

EBOOK EXTRAS: v1.0
Downloads, Updates, Feedback



TAKE CONTROL OF

YOUR DIGITAL STORAGE

**FOR
MAC**

by **JEFF CARLSON**

\$12.99

[Click here to buy the full 124-page "Take Control of Your Digital Storage" for only \\$12.99!](#)

Table of Contents

Read Me First	4
Updates and More	4
Introduction	6
Your Digital Storage Quick Start	7
Understand Storage	9
Hard Drives	9
Solid-State Drives	21
How Much Storage Do You Need?	25
How to Dispose of a Hard Disk	27
RAID	28
Disk Images	40
Cloud Storage	46
Format and Partition Disks	50
Understand Filesystems.....	50
Get Started with Disk Utility	58
Format a Disk and Erase Its Contents.....	59
Manage Partitions and Volumes	65
Run First Aid	70
Encrypt Disks.....	77
Use Network-Attached Storage (NAS)	85
Features to Look for in a NAS	86
Work with Files on a NAS.....	91
NAS for Photography	101
Manage Your Data	110
Choose Your Own Storage Adventure.....	110
Free Up Disk Space	115
Make Backups	118

About This Book.....	120
Ebook Extras	120
About the Author	121
About the Publisher	122
Copyright and Fine Print	124

Read Me First

Welcome to *Take Control of Your Digital Storage*, version 1.0.1, published in July 2018 by alt concepts inc. This book was written by Jeff Carlson and edited by Joe Kissell.

This book guides you through your ever-growing digital storage needs, from replacing or adding hard disks and SSDs to using network-attached storage (NAS) devices and cloud services. It demystifies deep-dive topics such as RAID, Apple's new APFS filesystem, creating and resizing volumes and partitions, and disk encryption, and it offers real world advice on freeing up disk space and choosing where data resides.

If you want to share this ebook with a friend, we ask that you do so as you would with a physical book: “lend” it for a quick look, but ask your friend to buy a copy for careful reading or reference. Discounted classroom and Mac user group copies are available.

Copyright © 2018, Jeff Carlson. All rights reserved.

Updates and More

You can access extras related to this ebook on the web (use the link in [Ebook Extras](#), near the end; it's available only to purchasers). On the ebook's Take Control Extras page, you can:

- Download any available new version of the ebook for free, or buy any subsequent edition at a discount.
- Download various formats, including PDF, EPUB, and Mobipocket. (Learn about reading on mobile devices on our [Device Advice](#) page.)
- Read the ebook's blog. You may find new tips or information, as well as a link to an author interview.

If you bought this ebook from the Take Control website, it has been added to your account, where you can download it in other formats

and access any future updates. However, if you bought this ebook elsewhere, you can add it to your account manually; see [Ebook Extras](#).

Basics: To review background information that might help you understand this book better, such as finding System Preferences and working with files in the Finder, I recommend reading Tonya Engst's ebook [*Take Control of Mac Basics*](#).

Introduction

In an ideal world, this book wouldn't exist. You should never need to worry about the specifics of where your documents, photos, videos, and other files are stored, only that they're safe and accessible when you want them.

We live in the real world, though, and you're likely reading this because your current storage arrangement needs adjustment: You're running out of disk space, or you need to replace or repair a drive that's not working. Perhaps you're in the market to buy a network-attached storage (NAS) device, but the sheer number of options is overwhelming. (Or, you might just like to learn new information. Hooray for curiosity!)

Storage mostly recedes into the background—until something goes wrong, or you need more of it, or you get a new computer and realize that what you really *should* do is re-evaluate your entire storage system.

So you dig in...and it's like opening a wall in your house. Which wires carry the electricity? Is that a cold water or hot water pipe? Is it even a water pipe? Are these old connections, or has some new technology emerged to replace them? And how did all of that dust and cruff get in here?

This is when knowledge of how storage works in your Mac helps immeasurably. The options are varied and can make even the most ardent technologist glaze over. But with an understanding of your storage options at hand, you can make better decisions that let you focus on the data that's important to you, not on finding or dealing with it.

