Getting Ready

CHAPTER 1

In This Chapter

Asking basic upgrade questions

Considering basic upgrade and repair techniques

Computers are indispensable for much of the work and play people do. After years of stagnation during which people focused on office automation and business applications and asked where the value was in the ever faster parade of new systems, PCs have crossed a price and performance threshold. Systems you can buy today for hundreds of dollars, not thousands, have the power to make home movies, store and play your music, serve as your home darkroom, and enhance a home theater.

They still do office automation, too.

As recently as when we wrote the third edition of this book, a computer with that kind of power cost thousands of dollars, and most people used a single PC. Four years later, a PC costing less than $500 can handle almost everything you might do, and a surprisingly large number of homes have three or more computers on a local area network. People's priorities have shifted to put stability and capability on par with minimum cost and maximum value.

You Can Do What You Can Imagine

Everyone does something different with their computer, or does similar things in different ways. These differences lead to different answers to the question of what's the best computer for you.

You can start the analysis to answer that question by thinking about these issues:

- What do you use the computer for? What programs do you use, and how?
- What are the benefits you expect from your computer? Will achieving those benefits alter the ways you use the computer?
- If you upgrade, what will limit the performance of your computer?

- ✦ If you buy new equipment, how much and what kind of equipment do you need? What are the options in choosing that equipment? How are you likely to want to upgrade that equipment in the future, and what should you do now to make that easier?
- ✦ For both upgrades and new purchases, what are the support and maintenance requirements, and how can your decisions make getting support easier when something goes wrong?
- ✦ After you select a hardware configuration, what are the growth options during the life of the equipment, and what are the benefits those options can provide? What choices can you make early on to reduce the cost of future growth?

The following pages expand on each of these questions to explain why they're important and how your answers affect your choices.

What do you do with your computer?

Different things you do create different amounts of work for your computer. The typist using an ancient DOS version of WordPerfect places relatively small demands on a computer. The host for a network game tournament needs some memory, a decent *processor* (also called a *central processing unit*, or *CPU*), and high-speed communications. The game player needs screamingly fast CPU and video. The publisher assembling books from text, photographs, and graphics needs it all — lots of memory, a fast CPU, high-resolution video, voluminous storage, and good communications capabilities if files are transmitted electronically.

How you use your computer determines how great a workload you impose on it, so we'll discuss not only what you use the machine for, but also what programs you use and in what combinations you use them. These factors affect how powerful a machine you need. For example, suppose you're still running the computer you bought in 1998. You might have an old version of Microsoft Word on a machine with a Pentium II processor clocked at 266 MHz, 16 megabytes (MB) of memory, and a 4 gigabyte (GB) disk. You're still running Windows 95 on the machine, but your partner says that you'll be fantastically better off with Windows XP and the improved reliability of the more recent versions of Windows. She convinces you to upgrade your software, but now you ask "Will I have to upgrade my computer to run that new software?"

With a computer like that, the answer is Yes. You'll need more memory, more disk space, and a faster processor. We'll look at how you can upgrade your machine, and examine the possibility of replacing the main processor board — the *motherboard* — as an alternative to piecemeal upgrades. We'll also talk about whether or not upgrading this machine makes sense compared to purchasing a new computer — sometimes it's far less expensive to get the same capabilities with a new machine than by upgrading one you have.

We want to caution you to be hardnosed about upgrades because much of the hype and noise you hear that computers are obsolete six months after you buy them is driven by the notion that people always need the fastest, latest hardware. That's absurd. If your computer does what you want the way you want, nothing forces you to upgrade your hardware or software. You may need

Less Than the Sum of the Parts

We recently decided to upgrade our daughter's old computer because the old 600 MHz Pentium III in it was too slow to support the programming and other schoolwork she was doing. We targeted a Pentium 4 at 2.4 GHz or faster, 512MB or memory or more, and at least 40GB of disk, and we planned to install the upgrades in her existing case.

Much to our surprise, that's not how it played out. We check the Dell site now and then to keep track of what's new and where current prices are, and stumbled across a configuration that was both significantly faster than what we'd planned and — including shipping — was about a hundred dollars less than we would have paid for upgrades. That deal went away in a matter of days, but not before we snapped one up. We couldn't buy the upgrade parts for the same price at which Dell could sell and ship the complete machine. It doesn't happen often, but it's worth remembering.

upgrades to do new things, or to do the same things with new software, but that's an explicit choice you get to make.

