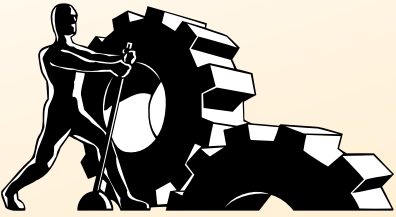


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# 802.11n AirPort Network

**Glenn Fleishman**



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# Read Me First

Welcome to *Take Control of Your 802.11n AirPort Network, Second Edition*, version 2.0, published in August 2011 by TidBITS Publishing Inc. This book was written by Glenn Fleishman and edited by Tonya Engst.

This book helps you install and get the most out of your network using Apple's AirPort and Time Capsule gear with the 802.11n Wi-Fi networking standard in Mac OS X 10.7 Lion. It also gives advice for 10.5 Leopard, 10.6 Snow Leopard, and Windows 7.

If you have an ebook version of this title, please note that if you want to share it with a friend, we ask that you do so as you would a physical book: "lend" it for a quick look, but ask your friend to buy a new copy to read it more carefully or to keep it for reference. Discounted [classroom and Mac user group copies](#) are also available.

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## Updates and More

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

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## Who Needs This Book

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If you're setting up, extending, or retooling a Wi-Fi network with one or more 802.11n base stations from Apple—including the AirPort Extreme, AirPort Express, or Time Capsule—with Mac OS X 10.7 Lion, this book will help you get the fastest network with the least equipment and fewest roadblocks. This book also has advice on connecting to a Wi-Fi network using older versions of Mac OS X and Windows 7.

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## What's New in Lion and in This Edition

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With Mac OS X 10.7 Lion, Apple has made significant changes in the look and feel of Mac OS X, mostly in features aimed at new users. In comparison, the differences related to AirPort and Wi-Fi are modest.

The most obvious change is that Mac OS X no longer uses the Apple product name “AirPort” to refer to Wi-Fi networking. Apple started offering radio-based wireless networking in 1999 around the time that the “Wi-Fi” term was coined (and trademarked). Now, with Wi-Fi built in everywhere, the term AirPort has become a confusing distraction for new users, and it is ignored by many experienced users.

Wherever you saw the term AirPort in Mac OS X in the past to refer to built-in networking, Wi-Fi now appears. However, Apple still labels two of its three base station models with AirPort—AirPort Extreme and AirPort Express—and AirPort Utility remains available to configure any base station.

Lion has two other Wi-Fi related points worth calling out:

- **AirDrop:** With this new feature, you can use Wi-Fi to trade files with a nearby Mac running Lion, but without either computer being connected to a Wi-Fi network. AirDrop works only with newer Macs because it requires newer generations of Wi-Fi hardware. Read [AirDrop](#) to learn how to use AirDrop and which Macs support it.
- **5 GHz channel options:** Lion's software base station and computer-to-computer networking features now work with 5 GHz channels:
  - Apple has offered a *software base station*, a way to create what is effectively a simple Wi-Fi router in a Macintosh, since before

Mac OS X. Before Lion, the feature was restricted to 2.4 GHz channels, even though Apple began adding 5 GHz Wi-Fi to new Mac models in late 2005. With Lion, you can now choose among the four low-power 5 GHz channels to share via 802.11a—not 802.11n. For details, see [Software Base Station](#).

- ▶ These same 5 GHz channels are also now available for computer-to-computer networking, which uses a slightly different approach. See [Ad Hoc Networking](#).

Besides the new Lion-related information, changes in this edition include these:

- **iOS devices:** This edition has more information about Apple’s iOS devices.
- **Strong focus on 802.11n:** This book has been updated regularly for nearly 6 years, and some material that made sense during the transition from 802.11g (the pre-2007 Wi-Fi standard in AirPort) to 802.11n (this standard began appearing in Apple products in 2007) is no longer useful for folks setting up new networks or upgrading old ones. I’ve removed quite a bit of background information and advice that’s outdated in an all-802.11n world. (If you still use 802.11g gear, it works perfectly well when connected via Ethernet to an 802.11n base station, a technique that I describe in [Add Access Points via Ethernet](#).)
- **Newer operating systems:** To make the book useful for people using recent versions of Mac OS X and Windows 7, I’ve removed a great deal of now-historical material about versions of Mac OS X before 10.5 Leopard and versions of Windows before Windows 7.


**Note:** If you need to work extensively with pre-802.11n AirPort gear, you may find it helpful to refer to an older edition of this ebook. You can download an older edition from this ebook’s blog. To access the blog, click the link in [Ebook Extras](#).

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## Basics

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Here are a few “rules of the road” that will help you read this book:

- **Path syntax:** I occasionally use a *path* to show the location of a file or folder in your file system. For example, AirPort Utility gets installed into the Utility folder, which is in the Applications folder. The path to AirPort Utility is `/Applications/Utilities/AirPort Utility`.
- **Menus:** When I describe choosing a command from a menu in the menu bar, I use an abbreviated description. For example, the abbreviated description for the menu command that creates a new folder in the Mac OS X Finder is “File > New Folder.”
- **Finding preference panes:** I sometimes refer to Mac OS X preferences, such as those in the Network preference pane. To reach a preference pane, open System Preferences by clicking its icon in the Dock or by choosing Apple  > System Preferences. Then, to open a preference pane, click its icon or choose it from the View menu.

For example, to see “the Network preference pane,” launch System Preferences and then click the Network icon or choose View > Network. To find the Wi-Fi view in the Network preference pane, you would use the same steps and then click the Wi-Fi item in the adapter list at the left of the Network preference pane.

- **Configuring a base station:** Throughout the book, I refer to using a program called AirPort Utility to configure a base station. In almost all cases, to configure a base station in AirPort Utility, you select the base station in the AirPort Utility sidebar, and then do one of the following:
  - ▶ Choose Base Station > Manual Setup.
  - ▶ Press Command-L.
  - ▶ Click the Manual Setup button in near the lower-left corner of the AirPort Utility window.
  - ▶ Double-click the base station in the left-hand list (this opens a freestanding window).

- **Wi-Fi menu:** The Wi-Fi status menu appears near the right side of the menu bar on a Macintosh. If yours isn't showing, you can turn it on via a checkbox in the Network system preference pane, in the Wi-Fi view. (This menu was labeled *AirPort* since before Mac OS X, and has changed to read *Wi-Fi* in Lion.) To learn about the icons that may mark the top of this menu, see [Mac Wi-Fi Iconography](#).

**Note:** If you are using 10.5 Leopard or 10.6 Snow Leopard, be aware that when I write "Wi-Fi" in regard to the Mac interface, you should mentally substitute "AirPort." For example, to follow the directions above for turning on the AirPort menu, you should look in the Network preference pane, in the AirPort view.

