connect to peripherals, networks, and other kinds of external systems. A port can connect two computing devices, too, like two smartphones or a tablet to a computer. The connection requires cabling—typically with metal inside its insulated cover, but sometimes containing a fiber optic strand—to connect a central computational thing to something else that provides something that isn't built into the main unit.

Note: Wireless devices that use Bluetooth, Wi-Fi, and proprietary standards rely on radio modules built into computers or add-on modules. These devices usually act just like wired peripherals even though no cable is involved. Wi-Fi and Ethernet, for instance, use a very similar protocol for packing and unpacking data networked data.

Tip: Already know all you want about ports? Skip ahead to [Identify Jacks and Plugs](#) to learn how to decipher which ports are on a computer, mobile, or other device, and what capabilities are in a cable.

Discover Peripherals and Devices

Peripherals are historically divided up among input, output, and storage, along with those that can do both, such as a multifunction printer. Other devices you can connect to include an Ethernet switch for local area networking, to a smartphone (or *from* a smartphone), and to power adapters.

Here are some examples among even narrower categories:

- **Data input and pointing:** Keyboards, mice, trackpads, and trackballs, game controllers, microscopes
- **Pixel or rasterized output:** Displays, printers, laser cutters, platesetters, 3D printers, and magnifiers for the visually impaired
- **Audio:** Mics, headphones, headsets, earbuds, and amplified or line-level sound output
- **Image acquisition:** Cameras, scanners, microscopes
- **Storage:** Hard disk drives, SSDs, read-only and read/write CD, DVD, and Blu-ray
- **Terminals:** TTYs for the hearing impaired, Braille keyboards/readers
- **Mobile computers:** Smartphones, tablets, gaming systems
- **Hubs and power adapters:** A hub is a collection of ports, optionally providing power. Older power adapters acted more like passive conduits for AC-to-DC conversion, but modern ones feature tiny computers and may have hub features built in. The hub and power adapter negotiate acceptable standards and the levels of power that may be passed.

Note: Devices that you can connect to a host computer may have their *own* ecosystems of peripherals. For example, an iPad can connect external USB mics and a display via an adapter, or a printer can connect to a separate paper-tray feeder through a connector.

Learn About Ports

To connect to peripherals and other devices you need ports: these are typically receptacles into which a plug slides, snaps, rotates, or magnetically connects. You need to know a little jargon that's commonly used before we proceed as you'll find it printed above ports, on cables, in manuals, and in online instructions.

Identify Jacks and Plugs

Since this book is about “untangling” connections, it’s a good start to know what kinds of hookups you can make with your computers and other devices. You may already know all the ports and their capabilities, but if not, read on in this chapter.

You can determine what ports your device has in three ways: via technical specifications found on the internet or that shipped with the hardware, through software and settings in the device’s operating system, and through visual inspection.

Read Technical Specifications

Every piece of gear you own has a document somewhere that explains all its parameters. The older the equipment, the harder it may be to find this. Here’s how you can proceed:

- **Paperwork:** Look for anything you kept that shipped with the device. It might be as straightforward as a single sheet of paper that labels all the ports.
- **Search online:** Go to the company’s website or use a search engine. Enter the exact model number.
- **Apple equipment:** The [EveryMac.com website](http://EveryMac.com) and the free [Mac-tracker app](#) cover all Apple products, despite the Mac in their names. (There doesn’t appear to be a comparable option for Android, Windows, or other systems.)

Find Operating System Information

All major operating systems reveal some amount of information about the capabilities of built-in and attached hardware.

Macintosh/macOS

Apple has a utility designed to provide all the information you could possibly want and more. Hold down the Option key while clicking the Apple  menu and choose System Information at the top; or launch the app from Applications > Utilities (**Figure 9**).

