Chapter 1

Creating a Mod-Worthy PC

In This Chapter

- Studying the modder species
- Looking at the parts of your computer
- Equipping yourself with the right tools
- Finding a place to do the work
- Handling your PC parts correctly

Whether you've never ventured to open your computer's case to look at the mysterious circuit boards and cables inside, or you upgrade so frequently you feel more intimate with your PC's innards than you feel with your family (and trust me, I understand — some of my PCs' cases are open on a permanent basis), modding is something totally different from day-to-day PC use and maintenance. Modding requires a different mindset, a more adventurous attitude, an almost reckless desire to bust out the baddest box on your block.

The subject of computer gaming comes up often in these pages. Computer modders tend to be enthusiasts, and enthusiasts tend to be gamers. Running modern 3-D games is by far the most power-intensive activity likely to be pursued outside of Hollywood. If you ask me, computers exist for the sole purpose of playing games — everything else, including banging out these words in my word-processing program, comes second.

One of the best venues, in fact, for showing off your PC modding skills is gaming LAN parties. LAN parties are gatherings of gamers who want to play games with/against each other in a latency-free environment.

Latency, or lag, is the phenomenon that affects computers communicating over networks, including the Internet. It's measured in milliseconds, and a function known as *ping* is used to determine the actual amount of latency. Ping times particularly affect gaming: Low pings, say around 50 milliseconds, result in smooth gameplay, while high pings, over 200 milliseconds, cause play to become choppy and degrade the experience. Figure 1-1 shows a Doom 3 server list with ping times.

Figure 1-1: The popular game Doom 3 (from Id Software), like many games with online components, lets you browse through available servers to hunt down the one with the lowest ping.

Understanding Why Modders Build Their Own Systems

It's all about power!

Modding is a hands-on activity. When someone mods a computer, he wants it to be an incredible system that can plow through data with the intensity of Cookie Monster attacking a plate of Oreos. Although you can certainly mod for your own satisfaction, one of the greatest joys of modding is showing off your creation to your fellow PC enthusiasts. Just like guys who drag-race with souped-up muscle cars, modders tend to ask each other the age-old question: "Whatcha got in that thing?"

Chances are, you're not going to want to answer, "I don't know," or indicate ancient parts like "a Celeron 133 and 64MB of RAM." Those drag racers aren't going to say that they've got a stock 4-cylinder, 100-horsepower engine. They're going to brag about having a huge motor, dual exhaust pipes, and those funky hubcaps that spin around.

So instead of ancient hardware, you want to make sure your computer is equipped with the most powerful gadgetry you can afford. This ties into gaming, too: Current games like Half-Life 2 and Doom 3 demand incredibly powerful computers with advanced processors and graphics equipment to get the most out of them.

Modders are control freaks. Instead of buying a system from a manufacturer that may or may not really care about placing the most horsepower into its computers, modders would rather buy the parts that they really want and assemble them into a monster rig. Major computer manufacturers have contracts with certain parts makers that, even if they allow you to customize the computer you buy from them, limit your choice of components. Modders can't handle such restraints. They want what they want and they'd rather do their own dirty work to get it.

That's not to say you absolutely must start from scratch and build a system to mod. You can certainly take an existing system, beef it up, trick it out, and mod the living hell out of it. You may run into problems, though.

Some computer manufacturers build their wares out of proprietary equipment. For example, if you bought a Bob's PC 3000 last year, and you want to upgrade it, you may discover that a standard motherboard won't fit in the case, or you may find out that it uses a graphics processor built into its motherboard and there's no slot to add a new one. You may be able to take what you've got, rip it open, and make it look like a beast, but what are you going to do when it won't run the latest games at a decent frame rate, or when someone asks you what's in it? Modding an old Bob's 3000 would be like putting a 12-inch lift kit on an '82 Chevy Citation. It's possible to do, but would you really *want* to?

Before you buy parts to upgrade a system you bought from a manufacturer, do a thorough check for compatibility in the documentation, at the manufacturer's Web site, or by calling the manufacturer's tech support. You don't want to end up with parts you can't install in your computer or, worse, parts that *seem* like they should work. One very prominent computer manufacturer in the recent past turned out computers with motherboards and power supplies that were designed specifically for each other. People who went to upgrade those computers found out the hard way that the proprietary power supply actually damaged standard motherboards. Don't let this happen to you. Be well-informed before you start your upgrade.

