Chapter 1

Introducing Radios and the Wireless World

In This Chapter

- Seeing where radios fit in the wireless world
- Introducing different kinds of radio signals
- Understanding what you can do with a radio
- Finding out a bit about the rules and regulations
- Getting extra help
- Building and fixing your own radio

If you go to the local electronics emporium, I bet you will see a display labeled Two-Way Radios. There you'll find the radios about which this book is written — *handheld radios* that use the unlicensed Family Radio Service (FRS) and their big brothers in the General Mobile Radio Service (GMRS). You may see some ham radios or maybe radios that use the *dot* frequencies. By talking as well as listening, these *two-way* radios connect people together when they talk business, participate in recreational activities, or need to communicate in emergencies.

A little farther down the aisle you'll meet the *one-way radios*, scanners and communications receivers — devices that let you listen in without talking back. *Scanning* the airwaves has become quite popular. You can follow the activities of your local public safety agencies, monitor business users, and listen in at sporting events just by punching a few buttons. *Shortwave radio* is going strong, as well, with broadcasts from around the globe arriving at every hour of the day and night. With a simple radio and minimal antenna, you can get connected in a way that the Internet just can't match.

Read on as I fill in the blanks for common terms and ideas that make radio the valuable resource it is. Consider this a book about grown-up radio!

Understanding How Radios Fit into a Wireless World

You hear people bandy about the term *wireless* a lot these days. Everything seems to have a wireless option — wireless toasters, wireless toys, wireless tote bags! All of them make use of radio technology to communicate. The days may be gone when radios were the only wireless game in town, but nowadays radios are everywhere!

Radios, PCs, and phones — Oh, my!

What is the most common two-way radio on the planet? Hint: You've probably used one without even thinking of it as a radio. It's the mobile phone! Those ubiquitous little items glued to everyone's ear contain a sophisticated two-way radio that sends and receives phone calls in a never-ending stream of signals. In fact, you have probably seen people using two radios at once, typing with one hand on a laptop connected to a wireless network at the coffee shop or mall while holding a mobile phone with the other. Both devices are examples of specialized radios. Figure 1-1 shows some more.

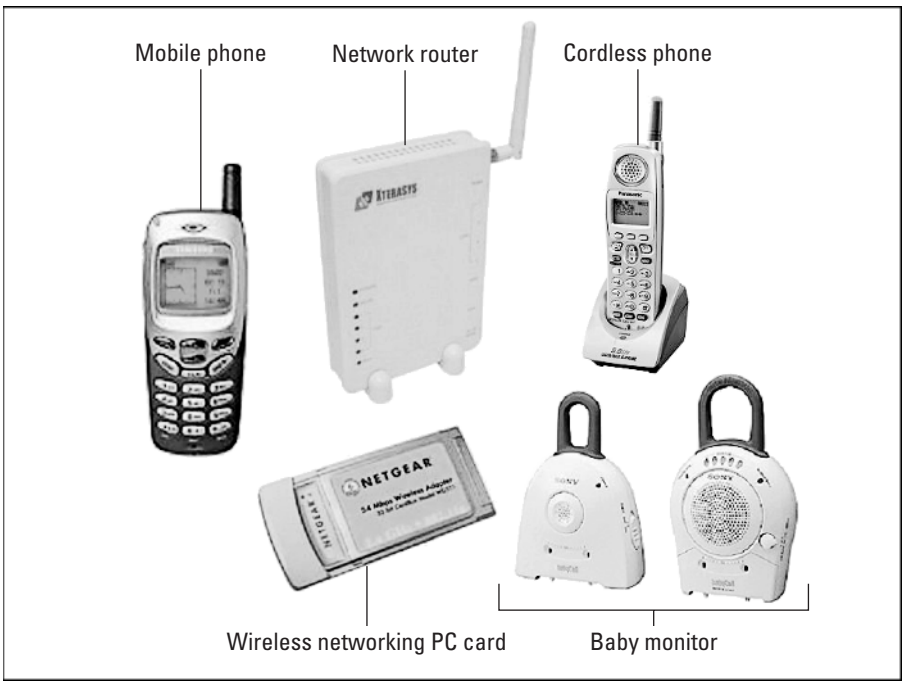

Figure 1-1: All these devices are radios!