# Introduction

Apple introduced integrated wireless networking to the world with AirPort in 1999. Although corporations had already been using forms of wireless networking for warehouse tracking and to connect buildings in large campuses, the costs were high, speeds were low, and complexity was manifest. Other companies were selling similar wireless hardware in 1999, but Apple's products shot off the shelves due to their relatively low initial price, simple configuration interface, and excellent performance.

AirPort came out of the same approach that allowed Apple to ship the iMac the year before: combining widely available, standard parts in a unique package that provided more value as a whole.

For the first several years, Apple offered Wi-Fi as an option that required an internal plug-in card. A few years ago, however, Wi-Fi became a must-have feature for both desktop machines, like the iMac, and laptops. Apple now builds the fastest flavor of Wi-Fi, called *802.11n*, into every Mac it sells, as well as every iPhone, iPod touch, and iPad.

Despite Apple's 12-year history with wireless networking and the general excellence of their software and support, setting up a wireless network isn't always a snap. This book helps you set up a wireless network and offers tips to help save time, improve security, extend range, and enjoy a technical edge when working with AirPort.

Although this book focuses on 802.11n AirPort networks, I also cover compatibility and connections with older hardware, and how to connect to 802.11n via Mac OS X 10.7 Lion and Windows 7. I also provide some information to help you use Wi-Fi with 10.6 Snow Leopard and 10.5 Leopard.

I start with wireless basics, move through installation and configuration, explain how to share printers and hard disks, tell you how to connect to a Wi-Fi network, give advice on extending a network's range and quality, look at using an AirPort Express's unique features, and finish with how-to information on security for those who want their AirPort networks safe from freeloaders and intruders.

# Quick Start to AirPort Networking

You can read this book from start to finish, and you'll find that it covers topics like learning about Wi-Fi, unpacking a base station, starting configuration, figuring out the network you want to build, and then configuring that network. More specific cases follow, such as how to add a printer, separating older and newer flavors of Wi-Fi into two separate networks, and securing a network.

Use this Quick Start to get an idea of how you might jump into the book if you are at a particular stage in working with your network, and to find more than one path through the material.

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***Need a quick solution?*** Flip ahead a few pages to the [Quick Troubleshooting Guide](#) or see [Light Reading](#) to learn what the light on your AirPort base station is trying to tell you. Also, you may especially wish to consult [Overcome Interference](#).

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## **Learn wireless basics:**

- Get a quick grounding in wireless terminology and technology. See [Key Glossary Terms](#) and [Learn Wireless Basics](#).
- Familiarize yourself with [Apple and Mac Wi-Fi Gear](#).

## **Plan your network:**

- For common configurations, see [Set Up a Network](#), and focus on the diagrams and descriptions at the beginning of: [New Network](#), [Single Base Station](#), [Extend a Network via Ethernet](#), [Replace an Existing Base Station](#), and [Extend a Network via Wi-Fi](#).
- For ideas on using the AirPort Express, skim [AirPort Express Extras](#) to learn about the features and networking arrangements.
- For more advanced possibilities, consult [Connect Multiple Base Stations](#), and pay special attention to the descriptions and diagrams at the start of [Add Access Points via Ethernet](#) and [Bridge Wirelessly](#). Also, note that Appendix C covers creating a [Software Base Station](#) and [Ad Hoc Networking](#).

## **Set up your base station(s):**

- Unpack your base station and start down the path of configuring it in [Plug In Your Base Station and Get Started](#). You'll likely continue in one of these sections:
  - Learn how to configure a new network with a single base station. See [New Network, Single Base Station](#).
  - For existing networks, find what you need to [Extend a Network via Ethernet](#) or [Replace an Existing Base Station](#).
  - When wireless is the way to go, learn what you need to extend a network using only Wi-Fi. See [Extend a Network via Wi-Fi](#) and [Bridge Wirelessly](#).
  - Hook up a larger network with many base stations. See [Connect Multiple Base Stations](#) to build a network that spans a house or office connected wirelessly, or via electrical outlets or Ethernet.
- Further configure your network's LAN settings for fixed addresses or special cases. See [Advanced Networking](#).
- [Determine the Band, Channel, and Location](#) for your base station, thus making sure your network reaches as far as you want with the bandwidth you need. For help with concepts used in that section, consult [Spectrum Trade-offs](#).
- Share a printer or a hard drive. See [Set Up a Shared USB Printer](#) or [Set Up a Shared USB Disk](#).
- Set up Time Machine backups with a Time Capsule base station. Read [Work with Time Capsule](#).

## **Connect to your base station:**

- Find out how to connect Macs and systems running Windows to a base station in [Connect Your Devices](#).
- Access your network when you're not physically on it. See [Reach Your Network Remotely](#).
- Access hard drives in and connected to your base station via Back to My Mac. See [Access a Base Station via MobileMe](#).

### **Add music and video:**

- Use the AirPort Express to stream music. See [Stream Audio with AirPlay](#) and [Share with Airfoil](#).
- Get jiggy with a video- and audio-streaming set-top box, the Apple TV. See [Appendix A: Apple TV and Wi-Fi](#).

### **Connect between Macs:**

- Understand the new AirDrop peer-to-peer file-transfer feature in Lion, and see if your hardware and situation are a good fit to use it. Read [AirDrop](#).

### **Secure your network:**

- Avoid security tricks that don't work. Consult [Simple Tricks That Don't Work](#).
- Apply encryption using the best—and often simplest—method. See [Use Built-In Encryption](#).
- With a 2009 or later AirPort Extreme or Time Capsule, you can [Set Up Guest Networking](#).

### **Learn still more advanced topics:**

- Find out what the future will bring for end-to-end connections with intermediaries in [Explore the Internet's Future with IPv6](#).
- Stop pulling your hair out over a problem with new firmware you install that doesn't work. See [Revert to Older Firmware](#).
- Get a few details about special configuration options for AirPort Utility that I don't cover elsewhere by reading the [AirPort Pane](#) topic in Appendix B.

# Quick Troubleshooting Guide

If you need quick help, here's the starting point. I first look at handling a locked-up base station and then give tips for solving a variety of common problems.

**Note:** [Light Reading](#), a few pages ahead, helps you learn information about a problem by decoding the appearance of a base station's LED status light.

