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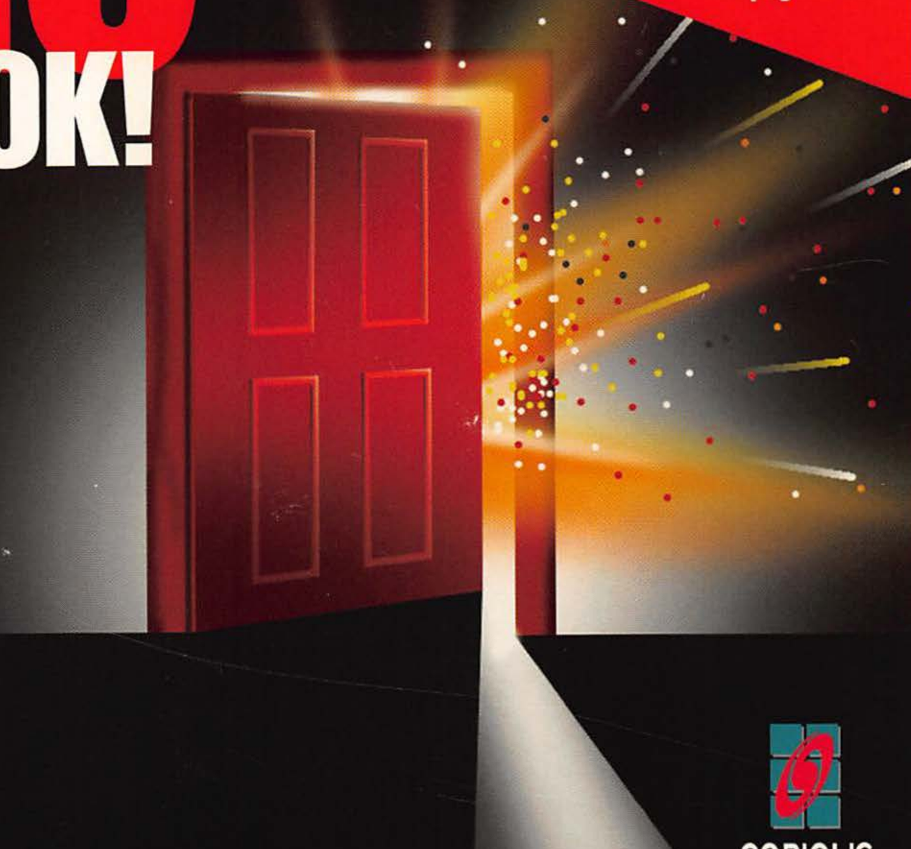

Your Essential Guide to Moving Up to the Power Mac

Ron Pronk

CORIOLIS GROUP BOOKS

The Power Mac Book! is the successor to Ron Pronk and Jeff Duntemann's bestselling Inside the PowerPC Revolution, the intriguing story of the development of the PowerPC technology used in Power Macintosh computers. Here's what the industry has been saying about Inside the PowerPC Revolution:

"This is one of the ten best computer books ever."
—Michael Swaine, contributing editor *MacUser*, editor-at-large *Dr. Dobb's Journal*

"This book gives a real insider perspective on Apple's push to PowerPC and what it means for the Macintosh user. It is a must-read for anyone wanting to make a smart transition to this exciting new technology."
—Andrew Lewis, President and CEO of DayStar Digital

"If, like me, you believe the PowerPC represents a watershed in personal computer development, then this is an important book to read. It presents in a breezy style more than you could possibly ever need to know about how the PowerPC is special and why."
—Robert X. Cringely, best-selling author of *Accidental Empires*

"The PowerPC is likely to cause a major upheaval in the world of desktop PCs. If you want to be prepared for these changes, you must read Inside the PowerPC Revolution. The authors' insight and provocative style produce a timely and hard-hitting book."
—Peter Aitken, best-selling computer book author

"Inside the PowerPC Revolution gave me a lot of insight into the battle between IBM, Apple, and Microsoft, and a lot of background on why the PowerPC came about."
—Nick Baran, Contributing Editor, *Byte Magazine*

"*Inside the PowerPC Revolution* reads like *Soul of a New Machine* meets *Inside Windows NT*."
—Vince Emery, former Marketing Director, Computer Literacy Bookshops

"Very informative and easy to read . . . goes a long way toward putting the PowerPC in an historical context . . . I felt like I was having a fireside chat with the authors. . . ."
—Nels Johnson, San Francisco Canyon Co., developers of QuickTime for Windows

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Publisher	Keith Weiskamp
Cover Design	Parkwest Graphics and Bradley Grannis
Interior Design	Bradley Grannis
Layout Production	Bradley Grannis, Michelle Stroup
Proofreader/Indexer	Jenni Aloi
Publicist	Shannon Bounds

Distributed to the book trade by IDG Books Worldwide, Inc.

Library of Congress Cataloging-in-Publication Data

Pronk, Ron
The Power Mac Book! / Ron Pronk
p. cm.
Includes Index
ISBN 1-883577-09-8: $34.95

Printed in the United States of America

10 9 8 7 6 5 4 3 2

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Introduction

I've been a Macintosh user since 1987, when I purchased a Macintosh SE. It was a weird-looking system, but that's one of the reasons I liked it. I was beginning to feel like the IBM PC world was a bit too stifling and stodgy, and those qualities are not in my personality (at least I don't *think* they are). I never understood why a business computer had to look like it was preparing to attend a power lunch at a mid-town Manhattan restaurant. I still curse the day I learned to use DOS, and I've never really been happy with Windows—even though I wrote a book about it to help other users figure out what in the heck to do to make Windows easier to use.

And that's one of the downsides of the business I'm in. I've got to stay on top of both the PC and Mac realms. It's not easy to do, and it's often not fun. The Wintel platform (in other words, the software/hardware marriage between Windows and the Intel 80×86 platform) has grown stale, and I no longer want a part of it. But until now, I haven't had much of a choice. I've needed to use both platforms (Wintel and the Mac), because there was no simple way to combine the two. Sure, Insignia had its SoftPC product available, which made it possible to run some DOS & Windows applications, but that approach was too slow and frankly unacceptable to me and to most cross-platform users. Until recently.

In 1993, Jeff Duntemann and I took a close look at the PowerPC technology under development by IBM and Motorola and liked what we saw. The fact that Apple was getting involved in the effort made the technology even more exciting, because it created the potential for some truly remarkable cross-platform computing solutions. In fact, we liked the technology so much that we decided to write a book about it. The end result was the publication of *Inside the PowerPC Revolution*, a book that critics have been very kind to in their reviews. But the critics haven't always been kind to Jeff's and my assertions about the significance of the technology and where the technology was headed.

For instance, when Apple announced its line of Power Macs, in Spring of 1994, critics said that sales of the new systems would suffer because there were very few native Power Macintosh applications that could be run on the machines. Jeff and I recalled that same criticism made of the first IBM PCs, introduced in 1981. We knew better. In general, software drives the development of hardware, but when a company comes up with a new, innovative hardware platform, it tends to suck in software developers like a black hole.

When Apple began shipping the 6100, 7100, and 8100 Power Macs in the Spring of 1994, they announced that their objective was to sell 1 million Power Macintosh systems within one year. But a lot of naysayers in the media and from other walks of life gave the Power Macs little hope of rising to popularity. The word on the street was that Apple needed to convince hundreds of developers to write native Power Mac software, and the natively available software in the Spring of 1994 was a pretty meager lot.

Jeff and I basically said, "Wait. It will happen."

And happen it did. There are now more than 350 native Power Macintosh applications available to the more than 1 million owners of Power Mac systems, as of January, 1995—less than one year after the introduction of the first Power Macs.

Take *that,* naysayers.

It reminds me of the way a new religion can catch on like wildfire if it provides the right solutions at the right time for a particular culture. The Power Macintosh solves so many problems for so many contemporary computer users that it was destined to become a hit.

And so I decided to write another book—this one devoted to the Power Macintosh systems, with a few detours taken to provide insight into the PowerPC technology and into a few hot areas available to Power Mac users, such as the Internet and the World Wide Web. I've also devoted a full chapter to cross-platform Macintosh/Windows computing, because I'm firmly convinced that this is an area of growth for Apple, even though it's one that most Macintosh users tend to think is unimportant. Look, gang. Do you want the rest of the world to come over to your side or not? If so, give them a bridge. SoftWindows and the DOS Compatibility Card offer two very significant bridges.

How to Use This Book

The best way to use this book is to not worry about how to use this book. What I mean is, I never intended to write an exhaustive reference work on the Macintosh. If you want basic information on how the Finder or the Trash works, there are other books that address these topics. Instead, I wanted to focus on what's new and different about the Power Macs—what makes them so different from their Macintosh predecessors.

And that's what you'll find in this book; in fact, that's *all* you'll find in this book: Information about your Power Mac and the Power Mac operating system that makes your setup different and, frankly, better than any other Macintosh ever created. I've talked to hundreds of users and have spent literally hundreds of hours surfing the Internet, America Online, CompuServe, and eWorld—not to mention hundreds of additional hours of my own experimentation—trying to uncover every benefit, every problem, every solution, every quirk, and every tip that might be of interest to Power Mac users.

Toward that end, I've included dozens of "Hot Tips," which provide little known information on bugs, troubleshooting solutions, obscure capabilities of the hardware and software, and facts that can help you use your Power Mac to its fullest.

But having said that, I also must admit that I haven't been exhaustive. Due to the confines of the publishing business, I've had to limit both the number of pages of this book and the amount of time I could spend writing it. So some topics had to be left out, possibly for inclusion in a later edition. (By the way, in computer publishing you get to write a "later edition" and make a bigger, monster book by selling scads upon scads of your first book. So if you like this book and want to see another, bigger-and-better edition, tell a friend.)

The two areas of Power Mac technology that I chose to omit are cross-platform networking and the Workgroup Servers. AppleTalk networking and linking Macs via Ethernet connections are fairly straightforward tasks, and ones that Mac network managers have been doing for years. And experience also tells me that most network managers stay on top of the technical literature and don't need a lot of help from book writers like myself.

In any event, if you think I'm wrong in making this assessment, please let me know and I'll add to the book when the next edition is printed. For any comments or criticisms about the book, you can reach me via E-mail at:

`rrpronk@aol.com`

I've also limited my coverage of the next-generation PCI Power Macs due out some time in mid-1995. Frankly, Apple has changed its tune so many times about what they will and will not deliver with these products that I no longer want to guess at the outcome. Suffice it to say that the PCI Power Macs will include the PCI bus architecture on the logic board, with PCI slots, and probably larger hard disks and faster CPUs than their predecessors. Beyond that, I'm not going to hazard a guess.

Acknowledgments

Creating this book was hardly a one-man operation. So let me take the opportunity to thank some of the people who made my life a bit easier during the research, writing, and production phases of this book.

At the top of the list, I have to put Brad Grannis of Coriolis Group Books. He served as Managing Editor, which normally is my job, except nobody at Coriolis trusted me (rightfully so) to manage myself as an author. Brad had to deal with not only the production details of the book, but also had to attempt to keep a very slippery author (me) on schedule and delivering chapters in a timely manner. I would thank him more, but since he took a lot of my money at a poker game recently, I think we're about even.

A close runner-up for Most Important Person on This Project is Shannon Bounds, also of Coriolis Group Books, who did much of the legwork required to get beta and evaluation software for me, as well as press releases for products and other information related to the Power Mac. I think her left ear is permanently affixed to her telephone handset. And since Shannon will also be responsible for seeing that this book gets reviewed in various publications around the country, and no doubt will be responsible for booking me on those radio talk shows crazy enough to have me, I have to be nice to her even *after* the book is published.

A third person I need to thank is Jenni Aloi, who was responsible for catching my mistakes in the manuscript, and in beating me over the head when she found one of my explanations to be even mildly on the incoherent side. Jenni's like a barely broken-in mustang. She's rough and tough and hard to harness, but you know she'll get you where you want to go.

Finally, there are many, many individuals from Apple, IBM, and elsewhere who provided me with valuable evaluation hardware, software, and general information. Many of these folks exhibited a fantastic degree of patience

with my (and Shannon's) questions and requests. Here's a list of the ones who stand out for their diligent efforts, in no particular order (and I'm sure I've missed several people):

- Joanne Hartzell, Insignia Solutions
- Dan Miranda, Apple Computer
- Greg Cornelison, Claris
- Patricia Pane, Sonya Schaefer,and LaVon Peck, Adobe Systems
- Jennifer Doettling and Ray Kingman, DeltaPoint
- Ted Cheney, DayStar Digital
- Gary Smith and Michael O'Malley, Macro Educational Systems
- Terri Chadbourne, Ray Dream, Inc.
- Greg Quinn, HSC Software
- Barbara Formichelli, IBM
- Judith Frey, Casady & Greene
- Ted Pine, Maris Multimedia
- Jennifer Pembroke, Microsoft Corporation
- Christiane Petite, Symantec

CHAPTER

1

The Evolution of the Power Mac

How Did They Get from There to Here?

Want to hear something *very* bizarre? Apple's Power Mac systems, PowerPC logic boards, and PowerPC upgrade cards are *all* (at this writing) powered by IBM.

I mean that literally.

You've probably heard or read about the Apple/IBM/Motorola (AIM) PowerPC alliance, and already know that IBM had a very big hand in the development of the PowerPC technology. But Motorola has also been heavily involved, right?

Absolutely. In fact, through much of 1993 and 1994, Motorola placed full-page and two-page ads in several computer-industry publications touting its new PowerPC microprocessor chips. Most of these ads included an enlarged photograph of the PowerPC 601 microprocessor, which happens to be the central processing unit (CPU) for all Apple Power Mac systems and PowerPC upgrade boards. In these photos, the 601 chip is stamped with the Motorola name and its characteristic batwing-M logo.

But here's a secret that nobody in the PowerPC alliance likes to admit: *Motorola has never manufactured a single PowerPC 601 chip, and probably never will.* All PowerPC 601 chips are currently manufactured and sold by IBM Microelectronics. So what *is* Motorola's role in the PowerPC technology, and why does Apple's sales and product literature show an IBM-manufactured 601 chip with a Motorola stamp on it? And why should you care?

Get ready for an intriguing story. It's a story that explains a lot about why Apple shifted from a Motorola CPU architecture to a radically different architecture owned by IBM. It's a story that explains how the new Power Macs are different from other Macintosh systems. It even provides a lot of insight into the future of PowerPC technology and Power Macs in particular.

Sowing the Seeds of Change

In May of 1991, you could easily have earned yourself a few chuckles during a business lunch simply by suggesting that Apple, Motorola, and IBM would soon join forces in a hardware and software alliance. Apple and Motorola together?

Of course. Motorola had long been Apple's main chip supplier.

Motorola and IBM together? Stranger things have happened. Perhaps Motorola and IBM could benefit by exchanging the best of their chip-making technologies.

But Apple and IBM?

Not possible.

To most Apple employees, IBM was *the* enemy. IBM PCs and compatibles were the main impediment to the success of Apple's Macintosh line of computers. To most IBMers, Apple was the "little guy." What could Apple possibly offer to IBM that IBM didn't already have? Actually, that's not the right question to ask. A better question: What did IBM have that Apple needed and that IBM would be willing to sell to a direct competitor in the PC marketplace?

If you had answered, "The PowerPC," you would have been wrong. Well, you would have been *half* wrong. No such beast existed at the time. What Apple wanted was IBM's RS/6000 CPU technology. Even that's only half *right.* The answer is more complex, and interestingly, involves Apple's business relationship with Motorola. And that fact leads to a second question: What was Motorola's interest in this strange alliance?

The story starts here: Rumors about a business relationship between Apple and IBM began in early June, 1991, when an Apple employee leaked information about an upcoming deal to the *Wall Street Journal.* Speculation ended on July 3, 1991, when Apple and IBM formally announced the new relationship and explained Motorola's role in it.

IBM and Motorola would co-design a family of single-chip RISC processors (I'll explain RISC later) for use in an upcoming line of Apple Macintosh computers. In turn, Apple and IBM would collaborate on the creation of an object-oriented operating system for use in the new high-performance machines.

What a Bunch of Boneheads

That was the comment of a senior developer for Adobe systems, specifically referring to Apple management, when he first heard about the new alliance. And he seemed to be echoing the sentiments of many in the industry, especially those software and hardware vendors who had long supported Apple and, specifically, the Macintosh.

At first blush, then, the proposed alliance didn't make sense. It was true that Intel's 80×86 series of processors appeared to be outpacing Motorola's 68000 line of chips—in terms of overall performance and speed. But this fact had little to do with inherent chip design superiority. In fact, it's generally acknowledged among microprocessor designers and developers that the Motorola 68000 architecture is superior to the Intel 80×86 design.

Ironically, Motorola wasn't able to keep up with Intel in the chip design wars due in part to the close marriage between Apple hardware and its underlying operating system. Apple users (today that means Macintosh users) don't buy Macintoshes for the hardware. They buy machines so they can have the superior, underlying operating system that Apple supplies. Apple's system software (currently System 7) provides several facilities that make using the machines an exercise in elegant simplicity and also allow program designers to build applications that are powerful, easy to use, and fast—especially in comparison to programs designed for Microsoft Windows.

One of the reasons System 7 is such a rich operating system is its ability to directly take advantage of features built into the hardware, and especially the main processor chip. This interdependency can lead to a nightmarish domino effect when changes are made. For instance, each new redesign of the Motorola 68000 architecture required a corresponding series of changes to the operating system, which in term meant that third-party programs had to be redesigned to take advantage of the new operating system features.

Technology industries have become accustomed to rapid change, but trying to get dozens of companies to change *in sync* is tantamount to working a jigsaw puzzle by committee: Too many players—all with a say in the outcome. Consequently, Motorola has gained a reputation for being notoriously late with its design of new 68000 chips, continually allowing Intel to get a leg up in the development of faster and fuller-featured processors. Motorola's tardiness put an additional stall on Apple's ability to revise its operating system to take advantage of new chip features, which in turn slowed down the ability of Macintosh developers to update their applications to take advantage of new operating system features. And on and on....

Historically, when Motorola has made a new chip available for production, the chip design has been superior to existing state-of-the art Intel x86 CPU chips. But since Intel has been so much faster to market with its x86 chips, Motorola began to be perceived in the industry as a Johnny-come-lately, much to the frustration of Apple executives and Macintosh application developers. One of Apple's long-standing marketing struggles has been its attempt to convince Intel-based PC users that Macintosh systems were a better product. It's an important strategy, because most desktop computers are sold to businesses, and most businesses have been firm in their insistence on using the less-expensive Intel-based, IBM clone PCs.

This is a critical point. Macintosh users *love* their Macs to death, and most wouldn't dream of switching to an Intel-based PC running the much-hated Windows graphical user interface (GUI). And it's even true that many Windows users pine for the elegance of a Macintosh. They just need Apple to give them a compelling reason to switch from the PC world to the Mac world. In other words, if Apple could only appeal to the wallets and pocketbooks of business users, it might be able to kick Intel's market share and profits backwards a few years. So Apple's main motivation in abandoning the Motorola 68000 (which we'll call 68K for simplicity) architecture was to embrace a CPU architecture that was better, faster, easier to upgrade in a timely manner, but most important, *cheaper* than anything Intel could manufacture.

Advantage: Intel

Anyway, several years ago, Apple realized that it could not grow or even survive as a company unless it found a way to make a dent in the business-computing marketplace. And to do that, Apple would need to clearly show that its Macintosh systems could easily outperform any Intel-based PCs *and* could be sold at prices competitive with or even lower than comparable Intel-based PC clones.

But until the Power Macs, Apple has been unable to brag that its systems are faster *and* cheaper. Businesspeople have just not been interested in Apple's marketing rhetoric. Until recently, the best Apple has been able to do is to argue that its Macintosh operating system provides a far superior graphical user interface than the Windows package used on PCs.

It's not much of an argument. Macintosh's System 7 (now System 7.5) wins hands-down. Windows is a joke by comparison (although Windows 95 is pretty compelling). But computer buyers in business tend to be bean counters. Ease of use is fine, but cost is more important in considering which desktop systems to buy in bulk—and businesses tend to order computer systems by the dozens or even by the hundreds.

For instance, a Macintosh Quadra that uses a 40 MHz Motorola 68040 chip can outperform many PCs operating with a 486 chip at 66 MHz—especially for graphics-intensive applications. This kind of leading-edge performance is possible because the processor chip, the operating system, and application programs all complement each other. The operating system takes advantage of processor capabilities, as do various hardware subsystem components, and applications take advantage of the operating system's capabilities.

In the world of marketing, though, perception is everything. Windows users wonder why they should send their 66 MHz 486 machine to the scrap heap in favor of a 40 MHz Quadra that surely must run slower and yet (until recently) costs *twice as much*, and sometimes more, than its Intel-based rivals. In trying to persuade Windows and other PC users to switch camps, Apple has had to fight these price/performance perceptions, and until the Power Mac, the fight has not gone well.

To combat the emphasis that Intel-based systems place on CPU speed, Apple has focused on upgrading its systems using a combination of CPU and related hardware improvements. Each new system has its own separate model number, which unfortunately has led to mass confusion even among diehard Apple users, while PC and Windows users haven't even been listening.

For instance, in 1993, Apple introduced these new desktop systems: the Color Classic, the LCIII, the LC475, the LC520, the Centris/Quadra 605, the Quadra 610, Quadra 650, Quadra 660 AV, Quadra 800, and Quadra 840 AV, and the Performa 405, 410, 430, 450, 46x, 47x, and 550. This throw-everything-at-the-wall-and-see what-sticks marketing approach has been confusing to Apple users and a complete turnoff to IBM-PC and compatible users.

Taking the Plunge

As far back as early 1990, Apple clearly needed to switch to a new chip design if it was going to have any chance of surviving into the 21st century.

But Apple already *had* switched, or so everybody thought. Earlier in the year, Motorola had announced a new line of single-chip RISC (for Reduced Instruction Set Computer) processors, and was nearing completion of the first chip, the 88110. RISC chips are far simpler, yet more powerful, in design than their CISC (Complex Instruction Set Computer) counterparts. As a result, RISC chips can be designed and manufactured at a fraction of the cost of CISC chips. Both the Intel x86 architecture and the Motorola 68K architecture apply CISC design principles. So Motorola's RISC design would provide Apple with a pricing edge when the cost of the chip was factored into the overall cost of new Macintosh systems.

In fact, Apple already had committed millions of R&D dollars to the design of high-performance Macintosh systems to be built around the 88110 CPU and successor chips. And early reviews of the 88110 chip were favorable—in fact, they were downright impressive.

So why did Apple suddenly switch its CPU allegiance to the enemy? It just didn't make sense. Were Apple executives really behaving like a bunch of boneheads?

Consider this: IBM's RS/6000 series of RISC workstations required seven- to nine-chip implementations, not suitable or cost-effective for use in a desktop PC. Certainly, IBM had the design talent necessary to create a single-chip implementation of the RS/6000 technology—eventually. But the Motorola 88110 was only months away from production. In other words, Motorola's single-chip RISC was *now* technology, while IBM's version was *maybe* technology. Why would Apple abandon today's technology and risk its future on some suitor's promise?

To answer this question successfully, industry watchers would have needed to be privy to two facts that had been effectively shielded from the public view by IBM and Apple. Fact one: IBM was already waist-deep in development on a single-chip RISC processor that could be used in low-end, low-cost workstations. The chip, called the RSC, was scheduled for production near the start of 1992. Adapting this chip to support Apple's system needs, and in a timely manner, would be little more than child's play for IBM developers.

Fact two: To ensure success of the new RISC-based Macs, Apple needed commitments from software vendors to develop applications that would run "native"—that is, applications that would be coded specifically to take advantage of RISC capabilities and that could run on the machines without the assistance of hardware or software emulation technology. A new breed of RISC-based Macintosh systems could succeed only if software vendors lined up *en masse* in support.

In 1991, Apple's market share in the desktop computing business was riding the downslope, approaching single-digit percentages. Neither Apple nor Motorola had the industry muscle to pull software developers toward the proposed RISC-based Macs. (Why develop software for an eroding market?) Add to that perception the fact that Motorola was developing a reputation as a laggard in the CPU technology war between itself and Intel.

IBM, on the other hand, had built a business around good ol' boy networking, and knew how to use its hardware and software industry connections. IBM proved this capability with the RS/6000 series of workstations, which gained quick acceptance and industry-wide support even though it was introduced as a *very* late player in the workstation marketplace. And Apple could claim (and did) that a joint venture with IBM would lead to more open systems and a corresponding movement toward a common hardware platform—great motivation for software developers.

Say what you will about IBM and their tardiness with operating systems and even with their own Power Personal (PowerPC-based) systems. IBM has arguably been the leader in the design and development of state-of-the-art RISC processors. There are other gee-whiz, pedal-to-the metal RISC chips available, like DEC's awesome Alpha series, but you pay state-of-the-art prices for this performance. By contrast, IBM presented Apple with a way to mass-market high-powered RISC chips so cheaply that it would have been difficult for Apple to refuse.

The IBM Incentive

For IBM, the incentive to work with Apple was even stronger than Apple's desire to work with IBM. In 1981, the Entry Systems Business arm of IBM Information Systems division, headquartered in Boca Raton, Florida, and responsible for the development of the IBM PC, made a very un-IBM-like decision. This group of big-blue mavericks decided to use a third-party supplier, Intel, to provide the CPUs for the first IBM PCs, rather than use an IBM-supplied chip.

This decision enabled the Boca Raton group to sidestep the deeply entrenched and bloated IBM bureaucracy, a strategy that would in turn make it possible to get the IBM PC to market in a timely matter. It would also make it possible for the engineers at Boca Raton to resolve design issues on its own, without having to channel issues past the infamous "Executive Committee," a top-level collection of IBM executives who had the final say-so in resolving any corporate problems.

For similar reasons, the Information Systems division signed a contract with the then-fledgling Microsoft Corporation to supply the operating system for the new PCs. (In other words, the Boca Raton staff didn't have to rely on its own IBM software divisions, which were notorious for their inability to meet schedules, for the prompt delivery of a PC operating system.)

When the first IBM PCs hit the market, they proved to be a technological sensation and a tremendous sales success. So far, so good. By 1985, though, Compaq and a few other upstart companies had managed to crack IBM's PC market by developing "clone" systems. Their success stems from a lawsuit-busting approach pioneered by Phoenix Technologies in 1984. Engineers at Phoenix Technologies formed two teams. The first team combed through IBM's published and copyrighted technical specifications for the ROM portion of the operating system in the IBM PCs, the basic input/output system (BIOS, although a better description would probably be "built-in operating system"), and then rewrote their own versions of a BIOS spec based on the IBM version.

This team then handed off their specs to the second team, which designed and developed their own, "independent" BIOS. The BIOS was then given to the first team to "test" by comparing it to the original, IBM specs. Ironically, this unique "clean room" (a term I always thought should be called "clone room") approach to reverse engineering was the brainchild of attorneys, not engineers, who wanted to ensure that Phoenix Technology's BIOS would withstand lawsuits by IBM. It did.

With the BIOS ROM code cracked, the clone market was off and running. Since Intel owned the CPU rights, and Microsoft owned the operating system rights, it was possible for clonemakers, through various purchasing and licensing arrangements, to assemble their own IBM-compatible systems by using non-IBM ROM chips.

Eventually, clone makers cut so severely into IBM's personal computer market share that IBM was no longer a major player. At first, the threat to IBM's personal computer sales didn't worry the IBM brass. In the early '80s, for example, sales of mainframes and minicomputers remained brisk. The total profit dollars on the sale of a single mainframe was often greater than the profit from the sale of a thousand PCs. So why worry about the lagging sales from a relatively small percentage of IBM's overall profits?

During the late '80s and early '90s, sales of mainframe and minicomputers (with the notable exception of IBM's AS/400 minicomputer line) slowed to a trickle—not just for IBM, but for *all* manufacturers of large systems. The reason for the sluggish sales was easy to identify: The desktop computer had become *the* dominant tool in the workplace. IBM was a victim of its own success in the desktop marketplace. Mainframes were becoming technological dinosaurs.

Meanwhile, IBM had lost a significant share of its PC market in part because it had unwittingly encouraged the development of an *open technology*. That is, IBM purchased the underlying hardware and software from third-party vendors, which opened up the PC development field to anybody who could negotiate alliances with Intel and Microsoft. (Eventually, Intel even lost some market share to suppliers of cloned Intel-compatible CPU chips.) Ironically, an important reason for Apple's failure to make more than a dent into the PC market stemmed directly from their decision to remain proprietary in the operating systems arena. (Until very recently, nobody could provide the operating system for a Macintosh except Apple.)

As mainframe sales continued to erode, IBM executives began to realize that saving the company might mean forming alliances with other major players who might also be down but not out. In short, IBM wanted to wrestle its way back into the PC market, and the key to this strategy would involve other players interested in breaking the Intel/Microsoft hardware and software monopoly.

A partnership with Apple would give IBM instant legitimacy in a business (personal computers) that it had lost through inattentiveness and strategic error. Apple was, after all, the largest manufacturer of desktop computers in the world—with more unit sales than any other computer manufacturer. That might sound surprising, since I've already indicated that Apple had been floundering in the '90s with extremely sluggish growth and rising overhead costs.

Apple's market leadership is actually illusory, since more than 85 percent of the desktop market is splintered across several dozen clonemakers. Apple's fluctuating 10- to 15-percent share is larger than any other clonemaker, but it's still only a fraction of the overall desktop market. The real winner in the desktop industry—at least at the hardware level—has been Intel, which until a few years ago supplied the CPUs for all PC clonemakers. IBM realized that an alliance with Apple would give it an instant market for selling its new RISC chips.

So, What About Motorola?

In light of these political and market realities, the Apple/IBM alliance begins to make sense. The inclusion of Motorola makes sense, too. Since Apple had already begun designing new system motherboards around the Motorola 88000 line of RISC CPUs, much of that system design effort could be salvaged if the proposed IBM RISC-chip adaptation made use of Motorola's bus design.

Also, IBM did not have a proven track record in its ability to supply CPU chips to the external market in the quantities that Apple would need for its new Power Macs. IBM's microprocessor fabrication technology, although state of the art, was geared toward supplying chips either at smaller quantities required for mainframe, minicomputer, and workstation markets, or to internal vendors like IBM's Ambra. Motorola, on the other hand, was equipped for high-volume chip production to external customers. Motorola might have garnered a reputation as a scheduling-challenged chip designer, but its manufacturing track record was excellent.

By encouraging Motorola and IBM to work together, Apple would be al to benefit from the combined microprocessor design and developm capabilities of the two companies, while ensuring that it would have a back manufacturing outlet from Motorola. Also, the alliance of Motorola a IBM has allowed the two companies to share development costs and e to spread the development costs across the full lines of PowerPC CPUs t would eventually be manufactured by both IBM and Motorola.

This additional cost benefit wasn't ignored by Apple—it clearly recogni that the resulting PowerPC chips would be cheaper, faster, and more p erful than any other desktop CPUs on the market. Apple would fin have an opportunity to realize its long-sought goal: It would become leading supplier of desktop computer systems, using leading-edge CPU te nology and selling state-of-the art systems at or *below* the prices of its cc petitors. Apple was taking a risk, but this time the spelling was "RISC."

RISC versus CISC

And now I have to make a confession: I've been strategically danglin carrot in order to offer a history lesson with minimal reader pain. I pro ised to explain why Motorola doesn't make PowerPC 601 chips. Go ahe and protest, but I can't possibly explain that without first explaining RI technology and both IBM's and Motorola's role in its development. So ple indulge me for a few more pages.

I'll at least try to keep you interested by revealing another secret: *There is such thing as RISC.* Nor is CISC necessarily what you think it is, or even clo Furthermore, there never was a RISC versus CISC war, nor even a civil ar ment. There are definitely some computer wars going on right now, but t center on entirely different issues. There is certainly a cheap CPU ve expensive CPU war underway. But RISC as an idea never really made of the labs alive (and CISC as an idea was created solely to make RIS good), so postulating a RISC versus CISC war is a waste of time.

Reduced? Reduced What?

RISC is a misnomer. The acronym technically means Reduced I Set Computer. But is the instruction set actually "reduced?" Nc earliest laboratory experiments in high-performance comp space on their experimental CPU chips to build new performance features like cache and greatly expanded register sets. They made room for these new features by shoveling instructions off the chip wholesale. One early experimental RISC chip had only 39 instructions.

How could they get away with this? Basically, if you have a fairly complete set of simple instructions, you can imitate complex instructions by stringing together series of simple ones. If your simplified chip is fast enough, these "emulated" complex instructions will run just as quickly as the built-in complex instructions that are part of the more traditional CPUs. Complex instructions take a lot of room on a CPU relative to simple ones. So it was one way to cut *way* back on the occupied space of a CPU chip without sacrificing functionality.

Chip fabrication technology has improved unimaginably over the past fifteen years or so, since the days when much of the early RISC research was done..The number of transistors on a CPU chip in 1980 was measured in the tens of thousands. Today, hardware designers are stuffing three or four *million* transistors on a single chip. So in making the transition from lab to market, RISC CPU manufacturers added back in all of the instructions they had earlier removed, all those and then some—and kept the cache and registers as well. We really have to face it: A rich instruction set adds enormous power to a CPU. Instructions are what allow a CPU to get its work done. Today, there is no inherent value in having fewer instructions, as long as you have the space on the chip to implement them efficiently. And the key word here really is *efficiency.*

Register Starvation

One of the lingering differences between CISC and RISC architectures is the number of *registers* available for storing instructions and data. In a CPU, a register provides a way to store a single instruction or unit of data within the processor chip itself while processing is taking place. A single register in a desktop CPU typically holds either 16, 32, or 64 bits.