Even many of the ID tags attached to goods you purchase at the store are very simple radios. So where does the regular, old-fashioned radio stop and the new, fancy radio begin? In this book, when I talk about a *radio*, I mean the traditional form that allows you to listen to signals from broadcasters or other radio users, as well as those that can transmit to communicate directly with someone else who also has a radio.

Why get enthusiastic about radio?

With all this communications gadgetry, why would you need a radio, anyway? Isn't radio obsolete? After all, you're just a few keystrokes away from the Internet via wireless networking. Flip open your mobile phone and reach just about anyone, just about anywhere on the earth's surface in seconds. Even considering the latest technology, two-way radio can do things that other fancy techno-gadgets can't.

What happens when you try to make a call and you see a message on your phone that says `No Service`? What happens when you try to access the Internet with a wireless connection and you see a message on-screen that says `No Connection`? People on the go, whether they're just roaming around a mall or driving through the Rocky Mountains, may find that a two-way radio does a better job at facilitating communication (at a lower cost, mind you) than these commercial service options. Why use up those calling plan minutes when a pocket-sized radio can keep you in touch with your family elsewhere at the ball game? If you're stuck on the road between cell towers, a *Citizens Band* (CB) radio is nice to have if you need to call for help. Radio gives you lots of alternative ways to communicate.

Plus, there's the fun part. You're doing it yourself and not relying on some big company (or paying their monthly bills) to communicate. After you become familiar with your radio, you might find yourself taking pride in seeing how far you can get. Or maybe you can take pride in being the first to respond to a request for help. Even when you're not transmitting yourself, you can have hours of enjoyment just listening to the public safety services around town with a scanner or pulling in the morning news from halfway around the globe on a shortwave radio.

Communicating person to person

Two-way radios are used the world over to put people in touch with people. Radio does this with a bare minimum of fancy supporting technology and so

provides a very inexpensive way of communicating. Examples of person-to-person radios shown in Figure 1-2 that you encounter in this book include

- Handheld *FRS/GMRS* radios (Chapter 4)
- *Citizens Band* (or CB) radios (Chapter 5)
- Business and public safety radio systems (Chapter 7)
- Marine radios for sailors (Chapter 8)
- *Ham radio,* the most powerful personal radio of all (Chapter 9)

You also find how to use a scanner to listen in as others use their own radios.

Figure 1-2: Some examples of person-to-person radios.

Images courtesy of Uniden Corporation

Saying, "Mayday!"

Marine radio, Citizens Band, amateur (or ham) radio — these services all have designated channels or common frequencies where help can be a transmission away. And yes, you say, "Mayday!" just like they do in the movies. Personally, I've reported a number of automobile accidents and stranded motorists to the 911 dispatchers using my ham radio. I've also monitored Marine Channel 16 as a grounded boater called looking for help from the Coast Guard. The most important emergency communications in which I've ever participated occurred during 1991, when troops from the Soviet Union surrounded the Lithuanian parliament building. Alerted by a fellow ham, I listened as the ham radio club station inside the parliament building relayed reports to a local Vilnius station, which then relayed them to a California station and on to the U.S. State Department. As the hours passed, we helped keep the frequency clear and supported a new American station in New Hampshire to take over when conditions to the West Coast began to fade. Later on, when we could only hear the new European relay station in Belgium, we were about to sign off when a formal message came through transferring the Lithuanian government's power of authority to a cabinet minister, who was kept outside the country for that very purpose! That was possibly one of the most important emergency messages ever sent by amateur radio. Since then, I've learned to keep my ears open; you never know what the airwaves will bring.