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## Reset a Locked-up Base Station

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If an AirPort Extreme Base Station, AirPort Express, or Time Capsule neither appears in the Wi-Fi menu as an available network, nor in AirPort Utility as an available base station, try these steps in order:

1. **Check a local connection:** Make sure that the computer running AirPort Utility is on the same local network as the base station. Try connecting the computer via Ethernet to one of the base station's LAN ports. Try AirPort Utility again.
2. **Failing a direct Ethernet connection, try power cycling:**

---

**Warning!** *You might damage the data on the internal drive by unplugging a Time Capsule. Make sure Time Machine backups or other transfers aren't in progress before you power cycle a Time Capsule—for each computer on your network that uses the Time Capsule, eject any mounted Time Capsule volumes and halt Time Machine backups. The easiest way is via the Time Machine preference pane: flip On to Off. After you power cycle the Time Capsule, you can flip Time Machine back on for each computer.*

---

Remove the power adapter's plug from the wall socket or remove the end that plugs into the base station. Wait 10 seconds. Plug it back in, and try to connect via AirPort Utility. Everything may be back to normal.

3. **Failing power cycling, try a factory reset:** This step erases any custom settings you've made (I recommend backing up these settings; see [Create and Manage Profiles](#)).

To reset any of Apple's three base station models, straighten one end of a paperclip, and with the base station plugged into power, hold down the base station's reset button with the paperclip end. The reset button is recessed in the rear right of the AirPort Extreme and Time Capsule and next to the audio jack on the AirPort Express; with all three models, the button is beneath the *reset symbol*, a white arrow reversed out of a gray circle (**Figure 1**).



**Figure 1:** The reset button is located below the reversed-out white arrow; here, it's next to the audio port of an AirPort Express.

4. **Failing a factory reset, try another method to reset the base station:** Unplug the base station from power, push in the reset button and hold it down, plug the base station into power, and keep the reset button pressed for at least 20 seconds.
5. **Failing all the above:** Call Apple for return instructions if the unit is still under warranty. If not, it may be time to invest in a new one.

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## Other Troubleshooting

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### Can't see base station's network from a device

Did you set the base station to use just the 5 gigahertz (GHz) band? Only Mac models released starting in 2005 with built-in 802.11a or 802.11n can connect.

Or, did you set the base station to allow 802.11n-only connections in 2.4 GHz? Late 2006 and later Macs have 802.11n built in, and the iPhone and iPod touch added it in 2010. It's also included in all iPad models. For more help, read [Determine the Band, Channel, and Location](#).

Further, computers can sometimes temporarily lose their capability to find Wi-Fi networks—and don't ask me why! It's a mystery of many years. Try turning the adapter off and back on—on a Mac, choose Turn Wi-Fi Off from the Wi-Fi menu, and then choose Turn Wi-Fi On. Another common fix is to restart the computer.

### **Can't connect to base station's network; get an error instead**

If you can see its network name, try these fixes:

- Did you inadvertently set the base station to allow 802.11n-only connections in the 2.4 GHz band? See [Connect Your Devices](#) (look for the first Warning in the chapter).
- Access control may be preventing access. See [MAC Address Filtering](#).
- Interference from other networks may be the problem. Consult [Eliminate Conflicting Signals](#).

### **Error occurs after connecting to a base station with the correct encryption key**

You might be using a Mac with the older AirPort Card with a base station set up with WPA2 encryption. See [Turning on WPA/WPA2 Personal](#).

### **Can't connect to a base station via Ethernet in AirPort Utility after selecting it and seeing the summary screen**

You might have hit an unusual bug. If you've changed the minimum transmission unit (MTU) for your Ethernet adapter to anything but the standard 1,500-byte setting, you need to change it back; or, you can turn off IPv6 networking.

This is rather obscure; Jumbo frames are used to speed network data transfers on gigabit Ethernet networks, but for it to work properly, all devices must support Jumbo frames automatically. Apple's base stations apparently do not support them.

In the Network system preference pane, select your Ethernet adapter, then click Advanced. In the Hardware view, choose Manually from the Configure pop-up menu, and then Standard (1500) from the MTU pop-up menu. Now, click OK, then click Apply.

### **Firmware update makes base station act erratically**

Try to [Revert to Older Firmware](#).

### **Network works erratically**

Another network might be interfering with yours. See [Eliminate Conflicting Signals](#).

### **Conflicting signals seem to cause network problems**

Read [Eliminate Conflicting Signals](#).

# Mac Wi-Fi Iconography

The Wi-Fi menu—located on the system menu bar—reveals what kind of connection is in progress on your computer. Knowing what the icons mean can help you troubleshoot problems. This icon is always at the top of the Wi-Fi menu.



A gray fan indicates an active Wi-Fi network adapter that isn't currently connected to any network. Read [Connect Your Devices](#) to get started.



A full fan with one or more black bars—the bars represent current strength—indicates a current Wi-Fi connection to either a base station or a network created through the Sharing preference pane's Internet Sharing service. (An animation of each wave turning black in turn occurs while the connection is underway.) For more information, consult [Connect Your Devices](#) and [Appendix C: Setting Up a Software Base Station](#).



A fan showing an up arrow indicates that the Internet Sharing service is active on this computer. See [Software Base Station](#), in Appendix C.



A fan containing a computer shows that the Mac has created an *ad hoc network*, a method of handling Wi-Fi communication among multiple computers without a base station—not even the “software” base station that's created by Internet Sharing. See [Ad Hoc Networking](#), in Appendix C.



An empty fan outline indicates that either there's no Wi-Fi adapter in the computer, or the Wi-Fi adapter has been turned off. To turn it on, choose Turn Wi-Fi On from the menu. If the Wi-Fi icon still looks like an empty fan or an error says that there's no card or it can't be turned on, you may have a hardware problem.

# Light Reading

The light on the front of any Apple Wi-Fi base station indicates what the base station is up to: handling data correctly, hitting an error, or in a special mode. The guide below helps you decipher the meaning.



**Off:** There's no power! Plug in the base station. If it is plugged in, check the outlet or power strip, and the places where the cord plugs into other cords or into the base station. If juice is flowing and the cord looks correct, you have a defunct base station or a bad cord.



**Blinking green:** The base station light blinks or flashes green in three cases:

- **Startup:** The light flashes green on and off for 1 second.
- **Reset:** This happens after you press the recessed reset button for long enough to trigger a reset.
- **Network activity:** You can set the light to show green flashes that approximate the amount of network activity. In AirPort Utility, on the AirPort pane, in the Base Station view, click Options and then change the Status Light pop-up menu. (See [Base Station Settings](#), much later.)



**Solid green:** The base station is configured correctly, has no updates available, and is connected to the Internet.



**Solid amber:** The base station is still powering up and hasn't loaded all its settings and connected to the network.



**Blinking amber:** A blinking amber light has several meanings:

- The base station has a configuration problem, has lost its network connection, or is suffering from another problem. Use AirPort Utility to troubleshoot.

