Apple Pro Training Series

macOS Support Essentials 11

Supporting and Troubleshooting macOS Big Sur

Arek Dreyer and Adam Karneboge

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macOS Support Essentials 11

Supporting and Troubleshooting macOS Big Sur

Arek Dreyer and Adam Karneboge

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macOS Support Essentials 11: Supporting and Troubleshooting macOS Big Sur – Apple Pro Training Series
Arek Dreyer and Adam Karneboge
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IMPORTANT: Some of the exercises contained in this guide can be temporarily disruptive, and some exercises, if performed incorrectly, could result in data loss or damage to system files. As such, it's recommended that you perform these exercises on a Mac computer that is not critical to your daily productivity.

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Thanks to Heather Jagman for her love, support, and encouragement.

—Arek Dreyer

This book is dedicated to my father, who gave me the greatest gift anyone could give another person. He believed in me.

—Adam Karneboge

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Contents at a Glance

About This Guide xv

Installation and Configuration

Lesson 1 Introduction to macOS 3
Lesson 2 Update, Upgrade, or Reinstall macOS 15
Lesson 3 Set Up and Configure macOS 45
Lesson 4 Use the Command-Line Interface 97
Lesson 5 Use macOS Recovery 129
Lesson 6 Update macOS. 161

User Accounts

Lesson 7 Manage User Accounts 181
Lesson 8 Manage User Home Folders 229
Lesson 9 Manage Security and Privacy. 253
Lesson 10 Manage Password Changes. 311

File Systems

Lesson 11 Manage File Systems and Storage 339
Lesson 12 Manage FileVault 381
Lesson 13 Manage Permissions and Sharing 393
Lesson 14 Use Hidden Items, Shortcuts, and File Archives. 421

Data Management

Lesson 15 Manage System Resources. 443
Lesson 16 Use Metadata, Siri, and Spotlight 463
Lesson 17 Manage Time Machine 493

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Apps and Processes

Lesson 18 Install Apps 523
Lesson 19 Manage Files 565
Lesson 20 Manage and Troubleshoot Apps 625

Network Configuration

Lesson 21 Manage Basic Network Settings 683
Lesson 22 Manage Advanced Network Settings 707
Lesson 23 Troubleshoot Network Issues 747

Network Services

Lesson 24 Manage Network Services 771
Lesson 25 Manage Host Sharing and Personal Firewall 813

System Management

Lesson 26 Troubleshoot Peripherals 863
Lesson 27 Manage Printers and Scanners 883
Lesson 28 Troubleshoot Startup and System Issues 921

Index 959

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Table of Contents

About This Guide xv

Installation and Configuration

Lesson 1 Introduction to macOS 3
Reference 1.1 macOS Big Sur 11 3
Reference 1.2 What's New in macOS Big Sur 4
Reference 1.3 Use macOS Help 11
Reference 1.4 Review macOS History 13

Lesson 2 Update, Upgrade, or Reinstall macOS 15
Reference 2.1 macOS Installation Methods 15
Reference 2.2 Prepare to Upgrade or Reinstall macOS 17
Reference 2.3 Upgrade or Install macOS 25
Reference 2.4 Troubleshoot Installation Issues 27
Exercise 2.1 Prepare a Mac for Upgrade 29
Exercise 2.2 Upgrade to macOS Big Sur 34
Exercise 2.3 Erase a Mac and Install macOS Big Sur 39
Exercise 2.4 Verify That macOS Is Installed Correctly 43

Lesson 3 Set Up and Configure macOS 45
Reference 3.1 Configure a Mac with a New Installation of macOS Big Sur 45
Reference 3.2 Manage System Settings 56
Exercise 3.1 Configure a Mac for Exercises 73
Exercise 3.2 Configure System Preferences 77
Exercise 3.3 Download Student Materials 86
Exercise 3.4 Install a Configuration Profile 89
Exercise 3.5 Examine System Information 93

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Lesson 4	Use the Command-Line Interface	97
Reference 4.1	CLI Basics	97
Reference 4.2	CLI Navigation	106
Reference 4.3	Manipulate Files in the CLI	109
Reference 4.4	Manage macOS from the CLI	112
Reference 4.5	Command-Line Tips and Tricks	113
Exercise 4.1	Command-Line Navigation	115
Exercise 4.2	Manage Files and Folders with Commands	119
Lesson 5	Use macOS Recovery	129
Reference 5.1	Start Up from macOS Recovery	130
Reference 5.2	Use macOS Recovery	135
Reference 5.3	Secure Startup	136
Reference 5.4	Create a Bootable Installer for macOS	146
Exercise 5.1	Use macOS Recovery	147
Exercise 5.2	Create a macOS Install Disk	153
Lesson 6	Update macOS	161
Reference 6.1	Automatic Software Updates	161
Reference 6.2	Use MDM to Install macOS Updates	173
Reference 6.3	Examine Installation History	173
Exercise 6.1	Use Automatic Software Update	174

User Accounts

Lesson 7	Manage User Accounts	181
Reference 7.1	User Accounts	181
Reference 7.2	Configure User Accounts	190
Reference 7.3	Restrict Local User Access with Screen Time	194
Reference 7.4	Configure Login and Fast User Switching	202
Exercise 7.1	Create a Standard User Account	210
Exercise 7.2	Manage a User Account Using Screen Time	219
Lesson 8	Manage User Home Folders	229
Reference 8.1	User Home Folders	229
Reference 8.2	Delete User Accounts and Preserve Their Home Folder Contents	237
Reference 8.3	Migrate and Restore Home Folders	238
Exercise 8.1	Restore a Deleted User Account	243

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Lesson 9 Manage Security and Privacy 253
Reference 9.1 Password Security 253
Reference 9.2 Manage Secrets in Keychains 256
Reference 9.3 Use iCloud Keychain 262
Reference 9.4 Manage Systemwide Security 264
Reference 9.5 Manage User Privacy 267
Reference 9.6 Use Find My 278
Reference 9.7 Protect Your Mac with Activation Lock 287
Reference 9.8 Approve Legacy System Extensions 289
Reference 9.9 Approve System Extensions 291
Reference 9.10 Lock Your Screen 293
Exercise 9.1 Manage Keychains 295
Exercise 9.2 Allow Apps to Access Your Data 305

Lesson 10 Manage Password Changes 311
Reference 10.1 Change Known Passwords 311
Reference 10.2 Reset Lost Passwords 313
Reference 10.3 Manage User Keychains 319
Exercise 10.1 Reset Account Passwords in macOS Recovery 323
Exercise 10.2 Reset Account Passwords 326
Exercise 10.3 Observe Automatic Login Keychain Creation 329

File Systems

Lesson 11 Manage File Systems and Storage 339
Reference 11.1 File Systems 340
Reference 11.2 Mount, Unmount, and Eject Disks 353
Reference 11.3 Inspect File-System Components 356
Reference 11.4 Manage File Systems 360
Reference 11.5 Troubleshoot File Systems 364
Exercise 11.1 View Disk and Volume Information 369
Exercise 11.2 Erase a Storage Device 375
Exercise 11.3 Repair Volumes in Recovery Mode 378

Lesson 12 Manage FileVault 381
Reference 12.1 FileVault Introduction 381
Reference 12.2 Turn On FileVault 384
Exercise 12.1 Restart a FileVault-Protected Mac 388
Exercise 12.2 Use a FileVault Recovery Key 390

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Lesson 13 Manage Permissions and Sharing 393
Reference 13.1 File-System Permissions 393
Reference 13.2 Examine Permissions for Sharing 400
Reference 13.3 Manage Permissions 405
Exercise 13.1 Create Items with Default Permissions 410
Exercise 13.2 Test Permissions Changes 416

Lesson 14 Use Hidden Items, Shortcuts, and File Archives 421
Reference 14.1 Examine Hidden Items 421
Reference 14.2 Examine Packages 425
Reference 14.3 Use File-System Shortcuts 427
Reference 14.4 Use File Archives 432
Exercise 14.1 Navigate Hidden Items 437

Data Management

Lesson 15 Manage System Resources 443
Reference 15.1 macOS File Resources 443
Reference 15.2 System Integrity Protection 450
Reference 15.3 Manage Font Resources 452
Exercise 15.1 Manage Font Resources 453

Lesson 16 Use Metadata, Siri, and Spotlight 463
Reference 16.1 File-System Metadata 463
Reference 16.2 Siri and Spotlight 470
Exercise 16.1 Examine File Metadata 487

Lesson 17 Manage Time Machine 493
Reference 17.1 About Time Machine 493
Reference 17.2 Configure Time Machine 496
Reference 17.3 Restore Files 506
Exercise 17.1 Configure Time Machine 511
Exercise 17.2 Restore Using Time Machine 516

Apps and Processes

Lesson 18 Install Apps 523
Reference 18.1 The App Store 523
Reference 18.2 App Security 535

Review Copy Only. All Rights Reserved. Copyright © 2021 by Pearson Education, Inc.

Reference 18.3 Install Apps Using Software Packages and Drag-and-Drop 542
Reference 18.4 Remove Installed Software 546
Exercise 18.1 Install an App from the App Store 546
Exercise 18.2 Use an Installer Package 552
Exercise 18.3 Drag and Drop to Install an App 555
Exercise 18.4 Remove Apps 562

Lesson 19 Manage Files 565
Reference 19.1 Open Files 565
Reference 19.2 Save Documents 579
Reference 19.3 Manage Automatic Resume 588
Reference 19.4 Store Documents in iCloud 590
Reference 19.5 Optimize Local Storage 604
Exercise 19.1 Use Alternate Apps 608
Exercise 19.2 Practice Auto Save and Versions 614
Exercise 19.3 Manage Document Locking 617
Exercise 19.4 Store Documents in iCloud 619

Lesson 20 Manage and Troubleshoot Apps 625
Reference 20.1 Apps and Processes 625
Reference 20.2 Manage App Extensions 633
Reference 20.3 Monitor Apps and Processes 645
Reference 20.4 Troubleshoot Apps 651
Exercise 20.1 Force Apps to Quit 667
Exercise 20.2 Troubleshoot Preferences 672
Exercise 20.3 Examine Logs 677

Network Configuration

Lesson 21 Manage Basic Network Settings 683
Reference 21.1 Network Terminology 683
Reference 21.2 Network Activity 686
Reference 21.3 Configure Basic Network Settings 690
Exercise 21.1 Connect to a Wi-Fi Network 699
Exercise 21.2 Monitor Network Connectivity 704

Lesson 22 Manage Advanced Network Settings 707
Reference 22.1 Manage Network Locations 707
Reference 22.2 Network Interfaces and Protocols 710

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Reference 22.3 Manage Network Service Interfaces 715
Reference 22.4 Configure VPN Settings 719
Reference 22.5 Configure Advanced Network Settings 724
Exercise 22.1 Configure Network Locations 736
Exercise 22.2 Advanced Wi-Fi Configuration 742

Lesson 23 Troubleshoot Network Issues 747
Reference 23.1 Troubleshoot General Network Issues 747
Reference 23.2 Use Terminal to Troubleshoot Network Issues 753
Exercise 23.1 Troubleshoot Network Connectivity 761

Network Services

Lesson 24 Manage Network Services 771
Reference 24.1 Network Services 771
Reference 24.2 Configure Network Service Apps 775
Reference 24.3 Connect to File-Sharing Services 788
Reference 24.4 Troubleshoot Network Services 799
Exercise 24.1 Use File-Sharing Services 807

Lesson 25 Manage Host Sharing and Personal Firewall 813
Reference 25.1 Turn On Host-Sharing Services 813
Reference 25.2 Control Remote Computers 825
Reference 25.3 Share Files with AirDrop 837
Reference 25.4 Manage the Personal Firewall 840
Reference 25.5 Troubleshoot Shared Services 845
Exercise 25.1 Use Host-Sharing Services 847
Exercise 25.2 Configure a Personal Firewall 854

System Management

Lesson 26 Troubleshoot Peripherals 863
Reference 26.1 Peripheral Technologies 863
Reference 26.2 Manage Bluetooth Devices 870
Reference 26.3 Troubleshoot Peripheral Issues 877
Exercise 26.1 Examine Peripherals Using System Information 880

Review Copy Only. All Rights Reserved. Copyright © 2021 by Pearson Education, Inc.

Lesson 27 Manage Printers and Scanners 883
Reference 27.1 Printing in macOS 883
Reference 27.2 Configure Printers and Scanners 885
Reference 27.3 Manage Print Jobs 900
Reference 27.4 Troubleshoot Print Issues 906
Exercise 27.1 Configure Printing 908
Exercise 27.2 Manage Printing 913
Exercise 27.3 Troubleshoot Printing 919

Lesson 28 Troubleshoot Startup and System Issues 921
Reference 28.1 System Initialization and Secure Boot 921
Reference 28.2 User Sessions 931
Reference 28.3 Sleep Modes, Logout, and Shutdown 933
Reference 28.4 Modify Startup 942
Reference 28.5 Troubleshoot System Initialization 950
Reference 28.6 Troubleshoot User Sessions 954
Exercise 28.1 Use Safe Mode 956

Index 959

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About This Guide

Audience

Whether you're an experienced system administrator or you just want to dig deeper into macOS, you'll learn to update, upgrade, reinstall, configure, maintain, diagnose, and troubleshoot macOS Big Sur.