Communicating in an emergency

Radio really shows its worth when the chips are down (and so are the mobile phones and Internet systems). Not many people realize that commercial communications systems (such as *POTS* — or plain old telephone service) are designed to handle only a few percent of their subscribers at any given time. In a smaller-scale emergency (such as a blizzard), you are likely to find the systems unavailable due to overload. This lack of service can last for many hours and in a true disaster (such as an earthquake, tornado, or hurricane), hours, or even days, may pass before service begins to be restored. In times like these, having a radio that doesn't rely on a separate company or special systems can literally be a lifesaver.

In an emergency, not only do you need to know how to make the best use your radio, and where to find help, but you also need to know how to interact with others in a similar situation, and with the people providing assistance. Chapter 6 leads you through the basics of preparing yourself and your radio for an emergency. I also discuss techniques for communicating efficiently under difficult circumstances, and provide you with resources for training and learning about emergency communication, or *emcomm*.

Using your radio for fun

You may have purchased a radio for pure utility, but (along with millions of other enthusiasts) you may find yourself enjoying making the radio work better and improving your own skills. For example, mobile CB and marine radio enthusiasts have many opportunities to experiment with antenna style and placement to get the most range on the road and on the water.

Using a radio can enhance the experiences of other activities. For example, auto racing fans use scanners to listen in to their favorite drivers talk with their pit crews. Hikers, campers, and recreational vehicle (RV) users often use radios to keep in touch with others and as safety aids. The worldwide community of folks that combine outdoors skills and radios in orienteering and direction-finding competitions is sizeable. Hang gliders and hot air balloonists can often be heard coordinating their flights with handheld radios.

Ham radio licensees have the most latitude to experiment and practice than users of any other type of radio. After passing the required test and receiving his or her Federal Communications Commission (FCC) license, *hams* (the term affectionately used to describe ham radio users) have access to a huge range of frequencies, can build and modify their own radios, use them for all sorts of activities, including public service, and even operate their radios in foreign countries. Think of hams as having graduated from Radio University and you've got the picture.

Putting radios to work

Public safety and service workers, such as fire and police officers, paramedics, and transportation and wildlife officers, all make use of radio on a daily basis. Radios like those in Figure 1-3 are commonly used by security staff at public events and concerts. To pilots, radio is a lifeline in the sky, guiding them safely from point to point and keeping them informed about conditions ahead and on the ground.

If you use a radio as part of your job, you can get the most performance out of your radio (and, as a result, do your job more effectively) when you understand how it works. You also raise your understanding of the radio system and interact at a much higher level with radio system planners and technicians.

Radio technology is a key element to making the world's extensive aviation industry fly, so to speak. Pilots, air-traffic controllers, and airport managers all engage in an intricate choreography that ensures our safety in the air and on the ground. The dance is conducted over the radio waves, and you can listen in any time. If you're an aspiring pilot, keeping an ear on the aviation channels is a great way to improve your own skills so that you feel more comfortable in the pilot's seat.

Figure 1-3: Some of the radios used by professionals include those in the aircraft cockpit as well as the ordinary-looking, but powerful, handheld radios used by police and fire departments every day.

Images courtesy of ICOM America Corporation

Listening to the radio transmissions made by professionals in the course of their work is fascinating — just ask any scanner enthusiast! News organizations make no secret of the fact that they have several scanners hot on the trail of developing stories, 24 hours a day. By tuning in yourself, you have the same access to breaking news as the local broadcast pros.

Even if you only want to use a radio to get the job done, finding out how the radio does its job helps you pick the right radio with the right signal. You can plan more accurately, train more quickly, and make use of your investment more efficiently.

Introducing Radio's Unique (And Magical) Forms

Radio signals are whizzing around the planet, between airplanes, up and down to satellites, and off into space. This is happening all the time and the only thing you need to get in on the action is (surprise!) the right radio. That

and a little bit of helpful information and instruction (surprise!) provided in this book to launch you beyond the basic functions. You'll be amazed at how much even a simple radio can do if used by a knowledgeable owner — that's you.