Your Digital Storage Quick Start

As we expand our digital storage needs to consume more data, we also find ourselves expanding the ways in which we manage and work with that data. Although you don't need to read this book front-to-back, I recommend you go through the [Understand Storage](#) chapter to get a baseline on which the rest of the book is built.

Understand storage basics:

- Learn the differences between internal and external [Hard Drives](#) (and the many ways they connect to your computer).
- Learn the advantages of [Solid-State Drives](#) (SSDs) compared to traditional hard drives, and when to choose one or the other.
- If you're looking to expand your capacity, [How Much Storage Do You Need?](#)
- Learn about [Disk Images](#) and when you'd use them.

Understand RAID:

- Learn what a [RAID](#) is and under what circumstances you'd use one.
- Determine which of the [RAID Levels](#) is best for your situation.

Look to Cloud Storage:

- Use [Cloud Storage](#) such as Dropbox, iCloud Drive, and Google Drive to store data remotely.
- Learn about which types of data are applicable when you [Choose Cloud Storage](#), including the option to optimize storage on your Mac.

Learn About Filesystems:

- Understand [APFS](#) (Apple File System), Apple's new underlying filesystem, and its advantages.

- Learn about other filesystems, such as [Mac OS Extended](#), MS-DOS (FAT), and ExFAT.
- [Manage Partitions and Volumes](#) using both APFS and Mac OS Extended, and learn how they work independently and together.

Use Disk Encryption:

- Use [FileVault](#) to protect your disk's data.
- [Encrypt a Non-Startup Volume](#) for security beyond your startup disk.
- What if you lost your password? [Recover Access to a FileVault-Protected Disk](#).

Manage drives using Disk Utility:

- [Format a Disk and Erase Its Contents](#).
- [Run First Aid](#) when a disk seems ill (and understand [What First Aid Does](#)).

Work with Network-Attached Storage (NAS):

- Learn which [Features to Look for in a NAS](#) if you're in the market to buy one.
- Learn how to [Work with Files on a NAS](#).
- Since photography occupies so much storage (and because I'm a photographer), learn how to use [NAS for Photography](#).

Manage your data:

- [Determine Available Storage](#) on a disk (and know when that number might not be accurate).
- Learn smart strategies to [Free Up Disk Space](#).

Understand Storage

Generally speaking, computer storage comes in two forms: hard drives and solid-state memory. Those can exist inside the computer, outside the computer (in external cases connected by a cable, or flash memory drives and cards), or as memory chips soldered directly to the computer's main logic board. This chapter looks at the structural details of how they work, which we will build on for other topics.

Hard Drives

The term *hard drive* has become a catch-all for nearly any type of computer storage, but in the context of this book, I'm talking about the traditional, spinning-platter media that has been the standard for decades. A hard drive (sometimes referred to as a *hard disk drive*, or *HDD*) is a self-contained box that includes several circular platters, with an actuator arm that reads and writes data to the magnetic surface of the platters (**Figure 1**).



Figure 1: Each metal enclosure here contains spinning platters and 4 TB of storage.

Typically, the platters spin continuously, although most drives also support power-saving features that pause them when they're not actively being used. If you've come back to your computer and experienced a short lag before it's responsive again, chances are the hard drive was spinning back up.

To get a picture of how hard disks work, and the specifications you need to know about them, let's start inside a drive and move outward.

Important Hard Drive Specifications

We think of drive capacity first when it's time to replace or upgrade storage, but just as important are the drive's dimensions, rotation speed, amount of cache, and the connection type.

Capacity

This comparison isn't practically relevant, but bear with me, because it's fun to think about: The original Apple I and Apple II models included no storage, but you could connect a cassette player and store software on the same type of magnetic tape used for listening to music. Even the first Macintosh models relied on floppy disks for storage, not hard drives. In fact, hard drives didn't start to appear regularly on Macs until the Macintosh SE, with its *optional* 20 megabyte (MB) or 40 MB drive.