Which operating system do you want, and why?

Upgrades that let you do more with your computer always seem better than ones required just to run new versions of the same programs the same way as before. Upgrades that increase capabilities and productivity create added value; ones that just maintain existing functionality are little more than a surcharge on the cost of the software upgrade.

The hardware upgrades you need also reflect the operating system you decide to run. For example, Windows 2000 and Windows XP are free from the resource restrictions that plagued Windows 95 through Windows Me. Windows 2000 and Windows XP can run more programs at the same time than their predecessors. If you take advantage of this — say by keeping your e-mail, word processing, and fax software open while you run a corporate order-entry application — you will use more memory than before. You may also find that you need higher resolution on your display to keep all those windows visible at once. Greater display resolution may in turn make you want to replace a 14- or 17-inch monitor with a 19-inch one to keep the text legible.

If your computer is on a home or office network, you may find Windows' improved capabilities invaluable when handling multiple forms of network communication. You can work with file servers, printers, cameras, and other devices at the same time that you search the Internet for the latest news. You can let your coworkers pull files off your disks to combine with their own work. As easy as this can now be, though, it means your computer is doing more work. That means memory and processor resources are being used to service the networking load. If you don't have enough of those resources, you'll need to upgrade to keep working at full speed while these features run behind the scenes.

If you're deploying an Internet server, you'll want to choose between Unix and Windows NT. Both can host a full suite of services, but you'll have to choose among a wide range of choices that affect the hardware you need, the available support, and the cost of software.

Gaining an understanding of your hardware requirements begins by estimating the basic hardware you need to maintain your current capability. This book shows you how to make those estimates and how to achieve a complete understanding of your growth options.

Should you upgrade your computer?

The starting point for upgrades is always the existing computer. We'll discuss how to characterize the performance you can expect from that machine and how to identify the components that limit the performance of your applications. Knowing that will let you predict if the machine's performance needs to be improved. You'll see how to identify the "choke points" that limit performance, how to eliminate them, and how to decide which upgrade options make sense. You'll learn how to identify when it's better to replace the entire computer than to make incremental upgrades.

For example, suppose your company's standard user workstation is a Pentium III processor running at 933 MHz, hosting Windows 2000 in 256MB of memory. You've been using desktop videoconferencing to talk to your children at college, but the video quality isn't very good. Can you afford to fix this? Perhaps. You might need faster communications, might need more memory, or might simply need to drop in a faster video card.

Or, suppose you have a Celeron 1 GHz processor with 128MB of memory, and you want to know if you can use it to process photos from your new digital camera. The analyses you'll do with this book will show you that you can, but you'll want to upgrade memory to 256MB or 512MB, and may need to add disk space too.

The process of analyzing upgrade options is very much like that of selecting options to include in a new machine. We'll look at a wide range of computer components from the point of view of what each can do for you, examining the characteristics of each and looking at how those characteristics affect the performance you can expect. We'll look at relative advertised prices to show the relative cost of features and performance. The prices you'll pay for equipment changes as technology evolves, so we'll use the comparisons to illustrate the analysis rather than as the rigid basis for choice.

What new computer should you buy?

Buying a new computer is very much like a 100 percent upgrade of an old computer; in fact, new computers are often bought as replacements for older ones. Upgrading a machine constrains the choice of components in order to remain compatible with surviving components, while configuring a new computer opens up all the technology options. The decision of what to buy is therefore more complex for new computers, requiring you to weed through more choices.

For example, suppose you've narrowed your selection to two models, one of which uses what the vendor calls a 533 MHz front side bus and the other of which offers an 800 MHz front side bus. The 800 MHz bus machine is more expensive, so you want to know if the extra money is worth it. We'll give you the tools to decide by showing you what a front side bus is, why its speed is important for some processors but not for others, and how to decide which choice is your best option.

What about support and maintenance?