Most of us use a radio as just another appliance — you just turn it on and get a specific radio station or program. Your car radio has a handful of buttons that can be set to individual stations, but what's *between* those stations? That little handheld radio you bought may have more than a dozen channels. What goes on there? The keys to finding out lay buried in your owner's manual. I can help you unravel the jargon and explain the purpose of common controls and settings so that you can play your radio like a musical instrument.

In Chapter 2, I discuss some basics on what makes radio work, but for now you should know that the signals have a wide range of characteristics. Some radio signals can travel, or *propagate,* for extremely long distances with a proper antenna. Often, signals are reflected off the upper layers of the atmosphere and return to the ground hundreds or thousands of miles away. Other signals ignore these layers, blasting off directly to or from a satellite. Sometimes, the weather gets into the act and allows signals that normally wouldn't travel beyond the horizon to be received in the next state. This variability leads to exciting adventures, tracking the wily signals from points known and unknown.

Not only do the signals travel surprising distances, but also there are many different types of radio signals. Some transmissions are of voices in broadcasts or conversations. Others are designed for carrying data or pictures that you can display or record. When you know where to listen, you can also hear the venerable Morse code and the almost-as-old *radioteletype*, or RTTY (pronounced "ritty" by those in the know).

You can use your computer to decode and display most of these signals with free software downloadable from the Internet. Get your weather map directly from a satellite without waiting for the TV news or logging on to the Web!

If you start viewing your radio as another set of eyes and ears, you'll discover that the number of signals at your fingertips, weak and strong, is enormous. It's the same as finding how your car works. Driving takes on a whole new dimension when you know what the car is doing and you become a much better driver and owner, as well. There's a whole 'nother world waiting for you behind a radio's power switch!

What You Can Do with a Radio

You probably had a very specific need in mind when you first starting looking for a radio. Maybe you've been able to satisfy that initial need, but if you're reading this book, you are likely the type of person who is interested in

getting the most out of the things that you use. You've probably seen radios used in many common ways or *applications.* The following sections suggest a few applications for your radio that you may not have considered. Maybe the information here will spark a few new ideas.

Roger: Sharing information

A two-way radio's primary purpose is to connect people so that they can talk to each other. Usually, those people want to be connected because they are sharing information. Here are some good examples of how radio can enhance everyday info-sharing activities:

- **Becoming a severe weather watcher:** The SKYWARN program run by the National Oceanic and Atmospheric Administration (NOAA) relies on volunteers just like you to spot developing weather systems and relay your observations via radio to the National Weather Service. Similar groups, such as the British Storm Watcher's Community (`groups.msn.com/BritishStormWatchersCommunity/welcome.msnw`) and the German Severe Weather group (`www.germanseverereweather.de/eindex.html`) exist in other countries.
- **Coordinating a school, church, or community event:** Keeping volunteers organized is so much easier with radio. After you run a parade, carnival, or outing with everyone on the radio, you'll wonder how you ever managed without radios.
- **Organizing your neighborhood for block monitoring or disaster relief:** In an emergency that eliminates phone services, being able to maintain contact with your neighbors without having to physically travel to each house is tremendously reassuring. Radio service is an excellent way to help each other.
- **Teaching your kids:** Giving kids a secret radio link with a friend is wonderful. There's nothing better than having your very own private channel. A few hours doing chores can provide an inexpensive pair of radios just right for best friends. What starts as just a fun gadget can lead to a lifelong interest in the real technology behind the buttons. A kid that can use a radio can make a real contribution at school, church, or community functions, as well!

Using your radio at work

When you begin using radios for business, you must abide by certain rules regarding which radios and channels are available. Nevertheless, you can be quite creative with radio at very low cost. Here are some options for you:

- **Keeping tabs on delivery vehicles or drivers:** The Citizens Band services are designed just for this type of use. An inexpensive radio with a cigarette lighter plug and a clip-on antenna turns a part-time delivery person's car into a radio-linked business office without the expense of mobile phones.
- **Coordinating marina operations:** By using a combination of handheld short-range and regular marine channel radios, a *harbor master* can coordinate incoming boaters, keep tabs on those out on the lake or river, communicate with marina staff, and talk to the marina store or fueling station.
- **Setting up a campground intercom:** With campers spread out over many acres, keeping order can be quite a chore for a campground manager or supervisor. If you hang out a sign directing campers to use a specific radio channel, they instantly have a way of communicating with you and each other.
- **Coordinating the emergency communications plan for your business:** Your employees probably use radios for day-to-day operations, but do they know how to use them in an emergency, such as a fire? Knowing where everyone is (and isn't) is a huge relief and helps avoid panic.

