Chapter 1: What's Different About a Gaming PC?

In This Chapter

- **Understanding the gamer's primary needs**
- **Determining which version of Windows to use**
- **Discovering other internal performance upgrades**
- **Answering questions about overclocking**

Hardcore PC gamers are demanding, impatient, and sometimes downright nitpicky. And those are often their *good* qualities. (I should know, I'm one myself.)

Even with our faults, however, you have to admit that we love immersing ourselves in The Game, whether it be the latest first-person slugfest, a multiplayer online role-playing game, or a thoughtful attempt to conquer any one of a thousand different worlds through stealth and strategy. If you'd like to join us, it's a great time to be a gamer!

Ah, but here's the catch: You've gotta have the right hardware to play with the big boys and girls at the highest resolutions and the fastest speeds. Gamers push their PCs to the limits because the most popular games typically demand it — if you've got a slower PC with stuttering graphics or a lousy Internet connection, you're already at a disadvantage.

In this chapter, I present the state of PC gaming hardware today, and what to look for when buying (or building) your own gaming monster machine!

But First, the Gamer Disclaimer

I know — catchy, right? More than any other chapter in this entire tome, the words that follow require a disclaimer. To wit: the gaming performance bar is raised practically *every month* with the introduction of all sorts of faster PC hardware (especially graphics cards). In the time it takes to publish and distribute a print book like this one, the CPU or graphics card that's the darling of the gaming community today will almost certainly be mediocre,

old-school equipment! Such is the nature of power-hungry, cutting-edge PC games and the computer hardware required to play them at the highest possible quality levels.

Therefore, I won't make any specific (and soon-to-be-outdated) hardware recommendations in this chapter. Instead, I provide more general information in the form of tips and feature lists that you can use to shop around for the Latest and Greatest when you're ready to build or buy.

Introducing the Big Three

Where do you start when shopping or planning a rock-solid gaming machine? Sure, there's the flashy case with the lights — which really count as nothing but eye candy — and the hefty price tag, but the *real* brawn behind any high-performance PC depends on what I like to call the Big Three: your CPU, system memory, and graphics card. These are the foundations of good gaming hardware, and they're hidden in the innards of your computer.

I discuss all three of these PC components in general detail in Book VII, and the recommendations I make there still apply to a gaming PC — however, in this chapter, speed is everything (and prices are typically sky-high). Here, I concentrate on keeping your PC running fast enough to play the latest games. Let's dig in, shall we?

Your PC's processor

As you probably already know, your PC's CPU processes data according to the instructions provided by a program — in our case, a game or Windows itself — and it also sends commands and data to the various peripherals in your system. But why are games so demanding on your CPU? Consider the work involved in running a popular 3D first-person shooting game such as Crysis 3, where the processor in your gaming computer must handle all of these chores:

- **Artificial intelligence:** Your PC must react to your movements, calculate the appropriate strategy, and manipulate the computer players (which are becoming more and more sophisticated with every passing year).
- **Level control:** Your PC must calculate the appearance of both your character and your surroundings for your current position on the game level. Plus, your computer must process the results when your character interacts with traps, switches, doors, and their corresponding keys.

- **Calculations and events:** Your PC must calculate the path of your last missile launch, determine whether it hit its target, and alter the statistics of the target where appropriate.
- **Multiplayer support:** If you're participating in a multiplayer match or a multiplayer online world, your PC must send and receive data packets across the network (whether it's a local network or the Internet) from other computers and incorporate other players into your environment. In today's games, that may also include voice chatting between players as the fight continues!

Oh, and meanwhile your PC must still keep Windows running smoothly, as well as any other background tasks you're using. No wonder your CPU needs its own cooling system! Of course, your graphics card relieves your CPU from the lion's share of the low-level graphic calculations necessary for 3D gaming, but your CPU's performance still determines what types of games you can play. (In other words, even the fastest graphics card won't help you play a game with computing requirements that swamp your CPU.) Therefore, when you're building or buying a new gaming PC from scratch, the processor you select is a hugely important decision.

