Introduction

Welcome to *Upgrading and Repairing PCs, 18th Edition*. Since debuting as the first book of its kind on the market in 1988, no other book on PC hardware has matched the depth and quality of the information found in this tome. The 18th edition continues *Upgrading and Repairing PCs*' role as not only the best-selling book of its type, but also the most comprehensive and complete PC hardware reference available. This book examines PCs in depth, outlines the differences among them, and presents options for configuring each system.

More than just a minor revision, the 18th edition of *Upgrading and Repairing PCs* contains hundreds of pages of new, revised, and reworked content. The PC industry is moving faster than ever, and this book is the most accurate, complete, in-depth, and up-to-date book of its kind on the market today.

I wrote this book for people who want to know everything about their PCs. How they got started; how they've evolved; how to upgrade, troubleshoot, and repair them; and everything in between. This book is for all those professionals and PC enthusiasts who want to know everything about PC hardware. This book covers the full gamut of PC-compatible systems from the oldest 8-bit machines to the latest in high-end 64-bit quad-core processor systems. If you need to know about everything from the original PC to the latest in PC technology on the market today, this book and the accompanying information-packed disc is definitely for you.

This book covers state-of-the-art hardware and accessories that make the most modern personal computers easier, faster, and more productive to use. Inside these pages you will find in-depth coverage of every PC processor from the original 8088 to the latest quad-core processors from Intel and AMD.

Upgrading and Repairing PCs also doesn't ignore the less glamorous PC components. Every part of your PC plays a critical role in its stability and performance. Over the course of this book's 1,600+ pages, you'll find out exactly why your motherboard's chipset might just be the most important part of your PC and what can go wrong when you settle for a run-of-the-mill power supply that can't get enough juice to that monster processor you just bought. You'll also find in-depth coverage of technologies such as new processors, chipsets, graphics, audio cards, PCI Express 2.x, HD DVD and Blu-ray drives, Serial ATA, USB, and FireWire, and more—it's all in here, right down to the guts-level analysis of your mouse and keyboard.

New in the 18th Edition

Many of you who are reading this have purchased one or more of the previous editions. Based on your letters, emails, and other correspondence, I know that, as much as you value each new edition, you want to know what new information I'm bringing you. So, here is a short list of the major improvements to this edition:

- A completely updated look at the newest processor families from Intel and AMD as well as the chipsets and motherboards that support them. Dual- and quad-core processors are the latest rage, and their impact on our collective computing experiences is not to be underestimated.

- A detailed look at how chipsets and motherboards are evolving, especially with regard to PCI Express. We also examine how the type of bus interconnect technologies implemented for a chipset and CPU affect your entire system's performance.

■ The landscape of the graphics card market continues to evolve as quickly as any in the PC industry. In this edition, the latest GPU and graphics chipsets are profiled, with an especially watchful eye on the latest developments in using two graphics cards to double your system's video performance using technologies such as NVIDIA's SLI and ATI's Crossfire.

■ With all the power today's PC hardware craves, the venerable PC power supply of yesterday is no longer up to the task of keeping every power-hungry component well fed. Given that, the power supply chapter has been extensively revised to include new information on power use calculations, and how to save power (and money) using ACPI suspend modes.

■ As always, we have new, high-quality technical illustrations. Every year we add, modify, and generally improve on the hundreds of figures in this book. These new and revised illustrations provide more technical detail, helping you understand difficult topics or showing you exactly how to complete a task.

■ Just like last year, you'll find a DVD-ROM plastered to the inside back cover of this book. On it you'll find all the usual standbys, such as the Technical Reference and complete electronic versions of prior editions. Rather than recycle the same video clips from edition to edition as many of my competitors do, I've once again included new video clips for this edition. For this edition, there are two hours of video on home networking components and technologies.

As with every edition, I've done as much research and homework as humanly possible to ensure that this volume is the most consistent and up-do-date text on PC hardware you're going to find in a book.