Listening in with a scanner

Keeping an ear on the local public safety action is the most popular use of a special radio receiver, commonly known as a *scanner*. There are quite a number of other ways to make good use of these receivers:

- **Monitoring the action at auto races or air shows:** Chapter 14 shows you how to become part of the team, allowing you to listen in on the pit chatter, adding a lot to your enjoyment of the event. This is a great way to discover how the drivers, pilots, and players do their thing and how the events are organized.
- **Picking the right line:** If you ride ferries or spend time in traffic lanes, having a portable or mobile scanner can let you listen directly to the transportation workers. You can find out what lane is held up and why, when the next boat will arrive, if a new lane is about to open up — wouldn't you just love to know?
- **Getting your weather directly from the satellite:** You don't have to have a 30-foot dish to pick up signals from the low-orbit weather satellites (called *birds* by the initiated). All it takes is a small antenna, a VHF receiver (VHF stands for *very high frequency*), and a computer to automatically record all types of photos and data from the many *remote sensing* satellites.

- **Tuning in for military surprises:** Although the men and women in uniform don't publish their lists of frequencies, you can make a pretty good guess about where to listen in when the military is active. Depending on their location, you might hear pilots talking to each other or to their command center from thousands of miles away!

Chasing broadcasts

You may have listened to one of the major shortwave broadcast services, such as the BBC or Deutsche Welle. While on the road, you may have heard the fluttery sound of a faraway AM (amplitude modulation) radio station coming in at night. (See Chapter 2 for more information on AM and other terms.) If those wet your whistle, here are a few more ideas:

- **Finding news in your native language when you're traveling abroad:** If you're not fluent in the local lingo, you'll find yourself yearning for news from home. A portable receiver and a hunk of wire can open a channel that receives shortwave broadcasts from anywhere on earth.
- **Crossing borders:** You can practice rusty language skills or experience entirely new holidays and festivals through the magic of shortwave radio. You find an immediacy and presence on shortwaves that the Internet just can't match.
- **Having a distance (*DX*) contest:** Do you have friends with radios of their own? Challenge them to see who can receive the most distant station! Then see who will be the first to receive a confirmation or *QSL card* bearing those exotic stamps from a faraway country.

DX is an old telegraphic abbreviation that indicates *distant station*. The term is still commonly used by shortwave and amateur radio enthusiasts as shorthand for a signal received from a distant station. A *QSL card* is a hard-copy verification of reception or of the contact; it contains important details about the date and time of the contact, as well as the frequency used and signal strength. The abbreviation QSL is one of many *Q-Signals* used by radio operators (`www.ac6v.com/Qsignals.htm`) to abbreviate common phrases and questions.

Knowing Radio Rules and Regulations

This book is primarily written with the U.S. reader in mind, so when I talk about the musts and mustn'ts, I am thinking specifically of the Federal Communications Commission (FCC). You can find out more about the FCC and all the radio rules at the FCC's Web site, `www.fcc.gov`. If you're an international reader, consult the information supplied by the manufacturer of your radio and read magazines and Web sites originated in your home country for the appropriate local information.

Check the owner's manual first to find references to applicable rules in your country. The manual also provides sources so that you can find detailed regulations.

Some two-way radios, such as those that use the GMRS (or *General Mobile Radio Service*) band, require a license to operate. Whenever I discuss such radios in this book, I'll be sure to let you know right up front that a license is needed and provide you with instructions on how to file the necessary paperwork to get licensed.