While shopping, consider a balance between the number of cores (in multicore processors like the AMD FX and Intel i7) and the processor's overall speed. I would definitely recommend at least a four-core processor, but there's typically not much need for additional cores after that in a gaming PC — instead, *concentrate on getting the highest processor speed you can afford* with four cores.

On-board cache memory is also important for the gamer's CPU because it's the fastest memory available on your PC. It acts as a temporary "waiting room" for data that your CPU is likely to need in the near future; some CPUs also use it to store data that has recently been accessed, so that it can be recalled again without reloading it from your hard drive or system RAM. The more cache you have, the better. It's also better to use *on-board* cache memory, which is actually built into the CPU itself; all current processors offer some amount of on-board cache.

Your PC's memory

Next up in our gamer's hardware Big Three list? It's our old friend RAM! Yep, I've already been harping on the importance of PC system memory throughout earlier chapters in this book, but a gaming PC with less than 8GB of RAM is doomed to slower performance with the latest titles.

And not just any RAM will do for a high-performance PC, either. Although most PC owners tend to think that "all memory is created equal," that's not the case with a gaming PC. At the time of this writing (and for at least the near future), your PC (or the motherboard you purchase, if you're assembling yourself) should use the fastest supported DDR3 memory your hardware can handle. Those memory modules should also be equipped with cooling fins or plates. (Yep, bunkie, you read that right. The memory a gamer demands can run so hot that — like your CPU — it needs additional cooling in order to avoid data errors!)

Now comes what folks my age still call the "64 thousand dollar question" — how much memory is necessary for a gaming PC? As I've already said, a minimum of 8GB is preferred, but as for a maximum, the sky (or, in this case, the motherboard) is the limit! As I discussed earlier in this book, the more memory you can afford to add to your motherboard, the faster everything runs (and that includes Windows and the other applications you run because most gamers use their hugely expensive toys for their other computing needs as well). Therefore, 16 to 32GB of system RAM is a zone I feel comfortable in recommending. (Personally, 64GB is out of the range of my wallet.)

Your PC's graphics card

The third element in any great gaming PC is the graphics card — in fact, most of my friends would revoke my membership in the hard-core gaming community if I didn't say graphics *cards* (in the plural) because most of the current crop of cards are designed to link together to provide even faster frame rates and detail.

And that, friends and neighbors, is what it's all about: Today's games provide 3D realism, Photoshop-quality visual effects, and a level of display complexity that would have been absolutely unthinkable a mere five years ago. (Of course, I was saying the same thing five years ago as well.) However, your PC must be able to deliver those details at an acceptable *frame rate* (that's the number of times the game can update the image you see, expressed as *frames per second* or *FPS*). If the frame rate is too low, the fluid motion you expect from the game slows to a jerky crawl. Today's PC games require at least 30 FPS (some can accommodate frame rates of over 100 FPS), and you can achieve that minimum 30 FPS in one of two ways:

- **Provide the performance.** If your PC's graphics hardware is up to the task, you can enjoy every detail and every 3D effect at the full settings, and at the full resolutions supported by today's high-definition monitors.

- **Turn stuff off.** If your graphics *aren't* fast enough for today's games, you'll have to disable details and 3D effects in order to reach that 30 FPS mark, significantly reducing the experience. You may also have to reduce the resolution of your system while you play. (In layman's terms, your game certainly won't look like it did on the back of the box.)

No need for speculation upon which option a hard-core gamer will choose.

Today's graphics cards carry their own on-board processors (called GPUs, short for *graphics processing units*), so don't be confused if I seem to be talking about more than one processor in this chapter. I am: the CPU, which resides on your motherboard, and the GPU, which resides on your motherboard (for integrated graphics hardware) or on a PCI adapter card (for a dedicated graphics card).

The truth about your built-in graphics hardware

Today's motherboards are equipped with built-in graphics hardware (although there should definitely be at least one dedicated graphics slot still available for you to use), and I'm often asked if a potential PC gamer can't save a little money and use the integrated graphics card rather than spend the money on an expensive PCI Express 3.0 card. The answer is a big "maybe" — everything hinges on the type of games you'd like to play. In general, integrated graphics hardware includes a cheaper GPU that's typically at least a generation old — if you're planning on playing older games or titles with less-demanding effects and lower resolutions (perhaps Civilization IV or something similar), your PC's integrated hardware should be able to deliver the goods.