You should be comfortable using a Mac before you read this guide. If you're not sure about basic Mac use, see "Mac Support" at support.apple.com/explore/new-to-mac.

How to Use the Guide

Use the reference sections to get familiar with macOS Big Sur. Then, use the exercises to practice what you've learned. After you've completed the guide, you should be able to:

- Explain how macOS Big Sur works
- Explain the best practices for updating, upgrading, reinstalling, configuring, and using macOS Big Sur
- Explain macOS Big Sur troubleshooting and repair procedures
- Use appropriate tools and techniques in macOS Big Sur to diagnose and resolve issues

Accessing the Web Edition and Lesson Files

Unless otherwise specified, references to macOS in this guide refer to macOS Big Sur 11.1. When you buy this guide from Peachpit (in any format), you automatically get access to its Web Edition.

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Exercises

The exercises in this guide are designed for independent learners and require a dedicated Mac. If you use a Mac that is also used for daily productivity, the exercises will not work as expected and they might disrupt your Mac. To complete the exercises, ensure that you have the following:

- An Intel-based Mac that meets the requirements to install macOS Big Sur
- macOS Big Sur (see Exercise 2.3, "Erase a Mac and Install macOS Big Sur")
- A high-speed internet connection
- Lesson files (see "Accessing the Web Edition and Lesson Files," earlier)
- An Apple ID dedicated to your independent learning (you don't need to provide credit card information to get free apps from the App Store)

The following items are not required, but they can be helpful:

- An iCloud account associated with the Apple ID you use for your independent learning
- An erasable external storage disk with a capacity of at least 12 GB for Exercise 5.2, "Create a macOS Install Disk"
- At least two Wi-Fi networks (one should be visible)
- A Mac with all-flash storage

Additional Materials

Apple Support

The Apple Support website (support.apple.com) includes the latest free online Apple Support articles.

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Lesson 23

Troubleshoot Network Issues

This lesson builds on the network topics covered in Lesson 21, "Manage Basic Network Settings," and Lesson 22, "Manage Advanced Network Settings." This lesson first covers general network troubleshooting and common network issues. Then, you learn how to use network troubleshooting tools and commands.

GOALS

- Identify and resolve network configuration issues
- Verify network configuration with Network preferences
- Use command-line interface commands to aid in troubleshooting

Reference 23.1
Troubleshoot General Network Issues

When you troubleshoot LAN and internet connection network issues, consider possible points of failure. Isolate the cause of the problem before you attempt generic resolutions.

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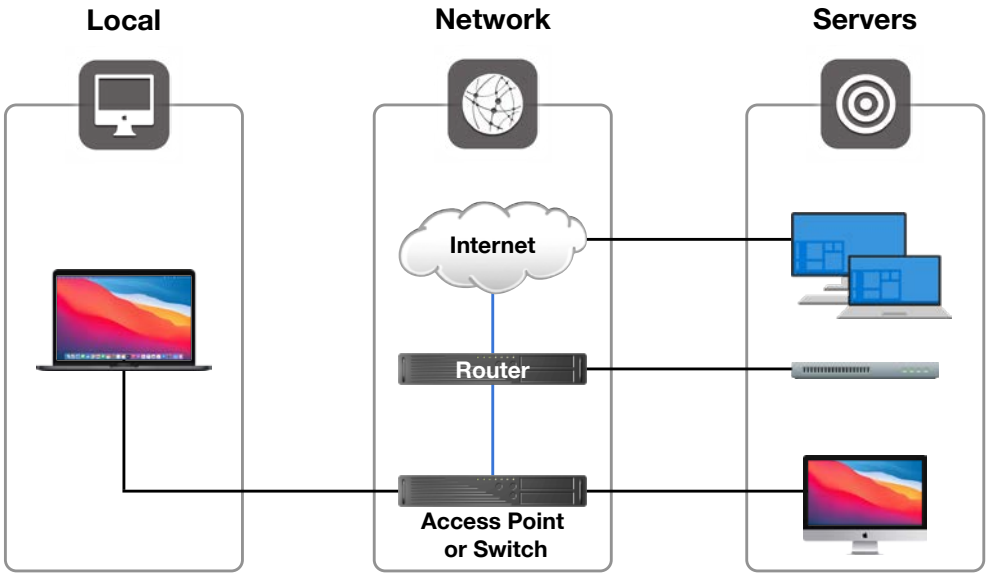

To help isolate network issues, you can categorize them into three general areas:

- Local issues—These are usually related to either improperly configured network settings or disconnected network connections.
- Network issues—Many possible points of failure could be involved. Become familiar with the physical topology of your network. Start by checking the devices that provide network access closest to your Mac. Something as simple as a bad Ethernet port on a network switch can cause problems. Start your investigation using the network diagnostic utilities included with macOS.
- Service issues—These issues are related to the network device or service you are trying to access. For example, the devices providing DHCP or DNS services could be temporarily down or improperly configured. You can often determine that the problem is with the service by testing other network services. If the other network services work, you're probably not dealing with network or local issues. Use diagnostic tools for testing service availability. Troubleshooting network services is also covered in Lesson 24, "Manage Network Services."

Use two main tools for diagnosing network issues in macOS: Network preferences and Terminal.

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Verify Network Preferences Status

One of the diagnostic tools you should check first is Network preferences. Network preferences features a dynamically updating list that shows you the current status of any network interface. If a network connection isn't working, you first find out about it here.

Network status indicators are:

- Green—The connection is active and configured with TCP/IP settings. This doesn't guarantee that the service is using the proper TCP/IP settings.
- Yellow—The connection is active but the TCP/IP settings aren't properly configured. If you are experiencing problems with this service, double-check the network settings. If the settings appear sound, move on to the other diagnostic utilities.
- Red—This status usually indicates either improperly configured network settings or disconnected network interfaces. If this is an always-on interface, check for proper physical connectivity. If this is a virtual or Point-to-Point Protocol connection, double-check the settings and attempt to reconnect.

Common Network Issues

A good starting point for resolving network issues is to check for some common causes before hunting down more complex ones. This includes verifying Ethernet connectivity, Wi-Fi connectivity, DHCP services, and DNS services.

Ethernet Connectivity Issues

If you use an Ethernet connection, verify the physical connection to the Mac, and if possible, verify the entire Ethernet run back to the switch. If that's not possible, try swapping your local Ethernet cable or use a different Ethernet port. If you use an Ethernet adapter, try a different adapter.

Verify the Ethernet status from Network preferences. Also, keep an eye out for substandard Ethernet cabling or problematic switching hardware.

You may also find that although the Ethernet switch registers a link, Network preferences still shows the link as down. This issue may be resolved by manually setting a slower speed in the advanced hardware settings of Network preferences, as covered in Lesson 22.

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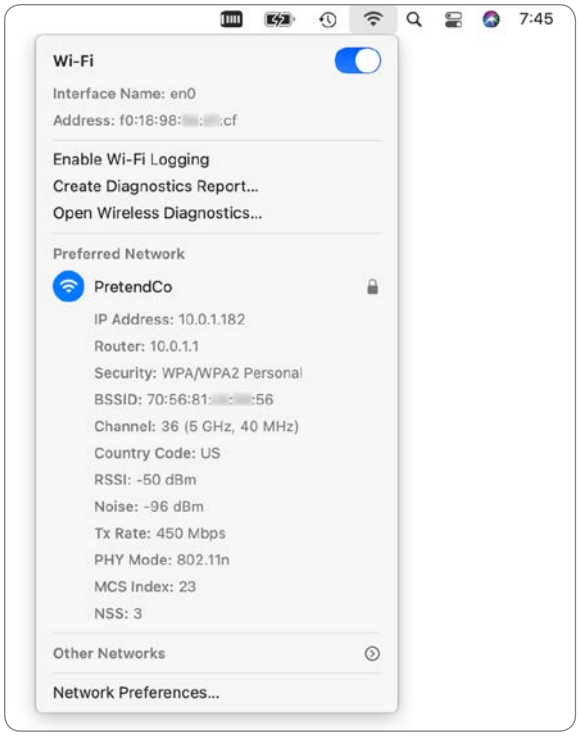
MORE INFO ► Built-in network hardware for Intel-based Mac computers can sometimes become unresponsive and may benefit from resetting the Mac computer's NVRAM or System Management Controller (SMC). For more information, see Apple Support article HT204063, "Reset NVRAM or PRAM on your Mac," and article HT201295, "How to reset the SMC of your Mac."

Wi-Fi Connectivity Issues

If you use Wi-Fi, start by verifying that you are connected to the correct SSID from the Wi-Fi status menu or Network preferences. Often, if the Mac detects a problem the Wi-Fi status menu shows an exclamation point (!) to indicate that there is a problem with the wireless network.

The Wi-Fi status menu can also serve as a diagnostic tool if you press and hold the Option key, then open the Wi-Fi status menu. This view shows connection statistics for the currently selected Wi-Fi network. Of particular note is the Tx Rate entry, which shows the current data rate for the selected Wi-Fi network. The Wi-Fi status menu is capable of other diagnostic tasks, including helping you quickly identify network issues and opening Wireless Diagnostics.



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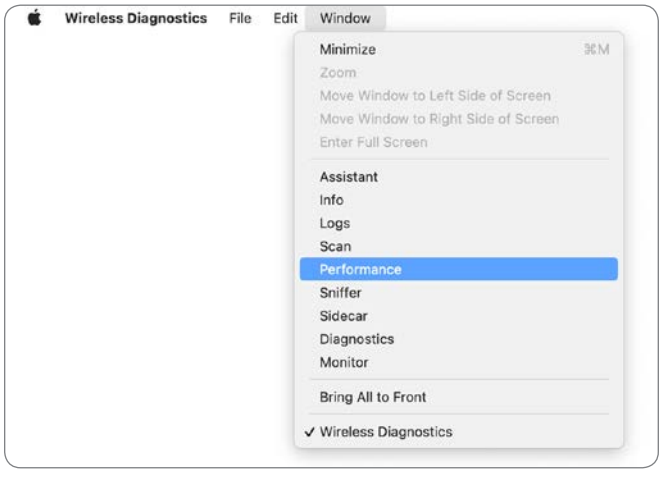
When you open Wireless Diagnostics, an assistant interface appears. Wireless Diagnostics creates and saves a diagnostic report archive about the Mac computer's wireless and network configuration. You must authenticate as an administrator user to create the report. The compressed archive is stored in /private/var/tmp. After Wireless Diagnostics completes the report, the Finder opens the folder that contains the compressed archive.

The Wireless Diagnostics archive contains relevant files that can you use to diagnose a connection issue. If the utility can't diagnose the problem, consult an experienced Wi-Fi administrator.

Open the Window menu to access additional advanced wireless network utilities in Wireless Diagnostics.



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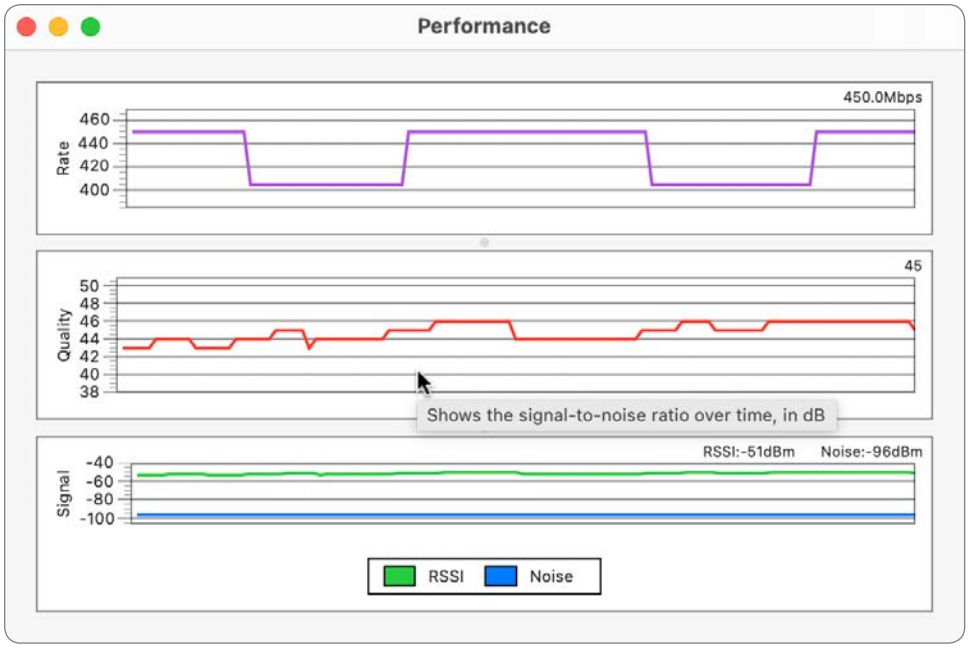
These utilities provide information that you can share with Wi-Fi vendors or support specialists to resolve Wi-Fi issues. For example, the Performance window provides a real-time view of the radio signal quality. With the Performance window open, you can physically move a Mac notebook computer around an area to identify wireless dead zones.