Don't think that you can get away without obtaining a license. You may last for a while, but getting caught can result in the loss of your equipment, a fine, and at the least a big hassle. And for what? There's nothing inherently difficult about obtaining a license to begin with. In fact, the perks are pretty good.

Even *receive-only* radios, such as scanners and communications receivers, have a few rules to play by. For example, listening to mobile phone conversations is illegal, period, as is modifying a radio to do so. Divulging what you overhear on the air may also be illegal. Various states also have laws restricting the use of mobile scanners that can receive law enforcement frequencies. Check your local laws before putting that scanner in the car.

Getting Training (If You Need To)

After you dive into radio in a big way, you'll soon discover that you need a lot more information than any single book can provide — even this one! Luckily, there are lots of resources out there for the aspiring radio guru. The following sections give you some resources.

Books and videos

The most common resources for further radio training are print books and video programs that you can buy, rent, or borrow. Libraries often have extensive collections of training materials. Radio manufacturers want you to have the best possible experience with their products, so they often provide free operating guides, tips, and articles on their Web sites or through their dealers. The larger radio clubs and users groups often list a number of resources on their Web sites for you to try. Here are a few:

- Strong Signals (`www.strongsignals.net`)
- National Citizen's Band Center (`www.bearcat1.com/ordercb.htm`)
- American Radio Relay League (`www.arrl.org`)
- North American Shortwave Association (`www.anarc.org/naswa`)

For all the activities in this book there are numerous online communities, such as those at Yahoo! Groups (`groups.yahoo.com`) and MSN Groups (`groups.msn.com`). You can also find many e-mail lists, such as those at `www.dxzone.com`. Take advantage of them to get more enjoyment and utility out of your radios!

Online training

Online tutorials and training courses are getting more popular every year, and they are widely available. Quality runs from cursory overviews to in-depth professional-level certification programs. As with books and videos, check the manufacturer and organization Web sites for references or sponsorship of courses. If you're interested in *emcomm,* or emergency communication, local organizations may sponsor training courses for a low fee — or perhaps for no charge at all.

In-person training

I can't think of a better substitute for getting the assistance of a more experienced radio user. If you're fortunate enough to have such a friend or acquaintance, congratulations! Not everybody has a radio mentor (or *Elmer*) to help them over the bumpy spots. To find these folks, look for a local or regional club that covers your area of interest, such as scanning or direction finding. Regional clubs may even have a special officer whose job is to welcome newcomers and help answer questions. In general, experienced radio gurus are quite willing to help even a rank newcomer. After all, even the saltiest veterans were once in your shoes!

You, Too, Can Build and Fix Your Own Radio

You can't do much with a cellphone beyond open it, use it, and pay the bill every month. Most types of radio, though, present a golden opportunity to optimize and expand your capabilities. You can find out about electronics in a big hurry by experimenting with radio, plus you'll meet a lot of like-minded folks that enjoy getting the most out of their radios.

Limitations on opening the hood

Not quite so fast, grasshopper. Although you may have an itchy screwdriver, you need to know and heed some rules of the road. Two-way radios require

FCC *type acceptance*, which means that the manufacturer guarantees the radio will play by the rules of its service. If the radio needs to be repaired, either the manufacturer or a certified technician must repair it to restore that guarantee of proper operation. If you look at the manual or manufacturer's nameplate of your radio, you will see an *FCC ID*, which is the stamp of approval for that radio. Every radio sold in the United States has to have one.

Because most users of radios are relatively untrained, tinkering with the radios can (and does) lead to serious radio misbehavior and interference to other users. This sort of thing attracts the generally unwelcome attention of the FCC. If you don't know what you're doing, enlist the services of a technician with the appropriate certifications.

The operating manuals for most radios are available online at little or no cost, either from the manufacturer's Web site or from sites like `www.w7fg.com`. Try entering your radio's model number along with the word *manual* into an Internet search engine.

Fiddling about inside can also void your radio's warranty, so exercise some caution. In Part IV, I present some technical chapters on tools, installing radios, and troubleshooting. Consult these and some training and reference resources before you open up that radio.