However, a dedicated graphics card offers two advantages that will greatly enhance cutting-edge games: a whopping amount of on-board memory and a fan that will significantly reduce the heat generated by the card (especially if you've decided to overclock your graphics hardware). Without these extras, your integrated graphics hardware will almost certainly be unable to deliver higher frame rates within the most demanding games, and you'll be forced to skimp on detail, resolution, and effects.

Here's the recommendation that I give most often: You have nothing to lose if you try your built-in graphics hardware with the games you buy, so go ahead and put your PC through its paces with the integrated card. However, if you're disappointed with the results, start saving for that new PCI Express 3.0 x16 graphics card right now! (And don't forget, future requirements for new titles will only get more demanding, so your integrated hardware is eventually doomed to obsolescence anyway.)

With the latest features in mind (as of this writing), here's what to look for when shopping for high-end video cards from AMD and NVIDIA:

- **DirectX 11 support.** Games running on Windows Vista, 7, and 8 can use Microsoft's DirectX 11 graphics software to provide the most complex and detailed effects currently available on a PC. Any card you're considering should support DirectX 11.
- **A minimum of 1GB of on-board memory.** Most of the current crop of cards carry either 1 or 2GB of RAM on the card — this is dedicated graphics memory, so it's separate from your PC's system RAM.
- **A minimum of one on-board fan.** Again, adequate cooling is an absolute necessity for a high-performance gaming graphics card.
- **PCI Express 3.0 x16 connector.** Today's fastest graphics cards use a PCI Express 3.0 x16 slot on your motherboard. If you're unsure what type of card slots are available on your PC, check your user manual (or your motherboard's manual).
- **Support for linking cards.** Cards with NVIDIA processors can use SLI, while AMD cards offer CrossFireX — both technologies involve linking multiple cards together using cables. (Note that the cards must use the same brand of GPU, so choose the cards carefully and make sure that they are compatible — many gamers choose two of the same cards. Naturally, your motherboard also needs more than one dedicated graphics card slot.)
- **HDMI and DVI ports.** Cards with both DVI and HDMI ports can connect to a wide range of monitors and HD TVs.

Pay close attention to graphic benchmark results while shopping for a new PC, motherboard, or graphics card. Like most of the gaming community, I use 3DMark 11 benchmark software from Futuremark (`www.3dmark.com`) when comparing specific cards. Hardware review sites like Tom's Hardware (`www.tomshardware.com`) are a great resource when shopping, and it always helps to be able to benchmark your current graphics hardware as a starting point.

What Version of Windows Is Best for Gaming?

This is a question that crops up often in Internet gaming forums, and those discussions can get heated! Typically, the argument involves two camps, each of which offers a number of advantages they see as essential:

- **The latest and greatest:** Some gamers maintain that the latest version of Windows is always the best choice for a gaming PC because Microsoft typically adds support for the latest graphics cards, game controllers, and the like, as well as the latest version of DirectX. In the case of Windows 8, the operating system also boots and shuts down significantly faster.
- **The previous version of Windows:** Naturally, gamers can't hang on to a specific older version of Windows indefinitely — for example, a number of the latest games won't run on Windows XP — but many gamers insist that previous versions of Windows require less system RAM and provide better performance on a new gaming PC. They also point out that game patches and updates may not be available or adequately tested for older titles running on the latest version of Windows. (I've encountered this problem myself with games that were produced while Windows XP was current.)

At the time of this writing, this debate rests squarely between Windows 7 and Windows 8 because Windows Vista has been dropped from future DirectX support. Windows XP (although a dependable workhorse otherwise) shouldn't be considered at all for a gaming PC.

Which should you choose? The way I see it, personal preference is king — at the time of this writing, there are no games that demand Windows 8 as a requirement, so if you're comfortable running Windows 7, you should have a clear gaming horizon for some time to come.