Sidecar Diagnostics is part of Wireless Diagnostics. You use it to gather information about wireless issues while you're using your iPad as a second display for your Mac with Sidecar.

For more information, see Apple Support article HT202663, "If your Mac doesn't connect to the Internet over Wi-Fi."

DHCP Service Issues

If you configure your Mac to use DHCP and the DHCP server runs out of available network addresses or doesn't provide configuration information to your Mac, your Mac might be able to communicate with other devices on the LAN even though it doesn't have access to WAN or internet resources. This is covered in Lesson 21, "Manage Basic Network Settings."

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DNS Service Issues

Most network services require DNS services. If you have DNS service issues, verify the DNS server configuration in Network preferences. In most cases, the top listed network service interface is primary, and macOS uses it for DNS resolution. The exception is if the primary network service lacks a router configuration, in which case DNS resolution falls to the next fully configured network service interface.

Reference 23.2
Use Terminal to Troubleshoot Network Issues

macOS provides several network identification and diagnostic commands that you can access in Terminal. This includes, but isn't limited to, the following:

- **ifconfig** (interface configuration)—Inspect details regarding hardware network interfaces.
- **netstat** (network status)—View routing information and network statistics.
- **ping**—Test network connectivity and latency.
- **nslookup**, **dig**, **host**, and **dscacheutil**—Test DNS resolution.
- **traceroute**—Analyze how your network connections are routed to their destination.
- **nc** (netcat)—Check whether a network device has specific services available.

You can also open Terminal when you start your Mac from macOS Recovery (as covered in Lesson 5, "Use macOS Recovery") by choosing Utilities > Terminal. In macOS Recovery you can access the Wi-Fi status menu to use a different Wi-Fi network.

ifconfig

The **ifconfig** command enables you to view the detailed status of any network interface. Each network interface has a short UNIX-given name; for example, the default Wi-Fi interface for Mac portable computers is en0.

If you run **ifconfig** by itself, it returns the status of all network interfaces, even ones that aren't configured and that don't appear in Network preferences. The following figure displays only a portion of the result of running the command. en7 is the name of an Apple USB Ethernet Adapter that's connected to the MacBook Pro with a USB-C adapter. The name for a network interface may vary depending on the configuration of your Mac, including the other network interfaces you've configured for your Mac.

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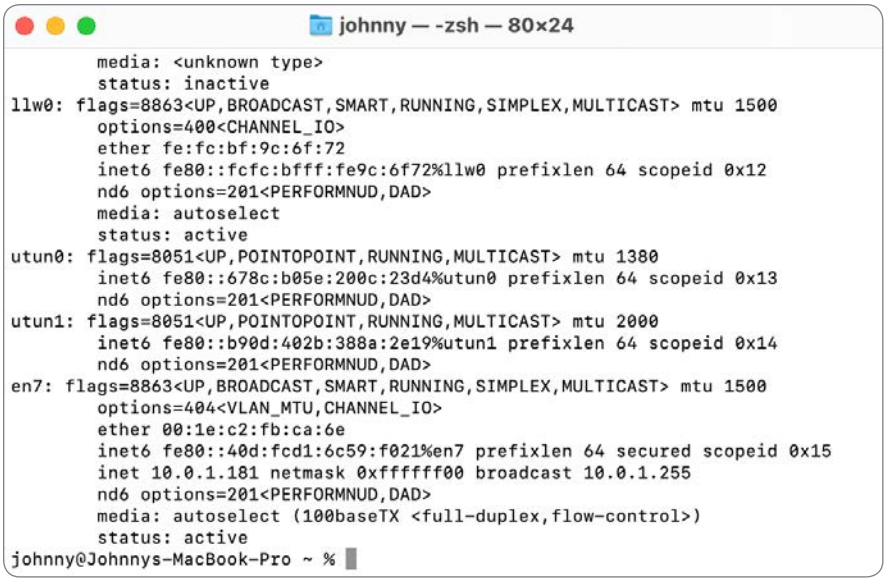
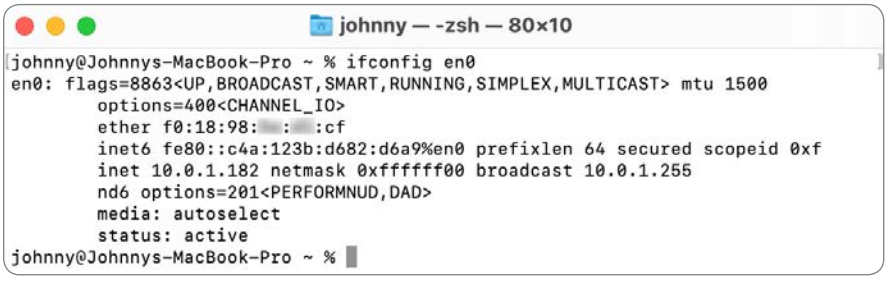


ifconfig is often run with the name of a single network interface. For example, the following figure illustrates running the command **ifconfig en0**, which returns information about the default Wi-Fi interface.



The entire extent of the output of the command is outside the scope of this guide, but some of the key pieces of information include:

- **ether**—MAC address
- **inet6**—IPv6 address
- **inet**—IPv4 address
- **netmask**—Subnet mask
- **media**—Connection speed and characteristics
- **status**—Active or inactive

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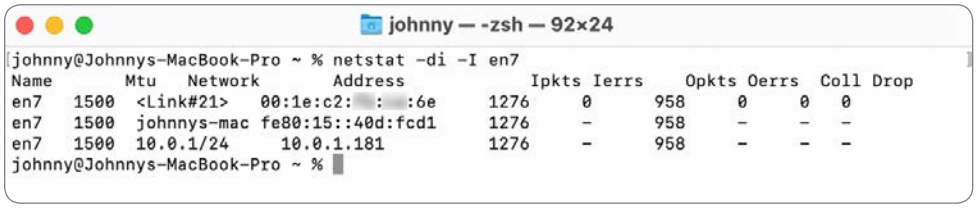
netstat

The **netstat** command enables you to view even more detailed status of any network interface. One example is **netstat -di -I**, followed by the interface name. The options include:

- **-di**—Show the number of dropped packets
- **-I (*name of interface*)**—Show information only about that specific interface

For example, the following figure illustrates running the command **netstat -di -I en7**, which returns information about a connected Apple USB Ethernet Adapter.



The **-I** option provides a table with cumulative counts of network packets transferred, errors, and collisions. The **-di** option adds a count of dropped packets as well. Here are some of the values in the table:

- **Name**—Name of the interface
- **Address**—MAC address, IPv6 address, or IPv6 address; it's common to see each interface have three addresses listed
- **Ipkts**—Number of packets received by the interface
- **Ierrs**—Number of errors related to packets received by the interface
- **Opkts**—Number of packets sent by the interface
- **Oerrs**—Number of errors related to packets sent by the interface
- **Coll**—Number of collisions detected
- **Drop**—Number of dropped packets detected

You can also use **netstat** to analyze network transfer statistics. If you open an app like Safari to cause some network traffic, then run the **netstat** command again, you can verify that packets are being sent and received from this interface. In the following example, there were initially 1,276 received packets; Safari was then used to generate network traffic; then there were 16,100 received packets. It's safe to conclude that Safari used the en7 interface for network traffic.

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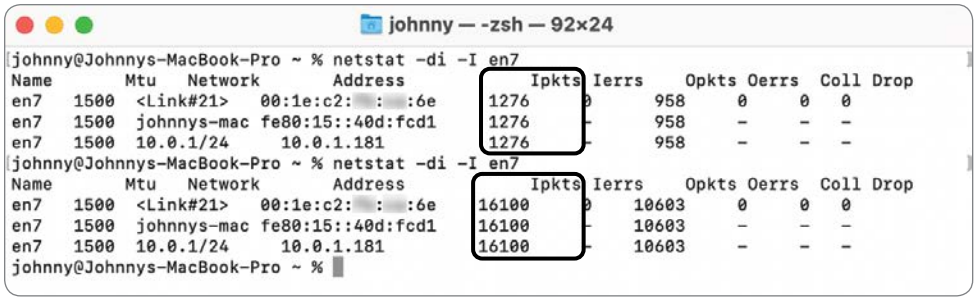

If the transfer statistics indicates activity but you still experience problems, the issue is probably a network or service problem and not the network interface. Or, if this interface is experiencing transfer errors, a local network hardware connectivity issue may be the root of your problem.

To resolve hardware network interface issues, check the physical connection. With wired networks, try different network ports or cabling to rule out physical connection issues. With wireless networks, double-check the Wi-Fi settings and the configuration of any wireless base stations. If the Mac network hardware isn't working, contact an Apple Autho rized Service Provider.

ping

If your network settings are properly configured and the hardware network interface appears to be working correctly but you still experience network issues, test network connectivity using the ping command.

The word *ping* refers to several concepts:

- The name of a command
- A kind of network packet
- The act of using the ping command to send a ping packet

The ping command determines whether your Mac can successfully send and receive data to another network device. Your Mac sends a ping data packet to the destination IP address, and the other device returns the ping packet to indicate connectivity.

To use ping, type **ping**, then a space, then an IP address to a device on the LAN that should always be accessible, such as the network router; then press Return. Using a domain name assumes that your Mac is properly communicating with a DNS server, which might not be the case if you're troubleshooting connectivity issues.

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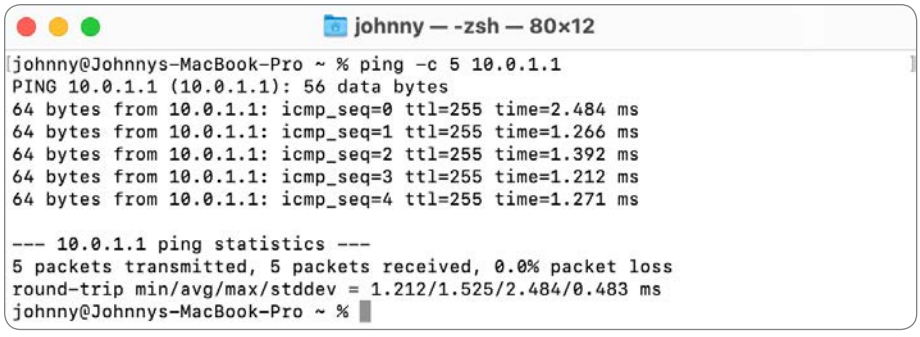
If the **ping** command is successful, it returns the amount of time it took for the ping to travel to the network device and back. This round trip typically takes a few milliseconds. You can use the **-c** option (count) with a number of packets to send, or if you omit the **-c** option, the **ping** command will repeatedly send packets until you stop the **ping** command by pressing Control-C or Command-Period.

After you stop the **ping** command, the **ping** command returns how many packets **ping** transmitted, how many packets were received by the remote device, and a percentage of packet loss.



Some network administrators configure their firewalls to block pings or to set up their network devices not to respond to network pings.

After you establish successful pings to local devices, branch out to WAN or internet addresses. Using **ping**, you may find that everything works except for the one service you were looking for that prompted you to start troubleshooting the network.

Lookup

If you are able to successfully ping other network devices by their IP address but you can't connect to another device by its hostname, you likely have issues related to DNS. Several commands are available that let you test name resolution against your DNS server. This section covers the following commands, each listed here along with the description from the name section of its man page:

- **host**—DNS lookup utility
- **dig**—DNS lookup utility
- **nslookup**—Query internet name servers interactively
- **dscacheutil**—Gather information and statistics and initiate queries to the Directory Services cache

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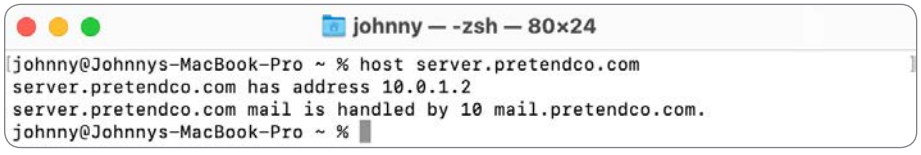
To verify DNS, use one of the commands in this section to query the hostname of a device or service in your local domain. If you can resolve local hostnames but not internet hostnames, your local DNS server is resolving local names but isn't properly connecting to the worldwide DNS network. If you don't have a local domain, use any internet hostname.

To start the network lookup process with the **host** command (DNS lookup utility), type **host**, a space, then an IP address or hostname; then press Return.

The following figure illustrates a successful forward lookup, which returns the IP address of the hostname you entered.



The following figure illustrates a successful reverse lookup, which returns the hostname of the IP address you entered.

The **nslookup** command returns a bit more information, which might be useful for your troubleshooting. The following figure illustrates using **nslookup** for a forward lookup and then a reverse lookup.