Looking At Your Computer as a Hot Rod

Cars have distinct parts: They have engines that determine how fast they go, they have bodies that show how cool they look, and they can be performance-tuned to max out their potential. Computers are the same way.

The engine and transmission: Your computer's internal parts

I love mucking about inside a computer. I know I said computers exist to play games, but even more than gaming I love to have a screwdriver in hand, a PC on my bench with its cover open, and a pile of components nearby. There's something very rewarding about swapping this out, putting this in, making sure the cables are connected tightly, being sure not to spill my coffee on my motherboard, and so on.

Car freaks like to rip into their vehicle's engine. They like to put in spark plugs, widen the intake, and such. To be honest, I don't know much about cars — I'd rather work on a computer — but I do have friends who are automobile gearheads and, in a way, we're brethren. We like to make stuff go.

The insides of a computer (see Figure 1-2) can be compared to the engine and transmission of a car:

- The size of a car's engine largely determines the power the car has to go fast. Similarly, the computer's central processing unit (CPU) determines how efficiently it deals with all those math problems that make the computer work.
- A car's transmission transfers the power of the engine to the wheels to make it go. A computer's main memory (often called RAM) serves as a depository of data the processor has to work on as well as work that the processor has completed. It transfers the data to and from the working program. Data conduits called *buses* provide pathways along which the various data are transmitted. RAM and buses serve a similar function to the computer as a transmission does to a car. Figure 1-3 shows installed RAM modules.

A car's engine generates power to make the car go, but it's the transmission that spins the wheels. Without a transmission, the car would probably sound spectacular if it had a big, roaring engine and some straight pipes, but it wouldn't go anywhere. The computer's CPU is in a similar situation: It can process math problems with amazing speed and grace, but it needs a little help getting the information to and from the programs that are running.

Later in this book, I babble in depth about CPUs and RAM. Chances are, if you're curious about modding, you're already well-versed in those concepts, but don't worry if you're not — I get to them in Chapter 5.

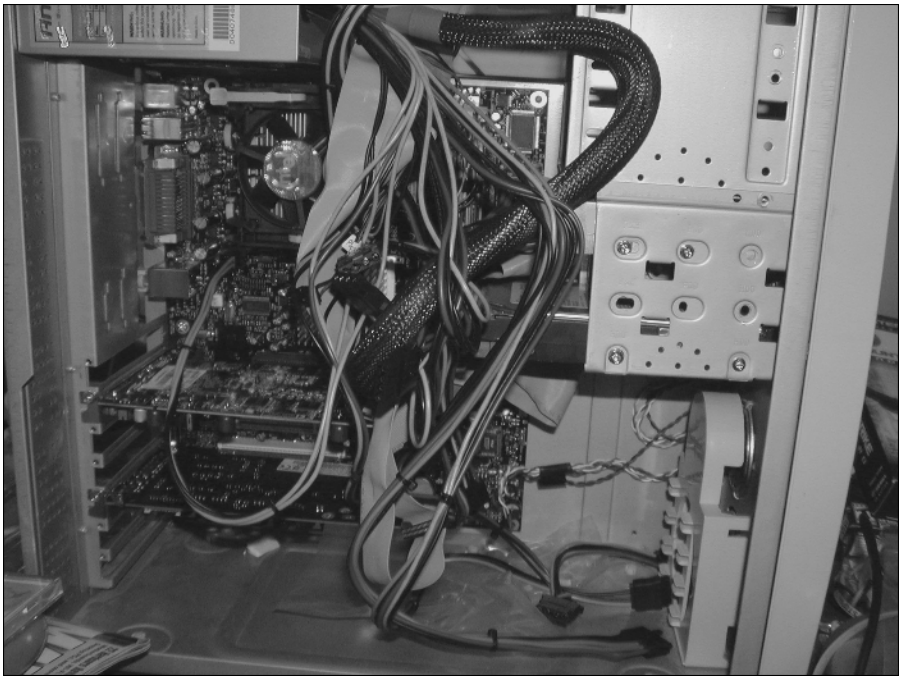


Figure 1-2: To me, there isn't a more satisfying way to spend a Sunday afternoon than fiddling with a PC's parts.