Whatever your demands on a computer, you'll want to carefully consider the support available from the suppliers you choose and the options you have for maintenance when something fails. Both hardware and software are constantly changing, and new versions will at times offer dramatically better performance or brand-new capabilities. Different manufacturers have very different track records for supporting their products as operating systems and hardware evolve. Some vendors position their products for specific markets, and offer support for some configurations but not others. We'll look at what's required to support hardware and software fully and examine the issues of manufacturer support.

There's a wide range of utilities specific to Windows that help automate some of the critically important periodic maintenance items. We'll look at what problems these tools can solve and what you need to do to be ready for disasters beyond their reach.

What about future upgrades?

Knowing the relative costs and benefits of upgrade options can help you make new equipment choices that extend the equipment's operating life. Choosing technologies and components that allow low-cost, high-payoff upgrades later requires some thought, but can help you use minor upgrades to put off the next major upgrade for years. We'll configure several sample systems and look at what the options and costs are for future increased capability.

For example, the Universal Serial Bus (USB) can interface many different types of equipment to your computer. You can connect disks, CD-ROMs, scanners, cameras, speakers, and networks to a USB port without adding new cards inside the computer. If you'll be hooking in network, modem, videoconferencing, and sound cards later, saving slots (the places you put cards in a computer) like this can be critical. Choosing whether to upgrade with USB 1.1 or USB 2.0 becomes an important decision because some applications won't run with the older USB 1.1 hardware.

The organization of this book follows the ideas above. We'll start by discussing ways to understand how you use your computer and how much work you make it do. A look at your operating system and what it can do for you helps you expand your understanding of what you need from your computer. We'll take a computer apart after that, looking at all the pieces inside to understand what they do. We'll examine the features and characteristics of each element,

learning to read manufacturers' descriptions with an eye to making smart decisions. We'll look at how to decide what components can be upgraded to solve performance problems, and make comparisons among competing upgrades. We'll use the same ideas to decide when a completely new computer is the right idea. Finally, we'll look at how to evaluate the growth left in a computer and how to get the most out of what you have.

Basic Techniques

You have to do a few things right if you're going to work on computer hardware effectively. Here they are:

- **Control static electricity.** You absolutely have to control static electricity (also called *electrostatic discharge*, or *ESD*). Voltages you can't see or feel can kill the chips in your computer.
- **Follow careful, well-defined procedures.** You get nowhere ripping hardware or software apart and making random changes hoping something will work. You have to have a carefully thought-through sequence in mind. You'll want to change only one thing at a time (and test the result) so you can isolate what causes different results.
- **Use the proper tools.** We're as guilty as anyone of using vise grip pliers as a universal tool, but that's not the right way to go about working on computer hardware. The parts are relatively small and fragile, so you must have tools appropriate to the job.

Static electricity

The hundreds of millions of transistors inside the chips in your computer are fantastically small. Although the small size of the transistors makes the speed and functionality those chips offer possible, that same small size reduces the voltage the transistors can withstand. Here's a typical warning about the maximum ratings on chips:

> Operating the device beyond the "Absolute Maximum Ratings" may cause permanent damage. Exposure to stress beyond the "Operating Conditions" limits specified for the device may affect reliability.

Typical signal and power level operating conditions for the largest chips in new computers are no more than 3 volts, down from the 3.3 volts and 5 volts used just a few years ago. You can't feel static electricity at much below 30 volts, and you can easily generate thousands of volts without intending to. The absolute maximum voltage rating for most chips is 6.5 volts; some are even less. Because you're not likely to feel less than 30 volts, you can destroy a chip without even feeling a tingle. What's worse is that you can weaken a chip (priming it to fail a little later), damaging it just short of complete failure. Ultimately, your feet scuffing on the ground, clothes rubbing on you, and a multitude of other small things can generate the ammunition that kills a chip.