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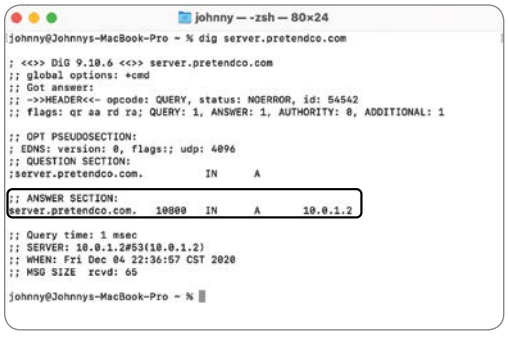
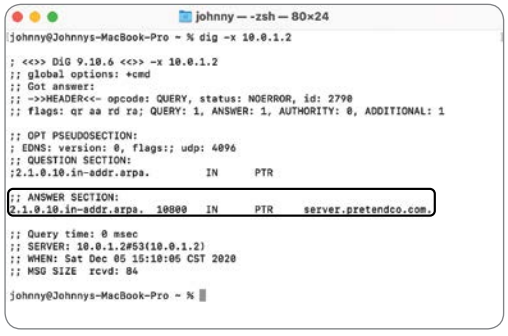
The **dig** command returns even more information. Use the **-x** option to perform a reverse lookup. The following figures illustrate using **dig** for forward and reverse lookups.





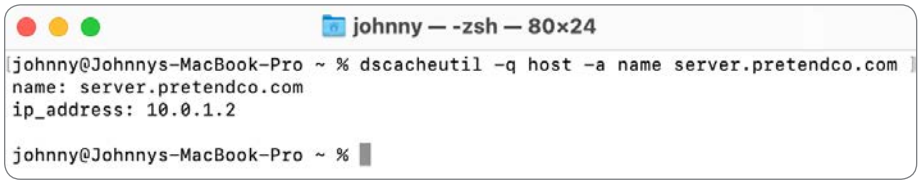
And finally, for this section, you can use the **dscacheutil** command for more advanced DNS troubleshooting.

> **NOTE ►** Although the other commands in this section ignore the /private/etc/hosts file, which is outside the scope of this guide, **dscacheutil** consults the /private/etc/hosts file.

For a DNS lookup, use two **dscacheutil** options followed by the hostname or IP address you want to look up. Here are the two options, along with arguments you should use for a DNS lookup:

- **-q**—This is the type of query, like user, group, or host. For DNS lookups, use **-q host**.
- **-a**—This is the key to look up. For forward lookups, use **-a name**; for reverse lookups, use **-a ip_address**. And as a bonus, to use an IPv6 reverse lookup, use **-a ipv6_address**.

To perform a forward DNS lookup, type **dscacheutil**, a space, **-q host -a name**, a space, and the hostname; then press Return.



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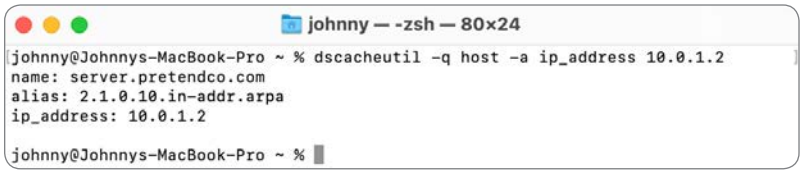
To perform a reverse DNS lookup, type **dscacheutil**, a space, **-q host -a ip_address**, a space, and the IPv4 address; then press Return.

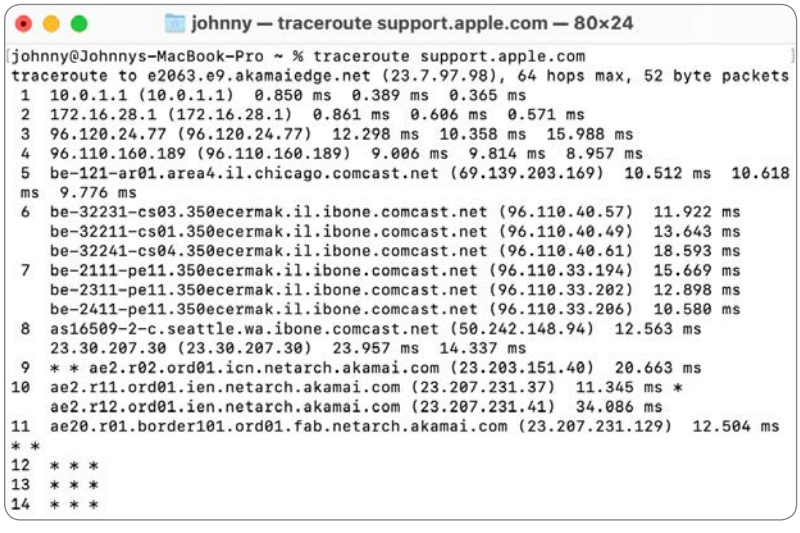


> **NOTE ►** The man page for **dscacheutil** warns that the **-flushcache** option, which flushes the DNS cache but also the entire Directory Services cache, "should be used in extreme cases. Validation information is used within the cache along with other techniques to ensure the OS has valid information available to it."

If you are unable to successfully return lookups, it's possible that your Mac isn't connecting to the DNS server. Use the **ping** command to test for basic connectivity to the DNS server IP address.

traceroute

If you are able to connect to some network resources but not others, use **traceroute** to determine where the connection fails. WAN and internet connections often require the data to travel through many network routers to reach their destination. The **traceroute** command examines every network hop between routers by sending packets with low time-to-live (TTL) fields to determine where connections fail or slow down.



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To verify a network TCP/IP route, use traceroute followed by an IP address of a device on the LAN that should always be accessible, such as the network router. Using a domain name assumes that your Mac is properly communicating with a DNS server, which might not be the case if you're troubleshooting connectivity issues.

If traceroute is successful, it returns a list of routers required to complete the connection and the amount of time it took for the test packets to travel to each network router. It sends three probes at each distance, so three times are listed for each hop. The delay is typically measured in milliseconds; experiencing delay times of any longer than a full second is unusual. If traceroute doesn't get a reply from a particular router at all, it shows an asterisk rather than listing the router address, but this could be because the network equipment is configured not to respond to network requests.

Once you've established successful routes to local devices, you can branch out to WAN or internet addresses. Using the traceroute command, you may find that a specific network router is the cause of the problem.

For more information about any of the commands in this lesson, use the man page for the command.

Exercise 23.1
Troubleshoot Network Connectivity

Prerequisites

- You must have created the Local Administrator (Exercise 3.1, "Configure a Mac for Exercises") and Johnny Appleseed (Exercise 7.1, "Create a Standard User Account") accounts.
- You must have created the Static Network location (Exercise 22.1, "Configure Network Locations").

NOTE ► Even if you don't meet these prerequisites, reading the exercises will enhance your knowledge of the processes.

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In this exercise, you intentionally misconfigure your network settings. You then use the macOS built-in troubleshooting tools to view symptoms and isolate the problem.

Break Your Network Settings

1. Log in as Johnny Appleseed.
2. Open Network preferences, then authenticate as Local Administrator.
3. Record the currently selected location so that you can return to it at the end of the exercise.
4. From the Location menu, choose Edit Locations.
5. Select the Static location, then choose Duplicate Location from the Action menu below the location list.
6. Name the new location **Broken DNS**, then click Done.
7. If necessary, switch to the Broken DNS location.
8. Click Apply.
9. Select the primary network service (the one at the top of the left sidebar), then click Advanced.
10. Click DNS.
11. If there are entries in the DNS Servers list, record them so you can reenter them, then use the Remove (–) button to remove them.
12. Click the Add (+) button under the DNS Servers list, then add the server address **127.0.0.55**.

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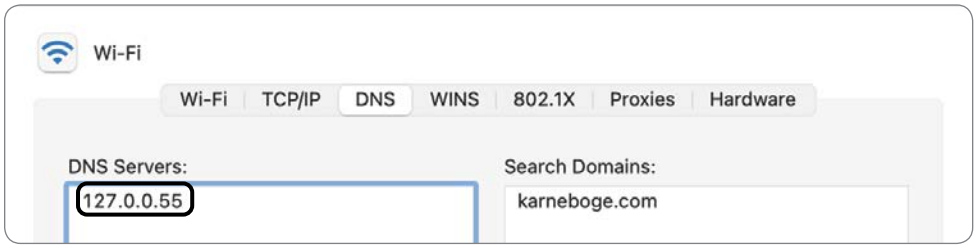
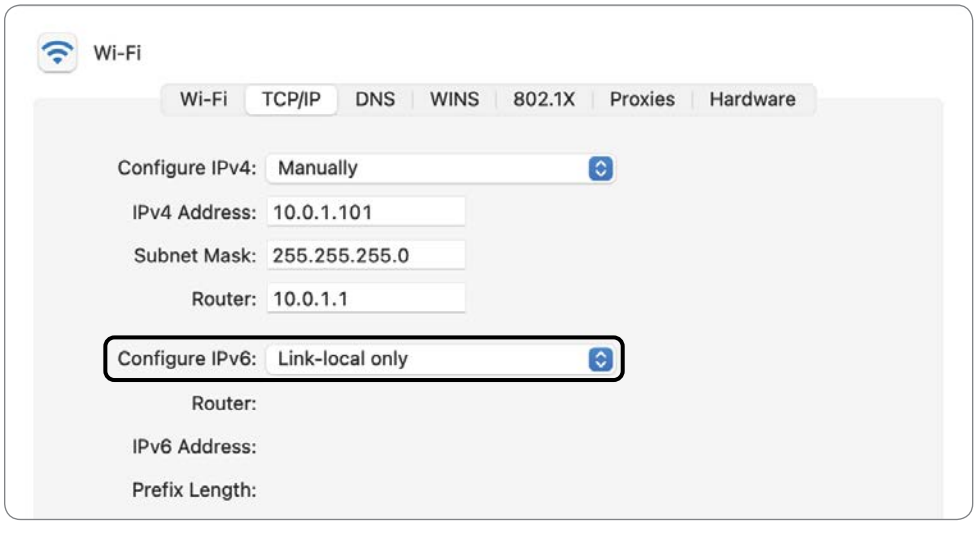
No DNS server is available at this address, which is in a block of addresses that do not legitimately appear on any network anywhere (with the exception of 127.0.0.1, which is the loopback address and outside the scope of this guide). As a result, 127.0.0.55 is an invalid address.



13 Click TCP/IP.

14 From the Configure IPv6 menu, choose "Link-local only."



This prevents IPv6 from being an alternate internet connection.

15 Click OK, then click Apply.

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Observe the Problem

1 Open Safari.

2 Type **www.apple.com** in the address bar, then press Return.

Safari attempts to load the webpage, but it doesn't get far because it's not able to reach anything. If you wait, it eventually gives up, then displays an error. Don't wait.

3 Quit Safari.

Check the Network Status in Network Preferences

When you have a network problem, one of the first things you should check is the network service status in Network preferences. Viewing the status lets you spot simple problems without performing detailed diagnostics.

1 Open Network preferences.

2 Examine the status indicators and the network services order.

If the network service you expect to be active isn't showing a green status indicator, something is wrong with the connection or a critical setting is missing. Examples could include a loose cable, not being joined to a Wi-Fi network, or a missing IP address.

If the wrong service is at the top of the list, the service order was set incorrectly or unexpected services are active. In this case, the expected service has a green indicator and is at the top of the list, so you must do more troubleshooting.

Use ping to Test Connectivity

In this section, you use the `ping` command. You can use `ping` to test network connectivity and DNS resolution.

1 Open Terminal.

Many of the macOS troubleshooting tools are available from the command-line interface.

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2 In Terminal, type **ping -c 5**, followed by the domain name of the server you want to reach (**www.apple.com**).

The option **-c 5** in the **ping** command indicates the number of ping requests to send to the host, which in this case is five.

3 Press Return.

After about 30 seconds, you receive a message telling you that **ping** couldn't resolve www.apple.com. The message indicates that **ping** wasn't able to use DNS to look up, or resolve, the name www.apple.com and match it to an IP address to send the ping to. In this case, you know that the name www.apple.com is valid because you have used it before, so this indicates that something is wrong with DNS.

Although this message gives you some information about the problem, it still doesn't tell you where the problem is. It can be hard to differentiate between a DNS problem and a complete network failure. If DNS resolution is the only thing failing, it can mimic a complete failure because almost all network access starts with (and depends on) a DNS lookup. If the network is completely disconnected, most attempts to use the network fail at the DNS step, so the only symptoms are DNS errors.

Try to reach a server by its numeric IP address to distinguish between a DNS-only problem and a complete network failure. This approach bypasses the usual DNS lookup and works even if DNS is broken.

4 At the prompt, type **ping -c 5 8.8.8.8**.

This is an easy-to-remember address of a public DNS server maintained by Google.

5 Press Return.

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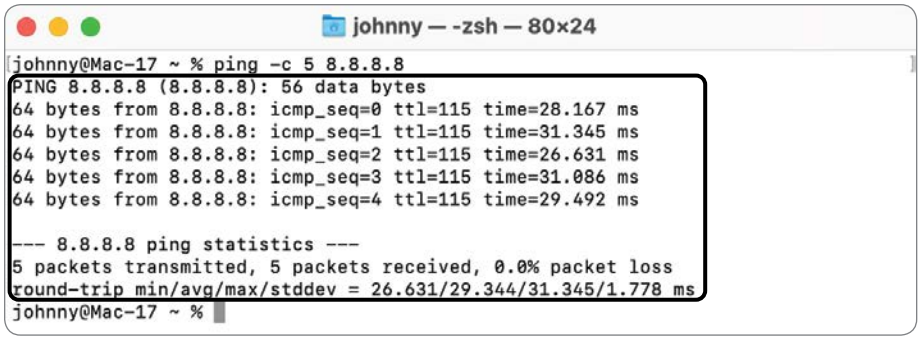
This time, ping reaches its destination successfully and shows statistics for its five test pings. This tells you that your basic network connectivity is OK and that it's likely only DNS isn't working.