When you begin to understand the roles of registers, they seem to be a lot like magic. They can be accessed by the CPU almost instantaneously because they're inside the CPU, and by using instructions that act on registers rather than memory (called load/store instructions), RISC CPUs reduce the need to go out to external memory to look for needed instructions and data. That near-instantaneous access is due to extremely clever circuit design and the use of a large number of transistors. Registers connect to one another and to other parts of the CPU in a great many subtle ways, and the more registers a CPU has, the more difficult it is to "string" all these connections inside the CPU.

Nonetheless, CISC designs—including the Motorola 68000 and Intel x86 architectures—seem more register-poor than they really ought to be, considering how useful registers are in improving program performance. For instance, many industry pundits have dubbed the Intel x86 machines "register starved" because there are only eight general-purpose registers in the x86 architecture (seven, if you want to really get technical). The PowerPC and nearly all other RISC CPUs have at least 32 registers. This allows them to use a load/store type of instruction set and perform most calculations inside the CPU, where instructions can work their fastest.

Register starvation is just one example of how CISC architecture has remained traditionally different from RISC. But in truth, RISC and CISC designers have been "stealing" ideas from one another for years. The end result is that chips that are labeled RISC tend to enforce more of a load/store architecture and tend to have larger register sets than their CISC counterparts. In fact, if you want a more current down-to-earth definition of RISC, it would be something like "a chip with lots of general-purpose registers." However, virtually all RISC designs have borrowed features from CISC designs, and state-of-the-art CISC chips have borrowed as many design features from RISC architectures as possible. And the phrase *as possible* is key here.

CISC chip designs, like the Motorola 68000 and the Intel x86 architectures, have had to include backward compatibility when new chip versions are released. In other words, an updated Motorola 68K or Intel x86 chip design needs to support operating systems and applications written for earlier chip designs. Both Motorola and Intel have felt this noose growing tighter and tighter, limiting their ability to make more RISC-like adjustments to their existing chip designs.

By contrast, RISC designs tend to be new by nature, and therefore don't have to provide chip support for a legacy of older operating systems and applications. Designers of RISC chips can afford to be more innovative, since they're often not tied to any particular instruction set. But even *that's* changing. To explain, let me digress into another brief segment of history.

IBM and the 801 Team

The evolution of RISC began in the early 1970s with IBM in a facility in Yorktown Heights, New York, called Building 801. In fact, the building name became the code name for IBM's then-nebulous CPU project—Project 801. The project was led by John Cocke, who wanted to develop a *scalable* CPU chip design—one that could be used in smaller computers but that would work just as well in even the most powerful mainframes. In short, Cocke's vision was the precursor to the PowerPC architecture that exists today in the Power Macs: create a simplified architecture that would be more powerful than its predecessors but that could be implemented inexpensively and in a wide range of systems.

Efforts began by doing *traces* of programs run on an IBM 370 mainframe system. A trace identifies and lists the program instructions that are actually used in processing data. (Not all instructions in a program are necessarily executed during a particular program run, while some instructions are executed repeatedly within program loops—often thousands or millions of times in succession.) By examining the trace listings, IBM researchers were able to determine which types of instructions were executed most frequently by the computer. The idea was to determine how to create an optimized processor that exploited the most frequently used program instructions.

The 801 research effort continued until 1977, and culminated in the development of what was then called the 801 minicomputer. Even though the term "RISC" had not yet been coined, the 801 minicomputer implemented many of the characteristics that came to define early RISC technology.

IBM's RISC technology would continue to evolve, and the research eventually spilled over into a few universities and into several other computer hardware companies. IBM realized its first successful RISC product line when it announced the RS/6000 line of workstations in 1990, but these systems were several years behind the release of competitive RISC workstations by DEC, MIPS, SPARC, and other system vendors. In 1990, IBM was no longer the only RISC innovator, although IBM proved that its original

RISC design principles, with some modifications, had stood the test of time and had culminated in a superior, state-of-the-art line of workstations.

The Somerset Design Center

In the next few paragraphs, with the help of some editorial sleight of hand, I hope to pull together all loose ends—chiefly, by defining the distinct roles of Apple, IBM, and Motorola in their nefarious alliance. The future of PowerPC technology began in 1991 with the establishment of the Somerset Design Center in Austin, Texas, which provides a cooperative working environment for RISC designers from both IBM and Motorola.

The name "Somerset" comes from the Grail legends, in which King Arthur gathered the knights of the Round Table at Somerset (a county in southwestern England) to set aside their differences and pursue the Holy Grail. The notion was to create a site for the technical meeting-of-minds where different corporate cultures could be set aside at the door and not impede the overall goal: to create the fastest, least expensive microprocessor in the business.

The specific goal of the Somerset Design Center was to take IBM's RS/6000 POWER CPU design technology and transform it into a superior, single-chip, and scalable architecture that could be mass produced easily and inexpensively. Here's where the roundtable began to tilt in IBM's favor—but only slightly and not enough for Motorola to walk away from the alliance.

The PowerPC architecture was intended to support several chips—from desktop-based CPUs and notebook CPUs to workstation CPUs and upward to massively parallel processing systems—a strategy called "scalability." The first chip in the architecture, the PowerPC 601, had been largely complete by the time the alliance got seriously underway in 1992. Even though it's not widely understood, the 601 was actually the immediate descendent of a pre-alliance IBM project—the RSC chip—aimed at getting the cost of the RS/6000 workstation down.

Most post-601 hardware design work has been and continues to be hammered out at Somerset, but the role and positioning of the 601 chip is unique, and explains much about the different roles of IBM and Motorola in the development of the PowerPC chip technology. Since IBM had developed most of the 601 architecture on its own time and money, it wouldn't have been realistic to expect IBM to hand over the chip design free of charge to Motorola. But it was nevertheless true that, in order to comply with Apple's wishes, IBM was modifying the bus design of the 601 chip to conform with the bus design of Motorola's 88100 RISC architecture.

In the interest of cooperation and mutual need, a contractual compromise was reached. IBM would retain ownership of the generic PowerPC architecture and the PowerPC 601 design, but would mutually work with Motorola in the development and co-ownership of future PowerPC chip designs. In turn, IBM would agree to offer the PowerPC 601 design to Motorola—for a licensing fee, of course. And Motorola could purchase and sell the chips under its own name if it desired to do so.

Motorola elected not to purchase the rights to the 601 design—for a seemingly good reason. The 601 was conceived of as a quick-to-market "bridge chip" that would rapidly be succeeded by more advanced PowerPC chip designs—designs that were co-owned by IBM and Motorola and that could be manufactured on equal footing by both companies. Apparently, it didn't make sense to Motorola to spend millions of dollars licensing the 601 design and retooling one or more chip fabrication plants to manufacture a chip that would have a relatively limited life span.

So, now you know. Only IBM manufactures the 601 chip. However, Motorola and IBM are both manufacturing 603, 604, 620, and several other PowerPC chip designs. Because Motorola has the legal right to purchase 601 chips from IBM and stamp them with the Motorola name and logo, it does so with great regularity. This makes good marketing sense for Motorola. And Apple certainly has no objection. It's in Apple's interest to allow longtime Mac users to believe that the new Power Macs use a CPU supplied by a longtime partner—Motorola—rather than a longtime adversary.

And IBM easily tolerates this minor deception. One of IBM's goals has been to reenter the desktop PC market, at the chip level, as a major player. IBM has scored several points with its Blue Lightning line of 486 knock-offs and as a manufacturer of Cyrix's x86 line of microprocessor designs. But selling chips in quantity to Apple is an even larger coup. As long as IBM retains Apple as a customer, it doesn't much care whether IBM or Motorola gets the publicity.

The PowerPC and the Future of the Power Mac

So why should you really care about the intrigue and politics that underlie the PowerPC technology? It helps to know who the major players are and what their ongoing roles will be. For instance, since only IBM manufactures the 601 chip, Apple has only one CPU supplier for its current Power Mac products. But the 604 and other PowerPC chips will be manufactured and sold by IBM *and* Motorola. So, even though the 604 is a more powerful and more expensive chip, IBM and Motorola will be competing for Apple's business in becoming the major supplier for next-generation Power Macs. That means better price positioning for Apple and better deals for the consumer—you. That's a good piece of information to know. With Apple's recent decision to license its operating system to clonemakers, third-party Macintosh system developers will also benefit from price competition between IBM and Motorola.

Here's another issue worth pondering: If it's true that the 601 microprocessor is a bridge chip to a better technology, then it makes sense to consider that the 6100/7100/8100 Power Macs (and the PowerPC 601-based Performas) are also bridge machines to even more powerful future Macintosh systems. And that raises an interesting question. Will the current Power Macs be obsolete in a year or two?

Yes, of course. But that shouldn't be news. By current standards, the Macintosh Plus, the Macintosh SE, and even most of the Macintosh II line of computers are also obsolete. Computer technology doesn't stand still, and *anything* you buy today will look and behave like an industry has-been within a matter of years.

A more important question is whether the current Power Macs will be *compatible* with future generations of Power Macs, and whether and how well the current Power Macs will be upgradeable to newer PowerPC CPUs, memory chips, and cards. Answers to these questions will help you determine whether to buy a Power Mac now (assuming you haven't already done so) or wait to buy a next-generation Mac. And if you do decide to buy now, answers to these questions will help you determine which model to buy (they're not all equally upgradeable). If you've already purchased a Power Mac, you're no doubt anxious to know how easy it will be to upgrade your system as the technology evolves. I'll tackle all of these issues in the next chapter and later chapters.

CHAPTER

2

Moving to the Power Macintosh

When, Why, and How?

You'll want to read this chapter if you haven't yet bought a Power Macintosh but would like to, or if you haven't yet upgraded your current Macintosh to Power Mac technology but would like to. If you buy computer systems for your company and are considering Power Mac computers, you'll also find this chapter useful.

Specifically, this chapter describes the basic Power Macintosh systems and upgrade opportunities that are currently available. Toward the end of the chapter, I'll explain some of the pros and cons and other issues that can help you determine when and how to upgrade. Later chapters will explore available systems and upgrade paths in more depth.

Power Mac upgrade decisions will come easy for a few users. But for most people, the issues are complex—especially since a majority of existing Macintosh users purchased their systems two or more years ago. That means a lot of Macintosh users haven't been keeping close tabs on the evolution of Macintosh hardware.

That's not surprising. Keeping up with Macintosh advancements has been difficult even for those of us in the industry who are paid to do so. We have to understand the differences among the various microprocessor chips in the Motorola 68000 family, the math co-processor chips used in some systems, the different lines of Macintosh systems (Classic, Macintosh II, Macintosh LC, Performa, Centris, Quadra, Power Macs, Workgroup Servers, etc.), and we have to understand the differences among different offerings within the same product line (IIci, IIfx, IIvi, etc.). Add to that the need to understand differences among operating system upgrades, networking approaches, audio/visual (AV) technology, and competing applications.

It's a messy business.

So why should Apple expect the average Macintosh user to understand all of these product distinctions? Apple doesn't. To the credit of Apple management, they have finally begun to realize that a key to increasing the presence of the Macintosh in businesses, homes, and schools is to simplify and standardize purchasing options. After all, the original goal of the Macintosh was to provide a machine that was friendly, easy to learn, and elegantly simple to use. Along the way, though, in trying to provide users with options, Apple made the Macintosh difficult to buy.

Introducing the New Power Macintosh Systems

That situation has changed with the Power Macintosh systems. You really only need to remember three numbers: 6100, 7100, and 8100. These are the three basic categories of Power Macintoshes and each category and its models target a particular user group. If you want to keep things profoundly simple, just remember the numbers 6, 7, and 8—you'll still be able to easily keep track of the different Power Mac systems.

Each Power Mac model number is followed by a slash, which is then followed by the clock speed of the system. For instance, the 6100/60 model runs at 60 MHz; the 7100/66 runs at 66 MHz; and the 8100/80 runs at 80 MHz. Apple feels that this approach will allow them to upgrade the product lines with faster microprocessors without adding to product name confusion. The newest Power Mac, for instance, runs at 110 MHz, but has the same basic hardware configuration as the 8100/80 Power Mac, so it's called the 8100/110.

Basic Configurations and Expansion Options

If life were only that simple. In truth, Apple needs to offer different hardware and software options to attract buyers who have more specific computing needs. In fact, the three initially offered Power Mac models—6100/60, 7100/66, and 8100/80—are subdivided into more than a dozen different configurations.

Apple's initial plans were to introduce 13 configurations, but the number of out-of-the-box offerings quickly rose to more than 15. The configuration differences, for the most part, are a shuffling of these six options:

- RAM (8 MB or 16 MB)
- Hard disk size (160 MB to 1GB)
- AV support
- Expansion slots
- Built-in CD-ROM
- Bundled SoftWindows (to run DOS and Windows applications)

Keep in mind that these are *factory-shipped* configurations. You can certainly add or modify the configuration by purchasing more RAM, a second hard disk or removable disk drive, and so on. You can also save money by mixing and matching components available from third-party vendors. For instance, you could buy a Power Mac without the Apple-supplied CD-ROM drive, and then shop around for a cheap CD-ROM drive from a different vendor. The drive can easily be installed in your Power Mac, since all Power Macs come with a CD-ROM drive bay, regardless of whether you purchase the CD-ROM drive itself.

In any case, Apple uses the term *catalog number* or *order number* to distinguish among different configurations for each model, but you would be better served to ignore the order numbers and simply focus on the particular equipment, or configuration, that you want. Table 2.1 compares the basic features of the three initially offered Power Mac models. Keep in mind that monitors and keyboards represent optional equipment across the complete Power Mac line. So any advertised price for a Power Mac will not include the added cost of a monitor and keyboard. (A mouse is included with all Power Macs, although not a very good one.)

To the average, cynical computer buyer, failure to include the keyboard and monitor in the base system price seems like a bit of con-artistry. Trust me, in this case it's not. In years of yore, Apple forced you to buy complete hardware systems; you couldn't pick and choose which monitor you wanted with your computer, as you can do with most Intel-based PC purchases. In the earliest days, even your printer had to come from Apple.

Table 2.1 Power Mac Model Features

	6100/60 Systems	7100/66 Systems	8100/80 Systems
Clock Speed	60 MHz	66 MHz	80 MHz
Relative Performance			
Native applications	Approx. 200% faster than a 68040/33 MHz system	25% faster than a 6100/60	200-400% faster than a 6100/60
Emulated applications	Fast 68030 to slow 68040	Fast 68040	Fast 68040
RAM	8 MB standard	8 MB standard	8 MB standard
DRAM expansion	72 MB	136 MB	264 MB
SIMM slots	2	4	8
L2 Cache	Cache slot available	Cache slot available	Cache slot available
Expansion Slots	PDS or one 7" NuBus via adapter card	3 full-size NuBus	3 full-size NuBus
Storage			
Standard HD	160 MB to 250 MB	250 MB to 500 MB	250 MB to 1 GB
Floppy	1.4 MB/Supports DMA	1.4 MB/Supports DMA	1.4 MB/Supports DMA
CD-ROM	Optional	Optional	Optional
Video			
DRAM	Standard	Standard	Standard
VRAM	None	1 MB	2 MB
VRAM expansion	None	to 2 MB	to 4 MB
Standard support	1 monitor	2 monitors	2 monitors
SCSI Support	High-speed asynchronous	High-speed asynchronous	High-speed asynchronous
Networking	Built-in Ethernet with DMA channel, AAUI connector	Built-in Ethernet with DMA channel, AAUI connector	Built-in Ethernet with DMA channel, AAUI connector
Other Built-in Support	16-bit audio stereo in/out 2 serial ports—LocalTalk and GeoPort compatible w/DMA channel Apple Desktop Bus (ADB)	16-bit audio stereo in/out 2 serial ports—LocalTalk and GeoPort compatible w/DMA channel Apple Desktop Bus (ADB)	16-bit audio stereo in/out 2 serial ports—LocalTalk and GeoPort compatible w/DMA channel Apple Desktop Bus (ADB)

Today is a different era for Apple, who is more than willing to provide buyers with options—almost to excess. So, the fact that the price of keyboard and monitor isn't figured into the base purchase price for Power Mac systems is an attempt to appease buyers, not confuse them. Apple correctly perceived that Power Mac buyers would for the most part be sophisticated, high-end users with some Macintosh experience—a category of buyers that is comfortable in mixing and matching components much in the way an audiophile mixes and matches stereo components to get the ideal system. In other words, Apple is perfectly willing to let you purchase an NEC or some other monitor of choice for your Power Mac. And frankly, most third-party hardware vendors offer products at substantially less cost than Apple charges for its comparable products. I'll have more to say on this subject later.

Table 2.2 provides a quick, at-a-glance view of the basic configurations for all of the introductory models. Even when these were the only suite of Power Mac configurations available, you could still mix and match components, as you can do now.

Table 2.2 Basic Power Mac Configurations (Initial Offerings)

Power Mac Model	RAM	Hard Disk Size	Built-in CD-ROM	Bundled with PDS Expansion Card
6100/60	8 MB	160 MB	No	No
6100/60	8 MB	160 MB	Yes	No
6100/60	16 MB (includes Soft Windows)	250 MB	Yes	No
6100/60	16 MB	250 MB	No	No
6100/60AV	8 MB	250 MB	Yes	Yes—AV card
7100/66	8 MB	250 MB	No	Yes—VRAM expansion
7100/66	8 MB	250 MB	Yes	Yes—VRAM expansion
7100/66	8 MB	500 MB	Yes	Yes—VRAM expansion
7100/66	16 MB (includes Soft Windows)	250 MB	Yes	Yes—VRAM expansion
7100/66AV	8 MB	500 MB	Yes	Yes—AV card
8100/80	8 MB	500 MB	No	Yes—VRAM expansion
8100/80	16 MB	500 MB	No	Yes—VRAM expansion
8100/80	16 MB	500 MB	Yes	Yes—VRAM expansion
8100/80	16 MB	1 GB	Yes	Yes—VRAM expansion
8100/80AV	16 MB	500 MB	Yes	Yes—AV card

Note, though, that SoftWindows is included with all 6100 and 7100 Macs that ship with 16 MB of RAM. However, if you buy an 8100 system and want SoftWindows, you have to purchase it separately. I suspect Apple's reasoning here is that the 6100 and 7100 systems are the likely candidates for use as general-purpose business computers, and businesses frequently require that at least one or more DOS/Windows applications can run on every office computer. On the other hand, the 8100 is the high-end system and will probably be purchased by people with heavy-duty graphics, video, and other multimedia needs. These customers are more likely to already be Mac users (for instance, Macintosh computers are far and away the systems of choice for desktop publishing and the video/film industry) and probably don't need or want SoftWindows. In any case, SoftWindows can be purchased separately and installed on any Power Mac that has at least 16 MB of RAM.

It's also worth noting, as you look over the tables in this chapter, that all Power Macs include one Processor-Direct Slot (PDS). However, you'll probably also notice that a PDS expansion card is already included with all systems except for the non-AV 6100 systems. (The 6100AV systems have been discontinued, but Apple sells an AV card that you can install in the PDS if you want to upgrade to the AV configuration.) So, except for the option to upgrade 6100 systems to the AV capability, PDS cards are not an upgrade option for Power Mac users. All Power Macs, however, are currently expandable via NuBus slots. (You can use most NuBus cards in a non-AV 6100 by purchasing a PDS-to-NuBus adapter, which is available from Apple and through reseller channels.) Next-generation Power Macs will be upgradeable via the faster and more versatile PCI local bus technology.

Most consumers realize that change occurs rapidly with computer technology. But sometimes the rate of change can be dizzying. Consider this: Tables 2.1 and 2.2 are already obsolete—Apple has already changed the configurations of its initial models. For a more current view of the most current models, take a look at Table 2.3.

When I started writing this book, Tables 2.1 and 2.2 were current. But in mid-September of 1994, Apple threw me a curve. Chiefly, all Power Macs now come with at least 250 MB of hard disk space and several higher-end models also come with increased hard-disk storage space. Some models now come available with 16 MB of memory, at less *cost* than their 8 MB

Table 2.3 Updated Power Mac Configurations

Power Mac Model	RAM	Hard Disk Size	Built-in CD-ROM	Bundled with PDS Expansion Card	Current Status
6100/60	8 MB	160 MB	No	No	Discontinued
6100/60	8 MB	250 MB	No	No	New Offering
6100/60	8 MB	160 MB	Yes	No	Discontinued
6100/60	8 MB	250 MB	Yes	No	Price Reduced
6100/60	16 MB (includes Soft Windows)	250 MB	No	No	Discontinued
6100/60	16 MB (includes Soft Windows)	350 MB	No	No	New Offering
6100/60AV	8 MB	250 MB	Yes	Yes—AV card	Discontinued
7100/66	8 MB	250 MB	No	Yes—VRAM expansion	Discontinued
7100/66	8 MB	500 MB	No	Yes—VRAM expansion	New Offering
7100/66	8 MB	250 MB	Yes	Yes—VRAM expansion	Discontinued
7100/66	8 MB	500 MB	Yes	Yes—VRAM expansion	Price Reduced
7100/66	8 MB	500 MB	Yes	Yes—VRAM	M2466LL/A
7100/66	16 MB (includes Soft Windows)	250 MB	Yes	Yes—VRAM expansion	Discontinued
7100/66	16 MB (includes Soft Windows)	500 MB	Yes	Yes—VRAM expansion	New Offering
7100/66AV	8 MB	500 MB	Yes	Yes—AV card	Discontinued
7100/66AV	16 MB	500 MB	Yes	Yes—AV card	New Offering
8100/80	8 MB	250 MB	No	Yes—VRAM expansion	Discontinued
8100/80	8 MB	500 MB	No	Yes—VRAM expansion	New Offering
8100/80	16 MB	500 MB	No	Yes—VRAM expansion	Discontinued
8100/80	16 MB	250 MB	Yes	Yes—VRAM expansion	Discontinued
8100/80	16 MB	500 MB	Yes	Yes—VRAM expansion	New Offering
8100/80	16 MB	1 GB	No	Yes—VRAM expansion	Discontinued
8100/80AV	16 MB	500 MB	Yes	Yes—VRAM expansion	Price Reduced
8100/80AV	16 MB	500 MB	Yes	Yes—AV card	Price Reduced
8100/80	16 MB	1 GB	Yes	Yes—VRAM expansion	Price Reduced

predecessors. In fact, the best part of this change is that Apple elected to upgrade its hardware without upgrading its prices. In fact, all of the replacement systems have a list price equal in price or less than their predecessors. Table 2.3 shows the product line as it has evolved, and includes the discontinued models as well as the upgraded models.

In light of the new line of Power Mac products, you might find it strange that I've left Tables 2.1 and 2.2 in the book. But I've done so for several reasons. Most importantly, many resellers will be clearing out stock of older models, and might still sell some of the models that Apple has discontinued. (You'll also be able to find these configurations advertised as used systems in your newspaper's classifieds and available from mail-order companies.) If that's the case, and you want to buy one of the discontinued configurations, make sure you get a significant discount. There's no reason *not* to expect one, since the replacement models in all cases have more hardware capabilities for equal or less cost than the models they replace.

For this reason, I've included Table 2.4, which compares the prices of discontinued configurations with the prices of their replacement configurations. (Again, please keep in mind that prices do not include keyboard and monitor.) I've used a bit of shorthand in this table, but the shorthand is commonly used by Apple and is common among resellers, so it's useful to know. For example, a "6100/8/250" Mac refers to a 6100 system with 8 MB of memory and 250 MB of hard disk space. A "7100/16/500/CD/AV," although annoying long, simply refers to a 7100 system with 16 MB of memory, 500 MB of hard disk space, a CD-ROM drive, and the AV card installed. This level of shorthand can look obtuse at first, but it does seem to be fairly

Table 2.4 Price Comparison of Discontinued Configurations with Their Replacement Configurations

Original Configuration and Price	New Configuration and Price
6100/8/**160**: $1819	6100/8/**250**: $1819
6100/8/**250**/CD: $2289	6100/8/**250**/CD: $2029 (Reduced)
6100/16/**250**/Soft Windows	6100/16/**350**/Soft Windows: $2499
7100/8/**250**: $2899	7100/8/**500**: $2899
7100/8/**250**/CD: $3179	7100/8/**500**/CD: $3109
7100/8/**500**/CD/AV: $3989	7100/16/**500**/CD/AV: $3699
7100/16/**250**/SoftWindows: $3879	7100/16/**500**/SoftWindows: $3419
8100/8/**250**: $4249	8100/8/**500**: $4249
8100/16/**500**/CD/AV: $5659	8100/16/**500**/CD/AV: $5062 (Reduced)
8100/16/1 **GB**/CD: $6159	8100/16/1 **GB**/CD: $5379 (Reduced)

self-explanatory. Anyway, I hope you don't find it too confusing, and I suspect you won't after you've used it a few times. Also, for each set of configurations in Table 2.4, the hardware portion that's been upgraded (if any) appears in bold so that you can make the product comparison easily.

Again, keep in mind that the 6100AV model has been discontinued, and hasn't been replaced with a 6100AV upgrade. If you want AV capabilities with a 6100, and you can't find a 6100AV Mac available out-of-the-box, you can purchase the Power Macintosh AV card separately, which currently lists for $479. (I'm always hesitant about giving prices, because they change so frequently, but I realize it helps for you to have a ballpark figure when you're deciding whether to make a purchase.)

Apple's Reach for the High and Low Ends of the Market

Only a few months after Apple began shipping its first suite of Power Macs, executives realized they had a bigger hit than even their most optimistic projections would have suggested. Few companies that have evaluated the Power Macs have been disappointed in what they've seen, and most companies (with the probable exception of Intel) were pleasantly surprised. True, SoftWindows has not lived up to its billing as an acceptable technology for running DOS/Windows applications speedily on Power Macs, but SoftWindows is a band-aid approach anyway. When companies and individual users evaluate Power Macs based on what they do best—which is to run native Power Mac applications—just about everybody is impressed. And the remarkable stability and speed of 68K (Motorola 68000-based Macintosh) applications running on Power Macs in emulation has impressed even the most cynical Macintosh users and observers.

It's not surprising, then, that Apple soon realized that the Power Mac, as a core product line, represented an ever greater possibility for capturing the overall market share of computer sales revenue. The Power Macs were initially perceived to provide a high-end computing solution for existing Mac users who needed more power, and for businesses who in the past could not justify purchasing Macintoshes based on cost and DOS/Windows compatibility issues.

But just about all computer users want more power out of their machines, and if the price is right, they're willing to pay for it. The existing Power Macs touched the edges of two major markets, yet weren't really designed specifically for those markets. It was these two markets that Apple realized it could lure into the Mac fold if the right machines and marketing approach were combined. At the low end, the Power Macs held out the opportunity to capture a larger share of the home computing market; at the high end, the same technology could potentially capture a significant piece of the workstation market.

Apple responded near the end of 1994 by introducing two new product lines, one geared for the home market and the other aimed at the workstation market. The home market is an especially fertile field for Apple because it's an extension of the education market, which Apple already dominates. For parents, it makes sense to buy a computer that runs the same software that their kids use in school—but it makes even more sense if that same computer can also run the same software that Mom and Dad use on their Intel-based PCs at work. Such a machine would be the ultimate "all in one" system. I saw this market potential back in 1993, as I'm sure many others did as well. Back then, I was scratching my head in amazement that Apple also didn't see this potential growth area.

In retrospect, I'm sure that Apple management was fully aware of the potential for capturing a larger share of the home computing market. I now think that they were just being cautious. Trying to capture larger market share or even a small share of an entirely new market can be an expensive business proposition, and I think Apple wanted to make sure the early Power Macs would be successful before risking capital by venturing into new markets.

The Performa Goes Power Mac

Apple's marketing arm has decided to go after the growing market of home computer users by attaching the Performa name to the Power Macintosh line of systems. And that's really the major difference between the Power Mac 6100 line of systems that I described earlier and the new line of home-targeted systems: the Performa name, which has proven value among home-computer buyers. In most other hardware respects, the new Performa line of Power Macs is identical hardware to the 6100 line of Power Macs, so you'll experience the same level of performance with the Performa 6100 systems as you would with the other 6100 systems.

Notice I *did* qualify that assertion with the word "most," but the news is just about all good in this regard.

The most significant addition to the Performa 6100 series of Power Macs is the Global Village 14.4 KBps fax/modem as a standard item. None of the other 6100 Power Macs comes equipped with a modem. Also, unlike the other 6100 systems, you *don't* have a choice in selecting a monitor and keyboard with the Performa 6100 systems. Apple elected instead to keep purchasing options simple to avoid confusing first-time buyers. So, all Performa 6100s come equipped with an Apple Multiple Scan 15" Display and an Apple Design Keyboard. And all Performa 6100 systems come with a CD-ROM drive installed.

That's why prices for the Performa 6100 series start at about $2,600, about $800 over the starting price for other 6100 Power Macs: The base price gets you a lot more hardware, although you don't get to choose which monitor and keyboard options you want. (All of the Performa systems come with 8 MB of RAM, but since their internal design is identical to other 6100 systems, you can add memory just as you can to other 6100 Power Macs.) Also, the Performa systems don't come standard with speakers, so if you want to make the most from the sound capabilities of your Performa Power Mac when you play CDs, you'll need to buy a set of stereo speakers (usually available for under $50).

The goodies don't stop with hardware, though, which leads me to the other major marketing strategy Apple adopted with the Performa Power Macs: a suite of preinstalled software—an approach that PC clone manufacturers have been doing for years. But the software bundled with the Performa systems, unlike a lot of the throwaway software I see on Intel-based systems, is genuinely useful and quite powerful. In fact, the only major differences among the different Performa 6100 models are hard disk size (from 250 MB to 500 MB) and the preinstalled software that's supplied. Table 2.5 shows the different Performa 6100 configurations, along with the software that each configuration is bundled with. I'll use the same shorthand that I used in Table 2.4 in identifying the hardware configuration of each system. For instance, the Performa 6110 8/250/CD comes with 8 MB of memory, a 250 MB hard drive, and a CD-ROM drive.

Table 2.5 Performa 6100 Series Models and Pre-Installed Software

Performa 6110 8/250/CD	**Pre-Installed Software** Claris Works 2.1 MacGallery Clip Art Treasure Pak ClickArt Performa Collection 2.0 Quicken 4.0 Now Up-to-Date 2.1.1 Now Contact 1.1 MacLinkPlus Easy Open Translators 7.52 American Heritage Dictionary 3rd Ed. eWorld 1.0 Spin Doctor Challenger 1.1 Spectre Challenger 1.0.1 **CD-ROM titles:** Grolier's Multimedia Encylopedia, 1994 Time Almanac, EA 3D World Atlas, Family Doctor, Around the World in 80 Days
Performa 6112 8/250/CD	**Pre-Installed Software** Microsoft Works 4.0 MacLinkPlus Easy Open Translators 7.52 Quicken 4.0 Mavis Beacon Teaches Typing 2.0.1 Kid Works 2 1.2.2 Thinkin' Things Performa Version The Writing Center 1.03 eWorld 1.0 American Heritage Dictionary 3rd Ed. Fractal Dabbler 1.0 Spaceway 2000 Spin Doctor Challenger 1.1 Spectre Challenger 1.0.1 SuperMunchies 1.0 **CD-ROM titles:** Grolier's Multimedia Encyclopedia, 1994 Time Almanac, EA 3D World Atlas, Family Doctor, San Diego Zoo Presents Animals, Around the World in 80 Days, Wacky Jack's CD Gameshow, KidSoft CD

Table 2.5 Performa 6100 Series Models and Pre-Installed Software (Continued)

Performa 6115 8/350/CD	**Pre-Installed Software** ClarisWorks 2.1 MacGallery Clip Art Treasure Pak ClickArt Performa Collection 2.0 Quicken 4.0 Now Up-to-Date 2.1.1 Now Contact 1.1 MacLinkPlus Easy Open Translators 7.52 American Heritage Dictionary 3rd Ed. eWorld 1.0 Spin Doctor Challenger 1.1 Spectre Challenger 1.0.1 **CD-ROM titles:** Grolier's Multimedia Encyclopedia, 1994 Time Almanac, EA 3D World Atlas, Family Doctor, Around the World in 80 Days, KidSoft CD
Performa 6117 8/350/CD	**Pre-Installed Software** ClarisWorks 2.1 MacGallery Clip Art Treasure Pak ClickArt Performa Collection 2.0 Quicken 4.0 Now Up-to-Date 2.1.1 Now Contact 1.1 MacLinkPlus Easy Open Translators 7.52 Kid Works 2 1.2.2 Thinkin' Things Performa Version The Writing Center 1.03 American Heritage Dictionary 3rd Ed. eWorld 1.0 Spin Doctor Challenger 1.1 Spectre Challenger 1.0.1 Spaceway 2000 **CD-ROM titles:** Grolier's Multimedia Encyclopedia, 1994 Time Almanac, EA 3D World Atlas, Family Doctor, San Diego Zoo Presents Animals, Around the World in 80 Days, Wacky Jack's CD Gameshow, KidSoft CD

Table 2.5 Performa 6100 Series Models and Pre-Installed Software (Continued)

Performa 6118 8/500/CD	**Pre-Installed Software**
	ClarisWorks 2.1
	MacGallery Clip Art Treasure Pak
	ClickArt Performa Collection 2.0
	Quicken 4.0
	Now Up-to-Date 2.1.1
	Now Contact 1.1
	MacLinkPlus Easy Open Translators 7.52
	Kid Works 2 1.2.2
	Thinkin' Things Performa Version
	The Writing Center 1.03
	American Heritage Dictionary 3rd Ed.
	eWorld 1.0
	Spin Doctor Challenger 1.1
	Spectre Challenger 1.0.1
	Spaceway 2000
	CD-ROM titles: Grolier's Multimedia Encyclopedia, 1994 Time Almanac, EA 3D World Atlas, Family Doctor, San Diego Zoo Presents Animals, Around the World in 80 Days, Wacky Jack's CD Gameshow, KidSoft CD

You won't be able to find all of the Performa 6100 series in all computer-store outlets. In fact, you might not find any of them at a typical computer store. To keep costs down and to simplify sales channeling, Apple is providing different Performa systems to different vendors, depending on their volume-purchase capabilities and their "rightness" for attracting the targeted Performa customers. In general, the Performa 6100 series will be carried in larger electronic stores, department stores, clubs, and educational outlets, including Sam's Club, Price Club, CostCo, Best Buy, Incredible Universe, Sears, Circuit City, Montgomery Wards, Lechmere, ABC, Adrays, RC Willy, Silo, The Wiz, Good Guys, Camp, Brandsmart, HH Greg, Apex, and McDuffs.