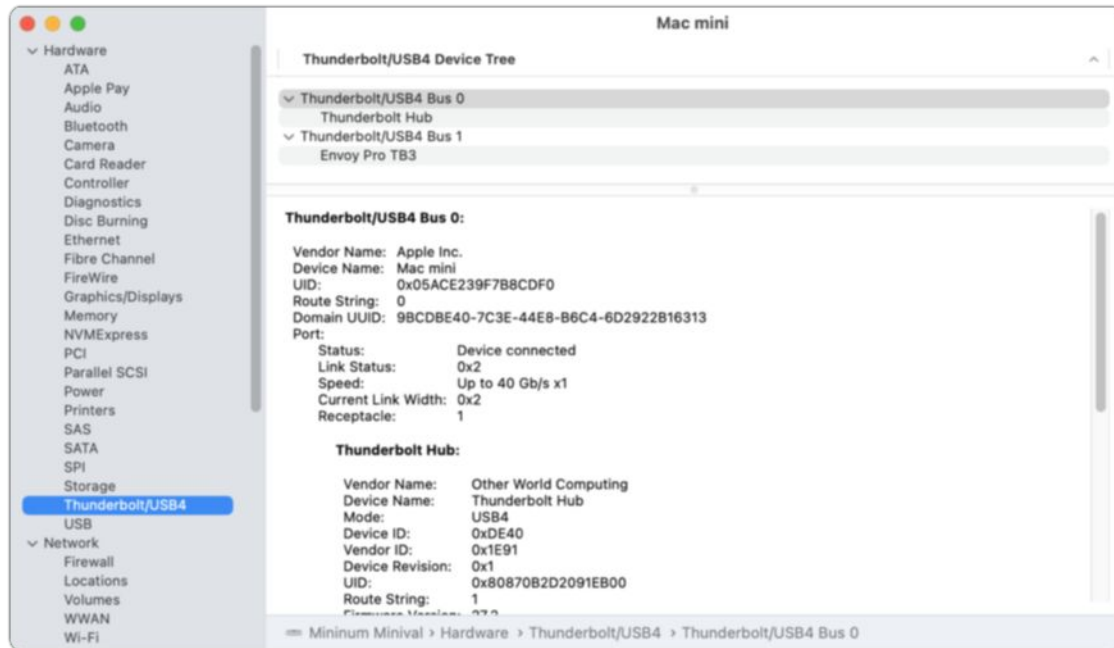


Figure 9: The System Information app in macOS provides all the information you need about ports (and much more you don't).

Along the left-hand side of the window, you see a label at the top that reads Hardware. The app has a separate entry for each different kind of interface or standard. You can click on each item for details. Most pertinent to this book are Ethernet, Graphics/Displays, NVMeExpress, SATA, Storage, Thunderbolt (on my Mac, Thunderbolt/USB4), and USB.

Tip: If you're trying to figure out how many buses you have so you know your system's overall capability, the Thunderbolt and USB items show the count under Device Tree at the top. Here: Bus 0 and Bus 1, or two Thunderbolt/USB4 buses. See also [An Internal Bus Detour](#).

Link Devices with Cables

Some of the key questions you are likely to have about any cable and adapter are:

- What standard(s) does it support?
- What's the highest throughput I can pass across it, and between which devices can I achieve that?
- What's the highest wattage power that can pass across it, if it's a cable that can pass power? (Most can!)

Or, more simply, the plaintive cry I hear all too often: How do I figure out what cable I have?! This section will help.

The good news is that a truly universal cable arrived for modern devices a few years ago: a Thunderbolt 4/USB4 cable works with all USB-C connected standards. An even more modern cable that supports all of the above plus Thunderbolt 5 and USB4 80 Gbps appeared in late 2024 supports all the older standards and those two newer ones. Jump to [Thunderbolt Capabilities](#) for the spoilers.

Tip: I dig into those compatibility questions further in the chapters on [USB and Thunderbolt](#), [Video and Audio](#), and [Networking](#).

Examine the Connector

Depending on your vintage of equipment, you are likely to only see cable or adapters with the following plugs, depending on the standard (see figures earlier in this chapter):

- **USB:** 2.0 or 3.0 Type-A, 2.0 Type-B, 3.0 Micro-B, 2.0 Micro-B, and USB-C
- **Thunderbolt:** Original version or Thunderbolt 2 (Mini DisplayPort style) or Thunderbolt 3, 4, or 5 (USB-C)

- **FireWire:** Appearing on Macs and some Windows systems from the late 1990s through the 2000s
- **DisplayPort or HDMI:** An unchanged connector type across several years, regardless of the generation of standard used
- **Ethernet:** Standard RJ-45, common for three decades
- **Audio:** 3.5 mm or TOSlink

Let's break that down further into the symbols that could appear to provide additional information, the variety of output formats supported, and charging aspects (where appropriate).

A Trend Towards More Detailed Labeling

Cables can be poorly labeled, so I wanted to give a hat tip to cable makers fighting the trend (**Figure 16**). Some use white silkscreening on a black cable for legibility, as in the figure (a generic maker); others mold the spec into the cable as relief or debossed type!



Figure 16: Mmmm, breathe in the rich detail that tells you all the capabilities of the USB cable above.

Not all cables have this kind of detail, of course, but it's a trend that would absolutely help every cable owner.