Other Gaming Hardware that Pushes Performance

Now that you're familiar with the three most important components in any gaming PC, it's time to cover Mark's Additional Gaming Hardware — you're not quite done yet! Although these features may not be absolute requirements for a well-rounded gaming PC, you shouldn't forget them while comparison shopping, so add them to your list as well.

Don't forget that these components are all located *inside* your PC's case — I'll be discussing external gaming hardware in Chapter 2 of this minibook.

Fast hard drives

Gamers often get so wrapped up in the exotic that they forget about the mundane. For example, I've talked to dozens of fellow gamers who wax enthusiastic about their "incredibly-fast, state-of-the-art, high-end, unbelievably-expensive" graphics cards — and yet, when I ask what type of hard drive they're using in their PC, they can't even name the brand.

Sure, the graphics cards in a gaming PC are very important, but the speed of your hard drive subsystem is also important in determining your final score against Dr. Destructive and the Legion of Inter-dimensional Monstrosities. Plus, if you have a fast hard drive, that game (and Windows, and your other applications) will load much, *much* faster, which is probably just as beneficial for your gaming well-being, at least in the long run.

There are three storage features you should add to your shopping list while evaluating a gaming system (or a bare-bones hard drive, if you're building):

- **RPM:** The faster the rotation, the faster the data transfer — I recommend a minimum of 7,200 RPM, but I use a 10,000 RPM drive on my gaming PC, and there are a number of (quite expensive) 15,000 RPM drives on the market.
- **Cache:** Look for a drive with a minimum of 16MB of cache memory (the larger the cache, the more data your drive can accept while reading and writing data, and the faster your transfer rates).
- **Interface:** Today's fastest consumer drives run on SAS or SATA connections at 3.0 or 6.0Gb/second (the interface your PC can accept depends on what the motherboard supports, of course, but if you're shopping for components, this information can come in handy).

Today's gamers can also choose from SSD (*solid-state* drives) and *hybrid* drives (which offer solid-state storage and magnetic storage in the same drive). Typically, solid-state drives do not perform as well as magnetic hard drives while gaming, but hybrid drives (although expensive) are well-suited to a gaming PC.

External ports

Now consider the external connections you may need to make with your gaming PC: backup drives, media devices like digital cameras and camcorders, smartphones, and an ever-growing list of digital hangers-on that surround your system like an entourage around a movie star.

Although the fastest external connection available for PCs today is Intel's Thunderbolt port, there aren't yet many motherboards (or consumer systems) that support Thunderbolt (and the peripherals that are currently on the market are hideously expensive). In the next couple of years, however, I predict that Thunderbolt will become the gamer's connection of choice for external hard drives and multiple high-resolution monitors on one PC. If you can afford a gaming PC with Thunderbolt ports (or a motherboard that offers them), spending that money is an investment in the future.

At the time of this writing, the primary ports of choice are

- **USB 3.0:** Considerably faster than USB 2.0 ports, but still backwards-compatible (so you can use all those USB 2.0 gaming controllers, mice, and keyboards you already have).
- **eSATA:** eSATA ports are an excellent choice for an external backup drive, or an external drive array that includes multiple drives.

Sound hardware

Here's an item that you may very well be able to skip! Why? Luckily, today's motherboards typically include excellent integrated 3D-capable sound hardware, complete with support for 5.1 (six-channel) or 7.1 (eight-channel) surround sound. For example, my gaming PC's motherboard already included excellent built-in RealTek 7.1 sound hardware, complete with software mixer and all sorts of effects. I often use the card's 3D spatial audio with those games that support this feature.

If you do need to shop for a sound card, a 24-bit, 96KHz PCI sound card with 7.1 surround sound support should set you back no more than $40 or so.

Oh, and unlike the integrated graphics hardware found on a motherboard, you won't be overclocking your sound hardware! (More on overclocking in the next section.)

Heavy-duty cooling

I can't stress enough the importance of *powerful* cooling for your gaming PC — and that includes

- Multiple fans for the case itself
- A CPU-mounted fan
- A GPU-mounted fan on your graphics card

If you're buying an assembled gaming PC, make sure that the manufacturer has provided your case with a strong steady airflow from front to back (and perhaps even back to top, as with my Antec case, which features a saucer-sized fan on top of the case as well as two fans in front and two in back). If you're shopping for a bare case, airflow is a top priority, so ensure that the case you buy is made especially for gaming (and that it comes with the fans, or they're preinstalled for you).