Book Objectives

Upgrading and Repairing PCs focuses on several objectives. The primary objective is to help you learn how to maintain, upgrade, and repair your PC system. To that end, *Upgrading and Repairing PCs* helps you fully understand the family of computers that has grown from the original IBM PC, including all PC-compatible systems. This book discusses all areas of system improvement, such as motherboards, processors, memory, and even case and power-supply improvements. The book discusses proper system and component care, specifies the most failure-prone items in various PC systems, and tells you how to locate and identify a failing component. You'll learn about powerful diagnostics hardware and software that enable a system to help you determine the cause of a problem and how to repair it.

PCs are moving forward rapidly in power and capabilities. Processor performance increases with every new chip design. *Upgrading and Repairing PCs* helps you gain an understanding of all the processors used in PC-compatible computer systems.

This book covers the important differences between major system architectures from the original Industry Standard Architecture (ISA) to the latest PCI Express interface standards. *Upgrading and Repairing PCs* covers each of these system architectures and their adapter boards to help you make decisions about which type of system you want to buy in the future and to help you upgrade and troubleshoot such systems.

The amount of storage space available to modern PCs is increasing geometrically. *Upgrading and Repairing PCs* covers storage options ranging from larger, faster hard drives to state-of-the-art storage devices.

When you finish reading this book, you should have the knowledge to upgrade, troubleshoot, and repair almost any system and component.

Is This Book for You?

If you want to know more about PCs, then this book is most definitely for you! *Upgrading and Repairing PCs* is designed for people who want a thorough understanding of PC hardware and how their PC systems work. Each section fully explains common and not-so-common problems, what causes problems, and how to handle problems when they arise. You will gain, for example, an understanding of disk configuration and interfacing that can improve your diagnostics and troubleshooting skills. You'll develop a feel for what goes on in a system so you can rely on your own judgment and observations and not some table of canned troubleshooting steps.

Upgrading and Repairing PCs is written for people who will select, install, configure, maintain, and repair systems they or their companies use. To accomplish these tasks, you need a level of knowledge much higher than that of an average system user. You must know exactly which tool to use for a task and how to use the tool correctly. This book can help you achieve this level of knowledge.

Over the years I have taught millions of people to upgrade and build PCs. Some of my students are computer experts, and some are computer novices. But they all have one thing in common: They believe this book has changed their lives.

Chapter-by-Chapter Breakdown

This book is organized into chapters that cover the components of a PC system. A few chapters serve to introduce or expand in an area not specifically component related, but most parts in the PC have a dedicated chapter or section, which will aid you in finding the information you want. Also note that the index has been improved greatly over previous editions, which will further aid in finding information in a book of this size.

Chapters 1 and 2 of this book serve primarily as an introduction. Chapter 1, "Development of the PC," begins with an introduction to the development of the original IBM PC and PC-compatibles. This chapter incorporates some of the historical events that led to the development of the microprocessor and the PC. Chapter 2, "PC Components, Features, and System Design," provides information about the various types of systems you encounter and what separates one type of system from another, including the types of system buses that differentiate systems. Chapter 2 also provides an overview of the types of PC systems that help build a foundation of knowledge essential for the remainder of the book, and it offers some insight as to how the PC market is driven and where components and technologies are sourced.

Chapter 3, "Microprocessor Types and Specifications," includes detailed coverage of processors from Intel and AMD. Because the processor is one of the most important parts of a PC, this book features more extensive and updated processor coverage than ever before. I dig deeply into the latest processors and the latest socket types designed to interface with them.

Chapter 4, "Motherboards and Buses," covers the motherboard, chipsets, motherboard components, and system buses in detail. This chapter contains discussions of motherboard form factors, including specifications on everything from Baby-AT to the various ATX, BTX and related standards. A chipset can either make a good PC better or choke the life out of an otherwise high-speed CPU. I cover the latest chipsets for current processor families, including chipsets from Intel, AMD, VIA, NVIDIA, SiS, ALi, and more. This chapter also covers special bus architectures and devices, such as high-speed Peripheral Component Interconnect (PCI), including PCI Express. Everything from the specifications of the latest chipsets to the proper spacing of holes on industry standard form factor motherboards can be found here.

Chapter 5, "BIOS," contains a detailed discussion of the system BIOS, including types, features, and upgrades. Also included is updated coverage of the BIOS setup and flash-upgradeable BIOSs. There is also an exhaustive list of BIOS codes and error messages.