USB and Thunderbolt

The dominant peripheral standards in 2023—and likely for the next decade...or century—are USB and Thunderbolt. These two standards have swept up nearly every other purpose inside their scope.

On a computer with just a USB 3 or USB4 40 (original or 40 Gbps) port, you can pass data up to 40 Gbps, video, and power up to 240 W; on a device with Thunderbolt 4, you can also pass 40 Gbps of data, video, Ethernet, PCIe (for external GPUs and other high-speed purposes), and power up to 100 W. Jump up to USB4 80 Gbps or Thunderbolt 5 for 80 Gbps of bidirectional data, or to reach a whopping 120 Gbps carrying 80 Gbps of video in one direction and 40 Gbps of bidirectional data in the other. A Thunderbolt 5/USB4 80 Gbps cable must also support up to 240 W.

The big difference to you between the USB and Thunderbolt is whether, when you purchase a new computer or peripheral, it includes a USB4 or Thunderbolt 4 or 5 controller. It's more likely your computer includes Thunderbolt 4 or later, while peripherals other than docks and high-performance SSDs and drive arrays opt for USB, as it's less expensive to build in.

However, that matters less and less, as USB4 and Thunderbolt have converged into a close-enough match that unless you need the absolute highest-throughput or video performance (in resolution or refresh rates), having USB4 40 Gbps or later or Thunderbolt 4 or later is sufficient on either end of the connection.

A USB and Thunderbolt Executive Summary

There's a lot of information in the pages ahead; jump ahead to [USB and Thunderbolt Data](#) if you don't need background on the standard. Here also is a summary of the most important points:

- ✦ USB and Thunderbolt converged on the USB-C connector.
- ✦ The optimal configuration for maximum compatibility and least fuss is a Thunderbolt 4 port and a Thunderbolt 4/USB4 cable up to 0.8 m long. Cables hitting the market in late 2024 can carry USB4 at 40 Gbps or 80 Gbps and Thunderbolt 5 at 80 Gbps.
- ✦ USB 3.2 can carry up to 10 Gbps over a Type-A connector and 20 Gbps over a USB-C connector with ports that support those rates.
- ✦ A Thunderbolt 3 and USB4 connection may top out at 20 Gbps or 40 Gbps. Thunderbolt 4 requires 40 Gbps of data throughput on a Thunderbolt 4 cable; similarly, Thunderbolt 5 requires a Thunderbolt 5 cable to pass up to 80 Gbps.
- ✦ Depending on the port and cable, you can feed 15 W to 100 W over Thunderbolt 3 or 4, 240 W to Thunderbolt 5, and 2.5 W to 240 W over USB 2 or 3 or USB4.

In this chapter, I deal with the recent past and the present, in which slight variations and different generations of technology may leave you swearing at a port or cable. Let's avoid that by diving into where USB-C fits in and the innards the USB and Thunderbolt standards. Then we'll move on to looking at the various ways to pass data and then power across cables, port adapters, and power adapters. But first, a few common scenarios you might encounter as a guide to understand the rest of the chapter.

USB and Thunderbolt Haven't Entirely Converged

The two standards have incorporated parts of each other without fully converging: USB4's higher data rates are an implementation of Thunderbolt 3, while Thunderbolt 3 and 4 rely on USB Power Delivery for laptop levels of power charging. USB4 2.0 (or USB4 80 Gbps) is the basis of Thunderbolt 5. USB4 seems reserved for mobile devices; Thunderbolt is the interface of choices for laptops and desktops.

Video and Audio

The previous chapter was all about USB and Thunderbolt, and you would be forgiven for thinking those two standards were the alpha and omega. That's not strange: USB and Thunderbolt over USB-C now dominate most of what we use with computers and mobile devices. However, other formats persist for now.

You might have a computer with a flavor of DisplayPort or HDMI built in, requiring an adapter on a USB-C-laden computer that omits video connectors. Even some mobile devices include a video port (sometimes in a mini or micro format), though sometimes that port is accessible only via a separate adapter that plugs in using USB-C. In an increasing number of cases, a display comes with native USB-C support alongside a DisplayPort or HDMI jack or a plug at the end of an integral cable.

An HDMI and DisplayPort Executive Summary

Here are the most salient facts about using HDMI and DisplayPort:

- ✦ You can almost always use an adapter to connect an HDMI jack to a DisplayPort jack on a display or DisplayPort to HDMI.
- ✦ Many displays include both HDMI and DisplayPort jacks.
- ✦ HDMI ports on computers may support an older standard, limited to 4K, or a newer one that allows up to 8K.
- ✦ DisplayPort over USB-C has become the preferred method for connecting 6K and higher displays.
- ✦ Most current computer models allow connecting one or more external displays at up to 4K; pro models may allow four to six at up to 4K. Some pro computer models can support one or more 6K or 8K monitors or even 16K.
- ✦ Mobile devices may allow mirroring or extending screens. The limit is set in hardware.
- ✦ Matching standards for the resolution, refresh, and quantity of displays on a host computer or other device and displays you want to connect to them requires reading specifications carefully.