Next Stop: The Workstation Level

And now for the high end of the marketing spectrum: With the introduction of the Power Mac 8100/110, Apple clearly has bragging rights to the fastest, most powerful PC on the market. The 8100/110 sports a 110 MHz 601 CPU, and easily provides workstation-level performance for those users who do the ultimate in high-end graphics, engineering, CAD, math, science, and/or desktop publishing application processing. The 8100/110 competes favorably in price with DEC, SPARC, IBM, and other UNIX-based workstations, with a base configuration listing for $6,379.

For that price, you get the following hardware features:

- 256 L2 cache built in
- 16 MB of RAM, expandable to 264 MB
- Fast SCSI 2 GB hard drive
- Internal double-speed CD-ROM drive
- 2 MB of dedicated video RAM, expandable to 4 MB, with additional DRAM support for a second monitor

Aside from these high-performance features, other capabilities of the 8100/110 are identical to the 8100/80 systems, including expansion capabilities. There's one notable exception here, though. The 8100/110 contains a revised NuBus BART controller chip that corrects some of the timing jitter that customers experienced when they installed certain third-party video capture cards. I probably don't need to do any additional selling of the 8100/110 system. If you don't know what most of these hardware enhancements mean in terms of your productivity, then frankly you probably don't need them. If you do need these capabilities, you'll probably instantly recognize their potential and benefits. Apple's quoted base cost of $6,379 does not include monitor or keyboard, nor does it include SoftWindows. At this writing, Apple promises the 8100/110 system in "limited supplies" only; that's because the 110 MHz 601 chip is only available from IBM in limited supply. As IBM increases its volume production of 110 MHz chips, expect Apple to ramp up production of its 8100/110 systems.

Extending the Line

Earlier, I suggested that you not rely on catalog (order) numbers when you're evaluating the different Power Mac models available. One important reason I discourage this stems from the fact that the Power Macintosh product line will grow throughout 1995 and probably into the end of the 20th century. So, the product information I've given in this chapter won't be current by the time you read this. There's no way I could keep you up to date without updating this book every two or three months. If you keep in mind the basic features of the 6100, 7100, and 8100 systems, along with the clock speeds of the systems, you'll have an easier time distinguishing among the different configurations and understanding the features of new configurations as they're announced.

For example, at the January, 1995 MacWorld Expo, Apple announced three upgrades to the 6100, 7100, and 8100 lines. Specifically, the new 6100 offering comes with a 66 MHz 601 chip (in other words, a 6100/66 systems) and will come standard with a 256K cache card; the new 7100 system comes with an 80 MHz 601 chip (so it's called the 7100/80) and also comes with a factory-installed 256 K cache card; the new 8100 system has an 100 MHz 601 CPU (the 8100/100, of course) and comes standard with a 700 MB hard drive.

Unfortunately, this book goes to press before the new systems ship, so I can't provide any more details than these. But expect to see more combinations of logic boards, CPUs, and storage capacities, especially when the clonemakers get rolling. Also expect the numbering system to change slightly when the second-generation PCI-based Macs are announced in mid-1995. Some of these systems will use 604 chips so Apple will probably modify its numbering scheme to accommodate this (the 6400, 7400, and 8400 line possibly?). At any rate, the better acquainted you become with the basic features of the current Power Mac line, the easier it will be to evaluate and understand the differences between new system configurations.

General Power Mac Features

Several basic features are built into all Power Macs, regardless of model and catalog number:

- All Power Macs provide an L2 cache expansion slot, which supports a 160-pin SIMM up to 1 MB in capacity. A 256K cache chip is standard on the 8100/80 and 8100/80AV models. On the 6100 and 7100 models, you have to purchase a cache chip separately—which can actually be a plus since larger 512 K and 1 MB cache chips are available.
- All Power Macs include built-in video support and use main RAM for frame buffers. (I'll have more on frame buffers in Chapters 6 and 15.) The built-in video supports monitor screen sizes up to 13 inches at color depths up to 16 bits, and monitor screen sizes up to 16 inches at color depths up to 8 bits.
- All Power Macs provide extensive RAM upgrade capabilities (described in Table 2.1) via standard 72-pin SIMMs. However, DRAM SIMMs cannot have an access time slower than 80 nanoseconds (80 ns). Slower RAM installed in older Macintoshes cannot be transferred to Power Mac systems.
- All Power Macs provide stereo sound input and output, including support for speech recognition and speech output. Sound I/O bandwidth is from 20 Hz to 20 KHz. System software or other sound-device software can be used to adjust speaker volume.
- All Power Macs now provide DMA (direct memory access) capabilities via a high-speed memory controller (HSMC) chip and an Apple Memory-Mapped I/O Controller (AMIC) chip. (I'll explain more about these and other hardware subsystems in Chapter 6.) DMA provides direct, fast transfers of data to and from memory and peripherals (including disk drives) by bypassing the CPU.

Also, the SuperDrive floppy disk drive, which supports GCR (Apple) and MFM (DOS-compatible) storage formats, no longer includes the "auto-inject" feature that Macintosh users have come to know and love (where you push the disk into the drive bay slightly and the drive grabs the disk and seats it). This change apparently was done to reduce the cost of the disk drive and make it more compatible with other third-party drives. Apple has been beleaguered by complaints from users whose floppy drives have failed and then have had to pay Apple $300 or more to replace the drive. Some users will be irritated by the absence of this feature, but it is really the result of a sound business move on the part of Apple. Users can replace faulty drives at a lower cost and through vendors other than Apple.

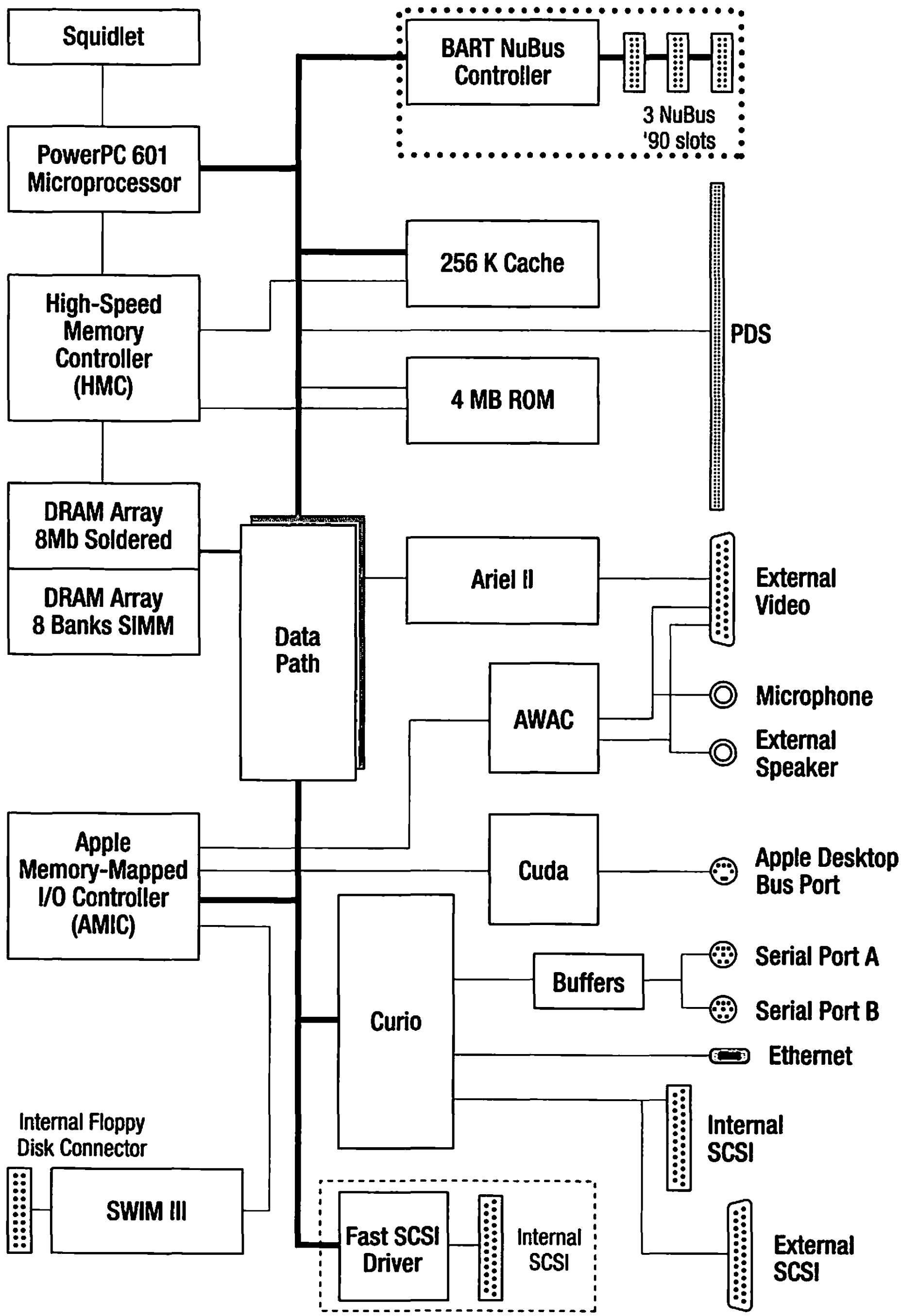


Figure 2.1 Diagram of the Basic Power Macintosh Logic Board

Figure 2.1 shows the basic block diagram for the logic board (also called the motherboard) of Power Mac systems. Components that are available only with the 8100/80 design are surrounded by a dashed line. (Basically, this is just the fast, internal second SCSI bus.) Components that are available only with the 7100 and 8100 systems are surrounded by a dotted line. Don't worry if this diagram makes little or no sense to you. I'll explain all of the Power Mac hardware subsystems in greater detail in Chapter 4. And if you don't want to understand this level of technical detail, you can just skip the illustration.

Basic Expansion and Upgrade Capabilities

As a prospective Power Mac buyer, one of the first questions you'll want to ask is how upgradeable your new system will be. You'll want to know how easy it will be to add expansion cards, RAM, cache, and other features that will improve the performance of a Power Mac. I'll review these basic features in this section. But I have to stress the word basic here. There are some fairly sophisticated expansion or enhancement capabilities that are beyond the scope of this chapter (such as kits to improve the clock speed of your CPU, video and graphics accelerators, and software tools). I'll have more to say on these "advanced" options in later chapters. I'll also have more to say later on available options for upgrading your existing Power Mac to newer Power Mac CPUs and motherboards.

Apple provides several expansion cards that allow you to upgrade Power Macs in various ways:

- **The 6100 NuBus adapter card**: As I mentioned earlier, the 6100/60 Power Macs do not provide NuBus expansion slots. However, you can purchase the NuBus adapter card, which plugs into the 6100/60 PDS. The adapter includes the BART controller chip (which is standard on the main logic board of 7100 and 8100 Power Macs) and accepts one 7-inch NuBus card. (NuBus slots built into the 7100/66 and 8100/80 systems support both 7-inch and 13-inch expansion cards.)
- **The 7100 VRAM expansion card**: This card allows you to add a second monitor to a 7100/66 system or to add 1 MB of 32-bit VRAM to support monitor capabilities over and above the system's built-in video support. The card comes standard with 1 MB of 80-nanosecond VRAM, but is

expandable to 2 MB via 68-pin VRAM SIMMs. Currently, the 7100 VRAM expansion card is not sold separately, but is bundled with all 7100 systems except the 7100/66AV. With the VRAM expansion card, you can display 24-bit color on some monitors.

- **The 8100 VRAM expansion card**: This card allows you to add a second monitor to an 8100/80 system or to add 2 MB of 32-bit VRAM to provide monitor support over and above the system's built-in video capabilities. The card comes standard with 2 MB of 80-nanosecond VRAM, but is expandable to 4 MB via 68-pin VRAM SIMMs. Currently, the 8100 VRAM expansion card is not sold separately, but is bundled with all 8100 systems except the 8100/80AV. When the 8100 VRAM card is fully loaded with VRAM SIMMs, you can display 24-bit color on a 21-inch monitor.
- **The Power Macintosh AV card**: Technically, all Power Macs can be upgraded to support AV capabilities; in September, 1994, Apple announced that it would be selling the Power Mac AV card as a separate item. The card includes 2 MB of VRAM and provides support for all of the Apple AV Technologies capabilities built into the Quadra 840AV and Centris 660AV Macintoshes.
- **RAM expansion**: The first 8 MB of RAM on all Power Macs is soldered to the main logic board. You can expand RAM via 72-pin SIMMs, which must be added in pairs. Here's why: The PowerPC 601 chip has a 64-bit address bus. However, current 72-pin SIMMs are 32-bit only. So, to provide 64-bit RAM access, SIMMs must be installed in pairs (32 bits + 32 bits). Failure to do this will make it impossible for the Apple operating system and the PowerPC CPU to recognize the additional memory. Table 2.2 provides more information on RAM expansion capabilities for different Power Mac models. Also, DRAM SIMMs *must* be 80 nanoseconds or faster and cannot be noncomposite SIMMs.

Apple also sells the following accessories to allow you to add I/O capabilities to various Power Mac systems:

- A PlainTalk microphone (and the corresponding PlainTalk extension) that plugs into the audio input connector available on all Power Macs. And please note: You need a *PlainTalk* microphone to provide speech recognition capabilities! Older Macintosh microphones will not work with Power Macs (as I'll explain later).

- Adapter cables for plugging the AV card into standard television equipment to provide composite video capabilities. You can also view and digitize videos on AV Macs by plugging a VCR to the AV card's input port.
- An Ethernet transceiver box that plugs into the built-in Ethernet connector on all Power Macs. You need this if you're connecting your Mac to a network that uses coaxial Ethernet cables.
- A telecom adapter that provides communications (modem and fax/modem) capabilities via standard telephone lines. This adapter plugs into either of the two GeoPort connectors built into all Power Macs.
- An adapter cable that allows you to connect a non-AudioVision monitor to your Power Mac (sorta—you might need an additional, intermediary cable adapter as well). The cable has a standard AudioVision plug at one end and a DB-15 monitor plug at the other end. This cable comes standard with the 6100 Power Macintosh configurations, allowing you to buy a third-party monitor for your Power Mac with little or no hassle. It isn't necessary for 7100 and 8100 Power Macs, which provide a separate, non-AudioVision plug for monitors.

I've already provided you with descriptions of the 6100, 7100, and 8100 Power Mac capabilities in Tables 2.1 through 2.4. But you might find it helpful to read brief descriptions of each category of system. I'll provide these descriptions in the next few sections.

The Power Mac 6100/60 Model

If you currently own a Macintosh II computer (any model), the Power Mac 6100/60 series of computers will offer you performance enhancements for virtually any application. In fact, most 68000 applications run faster under emulation on the 6100 than they do on a Macintosh II. For native PowerPC applications, expect to see the applications running three to five times faster than comparable applications on a Mac II.

The basic 6100/66 configuration comes with 8 MB of RAM, 1 MB of video RAM (VRAM), a 1.4 MB 3-1/2" SuperDrive (which uses PC Exchange software to read, write, and format disks for DOS and OS/2 formats), and an internal 350 or 500 MB hard disk (formerly a 250 MB hard disk). This basic configuration, like all other Power Mac configurations, also comes equipped

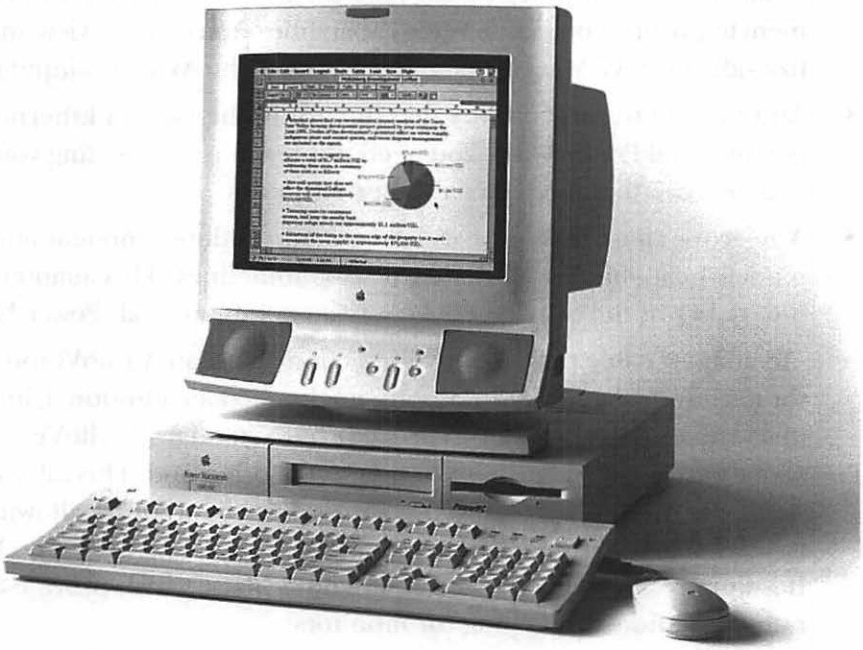


Figure 2.2 The Power Mac 6100 System

with a mouse, built-in Ethernet support, and complete system software and documentation. All 6100 configurations also support a half-height CD-ROM drive bay. Figure 2.2 shows the 6100/60 system. The figure shows an Apple AudioVision monitor, but most other VGA and SVGA monitors will also work with the 6100.

Please refer to Tables 2.2, 2.3, and 2.5 for other available 6100 configurations.

Apple initially offered an AV system for the 6100/60, which provides NTSC (U.S.) and PAL (European) video-in (camera) support, along with support for resizeable windows and frame and video capture. Video-out also supports NTSC and PAL. The data rate for NTSC video (full screen) is 18.43 MB per second, while the data rate for PAL video (full screen) is 22.12 MB per second. (If you're scratching your scalp over these terms and numbers, rest assured that I'll explain all of these AV technologies in Chapter 5.) All Power Mac AV systems include a composite video input cable that allows you to input live color video with a video camcorder. VRAM on the AV system is 2 MB, but is not expandable. The interface supports S-video for video in/out and includes composite (RCA) adapter plugs. The 6100AV system has been discontinued, but you can still purchase the AV card separately from Apple to transform your 6100 into an AV system.

All of the Power Mac logic boards support a 256K level 2 (L2) cache slot, but the cache card itself is standard only on 8100 models. However, users report that a 6100/60 equipped with the optional L2 cache easily matches or outperforms a 7100/66 that doesn't have an L2 cache. I count myself among these users. If you purchase a 6100 machine, give serious thought to buying the optional L2 cache. For my money, a 256K cache card is preferable to a 512K or 1 MB card. For example, the performance boost provided by a 512K cache card over a 256K card is less than 10 percent, although the cost can be more than double.

On the other hand, if you expect to heavily use cache-busting applications like Adobe Photoshop or VideoFusion, you will be better served by an 8100 or even a 7100 with an L2 cache. However, unlike a cached 6100 compared to a cached 7100, you won't get 8100 speeds by adding a cache to a 7100. The reason lies in the basic CPU speeds of the three models. The difference in clock speed between the 6100 and 7100 systems is 6 MHz. A cache card can add the equivalent of about 6 MHz, so a 6100 with a cache card is as fast as a 7100 without one. But the difference in clock speeds between a 7100 and 8100 system is 14 MHz. So, adding a cache card to a 7100 will boost its performance, but won't bring it to the level of an 8100 system.

Table 2.6 shows the color density support available for 6100/60 video systems. Use this table to determine the video system that best supports your display requirements.

Table 2.6 Available Color Density for the 6100/60 Video Systems

Monitor Size	6100/60 6100/60AV DRAM Video	6100/60AV 6100/60AV 2 MB VRAM
14-inch and 15-inch	32,768 colors	16.7 million colors
16-inch and 17-inch	256 colors	16.7 million colors
20-inch and 21-inch	not supported	32,768 colors

The Power Mac 7100/66 Series

The Power Mac 7100/66 series provides a mid-range solution for businesses and home users who want to ensure that their entry-level systems will be expandable. Although the 7100 offers only limited speed performance improvement over the 6100 series (and virtually no speed improvement if you install a cache card on a 6100), it does include three NuBus slots, which can be useful or even essential for users who want to grow their systems into more custom machines later. Personally, I opted for a 6100 system (and added a cache card and boosted the RAM to 24 MB) for my home use because the basic equipment provided just about all of the capabilities I need right now. I didn't really require the raw horsepower and video capabilities of the 8100 systems, although that would have been nice. Also, I figured that, by the time I was ready to add more bells and whistles, the new PCI-based systems would be available. Since I'm willing to trade up later, it didn't make sense to buy a

Figure 2.3 The 7100 Power Macintosh System

Table 2.7 Available Color Density for the 7100/66 Video Systems

Monitor Size	7100/66 7100/66AV DRAM Video	7100/66AV VRAM Video	7100/66 7100/66AV 2 MB VRAM Video
14-inch and 15-inch	32,768 colors	32,768 colors	16.7 million colors
16-inch and 17-inch	256 colors	32,768 colors	16.7 million colors
20-inch and 21-inch	not supported	256 colors	32,768 colors

7100. But that's just me. Your needs could be considerably different. I've also got other Power Mac systems available to me at my office.

The basic 7100/66 configuration includes 8 MB of RAM, 1 MB of VRAM, a built-in 1.4 MB SuperDrive, and a standard internal 500 MB (formerly 250 MB) hard disk. Figure 2.3 shows the 7100/66 system. Apple also offers several other out-of-the box configurations, which I've described in Tables 2.2, 2.3, and 2.5.

The 7100 is also available in an AV configuration that includes NTSC (U.S.) and PAL (European) video-in (camera) support, along with support for resizable windows and frame and video capture. Video-out also supports NTSC and PAL. VRAM on the AV system is 2 MB, but is not expandable. The interface supports S-video for video in/out and includes composite (RCA) adapter plugs. Table 2.7 shows the color density support available for 7100/66 video systems.

The Power Mac 8100/80 Series

For the uncompromising user, Apple provides the Power Mac 8100/80, which comes standard with a 256K L2 cache and a dual SCSI architecture. If you don't opt for the AV version of the 8100/80 system, you can also install an additional 2 MB of VRAM (for a total of 4 MB), which allows you to display 24-bit color on monitors larger than 20 inches—an unheard of option for current Macintosh users. The Power Mac 8100 provides a true dream machine for desktop publishers, graphic artists, CAD designers, scientists and engineers, and other users of high-end graphics and mathematics applications.

The basic 8100, shown in Figure 2.4, includes 8 MB of RAM, 2 MB of VRAM, a 1.4 MB SuperDrive, and a 500 MB (formerly 250 MB) hard drive. Apple also offers several other out-of-the box configurations for the 8100 system,

Figure 2.4 The 8100 Power Mac System

as described in Table 2.3 and 2.4. And don't forget that the ultimate, high-performance 8100 is available with the 110 MHz 601 chip, a system that I also described a few pages back.

The 8100 is also available in an AV configuration that includes NTSC (U.S.) and PAL (European) video-in (camera) support, along with support for resizable windows and frame and video capture. Video-out also supports NTSC and PAL. VRAM on the AV system is 2 MB, but is not expandable. The interface supports two S-video to composite (RCA) adapters. Table 2.8 shows the color density support available for 8100/80 video systems.

Table 2.8 Available Color Density for the 8100/80 Video Systems

Monitor Size	8100/80 8100/80AV DRAM Video	8100/80 8100/80AV 2 MB VRAM	8100/80 8100/66AV 4 MB VRAM
14-inch and 15-inch	32,768 colors	16.7 million colors	16.7 million colors
16-inch and 17-inch	256 colors	16.7 million colors	16.7 million colors
20-inch and 21-inch	not supported	32,768 colors	16.7 million colors

Take a Look at the Apple Bonus CD

If you purchase any of the Power Mac configurations that includes a built-in CD-ROM player, Apple throws in a CD that includes System 7 (currently System 7.5, and is much easier to install from a CD than from floppies) as well as dozens of bonus applications and demos. The Apple CD that I purchased provides demonstrations of native versions of these applications:

- ArchiCAD
- ArtPro
- cc:mail
- ClarisWorks
- Cumulus
- Electric Image
- Flying Nightmares
- Fractal Design Painter
- Framemaker
- Freehand
- Infini-D
- LanSurveyor
- LogoVista
- Mathematica
- Minicad
- Morph
- Nisus Writer
- Omnis
- PageMaker
- Persuasion
- Retrospect
- Sketch!
- Soft Windows
- Spaceway 2000
- StarWriter
- StudioPro
- Utimage
- Vellum
- Vertus VR
- Video Fusion
- Vidi Presenter Pro
- WordPerfect

The CD that you get when you purchase your Power Mac might contain a different set of applications, depending on what model you purchase, where you buy it, and when you buy it. Many of the demos are little more than slide shows, so you can't really use them to do real work. However, you can run the demos to evaluate whether these applications are worth buying. And some of the demos and "lite" software packages provide enough functionality for you to see how fast they can perform on a Power Mac. Again, these are all native Power Macintosh applications running at native speeds.

I should also mention that the CD-ROM disk supplied with this book does not include any of the demo programs mentioned above (except for Spaceway 2000). I didn't want to cheat you. (Why buy a book that contains a CD filled with demo software you already have?) The CD-ROM that comes with this book also comes with loads of great shareware—stuff I handpicked in order to provide diversity along with hours of fun.

Upgrade Options: Today and Tomorrow

If you already have a Macintosh, it's an even bet that you can upgrade your current system to a Power Mac without having to disturb the hardware and software on your current system. But take heed: The older your Macintosh, the less likely it will be that a Power Mac upgrade solution is available or will be made available in the future.

Currently, you can upgrade several Macintosh configurations via options available through Apple and through DayStar Digital. Apple has promised that virtually all color Macintoshes will eventually be upgradeable to Power Mac equivalents, but you probably know better than to rely on promises. So, I've supplied Table 2.9, which indicates which Macintosh systems can be upgraded to Power Mac technology, and whether the upgrades are available now or have been promised for a later date. Note that you can often upgrade existing Macs by trading in your main logic board for a Power Mac logic board. As an alternative, you can purchase either Apple's or DayStar's plug-and-play upgrade cards.

Table 2.9 Logic Board and Upgrade Card Options

Macintosh Model	Logic Board 6100/60 6100/60AV	Avail. Now?	Logic Board 7100/66 7100/66AV	Avail. Now?	Logic Board 8100/80 8100/80AV	Avail. Now?	Upgrade Card	Avail. Now?
Quadra 900, 950	No	N/A	No	N/A	No	N/A	Apple or DayStar	Yes
Quadra 840AV	No	N/A	No	N/A	Yes	N/A	Apple or DayStar	Yes
Quadra 800	No	N/A	No	N/A	Yes	N/A	Apple or DayStar	Yes
Quadra 700	No	N/A	No	N/A	No	N/A	Apple or DayStar	Yes

Table 2.9 Logic Board and Upgrade Card Options (Continued)

Macintosh Model	Logic Board 6100/60 6100/60AV	Avail. Now?	Logic Board 7100/66 7100/66AV	Avail. Now?	Logic Board 8100/80 8100/80AV	Avail. Now?	Upgrade Card	Avail. Now?
Quadra or Centris 660AV	Yes	Yes	No	N/A	No	N/A	No	N/A
Quadra or Centris 650	No	N/A	Yes	Yes	No	N/A	Apple or DayStar	Yes
Quadra or Centris 610	Yes	Yes	No	N/A	No	N/A	Apple	Yes
IIci, IIvx, IIvi, Performa 600	No	N/A	Yes	Yes	No	N/A	DayStar	Yes
Other Performas	No	N/A	No	N/A	No	N/A	Apple	No
LC Systems	No	N/A	No	N/A	No	N/A	Apple	No
IIsi, IIfx	No	N/A	No	N/A	No	N/A	DayStar	No
Other Mac II Systems	No	N/A	No	N/A	No	N/A	No	No
Mac Classic/SE	No	N/A	No	N/A	No	N/A	No	N/A

I need to issue a disclaimer here regarding what you see in Table 2.9. DayStar has announced that upgrade cards for the IIci, IIvx, IIvi, and Performa 600 will be available by the end of 1994, so I've said that the cards are currently available. And DayStar representatives have told me that IIsi and IIfx upgrade cards will be manufactured "eventually," so I've included them in the table. However, as I write this book, none of these cards are available. It's up to DayStar to deliver. In fact, if you have questions about future upgrade options for older Macs, you're best bet is to call DayStar to ask about their plans. To do so, call 800-962-2077.

Evaluating the Upgrade Options

As you can see, in deciding whether to upgrade your existing Mac to Power Mac technology, you are somewhat limited by the availability of upgrade options provided by Apple and/or DayStar for your particular system. For instance, if you own a Quadra 700, 800, or 840AV, you can't purchase a 6100, 7100, or 8100 logic board from Apple; however, you *can* purchase an upgrade card either from Apple or DayStar. On the other hand, if you own a Quadra or Centris 610, your only available upgrade option is a 6100 logic board from Apple; you can't upgrade to a 7100 or to an 8100 Power Mac via a logic board, nor can you purchase an upgrade card from Apple or DayStar.

Mighty confusing.

If you're considering converting your Macintosh to a Power Mac, you need to know two things: First, you need to know which upgrade options are available for your system. That's the purpose of Table 2.9. Second, if you have two or more alternative upgrade paths, you need to understand the tradeoffs involved among the alternatives. That's the purpose of the next few sections.

Apple's Upgrade Card

Apple's Power Macintosh Upgrade Card is the most affordable upgrade solution, although it is available for less than half of all Macintosh models. The upgrade card currently retails for $699, but like most Apple products, you can purchase it for considerably less if you comparison shop at various authorized resellers. Apple is providing aggressive educational discounts, so educational outlets often provide some of the best buys available for Power Mac systems and upgrades.

Currently there is only one basic upgrade card configuration, although the slot's bus configuration varies for the different PDS sizes of different Macintosh systems. You can't plug the Power Macintosh Upgrade Card into a NuBus slot.

The upgrade card includes a PowerPC 601 chip that runs at twice the clock speed of the host motherboard. The card does not contain its own clock, but does contain clock-doubling circuitry to double the speed of the clock on your motherboard. So, for instance, if you have a Quadra 950 that runs the 68040 chip at 40 MHz, the upgrade card can run at 80 MHz—as fast as the CPU on an 8100 Power Mac. If the clock speed of your Mac is 33 MHz or slower, you obviously won't get this kind of performance boost. In any case, just identify the clock speed of your Macintosh and then double that to determine how fast the 601 CPU will run on your system. The card also is currently bundled with the System 7.5 operating system, which includes native versions of AppleScript, PC Exchange, QuickTime, AppleCD Audio Player 2.0, PowerTalk, and QuickDraw GX.

The upgrade card does not come with RAM and does not support any RAM expansion capability. Instead, the card uses the existing RAM on the host motherboard and requires at *least* 8 MB of RAM. But the card does come standard with a 1 MB level 2 cache to provide a performance boost for CPU/RAM transfers. If you want to upgrade your Mac via the Power Macintosh Upgrade Card and your system currently has less than 8 MB of RAM, you will need to add RAM in order for the upgrade card to function. The 8 MB RAM limitation is a restriction of System 7.5 (the Power Mac operating system; System 7.1.2 enforces the same restriction), not the card or the 601 chip. If you add more than 8 MB of RAM to your Mac, the upgrade card will be able to use all of this memory up to the available expansion capability of your Mac.

One particularly attractive feature of the Power Macintosh Upgrade Card is the ability to switch between the 68040 Motorola CPU currently on your Macintosh and the Power PC 601 CPU. This approach is possible because you aren't required to remove the 68040 CPU from your system when you plug in the upgrade card. System 7.5 will disable the CPU by default when you boot. However, because the 68K CPU is still installed and functional, you can optionally specify which CPU to use when your system boots. No hardware adjustments are necessary.

You might find this approach handy if you know you will be running all 68K-based applications during a particular session. If you're running only 68K-based applications, it's sometimes faster to run them on your Motorola CPU than on the PowerPC 601 CPU under emulation. I'll have more to say on emulation later in this chapter and I'll devote an entire later chapter to the technical wizardry of 68K instruction-set emulation. Do keep in mind that you can't switch between the 68K and 601 CPUs "on the fly." You must reboot in order to switch to the other CPU.

Another benefit of the upgrade card over the logic board (other than price, of course) is ease of installation. You can purchase an upgrade card from either Apple or a reseller and plug the card in yourself—usually in a matter of minutes. As I'll explain in a moment, upgrading your logic board is more complex and costly.

Now for the downside. The upgrade card is rather fat and requires that the NuBus slot next to the PDS slot be empty in order for the card to fit inside the system. That means you have to remove any card that is already in this NuBus slot and either move it to another available NuBus slot or remove the card from the system altogether.

One very attractive feature of the new Power Mac systems is the advanced interface features they provide, including direct memory access, built-in Ethernet, flexible video support, enhanced serial ports, enhanced stereo sound I/O, and automatic SCSI termination if no SCSI devices are connected and if no terminator is capped to the SCSI port.