- A Time Capsule may be making an [Archive](#) or have a [Disk Integrity](#) problem.
- A firmware update is available. ([Base Station Settings](#) explains how to turn on this optional indicator.)



**Solid blue:** If you've used AirPort Utility to allow a client to connect via Wi-Fi Protected Setup (WPS), the light remains blue until a client connects or you cancel the mode in AirPort Utility. (See [Use WPS](#).)

# Learn Wireless Basics

Let's quickly run through some wireless basics to set the stage for what follows.

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## Adapters and Access Points

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Wi-Fi networks need two connected parts: a wireless adapter and an access point. The wireless adapter is part of a computer or mobile device, while the *access point* connects both to wireless adapters and to a broader network, such as the Internet via a broadband modem. An access point that's coupled with a router is called a *wireless gateway*; Apple calls its wireless gateway a *base station*.

Apple's line-up of base stations includes the AirPort Extreme Base Station, the AirPort Express, and the Time Capsule. When I talk about "AirPort equipment" I mean all Apple base stations, including Time Capsules. An *AirPort network* is a Wi-Fi network with some Apple extras that may work only with Apple software—under Mac OS X or Windows—or in conjunction with other AirPort equipment. Examples of such features include streaming audio, certain forms of hard-drive file sharing, and base-station-to-base-station connections.

### What's Wi-Fi?

The name *Wi-Fi* is a certification guarantee for which The Wi-Fi Alliance trade group owns the rights and controls the testing. *Wi-Fi* doesn't stand for anything—it's a made-up name—but it loosely connotes *wireless fidelity*, in the sense of *faithfulness*: devices with Wi-Fi stamped on them work with other Wi-Fi devices following the same standards, or are faithful to one another.

The wireless adapter uses client software on the computer or handheld device to connect to a specific base station (or set of affiliated base stations) after a user selects a network name from a list or manually enters the network's name. Mac OS X allows network selection from the Wi-Fi menu in the menu bar, and the Wi-Fi adapter in the Network system preference pane.

# Apple and Mac Wi-Fi Gear

A long history with Wi-Fi has led to three devices in Apple's current line up of base stations: each one includes 802.11n but has a distinct set of features. Let's look first at how Apple has chosen to work with 802.11n, and then at Apple's current base stations and the options for Apple and third-party adapters.

At the end of this chapter, you should better understand the gear that you already have, or be in a better position to shop for new equipment.

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## 802.11n and Apple's Choices

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Although Apple has made distinct choices when implementing 802.11n, all three of Apple's current 802.11n base stations can handle both the 2.4 band and the 5 GHz band. Current AirPort Extreme and Time Capsule base stations can manage networks on both bands at the same time. The AirPort Express requires that you choose one band or the other.

**Note:** The 2007 and 2008 models of AirPort Extreme and Time Capsule could only use a single band at a time as well.

For the 5 GHz band, Apple enables just 8 of the 23 possible channels in the United States for use in a base station. This is because of a compromise among the radio equipment industry, the military, and the FCC. This compromise protects 15 of the possible 23 channels for limited military use, but it also makes it more difficult to use those channels for home networks. Apple has chosen not to support those 15 channels in its base stations. The company doesn't think that they would be consistently available in a way that would be useful to most consumers and small offices who would buy AirPort gear.

**Note:** The adapters in a Mac can, in fact, connect to all the 23 legal channels in the United States. Some companies may deploy Wi-Fi networks using non-Apple base stations that allow the use of all 23 channels, as they're more likely to be available without hitting military rules inside buildings.

# Plug In Your Base Station and Get Started

Let's get unpacking! This chapter focuses on getting your base station plugged in and on launching AirPort Utility, the program that modifies a base station's settings.

(The next chapter, [Set Up a Network](#), helps you determine which network type you want to use your base station with, and provides the specific instructions for streamlined setup. Also, [Connect Your Devices](#), later, explains how to connect via Wi-Fi from any computer in the vicinity to the newly set up base station.)

---

## Unpack and Power Up

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Unpack the base station to determine what you have and if you need any additional hardware:

### 1. Remove the base station from its box and check the parts:

- ▶ **AirPort Extreme and Time Capsule:** The Extreme box and the Time Capsule box each include just a few necessary parts: the square base station, a thick setup booklet, a booklet full of software licensing information (silly, but required), and an AC power cord. The Extreme box also has a power adapter. These base stations don't come with a wall-mounting bracket; they're designed to work horizontally.
- ▶ **AirPort Express:** The Express box includes just the Express with its integral AC plug snapped away for storage and the booklets noted above.

### 2. Is the power cord long enough?

- ▶ **AirPort Extreme:** The power cord's length—17 feet/5.2 m—should aid in placement, but if you need to position the base station even farther from a power outlet, plan on purchasing a lightweight extension cord. In the U.S. version, the AC end of the Extreme's power cord terminates in a non-polarized two-prong

# Set Up a Network

How you configure your base station depends on the type of network you're building. In this chapter, I look at *scenarios*: pairing the kind of network that you want to which settings to make in the Assist Me mode of AirPort Utility.

Each scenario is followed by an explanation of how to use AirPort Utility for a basic configuration of that scenario. The next chapter helps you tweak your selection of channels and bands, and determine exactly where to place your base station. If you need more advanced scenarios and configurations, those are covered later in the book.

---

## Get Started

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### Placing a Base Station

If you haven't figured out where best to put your new base station or stations, you may wish to skip ahead and read [Pick the Right Place](#). Note that you can configure a base station first, and then relocate it, using advice in that section to find the optimal placement.

The first question that needs to be asked is: What kind of network are you trying to build? The scenarios in this chapter cover common situations. Pick a scenario and proceed as directed, noting that the links below lead to topics that begin with a diagram and explanation of the type of network and then give configuration steps.

Are you:

- Setting up a new network with a single base station connected to a broadband modem? See [New Network, Single Base Station](#).
- Extending an existing network via Ethernet, or via Wi-Fi? See the two corresponding sets of instructions: [Extend a Network via Ethernet](#) and [Extend a Network via Wi-Fi](#).
- Replacing an existing base station with a new unit or model and want exactly the same settings? See [Replace an Existing Base Station](#).

# Determine the Band, Channel, and Location

This chapter is aimed at people who have 2007 and 2008 AirPort Extreme and Time Capsule base stations that can use only one of the two bands supported at a time, rather than simultaneously as in the 2009 and later models. It's also for people who have a dual-band base station and a tricky situation involving the band or channel. And, anyone who has a large house or office or difficulty getting coverage in the area they want can benefit from [Pick the Right Place](#) for a base station.