You may have also heard bizarre tales of liquid-cooled gaming PCs — let me tell you that those aren't fairy tales, and that liquid-cooled gaming *does* indeed exist on Planet Earth! Liquid-cooled systems are generally favored by those gamers who are overclocking their PCs to exceptional levels because

these cooling units can quickly dissipate far more heat than a standard fan/heatsink combo. Today's liquid-cooling systems are far easier to install than those of three or four years ago, and the prices have dropped on these units dramatically as well. (For examples of liquid cooling units, visit `www.corsair.com` and check out the Hydro series of liquid CPU coolers.)

Should I Overclock My Processors?

Remember those custom hot rods and muscle cars of the 50s, 60s and 70s? Before the days of the sport utility vehicle, kids dreamed about adding huge superchargers and heavy transmissions to a sports car to make it a true hot rod. Sure, building a hot rod was more expensive than buying a typical car, but the raw power and speed of a souped-up Mustang, Camaro, or Javelin made it worthwhile. Unfortunately, most hot rods didn't last as long as a typical car, either — the high RPM and all that street racing took its toll on the car.

In a similar fashion, today's gamers often turn a typical CPU or GPU into a hot rod processor . . . but instead of adding a supercharger, they use a technique called *overclocking* to make a processor work harder and faster. Instead of adding high-performance parts, overclocking involves changing the bus speed and/or the clock multiplier on your motherboard or graphics hardware — although your CPU or GPU remains the same physically, it's running at a faster frequency (and therefore executing more instructions in the same time frame because a faster frequency means more instruction cycles per second).

Overclocking can be a complicated process, and it rarely provides a trouble-free boost the first time you try it. Although there are downsides to overclocking (which I list in a second), you'll find plenty of tutorials and articles on the web that will guide you through the process. You can locate these articles by simply searching for the word "overclocking" followed by your model of CPU or GPU on a search engine such as Google or Bing. Freeware and shareware overclocking software is also available for just about any processor.

Here's my honest opinion on overclocking . . . I personally don't recommend that you try it unless you know what you're doing, and your CPU or GPU is simply no longer fast enough to handle the games you want to play. (Overclocking is certainly cheaper than buying a new, faster PC!) Before you decide, here's a list of the important reasons why you should carefully consider the decision to overclock your CPU or GPU:

- **Your hardware must support overclocking.** Some CPU/motherboard and GPU/graphics card combinations are far more suitable for overclocking than others — if your hardware doesn't support overclocking (and it's not something that's generally mentioned in a PC user's manual), there is a risk of damaging your hardware. If overclocking isn't mentioned in your motherboard (or PC) user manual, you may find overclocking help on the Internet by searching for the model number of your motherboard or PC.
- **Overclocking usually voids a manufacturer's warranty.** If you do decide to overclock, you may be voiding the warranty from your PC's manufacturer. (This also applies to the manufacturer of your motherboard, CPU, and graphics card.)
- **Overclocking *will* shorten the life of your CPU/GPU.** Due to the effects of heat on the structure of today's chips, even processors running at their rated speed eventually degrade — this process takes many years, so it's not normally a concern. However, the extra heat produced by overclocking a processor automatically shortens its operational life. (Those who overclock are usually aware of this, but they argue that the rate of processor development will make any processor obsolete in three or four years anyway.)

Because of this ever-present danger from heat damage, smart PC owners who *do* overclock invariably invest in the best possible fans and cooling systems for their processors. Without such heavy-duty cooling, overclocking a processor will quickly destroy it.

- **Overclocking can produce lockups and errors:** This makes sense — if you're pushing hardware beyond its design specifications, you're going to introduce problems if your overclocking configuration isn't exactly right. Overclocking usually involves a long process of tweaking your processor's frequency to achieve the most trouble-free operation — but even with the best settings, you're likely to experience occasional lockups. (An overclocking PC gamer accepts this as part of the deal.)