Figure 1-3: Those little modules sticking up from the motherboard house the PC's RAM.

When a program runs, it can send information to the CPU in separate processes known as *threads*. Some programs are simply one long thread. Some modern CPUs can run multiple threads at the same time in a process known as *multithreading*. Threads are essentially subparts of a program that can run semi-independently but need to communicate with each other to complete program tasks.

Performance tuning: Making the engine (or the PC) purr

Car guys know all sorts of tricks to make cars fun smoother, faster, better. They can spend hours working on timing, air transfer, and other stuff that affects how well the car runs. In fact, you probably take your car to a dealer or repair shop every so often to have a tune-up performed on it. After it's tuned, it probably runs much better and gets better gas mileage than it did before.

Computers can be tuned, too. It's less of a physical task than tuning a car. You don't turn screws and adjust the internal equipment to tune up a computer; instead, you tweak settings in the BIOS and in Windows.

The BIOS (which stands for *basic input/output system*) is the computer's link to the components that are installed. The BIOS is built into the hardware of the system and is the program that enables the computer to start, check to see what devices are installed, and then turn over control of the system to the bootable operating system. Without a BIOS, the computer wouldn't know anything about its gear — it wouldn't be able to find the memory to transfer data; it wouldn't know where the graphics card is, so it wouldn't be able to give you visual cues; it wouldn't know what kind of storage drives are installed. It would just sit there wondering what to do with itself.

You can use the BIOS's setup program to tweak settings for everything from memory timing to what drive to boot off of (usually your computer's main hard drive, but alternately a floppy drive or an optical drive). The BIOS setup program is a powerful tool for tweaking your PC's performance by telling the PC exactly how to use each of its components. Figure 1-4 shows a BIOS setup screen.

Although I get into BIOS tuning in depth later on in this book, I want to say this now: Be careful when you change your PC's BIOS settings. You can degrade performance, overclock components, and generally cause mayhem if you don't know what you're doing. Never make an adjustment if you don't know what it does.

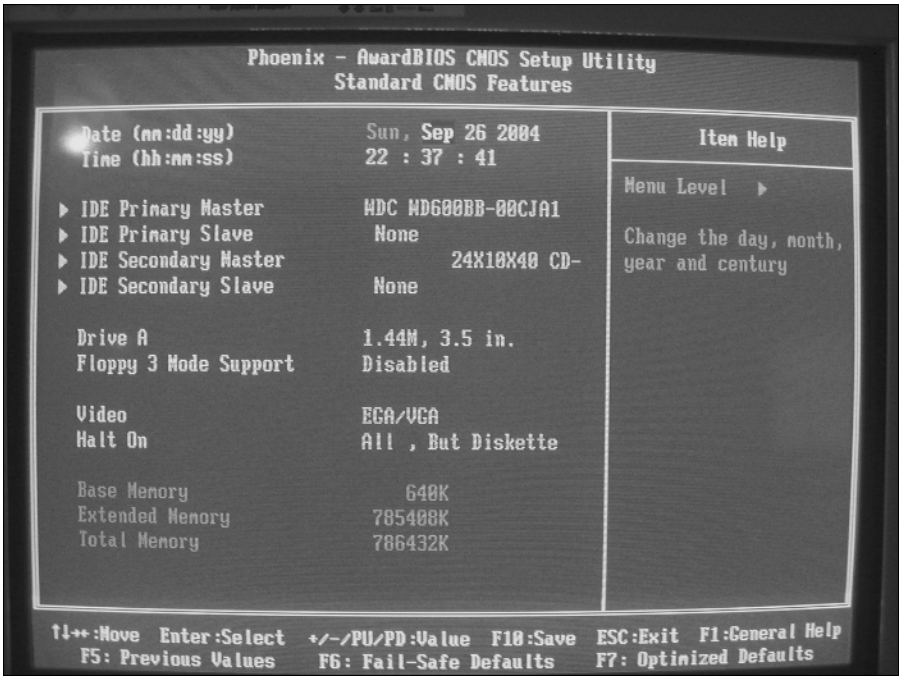


Figure 1-4: The BIOS setup screen of a typical motherboard. It's here that you can get a little bit of tweaking done.