A default configuration may work well for your network. However, if it doesn't work perfectly, you can read this chapter to:

- Understand and set backward compatibility for pre-802.11n gear.
- Understand and set a base station's channel or channels.
- Find the ideal placement for your base station or base stations.
- Test those above choices to see how they work.

**Note:** Before the early 2009 Extreme and Time Capsule, all 802.11n Apple base stations could use only one band at a time. That's still true for the Express. The simultaneous dual-band base stations introduced in early 2009 remove most of the complexity.

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## Spectrum Trade-offs

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Shortly, I explain how to use AirPort Utility to set the band (2.4 GHz and/or 5 GHz) and the channel for a base station. To make the best choice, you may need some background on spectrum and channel choices. (If you don't know the basics of spectrum bands and channels, read [The Spectrum Part of Wi-Fi](#), before proceeding here.)

Let's begin by comparing the two bands. The 2.4 GHz band is crowded with Wi-Fi networks, Bluetooth devices, and other uses; the 5 GHz band is relatively empty—in the United States, the band has almost seven times the amount of frequency available in 2.4 GHz. Further,

# Advanced Networking

Did the simplified setups explained in [Set Up a Network](#) not cover everything you needed to get up and running? In this chapter, I spell out all the details for how to connect your base station to a WAN and how to further configure addressing on your LAN. Advanced options are needed for networks that use static or fixed addresses, and for anything the slightest bit unusual.

---

**More than one base station:** *If you're building or re-building a network with more than one base station, read this chapter first for how to set up the base station that connects directly to your broadband service provider. Then read [Connect Multiple Base Stations](#).*

---

**Stream music:** *If you want help getting AirTunes to work with your AirPort Express, see [AirPort Express Extras](#).*

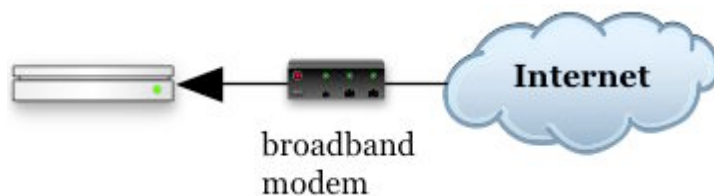
---

## Get a WAN Address

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The more complicated scenarios start with getting a WAN address for your base station; you'll then move to LAN configuration.

To communicate with the rest of the world, you need to hook the wide area network (WAN) port of your base station either into a broadband modem or, if you have an existing Ethernet LAN to which you are connecting the base station, into that larger network (**Figure 38**).



**Figure 38:** Plug your broadband modem into the base station's WAN port.

# Connect Your Devices

Once you've set up your Wi-Fi network and connected it to the Internet, you'll want to configure your computers to connect to the network properly, whether you're working with a few desktop computers or helping customers use a public hotspot.

Making a connection is quite simple, but configuring how your computers connect may take a little thought. You might choose to connect automatically to unknown networks, or need to connect to a network that doesn't advertise its name. You may also reconnect to networks that you've visited before.

Read this chapter to learn how to [Connect in Lion](#) (with notes on 10.5 Leopard and 10.6 Snow Leopard), [Connect in iOS](#), and [Connect in Windows 7](#). These topics discuss not just how to connect to networks, but also how to modify stored profiles, and choose when to connect to unknown networks.

---

**Warning!** Remember that if you set up your network as 802.11n-only in the 2.4 GHz band, neither an 802.11b nor an 802.11g adapter will be able to connect. If you can't see your network on a given computer or can't connect to a network that shows up in a list of available networks, check your base station setup (see [Compatibility](#) for more details).

---

**Connection problems?** Just because a network is visible doesn't mean you can connect to it. MAC address access control and other restrictions could keep you from joining. See [Secure Your Network](#).

---

## Connect in Lion

---

You connect in Lion, as with previous versions of Mac OS X, through either the Wi-Fi menu, a status menu near the right of the menu bar, or the Network system preference pane. If you don't see the Wi-Fi menu, launch System Preferences and select the Network preference pane. Select the Wi-Fi adapter at the left, and then check Show Wi-Fi

# AirPort Express Extras

The AirPort Express, for its modest size and price, includes several features found in neither a Time Capsule nor an AirPort Extreme Base Station, mostly around music. The Express also hides a nifty connection option for extending a network.

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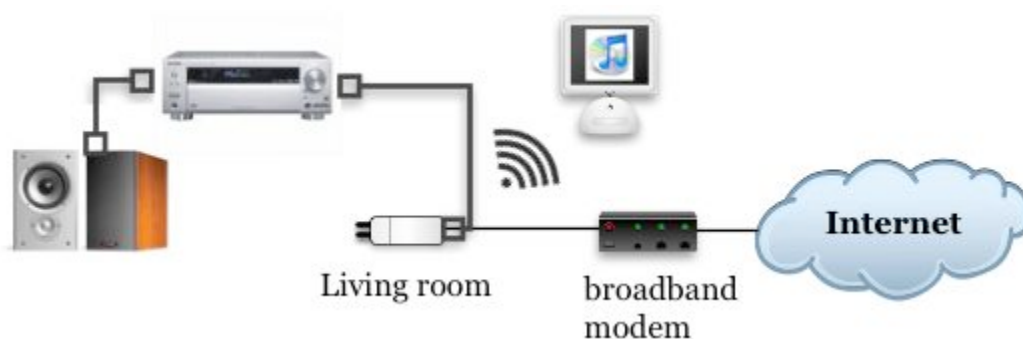
## Stream Audio with AirPlay

---

*AirPlay* is a method of streaming media from a computer or iOS device to an external output device, such as an AirPlay-compatible speaker or an Apple TV, or—most interestingly for our purposes—an AirPort Express.

In the case of the AirPort Express only audio can be streamed. The Express sends the stream through its audio output port (**Figure 61**) to stereo speakers. You control the settings in AirPort Utility, and then play the audio via iTunes on a desktop computer or via an iOS device.

**Historical note:** In early 2011, Apple updated and renamed what was AirTunes to AirPlay. AirTunes was available only in the AirPort Express and Apple TV, and it required iTunes on a desktop computer for management.



**Figure 61:** You can stream music from a computer on the network through AirPort Express to a stereo or powered speakers.

**Tip:** The fine folks at Rogue Amoeba offer Airfoil, a program that lets you play the sound output from any program on a Mac—not just iTunes—over AirPlay. See [Share with Airfoil](#), later in this chapter.

# Connect Multiple Base Stations

Wi-Fi is described as reaching “only” about 150 feet, which is a rough estimate of the radius of older B and G devices. With an 802.11n base station, the distance can be much farther, although it varies by which band you choose. And range measured as a linear dimension misstates the problem of *volume*, the three-dimensional space you’re trying to fill.