Use the host Command to Test DNS

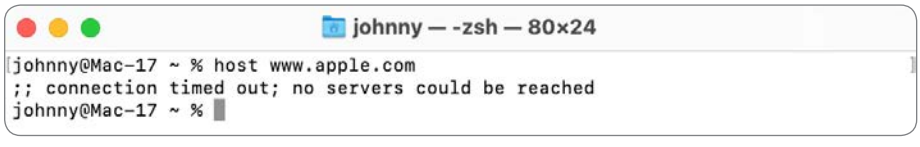
Even though the ping error message "cannot resolve" indicates a DNS problem, try the host command to discover whether it reveals a more specific error.

1 In Terminal, type **host www.apple.com**.

The host command is used for performing DNS lookups. You use it to convert names to IP addresses, and vice versa.

2 Press Return.

After about 30 seconds, you receive a message that the connection timed out and that no servers could be reached. This is the same result you got using the ping command.



Switch to Working Network Settings

1 From the Apple menu, choose Locations, then click the Static location.

Unlike the Broken DNS location, this location has valid settings, so your internet connectivity should be back to normal.

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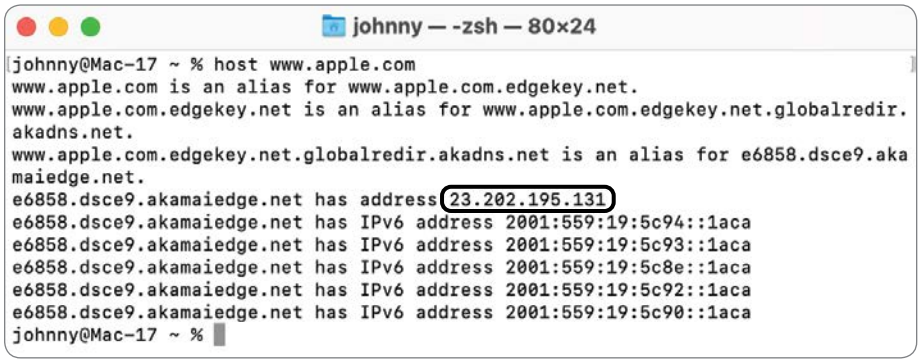
2 In Terminal, type **host www.apple.com** again.



This time the **host** command reaches a DNS server and finds the IP address corresponding to the domain name www.apple.com.

The address displayed by **host** may differ from the address in the figure because the Apple website is hosted by a number of servers throughout the internet and uses DNS to direct you to a server near your network location for faster access.

If you knew the address the name should resolve to, you could verify that, but the fact that it resolved to an IP address at all is a good indication that DNS is working.

The **stdout** of the **host** command may also display both an IPv6 address and an IPv4 address, because network services in macOS Big Sur are configured to use IPv6 automatically.

3 Open Safari, then try browsing a website.

This time, Safari is able to load webpages from the internet.

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Index

NUMBERS

6to4 service, 713
64-bit mode, 626
802.1X protocol, configuring, 730–732
802.11 specification, 692

SYMBOLS

* (asterisk) wildcard, using, 110
\ (backslash), using before space characters, 107
% CPU, examining statistics, 647
.. (double periods), using with parent folder, 107, 124
% GPU, examining statistics, 647
. (period)
  preceding items with, 108
  using with hidden items, 421
? (question mark) wildcard, using, 110
>> (redirect) operator, using, 109–114
/ (slash), using in paths, 439
[] (square brackets) wildcard, using, 110
~ (tilde), using with user home folder, 107

A

About This Mac window, 21, 93–95, 370–371
absolute paths, 124
accent, configuring, 61–62
Access Control pane, 301
Accessibility features
  configuring, 66–70
  keyboard, 69
  screen, 47–48
  Security & Privacy settings, 271
  Voice Control, 8–10
account name settings, editing for user accounts, 193
account passwords.
  See also user accounts
  resetting, 326–329
  resetting in macOS Recovery, 323–325
ACEs (access control entries)
  file-system permissions, 397
  removing, 408
ACLs (access control lists), file-system permissions, 397
Actions extensions, configuring, 636
Activation Lock, protecting Mac with, 287–289
activities, viewing and searching, 660
Activity Monitor
  force quitting apps, 669–672
  using with processes, 646–651
adaptive devices, using, 69
administrator accounts, 183–186, 189
AES (Advanced Encryption Standard), 382
AFP (Apple Filing Protocol), 789, 794–795
AirDrop, 837–840.
  See also file-sharing services
AirPrint, 883.
  See also printers and scanners
alias settings, editing for user accounts, 193
aliases
  creating, 430
  creating with Finder, 428
  repairing, 431
Allowed Boot Media
  configuring, 144–145
  and Secure Boot, 142
  settings, 133
Analytics & Improvements, Security & Privacy settings, 272
analytics data, viewing reports about, 659
APFS (Apple File System), 339, 350–352
  adding volumes, 350–352
  and Boot Camp, 352
  compatibility, 352
  and file sharing, 352
  Fusion Drive, 352
  overview, 339, 342–350
  SSV (signed system volume), 343–344
  volume formats, 341–342
  volumes, 347, 350–352
APM (Apple Partition Map), file systems, 341
app and hardware compatibility, checking, 30–33
app compatibility, verifying, 21–22
app extensions, managing, 633–640
app resources, troubleshooting, 666–667
App Store
  Apple ID, 532–533
  browsing, 523–526
  bundles with new Macs, 531–532

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downloading Installer from, 35
examining, 550–551
Family Sharing, 533
getting Apple ID, 530–531
installing apps, 533
keyboard shortcuts, 526
managing Apple ID, 532
preferences for automatic updates, 172
privacy information, 7
purchased apps, 533–534
searching, 526–529
Update behavior, 169–170
updating apps, 534
appearance, configuring, 61–62
Apple Advertising, Security & Privacy settings, 271–272
Apple Business Manager, 46
Apple Configurator 2, using to restore Macs, 133–134
Apple Diagnostics, 944–947
Apple ID
getting for App Store, 530–531
managing for App Store, 532–533
resetting password, 52, 314–317
signing in with, 49–51
two-factor authentication, 50, 263–264
unlocking FileVault volume, 385
Apple School Manager, 46
Apple silicon
Activate Mac window, 286
configuring Security Policy, 140
and macOS Recovery, 130, 133
selecting alternate system, 942–943
and Startup Security Utility, 137–138
and T2 chip, 922–925
Apple Support articles
AirDrop, 837
APFS volumes, 922
App Store, 534
Apple Diagnostics, 947
Apple IDs, 51, 263
automated device enrollment, 46
FileVault recovery key, 84
Hey Siri, 471
hiding user accounts, 184
iCloud Drive service, 597
iCloud Keychain, 262, 323
iCloud system requirements, 263
iWork documents, 580
"Mac computers with Apple silicon," 4
macOS Big Sur compatibility, 18
macOS version, 13
MDM (mobile device management) settings, 46
migrating content, 238–239
NVRAM or PRAM, 750, 950
packages, 426
password management, 318
Siri, 471
system extensions, 290
Thunderbolt 3, 869
Time Machine, 494
Voice Control, 273
Windows 10 and Boot Camp Assistant, 143
wireless devices, 870
zsh shell, 101
Apple Support website, 20
Apple T2 Security chip. *See also* security
and FileVault, 86
and macOS Recovery, 133
and Startup Security Utility, 137, 139
Apple Tech Specs website, 33
Apple Watch, unlocking Mac with, 266
AppleDouble file format, file-system metadata, 468–469
Applications, accessing, 89, 306, 444
apps, 550–551
"Allow apps downloaded from," 540–541
allowing to access data, 305–310
approving, 307–310
bundles with new Macs, 531–532
bypassing installation settings, 541–542
code signing, 536
copying to /Applications, 558
defaults for file types, 611–613
diagnostic reports, 654–656
diskimageshelper, 301–302
downloading, 608–609
driver implementation, 879
file quarantine, 537–539
force quitting, 652–654, 667–672
Gatekeeper security settings, 558–561
and hardware compatibility, 30–33
Install macOS Big Sur, 154–155
installation packages, 544–545
installing, 305–306, 542–545
installing from App Store, 546–551
installing with drag-and-drop, 543–544, 555–562
installing with installer package, 552–555
"Kind," 627–628
malware detection, 539
managing file locking with, 587–588
monitoring, 645–646
notarization, 536
obtaining, 555–558
for opening files, 609–610
process security, 535
and processes, 625–633
protecting data of, 122
registering, 568
reinstalling from App Store, 564
removing, 562–564
restricting installation of, 186

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sandboxing, 535
security, 535
selecting for purchase, 548–550
signature and notarization, 561–562
testing, 550
troubleshooting, 651–652
types, 627–630
Universal kind, 627–628
updating installed software, 545
using alternates, 608–613
verifying compatibility, 21–22
apps and processes
64-bit mode, 626
memory management, 626
overview, 625–626
Architecture, examining statistics, 647
ARP (Address Resolution Protocol), 687
AssetCacheLocatorUtil command, 678-680, 824
assistive technologies, 47
asterisk (*) wildcard, using, 110
audio devices as peripherals, 887–888
audio files, trimming, 577
Authenticated Ethernet protocol, 714
authenticating
to Wi-Fi networks, 692–696
to WPA Enterprise networks, 696–698
authentication as Local Administrator, 851. *See* two-factor authentication
Auto Mode, 61
Auto Save.
See also saving documents
disabling, 589
experimenting with, 614–615
Automated Device Enrollment, 46
automatic resume, managing, 588–589
Automatic Software Updates
App Store preferences, 172
App Store update behavior, 169–170
behavior, 162–167
checking, 177–178
downloading Installer with, 36
overview, 161–162
performing, 175–177
preferences, 174–175
preferences behavior, 168–169
preferences for automatic updates, 170–172
Automation, Security & Privacy settings, 271
Automator, using to create Quick Actions, 640–642
auto-saves, 582

B

backing up files and folders, 22–23, 34
backslash (\), using before space characters, 107
backup volume, selecting with Time Machine, 513–516
backups, with Time Machine, 494–495
BBEdit, 556, 561–562
Bluetooth devices
managing, 870–876
pairing, 873–874
PAN (personal area network), 711
Security & Privacy settings, 271
support for, 711, 869–870
Bluetooth Sharing, 817
Bonjour printer, configuring, 909–913
Bonjour protocol, 773–774
bookmarks and marks, using, 109
Boot Camp and APFS, 352
Boot Camp Assistant, 143
bootable installer, creating, 146–147. *See also* Installer
booter and system initialization, 922, 925–928
booter issues, troubleshooting, 952
border color, choosing, 578
browsers, troubleshooting, 803–805

C

caching.
See Content Caching service
caffeinate command, 814
CalDAV collaborative calendaring, 782, 784
Calendar and Reminders, configuring, 781–783
Calendars, Security & Privacy settings, 271
Camera, Security & Privacy settings, 271
cameras as peripherals, 877
cat command, using, 109–114
Catalyst. *See* Mac Catalyst improvements
cd command, using, 106, 117–118
CD or DVD Sharing, 816
cellular internet connections, 711–712
clear command, using, 114
CLI (command-line interface)
accessing, 98–101
advantages, 97
command string, 104
creating and editing text files, 125–126
creating files, 120–121
creating folders, 121–123
creating folders and copying files, 123
example, 104–105
file-examination commands, 109–110
invisible items, 108
man (manual) pages, 105
managing macOS from, 112–113
marks and bookmarks, 109
modifying files and folders, 111–112
moving files, 121–123
navigating to volumes, 109
navigating with commands, 106

navigation, 115–119
overview, 97–98
privacy preferences, 126–127
recursive commands, 111
removing folders, 124
renaming files, 123–124
special characters, 107
Tab key completion, 107–108
tips and tricks, 113–114
wildcard characters, 110–111
working in, 101–103
Command key.
See keyboard shortcuts
commands
AssetCacheLocatorUtil, 678-680, 824
caffeinate, 814
canceling, 114
cat, 109–114
cd, 106, 117–118
clear, 114
cp, 111
createinstallmedia, 146–147
exit, 112–113
file, 110
ipconfig, 753–754
ladmin, 851
learning about, 105
less, 110
loginwindow, 931, 939–940
ls, 106, 108, 116–117
managing files and folders with, 119–127
mdfind, 110
mkdir, 111
mv, 112
nc (netcat), 801–802
netstat, 755–756
ping, 756–757, 764–766
Print, 900
as processes, 625–626
pwd, 106, 116–118
q, 122–123
reading about in man pages, 118–119
resetpassword, 136, 141, 317
rm, 112
rmdir, 112, 124
shutdown, 934
sleep, 934
startup, 934
su, 112
sudo, 113
systemextensionsctl, 292–293
touch, 111
traceroute, 760–761
wake, 934
computer account, creating, 51–53
Computer command, accessing, 305
computer name, setting, 81–83
configuration profiles.
See also profiles
changing Dock settings with, 90–91
installing, 70–73, 89–92
removing, 92
configuring
fast user switching, 205–210
login, 203–205
system preferences, 77–78
user accounts, 190–194
configuring macOS.
See also macOS Big Sur 11
Accessibility, 47–48
Analytics or iCloud Analytics, 54
choosing looks, 56
computer account, 51–53
Country or Region, 47
Express Setup, 53
FileVault Disk Encryption, 55–56
Find My screen, 53
Location Services, 54
Network Settings, 48
overview, 45–47
Remote Management, 48
Screen Time, 54
with Setup Assistant, 74–77
sign in with Apple ID, 49–51
Siri, 54
terms and conditions, 51
Touch ID, 56
True Tone display, 56
connectivity standards, 4
Console
accessing Installer log with, 29
viewing logs, 679–680
viewing reports with, 656–661
Contacts, configuring, 271, 783–785
Containers and Group Containers folders, 445
Content Caching service, running, 678–679, 817, 819–825
Continuity Camera, 18
Control Center, 6, 64–65
Control key.
See keyboard shortcuts
cookies, blocking in Safari, 274
copies of documents, saving, 582
copying
files to network shares, 809–810
items, 111
and moving files, 121–123
corrupted app resources, troubleshooting, 666–667
corrupted preferences, managing, 676–677
country or region, selecting, 47
cp command, using, 111
CPU Time, examining statistics, 647
Crash Reports, viewing, 658
createinstallmedia command, 146–147
cropping items, 579
cross-site tracking, preventing in Safari, 274
CUPS printing system
features, 884
logs, 919–920