Today, the smallest capacity you can get for a Mac is 128 gigabytes (GB) of SSD storage (the MacBook Air); the entry-level iMac storage starts at 1 terabyte (TB). To put those numbers into perspective:

- 1 TB = 1,000 GB
- 1 GB = 1,000 MB
- 1 MB = 1,000,000 bytes

So, 1 terabyte is equal to *1 million* megabytes, or 50,000 Macintosh SE hard drives. For many uses, 1 TB is just the beginning—my photo collection alone tops 2 TB. As of mid-2018, you can buy single drives with capacities up to 14 TB. (See [How Much Storage Do You Need?](#) to determine the capacity that will work for you.)

Format and Partition Disks

I'm a terrible handyman, and yet even I know that if you start a project on shaky ground or incorrect measurements, you'll wind up with cascading problems later.

So when we look at managing the data on a hard disk or SSD, we need to start at the base layer and work upward from there. The filesystem that undergirds macOS is an invisible, but essential, component of the operating system that controls how and where data is written on the sectors on a spinning platter or in the cells of a solid-state memory chip. For years, the filesystem wasn't anything most people had to think about, but with the arrival of macOS High Sierra in 2017, the default Mac filesystem changed from Mac OS Extended to APFS (Apple File System) on some systems.

When you need to format a disk or split it into sub-volumes, you'll want to make an informed choice.

Understand Filesystems

To be fair, the filesystem is still something that most people don't need to think about. If you've upgraded to High Sierra (or later) and your Mac has an SSD, it was automatically upgraded to APFS. You may notice faster copying and other file operations, but otherwise you shouldn't notice a big change—that's a good thing. Before we get to formatting or partitioning a disk later in this chapter, let's cover the filesystem options you'll encounter and how they differ.

Mac OS Extended

The default Mac filesystem for years, Mac OS Extended (Journaled) is still in wide use, making it the most compatible option. Also commonly known as *HFS+* (where HFS stands for Hierarchical File System), it's designed to read and write data to spinning disks using the read/write heads at the end of the armature.

The “journaled” parenthetical in the name refers to a method of error correction used to prevent bad sectors or other data abnormalities. When copying a file, for instance, the operating system may need to write it in pieces to several sectors on the disk; journaling checks to make sure all the pieces are successfully written and the file is intact.

The disadvantage to Mac OS Extended (Journaled), and the reason it’s being replaced by APFS, is that it’s not optimized for use with solid state storage. The physical location of a piece of data isn’t as important within an SSD’s memory cells as it is on the surface of a magnetic platter.

For our purposes, the important part of Mac OS Extended is the way it allocates space on a disk.

Imagine the disk is a factory that builds rockets. (I suppose I could instead use an office building as a metaphor, but wouldn’t you rather imagine spaceships?)

On a disk formatted as Mac OS Extended, the factory is a giant open space where the rockets can be assembled, parts can be stacked in certain areas (or strewn across the floor, because they’re all easily located, but the factory manager keeps things orderly). That’s the free space on the disk.

There’s also a secret door that opens to a hidden room filled with emergency equipment that nobody pays attention to unless something goes wrong on the factory floor. That room represents macOS Recovery, the invisible startup partition that runs a scaled down version of the operating system when you want to run repairs on your main macOS installation.

Now, let’s say you want to partition the disk into two volumes; or, in our example, split the factory into two sections to build two rockets simultaneously. Under Mac OS Extended, you’d erect a permanent wall between the sections, creating two separate rooms. (The hidden macOS Recovery room is still there, too. Safety first, people.)

Soon your rocket business is growing quickly, and you realize you need to build a larger rocket that will get a spacecraft to Mars. The problem

Use Network-Attached Storage (NAS)

When I asked a technical friend about his opinion on which kind of Network-Attached Storage (NAS) device to buy, his response mirrored my own (and perhaps yours, too): He'd been thinking about getting one, but the sheer number of variables involved kept him away from actually making a purchase.