The upgrade card provides none of these new hardware features. You are limited to the interface and hardware subsystem capabilities available on your current Macintosh. If you don't feel that you need or want the enhancements of a Power Mac logic board, but the other benefits of the upgrade card satisfy you, then the card might be the ideal, economical upgrade path for you. For another view of your upgrade card options and what they'll mean in terms of speed and performance enhancements, take a look at Table 2.10. Apple's upgrade card is shown in Figure 2.5.

Apple's Logic Board Upgrades

Apple provides two categories of logic board (motherboard) upgrades—6100, 7100, and 8100 motherboards or 6100AV, 7100AV, or 8100AV motherboards. The major difference between the two categories lies in the video support. The AV motherboards provide NTSC, PAL, and SECAM video-in formats, and NTSC and PAL video-out formats. The AV boards also support video in resizeable windows, frame and video capture, S-video for video in/out, and include composite (RCA) video adapters. The non-AV boards, of course, don't support these features.

The biggest advantage of the logic board upgrades over the card upgrades is the fact that all interfaces and hardware support provided on the actual

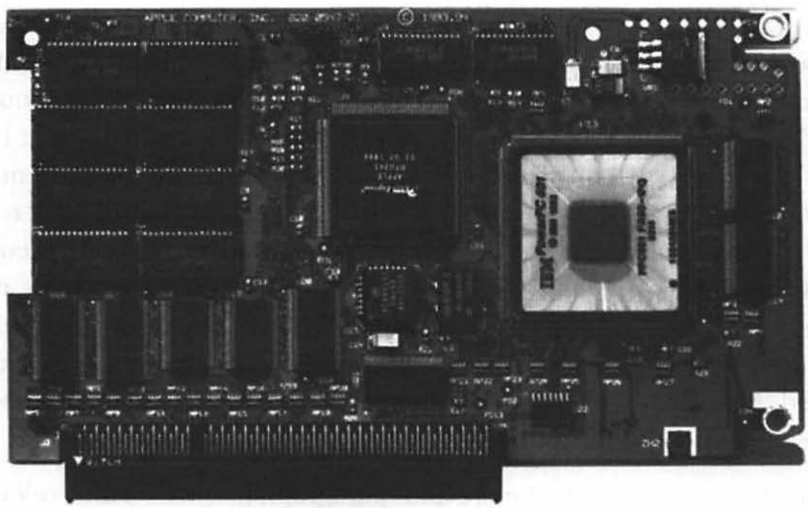


Figure 2.5 Apple's Upgrade Card

Power Macintosh systems are also available on comparable logic board upgrades. So, if you purchase a 6100 logic board upgrade, you will get all of the interface options and hardware subsystems available on a true 6100 Power Mac. You'll also get the same expansion capabilities that are available for corresponding Power Mac systems. As is the case with the upgrade cards, the logic boards are sold along with the System 7.5 operating system. You also get a new case, a new power supply, and full Power Mac documentation. In other words, it's a lot like buying a new Power Mac, except it costs less and you don't have to bother transferring your software from your old system's hard disk to the new system. (There are other benefits, of course.) Those are major considerations if you're thinking about upgrading several systems in your business. Logic board upgrades are a convenient and inexpensive way to convert several systems at a time to the new Power Mac technology and all that the new logic board design has to offer.

The other significant advantage of the logic boards is that the system's clock speed is not dependent on the clock speed of your existing motherboard. That should be fairly obvious since your existing logic board is being swapped for a true PowerPC logic board. So a 6100 logic board runs at 60 MHz, a 7100 board runs at 66 MHz, and an 8100 board runs at 80 MHz—just like their full-system Power Mac counterparts.

There are some significant caveats to consider, though, before you purchase a logic board upgrade. First, the price of a logic board upgrade can be more than double that of an upgrade card. Second, the memory on your existing motherboard might not be useable on the upgrade board. The logic board will only accept 72-pin SIMMs, which are used on many—but not all—Macs. More important, the 601 CPU and System 7.1.2 require that the transfer rate of the SIMMs be 80 ns or faster. If your system contains slower SIMMs, they won't work on the PowerPC-based logic board, even if the board uses standard 72-pin SIMMs. That means you might have to purchase 8 MB or more of RAM when you have your logic board installed. Also, RAM must be installed in pairs to support the 64-bit PowerPC 601's data bus with 32-bit SIMMs.

Some of the discussion in the previous paragraph might be a bit irrelevant to you because a logic board upgrade is really not yours to do. You decide, but an authorized reseller has to do the work. Apple won't sell PowerPC logic boards directly to individual users, only to resellers. So, a logic board upgrade must be purchased from and installed by an authorized Apple reseller. That means that labor charges are built into the logic board markup charged by the reseller. Table 2.10 includes explanations of the advantages that can be offered by upgrading various Macs with Power Mac logic boards.

DayStar PowerCards

If you expect or demand peak performance from your upgraded system, you might want to consider the PowerCard 601 upgrade card provided by DayStar. This is a more high-performance version of its Apple counterpart. In particular, the DayStar card uses an asynchronous design that insulates the upgrade board from the operations of the system clock on your host motherboard. Under this approach, DayStar's card can operate at the same speeds as the PowerPC chip installed on the DayStar board—currently 66 MHz or 80 MHz. As PowerPC chips are released for 100 MHz speeds and higher, DayStar will be able to provide this same level of speed with its upgrade cards—a feature unavailable with Apple's upgrade boards and cards.

The DayStar PowerCard can also accept 128 MB of 72-pin, 80 ns or faster memory in *addition* to the memory already installed on a Macintosh motherboard. In other words, the PowerCard will use the existing RAM on your system *and* any RAM installed on the PowerCard. Table 2.10 shows the

Table 2.10 Performance Improvements with Various Upgrade Options

This Mac:	Runs at This Speed:	With the Power Mac Upgrade Card, Runs at This Speed:	With the DayStar Card, Runs at This Speed:	With the Power Mac Logic Board Upgrade, You Can Achieve This Power Mac Level of Performance:	Which Runs at This Speed:	And Can Give You This RAM Capacity:
Quadra 950	33 MHz	66 MHz	80 MHz			
Quadra 900	25 MHz	50 MHz	80 MHz			
Quadra 840AV	40 MHz			8100/80	80 MHz	264 MB
Quadra 800	33 MHz	66 MHz	80 MHz	8100/80	80 MHz	264 MB
Quadra 700	25 MHz	50 MHz	80 MHz			
Quadra 660AV	25 MHz			6100/60	60 MHz	72 MB
Quadra 650	33 MHz	66 MHz	80 MHz	7100/66	66 MHz	136 MB
Quadra 630	33 MHz	66 MHz	66 MHz			
Quadra 610	25 MHz	50 MHz		6100/60	60 MHz	72 MB
Quadra 605	25 MHz	50 MHz				
Centris 660AV	25 MHz			6100/60	60 MHz	72 MB
Centris 650	25 MHz	50 MHz	80 MHz	7100/66	66 MHz	136 MB
Centris 610	20 MHz	30 MHz		6100/60	60 MHz	72 MB
LC 630	33 MHz	66 MHz				
LC 575	33 MHz	66 MHz				
LC 475	25 MHz	50 MHz				
IIvi	16 MHz	(Available soon)		7100/66	66 MHz	136 MB
IIvx	32 MHz	(Available soon)		7100/66	66 MHz	136 MB
IIci	25 MHz	(Available soon)				
IIsi	20 MHz	(Available soon)				
Performa 630	33 MHz	66 MHz				
Performa 575/577/578	33 MHz	66 MHz				
Performa 475/476	25 MHz	50 MHz				

total possible memory available when DayStar's PowerCard is installed on various systems. As is true for the Apple upgrade card, the software extension for the PowerCard will allow you to switch between the 68K chip on your logic board and the PowerPC 601 chip on the PowerCard whenever you boot—a great feature for those times when you want to run 68K applications natively rather than in emulation.

If you want the power benefits of a DayStar card, you had better be prepared to pay for them. DayStar cards typically run about $1,000 more than their Apple upgrade-card counterparts. Part of this higher cost is due to the superior capabilities and technologies provided by the board itself. But a significant part of the cost is required to recoup the licensing fee that DayStar has to pay Apple for the privilege of using its System 7 ROM. Anyway, for a comparison of DayStar card performance versus Apple's cards and logic board upgrades, take a look at Table 2.10.

What About Those Notebooks?

Apple had initially planned to ship PowerPC-based notebook computers, essentially a replacement for its existing PowerBook line, in the Fall of 1994. The new notebooks were to ship with the PowerPC 603 60 MHz chip, which is less powerful than the 601 chip, but runs cooler and provides for three power-saving modes, making it an ideal chip for laptop and notebook systems.

But unacceptable for Macintosh notebooks.

How come? The problem stems from the need for all Power Mac computers, regardless of their size, to run 68K applications in emulation at acceptable speeds. When IBM and Motorola designed the 603 chip, they departed from the use of a *unified cache*, the approach used in the 601 chip. With a unified cache, data and program instructions are all funneled through the same cache storage space on the chip. To help achieve optimal power savings, though, designers opted to split the cache into two sections: a separate data cache and instruction cache. With this *split cache* approach, the power-saving capabilities of the CPU could shut down the data cache and instruction cache independently, depending on what is entering the chip at any given time.

The split-cache approach created substantial problems for the 68K emulator provided with all Power Mac systems. First, the cache size on the 603 is 16K total (8K for the data cache and 8K for the instruction cache), while the total size for the unified cache on the 601 is 32K. So, on the 601, instructions can be funneled into 32K of cache space, while on the 603, instructions have to be squeezed into 8K of space—essentially 75 percent less room to roam.

For native PowerPC applications, the reduced size of the instruction cache still provides acceptable performance speeds. But when Apple tested the 603 chip with emulated 68K apps, performance was downright insufferable. During emulation, instruction throughput increases dramatically, because the operating system must first tell the CPU that each incoming instruction is not a native PowerPC instruction. The CPU then waits while the 68K emulator converts the 68K instruction to an equivalent set of native PowerPC instructions, and then sends these instructions to the CPU.

The result is that an emulated application on a 603-based system runs at a crawl. Apple had little choice but to request that the Somerset Design Center rethink the design of the 603 chip to better support 68K emulation.

Somerset has been doing just that. The resulting chip, although not yet available in quantity, is called the 603+ and has been redesigned to support more efficient instruction throughput. One of the major new features of the 603+ chip is a boost in speed—the new chip runs at 80 MHz (with faster versions of the chip promised). The on-board cache size has been doubled, and the 68K emulator has also been revamped to improve its efficiency.

But all this fuss over instruction caching has postponed the release of Power Mac notebooks. Currently, the new systems are slated for a May, 1995 release. Reports are that the Power Mac notebooks, code-named M2, will be an inch narrower than the already-slim PowerBook 500 systems, and will weigh in at a pound and a half less than the current PowerBooks. In fact, the design of the PowerBooks seems to be borrowed from IBM's design of its PowerPC-based notebooks. Both the IBM and Apple systems will include a removeable drive bay, allowing you to swap hard disks, floppies, and CD-ROMs on the fly, using the same drive bay. Both systems will also use PCMCIA slots (two available on the Power Mac notebooks) to provide expansion capability.

It still isn't clear which existing PowerBooks will be upgradeable to Power Mac status. But most or all notebooks can probably be upgraded to the PowerPC 603+ by adding an upgrade card to a PDS slot or by upgrading the logic board completely.

Buy Now or Buy Later?

If you haven't yet bought a Power Macintosh system or a Power Mac upgrade (and if you're reading this chapter, you probably haven't), then the logical question to ask is: "Should I upgrade now or wait?"

My answer is always this: "What are you waiting for?"

I'm not trying to be smug. I honestly want to know. Are you postponing your upgrade until a certain level of hardware sophistication is available? Are you waiting until Macintosh systems are able to run DOS/Windows at acceptable speeds? Are you waiting until more native Power Macintosh applications are available? Are you waiting until the next generation of Power Macs are shipping?

Each of these (and many other) questions suggests a different strategy for planning your Power Mac purchasing decisions. It would be impossible for me to cover all of the questions users have in deciding whether to upgrade now, later, or never. But I believe I can successfully tackle some of the more commonly asked questions and resolve some of the more widespread upgrade issues.

Where Are All the Natives?

When Apple announced its PowerPC-based Macintosh systems at the start of the year in 1994, cynics seemed eager to stand in line for the opportunity to blast the new systems' viability. The critique wasn't that the Power Macs wouldn't provide good 68K emulation or wouldn't provide the speed and hardware enhancements that Apple was boasting. No, the major criticism of the cynics was that few native PowerPC-based applications would be available when the Power Macs were ready to ship.

In this case, the cynics seemed at first to be on target—or close enough to the mark to be viewed as scoring a hit. In January, 1994, Apple made public a list of developers who would have native applications available on or near the date of the Power Macintosh rollout, March 14, 1994. (A native application is one that has been compiled to use the instruction set available on the PowerPC 601 chip; other applications use the instruction set available on Motorola 68000 CPUs and require that System 7.1.2 emulate these instructions as corresponding PowerPC instructions at run-time. Emulation means that applications often run slower than they would on a native CPU—such as a Motorola 68040.)

The list described more than 60 applications, and most of these were highly popular Macintosh applications that would be available by summer of 1994 if not sooner.

A little more than a month after the Power Macintoshes were made available (early June, 1994), Apple claimed that about 50 applications were available that ran native on the Power Macs. A survey by MacWeek magazine reported that the actual number of native Power Mac applications was about half that (25 or fewer).

After an initial burst in sales, Power Mac sales began to taper—a result that was expected but perhaps wasn't necessary. Here's why.

The lack of native Power Mac applications helped contribute to a significant stall in continued sales. Users of high-end systems, especially those users within the desktop publishing, pre-press, and video technology markets, were eager for the performance boosts that the Power Mac would offer. And software vendors for these high-end markets also immediately understood how much they had to gain by upgrading their software to native Power Mac versions. Aldus PageMaker, Adobe PhotoShop, Adobe Illustrator, Aldus Freehand, ArchiCAD, VideoFusion, Mathematica, and several other graphic- or compute-intensive applications were quickly updated to Power Mac versions. Some other forward-looking vendors, including Central Point and Claris, also made quick work of porting their existing applications to native Power Mac versions.

But hundreds more vendors balked at the opportunity to upgrade their software to the Power Macintosh immediately. Of course, more than a few of these vendors have long since closed up shop, so there's no way to receive Power Mac upgrades of their software. But for other developers, the major issue has been one of development cost versus return on investment. It's a basic, almost primitive, formula. Consequently, most application software developers have adopted a wait-and-see attitude or they have given their Power Mac upgrade software projects a relatively low priority until Apple convinces them that sales of Power Macs will lead to the kind of software sales that can justify development costs.

It's just third-grade math. Suppose it costs a developer two million dollars to develop a native Power Mac product, and marketing surveys show that their product has been purchased by about 10 percent of Macintosh users. Now suppose that the company adopts a realistic retail price point of $100 for its product, and Apple sells only 100,000 Power Macs in its first year. If all 10 percent of these users upgrade to the new version of Company X's software at a cost of $100, Company X would earn one million dollars on sales of its new product, for a net loss of one million.

That's not much of an incentive.

Apple executives have been bragging that they will sell one million PowerPC units within the first 12 months, and they actually achieved this goal early. But software developers were initially reluctant to listen to a computer company that has been falling behind in sales behind Intel-based systems. Yeah, you and I love our Macs and might not understand the attraction to Windows, but software developers have to answer to a wider audience, and that audience is largely and unfortunately doing Windows.

So, many software developers had been cautiously watching Power Mac sales to determine whether it's worth the expense to develop native Power Mac applications. But most of these vendors climbed on board pretty rapidly. Apple now reports that more than 330 applications have been ported to native Power Mac versions, and the number grows on a weekly basis. It's somewhat annoying, then, to consider the foot-dragging that Microsoft has exhibited in porting their applications to native Power Mac versions.

Microsoft and the Great Floating-Point Debacle

Back in January of 1994, Microsoft was one of the 60 or so developers to announce that they would be converting their applications, including their Microsoft Office suite (Excel, Word, PowerPoint, and Mail) to native Power Macintosh versions. The target release date for the Microsoft Office applications was announced as June 14, 1994.

June 14 passed with no sign from Microsoft that the applications were even nearing completion. Not long thereafter, Microsoft announced that all or most of the Microsoft Office applications would be available by September, 1994. Microsoft officials explained that they didn't want to simply do a quick recompile of their Macintosh applications to Power Mac versions.

Instead, they wanted to build in enhancements that would take direct advantage of the PowerPC 601's speed and floating-point features.

Apple executives and other Apple employees had been bristling with anger over that explanation, and with good reason. While it's true that basic data-crunching applications like word processors and database management programs don't achieve all that much of a performance boost from a quick-and-dirty recompile, spreadsheet applications like Microsoft Excel can be speeded up enormously. And that's important when you consider that the 68K version of Excel runs in emulation on the Power Mac like a dog with advanced arthritis.

When Apple engineers were converting System 7 to the native Power Macintosh version 7.1.2, it became clear that they would not have time to convert the entire set of Toolbox routines to native PowerPC code. (The Toolbox is comprised of thousands of program routines stored in ROM. These routines perform most of the basic graphical user interface functions for programs, such as drawing windows and dialog boxes, opening files, and so on. I'll explain much more about the Toolbox and System 7.1.2 and 7.5 in Chapter 11.)

Apple made an intelligent compromise. Tests have shown that most applications call about 10 to 15 percent or fewer of the total available Toolbox routines. And more important, most applications call the same 10 percent of routines. Armed with this information, Apple elected to convert to native PowerPC code only those Toolbox routines that were heavily used by applications. Since 60 to 80 percent of an application's work is handled by Toolbox routines, a 68K-based program that relies heavily on the native Toolbox routines can often run at or near native PowerPC speeds.

That's one of the more important reasons why users have been so pleasantly surprised by the speed of Power Macintosh's 68K emulation. Much of it isn't really emulation at all. It's also one of the reasons why users have been so *unpleasantly* surprised by the emulation performance of Microsoft Excel.

In keeping System 7.1.2 development time to a minimum, Apple elected not to emulate the 68040 chip's floating-point instruction set. The floating-point unit (FPU) is a dedicated portion of the Motorola 68040 chip used to perform precision numeric calculations, typically for applications that are calculation intensive, such as 3-D graphics applications, scientific applications, and large and complex spreadsheets.

Only a handful of applications won't run on Power Macs if they don't detect the presence of a 68551 floating-point unit, because most applications don't use floating-point instructions. And most of those applications that do rely heavily on floating-point capabilities have been designed to handle the situation in one of three ways:

1. The application has already been converted to a native Power Mac version, which takes advantage of the floating-point instructions of the PowerPC 601 chip.
2. The application does not use floating-point instructions directly and instead calls System 7's SANE mathematic library, which performs floating-point calculations for the application. Since the SANE library has been converted to native PowerPC code, the application runs quickly in emulation.
3. The application fails to detect the presence of a 68551 floating-point unit and in response defaults to a set of integer-based program routines instead of using its faster floating-point counterparts. As a result, the program runs much more slowly in emulation on a Power Mac than it would run natively on a 68551-based Macintosh, but at least it *runs*.

Developers who have handled the floating-point issue through either the first or second methods have been able to satisfy their users with good to outstanding performance. Developers who have handled the floating-point issue via the third method have had a lot of explaining to do. Unfortunately Microsoft adopted the third method for Excel.

Spreadsheet performance is critical for many businesses because spreadsheets handle much of the company's budgeting and accounting work. And Excel is the heavily favored spreadsheet application for the Macintosh. In fact, Microsoft has a full 80 percent of the market share for business software on the Macintosh. Corporate buyers by the hundreds have halted their bulk purchasing plans for the Power Macintosh until Microsoft announces availability of Excel for the Power Mac. In some companies, buyers want to see a stronger commitment on the part of Microsoft to support the Power Macintosh with its full range of business applications.

That's why Apple executives have become so frustrated with Microsoft's behavior. There was a strong feeling among Apple personnel that Microsoft was intentionally trying to sabotage sales of the Power Macintosh by dragging its feet in developing native Power Mac applications. Many people felt that Microsoft wanted to allow its new version of Windows (code-named Chicago) to take hold before releasing native Power Mac applications. By adopting this strategy, Microsoft would encourage sales of Intel-based PCs (which run Windows) and discourage sales of Power Macs (which run a version of the Windows API sold by Insignia, not by Microsoft).

Although this theory might seem to be born of conspiratorial paranoia, it has a foundation of legitimacy. Microsoft has a long history of corporate bullying to stifle competition, as the U.S. Department of Justice has so dutifully noted. But the paranoia about Microsoft is untrue. Microsoft wasn't trying to sabotage the Power Mac systems; it just *didn't much care about them.* To partially explain away their delay in providing native Power Mac applications for the Microsoft Office suite, Microsoft claimed several different things. For Word, Microsoft said that it wanted to focus on developing the 68K version of Word 6 before it tackled the native Power Mac version. And for Excel, well, I haven't heard a very good excuse for that delay.

But, after talking with Microsoft insiders, I do feel that I understand the reasons for all the delays. Bill Gates creates priorities for his developers based on economic realities. And the economic reality here is that Windows is a far more lucrative and therefore important platform for Microsoft than the Macintosh. With Word, Microsoft freely admitted that it wanted to develop the Word for Windows version of 6.0 before it tackled the Mac version. In turn, it acknowledged that it would develop the 68K version of 6.0 before it developed the native Power PC version.

What Microsoft didn't acknowledge is that second- and third-tier development platforms are low-budget, and therefore must find shortcuts to complete their software projects. I've heard it expressed this way: "Microsoft Word 6.0 for 68K Macs was a conversion of the 6.0 version for Windows. Word 6.0 for the PowerPC was a conversion of the 6.0 version for 68K Macs."

In other words, Word for the Power Mac is a "port of a port." What Microsoft did, according to my sources, was to recompile Word 6.0 for Windows (with admittedly some tweaking) to the 68K environment. This conversion was, in turn, recompiled (again, with some tweaking) to a native Power Mac version. Word 6 for the Power Mac was an afterthought created by entry-level (or at least experienced) programmers within Microsoft, and I suspect the same case can be made for the rest of the Microsoft Office suite. Again, it isn't that Bill Gates has it in for the Mac; it's just that he's not convinced that the Mac is a substantial market worth the time and energy of his premiere programmers. I don't know about you, but I find that extremely insulting.

The Future of Native Applications

Microsoft notwithstanding, it's only a matter of time before most Mac applications are ported to native Power Mac versions. In fact, when I first started working on this book, I had planned to include a list of all native Power Mac applications. But the number has mushroomed too fast, and continues to grow. As I mentioned earlier, more than 300 native applications are already available, and that doesn't include the dozens of native Power Mac shareware applications. (I'll provide a list of available native applications in Chapter 9.)

But time is a factor for many users, especially those who are responsible for making purchasing decisions for their companies. Most of the sales of Power Macintoshes to date are attributed to existing Macintosh users who were eager to upgrade. As I've already indicated, a majority of these people are high-end users who truly need the performance advantage of the Power Macintosh systems. Since most high-end applications have already been converted to native Power Mac versions, Apple has been able to satisfy this category of users on both the hardware and software fronts.

But there is a much larger base of Macintosh users who have struggling along for years, doing what they can to squeeze every performance advantage possible from their aging Macs. Many of these users have invested hundreds or even thousands of dollars on hardware and software enhancements to keep their Macs as up to date as possible.

If you're part of this group, you probably already realize that Apple has to convince you that it's time to discard your investment and upgrade to the Power Mac. Apple's best chance of convincing you, as a longtime Mac user, to upgrade is to show you that the applications you routinely use have all (or most of them) been converted to native Power Mac versions, and that these new versions can perform some truly spectacular feats.

For instance, a word processor can take advantage of the Power Mac's floating-point and enhanced sound capabilities by offering such features as spell checking and correcting on the fly, or immediate voice-response notification of a potential grammatical error. Other programs can build in better graphic interfaces, sound capabilities, real-time animation, and other multimedia capabilities that offer genuine value for the business, home, and school user.

Although it's true that developers of these second-tier applications were initially slow to develop native versions for the Power Macs, sales of these systems forced them to get off their collective keesters. But many developers have explained that their delays in introducing Power Mac applications are due to reasons that don't directly relate to the acceptance of the Power Mac. Common reasons include the slowness or bugginess of early development tools, the learning curve required for developers to learn the new PowerPC 601 architecture, and the lack of beta sites available to thoroughly test preliminary software. All of these problems are rapidly becoming history. The fact that hundreds of native applications are currently available is proof of this.

In fact, only a few vendors of existing Macintosh applications have announced they will not be developing native Power Mac versions of their software. (Lotus abandoned Power Mac software versions for all but its Lotus Notes and cc:Mail programs, essentially conceding victory to its competitor Microsoft regarding Lotus 1-2-3 and other applications.) Early sales of Power Macs have been encouraging enough that even some of the most hesitant developers have begun looking at the Power Macintosh more seriously. For instance, Corel recently announced that it would be porting its popular Windows-based CorelDraw! to the Power Mac platform.

A study (admittedly outdated now) performed by a La Jolla, California company called Computer Intelligence InfoCorp found that the Power Macintosh line has been outselling all Pentium systems. Although the report has been controversial, with Intel claiming that CII overlooked mail-order companies and other outlets, the results are still very encouraging for Apple.

The report stated that in the four-month period beginning with the rollout of the Power Macs on March 14, Apple had sold approximately 66,300 Power Macs, compared to total Pentium-based system sales of 40,900. Total Power Mac sales worldwide had reached more than 200,000 systems.

The bottom line: Sales of the Power Mac have been strong and that will encourage more developers to accelerate the development of native Power Mac versions of their existing applications. By the time you read this, you can expect to see a far more robust set of native applications than the list that's available as I write this. For more information on existing and future native Power Mac applications, give Chapter 9 a read.

68000 Emulation Performance

I've already explained the basics of 68000 CPU emulation on the Power Macs, but a few additional words are in order regarding the performance of the Power Mac's emulation capabilities. (I'll explain the *technology* of emulation in great detail in Chapter 9.)

Emulation is handled by a system software component stored in ROM called the LC68040 Emulator. The name stems from the fact that the emulation software closely reflects the instruction set of Motorola's LC68040 microprocessor. (Actually, the emulator presents itself to System 7 as a 68020 chip, but that would be bad marketing. And it's true that most of what an LC68040 chip can do can also be managed by the emulator.)

As I've already explained, only a portion of the System 7 Toolbox has been converted to native PowerPC code, although the most commonly used routines have been converted. Other important components of System 7, including the SANE mathematic library, have been converted to native PowerPC code.

Because System 7 for the Power Mac is really an ongoing development effort, it's important to ask whether the current emulation and other operating system components are good enough to encourage you to buy now rather than wait for the next version of the emulator. The best way to answer that question is to turn to experienced Power Mac users.

In June, 1994, *MacWeek* magazine conducted a poll of Macintosh corporate sites to determine how many sites had purchased Power Macs or Power

Mac upgrades and how well the users have been satisfied with their purchases. Fifty-three percent of 6100 system users rated software emulation as being excellent, compared to 30 percent for 7100 users and 36 percent for 8100 users. (I'll provide an in-depth discussion of how these three systems differ in performance in Chapter 5.) Overall, 65 percent of Power Mac users rated their systems as good or excellent.

I've conducted an unscientific survey of my own by reviewing hundreds of comments about the Power Macintosh on the various online services' hardware and Macintosh developers' forums. Although some emulation bugs have been reported, these have been relatively minor and low in number. The vast majority of developers and users have been very satisfied with the overall performance and 68K emulation of the Power Mac systems, logic board upgrades, and upgrade cards. (Please don't expect me to quantify what I mean by "vast majority." I *did* say that my survey was unscientific.)

Apple has reportedly upgraded its emulator technology, but reportedly won't release it until the "Copland"or "System 8" operating system version is made available.

Another issue involves whether existing systems will be upgradeable with future versions of faster and more powerful PowerPC chips. If you're thinking of buying a Power Mac now rather than waiting, or if you've already purchased a Power Mac, it makes sense to ask whether Apple will make upgrade cards that contain these faster 601 chips (or even the blazing fast 604 chips) and that can be plugged into a PDS on your first-generation Power Mac, or into the L2 cache slot.

For Apple, such plans are too far in the future to commit to any public announcements. However, even if Apple doesn't offer these kinds of plug-and-play upgrades, you can be near certain that DayStar or some other third-party provider will. Since Apple now has agreed to license System 7 to any hardware manufacturer who wants it, we no longer have to rely on Apple for upgrade options.

Apple's emulation and other operating system upgrades will probably be implemented in ROM for newly built Power Macs, but Apple will fairly certainly offer these same upgrades on disk as software patches for users who have already purchased Power Macs.

Trick Your Power Mac into Running a 68040 Floating-Point Application

I hear a lot of confusion from people who try to run 68K applications in emulation on the Power Macs, but get a "floating-point unit not found" error message. "I thought the PowerPC chip had a built-in floating-point unit?" they typically ask. As I explained earlier in the chapter, the PowerPC chip does have a floating-point unit but it accepts native floating-point instructions only.

The problem here is that Apple, in designing the 68040 emulator, elected not to emulate the 68040 floating-point co-processor instruction set. So, when applications that *require* a 68040 floating-point unit load, look for the FPU, and then don't find one, they quit. AutoCad, which has yet to be made native for the Power Mac, is a particularly grievous offender in this regard.

There's a way around the problem, though. The key is to use SoftwareFPU, a small program that emulates the instruction set of Motorola's 68040 math co-processors. It's not a great solution, though, because emulated floating-point instructions slow down your application considerably. SoftwareFPU is available as shareware from several online services and bulletin boards. But it's actually designed to run on 68K machines. If you want the version that's been made native for the Power Mac, which runs your emulated floating-point apps at a better clip, you'll have to purchase it. It's only a $20 investment. To get a copy, call John Neil & Associates at 415-661-2943.

The PCI Issue

Not long after Apple introduced its initial line of Power Macs, reports leaked out that Apple was already busy developing a second generation of Power Macs. These next-generation systems, reports say, will be compatible with existing Power Macs, save for one very important feature: PCI. The Peripheral Components Interconnect local bus standard is slated to replace the existing slower, and less versatile NuBus expansion bus architecture.

But unlike PDS, where you can add a NuBus card to the PDS slot via an adapter, you won't be able to add PCI cards to the PDS or NuBus slots on the existing Power Macs. The reason is fairly simple, although the details are complex. Basically, PCI offers a local-bus architecture, where PCI-based cards can communicate with and transfer data to and from the CPU directly. And unlike the PDS or VESA local-bus standards, PCI can support multiple PCI slots.

To provide this support, PCI relies on a subsystem that is part of the logic board of the computer. Since the logic boards of existing Power Macs don't include the PCI bridge and caching subsystem, you won't be able to add PCI expansion boards to a non-PCI Power Mac. And the only way to upgrade your Power Mac to the PCI standard is to upgrade your logic board.

That's something to consider as you plan a long-range computer use and upgrade strategy. The PCI-based Power Macs won't be available until at least Spring, 1995. If you can wait that long, you might, just might be able to purchase a system that will be the standard for the years to come.

But maybe not. Apple, IBM, and Motorola have already announced plans to develop a common hardware platform that will allow multiple operating systems—including OS/2, System 7.5 and beyond, and Windows NT—on the same machine. I'll explore this common platform in more depth in the next chapter. For now, I would just like to bring home this point: It doesn't matter what you buy today; it will be obsolete tomorrow. It's the nature of this crazy personal computer business.

The Power Mac Does Windows (Sorta)

Most Macintosh users don't really care whether Windows applications will run on their systems. In fact, most Macintosh users sneer at Windows; it's just a System 7 wannabe. But the Windows user base is so large that it's impossible for Apple to ignore. Apple has long sought to entice Intel-based PC users into the Macintosh fold in order to improve its overall presence in the business computing sector. But results toward this end have never been successful. Apple is hoping that the Power Mac technology will change some important corporate minds.

Insignia Solutions, through a licensing agreement with Microsoft, has for several years been a provider of DOS and Windows applications on the

Macintosh platform. However, when Insignia's DOS/Windows solutions have been implemented solely as software, performance has been fair to terrible. Hardware-based solutions for running DOS/Windows applications on the Mac have fared better, but they've always been unpopular because they are just too expensive. Apple's Houdini card used in the test-marketed DOS-Compatible Centris system was an exception; it was wildly popular, and Apple has reintroduced a new incarnation of the DOS Compatibility card for use in 6100 systems (more on this in Chapter 9).

Both Apple and Insignia hoped to achieve good DOS/Windows performance results—in software—with Insignia's SoftWindows 1.0, a software package designed specifically to run on Power Macintosh systems. But reviews of this new DOS/Windows solution have been less than stellar, and the reasons are many.

First, SoftWindows 1.0 emulates Intel's 286 CPU architecture, which means that Windows applications can only run in standard mode. Applications that require enhanced mode (essentially 32-bit Windows, also called Win32 applications) won't run under SoftWindows 1.0. Insignia has been working to address this limitation, and will release a 486-based version of SoftWindows in Spring, 1995. Until then, though, SoftWindows 1.0 is the only game in town.

Second, the performance of SoftWindows can be slow—unacceptably slow for users of 486 and Pentium systems who are accustomed to much snappier performance from their Windows applications. The next version of SoftWindows promises to overcome some of these speed problems because it will support 32-bit instructions. But it's hard to say whether Windows applications that use mostly or entirely 16-bit instructions will run much faster under the next version of SoftWindows. My guess? Not much faster.

Third, SoftWindows is a memory hog. If your Power Mac has less than 12 MB of RAM, you can't even install SoftWindows, and you really need at *least* 16 MB for your Windows applications to run at acceptable speeds—especially if you plan to do any multitasking. The memory problem might become less significant as the cost of RAM SIMMs drops. Thanks to an unfortuitous 1992 fire in a Japanese chip-making plant, the price of SIMMs has risen sharply through 1994. However, DRAM prices should drop again, making memory upgrades a more economically feasible option for users.