D

Dark Mode, 61
data
backing up, 34
recovering from nonstarting system, 368–369
deleted user accounts, restoring, 243–252.
See also user accounts
restoring, 243–252

deleting
ACEs (access control entries), 408
apps, 562–564
apps in Finder, 564
configuration profiles, 92
folders, 112, 124
installed software, 546
items from iCloud Drive, 597–598
keychains, 320
user accounts, 237–238
Desktop, storing in iCloud Drive, 595–597
devices, viewing reports about, 657.
See also peripheral devices
DFS (Distributed File Service) architecture, 789
DHCP (Dynamic Host Configuration Protocol), 48, 689–691, 752
DHCP-supplied settings, confirming, 724–725, 736–739
diagnostic commands, Terminal, 753–761
diagnostic information, sending, 54
Diagnostic Reports, viewing, 654–656, 658–659
diagnostics, using, 944–947
dialogs, dismissing, 218
Dictation privacy, 273
dig command, 757–760
directories.
See also working directory
examining and changing, 116–118
removing, 124
directory service settings, checking, 846
Directory Utility and administrator users, 189
disk images, mounting and creating, 434–437
Disk Utility
erasing and reformatting devices, 375–377
examining, 149–150
examining storage, 357–359
First Aid feature, 365
and macOS Recovery, 135
remounting volumes, 354
viewing disk information, 371–374
diskimageshelper app, 301–302
disks.
See also external disks; unreadable disks
ejecting, 353–354
erasing, 361–363
viewing information about, 369–374
DNS (Domain Name System).
See also mDNS
overview, 688–689
protocol, 714
troubleshooting, 753, 757–760
verifying, 758
Dock
changing settings, 90–91
force quitting apps, 667–668
Dock & Menu Bar, 6, 63–64
dock settings, changing, 90–91
document storage.
See iCloud Drive service
document versions, exploring, 584–585
documents.
See also files
locking, 585–588, 617–618
locking and unlocking, 617–618
previewing, 570–577
previewing in Finder Preview pane, 570–573
previewing with Quick Look, 573–575
saving, 579–588
standards, 4
storing in iCloud Drive, 595–597
Documents command, 488
double periods (..), using with parent folder, 107, 124
downloading
Installer from App Store, 35
Installer using Software Update, 36
macOS Big Sur, 322–322
student materials, 86–88
drag and drop
from Finder to Terminal, 107
to install apps, 555–562
Drop Box folder, 236
dscacheutil command, 757–760
Duplicate command, 582–583
DVD or CD Sharing, 816
Dynamic Desktop, configuring, 62–63

E

ejecting disks or volumes, 353–354
encrypting external disks, 363–364.
See also FileVault Disk Encryption
Erase This Mac, confirming, 284–285
erasing
disks or volumes, 361–363
Mac and installing macOS Big Sur, 39–43
startup disk, 16
storage device, 40–41
storage devices, 40–41, 375–377
Ethernet.
See also PPPoE (Point-to-Point Protocol over Ethernet)
configuring manually, 734–735
connectivity issues, 749
hardware options, 714
network connectivity, 705
protocols, 714
support for, 711
exit command, using, 112–113
Express Setup screen, 53
extensions, displaying for files, 445, 565–566, 578
external disks, encrypting, 363–364.
See also disks
external storage devices.
See also storage devices
permissions for, 409
reformatting, 155–157

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F

FaceTime, configuring, 787–788
fast user switching, configuring, 205–210
FAT32 volume, 469
file archives, using, 432–437
file command, using, 110
file resources
  app group containers, 448–449
  hierarchy, 446–447
  Library, 444
  sandbox containers, 447–448
file sharing
  with AirDrop, 837–840
  and APFS, 352
  using, 816, 818–819
file systems
  aliases, 430–431
  APM (Apple Partition Map), 341
  GUID Partition Map, 340
  managing, 360–364
  MBR (Master Boot Record), 341
  navigating, 106
  partitions, 340–341
  shortcuts, 427–430
  storage, 340
  troubleshooting, 364–369
  volumes and volume formats, 341–342
file types, previewing with Quick Look, 568
filenames
  displaying extensions, 565–566
  using spaces with, 107
files.
  See also documents
  backing up, 22–23
  copying to folders, 123
  copying to network shares, 809–810
  creating, 120–121
  erasing in Terminal, 363
  locking, 585
  managing with commands, 119–124
  manipulating in CLI, 109–114
  marking up, 578–579
  modifying, 111–112
  opening, 565–567
  renaming, 123–124
  restoring, 506–511
  restoring with Finder, 510
  restoring with Time Machine, 506–510
  rotating, 577
  unhiding, 108
  viewing with Quick Look, 609
Files and Folders, Security & Privacy settings, 271
file-sharing services.
  See also AirDrop
  authentication, 791–794
  browsing, 790–791
  connecting to, 788–789
  connecting to manually, 794–796
  file shares, 798–799
  mounted shares, 796–797
  overview, 788–789
  troubleshooting, 806
  using, 807–812
file-system components, inspecting, 356–360
file-system metadata
  AppleDouble file format, 468–469
  examining, 487–492
  extended attributes, 463–464
  file flags, 463–464
  tags, 464–468
  tags and comments, 488–491
file-system permissions.
  See also permissions
  ACEs (access control entries), 397
  ACLs (access control lists), 397
  hierarchical context, 397–400
  inspecting, 393–394
  ownership, 394–395
  Read & Write, 398–399
  standard structure, 396
  UNIX privilege combinations, 396
file-system standards, 4
FileVault Disk Encryption.
  See also encrypting external disks
  enabling users, 386
  and guest accounts, 187
  IRK (institutional recovery key), 388
  overview, 381–383
  recovering lost recovery key, 87
  recovery key, 84–85, 390–392
  Security & Privacy settings, 267
  Setup Assistant, 55–56
  and system initialization, 926
  turning on, 84–86, 384–388
FileVault recovery
  configuring, 385–386
  key, 314–317, 390–392
FileVault-protected Mac, restarting, 388–389
fill color, choosing, 578
Find command, 491
Find My
  confirming Erase This Mac, 284–287
  confirming Mark As Lost, 283–284
  screen, 53
  using, 278–283
Finder
  adjusting preferences, 79–80
  aliases, 428
  drag-and-drop, 107
  managing permissions, 405–408
  opening, 116
  performing tasks from, 577–578
  removing apps in, 564
  restoring files, 510
  revealing hidden items, 422–425
  special characters, 107
Finder extensions, configuring, 636–637
Finder Info window, opening, 393

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Finder preferences, adjusting, 79–80
Finder Preview pane, previewing documents in, 570–573
Finder Quick Actions extensions, configuring, 639
Finder Sync extensions, configuring, 636–637
firewall settings, accessing, 267. *See also* personal firewall
FireWire, support for, 870
firm links, file system, 430
firmware and system initialization, 922, 925–927
firmware issues, troubleshooting, 950–952
firmware password, turning on, 140–142
First Aid feature, Disk Utility, 365
folder permissions, propagating, 408
folders.
See also packages; parent folder; root folders
accessing, 439
backing up, 22–23
copying files to, 123
creating, 121–123
deleting, 112
modifying, 111–112
removing, 124
unhiding, 108
fonts
confirming availability, 456–459
disabling, 459–460
installing, 452–455
validating, 460–461
Fonts folder, 445
force quitting apps, 652–654, 667–672
formatting unreadable disks, 360–361
Framework plug-ins, 879
Frameworks folder, 445
FTP (File Transfer Protocol), 789, 795–796
Full Disk Access, Security & Privacy settings, 271
full name settings, editing for user accounts, 193
Fusion Drive, 352

G

Gatekeeper security settings, testing, 558–561
Get Info command, 393
GPU Time, examining statistics, 647
group settings, editing for user accounts, 193
guest accounts, 186–188
GUID Partition Map, 156–157, 340

H

Handoff, 18
hard links, file system, 429
hardware and app compatibility, checking, 30–33
hardware issues
checking for, 944–947
troubleshooting, 951
Help feature, using, 11–13
Hey Siri, searching with, 471
hidden items
examining, 421–425, 437–440
navigating, 437–440
revealing in Finder, 422–425
viewing, 108
hidden system folders, examining, 439–440
hidden Wi-Fi networks, joining, 699
HIDs (human input devices), 877
highlight color, configuring, 61
Home command, 437–438
home directory settings, editing for user accounts, 193. *See also* user home folders
Home folder
permissions, 401–403
viewing, 115–116
HomeKit, Security & Privacy settings, 271
host command, 757–760, 766
hostname, displaying, 82
host-sharing services
configuring network identification, 815–816
content caching, 819–825
file sharing, 818–819
Screen Sharing, 847–849
shared services, 816–817
turning on, 813–815
using, 847–854
HTTP (Hypertext Transfer Protocol)
and Safari, 775
and WebDAV, 789

I

iCloud analytics, sending information about, 54
iCloud Drive service.
See also storage devices
configuring, 619–620
features, 50–51
local storage, 598–599
opening documents from, 621–623
optimized storage, 599–600
removing items from, 597–598
requirement of, 46
saving to, 620–621
storing Desktop and Documents folders, 595–597
storing documents in, 619–624
turn off features, 600–604
turning on, 590–592
using, 592–594
using Contacts from, 624
verifying changes, 624
iCloud Keychain, 262–264. *See also* keychains
iCloud Security Code, resetting iCloud keychain, 322–323
Idle Wake Ups, examining statistics, 647
IEEE 802.3, 711
images, rotating, 577
input devices, 877. *See also* wireless devices
Input Monitoring, Security & Privacy settings, 271
inspector, opening, 114

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install disk
creating, 153–158
testing, 158–159
Install macOS Big Sur app, getting copy of, 154–155
installation
history, 173
process of, 16
verifying, 43–44
installation issues, troubleshooting, 27–29
installation of macOS, verifying, 43–44
installation requirements, verifying, 17–22
installed software, removing, 546
installed updates, checking, 177–178
Installer.
See also bootable installer
downloading from App Store, 35
downloading using Software Update, 36
Installer log
using for troubleshooting, 28–29
viewing, 43–44
installer package
resources, 427
using with apps, 552–555
installing
apps, 305–306, 542–545
apps from App Store, 546–551
configuration profiles, 70–73, 89–92
fonts, 452–455
macOS, 25–27
macOS Big Sur, 39–43
macOS Big Sur 11, 41–43
Rosetta, 630–633
Instant Hotspot, 18
Intel-based Macs.
See also Macs
alternate system, 943–944
kernel issues, 953
single-user mode, 949–950
startup shortcuts, 926, 950
using Internet recoveryOS with, 134
verbose mode, 949–950
internet access, testing, 741–742
Internet Accounts preferences, 776–777
Internet recoveryOS, using with Intel-based Macs, 134
Internet Sharing, 817
invisible items, viewing, 108
IP (Internet Protocol) addresses, 684–685.
See also network host addressing
IP proxies, 714
ipconfig command, 753–754
IRK (institutional recovery key), FileVault Disk Encryption, 388