Audio isn't an afterthought, but in modern devices it's incorporated directly into the video standard, obviating the need for a separate audio connection, cable, or configuration. I explain where audio fits in.

First, let's ask our most pressing questions about outputting visual and auditory data. Next, we need a quick detour into compression and why it matters for video standards. Then I take you through DisplayPort and HDMI as standards and what they offer. Finally, we can get into the nitty-gritty of what plugs into what and what number of displays are possible, and at which resolutions and refresh rates.

Video Questions and Answers

People usually pose one of the four following questions about connecting video displays to host devices:

- What cable do I need? The answer is in [DisplayPort and HDMI Capabilities](#). It's straightforward once you know what display and resolution you're using, as determined from the next questions and the rest of this chapter.
- How can I connect a display with a particular resolution and refresh rate to my computer or other device? And...
- Why doesn't my host device support higher resolutions or refresh rates when connected to my display? And...
- How many displays can I attach to my host device?

Those last three questions are linked together. The general answer is that you need to know the capabilities of your host device and display or displays—ones you own or might buy—to see where they intersect. Every piece of hardware has a limit as to how many and what kind of displays you can connect to it; every display has a set of built-in resolutions and refresh rates that it can negotiate with a host controller.

Let's consider a scenario. Suppose Neha owns a desktop computer that predates Thunderbolt 3 and USB-C. It includes just an HDMI port for external video. Should she purchase a 6K display? No: HDMI on her

Networking

Once upon a time, those of us trying to connect devices spent an inordinate amount of time messing with networking. We drilled holes in walls, pulled cables through ceilings and crawl spaces, carefully read the specs on network interface cards, and installed drivers.

There are many reasons I'm grateful to live in the current technological reality, and not having to mess much with networking is one of them. One flavor of Ethernet networking won for wired high-speed local area networks (LANs), and it has continued to mature over several decades.

Note: Wi-Fi, of course, won the wireless LAN battle. Besides its physical component, using radio waves instead of wiring, Wi-Fi is nearly identical in function and form to Ethernet.

As I first explained in [Ethernet Capabilities](#), the RJ-45 connector/jack that resembles a supersized telephone plug is all you encounter for home and nearly all business Ethernet networking. (You may see other versions for 10 Gbps or faster flavors on servers and in very high-end applications.)

Many desktop computers and some laptops include an Ethernet jack. However, if you need one and it's not available on your computer or you're using a mobile device, you can almost always use a USB or similar adapter:

- **USB 3.0 and later over Type-A or USB-C:** Many operating systems, including macOS and Windows, support Ethernet natively passed via USB or Thunderbolt. Adapters don't require drivers if the operating system supports it. Data is passed seamlessly, just as if native Ethernet were in use.
- **Docks:** Many USB-C docks (USB 3.x and Thunderbolt) include a gigabit Ethernet port. Some include 2.5 Gbps Ethernet.
- **USB 2.0 Type-A:** Many companies still offer USB 2.0 Ethernet adapters that work with Type-A connectors. These may require

drivers and may not work on all operating systems. Even though USB 2.0 operates at 480 Mbps, you can still use gigabit Ethernet, capped at that speed.

- **Lightning and mobile USB:** Some mobile devices can also accept Ethernet via a USB or proprietary adapter. For instance, Belkin offers a Lightning-based [iPhone Ethernet/passthrough power adapter](#) for up to 180 Mbps data rates over gigabit Ethernet.

The most likely form of Ethernet you encounter is gigabit Ethernet, which operates, unsurprisingly, at 1 Gbps. Once a luxury, gigabit Ethernet is the baseline flavor in all currently sold computers and other hardware that includes wired networking, and in most computers dating back several years—even a decade or more.