Chapter 6, "Memory," provides a detailed discussion of PC memory, including the latest in cache and main memory specifications. Next to the processor and motherboard, system memory is one of the most important parts of a PC. It's also one of the most difficult things to understand because it is somewhat intangible and how it works is not always obvious. If you're confused about the difference between system memory and cache memory; L1 cache and L2 cache; external and integrated on-die L2 cache; SIMMs, DIMMs, and RIMMs; DDR SDRAM versus DDR2 and the new DDR3, this is the chapter that can answer your questions.

Chapter 7, "The ATA/IDE Interface," provides a detailed discussion of ATA/IDE, including types and specifications. This covers the faster parallel and serial ATA modes that allow 133MBps to 300MBps operation and why they might not increase your PC's performance much. There's also more new content on Serial ATA AHCI (Advanced Host Controller Interface) mode, which allows for additional SATA capabilities and performance.

Chapter 8, "Magnetic Storage Principles," details the inner workings of magnetic storage devices such as disk and tape drives. Regardless of whether you understood electromagnetism in high school science, this chapter breaks down these difficult concepts and presents them in a way that will change the way you think about data and drives.

Chapter 9, "Hard Disk Storage," breaks down how data is stored to your drives and how it is retrieved when you double-click a file.

Chapter 10, "Removable Storage," covers every type of removable storage drive you're likely to see used on a system, both young and old. From floppies to Zip disks to flash memory drives and magnetic tape drives, it's all here.

Chapter 11, "Optical Storage," covers optical drives and storage using CD and DVD technology, including rewritable CD and DVD discs as well as the latest HD DVD and Blu-ray technology.

Chapter 12, "Physical Drive Installation and Configuration," covers how to install drives of all types in a PC system. You learn how to format and partition hard drives after they are installed.

Chapter 13, "Video Hardware," covers everything there is to know about video cards and displays. Learn about how both CRT and flat-panel monitors work and which is best suited for you. If you're a gamer or multimedia buff, you'll want to read about choosing the right video card with the right chipset and amount of video memory to fill your needs.

Chapter 14, "Audio Hardware," covers sound and sound-related devices, including sound boards and speaker systems. Quality audio has become an increasingly important part of any good PC, and in this chapter I help you learn which features to look for in an audio card and which types of audio cards and chips are suited to your needs.

Chapter 15, "I/O Interfaces from Serial and Parallel to IEEE 1394 and USB," covers the standard serial and parallel ports still found in most systems, as well as newer technology such as USB and FireWire (IEEE 1394/i.LINK). I also cover the latest developments in USB 2.0, USB On-The-Go, wireless USB, and FireWire 800.

Chapter 16, "Input Devices," covers keyboards, pointing devices, and game ports used to communicate with a PC, including wireless peripherals that finally let you cut the cord without sacrificing responsiveness.

Chapter 17, "Internet Connectivity," compares your options for getting on the information super-highway using either low-speed dialup connections or the multiple high-speed connectivity methods that have come to the home desktop, including DSL, cable modems, and satellite.

Chapter 18, "Local Area Networking," covers setting up a wired or wireless Ethernet network in your home or small office. I show you how to install NICs, make your own Ethernet cables, and set up Windows networking services.

Chapter 19, "Power Supplies," is a detailed investigation of the power supply, which still remains the primary cause of PC system problems and failures. When you buy a new PC, this undervalued component is the one most likely to be skimped on, which helps explain why it's the source of so many problems often attributed to Windows, memory, and several other components. You'll also find detailed specifications on the power connectors found in systems from AT to ATX and BTX, including some nonstandard connectors that can cause problems. New information added covering power management can be used to save several times the cost of this book in just one year, by properly configuring your systems to use less power.

Chapter 20, "Building or Upgrading Systems," is where I show you how to select the parts you'll need for your upgrade or to build a PC from scratch. Then, I walk you step by step through the process. This chapter is loaded with professional photos that help you follow along.

Chapter 21, "PC Mods: Overclocking and Cooling," covers the technology that controls the speed of your system and how to safely run the system faster than the basic specifications call for (called *over-clocking*). A detailed examination of system cooling is also found here, from air cooling, to liquid cooling, and even refrigeration. The latest chassis upgrades to improve cooling are also discussed, and a simple modification is detailed that can dramatically improve the cooling in existing systems for less than $10.