Here's the no-compromises plan to prevent static electricity problems:

- **Ground everything, including you.** It's not enough to simply touch a piece of metal — static electricity can build back up simply from your moving as you work. The best way to prevent a static electricity discharge is to not let any charge build up to begin with. Grounding everything — connecting you, your tools, and the equipment to a good ground — takes care of this. A proper anti-static workstation includes not only a grounded workbench, but also a ground mat, a grounded wrist strap (which fastens securely around your wrist), and foot straps. Grounds should connect through an unbroken wire to a secure cold-water ground. (Be sure the pipe into the ground is an unbroken length of metal, with no plastic sections.) If you're going all out, consider grounded tools and a humidifier. Increased water in the air helps static charges bleed off.
- **Avoid materials that build up static charges.** Workbench tops should be a conductive, anti-static material. Under no circumstances should you work on a plastic, vinyl, carpeted, cloth-covered, finished, or waxed surface. Parts should be stored in plastic bins or bags made of conductive, anti-static material. Check bins and bags for extraneous material that could cause static buildup.
- **Floors should be conductive tile.** Avoid vinyl, carpet, finished wood, sealed or dusty concrete, and floor wax. You can get carpet spray to minimize static buildup, but it's not really the right answer.

  You'll also want to keep static-building material out of your work area. This includes most plastics, nylon, polyethylene, Styrofoam, vinyl notebooks, cellophane, and adhesive tape. Clothing often includes static-building material, so your best bet is to wear a conductive smock.
- **Avoid other people.** Onlookers are inevitable, but without their own anti-static protection, they can destroy in a second what you've worked to protect. Keep people without appropriate anti-static protection at least 3 feet away from the work area so they can't touch anything.

Obviously, you can work in a less protected environment, and realistically, a work area like that is more than most homes and offices can afford. Many service centers, operations that *should* take careful precautions, do with less protection than we've recommended above. Simplifying the protections increases your risk, especially in a dry atmosphere, so we'll cover what you should do for sufficient protection with minimum fuss.

Tools

Almost everything you need to do to a personal computer can be done with just a few simple tools, such as screwdrivers, socket drivers, and pliers. You'll need some more-sophisticated tools if you're making cables. (Of course, if you're making cables, you might need to have your head examined. Making

cables takes lots of time, saves very little money — if any, and may actually cost more — and is one of the most error-prone assembly jobs there are. If we had a dollar for every screwed-up cable we've had foisted on us. . . .)

- **Screwdrivers —** You'll need both slotted and Phillips screwdrivers. You'll want a range of sizes from small to medium.
- **Socket drivers —** Many of the screws used in personal computers have heads that fit hex drivers, which lets you avoid stripped heads and makes it less likely that you'll drop the screw where it doesn't belong. The most common sizes are 3/16, 7/32, and 1/4 inch. We've seen Torx heads on screws in a few computers, but only rarely.
- **Pliers —** The ones we use the most are a pair of very long needle-nose pliers. They won't exert much force, but they'll handle small parts and get into tight places.
- **Flashlight —** You'll want one of the compact, halogen bulb flashlights so you can get a lot of light in a small place. One you can make stay put in small places is even better.
- **Mirror —** You can't always see what you need to directly. A small mirror on a long handle can solve a lot of problems that otherwise require you to disassemble more than necessary.
- **Multimeter —** Some failures are best diagnosed with a multimeter. We have a portable one from Heath we bought many years ago, but you can get multimeters anywhere. You don't need extreme accuracy (which is expensive), but you'll want to look for one that's durable. They have a habit of falling off workbenches and other places.
- **Soldering iron —** If you know what you're doing to the point where you want to be able to repair connectors or remove and replace components from circuit cards, you'll need a soldering iron. Not a soldering gun, and not the sort of iron Grandpa used to make tin cans with. If you're working on circuit card components, you want a grounded, temperature-regulated unit that protects components from overheating and static electricity. If the cost of one of those seems too high, think twice about whether you can afford to be without one, and think three times about why you need to be soldering on a circuit board at all.

You'll find most of these tools, if not all, in a compact tool kit for PC service. They're sold by a lot of companies. You don't need the super-spiffy giant size. Look for good quality tools, however — junk is too frustrating to bother with.

As important as these tools are, the most important tools you'll have are your eyes and ears, and some programs you'll keep on disk. You provide the eyes and ears; we'll cover some of the programs later in the book.

Summary

- ✦ This book can help you decide on the computer configuration or upgrade that is best for you.
- ✦ The computer that's best for you depends on what you do with it.
- ✦ The computer you need may be the one you already own after some upgrades.
- ✦ Understanding what's in computer hardware gives you the tools to choose upgrades or a new computer to meet your needs and budget.
- ✦ You can simplify support and maintenance and reduce your future computer costs by choosing hardware effectively now.