Fourth, Insignia will always be leapfrogging Microsoft in terms of current Windows technology. Insignia will be releasing its next version of SoftWindows about the same time (or just a bit earlier) that Microsoft will be announcing the next generation of Windows (Windows 95, of course). By the time Insignia has a Windows 95-based version of SoftWindows available, Microsoft will probably be well on its way toward development of a more advanced Windows version—probably one that welds the best of Windows NT, System 7, and Windows 95.

It's safe to say that Windows applications running on Power Macintosh systems will always be a "second-best" alternative to running Windows natively on Intel-based systems. If you need to run Windows applications, the question to ask is whether "second best" is good enough. Again, I'll turn to the *MacWeek* survey, which reported that two out of five sites surveyed had purchased Power Macintoshes with SoftWindows preinstalled. Of these sites, only 1 in 10 reported Windows emulation as excellent. (Actually, the term "Windows emulation" is a misnomer. Windows applications run natively on the Power Macs. It's the Intel 286 *instruction set* that is emulated in order for Windows to run.)

In my own unscientific survey of comments on bulletin boards, I've concluded that most SoftWindows users have been disappointed with the software chiefly because Apple and Insignia made performance boasts that don't hold up under real-world testing. But I've also noted that once users have overcome their initial disappointment, they're often satisfied with the performance of SoftWindows; in other words, they're "satisfied" that Windows applications run at speeds acceptable enough to get the job done without sorely trying their patience, as was the case with SoftWindows' predecessor, SoftPC.

Another point to ponder is that an increasing number of Macintosh applications allow you to save and store files in DOS or Windows-compatible formats. Since PC Exchange is bundled on all Power Macintoshes, all Power Mac logic board upgrades, and all Power Mac upgrade cards, it's often quite easy to port your Macintosh files to DOS/Windows equivalents. That's good news if you're a Macintosh user at home but have to be able to bring your Macintosh-based files to work for use on your office PC. I still have a 486 PC on my desk at home, and I find it increasingly easy to port my

Power Mac work to the Windows environment with just a diskette swap—no MacLinking or other remote cabling solutions required.

There is, however, one important advantage of SoftWindows that should not be overlooked or underestimated. A Power Mac running SoftWindows can connect seamlessly with any Windows-compatible network. For 90 percent of PC-based businesses, that means Novell NetWare. Since all Power Mac systems and logic board upgrades provide built-in Ethernet support, this level of connectivity is extremely easy to provide. And, although it's not widely known, you can install Windows for Workgroups 3.1 on top of SoftWindows to connect with a Windows for Workgroups server. (You can't install Windows for Workgroups 3.11, though, because that's a 32-bit —in other words, 386-based—version and thus won't run under SoftWindows 1.0.)

Also noteworthy: Novell has been working furiously on porting Novell NetWare 4.1 to Apple's new PowerPC-based workgroup servers. When this technology is in place, corporate sites can link Power Macintoshes and Intel-based machines in a 100-percent seamless manner, assuming that all network drivers are made Power Macintosh compatible. Under this technology, SoftWindows will not be required to support NetWare. I'll explore SoftWindows and other DOS/Windows alternatives for the Power Mac in depth in Chapter 9.

This Unified Platform Thing

There's been a lot of talk in recent months of a unified hardware platform being developed for both Power Macintosh and IBM's PowerPC systems. Such a unified platform will allow both System 7 and IBM's operating systems to run on the same platform, which means applications for these two environments can run simultaneously on a single machine. Although this unified-platform concept offers some great opportunities for users, and Apple and IBM have already announced their intentions to create this platform, there are some roadblocks.

I'll have much more to say about the concept of a unified platform, along with other issues that IBM and Intel-based PC users have addressed about the Power Mac systems, in the next chapter.

A Few Final Purchasing Caveats

If you've decided to purchase one or more Power Macs for your home, office, or school, you'll probably find the information in this section to be useful in determining how to make the smartest purchase.

The first point to keep in mind is one I've already made a few times in this chapter, but I'm surprised how irritated people get when they discover that any quoted Power Mac price (for a new 6100, 7100, or 8100 system) does not include monitor or keyboard. (An ADB mouse is standard for all system purchases.) Of course, Apple sells its own monitors and keyboards, and some of these monitors are specifically designed to take advantage of the Power Mac's enhanced capabilities. But other third-party monitors can be had at a bargain. So, it's smart to know all your options up front.

For instance, the standard AudioVision monitor that Apple sells with the Power Mac 6100 systems includes built-in stereo speakers to take advantage of the enhanced sound capabilities of Power Macs. But the Power Mac's built-in video support allows you to plug in just about any third-party VGA, SVGA, or higher-resolution monitor into your Power Mac. (However, you might not be able to take full advantage of the resolution capability of the monitor. See Tables 2.6 through 2.8 for available resolutions and color densities for the different Power Mac systems.) If you want stereo sound, you can purchase and plug in speakers to the sound port available on all Power Macs.

By way of example, I purchased an NEC MutiSync 3V SVGA monitor for one of my Power Macs, and I've been extremely pleased with the results. The Apple AudioVision monitor was selling at CompUSA for $700. I purchased my NEC monitor for under $400 and I think it provides comparable or better performance over the overpriced Apple monitor. The problem is that many salespeople aren't well trained in the features and options available with Macintosh systems. At a lot of computer superstores, there seems to be the designated "Macintosh guy," with all of the other salespeople specializing in the "Wintel" (just a combination of the Windows software and Intel hardware names) platform. Unfortunately, you might very well be the most well-informed Mac person in the store. If so, it's up to you to figure how to get the best system at the best price.

The only caveat here is to make sure the monitor you buy can be cabled to your Power Mac motherboard. With 6100 systems, Apple supplies an adapter cable that contains an AudioVision HDI-45 plug at one end and a DB-15 monitor socket at the other end. However, this adapter won't work for most VGA and SVGA monitors. You'll probably need to purchase an intermediary adapter, at a cost of about $5 to $20.

Fortunately, NEC makes this adapter, chiefly because NEC monitors have long been popular among Macintosh users and NEC has been eager to provide connectivity solutions for Macintosh users. If you purchase a NEC monitor for your Power Mac, NEC will even send you the required adapter cable free of charge. In any case, before you purchase a third-party monitor, insist that the salesperson take it out of the box and plug it into one of the demonstration Power Mac models. (If the store doesn't have any running demonstration models, run, do not walk, to the exit.) That way, you can verify whether you'll need any additional cable adapters and whether the monitor does in fact work with the Power Mac. If the salesperson is unwilling to help you in this regard, I suggest you go to a place that really wants your business.

Although the NEC monitor I purchased doesn't include built-in speakers, I already owned a pair of Labtec stereo speakers, which I plugged into the sound port on my Power Macintosh. Took me about 3 seconds. Labtec and comparable stereo speakers typically cost about $30 to $60. So you can save hundreds of dollars by shopping for third-party monitors and speakers.

I also declined to purchase Apple's extended keyboard, which retailed at CompUSA for about $150. Instead, I opted for SIIG's MacTouch extended keyboard, which sold for $100. I actually prefer the rapid-release touch of their keyboard to the mushier Apple keyboard—and I saved $50. In fact, by shopping for monitor and keyboard bargains, I saved about $350 over what I would have spent on an all-Apple system. The moral, of course: You'd better shop around.

RAM, too, can be had for some decent bargains. Dozens of mail-order firms sell 72-pin 80 ns or faster RAM SIMMs. If you're not afraid to install SIMMs yourself, you can often save money on a Power Mac system by buying a base memory configuration and then adding RAM yourself by purchasing it mail-order. The only problem here is that some mail-order vendors sell RAM "as is," which means you can't return the SIMMs if they don't work. The vendor's concern is that you're returning the RAM because you damaged it during installation. That's less easy to do with Power Macs then it once was with older

Macs. SIMMs today are pretty sturdy, and the Power Mac logic board can take some pretty rough treatment without suffering any damage. If you want to add RAM yourself, find an outlet that will allow you to return the RAM if it's defective or the wrong size, speed, or configuration for your system.

You might also want to consider shopping around if you plan to purchase a CD-ROM drive for your Power Mac. I have to confess that I opted for Apple's built-in CD-ROM drive because I didn't want to hassle with installing a third-party CD-ROM drive. But you might not want to be so lazy. The 6100, 7100, and 8100 systems all provide a bay for an internal CD-ROM drive. If you shop around, you can probably save some cash by purchasing a third-party CD-ROM drive and installing it yourself.

On a final note: If you're buying a new 6100, 7100, or 8100 system, make sure you're not being sold a bill of goods. Some unscrupulous resellers are swapping motherboards on their existing Mac systems or plugging in upgrade cards, and then trying to sell these upgrades as Power Macintosh systems. Some users have reported that dealers have tried to justify this tactic by stamping "Power Macintosh Upgrade" or something similar on the packaging. These resellers are trying to recoup losses they expect due to dwindling demand for 68040 system stock when Power Mac systems offer so much more to new buyers. When you buy your system, insist on having the salesperson open the box and allow you to inspect the system.

Of course, if the reseller has swapped the motherboard in an existing 68040 system for a Power Mac motherboard upgrade, you'll find it difficult to tell the difference. Ask the dealer whether the system you're buying is a new, off-the-shelf Power Mac or is an upgrade package. If the dealer tells you you're buying a new Power Mac system when in reality you're getting an upgraded system, you then will at least have some legal recourse if you want to sue these jerks for trying to deceive you.

I've also heard of Apple resellers trying to sell all kinds of nonexistent add-ons, such as additional video memory for 6100 systems (no such beast), built-in 604-chip upgrade capability (they're probably banking on the possibility that the L2 cache slot will be used to plug in a 604-chip upgrade), and other assorted chicanery. It's unfortunate that a few crooked resellers make it difficult for the rest of the reselling world to establish their reputations—unfortunate but true. As always, buyer beware.

CHAPTER

3

The Power Mac versus the Competition

Some Business Incentives

In Chapter 1, I provided some background into the forging of the Apple, IBM, and Motorola alliance, and explained why these three mega-corporations have almost been forced by circumstances into working together. It's ironic, then, that all three companies are using the PowerPC technology to *compete* with one another. Both IBM and Motorola have announced their own PowerPC-based personal computers, and the forthcoming unified platform means virtually any manufacturer that wants to can make PowerPC systems in the future. And of course, all of these PowerPC computers have to face stiff competition from the "Wintel" platform providers.

As a Power Mac user or potential user, your chief interest in this area probably lies in knowing how Apple's new systems compare with the competition. You're probably also interested in knowing more about the unified platform and what that will mean to you as a computer user in the future. Both of these issues are the focus of this chapter. In fact, this chapter deals with the wider range of PowerPC issues that extend beyond the basic 6100, 7100, and 8100 Power Macintosh systems. It's chiefly intended for business people who need to assess and compare the PC and Macintosh platforms that are currently available and that will be made available in the near future. But non-business Macintosh users will also find much of the material in this chapter useful.

The PowerPC World Viewed through Big Blue Glasses

IBM has had a critical role in the development of PowerPC technology and in the longer term has played an essential role in the evolution of personal computing. Evidence of this continued influence is Apple's recent decision to clone its Power Mac systems and to work with IBM to develop a common hardware platform that clonemakers can follow to build systems that run both Apple's and IBM's operating systems, as well as others.

IBM will be ramping up sales and marketing of its own PowerPC-based systems, called Power Personal Systems as early as the Spring of 1995. As a result of some ongoing bungling within IBM, Apple has been given a long head start in the PowerPC systems game. But when Power Personal Systems are available, many users who want to jump to RISC and PowerPC-based systems will have to make a tough decision over the short term: Power Mac or Power Personal? That decision will be less important, though, in 1996 when clonemakers begin to release unified-platform PowerPC systems that can run both OS/2 and Mac OS applications natively.

HOT TIP

IBM's Reference Platform (Prep)

The initial PowerPC-based systems that IBM's Power Personal Systems division will offer follow a common platform design created by IBM—and *not* followed by Apple. IBM created this PowerPC Reference Platform (Prep) as a standard hardware/operating system design that clonemakers can follow in building their own PowerPC computer systems.

Unlike Apple, IBM has never been unwilling to encourage other manufacturers to clone its PowerPC systems. In fact, IBM wants to encourage clonemaking. The reason is fairly simple. IBM, along with Motorola, is the major supplier of PowerPC CPUs. While personal computers are a small-margin business, CPU sales margins can be much bigger.

The Prep platform is a temporary standard, though, to be replaced by the AIM unified platform design sometime in 1995. (I'll discuss this platform later in this chapter.)

Defining the Term "Native Application"

I should pause here to explain a widely used but widely misunderstood term. I briefly introduced the expression "native application" in Chapter 1, and it's one you're likely to hear frequently as operating system developers (including Apple, IBM, and Microsoft) jockey for ideal position in the changing computer systems marketplace. If you're still a bit fuzzy about what's meant by the word "native," you're part of a very large club. The word is frequently used, but rarely explained. So I'll do both right now.

The program code that makes up a particular application can run only on one operating system—be it the Mac OS, DOS, Windows 95, OS/2, UNIX, or any other operating system. That's because an application relies on the operating system to handle many basic functions, from opening a file or printing it, to drawing windows and dialog boxes on the screen.

In order for an operating system to perform these functions, it in turn must be written to take advantage of the features of a particular CPU chip design. Specifically, the chip is designed to support a specific "instruction set"—that is, the basic processing operations the chip is capable of performing. The role of an operating system is to supply these native instructions to the CPU so that the chip can in turn do the work that's requested by the application, or more importantly, by you. So, an application relies on an operating system which relies an the services of a microprocessor chip.

Simple, yes? When you hear the term "native application," it refers to the fact that the application is designed or coded specifically for a particular operating system. But you also need to know what *isn't* a native application. In this regard, the opposite of "native" is "emulated." Some operating systems or operating system add-ons have the capability to run code for an application that was actually designed for some other operating system and CPU (remember, these two are closely linked—if an application isn't native to an operating system, it also isn't native to that operating system's CPU). SoftWindows, for instance, runs on a Power Mac and emulates the Intel 80286 chip instruction set so that you can run DOS on Windows on your Power Mac. A separate LC68040 emulator program is included on a ROM chip in your Power Mac to do a similar job in emulating code for applications that were designed to run on Motorola 68000-series Macintoshes.

To do this, the operating system or its emulator utility converts each original, or native, instruction, into one or more corresponding instructions that are part of the foreign CPU's instruction set. Obviously, this takes time to do, and slows down the application. The amount of speed reduction that occurs for the most part depends on how good the emulator is.

So a native application is one whose code is written specifically for a particular operating system/CPU combination. An emulated application is one whose code must be converted to "native" instructions as it runs. That's why Apple and other hardware and operating system manufacturers try to increase the number of native applications available for their platform. If a given hardware platform or operating system has a large number of fast, native applications, it makes that platform more attractive to potential buyers. Emulation is the focus of Chapter 7, so if you want to know more about emulation technology on the Power Macs, that's the place to look.

The Windows That Mac Users Love to Hate

And then there is that massive corporate user base known as the Windows community, which has been relying on Intel-based systems for years—thus, the term "Wintel platform," which refers to the combination of an Intel 80×86-based system running some version of the Microsoft Windows "operating system." (Technically, all versions of Windows prior to Windows 95 and Windows NT are not operating systems; they're just graphical interfaces that run on top of the DOS operating system. That's one of the more important reasons why the Mac OS is inherently superior to these Windows versions.)

From its market research, Apple knows that within this Wintel user base is a category of "fence sitters," people who might be enticed into switching from Windows and Intel to the Macintosh technology. What Apple has no way of knowing is how many people on that fence *will* switch.

In any event, Apple knows its window of opportunity into the business community has never been wider. Until IBM and some clonemakers jump in, Apple will be the only PowerPC-based company offering these systems to businesses. If Apple can earn just an additional 5 percent of the business computing market, its sales would grow by hundreds of millions of dollars. And one of Apple's more important strategies is actually to *give* part of its business away to clonemakers, a strategy that Apple feels will increase the overall presence of the Macintosh in the marketplace. Apple has a two-tiered strategy to achieve this increased presence.

The first approach—a short-term solution—is to allow other vendors to clone the Macintosh. Apple has developed a common hardware platform called the Macintosh RISC Architecture (MRA) that clonemakers can follow to build their own Power Macintosh systems. System vendors simply pay hardware and software licensing fees to Apple, which then entitles the vendors to purchase logic board parts from Apple's suppliers.

Because of these fees, Power Mac clonemakers won't be able to compete with Apple based on logic-board savings that are passed on to consumers. Instead, clonemakers try to build less expensive Power Macs by shopping carefully for other hardware components—such as SCSI drives, power supplies, cooling fans, cases, and so on—that will allow these vendors to sell Power Macs at or less than Apple's prices. This has been basically the same approach that PC clonemakers used to undercut IBM's PC price structure in the mid-1980s. But Apple is willing to encourage this kind of competition as a tradeoff for increasing the presence of Power Macintosh systems in the marketplace.

The second, long-term approach, is to develop a unified hardware platform with IBM and Motorola so that multiple operating systems can run on any system that's built according to these hardware-platform specifications. When that happens (during 1996), *anybody* who wants to can build Power Macintosh systems. At first blush, that idea seems suicidal for Apple. But under close examination, it's an idea that's sensible to the point of being visionary.

You'll want to read the remainder of this chapter, then, if you're interested in multi-platform capabilities, or if you're just interested in how Apple's existing marketing strategies for the Power Mac will metamorphosis throughout 1995 and 1996 in order to pit the Power Macs against the competition. The bottom line here is that multi-platform agreements mean a wide range of purchasing options for users. So, I plan to assess, in as objective a manner as I can muster, the relative merits of the Power Macintosh, Power Personal, and Windows platforms, I'll explain how they compare with one another, and explain how two if not all three of these platforms might someday merge into a single platform.

Growing the Seeds of Discontent

I originally hadn't planned to discuss Windows on the Power Mac except in passing, because I felt that interest in this kind of cross-platform or multiplatform use was too low. I wasn't convinced that Wintel users would give any real consideration to switching to the Power Macintosh platform. History would seem to agree with that assessment. Apple has made several attempts to lure Windows users over to the Macintosh platform, with almost no success. Why should I expect Apple to have better results with the Power Mac platform?

I changed my opinion when I was in Cupertino, California to give a talk, along with Jeff Duntemann, on the PowerPC technology. The talk was sponsored by Computer Literacy Bookshops and was to be given in an auditorium on the Apple campus. The day was May 20, just two months after the rollout of the Power Mac systems. Given the location and timing, I was feeling a bit intimidated. I expected that a large percentage of the audience would be Apple employees and other Macintosh users—many of whom would know more about the Power Mac systems than I knew.

I was extremely surprised, then, when I polled the audience and discovered that only about 5 percent of the crowd worked for Apple. Surprise turned to shock when I asked for a show of hands of those who were primarily or solely users of Windows-based systems. A full 90 percent of the audience raised their hands. But that wasn't the stunning blow. When I then asked how many of these users would *prefer* to use Macintosh systems, almost the same 90 percent raised their hands.

It seems that Apple's unrelenting advertisements about the Macintosh being a "better Windows than Windows" have actually had some effect. When I think back to my discussions with Windows users through the years, I probably shouldn't have been surprised by the strong tide of discontent. I constantly hear that Windows applications are pretty easy to use, but that Windows itself is a pain in the rumpus. Printing can be difficult, networking is always difficult, getting Windows to cooperate with COM ports can be a hassle, and memory conflicts between Windows and DOS applications and terminate-and-stay-resident (TSR) programs are a continual headache. When I ask users how often their systems or networks crash, I far too often hear answers like "once a week" or "daily" or "when *doesn't* our network crash?"

Contrast that with the dear love for Macintoshes showered by Macintosh users. As frustrated as Macintosh users often get with Apple as a company, they almost never express any disloyalty or disdain for their Macintosh systems. Should I have really been surprised, then, to find that so many Windows users have Macintosh envy?

The Power Mac versus Wintel: And the Winner Is...

There are two ways to compare the Power Mac Davids with their Goliath Wintel-based opposition: Compare the PowerPC chips against comparable Pentium chips or compare full-blown Power Mac systems with comparable Pentium systems. A comparison of the chips is beyond the scope of this chapter, but I'll address that issue in Chapter 4. Here, I'll focus on comparisons between the systems.

There are *at least* two ways to compare Power Mac and Pentium systems: Price and performance. A number of other approaches are possible, of course, such as "number of native applications available," "built-in networking capabilities," "cross-platform compatibility," and so on. But price and performance provide the two most widely recognized benchmarks.

Comparing Power Macs and Pentiums on the basis of performance is a near-impossibility. In terms of raw performance at the chip level, the PowerPC chip clearly wins over a Pentium chip of comparable speed. (Again, see Chapter 4 for a chip-to-chip comparison.) But if you try to compare performance on actual systems, all you'll get is a headache. Here's why: System performance is not just tied to the speed of its CPU. Other factors become critical, including the type of bus used, the efficiency or presence of L2 cache, the quality of the operating system and native applications, the number of hardware subsystems that are supported, and much more.

For instance, for a PC to be designated as an "MPC" (Multimedia Personal Computer), it must come equipped with a sound card, along with a CD-ROM drive and a few other multimedia hardware capabilities. But you can't install a sound card in a Power Mac, because *all* Power Macs include stereo sound capabilities built directly into the logic board. In other words, there's no need for a separate sound card on Macintosh computers.

To support fast, high-resolution graphics on a PC, you need to purchase a system with a VESA local bus. On a Power Mac, you can't get comparable video on a 6100 system (chiefly because you can't add video memory to a 6100), but on 7100 and 8100 systems, video speed and resolutions are superior to Pentium systems and you don't need any special hardware (although you can add video RAM to the base 7100 and 8100 configurations to boost video performance even higher).

At the application level, consider Microsoft Word 6.0, which runs much slower on a Power Mac than it does on a Pentium system. PageMaker 5.0, by contrast, runs faster on a Power Mac than it does on a Pentium. So even when a level playing field is created by outfitting a Power Mac and a Pentium with comparable hardware, some applications will perform better on one platform or the other.

Feeling confused?

The bottom line is that it's possible to demonstrate better performance on a Pentium or on a Power Mac, depending on which variables you choose to jury-rig. Personal and business requirements play a role here. If you prefer the Mac OS over Windows, then the Power Mac is the clear choice. If you need 100-percent compatibility across a Novell network, you're currently better served by going with Pentium systems. If your company does a lot of high-end graphics processing, you'll want to outfit your company with Power Macs. If all your company does is spreadsheet, database, and word processing, then Power Macs and Pentiums are *both* overkill for your organization.

And that might be the biggest performance difference between the two systems. If your applications demand that your system be processor intensive—that is, be capable of pounding through as many instructions as possible within a short period—then both the Power Mac and the Pentium are excellent choices. Both the 601 and Pentium processors perform integer instructions at comparable speeds.

If you want ease of training, the Power Mac again is the choice. A May, 1993 report conducted by Gartner Group Inc. (prior to the introduction of Power Mac systems) revealed that training costs for new Macintosh users are lower than training costs for new Wintel-platform users. Since the Power Mac uses the same operating system interface as earlier Macintoshes, it's reasonable to conclude that users can more easily be trained on Power Mac systems than on Pentiums.

If you need to perform graphics- or math-intensive processing on a regular basis, you'll want a Power Mac. Its operating system and hardware subsystems provide excellent graphics support, and the floating-point capabilities of the 601 chip far outstrip the capabilities of the Pentium. But again, that's a difference in chip design, which I'll postpone until Chapter 4.

So, the critical difference, then, is a price comparison when it's *combined* with a performance comparison—to provide a meaningful price/performance ratio. *MacWeek* performed just such a comparison and printed the results in its January 2, 1995 issue. *MacWeek* compared the 6100/66 system against three leading Pentium systems, and compared the 8100/110 against three comparably equipped Pentium systems. Although you might expect *MacWeek* to be biased in favor of the Power Macs, their comparisons were made using fairly objective price and hardware variables.

The results of the study reveal that the Power Macs have a significant advantage when price and comparable hardware configurations are combined. Table 3.1 shows the results of the *MacWeek* survey.

Need Relief? Just Go to Chicago

Microsoft has promised that most of the complaints about Windows will disappear with the release of their next version, now called Windows 95 and formerly code-named Chicago.

With Windows 95, logging onto a network and using network services will be an exercise in elegant simplicity, we are told. Device and memory contention will be much less of a problem because DOS will no longer be the underlying operating system, although it will remain an option for use as a virtual machine running within Windows. (In a virtual DOS machine, Windows runs DOS and applications in a separate, isolated area of memory so that DOS "thinks" it's the only operating system running on the computer.)

The clunky Program Manager will disappear, to be replaced by a more Mac-like user interface that will make finding files and programs much simpler. And perhaps most important, the new Windows 95 version will be a true 32-bit preemptive multitasking operating system, something that Apple can't

Table 3.1 Desktop System Comparison

Model	**Power Mac 6100/66**	**Compaq Deskpro XL 566***	**AST Bravo MS P/60**	**Dell Optiplex XL575**
Price	$2,029	$4,198	$2,528	$2,045
Processor	66 MHz Power PC 601	66 MHz Pentium	60 MHz Pentium	75 MHz Pentium
RAM (min./max.)	8/72	16/144	8/128	8/128
Hard Disk	350 (SCSI) /CD-ROM	535 (SCSI-2) /CD-ROM	420 (EIDE) /CD-ROM	528(EIDE) /CD-ROM
Expansion Ports	1 PDS or NuBus slot	3 EISA, 2 PCI	3 ISA, 2 PCI	3 ISA
Open Drive Bays	None	Two 5.25	One 5.25, one 3.5	None
Built-in video support	16-bit at 640×480; 8-bit at 832×624	QVision 2000 (8-bit at 1,280×1,024; 24-bit at 640×480)	16-bit at 1,024×768	SE Vision 864 4-bit at 1,280×1,024 to 24-bit at 640×480)

Model	**Power Mac 8100/100**	**Compaq Deskpro XL 590***	**AST Premmia GX P/100**	**Dell Omniplex 5100**
Price	$4,559	$4,798	$7,952	$5,657
Processor	100 MHz Power PC 601	90 MHz Pentium	100 MHz Pentium	100 MHz Pentium
RAM (min./max.)	16/264	16/144	32/192	16/192
Hard Disk	1 GB (SCSI-2) /CD-ROM	1 GB (SCSI-2) /CD-ROM	1 GB (SCSI-2) /CD-ROM	1 GB (SCSI-2) /CD-ROM†
Expansion Ports	3 NuBus	3 EISA, 2 PCI	5 EISA, 1PCI	3 EISA, 2 PCI/EISA
Open Drive Bays	One 5.25	Two 5.25	Two 3.5, one 5.25	One 3.5, two 5.25
Built-in video support	16-bit at 640×480; 8-bit at 832×624; 24-bit at 1,152×870 w/4 MB VRAM	QVision 2000 (8-bit at 1,280×1,024; 24-bit at 640×480)	ATI Mach 64 (24-bit at 1,280×1,024)	ATI Mach 32 (4-bit at 1,280×1,024; 24-bit at 640×480)

Note: *All systems include keyboards but not monitors. For Intel-standard machines, add approximately $109 for Ethernet support and $119 for 16-bit audio.*

**Includes built-in Ethernet. †Triple-speed CD-ROM drive.*

currently claim for System 7.5. (As I'll explain in more depth in Chapter 11, System 7.1.2 and 7.5 still use an inferior cooperative multitasking approach.) That's why Microsoft is combating Apple's Power Macintosh advertisements by claiming that when Windows 95 is released, users will no longer have any reason to prefer the Macintosh over Windows.

Microsoft certainly has the talent and muscle to pull it off—the question is whether they can pull it off in a timely manner. Microsoft, at this writing, has a massive beta test program underway and until Insignia releases its 486-based version of SoftWindows (slated for Spring 1995—possibly by the time you read this book), Microsoft can progress with Windows 95's development at a moderate pace.

Native Power Mac applications now number over 300, but that's small beans in comparison to Windows. All existing Windows applications, even the 16-bit ones, will run natively under Windows 95. (That's not even the case for Windows NT or OS/2.) And because DOS and Windows application development is currently a $50 billion business, Microsoft doesn't have to do any arm-twisting to convince developers to write new Win32-bit versions of their applications to take advantage of all that Windows 95 has to offer.

So, applications for Windows 95 will be available by the thousands on or near the day the new operating system is released. And if Microsoft delivers on its other promises, the Windows 95 user interface will be as easy (or maybe just *almost* as easy) to use as System 7. Does that mean Windows 95 will kill Apple's chances of making significant inroads in the business community?

Maybe, but not necessarily. There are several reasons why Apple has good reason to continue to hope.

Timing Is Everything

No matter what claims Microsoft is making about Windows 95 today, it's nevertheless true that Windows 95 is *tomorrow* technology. Unlike the Power Macintosh and its operating system, you can only buy Windows 95 now in its "pre-release" form. But do you want to hear an interesting rumor—one that I think is credible because it comes from good sources?

There never will be a Windows 95.

I believe, as do several of my industry sources, that Microsoft will continually offer "pre-release" upgrades as it adds new features. By the time Windows 95 is in its "final" form, it will be virtually identical to—guess what?—Windows NT.

Here's what's going on in the view of many industry pundits. One problem with Windows NT has long been its heavy memory, hard disk, and CPU bus transfer requirements. So NT has something of a bad reputation among a lot of users, who view the operating system to be useful chiefly as a file server. There are still millions of 386 and bare-bones 486 systems in offices, and Windows NT taxes the resources of these machines beyond acceptable limits.

Microsoft knows it will be hard to sell Windows NT in mass quantity. But as Windows 95 gradually "turns into" Windows NT, Microsoft will have effectively converted Windows 3.1 users into Windows NT users without most of the users realizing they've been taken for a ride. Pretty sneaky, huh? Yes, but excellent marketing.

So expect Apple to step up its marketing, too. This is war. Apple can make a good case for the Power Macs with an argument similar to this one: "Look, if you purchase Windows 95, your company is probably going to have to buy new systems or at least new hardware in order for Windows 95 to run effectively. As long as you're going to have to buy new systems anyway, why not consider the Power Macs? With our machines, you get a great operating system and a great hardware system right out of the box."

With significantly faster 68K and Windows emulation via SoftWindows 2.0 or the DOS Compatibility Card (both of these options are explained in depth in Chapter 9), faster 601 machines already available and superfast 604 machines on the horizon, Apple can make a strong case that the Power Macs offer more versatility for business users than systems running Windows 95. You can run Macintosh applications, DOS applications, and Windows applications all on one machine. You can have it all.

Use Apple Personal Diagnostics to Compare Performance of Power Macs

Version 1.0 of Apple Personal Diagnostics (APD) has been available for several years to Macintosh users. However, a newer version of APD has now been released for the Power Macs.

This enhanced version of APD is a tremendous aid in troubleshooting Macs, providing hardware testing, system profiling, disk-file structure repair, and system-software checking. It's an essential aid for anybody responsible for the care of multiple Macintosh systems.

But APD also includes a benchmark testing feature that's been upgraded for the Power Mac systems. You can use this feature to compare the performance of different Power Macs—for instance, to compare different systems of the same speed running with different memory and/or cache card configurations. It's much easier to make quantity purchasing decisions when you have specific values available for assessing what a given purchase will mean in terms of performance improvement in your business.

Other commercial and shareware personal diagnostics programs are available, but APD probably will provide the most robust troubleshooting and benchmark features for the Power Macs. Apple Personal Diagnostics 1.1 is available from Apple for $129, or for a $19.95 upgrade fee for APD 1.0 users. Call 1-800-769-2775 to order the software.

Mac Applications Running on Intel Boxes: Why It Won't Happen Any Time Soon

I'm asked the following question on a regular basis: "If I can run Windows applications on a Macintosh, why can't I run Macintosh applications under Windows?" The public line from Apple has long been that System 7 is too closely linked with its hardware subsystems to be ported easily to the Intel platform. Just the Toolbox alone, which is now stored in ROM, would all have to be loaded into RAM on a Windows machine (or some set of application services that approximate the Toolbox would have to be stored in RAM). Apple says it was able to create the Macintosh Application Services (MAS) to run on UNIX-based workstations because workstations tend to have sufficient resources to handle the added load. But by the time Apple ported System 7 to the Intel platform, the result would be something so big and unwieldy that nobody would want it.

But I think that's an excuse.

Here's why: Apple believes that handing System 7 over to the Intel-based world would be tantamount to handing over Apple Computer, the company, to the Intel-based world. Intel-based personal computers account for almost 85 percent of all personal computers used in business. If Apple were to allow Macintosh applications to run on Intel-based systems, they could potentially kill the market for Macintosh and Power Macintosh systems.

Under that scenario, Apple could only make money by selling tens of millions of Mac OS licenses, since sales of its Power Mac systems could slow significantly. With the current dominance of Wintel applications, it's highly unlikely that Apple can compete with Microsoft solely as an operating system reseller. (IBM has been trying to compete on this basis with its superior OS/2, but this approach has hardly made a dent in Microsoft's Windows sales.)

Apple can allow Macintosh applications to run on UNIX-based workstations because UNIX and workstation RISC systems have never posed a serious threat to Apple's computer sales. In fact, Apple's high-end 8100/110 system actually poses a threat to other workstation sales.

Apple executives are not paranoid in keeping the Mac OS off of Intel-based PCs. They're basically correct in their fears. But they're correct only because they waited too long to move into the open systems business. If they had made a System 7 version for Intel-based machines before Microsoft had come along and essentially done it for them with Windows, Apple Computer would be a cash cow today—just as is Microsoft. But that's all hindsight. The truth is that, today, Apple has to tread very carefully in the manner and timing it uses to bring its hardware and software onto a more open platform. On the other hand....