J

JPEG (Joint Photographic Experts Group) format, 565

K

kernel and system initialization, 922, 928–929
kernel issues, troubleshooting for Intel-based Macs, 953
kext (kernel extension)
driver implementation, 878
explained, 289
system initialization, 927–928
keyboard shortcuts
Accessibility Shortcuts panel, 66
aliases, 430
App Store, 526
Applications, 89, 306
canceling actions, 218
for CLI, 113–114
Computer, 305
Documents, 488
Duplicate, 582
Find, 491
Finder, 116
Finder Info window, 393
Finder preferences, 422
Finder Preferences window, 80
Go to Folder, 439
Home, 437–438
inspector, 114
Lock Screen, 293
Network view, 851
Save, 581
Save As, 488, 583
text size, 13
View Options, 423, 490
VoiceOver, 46–47
Keychain Access, using, 254
keychains.
See also iCloud Keychain; login keychains; user keychains
deleting, 320
local files, 255–256
locking automatically, 295–298
locking login sessions, 298–299
managing secrets in, 256–262
managing with Safari, 258–262
moving passwords to, 303–305
overview, 254
resetting, 321–322
retrieving passwords from, 300–302
Screenshot utility, 22–23
storing passwords, 299–300
Utilities folder, 300
Keychains folder, 445

L

ladmin command, 851
LAN traffic, 686–687
Launch Services, managing, 569–570
launchd
and system initialization, 922, 929–931
troubleshooting, 953–954
user sessions, 932
LaunchDaemons and LaunchAgents folders, 445
Launchpad, removing apps from, 563

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legacy system extensions, approving, 289–290
less command, using, 110
Library folder
examining, 437–439
resources, 444–445
system resource domains, 446
Light Mode, 61
link aggregate service, 713
links.
See hard links; symbolic links
Local Administrator
account, 185
authenticating as, 91
authentication as, 851
password, 153
Local domain, 446
local group accounts, 189–190
local storage, optimizing, 604–608.
See also storage
local user accounts.
See also user accounts
restricting access with Screen Time, 194–202
verifying, 846
types, 182–183
Location Services
enabling, 54
Security & Privacy settings, 270
Lock Screen, 293–295
locking
documents, 617–618
files, 585–588
Mac after losing, 283–284
screen, 293–295
and unlocking documents, 617–618
log data, generating, 678–679
log files, using for troubleshooting, 28–29
Log Reports, viewing, 658
logged-in identity, verifying, 112
login, configuring, 203–205
login keychains, observing effects of, 329–336.
See also keychains
login passwords, resetting, 314–317
login shell settings, editing for user accounts, 193
loginwindow process, 931, 939–940
logout
process of, 939–941
resuming after, 588–589
troubleshooting, 955
logs
examining, 677–680
searching, 660–661
viewing in Console, 656–661
viewing with Console, 679–680
Logs folder, 445
Look Up, searching with, 474–475
lost Macs, locating, 278–287
lost passwords, resetting, 313–319.
See also passwords
ls command
and seeing hidden items, 108
using, 116–117
using for navigation, 106

M

MAC (media access control) addresses, 684
Mac Analytics Data, viewing reports about, 659
Mac Catalyst improvements, 10
"Mac computers with Apple silicon," Apple Support article, 4
Mac model, identifying, 19–20
Mac notebooks, plugging into power, 23
macOS
Help, 11–13
history, 13–14
installation methods, 15–16
Installer, 151
upgrade and reinstallation, 17–25
upgrading or installing, 25–27
verifying versions of, 13–14
version numbers, 15–16
macOS Big Sur
installing, 41–43
upgrading to, 34–38
macOS Big Sur 11.
See also configuring macOS
accessibility features, 8–10
App Store privacy information, 7
configuring with Setup Assistant, 74–77
Control Center, 6–7
design, 5–6
downloading, 23–25
installation methods, 15–16, 25–27, 41–43
integration through standards, 3–4
Mac Catalyst, 10
managing from CLI, 112–113
maps, 7
messages, 7
new features, 4–5
Notification Center, 7
Photos, 10
reinstalling, 135
reviewing history, 13–14
Safari update, 7
Time Machine, 7
upgrading, 25–27
upgrading to, 37–38
verifying installation of, 43–44
Voice Control, 8–10
web page, 5
macOS Recovery.
See also restoring; Startup Security Utility
apps, 149–152
resetting account passwords in, 323–325
resetting passwords, 317–318
start up from, 39–40, 130–134, 147–149
startup disk and restart, 152–153
using, 135–136
Macs.
See also Intel-based Macs
erasing and installing macOS Big Sur, 39–43
finding after losing, 278–287

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keeping awake, 814
locking after losing, 283–284
preparing for upgrade, 29–34
unlocking with Apple Watch, 266
Magic wireless devices, 870
Mail
configuring, 778–780
troubleshooting, 806
man (manual) pages
reading about, 113
reading details about commands in, 118–119
using, 105, 118–119
maps, redesign of, 7
marks and bookmarks, using, 109
MBR (Master Boot Record), 155, 341
mdfind command, using, 110
MDM (mobile device management) solution
automating, 46
installing macOS updates, 173
and profiles, 73
restrictions for Macs, 186
turning on Screen Sharing, 836–837
mDNS, 3.
See also DNS (Domain Name System)
Media & Apple Music, Security & Privacy settings, 271
Media Sharing, 816
memory management, 31, 626
menu bar, configuring, 63–64
Messages
configuring, 785–787
controlling Macs remotely, 833–836
update, 7
Messages Screen Sharing, 832–836
metadata.
See file-system metadata
Microphone, Security & Privacy settings, 271
Migration Assistant, using with home folders, 238–242
mkdir command, using, 111
mobile user accounts, 182
Model Identifier, recording, 31
mounted shares, 796–797
mounting
disk images, 434
network shares, 810–811
mouse and trackpad preferences, adjusting, 83–84
movies, rotating and trimming, 577
MTU (maximum transmission unit) support, 789
music, Security & Privacy settings, 271
mv command, using, 112

N

name settings, editing for user accounts, 193
nano text editor, 112, 125
nc (netcat) command, 801–802
NetBIOS name, 774
netstat command, 755–756
network apps, troubleshooting, 803–806
network connectivity, troubleshooting, 761–767
network host addressing, 774–775.
See also IP (Internet Protocol) addresses
network identification, configuring, 815
network issues
DHCP service, 752
diagnostic tools, 748
Ethernet connectivity, 749
isolating, 748
troubleshooting, 747–753
troubleshooting with Terminal, 753–761
verifying preferences status, 749
Wi-Fi connectivity, 750–752
network list.
See Preferred Networks list
network locations.
See also static network location
configuring, 708–709, 736–742
selecting, 709–710
network printers, configuring, 887–888
network proxies, configuring, 733–734
network service access, troubleshooting, 846
network service apps
Calendar and Reminders, 781–783
configuring accounts, 777–778
Contacts, 783–785
FaceTime, 787–788
Internet Accounts preferences, 776–777
Mail, 778–780
Messages, 785–787
Notes, 780
Safari, 775
network service communication, troubleshooting, 845–846
network services
Calendar and Reminders, 781–783
configuring accounts, 777–778
Contacts configuration, 783–785
dynamic service discovery, 772–774
FaceTime configuration, 787–788
host addressing, 774
identification, 772, 775
list, 716
Mail configuration, 778–780
managing interfaces, 715–718
Messages configuration, 785–787
Notes configuration, 780
protocols, 789
Safari configuration, 775
scanning for, 802
software, 771–772
troubleshooting, 799–806
network settings
802.1X, 730–732
configuring, 690
DHCP (Dynamic Host Configuration Protocol), 691, 724–725

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documenting, 22–23, 33–34
Ethernet, 734–735
proxy servers, 733–734
Setup Assistant, 48
TCP/IP, 725–727
verifying, 699–702
Wi-Fi, 727–730
WINS (Windows Internet Naming Service), 732–733
network shares
copying files to, 809–810
mounting automatically, 810–811
network standards, 4
network user accounts, 181–182
Network view, opening, 851
networks
adding to Preferred list, 745–746
configuring settings, 690
DHCP (Dynamic Host Configuration Protocol), 689–691
DNS (Domain Name System), 688–689, 753
elements, 683–684
interfaces and protocols, 710–714
IP addresses, 684–685
LAN traffic, 686–687
lookup process, 758
MAC addresses, 684
monitoring connectivity, 704–706
overview, 683–684
protocols, 714
router addresses, 685
subnet masks, 685
TCP (Transmission Control Protocol), 686
verifying connections, 702–703
WAN traffic, 687–688
NFS (Network File System), 789, 795–796
Notes, configuring, 780
Notification Center
managing widgets, 643–645
update, 7
nslookup command, 757–760
NVRAM or PRAM, Apple Support article, 750, 950

O

opening files, 565
Option key. *See* keyboard shortcuts

P

packages, examining, 425–427. *See also* folders
Panel Editor, using with accessibility features, 69
PANs (personal area networks), 711–712
parent folder, indicating, 107, 124. *See also* folders
partition table, repairing, 378–379
passcode, providing for remote lock, 284
Password Assistant, using, 313
password security, 253–256
passwords, 323. *See also* lost passwords; **resetpassword** command
changing, 311–313
moving to keychains, 303–305
moving to system keychains, 303–305
resetting, 136
resetting for Apple ID, 52
resetting in macOS Recovery, 317–318, 323–325
retrieving from keychains, 300–302
storing in keychains, 299–300
paths
/ (slash) in, 439
absolute and relative, 124
using spaces with, 107
PCL (Printer Command Language), 884
PDFs
creating, 578, 903–904
printing to, 918–919
period (.)
preceding items with, 108
using with hidden items, 421
peripheral devices, 877–879. *See also* devices
peripheral issues, troubleshooting, 879
peripheral technologies
Bluetooth, 869–870
connectivity, 863–864
examining using system information, 880–882
FireWire, 870
Thunderbolt, 867–869
troubleshooting, 877–879
USB, 864–867
permissions. *See also* file-system permissions
creating defaults, 410–416
examining as other user, 411–416
for external storage devices, 409
managing, 405–408
testing changes, 416–419
permissions for sharing
home folder, 401–403
securing new items, 404
Shared folder, 403–404
personal firewall. *See also* firewall settings
configuring, 854–860
managing, 840–844
Photos
improvements, 10
Security & Privacy settings, 271
Photos Editing extensions, configuring, 637–638
PID (Process Identification), examining statistics, 647
PIN, providing for remote lock, 284, 286
ping command
and **nc** (netcat), 801–802
using, 756–757, 764–766
POST (power-on-self-test), 925
Power Nap mode, 936–939

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PPPoE (Point-to-Point Protocol over Ethernet), 713.
See also Ethernet
PRAM or NVRAM, Apple Support article, 750, 950
PreferencePanes folder, 445
preferences.
See also System Preferences
disabling and restoring, 674–676
troubleshooting, 661–666, 672–677
Preferences folder, 445
Preferred Networks list
adding networks to, 745–746
clearing, 744–745
Preview Pane extensions, configuring, 639
Preview preferences, creating and locating, 672–674
Print command, 900
print issues, troubleshooting, 906–908
print jobs, managing, 900–906
print settings and presets, configuring, 901–903
printer drivers, 884–885
printer queues, managing, 904–906, 916–918
Printer Sharing, 816
printers and scanners.
See also AirPrint
configuring, 885–898
as peripherals, 877
sharing, 898–899
printing
configuring, 908–913
managing, 913–919
resetting, 920
troubleshooting, 919–920
printing in macOS
AirPrint, 883
CUPS, 884
printer drivers, 884–885
privacy preferences, editing and re-securing, 126–127.
See also user privacy
Process Name, examining statistics, 647
processes
apps as, 625–626
discovering for volumes, 355
monitoring, 646–651
monitoring with Activity Monitor, 646–651
types, 625–626
processes and use, viewing, 672
Profile Manager, 185
profiles.
See also configuration profiles
accessing, 90
sharing, 73
types of, 70
property list files, editing, 665–666
proxy servers, configuring, 733–734
Public folder, 236
pwd command, using, 106, 116–118

Q

q command, using, 122–123
question mark (**?**) wildcard, using, 110
Quick Actions
creating with Automator, 640–642
marking up files, 578
Quick Actions feature, 577–578, 640–642
Quick Look
configuring extensions, 638
marking up files, 578
plug-ins, 575
previewing documents, 573–575
previewing file types, 568
viewing files with, 609
window, 575–577
quit, resuming after, 588–589

R

Read & Write, file-system permissions, 398–399
recovering data from nonstarting system, 368–369
recovery.
See macOS Recovery
Recovery Assistant
resetting passwords, 318
using, 145–146
Recovery mode, repairing volumes in, 378–379
recursive commands, using, 111.
See also CLI (command-line interface)
redirect (**>>**) operator, using, 109–114
region or country, selecting, 47
reinstallation, process of, 16
reinstalling macOS Big Sur, 135
relative paths, 124
Reminders
and Calendar, 781–783
Security & Privacy settings, 271
Remote Apple Events, 817
remote computers.
See Screen Sharing
Messages Screen Sharing, 832–836
Screen Sharing, 825–832
Remote Login, 816
Remote Management, 817
remote management, Setup Assistant, 48
removing
ACEs (access control entries), 408
apps, 562–564
apps in Finder, 564
configuration profiles, 92
folders, 112, 124
installed software, 546
items from iCloud Drive, 597–598
keychains, 320
user accounts, 237–238
renaming files, 123–124
reports, viewing with Console, 656–661
resetpassword command, 136, 141, 317.
See also passwords
restart and shutdown, 941
restoring.
See also macOS Recovery
files using Time Machine, 506–511, 516–520