A NAS itself typically looks like an unassuming largish box, sometimes with just a single drive, but more often with two or more drive bays into which you insert bare hard drives or SSDs (making it possible to upgrade the overall storage over time by using higher-capacity drives). The magic that makes it special is that it's also a computer in its own right, with a processor, operating system, and RAM to handle all of its tasks.

The NAS connects to the network via Ethernet cable, making it available to everyone else on the same network. And in many cases, the NAS can be accessed when you're outside the local network. If you arrive somewhere and realize that an important file is stored on a disconnected hard disk (even if you're on the couch downstairs and the drive is in the home office upstairs), it's no problem; that file is available just as if its drive was directly connected to the computer.

Several vendors sell NAS units, such as [Synology](#), [QNAP](#), [Drobo](#), and [WD](#). And among those, you'll find models designed for personal use, for small offices, and for industrial applications.

Disclaimer: NAS devices come in many sizes, configurations, feature sets, and price ranges. It would be madness to try to cover all of them. So, in this chapter where I'm covering most of the major features to pay attention to in a NAS, I'm using the one I eventually purchased, a Synology model, as an example, not an endorsement.

Features to Look for in a NAS

If you thought looking at hard drive specs was eye-glazing, wait until you wade into the technicalities of NAS devices. Price is always a consideration, and some manufacturers mix and match components to hit price points—a unit might have four drive bays instead of two, for example, but use an older processor and offer less RAM. But that also means you can find something in your budget that does the tasks you expect a NAS to do.

NAS vs. External Drive

Before we step through the features themselves, ask yourself why you might consider a NAS instead of an external hard drive. Some common reasons include:

- **More storage:** A NAS can offer more storage than a single external drive. I put off buying a NAS for a long time because hard drive capacities kept expanding to fit my needs (thanks, manufacturers!). Although I knew a NAS could provide more than what a single disk offered, it was easier to bump up the storage and go with what I was familiar with. That started to get expensive, though. When storage needs outpace individual disk sizes, a NAS with several drive bays becomes more appealing.
- **Expandable storage:** A NAS is designed to grow with your data needs; when an internal hard drive fills up, replace it with a higher-capacity one. I could go through my office and count the current and retired external hard drives, with their enclosures and cables and power supplies, but that would be too depressing.
- **Protection against drive failure:** Related to the above, it's no fun when hard drives fail—and they do fail. Some NAS devices are built as RAID 1 or RAID 5 arrays (see [RAID](#)), or proprietary variations that incorporate the same technology, to mirror data such that if a disk crashes, you don't lose data. And if that does happen, you can keep using the NAS volume while swapping out the bad drive.

Manage Your Data

At one point, having all your data on one internal disk was sufficient, but smaller-capacity SSDs and other factors have made storage more complicated. In this chapter, I recommend strategies for choosing which data belongs where—internal storage, external storage, or in the cloud—and how to free up disk space. The goal, as much as possible, is to make sure your stuff is easily accessible and to avoid any surprises.

Choose Your Own Storage Adventure

It's tempting to start shoving data onto other disks when your primary storage fills up, like cramming stuff into a closet when you need to clean a room quickly. That gets the data out of sight, but also out of mind, making it harder to find later. Plus, some types of information need to stay on the internal disk, while others are more suited to external or cloud storage.

Choose Internal Storage

Setting aside non-trivial components like the system itself and apps, you generally want to keep active project files and documents you use on a daily basis on the internal disk. Basically, that includes anything that would interrupt what you need to do on the computer if the data were unavailable. Leave the `/System` and `/Library` folders alone.

For performance reasons, you may want to keep local scratch files used by Photoshop or video editing apps on your startup disk, even though those can temporarily occupy a lot of space. The speedy solid-state memory built into the latest MacBook Pro models will give you better performance than mechanical disks. That said, this is highly dependent on your computer, the amount of RAM installed, and the level of editing you're doing. Serious editing pros typically set up an external drive or a RAID 0 array dedicated solely as a scratch disk.

Note: The flip side of using solid-state storage for scratch files is that the frequent data writes shorten the SSD's lifespan. However, SSDs are designed to last for hundreds of terabytes of use. As always, your mileage may vary.