But you can extend the covered volume by adding more base stations with overlapping signals. As a Wi-Fi adapter in a laptop or handheld moves across overlapping regions, it can automatically switch base stations while maintaining a network connection.

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## Know the Basics

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When you extend a network, the additional base stations tend to be dumb; that is, they don’t assign addresses or handle other features you think of as belonging to a base station. Rather, one base station remains smart, offering DHCP and NAT (if needed), among other network choices. The rest pass through traffic from that main unit. Dumb base stations are often called *access points* to distinguish them from gateways.

Because dumb base stations (access points) just pass traffic through, an adapter retains the same IP address as it switches from one base station to another, thus maintaining its connection in most cases.

There are two mix-and-match methods of extending your network:

- Add base stations via Ethernet. Ethernet requires wires, of course, but has a huge speed benefit over wireless extensions.
- Add base stations wirelessly via Wireless Distribution System (WDS). This method avoids new wires, but can have severe speed limitations in comparison to Ethernet.

# Reach Your Network Remotely

When you share an Internet connection among one or more computers on a local network using private addresses, you give up having an easy way to connect from the outside world to a service, like a Web server or fileserver, that's located on one of those local computers.

Public IP addresses allow anyone on the Internet to connect directly to a computer, barring any firewalls or other blocks in place, but private IP addresses are specifically non-routable without a bit of extra work.

You can also access your base station remotely for file sharing and configuration using a MobileMe or iCloud account and Back to My Mac, thanks to a new feature Apple added in March 2009 to all the 802.11n AirPort models it ever sold.

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## Know Your Options

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AirPort Utility paired with the first 802.11n base station marked a major breakthrough for Apple, finally adding features that had been found in other gateways for years, but adding the usual Apple twists: their products are later than similar ones from competitors, but they are easier to use. You can choose from several different methods of reaching your network from the outside world:

- **Basic port mapping and reserved addressing:** While earlier Apple base stations offered *port mapping*, a way to connect a public port on a routable address on the base station with a private port on a locally connected computer, 802.11n base stations also let you assign addresses to local computers on a persistent basis—these *reserved* addresses don't change over time. When the base station is restarted, or when the computer is restarted, the same address is assigned to the computer once again.

# Set Up a Shared USB Printer

With a base station set up to handle local computers and hooked into the Internet, your next step may be to attach a USB printer to the base station so that it can be shared among all the local computers.

The AirPort Extreme and the Time Capsule can connect to either a single printer or hard drive through its lone USB port. Add a USB hub, and you can connect one or more printers and drives in any combination. (To maximize reliability and performance, I recommend a Hi-Speed powered hub with external AC power.) The AirPort Express is designed to allow only a single USB printer to connect, and it cannot handle an attached hard drive nor a hub.

In this chapter, I explain how to configure a base station for an attached printer, and how to connect to that printer from Mac OS X and Windows.

---

## Add a Printer

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For each printer you want to attach to the base station:

1. Plug the printer into the base station (any model) or a USB hub (Extreme, Time Capsule). You should not need to reboot your base station for it to recognize the printer.
2. Give the printer a custom name and share it over a larger LAN or the Internet; see [Rename and Widely Share a USB Printer](#), next.
3. As needed, configure Macintosh computers to connect to the printer. [Add a Shared Printer in Mac OS X](#) explains how.
4. As needed, configure Windows machines to connect to the printer; [Add a Shared Printer in Windows](#) has instructions.

# Set Up a Shared USB Disk

The AirPort Extreme and the Time Capsule both add an interesting option to your network: they can share disks across a network without those disks being attached to a computer. Both models can accept one or more external drives plugged in via USB or via a USB hub; the Time Capsule also includes a non-removable internal drive.

Either model can share drives over a network with both the standard *Apple Filing Protocol* (AFP) format, the same format used with Personal File Sharing and Mac OS X Server share files, and *Samba*, a network file-sharing service compatible with Mac OS X, Windows, and Linux.

Attached hard drives can be accessed over the Internet via AFP using Back to My Mac, too (see [Access a Base Station via MobileMe](#)).

In this chapter, I cover a handful of procedures for using the Time Capsule and the Extreme to share disks:

- Read [Prepare Your Drive](#), next, to find out about formatting and physically attaching drives.
- [Work with Time Capsule](#) covers setting up Time Machine backups as well as how to use AirPort Utility to make a backup archive of a Time Capsule disk or to erase the disk.
- [Grant Access](#) and [Gain Access](#) look at how users on the network can best access the disks.

---

**Warning!** *You can't share volumes via either only AFP or only Samba; you must share through both.*

---

# AirDrop

Have you ever wanted to swap a file between a couple of your computers without setting up file sharing and mounting a volume? Or pass a file to a friend or colleague without joining a common Wi-Fi network, setting up ad-hoc networking, or emailing it?

AirDrop is the answer to that common task. Added in Lion, the feature lets you find and share files with other Lion users near you.

It has a pile of provisos that I'll discuss below, but it's a remarkably nifty way—when all the right hardware is available—to hand files back and forth.

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## What Makes AirDrop Tick

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AirDrop relies on a special feature in new Wi-Fi adapters that allows a network card to connect simultaneously to a Wi-Fi network and to other devices on a peer-to-peer basis. A Wi-Fi network is typically called an *infrastructure* network, as it provides a hub around which all network activity zooms. In contrast, a peer-to-peer network is known as a *personal area network (PAN)* network; it allows direct communication among devices without a central coordinating switch.

This sounds a lot like [Ad Hoc Networking](#), doesn't it? With *ad hoc* or *computer-to-computer* networking, a set of computers can all connect to one another as peers.

However, ad hoc networking has three drawbacks. First, it doesn't include robust security, and even the available security requires each party to type in an encryption key. Second, you can't maintain a connection to an Internet-connected base station network and use ad hoc networking at the same time. And, finally, you still have to establish a file-sharing connection on top of the ad hoc network.

AirDrop eliminates all that. Click a button in the Finder, and an AirDrop window opens showing all available peers in the vicinity. Drag a file or files or receive one or more, and it's done. No hassle involved.

However, you can use AirDrop only with other computers that are running Lion, and those computers must have a fairly recent vintage

# Secure Your Network

If you use a wired network in your home, someone would have to break into your house, plug into your Ethernet switch, and then crouch there in the dark to capture data passing over your network.

Wireless networks have no such protection: anyone with an antenna sensitive enough to pick up your radio signals can eavesdrop on traffic passing over your network. This could be a neighbor, someone in a parked car, or a nearby business. Many free, easy-to-use programs make this a simple task for only slightly sophisticated snoopers.