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Macs, 133–134
preferences, 674–676
Resume, managing, 588–589
rm command, using, 112
rmdir command, using, 112, 124
root folders, 444.
See also folders
root user accounts, 113, 188–189
Rosetta, installing, 630–633
rotating items, 577–578
router addresses, 685

S

Safari
configuring, 775
managing keychain items with, 258–262
privacy, 274–277
update, 7
safe boot. *See* safe mode
safe mode
login, 955
using, 935, 947–949, 956–957
Save As command, 488, 583
Save command, 581
saving documents, 579–588.
See also Auto Save
scanners and printers.
See also AirPrint
configuring, 885–899
as peripherals, 877
sharing, 898–899
Screen Recording, Security & Privacy settings, 271
Screen Sharing.
See also remote computers
automation and MDM solution, 836–837
connecting to virtual display, 851–854
connecting with, 827–831
controlling Macs with, 831–832, 849–851
Messages app, 832–836
remote control of Macs, 849–851
services, 825–826
turning on, 826–827, 836–837, 847–849
Screen Time
creating accounts, 219–220
logging in to user accounts, 220–221
managing user accounts, 219–228
restricting user access with, 194–202
setting up and testing, 222–228
screens
enlarging with Zoom pane, 67
locking, 293–295
Screenshot utility, using to document settings, 22–23
Search field, entering terms in, 11–12
search results, about, 476–477
search security, 479
searching
with Hey Siri, 471
logs and activities, 660–661
with Look Up, 474–475
with Siri, 470–471
with Spotlight, 471–474, 479–483, 491–492
secrets
managing in iCloud Keychain, 262–264
managing in keychains, 256–262
Secure Boot
and Allowed Boot Media settings, 142
configuring, 143–144
security, 264–267.
See also Apple T2 Security Chip; Startup Security Utility
Security & Privacy settings
approving System Extensions, 291
Gatekeeper, 558–561
preferences, 265
Privacy pane, 268–272
Security Policy
Apple silicon and T2 chip, 922–925
configuring with Apple silicon, 140
serial number, locating, 20, 31
Service button, 20
Setup Assistant
for additional users, 191–192
administrator account, 185
analytics or iCloud Analytics, 54
Apple ID, 49–51
choosing looks, 56
configuring macOS, 74–77
configuring macOS with, 74–77
Create a computer Account, 51–53
Enable Location Services, 54
Express Setup screen, 54
FileVault Disk Encryption, 55–56
iCloud Drive service, 50–51
network settings, 48
remote management, 48
Screen Time, 54
Siri, 54
terms and conditions, 51
Touch ID, 56
True Tone display, 56
using, 45
SFTP (Secure File Transfer Protocol), 816
shapes, working with, 578
Share Disk and macOS Recovery, 136
Share Menu extensions, configuring, 639
Shared folder, 403–404
shared services
checking access settings, 846
troubleshooting, 845–846
using, 816–817
sharing-only accounts, 188
shutdown
commands, 934
and restart, 941
troubleshooting, 955
signature, creating, 578
single-user mode, Intel-based Macs, 949–950
SIP (System Integrity Protection), 113, 184, 450–452

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Siri
preferences, 483–485
searching with, 470–471
setting up, 55
slash (/), using in paths, 439
sleep commands, 934
sleep modes, 814, 933–936
S.M.A.R.T. (self-monitoring, analysis, and reporting technology), 357
SMB (Server Message Block) protocol, 774, 789, 794–795, 818
SMB share, connecting to, 807–809, 811–812
SMC (System Management Controller), 950
Software Update, downloading Installer, 36
Software Updates.
See also updates
App Store preferences, 172
App Store update behavior, 169–170
behavior, 162–167
checking, 177–178
downloading Installer with, 36
overview, 161–162
performing, 175–177
preferences, 168–169, 174–175
preferences for automatic updates, 170–172
spaces, using with filenames and paths, 107
special characters, using, 107
Specifications link, 20
Speech Recognition, Security & Privacy settings, 271
spin reports, viewing, 658
Spoken Content pane, 68
Spotlight
advanced search, 479–483
indexing, 477–478
plug-ins, 478
preferences, 486–487
searching with, 471–474, 491–492
using from command line, 110
square brackets ([]) wildcard, using, 110
SSH (Secure Shell) remote login, 100–101, 188, 816
SSID (service set identifier), using with Wi-Fi, 692
SSV (signed system volume)
APFS, 343–344
and SIP, 450
Time Machine, 494
standard user accounts
creating, 210–218
using, 185–186
standards supported by macOS, 4
standby mode, 936
starting up
from macOS Recovery, 39–40
in safe mode, 956–957
using macOS Recovery, 147–148
startup
commands, 934
methods of, 39–40
modifying, 942–950
startup disk
erasing, 16
and macOS Recovery, 135
selecting and restarting, 152–153
Startup Security Utility.
See macOS Recovery; security
Allowed Boot Media, 144–145
examining, 151–152
Firmware Password, 140–142
Recovery Assistant, 145–146
Secure Boot, 143–144
security policies with Apple silicon, 140
using, 137–139
volume, 31
static network location, creating, 738–741.
See also network locations
stealth mode
enabling for personal firewall, 844
testing, 858–860
Sticky Keys and Slow Keys, turning on, 68
storage.
See also local storage
examining with Disk Utility, 357–359
examining with system information, 359–360
Storage category, selecting, 31
storage devices.
See also external storage devices; iCloud Drive service
erasing, 40–41, 375–377
as peripherals, 877
storage space, verifying, 20
student materials, downloading, 86–89
su command, using, 112
subnet masks, 685
sudo command, using, 113
Support button, 20
Switch Control pane, using adaptive devices with, 69
symbolic links, file system, 428–429
System Administrator account, 113, 188–189
system domain, 446
System Extensions
approving, 291–293
driver implementation, 878
System Information
examining peripherals, 880–882
examining storage with, 359–360
using to monitor apps, 645–646
verifying, 18–21, 93–95
system initialization
booter, 927–928
booter process, 927–928
components, 922
firmware, 925–927
kernel, 928–929
launchd, 929–931
and secure boot, 921–922
security chip, 922–925
troubleshooting, 950–954
and user sessions, 921

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system login window options, managing, 203–205
System Preferences.
See also preferences
accent, 61–62
accessibility, 66–70
appearance, 61–62
configuration profiles, 70–73
Control Center, 64–65
Dock & Menu Bar, 63–64
Dynamic Desktop, 62–63
highlight color, 61–62
opening and using, 56–60
using, 57–60
system preferences
computer name, 81–83
configuring, 77–78
FileVault, 84–86
Finder, 79–80
trackpad and mouse, 83–84
system resources, troubleshooting, 449
System root folder, 444
system settings, managing, 56
system sounds, 6
system volume issues, troubleshooting, 951–952
systemextensionsctl command, 292–293
system.log reports, viewing, 659

T

T2 chip.
See also security
and FileVault, 86
and macOS Recovery, 133
and Startup Security Utility, 137, 139
Tab key completion, using, 107
target disk mode, using, 366–368
tasks, performing from Finder, 577–578
TCP (Transmission Control Protocol), 686
TCP/IP (Transmission Control Protocol/Internet Protocol)
configuring manually, 725–727
explained, 714
Terminal
and administrator users, 189
and CLI (command-line interface), 98–103
diagnostic commands, 753–761
erasing files in, 363
ifconfig, 753–754
lookup, 757–760
and macOS Recovery, 136
netstat, 755–756
opening, 115
ping and **nc** (netcat), 756–757, 801–802
special characters, 107
standard output, 678
traceroute, 760–761
troubleshooting network issues, 753
terms and conditions, Setup Assistant, 51
tethered caching, turning on, 820
text
entering, 578
highlighting, 578
resizing, 13
text files
creating and editing, 125–126
viewing, 110
text style, choosing, 578
TextEdit menu bar, using, 120
Threads, examining statistics, 647
Thunderbolt and Thunderbolt Bridge, support for, 711, 867–869
tilde (~), using with user home folder, 107
Time Machine
backups, 494–495
configuring, 511–516
configuring exclusions for, 512–513
configuring preferences, 504–505
improvements, 7
inheriting backups, 503–504
local snapshots, 495
managing options, 505–506
overview, 493–494
restoring files, 506–511, 516–520
restoring from, 135
selecting backup volume, 513–516
setting up from alert, 496–498
setting up manually, 498–503
volumes, 504
TLS (Transport Layer Security) encryption, 837
Touch Bar extensions, configuring, 640
touch command, using, 111
Touch ID, Setup Assistant, 56
traceroute command, 760–761
trackpad and mouse preferences, adjusting, 83–84
trimming files, 577
troubleshooting
app resources, 666–667
apps, 651–652
booter issues, 952
DNS (Domain Name System), 757–760
file systems, 364–369
file-sharing services, 806
firmware issues, 950–952
hardware issues, 944–947, 951
installation issues, 27–29
kernel issues, 953
launchd issues, 953–954
logout, 955
Mail, 806
network apps, 803–806
network connectivity, 761–767
network issues, 747–753
network services, 799–806, 845–846
peripheral issues, 879
peripheral technologies, 877–879
preferences, 661–666, 672–677
print issues, 906–908
printing, 919–920
shared services, 845–846

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shutdown, 955
system initialization, 950–954
system resources, 449
system volume issues, 951–952
user sessions, 954–955
web browsers, 803–805
True Tone display, Setup Assistant, 56
two-factor authentication, use with Apple ID, 50, 263–264

U

UEFI (Unified Extensible Firmware Interface), 924
Universal apps, 627–628
Universal Clipboard, 18
UNIX privilege combinations, file-system permissions, 396
unreadable disks, formatting, 360–361.
See also disks
updates.
See also Software Updates
installing with MDM, 173
receiving automatically, 171
releasing to macOS Big Sur, 15
updating, process of, 16
upgrades
preparing Macs for, 29–34
releasing, 15
upgrading
macOS, 25–27
to macOS Big Sur, 34–38
process of, 16
usage information, sending, 54
USB devices
examining, 882
support for, 711–712, 864–867
User, examining statistics, 647
user access, restricting with Screen Time, 194–202
user accounts.
See also account passwords; deleted user accounts; local user accounts
administrator accounts, 183–185
attributes, 192–194
configuring, 190–194
creating and editing, 190–191, 210–218
deleting, 237–238
guest accounts, 186–188
hiding, 184
local group accounts, 189–190
managing using Screen Time, 219–228
root user accounts, 188–189
Setup Assistant for users, 191–192
sharing-only accounts, 188
standard accounts, 185–186
switching between, 205–210
types, 182–183
Users & Groups preferences, 190
User domain, 446
User Guides, using, 12–13
user home folders.
See also home directory settings
migrating and restoring, 238–242
overview, 229–237
preserving after deleting user accounts, 237–238
restoring manually, 242
using tilde (~) with, 107
User ID settings, 192
user keychains, 319–323.
See also keychains
user login items, managing, 203
user privacy, managing, 267–277.
See also privacy preferences
user sessions
environment, 932–933
launchd, 932
login window, 931
pausing and ending, 933–934
and system initialization, 921
troubleshooting, 954–955
users, logging out, 939–941
Users & Groups preferences, 190
Users root folder, 444
Utilities folder, accessing, 300
UUID (Universally Unique Identifier)
assignment of, 251
editing for user accounts, 193

V

verbose mode, Intel-based Macs, 949–950
version numbers, 15–16
versions
identifying, 19–20
working with, 615–617
Versions browser, using with documents, 584
video devices as peripherals, 877
View Options command, 423
virtual display, connecting to, 851–854
virtual network services, 712–713
VLAN (virtual local area network), 713
voice, customizing, 68
Voice Control, 8–10
VoiceOver, enabling and disabling, 46–47
volumes
APFS (Apple File System), 347, 350–352
discovering process for, 355
ejecting, 353–354
ejecting in use, 355
erasing, 361–363
navigating to, 109
remounting, 354
repairing in Recovery mode, 378–379
viewing information about, 369–374
and volume formats, 341–342
VPN settings
configuration profiles, 719
configuring, 719–724
configuring manually, 720–722
VPNs (virtual private networks), connecting to, 713, 722–724

W

wake commands, 934
WAN traffic, 687–688

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web browsers, troubleshooting, 803–805
WebDAV (Web Distributed Authoring and Versioning), 781, 789, 795–796
WEP (Wired Equivalent Privacy) authentication standard, 694
Wi-Fi connectivity, troubleshooting, 750–752
Wi-Fi networks
configuring, 742–746
configuring manually, 727–730
connecting to, 699–703
selecting and authenticating to, 692–696
support for, 711
Wi-Fi PAN, support for, 712
Wi-Fi-only location, creating, 742–744
wildcard characters, using, 110–111
WINS (Windows Internet Naming Service), 714, 732–733
wireless devices, 870. *See also* input devices
Wireless Ethernet protocol, 714
wireless networking, 692–696
working directory. *See also* directories
examining and changing, 116–118
explained, 101
WPA (Wi-Fi Protected Access) authentication standards, 694–698

X

Xcode, using with property list files, 665
XML format, analyzing, 665

Z

Zero Configuration Networking (Zeroconf), 773
ZIP archives, creating and expanding, 432–433
Zoom pane, enlarging screen with, 67
zsh, using as default shell, 101

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