Choose External Storage

Data you shunt to an external disk is usually old, large, or both. Material you don't need to access day to day can be archived on an external drive; if you have a NAS, you can easily grab the data when you need it (see [Work with Files on a NAS](#)).

Large files seem ideal for transferring to an external disk, since they're usually the first space hogs that you identify when you're looking to [Free Up Disk Space](#). However, that approach can be mixed, depending on the data. Some common considerations include:

- **Virtual machines:** The disk images created by Parallels Desktop and VMware Fusion tend to be huge, because they contain entire operating systems and computing environments. Moving them off your internal storage can slow their performance unless the destination is a fast SSD connected via USB 3.0 or Thunderbolt.
- **Music and videos:** Your iTunes library is composed of many music and movie files you probably don't consume every day, so moving it to an external disk will often free up a lot of disk space. (See [Manage and back up your iTunes media library](#) for detailed steps on how to accomplish the move.) However, the library must be on a disk that's always connected to your Mac, otherwise you can't access the media.

Another option is to keep the iTunes library database on your internal disk, but reference the media files themselves from an external disk. To do this, go to iTunes > Preferences, click the Advanced button, and then turn *off* "Copy files to iTunes Media folder when adding to library" (**Figure 51**). When you import new media using File > Add to Library, iTunes just remembers the files' locations for playback.

About This Book

Thank you for purchasing this Take Control book. We hope you find it both useful and enjoyable to read. We welcome your [comments](#).

Ebook Extras

You can [access extras related to this ebook](#) on the web. Once you're on the ebook's Take Control Extras page, you can:

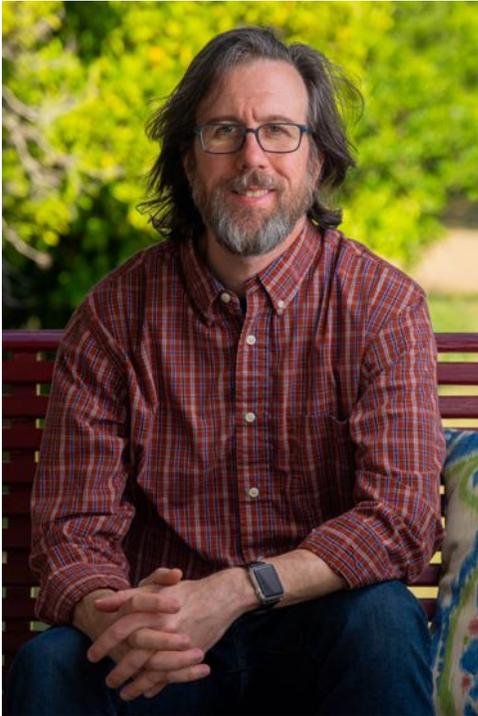
- Download any available new version of the ebook for free, or buy a subsequent edition at a discount.
- Download various formats, including PDF, EPUB, and Mobipocket. (Learn about reading on mobile devices on our [Device Advice](#) page.)
- Read the ebook's blog. You may find new tips or information, as well as a link to an author interview.
- Find out if we have any update plans for the ebook.

If you bought this ebook from the Take Control website, it has been automatically added to your account, where you can download it in other formats and access any future updates. However, if you bought this ebook elsewhere, you can add it to your account manually:

- If you already have a Take Control account, log in to your account, and then click the “access extras...” link above.
- If you don't have a Take Control account, first make one by following the directions that appear when you click the “access extras...” link above. Then, once you are logged in to your new account, add your ebook by clicking the “access extras...” link a second time.

Note: If you try these directions and find that your device is incompatible with the Take Control website, [contact us](#).

About the Author



Author and photographer Jeff Carlson (@jeffcarlson on [Twitter](#) and [Instagram](#), jeff@jeffcarlson.com) is a columnist for the Seattle Times and a contributing editor at [TidBITS](#), plus he writes for publications such as Macworld and DPReview. He is the author of [Take Control of Your Digital Photos](#) and [Take Control of Lightroom CC](#), among many other books. He believes there's never enough coffee and does his best to test that theory.