However, you're not powerless to prevent such behavior. Depending on what you want to protect and whom you're protecting against, you can close security holes with tools that range from a few settings up to industrial-grade protection that requires separate servers elsewhere on the Internet.

---

## Simple Tricks That Don't Work

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You may have read suggestions for setting up basic security that advise you to hide your network's name and make it hard to connect to, such as employing a closed network or using MAC address filtering.

### Closed Network

In a closed network, your base station stops broadcasting its network name, or SSID (Service Set Identifier), as part of its *beacon*, an "I'm here" message that access points regularly transmit in order to help clients connect to them. However, the beacon continues to be sent because it still includes information that is used for network data synchronization.

An open network appears by name in the Wi-Fi menu or in other places in the Mac OS and Windows that show the names of networks you can connect to. But closing the network makes it only slightly obscure. A cracker can easily find out that the network exists, and by monitoring for a connection or using a tool to create a *disassociation* for a computer on the network—which forces that computer to

# Explore the Internet's Future with IPv6

IPv6 is the next big thing to hit the Internet—in 1999! This “new” technology was developed in the late 1990s to address a problem with IP addresses. The Internet as widely deployed into the 1990s uses IPv4 (version 4) networking, which has a relatively small number of possible addresses. IPv6 fixes a few other problems, but it mostly expands the address space from offering about 4 billion IP addresses to offering 4 billion raised to the fourth power. This increase in available addresses should let the Internet run until perhaps the end of time.

In 2011, IPv4 addresses were at the nub end of being exhausted—no more are available in large quantities for new networks. IPv6 is finally moving toward wide-scale availability over the public Internet.

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## IPV6 Background

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Because IP addressing is a fundamental part of how data travels between end points on the Internet, all the infrastructure that handles IP addressing must become IPv6 savvy. That's been both a delaying factor and part of the increased momentum: if you upgrade a bunch of core Internet routers, suddenly IPv6 works in a lot more places.

---

***Same Internet:*** *IPv4 and IPv6 can work on the same Internet; I explain that shortly.*

---

IPv6 came into being because IPv4 addresses were predicted to run short sometime after the turn of the millennium. The Internet wasn't designed with billions of computers and devices in mind, and thus the possible addresses available to use in IPv4 weren't sufficient.

Running out of IP addresses was one problem, but we don't need all the tens of decillions of addresses that IPv6 provides, though we may need trillions some day. Rather, what we do need is the simplicity that IPv6 offers, giving us an abundance of addresses so that the tens of

# Appendix A:

## Apple TV and Wi-Fi

The 2nd-generation Apple TV, released in 2010, is a nifty device designed to act as a conduit for streaming content from computers on your network to an HDTV set. You can also use the device to rent movies and TV shows, stream Netflix movies, watch games from MLB.tv, and access other video sources over the Internet.

In this chapter, I cover how to set up your network for a 2nd-generation Apple TV, which makes it available for use on the network and as a destination for iTunes and iOS devices.

---

***Cheap music:*** *The AirPort Express is a great alternative to the Apple TV for transferring just audio over your network. You can connect to an Express wirelessly or via Ethernet on an 802.11n network with no problems.*

---

The Apple TV has 802.11n built in and can use the 2.4 GHz and 5 GHz bands, just like any 802.11n-savvy Mac. It has just 10/100 Mbps Ethernet, not gigabit Ethernet, which after nearly five years and two product generations, remains peculiar for a device intended to receive a lot of data.

When connecting to a simultaneous dual-band base station, the Apple TV should automatically choose the 5 GHz network, which offers the best throughput.

**Tip:** Like me, you might use Ethernet if your router is anywhere near the Apple TV rather than occupy your Wi-Fi network with streaming data. Wi-Fi is a great second option if Ethernet won't work.

The Apple TV connects to a network in a straightforward way:

- **Ethernet:** If you plug the Apple TV into an Ethernet network with a DHCP server feeding out addresses—such as the default configuration for all Apple base stations—the device automatically obtains an address. With an Ethernet connection, there's zero configuration needed for a network connection.

# Appendix B:

## AirPort Utility Extras

AirPort Utility has a few more tricks up its sleeve. Notably, you can back up, export, and import configuration profiles; connect over the Internet to configure a base station; and revert to an older version of the firmware. At the end of this appendix, I also clarify the use of a few settings in the AirPort pane and the Advanced pane.

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### Create and Manage Profiles

---

The original AirPort Express compact base station released in 2004 included a unique feature: defining and storing multiple *profiles*. A profile is a complete set of configuration parameters; each profile resides on the base station in non-volatile (persistent) memory. Profiles are available on all 802.11n base stations.

---

***Stored versus exported profile:*** I call this form of profile a “stored” profile to distinguish it from the “exported” profile described just below.

---

These profiles can be useful when you’re sorting out precisely what options you want for your network and want to create different scenarios to test. Stored profiles are also useful if you take the base station to different locations.

I suggest starting with a base profile that you can duplicate to test other options, and then you can simply revert to it whenever you like.

Since you created the equivalent of a profile in following the steps for initial setup of a base station, you can rename that first profile to something descriptive and then duplicate it:

1. Select the base station in AirPort Utility, and then choose Base Station > Manual Setup (Command-L).
2. Choose Base Station > Manage Profiles.

The screen that appears lets you create, activate, and delete profiles.

# Appendix C: Setting Up a Software Base Station

You can use a Mac equipped with a Wi-Fi adapter card not just as a client on a Wi-Fi network, but also as a base station. In this appendix, I explain how to set up a software base station in Leopard and later, as well as how to use [Ad Hoc Networking](#), which has some elements in common with software base stations.

## Software Base Station or Ad Hoc Network?

A *software base station* walks and talks like a base station: it puts out the same kind of messages that other computers recognize from a base station. You need at least two network interfaces to turn on a software base station: a Wi-Fi adapter plus some other interface, like an Ethernet network connection.

*Ad hoc networking* is a computer-to-computer mode, and it doesn't require a second adapter to reach another network, although it can handle that. Ad hoc can be used sometimes by simpler devices.

Most operating systems distinguish between ad hoc networks (which are sometimes seen as more risky) and base stations. The fact that you can create software base stations eliminates the risk distinction; crackers use software base-station programs to lure hotspot users, for instance.

---

## Software Base Station

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Apple's software base station has one distinct problem with security and one particular choice for channel selection, which I should address before you get turn the feature on.

### Security

You can use only WEP encryption, which I describe back in [Use Built-in Encryption](#) as a last-resort method of security. It's definitely better than nothing, however. With Lion, Apple once again avoided updating this feature for the appropriate level of security.