Similarly, Windows itself contains a myriad of settings that you can alter, adjust, and tweak to squeeze the utmost performance out of your computer. Windows makes a lot of assumptions about how it expects you to use your computer, and its default settings leave a lot of room for improvement. By tuning the BIOS and Windows, you'll squeeze a lot more performance out of your system.

The body: Your computer's case

When you look at a car, you see its body. That includes the shape of the car (which automakers typically design around aerodynamics), its paint job, and its trim. The body of the car determines how utterly cool it looks at first glance. You're more likely to drop your jaw at the sight of a red Lamborghini than you are at a featureless tan sedan.

Your computer's case is like the car's body. It can be a standard, boring, opaque, beige case, which makes me think of working in a cubicle in a huge faceless company under fluorescent lights with a little phone headset and a sensible desk. Or, your computer could have windows, lights, lit fans, and an

awesome paint job, which makes me think of an ultracool dance club with disco balls and flashing lights and designer shots in test tubes and happy party people all around. Where would you rather be: the office or the club?

After you get your computer's guts in gear, you'll probably want to trick it out to look like a work of art. This is the heart of modding: making something that's awesome to behold, something that you'd be proud to show your friends, something your mother would fear at first sight.

Getting the Right Tools for the Job

Building, cutting and painting a computer are largely mechanical tasks. For any mechanical task, you need the right tools for the job.

If you don't have any of the tools I cover in this section, expect to shell out a bare minimum of $100 for the full complement. You can get most of the tools discussed in any hardware store or home-improvement store.

The quality of the tools you purchase is entirely in your power. Typically, the more you spend, the more convenient, powerful, comfortable, and reliable the tools will be. I'm not saying that you have to buy the top-shelf gear in every category; let your budget dictate exactly what you procure.

The building and modding process can be broken down into three major steps: assembling or upgrading the PC, cutting the case, and painting the case. For each task, you need a different set of tools.

Tools for building or upgrading your PC

To work on a PC, you'll rely mostly on two tools:

- A small Phillips head screwdriver (no. 1–size head)
- A medium Phillips head screwdriver (no. 2–size head)

Nearly any task you take on involving swapping out circuit boards, opening and closing the case, adding and removing fans, and securing drives in their bays, you can accomplish with the right size Phillips head. I tend to work with one of those four-in-one screwdrivers that has reversible heads — two sizes of flatheads (that I don't think I've ever used) and two sizes of Phillips heads.

In rare instances, you may need special tools to crack the case and swap out parts. I've encountered some older systems that required star-head screwdrivers (also called Torx heads). To be prepared for the rare instance that I need a specialized head, I purchased a set of tools that contains a screwdriver

handle and a host of bits of all shapes and sizes, including star heads, square heads (also called Robertson heads), hex heads (also known as Allen heads), and more. You probably won't need this, but if you discover your case has odd screws, you may want a multibit screwdriver set.

If you have to install a motherboard, in most cases you'll have to position little hex-shaped brass standoffs in the case, into which go the screws that hold the motherboard in position. To loosen and tighten the standoffs, I use an ordinary pair of pliers.

Because you'll be using these tools often, especially the screwdrivers, I suggest purchasing high-quality versions of them. Make sure they're comfortable in your hand and that they're made with casehardened metal so that the blades won't deteriorate over time.

Some computer-geek friends of mine use a cordless screwdriver with a comprehensive bit set to loosen and tighten the screws they encounter while working on a computer. I find that I don't actually need one; the screws are short enough that my wrist doesn't fatigue from manually turning the screws.

In some cases, seeing into the recesses of your computer case can be difficult. You may want to locate a dropped screw, or read the model number of your motherboard printed in between the expansion slots. For such instances, it's optional but nice to have a penlight.

Tools for cutting the case

You're likely to cut the case in two scenarios: when adding a blowhole for a fan, and when chopping a window into the case. This is where it gets expensive: You'll need power tools to accomplish this job. I don't suggest tearing away at your computer case with a pair of tin snips.

Let's start with blowholes. You'll need to measure, square, draw, and cut a hole right through the case. First, you'll want to draw the hole on the case itself. You'll need:

- A tape measure
- A pencil
- A compass (the drawing tool, not the lost-in-the-woods tool)
- A hammer
- An awl or metal punch

You'll measure out and map your hole, mark the center with the punch and the hammer, and draw the hole with the compass.