Toward a Unified Platform

Eventually, Apple will *have* to make the Macintosh an open platform or watch it die a slow death. That's not just my opinion. Even Apple acknowledges that this statement is fact. The rest of the computing world is just too open and interchangeable. You can now buy a 486 that *doesn't* have "Intel Inside," but instead has Cyrix or AMD or IBM inside. And yet these systems are just as Intel-compatible and Windows compatible as a "true" Intel system. And almost all of these system are shipped with Windows preinstalled. As an option, though, you can install OS/2 2.1 for Windows, which runs all OS/2 applications and Windows applications seamlessly.

Apple can't buck this tide on its own, and Michael Spindler, Ian Diery, and the rest of the decision-makers at Apple know it. That's why on November 7, 1994, after months of sometimes-heated negotiation, Apple, IBM, and Motorola announced their agreement to create a unified PowerPC-based platform—one that will allow Macintosh, DOS, Windows, and OS/2 applications all to run natively on *the same system.* Here's the announcement in Apple CEO Michael Spindler's own words: "We believe that an openly licensed Mac OS running on top of an open, industry standard RISC hardware platform represents a broadside against the reigning Wintel platform, and will play a key role in our ongoing efforts to greatly increase the presence of Macintosh in all markets."

Sounds like a lot of marketing hype, doesn't it? Well, let me dissect that statement in the next few paragraphs, because I think it will help to explain more about the unified platform concept and what it truly means for the computing world.

"An openly licensed Mac OS" Pinch me. Could this really be true? Apple already allows licensing of its operating system to DayStar and to any clonemaker willing to pay the licensing fees (Apple charges software as well as hardware licensing fees, something that many clonemakers find daunting.) But that's more an attempt to ensure that a sufficient quantity of systems are available to meet user demands and to increase the presence of Macs in the marketplace than it is an attempt to encourage a more open Macintosh platform.

The true key to openness comes with Apple's willingness to provide an open platform specification that any hardware manufacturer can use to build Mac clones—free and clear of any hardware licensing fees. (Apple will always license its operating system, as it well should—that's the same approach Microsoft has used to bring Windows to prominence on PCs.)

I've long felt that Apple could make as much if not more money—selling OS licenses as it could selling actual Macintosh systems—as long as the operating system could run on something other than a Mac. (Again, though, it's too late to safely port the Mac OS to the Intel PC platform.) Look at Bill Gates. He's never sold a computer in his life and his little company is doing just fine, thank you. Until now, Apple has kept the Mac OS to itself, proprietary in ROM chips, considering it as the engine for its hardware. In other words, Apple clearly has been a hardware company. But by licensing the

Macintosh operating system freely (and charging nothing for the rights to build an Apple-compliant hardware system), Apple will be making a sharp shift in its marketing and sales direction. It will now become a combined software and hardware seller.

"running on top of an open, industry standard" This is the key to making a freely licensable operating system work as a money generator. As long as Apple licenses the Mac OS only to Macintosh clonemakers and upgrade-board manufacturers, it will probably never be able to use OS licensing as a significant revenue generator. The market is likely to remain too small. In fact, Wall Street's biggest concern in watching Apple's clone licensing approach is that none of the big U.S. clonemakers would join in. And without the presence of at least one big clonemaker in the Power Mac market, the market itself doesn't have a lot of legitimacy.

But with the OS running an industry-standard platform that also accepts other operating systems and their applications, Apple is entering a market that has unlimited potential for growth. Wall Street traders go gaga at the thought of this opportunity.

Consider that the new unified platform can be built by *any hardware manufacturer* with *no hardware licensing fees* attached. The clonemaker simply uses the unified platform specification as a guide to ensuring that their systems run all of the operating systems designed for that platform. And look at the number of operating systems that will be made native for the new unified platform:

- The Macintosh OS
- OS/2
- Windows NT
- AIX

And remember my assertion that Windows 95 is designed to evolve into Windows NT. That means the next generation of Windows applications will all run native on the new unified platform—side-by-side with your native Power Macintosh applications. And, of course, existing 16-bit Windows and DOS applications will still be able to run in emulation on the new platform. In fact, IBM has a little trick up its collective sleeve—something called the PowerPC 615 chip. This CPU is reported to emulate the Intel

486 instruction set in hardware—that is, as microcoded instructions etched onto the chip itself. So, if you buy a PowerPC system for the new unified platform with a 615 chip as the CPU, all of your applications will fly, regardless of whether they require emulation.

"RISC hardware platform" Quickly translated, this phrase means "PowerPC." The benefit of the PowerPC chip design has already been proven in the Power Macs, to such an extent that Intel has teamed up with Hewlett-Packard to built their own RISC chips. But that's still several years in the future. The PowerPC is here today. In fact, the new platform is actually the logic board, PCI bus, and collection of I/O subsystems all built to support one of the PowerPC family of CPUs—regardless of whether it's a 601, 603, 604, 620, or one of the other PowerPC-compliant specialty chips being built by Motorola and IBM.

I've already explained why it's good to have multiple vendors supplying chips (in a word, competition). What's intriguing to me is that executives at both Motorola and IBM have told me they're willing to license the PowerPC chip designs to other hardware manufacturers. Actually, there are few other chip makers that have the billion-dollar fabrication facilities required to produce sophisticated RISC microprocessors in volume. But if the PowerPC technology takes off, I expect to see other chipmakers jumping into the existing alliance. Wouldn't it be interesting to see Intel make that leap?

"represents a broadside against the reigning Wintel platform" I find it interesting that Mr. Spindler is making an open admission that the new unified platform is designed as a direct assault on Microsoft and Intel. There's no secret here, but this statement makes it clear precisely what the motivation is behind Apple's participation in the unified platform: increased market share and a direct attack on Microsoft and Intel. Apple doesn't believe it can significantly increase its market share solely with the existing, proprietary Power Macintosh platform.

But in order to stall the "reigning Wintel platform," Apple, IBM, and Motorola will have to convince users that it's in their best interest to switch to the new platform. It seemed strange, then, that the industry reacted to the unified platform announcement with little more than yawns—not so strange, though, when you consider that the actual technical specification for the new platform will not be published until Spring 1995 and that systems will not be available until 1996. Members of the cynical computer media have been burned many times before by reporting on promises made by technology industries. Seeing is believing, and a mere "announcement" offers little to look at. The alliance's unwillingness to offer even the briefest of technical specifications for the new platform made most computer journalists skeptical.

But if, as a user, you have vision, then you also have reason to get excited today. It's clear that industry change is being spurred by the AIM alliance, not by Microsoft and not by Intel. The Power Mac is part of that change, but it's not the whole bailiwick. Imagine being able to buy any application that you want, knowing it will run on your system, regardless of what operating system it requires. On the other hand, the Power Mac you buy today won't be capable of this, but it comes close. And as an existing Power Mac user, you'll be assured that, when it's time to upgrade your hardware and software, you'll have many options.

"to greatly increase the presence of Macintosh in all markets" As I've already indicated, a unified platform eventually means that Apple will have to fork its integrated hardware/software operations into two distinctly separate businesses, which will both have to compete on their own terms with other clonemakers and operating system vendors. In the past, that has not been a pleasant pill for Apple to swallow. But Apple executives have seen the handwriting on the wall, and it says "open up."

Users have come to expect openness, and don't easily tolerate multiple standards. They pick one and ignore the others. Witness the fight between the Beta and VHS standards. Beta died a rapid death, and Apple doesn't want to be on the Beta end of the fight for the hearts and minds of computer users, who have long indicated they would like to pick and choose freely the hardware, operating system, and applications that they use, without being forced to make a decision of allegiance to any one player. With IBM already having encouraged openness for its systems, it was inevitable that Apple would have to follow suit.

It's to Apple's credit that they've finally agreed to become a fully open vendor, and that they realize this actually can stimulate business growth. When Spindler says that the new platform standard will help the Macintosh to penetrate "all markets," you can read that to mean "the business market." Apple has tried every which way till Sunday to evangelize the Mac in the business world, with very limited success. And the reason has been simple: Because the Macintosh is a nonstandard platform, Apple's been forcing business users to pick one system over another. With a unified platform, Apple for the first time has a legitimate opportunity to crack the business market wide open.

Sure, Apple will have to share the market with Intel, IBM, and all of the clonemakers, but if this means Apple owns 15 percent of the business market rather than 7 or 8 percent, that alone would represent a 100-percent increase in market share, and billions of dollars in new revenue. The increase may come largely in sales of the Mac operating system at the expense of Power Mac system sales, but hey, whatever puts butter on your bread. Maybe we should all buy stock in Apple.

Features of the Unified Platform

As I've already stressed, one of the most significant features of the new platform will be the ability to run multiple operating systems. Even so, operating system vendors will have to modify their systems to support the platform. Apple has committed to doing so with the Mac OS, IBM has committed to this for its OS/2 and AIX operating systems, and Motorola has committed to porting Windows NT to the new platform.

It's not widely known, but Motorola currently has a licensing agreement with Microsoft to develop Windows NT for PowerPC platforms; Motorola has already developed a version of Windows NT that will run on the PowerPC systems to be sold by the Power Personal Systems division of IBM. This same version of Windows NT will also run on the PowerPC systems that Motorola will sell. (Yes, Motorola will actually be selling complete PowerPC systems.) So, like IBM, Motorola stands to profit heavily from a unified platform. It sells PowerPC CPUs, PowerPC systems, owns partial rights to Windows NT for the PowerPC, and also sells many of the I/O subsystem ASIC chips that are used in PowerPC-system logic boards. In fact, executives at Motorola have been instrumental in encouraging Apple to work with IBM to develop the unified platform.

One question that remains about the unified platform involves the built-in presence of operating system capabilities. Currently, most of the Mac OS is stored in a ROM chip. On the PC end, a small subset of operating system capabilities is stored in a BIOS chip. The initial unified-platform agreement calls for dual ROM sockets, so that systems could either contain the PC BIOS or the Mac OS, or could contain *both* the Wintel PC BIOS and System 7 ROM chips.

The question remains, though: How many system vendors will decide to install ROM chips that contain both the PC BIOS and the Mac OS? Although the Mac OS ROM socket is a requirement of the unified platform, vendors don't actually have to *install* the Mac OS ROM chip in the socket. Apple has promised to keep Mac OS licensing fees competitive with Windows licenses (about $50) to encourage clonemakers to install the Mac OS ROM. But that doesn't include the actual cost of the ROM chip, which could be $100 or more.

If most vendors decide to install a PC BIOS ROM chip only, Apple is back to square one. The challenge for Apple is to rewrite its operating system so that it can boot into RAM from the hard disk, as is the case with just about all other operating systems. Expect to see this capability with System 8 (currently code-named Copland).

There are some other hardware and software obstacles that need to be tackled for a unified platform to work. The major obstacle has to do with *endianism,* which is a term used to describe the order in which bytes of data are stored within memory and within a processor's registers. At the risk of oversimplicity, I'll mention here that the two different endian choices are essentially forward and backward. (You can store the characters PRONK in memory either as PRONK or as KNORP, depending on how memory addresses are ordered.) Hardware architects describe these two approaches as *big endian* and *little endian* ordering. I'll explore these two byte-ordering approaches in more depth in later chapters.

For now, just keep in mind that the PowerPC chips support a bi-endian architecture—that is, they can support memory operations that store data and program instructions in either little-endian or big-endian mode. But operating systems need to go one way or the other. That is, they need to store data under one memory ordering scheme or the other—but not both. System 7 is a big-endian operating system, while OS/2 for the PowerPC is a little-endian operating system.

Never the twain shall meet? No, it's possible to get two operating environments to coexist—possible, but not easy. It's already been done, in fact. (Remember, Windows applications can run on Macintosh systems—two different endian environments.) But the solution doesn't come cheaply. After all, users need to be convinced that the solution to running multiple platforms on a single machine won't lead to significant compromises in performance—a criticism that has long been leveled at Insignia's Windows-based solutions on Macs.

So, the ability to run Macintosh applications on unified-platform machines depends on the ability to support different-endian operating systems. To address this issue, the unified platform announced by Apple, IBM, and Motorola will include built-in system boot or startup capabilities that are independent of the operating systems installed on the machine. But that will probably also mean that you can't run two native operating systems simultaneously (although you can run one in emulation as a "personality" of the server operating system, as is done with SoftWindows running on the Mac OS). You'll probably have to reboot in order to switch from one OS to another. Most users will find this to be a significant hassle. If the alliance can find a way to support multiple operating systems running simultaneously, the unified platform will almost certainly be a Wintel killer.

Another major issue for users involves backward compatibility. Will existing Power Macintosh applications will be able to run 100-percent bug-free on unified-platform Power Macs? The AIM alliance assures us that they will. In any case, Apple has always been a stickler for ensuring backward compatibility. I expect that existing Power Mac applications will run seamlessly on the unified-platform systems.

The other major components of the unified platform are the expansion bus architecture and the I/O subsystems. The expansion bus will be PCI local bus, a standard that is much faster than NuBus, and uses a caching technique to allow multiple cards to make transfers to and from the PowerPC CPU simultaneously. The VESA local bus standard, although fast, only allows one card to control the bus at a time—the chief reason why only one VESA card (usually the video card) can be used on any given Intel-based system.

PCI supports several cards on the same system. However, for backward compatibility with existing PCs, the unified platform also supports the older and slower Industry Standard Architecture (ISA) expansion bus. System vendors will have the option to include or refuse to include ISA slots, while PCI slots will be mandatory.

The I/O subsystems include everything from system ROM to hard-disk controllers to clock chips to UART subsystems. The key again will be to ensure that applications designed for both the PC and the MAC will run

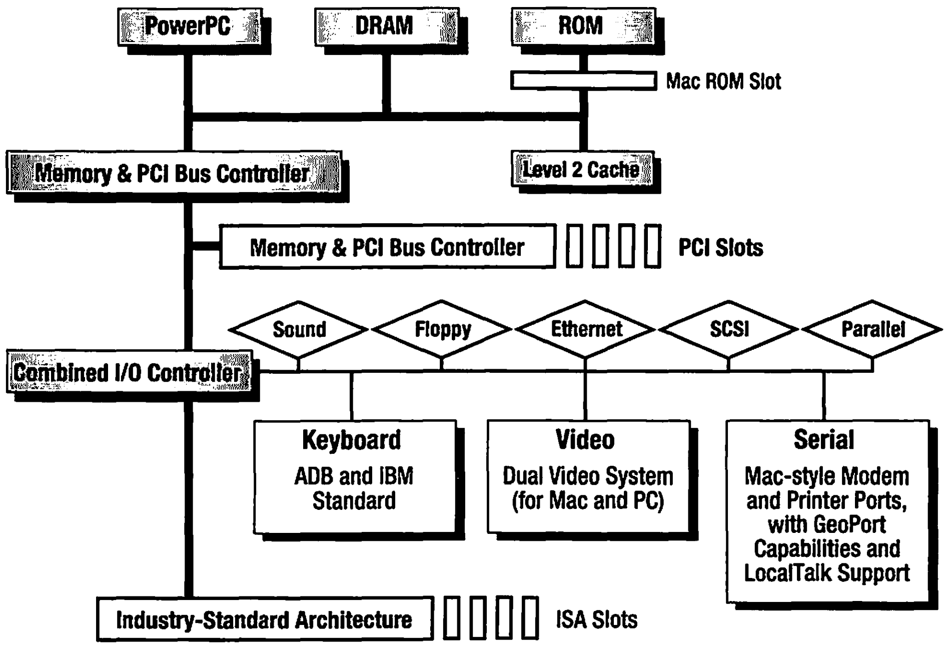


Figure 3.1 A conceptual view of the Apple-IBM-Motorola unified platform

successfully on the unified-platform machines. That means the new standard must support both PC and Macintosh video systems, GeoPorts, SCSI and ADB ports, a PC-compatible parallel port, LocalTalk support, and Ethernet support. All of these subsystems require low-level controller chips, too. To support the multiplicity of subsystems, the alliance is redesigning its controllers to be more robust. Figure 3.1 illustrates the basic design of the proposed unified platform.

Is the Unified Platform Truly Unified?

Since the unified platform is designed to combine the features of the existing PC and Mac hardware capabilities, I've heard some people say that this is not a unified platform at all, just two platforms on one system. But as long as you can run multiple operating systems and their applications in one box, do you really care what's in the box itself? Well, you will if supplying multiple hardware subsystems to support multiple operating systems means that the cost of the system increases. The challenge will be to provide a unified-platform standard that can be built cheaply enough to compete with Pentium and Power Mac systems. If unified-platform systems are priced significantly higher than other, comparably powered PC systems, I suspect many users will balk.

Intel Never Stands Still

Intel may yet toss a monkey wrench into this movement toward a unified platform. On the other hand, it might help bring it about. Intel knows that its x86 architecture is nearing the end of its life cycle and that RISC is the architecture of the future. The Pentium is inferior to the PowerPC architecture, period. (Forget about the great floating-point-error debacle; there are plenty of other reasons to consider the Pentium a flawed chip.) It doesn't matter how fast Intel is able to boost the clock speed of its Pentium chips. IBM and Motorola can always do the same with their PowerPC chips. But Intel has no intention of allowing either IBM and Motorola to replace it as the leader in the microprocessor business.

That's why Intel recently announced a partnership with Hewlett-Packard, as I mentioned earlier, which owns an excellent RISC architecture, called PA-RISC. HP's RISC chips are used in its UNIX workstations, but that's a tiny market compared to Intel's mega-billion-dollar market for desktop PC microprocessors. With Intel's marketing position and HP's RISC design, the two companies can pose quite a threat to IBM and Motorola by designing and selling a RISC chip that includes the x86 architecture in microcode, similar to IBM's 615 PowerPC chip.

The question then becomes: What operating system will run on this new high-powered, Intel/HP RISC chip? Microsoft knows a few things about RISC architecture, having already ported Windows NT to several RISC chips, including the PowerPC. It would be a relatively modest task for Microsoft to design a Windows version to run on the new Intel/HP chip. Microsoft has been moaning about the fact that Windows is written heavily in assembly language, so it can't be easily ported to other environments like the PowerPC. But by the time these new Intel RISC chips are available, the more portable Windows NT will be the standard, so porting earlier versions of Windows will probably not be an issue.

At issue here is whether Intel's long-term strategy is good for the user or just good for Intel. Through sheer need to survive, IBM, Motorola, and Apple are gradually working to develop a unified hardware/software platform that can only be beneficial to end users. But Intel, motivated to maintain its microprocessor dominance, is looking to decimate the competition. That's the same game Microsoft has been playing in recent years, and the strategy definitely *limits* user options.

But there's an interesting Catch-22 at work here. Chiefly, Bill Gates knows that users rule the roost in this business. What users want, users get. And users want a unified software platform. That's why Microsoft is rumored to be working with Motorola and the IBM Porting facility in Washington to create a PowerPC version of Windows 95.

Users are in control in a way they never have been before. The cries for a unified platform are impossible to ignore, even by Andy Grove and his mighty Intel machine. Intel has been driven to its partnership with HP *because of* the threat posed by the PowerPC technology. Intel can't rely on Microsoft to carry its x86 architecture any longer. Bill Gates could flip-flop his company's allegiance to the PowerPC technology faster than Andy Grove can say "Pentium rules." And the PowerPC technology has received such a warm reception precisely *because* users are tired of the lock that Intel and Microsoft have on the desktop computing environment.

Intel must now compete with the PowerPC. Microsoft can easily change its spots, but Intel will have a much harder time adapting to a new marketplace. It's too late to quash the PowerPC revolution. Let's for the sake of argument assume that Microsoft has no plans to develop Windows 95 for the PowerPC platform. If Microsoft designs a Windows operating system solely for the new Intel/HP architecture, it will have to be compatible with the existing Windows operating environment; otherwise, those tens of thousands of DOS and Windows applications currently in use will be obsolete. Of course, we can't have *that.* And if Microsoft can design a backwardly compatible operating system for Intel/HP, so can IBM. So can Apple. We may yet see the day when it doesn't matter which CPU your system uses or which operating system you prefer. All applications will run on all systems regardless. Wouldn't that be fun?

When, When, When?

I realize I'm starting to sound like Alvin Toffler after he's taken one too many trips to the punch bowl. Maybe all of this unity will never come about. Or maybe it will start to gel and then turn sour.

The vision I've foretold will only come about if users refuse to complacently sit back and let the large technology corporations jockey for position. We've got to mount up, take the reins, and *direct* them. We do that by insisting that our hardware and software become as interchangeable as Winchester rifle parts.

If a more unified computing environment comes about, it won't happen until *at least* 1996. Apple is still pursuing its agenda of delivering next-generation PCI-based Power Macintoshes in May, 1995. IBM is still trying to get its Power Personal Systems and OS/2 for PowerPC out the door under a cloud of suspicion that it can't quite get anything right these days. And Intel isn't even planning on introducing its new Pentium-successor RISC chips until 1997.

I'm not willing to wait until 1996 or 1997 to upgrade my computing environment, and you're probably not either. It's unfortunate but true that we must continue to pick and choose among a number of tradeoffs when trying to determine which system will best suit the way we work as individuals—or as a company in many cases. So to be unscrupulously fair, I now need to reveal what I know (or what IBM will allow me to say) about the Power Personal Systems that IBM is gearing up to ship.

Let's Get Power Personal

It's not widely known, but IBM, not Apple, introduced the first PowerPC systems. However, IBM's initial offering was a workstation—specifically its RS/6000 workstation Model 250, shown in Figure 3.2. This system is powered by a single PowerPC 601 chip but includes heavy hardware resource support designed to support the AIX operating system and memory-hungry workstation applications. It was never intended to be a desktop system in the traditional desktop marketplace. However, the current version of AIX supports the Macintosh Application Environment, which allows PowerStation 250 users to run Macintosh applications on their systems.

Figure 3.2 The IBM PowerStation 250 Workstation

The Model 250 did whet a lot of business users' appetites for the PowerPC technology. The base configuration system could be purchased for as little as \$5,445 (less than Apple's top of the line 8100/110 system), and provided two to three times the performance of comparable RS/6000 workstation configurations. The higher-end version of the workstation, called the 25T, retails for more than \$9,000. In any event, the Model 250, introduced in October 1993, suggested how rapidly the PowerPC alliance was working to develop both PowerPC chips and full-blown systems. Apple's Power Mac line of systems has helped to reinforce the early reputation of the PowerPC 601 chip as a powerful, low-cost alternative to other RISC and CISC chip families—including the Intel x86 architecture.

Even though IBM (at this writing) does not have PowerPC systems in the marketplace, it has announced some information about the three major PowerPC systems that it will reportedly introduce by mid-1995. Two of IBM's PowerPC designs were either complete or nearly complete as early as the first quarter of 1994. However, IBM needs to provide at least one native operating system with its machines. That being the case, the main desktop model has been held from the market until the native version Windows NT or OS/2 for PowerPC, along with a respectable set of native applications—are made available. (The second desktop model, with a compact, ergonomic design referred to as a "bookshelf" system, uses the 603 chip.)

I would like to offer an interesting aside here. A lot of computer-technology writers have been saying that the real reason for IBM's delay in releasing its PowerPC systems is that it is having trouble lining up native OS/2 applications for PowerPC software vendors.

Not true.

After talking directly with literally hundreds of IBM employees (and former employees), OS/2 specialists, and application vendors, and I've reached a much different conclusion. In attempting to revamp the OS/2 operating system to run native on the PowerPC, IBM elected to switch totally to a microkernel-based operating system design. (I'll have more to say on the concept of microkernels near the tail end of this chapter.) In taking this approach, I believed that IBM bit off more than it could chew, because it basically meant rewriting the entire operating system. We all know how long it took IBM to get a respectable version of OS/2 up and running; the time required to get a new, microkernel-based OS/2 running and stable is turning out to be as long, if not longer.

IBM's alternative approach was to ship PowerPC systems at the end of 1994 with a native version of Windows NT installed. There were some high-powered people at IBM who were in favor of this approach, and they eventually "won," although there was fear that, by shipping systems with Windows NT several months prior to the release of OS/2 for PowerPC, IBM would be allowing Intel to kill the market for this new OS/2. But it was deemed wiser not to wait and instead release the PowerPC systems when Windows NT for PowerPC was ready.

HOT TIP

IBM Is Not Waiting for Native PowerPC Applications

The other myth about why the "IBM needs native applications" argument is wrong is even easier to debunk. OS/2 currently has hundreds of native applications. I've personally talked to several developers who have participated in IBM's developer assistance program in Boca Raton, Florida. As part of this program, IBM helps these vendors convert their existing 32-bit OS/2 applications to native OS/2 for PowerPC versions.

> Every participant that I talked to reported the same experience: Converting to OS/2 for PowerPC was almost magic. For each application, vendors reported that between 95 to 99 percent of their code required only a simple recompile. The remaining hand-tuning of code took as little as a day to as long as a week to complete. It's fairly obvious that existing OS/2 applications can be converted to native PowerPC versions in less time than it took to create the universe.

IBM's Desktop System

An immediate caveat is in order here. Even though IBM has made public announcements about its three introductory PowerPC systems, it has not released final, detailed specifications for any of them. IBM has indicated many of the general features that will be included with the systems, but even these could change by the time they actually ship. So keep in mind that this first glimpse here might not be identical to the final view.

IBM's main desktop offering, shown in Figure 3.3, will use the PowerPC 601 chip running at 66 MHz, although you should expect to see faster

Figure 3.3 IBM's entry-level desktop PowerPC system

desktop systems (running a 601 chip at 100 MHz or faster) available on or near the initial ship date. The system will come standard with 16 MB of RAM, and will accept up to 128 MB of RAM on the motherboard. (In the PC world, the term "motherboard" is used instead of Apple's term, "logic board," but both terms mean essentially the same thing.) Expansion capabilities will be provided through a combination of one SCSI-2 PCI slot, a second half-length PCI slot, and a bridge chip to ISA expansion slots.

An interesting feature of the desktop system, as well as the other two PowerPC systems, is the advanced sound support, which IBM calls "Business Audio." This feature incorporates the Crystal Semiconductor CS4231 stereo audio integrated circuit, and performs 16-bit samples at 22.05 KHz and 44.1 KHz, nearly identical to the Power Macintosh's sound capabilities. The motherboard provides audio input, audio output, and separate line in and line out connectors. Other standard features will probably include a built-in CD-ROM drive, a built-in microphone for speech input, and perhaps a human-centered software package that will support videoconferencing, audiographic conferencing, and pen-based input as an add-on to OS/2 for PowerPC.

This desktop system is expected to retail at prices that rival or beat comparable Pentium-based systems. Figure 3.4 shows the basic hardware design for the desktop system. Figure 3.5 shows the actual motherboard used in this system. The desktop system will include an L2 cache slot that can be used either to add a cache chip (up to 1 MB of cache) or to upgrade to a faster PowerPC processor chip at a later date.

IBM's Bookshelf System

IBM is also offering a unique, compact system that is something of a cross between a desktop PC and a notebook. IBM refers to this machine as its "bookshelf" or "ergonomic" system due to its size and energy-saving features. This bookshelf system uses a PowerPC 603 chip, operating at 75 MHz or higher, which employs power-management features typically found only in notebook and sub-notebook systems. Other portability features include four easily accessible PCMCIA slots (accessible via a hood that opens at the front of the system and into which PCMCIA devices may be installed and removed without taking off the system cover), and a single-plug design that allows the system to be easily moved without having to hassle with a tangle of peripheral cords.

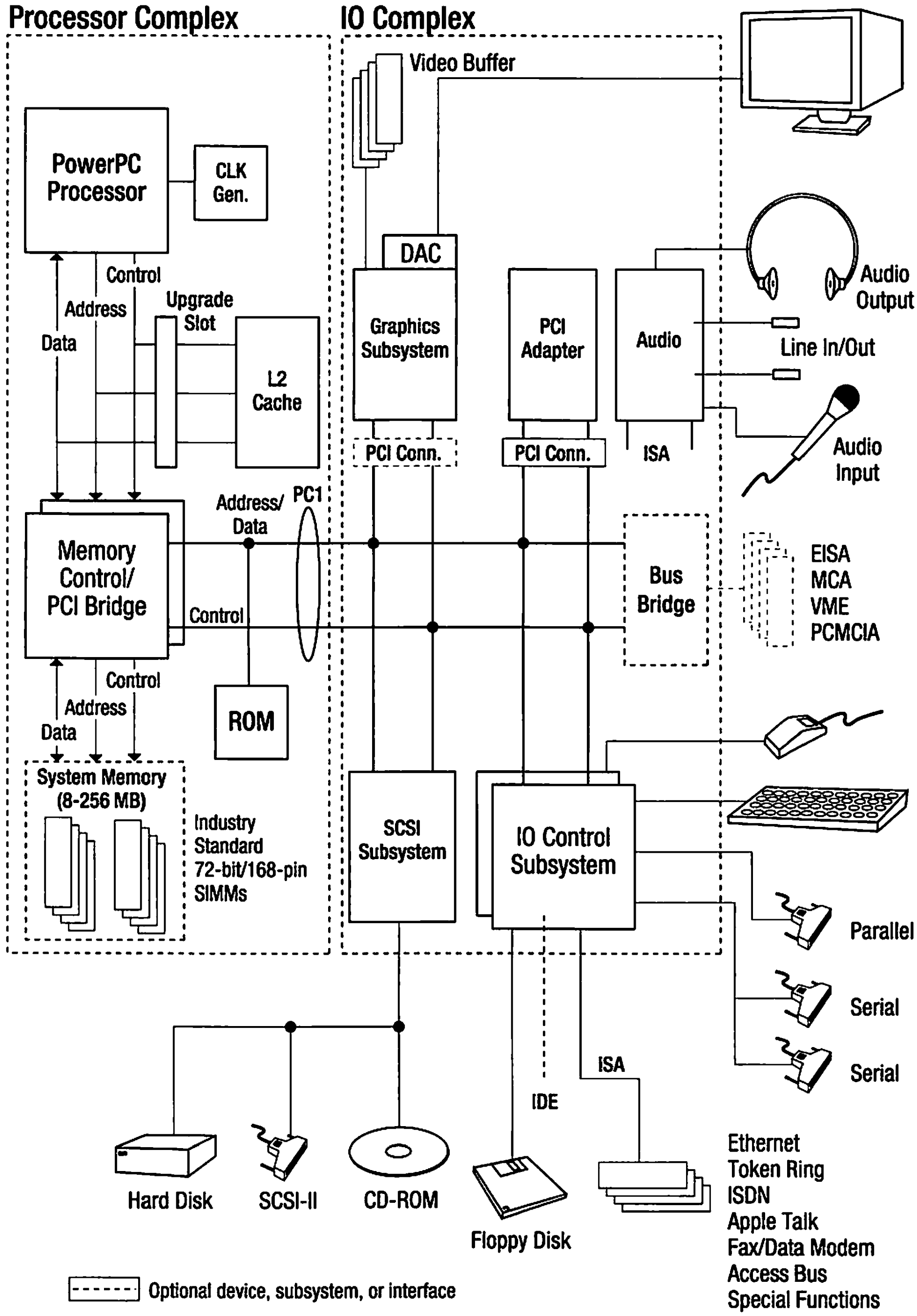


Figure 3.4 The Power Personal desktop system's motherboard and hardware subsystems

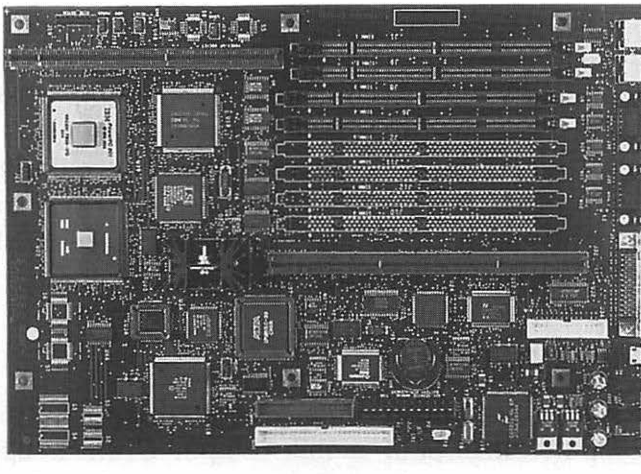


Figure 3.5 The motherboard for IBM's desktop system

Figure 3.6 shows the bookshelf system. The PCMCIA card slots are hidden under the Darth Vader-like hood. (Some IBMers call this the Sir Lancelot cover. I guess they're trying to emphasize the light side of The Force.) The

Figure 3.6 IBM's "bookshelf" PowerPC system

bookshelf system can also support either a flat screen or a standard monitor. Basic configurations for the bookshelf system are expected to sell for about $1,000 less than comparably equipped desktop systems. Since the bookshelf system is designed specifically for business users, it's probable that IBM will provide a human-centered, audio/videographic package bundled as standard equipment. "Human-centered" refers to enhanced speech recognition and response and graphic interface capabilities that are designed to make the system easier and friendlier to use.

IBM's Mobile Computer

IBM, like several other computer companies, is moving away from the term "notebook computer" in favor of "mobile computer," which suggests better portability and allows for the development of a more broad-based line of portable systems. IBM's long-term strategy calls for the development of several mobile systems, all with improved portability, power management and consequently lower power consumption, and superior built-in video and audio support.

Figure 3.7 shows IBM's PowerPC mobile (notebook) system. Figure 3.8 shows a view of the system's design. IBM originally announced that the system would use a 603 chip running at 75 MHz and sell for between $2,000 and $3,500. However, if the 80 MHz 603+ chip is available in sufficient quantity, IBM might use this CPU instead. In any case, the mobile system is expected to come standard with a swappable CD-ROM/hard disk setup, where the CD-ROM and hard disks share the same slot and can be plugged in or out so that the two devices can be swapped. The user will be able to swap the CD-ROM and hard disk while the system is running, as often as necessary.