# Appendix D: Channels Explained

The ins and outs of channels used in each band have wound up in this appendix, as you may need to know the details only when something goes wrong—or you may be among the more technically inclined readers who want to know more about the technical minutiae of Wi-Fi. In this appendix, you can learn about why the 2.4 and 5 GHz channels are organized the way they are, and what happened to 15 missing 5 GHz channels.

See [Pick Compatibility and Optionally Set a Channel](#) to learn how to set your base station's channel in AirPort Utility.

Channels in both 2.4 and 5 GHz are 20 MHz wide; an optional 40 MHz wide or double-channel option was added in 802.11n, although Apple allows wide channels only in 5 GHz. The two bands have very different ways of defining and making those channels available.

Channel availability varies widely from country to country. Apple lists precisely which channels it supports in the technical specs for its base stations: <http://support.apple.com/kb/SP509>. You can also see a table of 5 GHz channels worldwide at [http://en.wikipedia.org/wiki/List\\_of\\_WLAN\\_channels](http://en.wikipedia.org/wiki/List_of_WLAN_channels).

## MHz and Mbps

Megahertz does, in fact, correlate to megabits per second. *Shannon's Law* (or the Shannon-Hartley Theorem), a bit of information theory, says that there's a direct relationship that ties the width of a channel and the ratio of signal to noise to the achievable data rate. Twice the channel width means up to twice the raw data.

In case you were wondering, the formula is: maximum bit rate equals channel width in hertz multiplied by log<sub>2</sub> multiplied by the sum of 1 + signal divided by noise (**Figure 117**).

$$C = B \log_2 \left( 1 + \frac{S}{N} \right)$$

**Figure 117:** *Shannon's Law (image via Wikipedia).*

# Appendix E: What and Where Is a MAC Address?

The MAC, or *Media Access Control*, address is a unique, factory-assigned address for every Ethernet and Wi-Fi adapter. A MAC address consists of six two-digit hexadecimal numbers separated by colons, such as 0C:F2:33:01:02:FC. (*Hexadecimal*, or *hex*, is the base 16 number system, with values running from 0 to 9, and then from A to F for 10 to 15.) The first three numbers are assigned to a manufacturer by a coordinating association; Apple has at least two common ranges, which begin with 00:0a:95 and 00:03:93. MAC addresses are frequently used for filtering, authentication, and WDS, often without requiring direct entry.

Some routers from other makers can have their MAC address changed in a process called *MAC cloning* or *spoofing*, which is sometimes useful when you have to register a computer's MAC address, but then want to use a router in its place. No Apple base station has ever offered this capability, although Mac OS X allows it for Macintoshes via a Terminal command.

Here are various ways to locate Mac addresses:

- **Base station:** Look on the bottom of the base station (Extreme, Time Capsule) or near the plug (Express). Or, in AirPort Utility, select a base station at the left and click the Manual Setup button to see its MAC addresses on the right (you can copy a MAC address from AirPort Utility):
  - The *AirPort ID* is the wireless MAC address. Starting with the early 2009 models of the Extreme and Time Capsule, these devices have two AirPort IDs, one for each band's radio, and they are noted by band on the base station itself and in AirPort Utility.
  - The *Ethernet ID* is the WAN port's MAC address.
- **Computers connected to a base station via Wi-Fi:** In AirPort Utility, select the base station in the sidebar and then click Manual Setup. Click the Advanced icon, click Logging & Statistics, and then click the Logs and Statistics button. Click the DHCP Clients button,

# Key Glossary Terms

In this chapter, I've defined a few terms that you'll encounter over and over in this book. Read the list below to become familiar with any new terms and refresh your memory on the rest. I've presented the concepts in the order you need to understand them, building one on top of the other.

**Wi-Fi:** *Wi-Fi* refers to the set of wireless networking standards that encompasses all of Apple's AirPort products, and thousands of wireless networking products made by other firms. Wi-Fi provides a test-based way of ensuring that devices work in a consistent way using four IEEE 802.11 Working Group standards: 802.11b, 802.11g, 802.11a, and 802.11n (B, G, A, and N, respectively). (The IEEE is an international engineering standards group.)

**802.11n:** The most recent Wi-Fi addition is *802.11n*. It seemed to take forever to finalize at the IEEE, during which time many products came to market under the Draft N name. With ratification of the standard came final tests from the Wi-Fi Alliance to assure buyers that devices that are labeled Wi-Fi and "N" work correctly together.

**Spectrum bands:** Wi-Fi operates in slices of radio-frequency spectrum: the 2.4 gigahertz (GHz) and 5 GHz bands. 802.11b and 802.11g operate exclusively in 2.4 GHz; 802.11a exclusively in 5 GHz; 802.11n may operate in either band.

**Ethernet:** Ethernet refers to a set of standards for connecting computers by wire, typically at speeds of 10 megabits per second (Mbps), 100 Mbps, and 1,000 Mbps. 1,000 Mbps Ethernet is commonly called *gigabit* Ethernet.

**Local Area Network (LAN):** A *LAN* comprises computers connected via Ethernet and/or Wi-Fi into a small or large group. A LAN's computers are in close physical proximity, usually in an area as small as a home office or as large as an entire office building. A LAN is typically thought of as a single network, especially when considering local network resources like file servers.

**Wide Area Network (WAN):** A router, like the AirPort Extreme Base Station, connects its own LAN to a wider network that's known as a *WAN*. A WAN, from the perspective of a base station, is often simply

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## About the Author

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Glenn Fleishman contributes regularly to *Macworld*, *BoingBoing*, and *Ars Technica*. He's the Macintosh columnist for the *Seattle Times*, and a contributing editor at *TidBITS*, where he built the content

management software. Glenn writes weekly for the *Economist's* Babbage blog and regularly for the print version of the magazine. Glenn spends much of his time writing about wireless networking. He co-wrote *Take Control of Your Wi-Fi Security* with Adam Engst, and for 10 years he edited a daily news site about wireless systems called Wi-Fi Networking News (he recently retired the site). Glenn also appears regularly on American Public Media's Marketplace Tech Report to talk about technology (<http://kuow.org/>). He lives in Seattle in a bungalow with his wife and two sons. His older child's first word was "book," not "Mac."

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## Author's Acknowledgments

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## About the Publisher

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Publishers Adam and Tonya Engst have been creating Apple-related content since they started the online newsletter *TidBITS*, in 1990. In *TidBITS*, you can find the latest Apple news, plus read reviews, opinions, and more (<http://tidbits.com/>).

Adam and Tonya are known in the Apple world as writers, editors, and speakers. They are also parents to Tristan, who thinks ebooks about clipper ships and castles would be cool.

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