Don't assume you can draw the hole with the compass without a metal punch. The sharp end of the compass won't stay still on flat metal. Trust me, I've found this out the hard way. Profit from my mistakes!

After you've marked the hole, you'll have to cut it and smooth it. To do so, I suggest using:

- A drill
- A hole saw (around the same diameter as the fan blades of your fan)
- Sandpaper

To ensure you obtain a hole saw of the proper diameter, you'll either need to measure the diameter of the blades of the fan you plan to install, or you can just buy a set of hole saws that contains different sizes. You never know when you'll need to make a hole in something, so it's nice to have a set. Make sure they're designed to cut through metal if your computer case is metal. If it's plastic, just about any hole saw will do.

You'll also need to line up and drill the mounting holes for the fan. For that, you'll need:

- A square
- A 5/32-inch drill bit (or another drill bit that's slightly thinner than your fan screws' threads)

As with the hole saws, I suggest you purchase a set of drill bits rather than just one. They could very well come in handy one day.

Blowholes aren't the only things you'll likely cut into the case. You may also want to add a window. You'll need the pencil, square, sandpaper, and drill mentioned earlier. For measuring rounded corners, you may want a protractor. For cutting the case and the clear plastic sheet of acrylic that will serve as the window, I strongly suggest a rotary tool (such as a Dremel) with an attachment appropriate for cutting metal. You may also use a jigsaw, but they're expensive.

To secure the acrylic in place, I suggest using one of two methods. By far the easiest method is to use strips of Velcro. You can get Velcro strips at any hardware store. To cut them to the correct size, all you need is a pair of scissors.

Alternately, you can secure the acrylic in place with nuts, bolts, and the appropriate-size drill bit for your bolts. The number of nuts and bolts you need depends on the shape of your cut and how you want it to look. Some people go for a gritty, mechanized look with bolts every few inches, while minimalists with square windows only use one in each corner. Ultimately, it's up to you how many you use, but be sure to securely fasten your acrylic to the case panel.

Safety first! When you're cutting metal, little shards will fly everywhere. You'll also encounter sharp edges that will easily cut your fingers. While chopping up your case, be sure to wear a pair of work gloves and safety glasses. I know, I know — you'll be careful. You don't want to spend the money. You're too cool for safety. Guess what: I *insist* that you wear gloves and safety glasses. Sanding jagged edges of aluminum or steel is a terrific way to shred the skin on your fingers, resulting in blood and carnage. And you absolutely do not want a tiny shard of metal to lodge itself in your eye. That would require a trip to the emergency room. Be safe! Wear gloves and safety glasses!

Tools for painting

Why settle for a boring, beige paint job when you can throw on a few coats of a more appealing color? Painting requires time and patience.

To start the painting process, you'll need:

- A sanding block
- Several sheets of wet-dry various-grit sandpaper, from 320 to 600 grit
- Clean rags

If you don't have a well-ventilated area, or if you're unable to do your painting outdoors, you should strongly consider buying a face mask.

You'll need lots of sandpaper because you'll sand in between each coat of primer and paint you apply. Although a sanding block is technically optional, you should strongly consider buying one — they're inexpensive and they give you something to grip while you sand your case.

Of course, you'll need paint. Plan to purchase:

- A can of primer
- Two or three cans of spray paint in the color you desire
- A can of clear coat

Creating the Ideal Work Area

Technically, you can build a computer just about anywhere that you can lay the case on its side. It would be reckless, however, to work on a carpet or on a little wobbly table. To do the work I discuss in this book, you'll need to find a large, well-lit bench where you can lay out all your stuff with room to spare.

Conquering the fear of handling electronic components

If you handle electronic components by the edges and you pay attention to the excellent advice in this chapter about preventing electrostatic discharge (ESD), you really have nothing to worry about when you handle electronic parts, but there are a few things you should know.