Three other speeds of Ethernet still circulate:

- **100 Mbps:** The oldest form widely in use, introduced in 1995, you find it almost exclusively in inexpensive wireless network extenders. Avoid it where possible, but it won't slow down other devices: all gigabit Ethernet equipment is backwards compatible.
- **2.5 Gbps:** The 2.5 Gbps flavor bridges the gap between 1 Gbps and the corporate-oriented and expensive 10 Gbps. As you move more data around a network, particularly streaming video, 2.5 Gbps may feel necessary. Some Thunderbolt docks include 2.5 Gbps Ethernet connections. This flavor of Ethernet remains backwards compatible with 100 Mbps and 1 Gbps versions.
- **10 Gbps:** Most homes have no need for 10 Gbps, and Ethernet switches that incorporate 10 Gbps remain expensive for the most part. However, Thunderbolt 4 adapters for 10 Gbps (also expensive) make it feasible if it's really one of your needs.

Note: While 100 Mbps Ethernet still floats around, you're unlikely to encounter it except with old adapters. I have found some cheap Wi-Fi extenders still sold that feature 100 Mbps, too. It doesn't matter, though: If you're using 1 Gbps Ethernet or faster, it handles 100 Mbps without missing a beat (or packet).

Cable Organization

How could a book with untangling in its title avoid offering suggesting on the actual management of physical cables? And how could a writer of a book with this title be anything less than exemplary in his organization of cables in his home (**Figure 46**)?



Figure 46: Witness an example of household cable management.

I'll confess: I'm not perfect. But I do use a variety of techniques to keep my cables from become tangled, bent, worn, or hard to access:

- **Use Velcro wraps to loop cables:** Avoid the sprawl of cables everywhere by using the simplest thing possible: Velcro cord wraps. They come in many sizes and colors, can be easily adjusted, and are removable. I'd avoid zip ties: most kinds can't be easily removed after they're ratcheted on without cutting them off—carefully!

- **Mount power strips and devices to the wall:** To avoid running cables all over the floor, use the built-in screw mounts in most wireless routers, Ethernet switches, power strips, and surge protectors to attach them to the wall. It's much easier to control cables dangling or extending from the wall.

Coil a Cable Correctly

As a former soundboard engineer for indoor and outdoor theatrical performances, one of the most painful things I see is people rolling up audio cables incorrectly—it also happens with Ethernet, Thunderbolt, USB, and others!

The cords that connect from a device to an AC/DC converter and the AC power cords that connect from computers or bricks to the wall tend to be forgiving.

But cords that carry audio or data use finer wire and sometimes even fiber optic strands. They're carefully constructed and fragile enough that you can't just wrap them tightly and tuck in one end to secure the wrapped bundle.

Instead, when rolling an audio or data cable, you need to "feel" the natural direction of the roll as you coil it. Alternate loops generally coil over (on top of the current coils) and under (wrapped beneath the round you're making).

Let the slack end drop and gently try to roll the cable as you make loose rounds, typically between about 8 and 18 inches (20–45cm), depending on the cable thickness. You sense the cable naturally flopping into the right position as it loops, and watch the loose end twirl as it untwists itself. [This video may help](#).

- **Label cables or use differently colored labels:** As I've noted throughout this book, you might wind up with a lot of different cables that have different capabilities—particularly USB-C. Finding cables that aren't just wrapped in black or white plastic or that you can easily attach a label or colored tape to can help you avoid having to test a cable every time you find it (**Figure 47**).

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About the Author



Glenn Fleishman never stops writing about technology and its implications. He's in his fourth decade of writing for publications as varied as *American History*, *Fast Company*, the *Economist*, the *New York Times*, *Macworld*, and TidBITS, among many others. In 2012, he was a two-game champion on Jeopardy!

You can find Glenn on the socials: [Mastodon](#), [Bluesky](#), [Instagram](#), and [Threads](#), as well as [on his blog](#). Oh, and he does answer email sent to glenn@glennf.com.

Shameless Plug from Glenn

My latest non-computer technology book is *How Comics Were Made*, a 288-page full-color book that traces the history of newspaper comics in North America from 1896 to the present. I take a unique angle: I look at production (how cartoonists made them) and reproduction (how newspapers printed them), from original art through printing artifacts and onto the newsprint page. I also discuss modern digital production, including webcomics.

You can get a copy of the book directly from me while copies last. Visit <https://howcomicsweremade.ink> for more information.

About the Publisher

alt concepts, publisher of Take Control Books, is operated by [Joe Kissell](#) and [Morgen Jahnke](#), who acquired the ebook series from TidBITS Publishing Inc.'s owners, Adam and Tonya Engst, in 2017. Joe brings his decades of experience as author of more than 60 books on tech topics (including many popular Take Control titles) to his role as Publisher. Morgen's professional background is in development work for nonprofit organizations, and she employs those skills as Director of Marketing and Publicity. Joe and Morgen live in Saskatoon, Saskatchewan, Canada, with their two children and their cat.

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