Kits and homebrewing

If you really want to build and tinker with radio circuits, you should look into getting an amateur or ham radio license. Ham radio is a great hobby for electronic tinkerers and builders! Right behind hams come the scanner and broadcast listeners who strive to pull out weak transmissions with a collection of sensitive antennas and signal-enhancing electronics.

Both ham radio operators and the listen-only folks have lots of opportunities to build and test their own radios and accessories. A few are shown in Figure 1-4.

Accessorizing

Don't let my cautionary advice take all the fun out of playing with your radio. For most services, you can add all sorts of accessories like headsets, special microphones, signal monitors, and audio processors. Radios can often make use of dozens of different types of antennas. Instead of working on the radio itself, you can build the *station*. Installing and using accessories can help you gain a whole lot of radio savvy. Just take a look at a catalog from a marine radio dealer, for example, and you'll see just how much there is to choose from.

Ham radio operators have to pass a somewhat-technical test and so are presumed to have the technical qualifications (and the responsibility) to keep their transmitted signals up to snuff. Radio listeners don't transmit at all and there are few restrictions on what they can use to receive signals. You can build your own inexpensive shortwave broadcast receiver in a few hours!

You can find literally hundreds of different kits to create everything from power sources and test instruments to radios and antennas that push the state of the art. Along with kits, many magazines and Web sites publish circuits and instructions for builders. Building from scratch (individual components or stock materials) is called *homebrewing,* and it is a real badge of honor to use homebrew equipment and antennas.

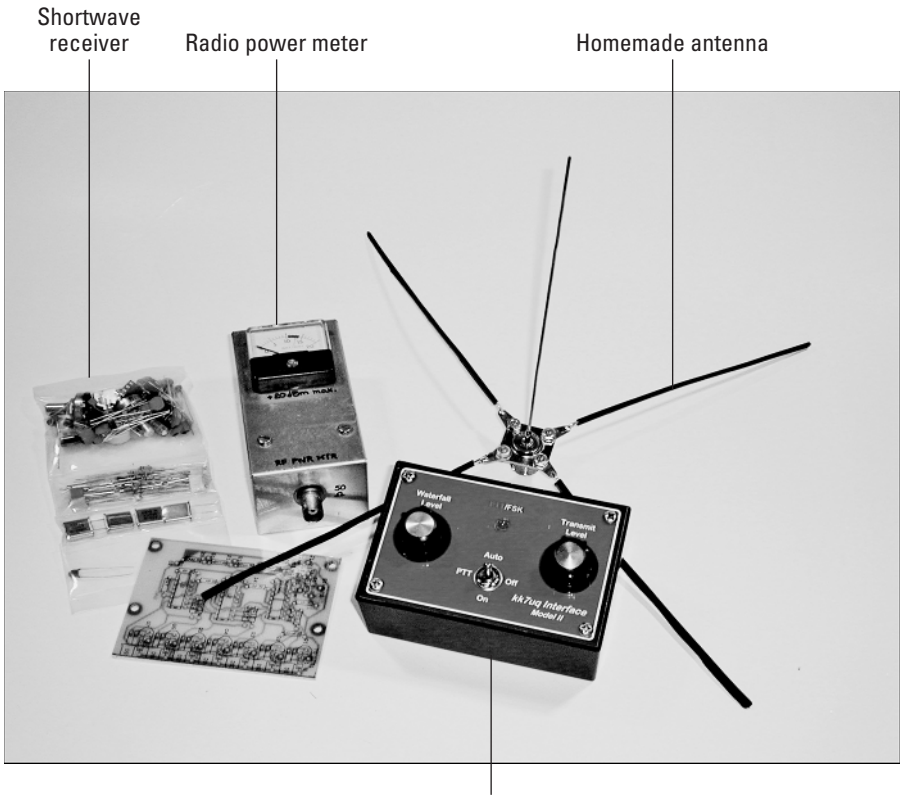

Figure 1-4: Homebrew kits include several gadgets that you put together yourself.