Chapter 22, "PC Diagnostics, Testing, and Maintenance," covers diagnostic and testing tools and procedures. This chapter also adds more information on general PC troubleshooting and problem determination. Here, I show you what the prepared PC technician has in his toolkit. I also show you a few tools you might have never seen or used before.

The 18th Edition DVD-ROM

The 18th edition of *Upgrading and Repairing PCs* includes a DVD-ROM that contains nearly as much valuable content as you'll find in the pages of this book.

First, there's the all-new professional-grade video (the DVD will play in your standalone DVD player, too) with all-new segments covering the components and technology that will enable you to create a robust and secure home network including all of your systems.

There's also my venerable Technical Reference material, a PDF repository of material that has appeared in previous editions of *Upgrading and Repairing PCs* but has been moved to the disc to make room for coverage of newer technologies. The disc, combined with the printed content of the book, makes *Upgrading and Repairing PCs* far more than 2,000 pages long! Its contents include a detailed listing of BIOS codes and legacy coverage from earlier editions of the book. It's included on the disc in printable PDF format.

Two appendixes—Appendix A, "Glossary," and Appendix B, "List of Acronyms and Abbreviations"—are also included on the DVD.

Finally, there is also a full PDF version of a previous edition of *Upgrading and Repairing PCs*. All told, there's more PC hardware content and knowledge here than you're likely to find from any other single source.

My Website: upgradingandrepairingpcs.com

Don't forget about the www.upgradingandrepairingpcs.com website! Here, you'll find a cache of help-ful material to go along with the book you're holding. I've loaded this site with tons of material, from video clips to book content and technology updates. These articles are archived so you can refer to them anytime.

If you find that the video on this book's disc isn't enough, you'll find even more of my previously recorded videos on the website. Not to mention that it is the best place to look for information on all of Que's *Upgrading and Repairing* titles. In the last year, we've released *Upgrading and Repairing Servers,* and *Upgrading and Repairing Windows*, and *Upgrading and Repairing Networks 5th edition.* Check the www.upgradingandrepairingpcs.com website to see when new editions of my other books are coming out.

I also have a private forum (www.forum.scottmueller.com) designed exclusively to support those who have purchased my recent books and DVDs. I use the forum to answer questions and otherwise help my loyal readers. If you own one of my current books or DVDs, feel free to join in and post questions. I endeavor to answer each and every question personally, but I also encourage knowledgeable mem-bers to respond as well. Anybody can view the forum without registering, but to post a question of your own you will need to join. Even if you don't join in, the forum is a tremendous resource because you can still benefit from all of the reader questions I have answered over the years.

Be sure to check the upgradingandrepairingpcs.com website for more information on all my latest books, videos, articles, FAQs, and more!

A Personal Note

When asked which was his favorite Corvette, Dave McLellan, former manager of the Corvette plat-form at General Motors, always said, "Next year's model." Now with the new 18th edition, next year's model has just become this year's model, until *next* year that is….

I believe this book is absolutely the best book of its kind on the market, and that is due in large part to the extensive feedback I have received from both my seminar attendees and book readers. I am so grateful to everyone who has helped me with this book through each of its 18 editions, as well as all the loyal readers who have been using this book, many of you since the first edition was published. I have had personal contact with many thousands of you in the seminars I have been teaching since 1982, and I enjoy your comments and even your criticisms tremendously. Using this book in a teach-ing environment has been a major factor in its development. Some of you might be interested to know that I originally began writing this book in early 1985; back then it was self-published and used exclusively in my PC hardware seminars before being professionally published by Que in 1988.

In one way or another, I have been writing and rewriting this book for more than 20 years! In that time, *Upgrading and Repairing PCs* has proven to be not only the first but also the most comprehensive and yet approachable and easy-to-understand book of its kind. With the new 18th edition, it is even better than ever. Your comments, suggestions, and support have helped this book to become the best PC hardware book on the market. I look forward to hearing your comments after you see this exciting new edition.

Scott