IBM and the Future of Power Personal Systems

IBM's Power Personal Systems (PPS) division has been plagued by delays, some of which aren't of its own making. Assuming that the PPS division is able to get to market in time to make significant market penetration, you can expect them to remain aggressive. IBM hopes to accelerate its penetration of PowerPC markets vertically, in both directions. Expect to see bargain-basement desktop systems that are fully Prep-compliant but that use the less-expensive 50 MHz 601 chip, and expect to see faster desktop and notebook systems made available throughout 1995 and beyond, as well as

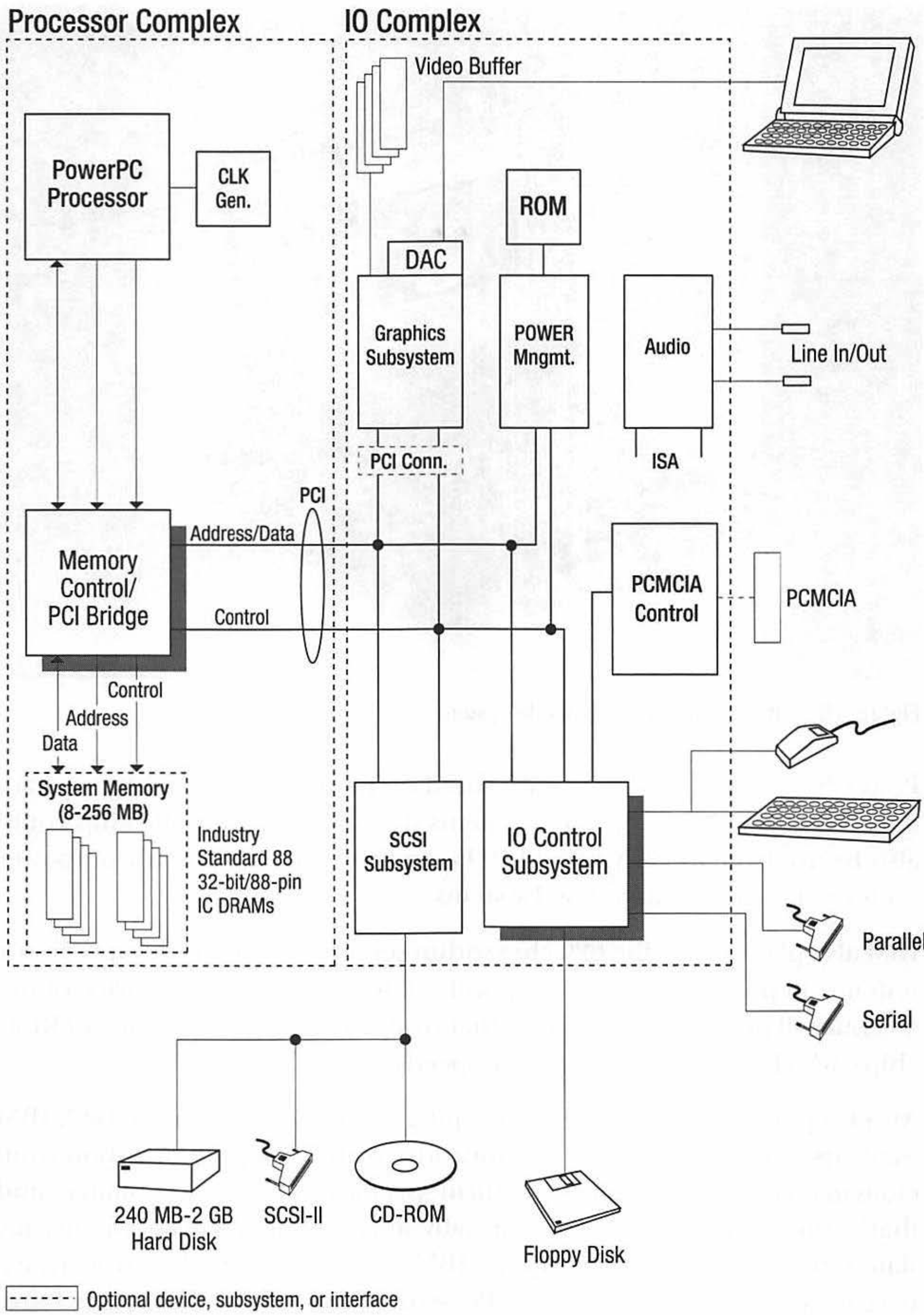


Figure 3.7 IBM's mobile PowerPC system

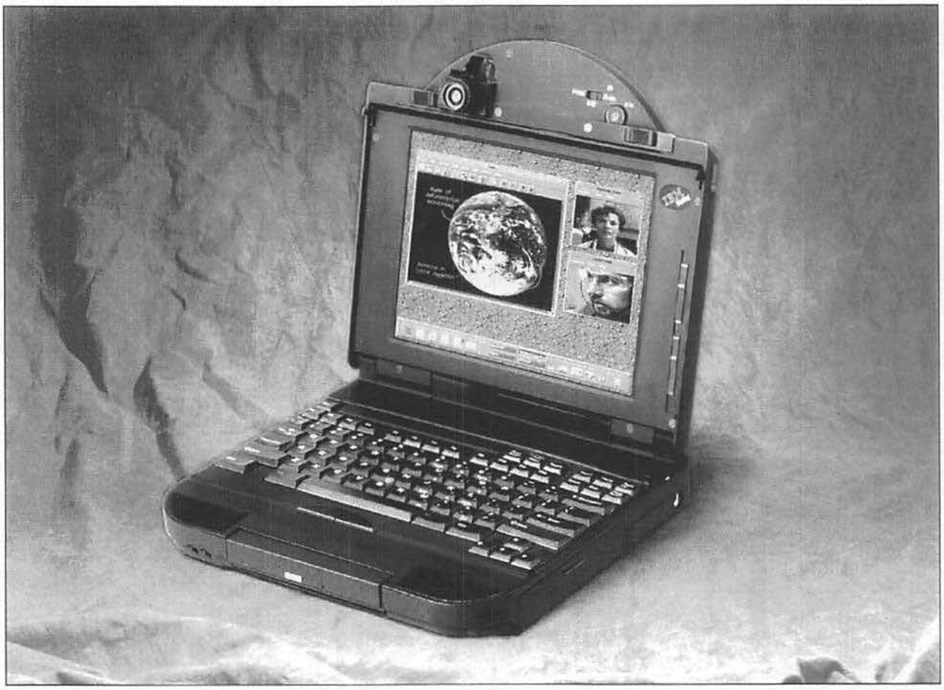


Figure 3.8 The Power Personal mobile system

PowerPC systems in 1996 that are based on the new unified-platform standard. Desktop and workstation systems that use the faster 604 chip could also be available as early as mid-1995, and will almost certainly outpower even the fastest Pentium-based systems.

IBM also plans to use the 620 chip within servers and other multiprocessor systems. Reportedly, the 620 chip will sell for about twice the price of the 604 but will provide performance that rivals DEC's Alpha AXP line of RISC chips, which reportedly have clock speeds up to 275 MHz.

Also keep in mind that IBM isn't keeping its desktop designs to itself. IBM wants its reference platform specification to encourage competition from clonemakers. If the reference platform specification gains acceptance (and that's still an iffy proposition, especially since the platform spec is already slated to be replaced by the Apple/IBM/Motorola unified platform), expect to see other IBM-like PowerPC systems offered by third-party hardware companies. Several Pacific Rim hardware manufacturers are already building Prep-complaint systems, as is Motorola.

OS/2 for PowerPC and Its Personalities

OS/2 for PowerPC is expected to be the dominant platform for IBM-reference-platform-compliant desktop PCs—whether they're offered by IBM or a third-party vendor. OS/2 for PowerPC is unique among operating systems technologies because it is currently the only desktop OS that uses a true microkernel architecture, called Workplace OS (WPOS), although Windows NT is also arguably a microkernel operating system. Since a microkernel architecture contains only the most basic services required to support the CPU and attached hardware (and runs in the supervisor mode of the CPU), all other system services can be provided by writing abstraction and user layers on top of the microkernel (which run in the CPU's user mode).

The OS/2 for PowerPC microkernel does not include a user interface, and that's one of the major benefits of a microkernel OS: Multiple user interfaces can be built on top of the microkernel. IBM's initial release of the WPOS technology will actually be called OS/2 for PowerPC because the microkernel will run the OS/2 2.1 user interface.

In a microkernel architecture, user interfaces are implemented in layers called *personalities*, and a particular machine can implement a *dominant personality* and *alternative personalities*. The dominant personality is responsible for booting and terminating the machine, and can directly communicate with the microkernel and device drivers. Alternate personalities access these services through the dominant personality or through a software layer called Personality Neutral Services (PNS). Figure 3.9 shows the relationships among a microkernel, device drivers, graphical interface personalities, and applications.

OS/2 for PowerPC and Windows: An Oxymoron?

Many users have expressed fear that, even though IBM has rights to Windows 3.1 code, OS/2 for PowerPC will not be able to run later versions of Windows—specifically Windows 95. This possibility certainly exists, because IBM does not have rights to any of the next-generation Windows source code. However, Insignia Solutions does.

Insignia has announced plans to use portions of the Windows 95 source code while implementing later versions of SoftWindows for the Power Mac systems. From a licensing standpoint, nothing prevents Insignia from de-

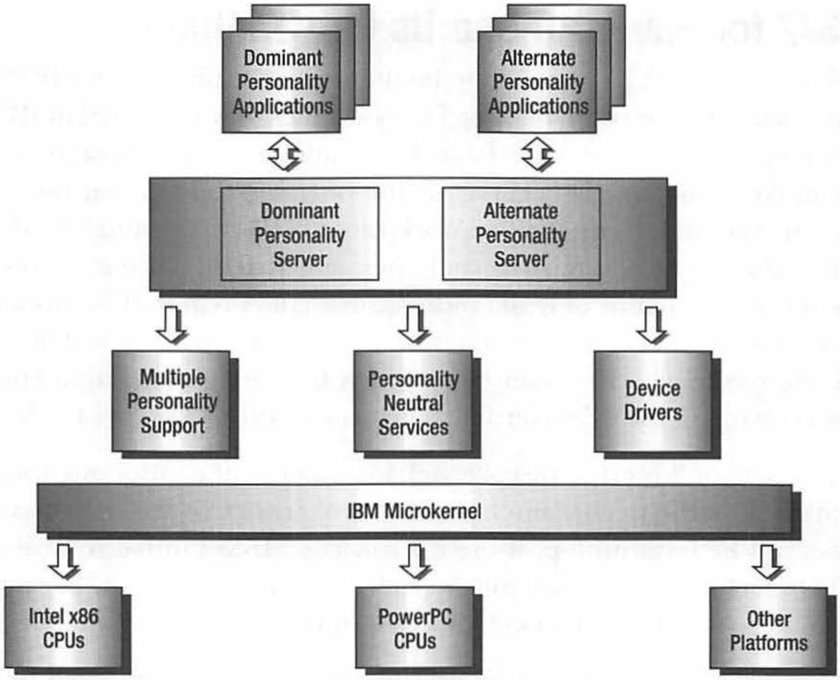


Figure 3.9 The layers used in a microkernel-based operating system

signing a Windows 95-based SoftWindows version for OS/2 for PowerPC. However, my guess is that Insignia is adopting a watch-and-wait approach, tracking the acceptance or rejection of IBM's PowerPC systems before commitment to a full development effort.

IBM is hoping that the increasing acceptance of OS/2 2.1 will encourage support for native OS/2 32-bit applications, which in turn can be easily recompiled as native PowerPC applications. IBM reports that it has currently sold 5 million OS/2 2.1 licenses. Considering the nature of many users to ignore licenses and instead bootleg operating systems and applications, the number of OS/2 2.1 packages actually installed (legitimate or otherwise) could be two to three times greater.

From a global perspective, 5 million OS/2 2.1 licensees does not represent a large number when you consider that more than 100 million estimated Intel-based PCs are in use today. But from the perspective of independent software vendors, an installed base of 5 million or more OS/2 copies is a relatively strong market, and provides a significant incentive to supply programs for OS/2. IBM hopes that, by evangelizing the growing support for OS/2, and by stressing how easily 32-bit OS/2 applications can be ported to the PowerPC platform, software vendors will begin to line up behind OS/2 for PowerPC and the unified platform.

Putting It All Together

For all my bluster about the prospects for a unified hardware/software platform, I have to acknowledge that the market looks terribly unsettled right now. Apple is starting to adopt marketing strategies that look startlingly familiar to the way IBM has been doing business; Big Blue is starting to look more like Big Blur, splintering itself into more and more separate businesses, and allowing most of them to compete with one another as well as the market at large; Intel is moving to a RISC architecture pioneered by Hewlett-Packard; and Microsoft seems determined to make not only a better Windows, but also a better System 7.

Depending on whether you're an optimist or a pessimist, you could make a case that all of this technology-borrowing is leading to a more unified environment or is just helping a lot of corporations to protect their markets. I say unification will be the outcome. The Soviet Union crumbled and that allowed the different states to compete in their own way and to use their own strengths. I see the protective walls of Intel and Microsoft crumbling, too, and I expect that the increased competition that results will be directed at the needs of you and me. The lowly end user may yet prevail.

CHAPTER

4

PowerPC Technology

Inside the CPU Architecture

I regularly hear misinformed comments about the PowerPC chips that drive the Power Mac systems. In Chapter 1, I mentioned one of the more widespread misunderstandings—the belief that Motorola manufactures the 601 chip. But I also hear incorrect descriptions about the chip technology itself. For instance, I overheard one fairly sophisticated user tell another user that the 603 chip was a "more advanced" version of the 601. In no way is that true. Other users have endowed the PowerPC 601 or 603 chips with features that they don't have, or have criticized the chips for lacking features that they, in fact, do have.

This chapter, then, is intended to help clear up most of the confusion regarding the CPU technology that drives your Power Mac system. But the only way to do that effectively, I think, is to explain the PowerPC technology itself and to offer some comparisons of the PowerPC to the Pentium technology. I realize that you might not be interested in this level of technical detail. That's fine. If you want to skim this chapter or even skip it, feel free to do so. In any case, I'll try to make the explanations as painless to read as possible.

In many of the following discussions, you'll note that I compare the PowerPC technology to Intel's x86 architecture rather than to the Motorola 680×0 architecture. I've chosen to do so because Intel's architecture is the target competition for the PowerPC chips, not the Motorola 680×0 family.

Trace Width Technology: Advantage PowerPC

In general, CPU technology has advanced on the heels of a "smaller-is-better" strategy. For instance, in the early 1980s, CPU designers were talking about the possibility of using *1-micron fabrication technology*—a very large scale integration (VLSI) design that up to that time had not been practical. The value *1 micron*, or 1 millionth of a meter, refers to the trace width of the electrical-current pathways etched into the silicon. As trace widths decrease, the number of transistors that can be packed onto a chip increases.

In a CPU, transistors equal performance. A transistor is basically a switch, but an extremely valuable switch. The on/off voltage-switching provided by transistors is the foundation for the logic capabilities of a CPU. The more transistors that are available on a chip, the more processing power can be designed into the chip.

When Intel's 486 family of CPUs was announced in 1990, its 1-micron fabrication technology was state of the art for desktop processors. (The chips used in IBM's initial RS/6000 workstations also employed 1-micron technology.) But even in 1990, 1-micron technology was not the smallest trace width possible. In fact, .5 micron and even smaller fabrication technologies were possible, but rarely used. The reason: Cost.

Half-micron (.5) fabrication technology requires expensive and sophisticated development tools, which can—and typically do—offset the benefits of using smaller trace widths. (Even .1-micron devices have been achieved by some researchers, but the cost to develop such finely traced chips is, for now, enormous—making the technology impractical for producing chips in production volumes.)

So, CPU designers employ trade-offs to increase the number of transistors available on a chip. Basically, three approaches are possible: smaller trace widths, a larger die size, or multiple layers of metal. By combining all three approaches, CPU designers can achieve a price/performance ratio that makes it possible to produce powerful chips at competitive prices.

In fact, that's precisely the approach used in the design of the PowerPC 601 chip. At 132 square millimeters, the 601 chip is 40 percent larger than the 486, but the 601 chip contains approximately 2.8 million transistors on four layers of metal, while the 486 contains less than half this number on one- and two-layer chips. Even more important, the 601 chip contains a 32K cache. The 486 has room for only an 8K on-chip cache.

Consider a more contemporary comparison: Intel's Pentium currently uses .8-micron technology (.6- and .5-micron Pentium chips are also available) to pack approximately 3.1 million transistors on the die, along with two 8K on-chip caches. Although the Pentium contains slightly more transistors than the 601, the Pentium's die size contains about two times the surface area of the 601.

Smaller Is Better, but More Chips Mean More Profits

Obviously, smaller trace widths make it possible to produce smaller chips. And, although smaller trace widths lead to increased production costs, smaller chips actually *reduce* production costs. The reason is simple: Semiconductor material is prone to a certain percentage of surface defects per wafer, and CPUs are typically developed on 8-inch wafers. The more chips that can be etched onto each wafer, the fewer defective chips will be manufactured per wafer. So, chipmakers have to balance the cost of smaller trace widths with the cost savings of smaller chip dies.

IBM's .5-micron RISC design technology is among the most advanced CPU designs available, and employs techniques that help decrease the production costs of relatively small trace widths. As you might expect, then, the 601 chip's relatively small die size in comparison to the Pentium contributes to a lower per-chip cost for the 601. (The 601 chip sells for about half the price of the Pentium, based on competitive clock speeds.)

However, per-chip costs are also directly related to volume sales. If you're a product or systems manager, that probably seems obvious. Most of the cost of any CPU technology is buried within the research and development budget. The more chips that a manufacturer can sell, the easier it is to recover R&D costs. One reason the PowerPC 601 chip underprices the Pentium is its suitability in *embedded systems* and, of course, the built-in market for the chips in Power Mac systems. (An embedded system is any device that is controlled by one or more preprogrammed microprocessors and is not intended for interactive computer use. Embedded systems are found in everything from telephones to microwaves to automobiles to jet engines.)

The register-rich RISC CPUs work well as embedded controllers. And since Motorola is one of the largest developers of embedded systems, it is well poised to make immediate use of the PowerPC 601 and other chips that use a modification of the PowerPC technology.

PowerPC Is an Architecture, Not a Chip

It's important to stress that PowerPC is an open architecture, and is not limited to a particular chip design. In fact, IBM has already made available the *PowerPC Architecture*, a softcover publication that contains a full description of PowerPC CPU design standards. PowerPC chip development, then, is not limited to IBM and Motorola, although you can expect to see these two companies maintain a leadership position in the sales of PowerPC chips for several years.

As I indicated in Chapter 1, the PowerPC architecture is a simplified and streamlined redesign of IBM's POWER architecture used in chip sets for RS/6000 workstations. The PowerPC architecture defines a uniprocessor (single chip) design, while POWER defines a multiple-chip architecture.

What are the big changes between the POWER and PowerPC architectures? To the casual user, the uniprocessor design is probably the most significant change. A new set of 64-bit instructions is also provided, but these instructions are currently only implemented in the PowerPC chip. For programmers and system designers, differences between the two architectures really amount to numerous small changes, rather than to any large-scale differences.

The PowerPC architecture defines the full instruction set available to hardware and software designers, and describes the registers and other architectural features for three main instruction units: a branch processor, a fixed-point (integer) processor, and a floating-point processor. A general model of the PowerPC processor design is shown in Figure 4.1. The architecture also details the storage model to be used in all PowerPC chips.

PowerPC: A Bi-Endian Architecture

It sounds unusual for an 18th-century literary classic to provide the source for one of the more technical anomalies of CPUs. But that's precisely the situation with Jonathan Swift's *Gulliver's Travels*. Swift wrote about a long

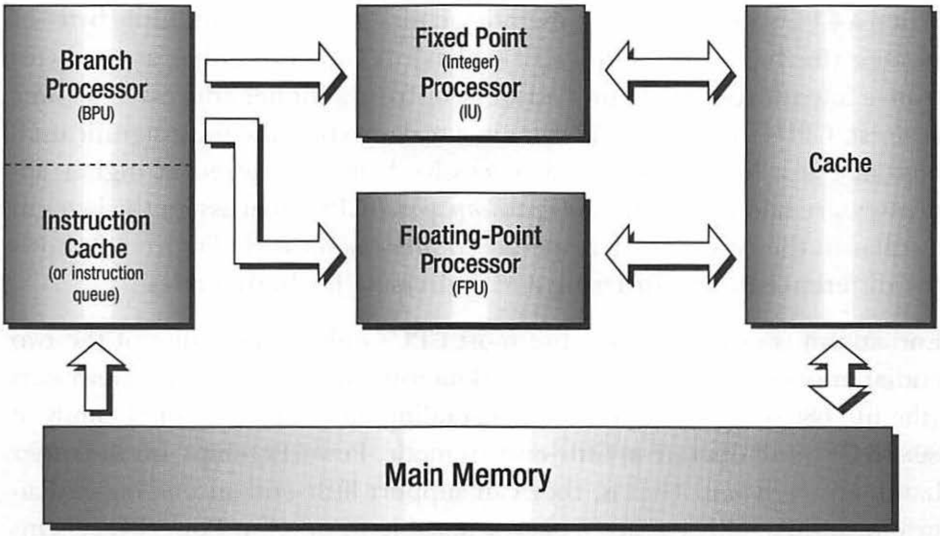


Figure 4.1 A general model of the logical flow of instructions and data through a PowerPC CPU

standing war fought between the two fictional empires of Lilliput and Blefuscu—a war fought over the "correct" technique for cracking eggs.

Here's the dispute: The Lilliputians had long believed that the correct approach was to crack an egg at the big end. But when an emperor of Lilliput was a boy, he cut his finger while cracking an egg in this manner. Later, as emperor, he decreed that the correct way to crack an egg was at the little end.

Scores of Lilliputians rebelled against this decree, refusing to crack their eggs at the little end. To avoid the wrath of the emperor, these rebels fled and formed their own empire—Blefuscu—and were known to the more conformist Lilliputians as Big Endians. A multi-generational war ensued between the two empires, motivated solely by strong notions about eggshells.

And now you're no doubt wondering what *Gulliver's Travels* has to do with the PowerPC: In hardware and software terminology, a single instruction or data unit is called a *scalar*. In turn, the smallest addressable unit of storage is 1 byte (8 bits). A scalar is typically composed of multiple bytes—a half-word scalar is 2 bytes long, a full word scalar is 4 bytes long, and a double word scalar is 8 bytes long.

When a CPU stores a scalar in memory, it may need to use multiple bytes of storage (for half-words and larger scalars). A CPU can either assign bytes from a low address to a higher address, or from a higher address to a lower address. CPUs that assign the bytes in a scalar so that the most significant 8 bits start at a low address, and successive bytes are stored at higher addresses, are said to operate in *big-endian model.* CPUs that assign the bytes in a scalar in the reverse order operate in *little-endian mode.* Figure 4.2 shows the difference in byte ordering and addressing for both modes.

Endian-ism is important because most CPUs only support one of the two endian modes. CPUs in RS/6000 workstations and in Macintosh computers (the full 680×0 family) operate in big-ending mode. But the Intel family of 80×86 CPUs all operate in little-endian mode. PowerPC chips, on the other hand, are *bi-endian.* That is, they can support little-endian *and* big-endian byte ordering. This feature makes it possible to develop PowerPC systems that conform to the endian mode assumed by different, existing system software (including DOS, Windows, OS/2, Windows NT, AIX, and System 7).

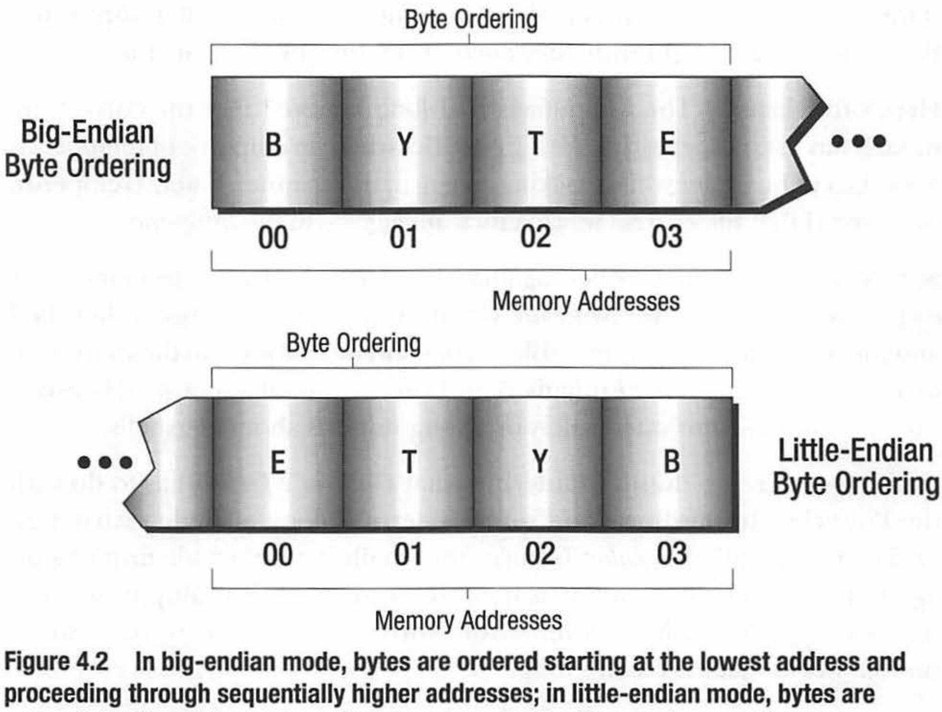


Figure 4.2 In big-endian mode, bytes are ordered starting at the lowest address and proceeding through sequentially higher addresses; in little-endian mode, bytes are ordered starting at the higher address and proceeding through lower addresses

At system startup, all PowerPCs run in big-endian mode by default. However, operating systems can easily change the byte ordering to little-endian during bootup. Byte ordering also has a significant effect on software emulation. For example, a Macintosh PowerPC equipped with SoftWindows software can run DOS and Windows (normally little-endian operating systems) on a big-endian system. On the other hand, emulating Macintosh applications on UNIX workstations is less complex (if anything having to do with UNIX can said to be "less complex") because no byte reordering needs to be performed—both the Mac OS and UNIX are big endian.

The PowerPC 601

The material in this section is included to provide you with a good technical overview of the PowerPC 601. If you're a casual user rather than a programmer or system developer, some of the terms and information provided here might seem foreign to you. Fell free to skip over some material if it doesn't fit your level of technical knowledge or interest.

The 601 chip was the first PowerPC chip in production, and is currently used in all Power Mac and IBM desktop systems, as well as in IBM's PowerStation 250. As I've mentioned before, only IBM is producing the 601 chip—at its fabrication facility in Burlington, Vermont.

The 601 Instruction Set

The 601 chip supports 69 new instructions defined in the PowerPC architecture but that aren't in the POWER architecture. Most of these instructions are included to improve cache management, single-precision, floating-point operations, and bit-shifting operations. In turn, ten 32-bit instructions defined in the PowerPC architecture are not in the PowerPC 601 chip. (Remember the PowerPC architecture is a design standard; it's not essential all chips in the PowerPC series to use all instructions designed in the architecture.)

Of course, all 64-bit instructions defined in the PowerPC architecture are illegal on the 601, which has 32-bit integer registers only and thus can't support 64-bit instructions. Illegal instructions are ones that are available in the generic architecture, but can't be trapped and emulated on a particular CPU implementation—in this case, the 601.

The 601 Chip Was Designed with Workstations in Mind

At the instruction-set level, one of the biggest differences between the POWER and PowerPC architectures is that the MQ (Multiply/Quotient) register was removed from the PowerPC architecture, and all POWER instructions that used the MQ register were eliminated. The MQ register proved to inhibit instruction cycle time in the PowerPC's single-chip approach.

Interestingly, the PowerPC Architecture Working Group (PAWG), which was responsible for defining the PowerPC instruction set for specific chips, elected to retain the MQ register and corresponding instructions in the 601 chip design. Doing so makes it possible to run most RS/6000 applications in 100-percent native mode on a workstation that uses the 601 chip (such as the PowerStation 250).

But this "feature" is absolutely useless on your Power Mac. In other words, the 601 chip in your Power Mac is capable of executing instructions that the Macintosh operating system will never use. On the positive side, if you ever start to feel that your 601-based Power Mac is inferior to the next generation of 604-based systems, just remember that IBM considered the 601 chip to be an ideal CPU for one of its most successful workstation systems.

The 601 Chip Design

The 601 chip contains three main execution units to support superscalar dispatch of instructions: The integer unit (also called the fixed-point unit), the floating-point unit, and the branch-processing unit. The block diagram for the PowerPC 601 chip is shown in Figure 4.3. As you can see, the branch-processing unit is actually a subsystem of the main instruction unit, which is responsible for fetching and prefetching instructions. The instruction unit can store up to eight instructions at a time in its instruction prefetch queue. Since the instruction unit can prefetch instructions concurrently with the execution of instructions in the integer, floating-point, and branch-processing units (IU, FPU, and BPU respectively), instruction prefetch provides a way to speed up instruction throughput from memory or the cache into the CPU.

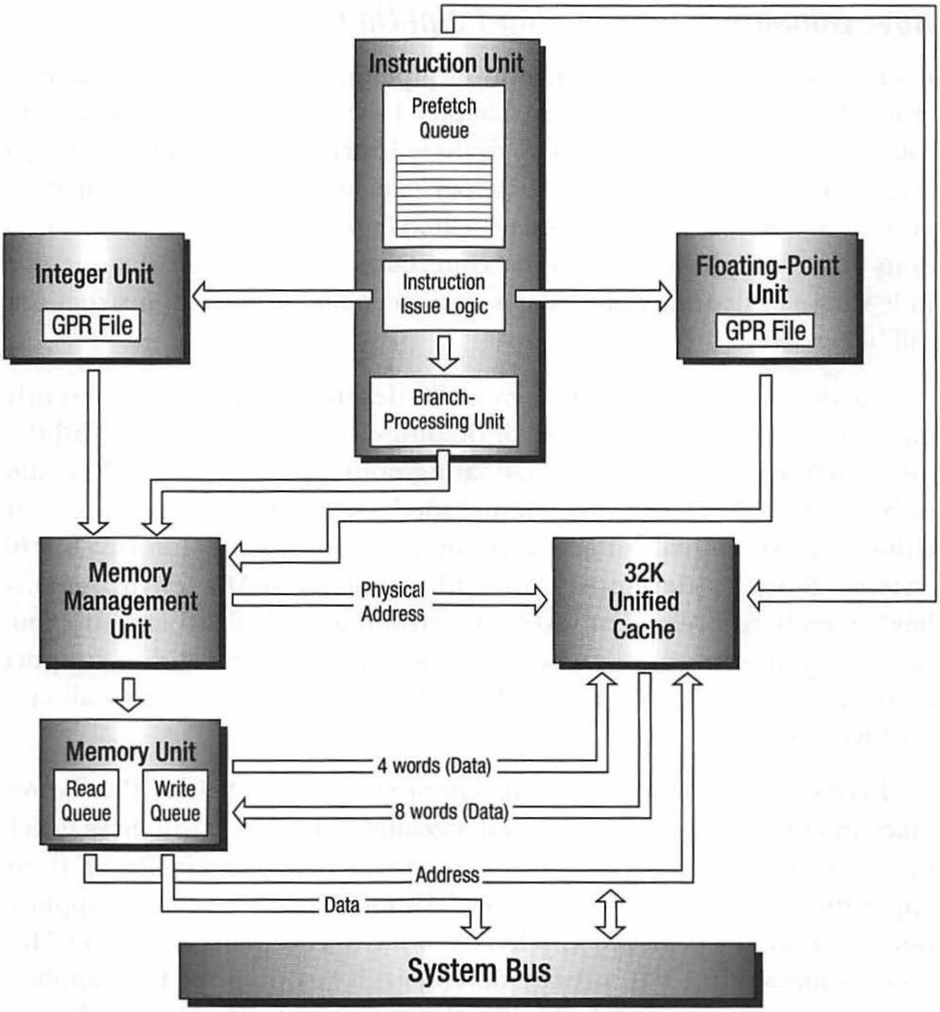


Figure 4.3 A simplified overview of the logical flow of data and instructions through the execution units, cache, and other subsystems of the PowerPC 601 CPU

The PowerPC 601 chip includes fully interlocking hardware between its execution units and all pipelines. Interlocks allow different pipelines to communicate with one another to ensure that an instruction doesn't complete if it requires data currently being manipulated by an instruction in a different pipeline or even in a different stage of the same pipe. Also, the 601 chip provides a 64-bit data bus (although it only supports 32-bit instructions).

How Valuable Is the Floating-Point Unit?

If you're familiar with the concepts of pipelining and superscalar execution (which I described briefly in Chapter 1), it will probably be obvious to you that the 601 chip supports up to three instruction dispatches during a single clock cycle (one instruction per execution unit). In information processing, most instructions are executed in the integer unit. For applications that use sophisticated graphics interfaces or require calculations on a wide range of floating-point values, a respectable number of instructions will be passed to the FPU.

It's worth noting, however, that most PC desktop applications currently make only marginal, if any, use of floating-point instructions. Until the introduction of the 486DX chip, floating-point operations on a PC could only be performed if the system included a separate math co-processor chip—a situation that's similar to the approach used with Motorola 68040 systems. Software developers for both the PC and Mac environments have been hard-pressed to justify the cost of adding floating-point routines to their applications when the majority of systems didn't support floating-point math. But an on-chip FPU is standard for nearly all current RISC designs.