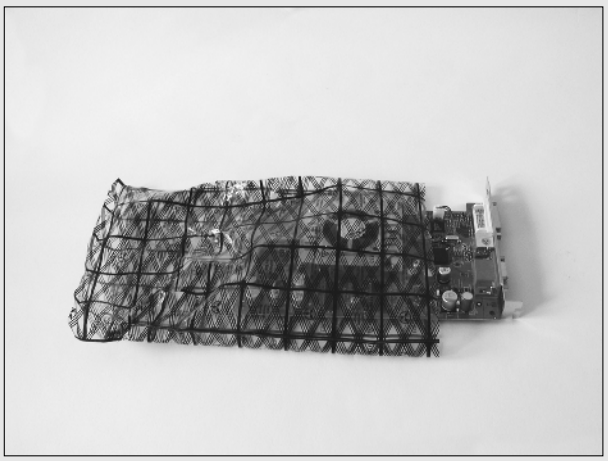
You'll notice that when you buy a graphics card, a sound card, a motherboard, or some other amazing piece of PC technology, it comes in a bag that's usually silver, pink, or clear with black designs on it. This is what's known as an *antistatic bag.* It protects components from being accidentally damaged by ESD. You should keep your components in antistatic bags when they're not installed in a PC (see the figure).

You'll notice that expansion cards, including sound cards, graphics cards, network interface cards, modems, and other gear have a metal plate on the back that corresponds to the slots in the back of your computer's case. If you have to walk around with a component that's not in an antistatic bag, hold it by the metal plate.

Also on expansion cards is a little edge that's covered in gold stripes. This is the contact edge, where the card meets the motherboard and through which data are transferred back and forth. Don't handle the card by the edge — the oils in your hands could coat the metal contacts and interfere with the electrical signals, causing all sorts of problems.

That sounds like a lot to be worried about, but it really isn't. The more you handle components, the more you'll get used to it; these tips will quickly become second nature.

Electronic components are hardier than you may think. I'm not suggesting that you do this, but I actually have stacks of circuit boards on my shelves, without antistatic bags, and they all work perfectly fine. Of course, I wouldn't miss most of them if something bad were to happen, and I do keep the ones I care about in antistatic bags to protect them not only from static, but from dust as well.



Consider a long table or a bona fide workbench in a workshop or garage. It should be clean and free of oil, grit, and grime, and you should have a few lights around it or even a fluorescent fixture mounted above.

In the course of working on your computer, you'll encounter tons of little bits of hardware: screws, standoffs, *gates* (those little metal panels that fit over the holes behind unused expansion slots), and other odds and ends. I have several small boxes that I use to toss such debris into. For the computer that I'm working on at the moment, I'll use those little black canisters that 35mm film comes in (I know, nobody uses film anymore) to store screws and stuff that I'll need to find later on.

For cutting the case, take precautions to keep a handle on metal shavings. Take care to vacuum them up with a shop vacuum cleaner or a handheld vacuum.

Never, *never* cut a metal case anywhere near your computer's components! Metal shavings are good electrical conductors, and if they land on a motherboard or other circuit board, they can wreak havoc with its current, rendering the board useless! Before you cut your case, get the computer and all its circuitry out of there, far away from where you're cutting.

Finally, work in an area free of carpeting. Carpeting generates static, and static is the enemy.

Getting a Handle on Static Electricity

Electrostatic discharge (ESD) is the computer gearhead's greatest enemy. ESD is what happens when you walk on a carpeted floor and touch a doorknob. That little pop is static electricity, and if you can feel it then it's about three times more powerful than the discharge it would take to blow a component on a circuit board.

You can combat ESD in several ways. First, and most important, handle circuit boards by their edges. Don't touch the chips or the resistors or other electronic components.

Second, before you reach into your computer or pick up a board:

1. **Plant your feet.**
2. **Ground yourself to eliminate any static charge you've built up by touching the metal computer chassis.**
3. **Don't move your feet as you work on your PC.**
4. **If you shuffle your feet, repeat steps 1 through 3 before handling more components.**

If you want to be really safe, go to a computer store and buy an antistatic bracelet (see Figure 1-5). It consists of a strip that wraps around your wrist, which has a metal contact. The contact is attached to a cord. You clamp the other end of the cord to grounded metal, such as the computer chassis or a metal table strut or something else. It'll feel like you're on a leash, but an antistatic bracelet will keep you from accidentally making a costly mistake by rendering an expansion card utterly useless.

Figure 1-5: If you're worried about static electricity, an antistatic bracelet will keep you grounded and free from static buildup.