Acknowledgments

First and foremost, my thanks go to Joe Kissell for shepherding this project into existence, cajoling me in the most encouraging way possible when needed, and for being a patient and keen editor.

I also want to thank Morgen Jahnke and Joe as co-publishers of Take Control, for their steady hands directing this wonderful publishing house.

I owe gratitude and sushi to Glenn Fleishman for his contributions to this book, and drinks to Agen Schmitz and Andrew Laurence for letting me bounce ideas and questions at them.

And no project is complete without the support of my wife, Kimberly, and my daughter, Ellie, who endure this late-night writer's schedule and occasional stress levels.

Shameless Plug

I produce a lot of creative material—something which I'm honored to be able to do—including photographs, books for Take Control and Rocky Nook, the [PhotoActive podcast](#), and articles for Macworld, the Seattle Times, DPReview, CreativePro, and other outlets. Find my work at jeffcarlson.com and sign up for my [low-volume newsletter](#) to learn about new projects and occasional deals and giveaways. Thank you!

About the Publisher

alt concepts inc., 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 May 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 San Diego with their two children and their cat.

Credits

- Editor and Publisher: Joe Kissell
- Cover design: Sam Schick of [Neversink](#)
- Logo design: Geoff Allen of [FUN is OK](#)

More Take Control Books

This is but one of many Take Control titles! Most of our books focus on the Mac, but we also publish titles that cover other Apple devices, along with general technology topics.

You can buy Take Control books from the [Take Control online catalog](#) as well as from venues such as Amazon and the iBooks Store. But it's a better user experience and our authors earn more when you buy directly from us. Just saying...

Our ebooks are available in three popular formats: PDF, EPUB, and the Kindle's Mobipocket. All are DRM-free.

Copyright and Fine Print

Take Control of Your Digital Storage

ISBN: 978-1-947282-25-4

Copyright © 2018, Jeff Carlson. All rights reserved.

[alt concepts inc.](#) 4142 Adams Ave. #103-619, San Diego CA 92116, USA

Why Take Control? We designed Take Control electronic books to help readers regain a measure of control in an oftentimes out-of-control universe. With Take Control, we also work to streamline the publication process so that information about quickly changing technical topics can be published while it's still relevant and accurate.

Our books are DRM-free: This ebook doesn't use digital rights management in any way because DRM makes life harder for everyone. So we ask a favor of our readers. If you want to share your copy of this ebook with a friend, please do so as you would a physical book, meaning that if your friend uses it regularly, they should buy a copy. Your support makes it possible for future Take Control ebooks to hit the internet long before you'd find the same information in a printed book. Plus, if you buy the ebook, you're entitled to any free updates that become available.

Remember the trees! You have our permission to make a single print copy of this ebook for personal use, if you must. Please reference this page if a print service refuses to print the ebook for copyright reasons.

Caveat lector: Although the author and alt concepts inc. have made a reasonable effort to ensure the accuracy of the information herein, they assume no responsibility for errors or omissions. The information in this book is distributed "As Is," without warranty of any kind. Neither alt concepts inc. nor the author shall be liable to any person or entity for any special, indirect, incidental, or consequential damages, including without limitation lost revenues or lost profits, that may result (or that are alleged to result) from the use of these materials. In other words, use this information at your own risk.

It's just a name: Many of the designations in this ebook used to distinguish products and services are claimed as trademarks or service marks. Any trademarks, service marks, product names, or named features that appear in this title are assumed to be the property of their respective owners. All product names and services are used in an editorial fashion only, with no intention of infringement. No such use, or the use of any trade name, is meant to convey endorsement or other affiliation with this title.

We aren't Apple: This title is an independent publication and has not been authorized, sponsored, or otherwise approved by Apple Inc. Because of the nature of this title, it uses terms that are registered trademarks or service marks of Apple Inc. If you're into that sort of thing, you can view a [complete list](#) of Apple Inc.'s registered trademarks and service marks.