So, here's the obvious question: If software developers believe that Power Macs and other PowerPC systems will become widely used, will these developers start adding floating-point routines to the majority of their applications. The answer so far is "Yes." Although many Macintosh applications have simply been recompiled in order to run native on Power Mac systems, many other Mac software developers have optimized their applications to take advantage of the built-in floating-point instructions and other capabilities of the PowerPC chips.

That's why many Power Macintosh applications outperform their PC counterparts running on Pentiums. The floating-point capabilities of the PowerPC 601 are far better than the floating-point capabilities of the Pentium chip (a fact that I'll explain later in the chapter). So when Macintosh applications are optimized to take advantage of the PowerPC 601's floating-point capabilities, their Pentium counterparts literally can't keep up.

What "Accelerated for Power Macintosh" Really Means

The red burst logo "Accelerated for Power Macintosh" is appearing with increased regularity on software boxes and in software advertisements. You've seen it dozens, if not hundreds, of times. Apple permits a software vendor to use this logo only if the software has been recompiled into 100-percent PowerPC-native code. So when you see this burst, you can be certain that the application doesn't run in 68K emulation—ever.
But "recompiled" is not the same as "optimized." An optimized Power Mac application has been modified and enhanced to take advantage of new instructions in the PowerPC instruction set that were not available in the Motorola 68K instruction set. The superior set of floating-point instructions available in the PowerPC instruction set are a prime example.

You *can't* be certain that an application boasting the "Accelerated for Power Macintosh" burst has actually been optimized to take advantage of new PowerPC instructions not available in the Motorola 68K architecture—especially floating-point instructions. Developers can slap that "Accelerated for Power Macintosh" logo onto their software boxes even if the software has not been optimized for the PowerPC instruction set—although many graphics intensive applications, like PageMaker, Photoshop, Premier, and many game programs, have been optimized, as have many other business applications, including Microsoft Excel.

The best way to tell whether an application has actually been *optimized* for the PowerPC (aside from actually viewing the source code) is to find out whether the current version of the software is an upgrade to a previously released native Power Mac version. Many developers simply recompiled their existing 68K applications to native PowerPC code in order to rush a native version of their program to market. The idea was to get the native version out the door fast, then work on optimizing the code for release in a later version. So, if a software package is a second- or third-generation native Power Mac program version, it's probably been optimized to take advantage of all that the PowerPC instruction set has to offer.

The Instruction Unit and BPU

Since the PowerPC 601's instruction unit and BPU work in close coordination, it's easy to combine the discussion of both units.

The instruction unit contains issue logic that determines whether the current instruction should be sent to the IU or the FPU. This step is important because it allows integer and floating-point instructions to execute independently of branch prediction and branch instruction processing. The BPU contains its own set of dedicated registers, which allows branch instructions to execute directly within the BPU.

The BPU can actually fetch branch instructions from the queue on its own, separately from the logic used to evaluate integer and floating-point instructions. Specifically, the BPU searches the bottom half of the instruction queue for the presence of branch instructions. When the BPU finds a conditional branch instruction (one that may or may not branch to a different location in the program code based on the results of a conditional test), it removes the instruction from the queue and evaluates it within the BPU.

At this point, the BPU scans the IU and FPU pipelines to determine whether a currently executing instruction will effect the condition bit register that the BPU uses to evaluate a conditional branch instruction. If not, the BPU can resolve the instruction immediately by using the current value in the condition bit. (In other words, previously executed instructions have already produced the operand that determines whether the branch instruction will be taken.)

If the BPU needs to wait for a currently executing instruction to complete before the branch instruction can be evaluated, the BPU performs a *speculative branch.* Here's what happens: While the BPU is waiting to evaluate the condition bit, it determines whether to take the branch based on the *direction of the branch itself.* This approach is called *static branch prediction.*

If a conditional branch instruction specifies that the program will branch backward if the condition test is true, then the BPU fetches and issues the target branch instructions. If the branch instruction specifies that the program will branch forward for a true condition, the BPU will not fetch the target branch instructions. Different RISC designers, operating independently, have conducted extensive research in branch prediction logic, with more or less uniform results. The static branch prediction method I've just described produces correct predictions far more often than it produces incorrect ones, resulting in increased superscalar execution and pipeline throughput.

Figure 4.4 illustrates the way the BPU interacts with the prefetch queue. If the BPU finds a conditional branch instruction, pulls it from the queue, and then is forced to speculatively execute the instruction, the BPU then determines the direction of the branch. The operating system itself determines whether the CPU will take the branch forward or will take it backward—by setting a branch prediction bit. For this discussion, assume that the BPU takes the branch only if the target address is backward, rather than forward, within the program.

If a backward branch is identified, the BPU takes the branch. It requests the prefetcher to replace the instructions that were behind the branch instruction in the queue with instructions starting at the branch target address. This effectively flushes the instruction queue. These instructions are allowed to be decoded and executed within the IU and FPU. However, the results of the instructions cannot be written back to registers until the BPU determines whether the branch was predicted correctly.

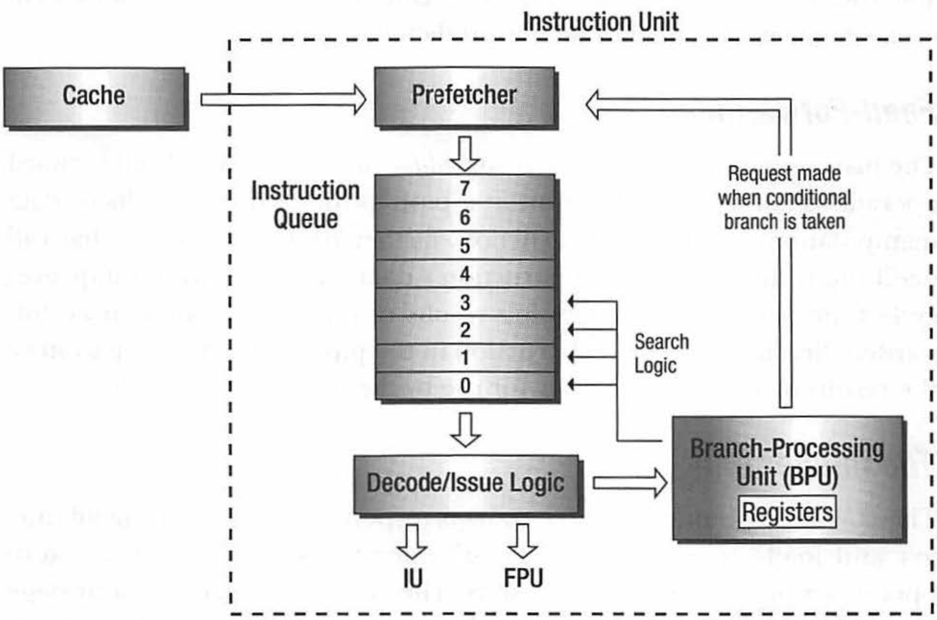


Figure 4.4 How the BPU interacts with the prefetch queue

If a forward branch is identified, the branch itself is not taken. The BPU marks all instructions that were behind the branch instruction as conditional, allowing them to be decoded and executed within the IU and FPU. However, the results of these instructions cannot be written back to registers until the BPU determines that the branch was predicted correctly.

If the BPU predicts a branch incorrectly, regardless of whether the branch is taken or not taken, the penalty is a complete flush of the instruction queue and all pipelines. The BPU then tells the prefetch unit the starting address for the instructions to be reloaded into the instruction queue. If the prefetcher can find all of the instructions in the on-chip cache (all are cache hits), then the performance penalty is minimal; the bus between the instruction queue and the cache can transfer eight instructions at a time—in a single burst. So, an empty instruction queue can be reloaded within one clock cycle.

If the prefetcher cannot find the desired instructions within the on-chip cache (one or more cache misses), it must fetch the instructions either from the off-chip (L2) cache, if one exists, or from RAM. In either case, performance penalties are greater because both L2 cache and RAM chips are much slower than the on-chip cache. This fact demonstrates how valuable the 601 chip's large on-chip cache can be in keeping pipelines busy, even when a conditional branch is predicted incorrectly.

Feed-Forwarding

The instruction unit also controls all *feed-forward* operations. Feed-forward operations allow one instruction in a pipe to forward the results of data manipulation to a second instruction, farther back in the pipe, that will need the results of the first instruction's data. Feed-forwarding improves cycle time because the processing results of one instruction can be forwarded directly to the next instruction in the pipe, without having to store the results in a separate register for use by the second instruction.

The Integer Unit

The IU (fixed point, or integer, unit) is responsible for executing all integer and load/store (memory access) operations, including load/store operations on floating-point registers. The IU is composed of a four-stage pipeline: implementing fetch, dispatch and decode, execute, and write back.

The PowerPC 601's IU is considered to be fairly typical of RISC implementations, although its feed-forward capabilities are not available on many RISC and RISC-like CPUs, including the Pentium.

The Floating-Point Unit

The FPU in the 601 chip supports floating-point operations on both single-precision and double-precision values, using the IEEE-754 floating-point standard. (IEEE stands for Institute of Electrical and Electronics Engineers; IEEE-754 specifies the format for single-precision—32-bit—floating-point values and double-precision—64-bit—floating-point values.)

HOT TIP

Politics and Floating Points

The 601 chip instruction set provides hardware support for all IEEE-754 floating-point data types. The *PowerPC 601 User's Manual* states that this approach prevents the pipeline latency that occurs when an application has to perform an exception routine for an unsupported floating-point operation. But it's more likely true that the rich floating-point instruction set is provided to specifically support the Macintosh OS's SANE (Standard Apple Numeric Environment) math routines. Most PC applications won't need the extensive floating-point hardware support provided by the PowerPC 601. But this may change as software developers add new floating-point capabilities to their native PowerPC applications.

The FPU includes 32 registers for performing floating-point operations. As you might expect, each register is 64 bits in length to support double-precision values. The FPU contains six pipeline stages: fetch, dispatch, decode, execute1, execute2, and write back. The execute1 and execute2 stages allow two floating-point instructions to be executed back-to-back.

An added bonus: The 601's FPU can search the bottom half of the instruction queue (just like the BPU) and then execute floating-point instructions that do not depend on the results of other instructions in the queue. This technique, of course, helps increase pipeline throughput.

And one drawback: The FPU doesn't support feed-forwarding. If a floating-point instruction needs the result stored by another floating-point instruction further along in the pipe, the instruction must stall until the previous instruction has stored its result in an FPU register. The omission of a feed-forwarding mechanism in the FPU pipe is more understandable than it would have been with the IU, because floating-point routines often interleave floating-point and integer instructions, so pipeline stalls in the FPU are often not critical. Nevertheless, the addition of feed-forwarding to the FPU pipe in later PowerPC chips would be very welcome.

The Cache Unit

The 601 chip contains a 32K on-chip cache—larger than any cache available on CISC CPUs, and larger than the on-chip caches on most RISC CPUs. The ability of IBM to stuff a 32K cache onto an affordable and relatively small RISC processor says volumes about the carefully crafted design of the 601 and about the sophistication of IBM's fabrication technology.

One interesting quirk is that the cache is *unified*, which means that instructions and data are stored in the same cache. IBM pioneered the split-cache concept, which separates data and instructions into separate caches. Split caches are a staple of the POWER RS/6000 technology. But it's important to keep in mind that the main goal of the 601 design was to provide maximum performance at the lowest possible price. A unified cache is clearly less expensive to implement than a split cache, and *does* provide a few benefits. But overall, a split cache provides better CPU throughput than a unified cache. In fact, the PowerPC 604 chip contains a split cache—a 16K data cache and a separate 16K instruction cache.

Cache control logic can be somewhat complex and involves such concepts as set associativity, cache data and cache tag memories, translation lookaside buffers, and read/write protocols. These concepts require more technical depth than I think most readers would be willing to sift through, so I'm going to stay away from those topics.

Evaluating the 601's Performance

IBM has currently made available PowerPC 601 chips that run at 60, 66, 80, 100, and 110 MHz. Since the 66 MHz provides an intermediate standard, and since the most widely sold Pentium chip runs at 66 MHz, it serves our purposes to use the 66 MHz PowerPC as the benchmark for comparison with the Pentium. Just keep in mind that there are faster PowerPC 601s and faster Pentiums. The differences between the two chips, then, really have little if anything to do with speed.

The SPEC Benchmark Standard

Several benchmark standards are available for evaluating CPUs, but the most widely used standard at present is SPEC-92. (SPEC stands for Systems Performance Evaluation Cooperative, a consortium formed by Hewlett-Packard, Apollo, MIPS, and Sun to evaluate and compare the performance of RISC processors.) The SPEC consortium designed a set of floating-point and integer tests in 1989, which were called the SPEC-89 benchmark standard. These early benchmark tests were revised in 1992 to more accurately reflect the capabilities of newer RISC processors.

Again, benchmark tests fall within two groups: Integer (SPECint) and floating point (SPECfp). The results for each test fall within a performance range based upon a normal of 1, which is based upon SPEC results for a (by today's standards) rather creaky VAX minicomputer. A system that achieves a SPEC rating of 2, then, is twice as fast as its VAX ancestor.

After the full battery of SPEC tests for each group have been completed, the geometric mean is calculated for each group.

Although SPEC benchmarks are designed to yield objective results regardless of who runs the tests, the tests in reality are highly dependent on the overall design of a particular system. (A simple analogy will work here. If you emission-test two 1982 Toyota Corollas that have identical engines, you can still get divergent hydrocarbon and CO results, since all mechanical parts of the two vehicles won't be of identical performance levels.) Memory speeds, motherboard design, and expansion bus type all can affect the outcome of benchmark testing.

But even though SPEC results can vary for tests conducted on different systems, the variance usually is not great and, in fact, the SPEC tests are a fairly reliable indicator of the basic performance capabilities of a given chip.

For the PowerPC 66 MHz 601 chip, IBM reports a value of 62 for the SPECint92 rating (in other words, 62 is the geometric mean for the full battery of integer tests) and a value of 72 for the SPECfp92 rating (the geometric mean for all floating-point tests). Apple reports a SPECint92 rating of 60 and a SPECfp92 rating of 80. As a point of comparison, consider these Pentium ratings: Intel's published benchmark results for the 66 MHz chip are 65 SPECint92 and 57 SPECfp92.

These numbers show that the Pentium's integer instructions perform at a slightly higher rate than the PowerPC 601, but that floating-point ratings for the PowerPC 601 are substantially higher than the floating-point rating for the Pentium. When you consider these numbers, it seems clear why Intel is downplaying the importance of floating-point computation in new software designs.

Another important factor in evaluating chip performance is power consumption. On average, the PowerPC 601 66 MHz chip dissipates about 7 watts. By comparison, the Pentium averages out at 13 watts. This has been Intel's single biggest problem in getting the Pentium chips into notebook computers. Power dissipation for desktop PCs isn't as critical as it is for notebook computers, which don't have the space to support heavy and bulky cooling systems, but it *is* important. Lower power consumption makes it easier for system designers to design inexpensive cooling systems. So, in the end, low power consumption—even for desktop systems—translates into lower system prices.

Unveiling the 604 Chip

Even though the PowerPC 604 chip is being positioned as a processor for low-end workstations and file servers, it will undoubtedly travel the same path that Intel x86 processors have traveled. In other words, expect the 604 to become the successor to the 601 in next-generation Power Mac system. In fact, you'll probably be able to use the L2 cache slot in your current Power Mac to plug in a 604-based daughtercard in order to upgrade your system to the PowerPC 604 level. I say "probably" because there are some thermal issues involved in upgrading the hotter-running 604 chip into existing 601-based systems. However, I suspect that most of these potential hurdles can be surmounted.

IBM and Motorola publicly announced the PowerPC 604 chip at the end of March 1994, and it was an impressive announcement. In 1993, IBM and Motorola stated that the 604 processor would be able to issue four instructions in parallel—the first desktop-level processor to boast such a high level of superscalar performance. The 604 can, in fact, issue four instructions simultaneously. However, because it contains six execution units, the 604 can *execute and retire* up to six instructions simultaneously.

Features of the 604

The 604 is so feature-packed it's difficult to know where to start. However, the most important set of features is probably the 604's heavily superscalar design, providing these six execution units, all of which can operate in parallel:

- One floating-point unit (FPU)
- One branch processing unit (BPU)
- One load/store unit (LSU)
- *Three* integer units

That final bullet is not a misprint. The 604 does indeed provide three integer units—two integer units that can process single-cycle instructions and one integer unit to process multiple-cycle instructions. The 604's integer capability is important, especially considering that Intel has been bragging about the Pentium's dual-integer pipe architecture and its slightly faster integer performance over the PowerPC 601 chip. Now its time for IBM and Motorola to brag. The 604 CPU outperforms *all* existing versions of the Pentium, including the P54C, in both integer and floating-point performance.

The 604 departs from the 601 design in several respects, but perhaps the most important is the return of separate caches for instructions and data. (Remember, the 601 provides a unified cache; the 604 provides a 16K instruction cache and a 16K data cache.) The 604's instruction cache can issue four instructions per clock cycle, while the data cache can supply two words per cycle. And the BPU in the 604 uses a dynamic branch prediction approach similar to the one used in the Pentium. (Dynamic branch prediction is one of the few features of the Pentium that is superior to the 601; the 601 uses a static branch prediction technique.)

Managing Instruction Flow in the 604

The 604 actually has two categories of functional units: units designed specifically to manage the flow of instructions through the processor and the execution units themselves (the BPU actually fits in both categories). To manage instruction flow, the 604 provides a fetch unit, a decode/dispatch unit, the BPU, and an instruction completion unit.

- The fetch unit provides instructions to the eight-entry instruction queue by accessing the on-chip instruction cache.
- The decode/dispatch unit decodes instructions and issues them to the appropriate execution unit.
- The BPU, of course, predicts and resolves branch instructions. All branch instructions are placed in a reservation station within the BPU until their conditions are resolved and they can be executed. For conditional branches, the BPU predicts whether a branch should be taken by using a two-bit four-state branch history target (BHT) buffer. This is nearly identical to the branch prediction approach used in the Pentium. If the BHT indicates that a conditional branch should be taken, the instructions are executed and placed in the completion unit until it has been determined whether the branch prediction was correct.
- The completion unit uses a *reorder buffer* to retire executed instructions, including instructions completed for a mispredicted branch. An instruction is retired from the reorder buffer when it has finished execution and after all instructions ahead of it have been completed. The instruction's result is then written to the appropriate register file.

Rename Buffers

The 604 uses a slick approach to prevent two or more instructions from contending with one another over the same register. Specifically, the 604 provides several *rename registers*—12 for the general-purpose register files for each integer unit, 12 for the FPU, and eight for the condition register.

The rename buffers help prevent pipeline stalls and other bottlenecks, especially those that might result from an incorrectly predicted branch. The completion unit doesn't transfer instruction results from the rename registers to the actual register files until any speculative branch conditions preceding the instruction have been resolved. If a branch is predicted incorrectly, the speculatively executed instructions following the branch are flushed from the completion queue and the results of those instructions are flushed from the rename registers. It's never necessary to flush the registers themselves following an incorrectly predicted branch.

Inside the 604's Execution Units

The two single-cycle integer units (SCIUs) each have three subunits: an adder/comparator, a subunit to perform logical operations, and a subunit for performing bit manipulations like rotates and shifts. Although the three subunits perform different tasks, only one subunit at a time can execute an instruction. The multiple-cycle integer unit (MCIU) contains a 32-bit integer multiplier/divider and accepts only those instructions that require two or more clock cycles to execute—for instance, instructions that read and write to special-purpose registers. The three integer units give the 604 a SPECint92 rating of 160. (Again, the SPECint92 rating of the 601 is about 85.) Floating-point performance on the 604 achieves an impressive SPECfp92 rating of 165.

The FPU accepts floating-point instructions from the decode/dispatch unit and allows other instruction units to access the content of its registers and rename registers. The FPU supports both single- and double-precision floating-point instructions.

The load/store unit (LSU) transfers data between the data cache and the *result buses*, which route data to other execution units that need results from previously executed instructions—in other words, feed forwarding. The LSU includes load and store queues to buffer instructions that have been executed and are waiting to be retired. The contents of the queues can then be used to forward data to other execution units. The LSU also supports cache-control instructions and load/store, multiple-string instructions.

A One-Minute 604 Synopsis

A few additional, general notes: The 604 chip implements all of the 32-bit instructions defined by the PowerPC architecture. The 604 *does not* directly implement any 601 instructions that are not part of the PowerPC architecture. But that doesn't mean that existing Power Mac applications won't run on 604-based Power Macs. Remember that the 601 included several POWER instructions that were not made part of the basic PowerPC architecture—to provide backward compatibility for RS/60000 applications. Few if any Power Mac applications use these RS/60000 instructions. In any event, the 604 can trap and emulate these non-PowerPC instructions by treating them as exception conditions.

The 604 contains 3.6 million transistors on a 196 square-millimeter die, and can operate at 3.3 volts (by contrast, the 601 can operate at 3.6 volts). It also includes a nap mode to support power saving. Software can trigger the nap mode by setting a dedicated bit, which causes the 604 to suspend instruction dispatch and most of its internal operations until it detects any asynchronous interrupt signals.

The 603 Chip

IBM and Motorola initially designed the 603 chip as a low-cost, power-saving implementation of the PowerPC architecture. The 603 chip's SPEC ratings are actually slightly lower than the 601's rating, but that doesn't mean it's an inferior chip. The 603 chip serves a different marketing niche than the 601 chip, and within this niche, the 603's SPEC marks are impressive. Specifically, the 603 chip was designed for use in notebook computers and other "green" systems that can benefit from low power consumption.

Apple initially had planned to use the 603 chip in its Power Mac line of notebooks to succeed the PowerBook line. But when Apple tested the chip, they discovered that its split-cache architecture could not support 68K emulated applications at acceptable speeds. So Apple asked IBM and Motorola to return to the drawing board to design a version of the 603 that would better support 68K emulation.

The result will be the 603+ chip, which is not yet available as I write this. Since IBM and Motorola have not yet published specifications for this new chip, I can only speculate on the ways in which it will be different from the existing 603. First, IBM and Motorola have already indicated that the base speed of the 603+ chip will be faster—80 MHz rather than the 66 MHz base speed of the 603 chip. IBM and Motorola have also indicated that the 603+ chip will use a different cache architecture. This could mean either a unified cache, a larger instruction cache, or some other prefetch approach that will speed up cache performance. It's all guesswork at this point.

The following paragraphs describe the architecture of the 603 chip as it exists now. Just keep in mind that some changes will be made to the 603+ chip to support better 68K application emulation. Aside from adjustments to the cache architecture, I doubt that fewer other design changes will be made.

The 603 chip's transistors, registers, and internal bus paths all can operate successfully at 3.3 volts. Most CPUs designed for desktop PCs and larger systems require the application of 5 volts to change the state of transistors and registers. Other CPUs, designed specifically for notebook systems, achieve this same 3.3-volt level, but the 603 chip does so while providing significant RISC features and other chip capabilities that aren't available in its competitors.

Specifically, the 603 CPU integrates 1.6 million transistors on an 85 square-millimeter die, about two-thirds the die size of the 601 (132 square millimeters). Figure 4.5 shows the difference in size for the 601 and 603

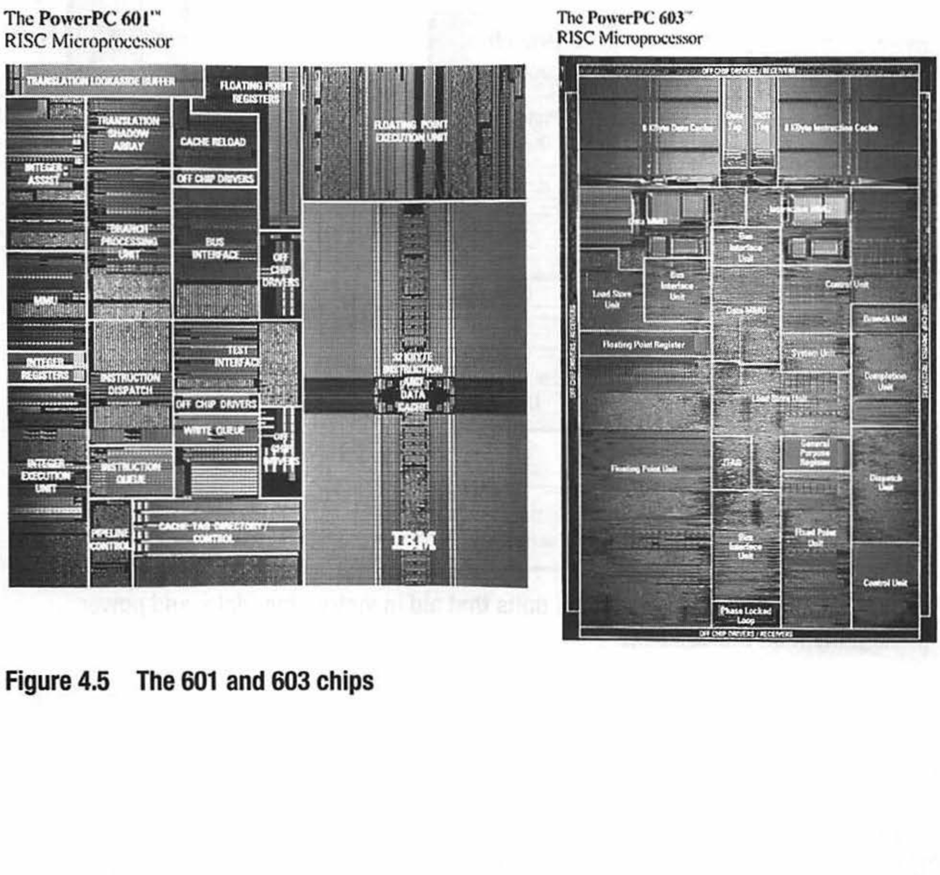


Figure 4.5 The 601 and 603 chips

chips. The 603 uses a .5 micron fabrication technology, which betters the .65 micron design of the initial 601 chip release. The 603 chip's small die size and narrow-width fabrication technology both help contribute to low power consumption—essential for notebook systems that can't contain massive batteries or employ large heat sinks, powerful fans, and other system designs that help dissipate heat in larger, desktop systems.

But the 603 chip also includes some specific design characteristics that go even further toward reducing power consumption. Case in point: The 603 chip actually *adds* functional units over and above the three-instruction dispatch units provided by the 601 chip. Figure 4.6 shows a simplified block diagram of the 603 chip. Keep in mind that the cache design for the 603+ chip will probably differ from the one shown here.

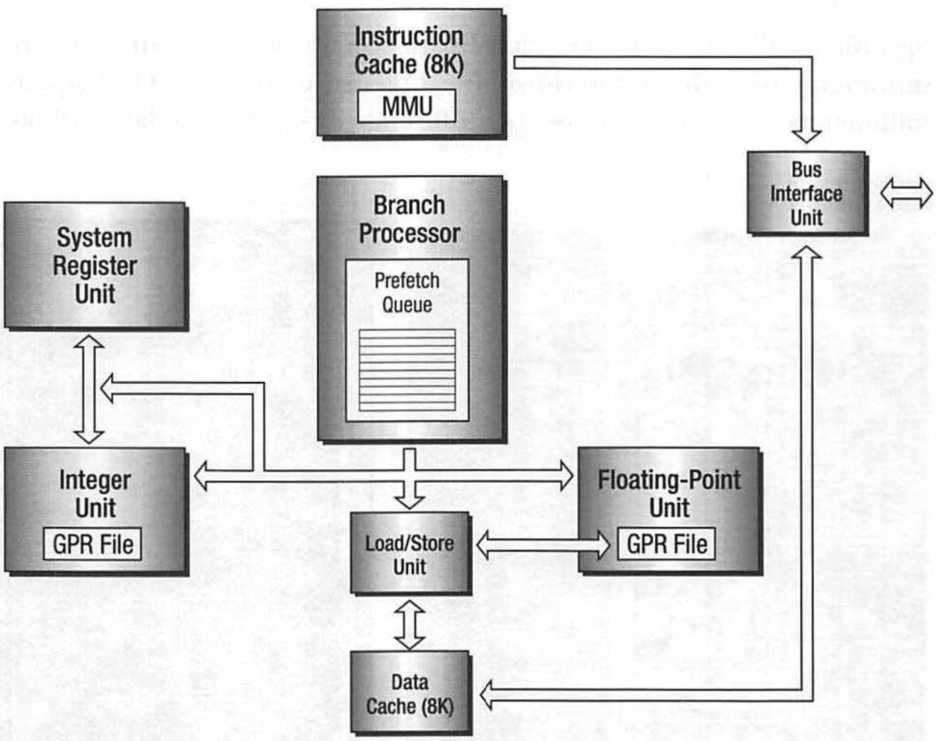


Figure 4.6 The multiple functional units that aid in instruction, data, and power management on the 603 chip

The 603 incorporates a separate load/store unit (LSU) and a system-register unit (SRU), both of which help contribute to power management. The LSU manages the transfer of data between the on-chip cache and general-purpose registers. The SRU is responsible for executing instructions that use special-purpose registers (rather than the general-purpose registers available in the IU) and condition registers (for branch-processing instructions).

But the additional execution units on the 603 chip aren't designed to increase the number of instructions executed per clock cycle—they're included to reduce power consumption. The LSU and SRU can separately be disabled if they are not currently being used, providing significant power savings.

The 603 processor includes three built-in power saving modes: *doze, nap,* and *sleep.* In general, the three modes operate under control of a phased lock loop (PLL) clock multiplier circuit. The PLL allows internal operations within the CPU to run at multiples (1,2, 3, or 4 times the speed) of the bus transfer rate. This technique is especially useful when one of the three power-saving modes is in effect, since internal processing can zoom along even while external operations are using a slower clock speed to conserve power.

In doze mode, the 603 chip shuts down all of the processor's execution units and subsystems (after determining they are inactive), but allows the CPU's *bus snoop* logic to operate. Bus snooping is a clever way of describing the ability of the CPU to monitor all bus transfers to determine whether a memory access will affect the contents of the on-chip cache. In doze mode, bus snooping allows the CPU to support caching of incoming data and instructions, even if the execution units of the CPU itself are not busy.

In doze mode, the chip continues to update the time-base register, which is incremented at some frequency to allow system software to keep track of the timing of instruction execution. With the time-base register operating, it is also possible to keep the PLL circuit powered on (IBM calls this "locking" the PLL), which in turns allows the CPU to recover to full-power mode using fewer clock cycles than would be possible if the PLL circuit were shut down. If all this sounds a bit too technical for your taste, just keep in mind that doze mode shuts down most of the CPU's functions but provides a way for it to return to full implementation within a minimum number of clock cycles.

In nap mode, the time-base register and PLL circuit are still enabled, but bus snooping logic is disabled. In effect, nap mode disables the cache but still provides a way for the CPU to return to full implementation within a reasonable number of clock cycles. (More clock cycles are required than doze mode, since the cache must be reloaded, but fewer clock cycles are required than sleep mode, discussed next.)

In sleep mode, the time-base register and PLL circuit are disabled to supply additional power savings when the CPU is totally inactive and when no user application is requesting any CPU services. With sleep mode, the CPU is "nearly dead," which means that numerous clock cycles are required to resynchronize the PLL with the system clock, to update the cache, and to power up all of the CPU's execution units. So, sleep mode provides optimal power savings, but also requires the most clock cycles to return the CPU to full power.

So what exactly do I mean by "optimal power savings?" Maximum power dissipation for the 603 is rated at 3 watts—less than half the maximum power dissipation of the 601 chip. But by switching between the three power-saving modes, the average power dissipation of the 603 can drop to below 2 watts, even as low as 1 watt during minimum use. This level of power saving obviously leads to longer lives for notebook batteries, yet still provides state-of-the-art performance. Existing Pentium designs don't even come close to this performance/power-saving ratio.

My closing remarks on the differences between PowerPC chips and Pentium chips: We should spend less time chuckling over precision Pentium bugs that lead to faulty division in a rare number of situations and focus instead on the superior design and performance of PowerPC chips. If Intel wants to go head-to-head with the PowerPC technology, it has no choice but to abandon its existing 80×86 architecture in favor of a design that looks a lot more like what IBM and Motorola have done with the PowerPC architecture—a *very* RISCy move for Intel. But they'll do it because the success of the PowerPC has forced them to do it. Until then, your Power Mac will continue to be the best and fastest desktop platform on the market. And if you've survived the technical discussions in this chapter, you now know why.

CHAPTER

5

Inside the 1994 Power Macs

Some Technical Meat

Chapter 2 explained most of the basic—and I stress *basic*—features of the 6100, 7100, and 8100 Power Mac systems as well as options for upgrading your existing Mac to Power Mac technology. That chapter was intended to help you understand the differences among the different Power Mac purchasing options and their capabilities.

In this chapter, I assume you've already purchased a Power Mac or that you want more technical meat regarding Power Mac features. In fact, that's the thrust of this chapter—to provide you with some technical (although I hope easy-to-understand) depth involving the capabilities and features of Power Mac systems. This information is designed to help you determine how to fine-tune certain PowerPC-specific Macintosh features, how to recognize limitations that might lead you to later upgrade your Power Mac when more advanced upgrade technology becomes available, and how to diagnose problems. After all, when you take your sick Power Mac to a repair shop, and the repair jockey says "you've got a bad BART," wouldn't you like to know whether your chain is being yanked?

Is an Upgraded Macintosh a "True" Power Mac?

At this writing, there are three basic upgrade paths to convert an older Macintosh to Power Mac technology: An Apple PDS-based upgrade card, an Apple logic board upgrade, and a DayStar PDS-based upgrade card. I briefly discussed these options in Chapter 2.

Upgrade cards are much different from the 6100, 7100, and 8100 systems because you don't get a lot of the same hardware functionality with either an Apple or DayStar PowerPC upgrade card. And much of the material in this chapter directly involves hardware capabilities and problems that are specific to the 6100, 7100, and 8100 out-of-the-box systems. Again, I've already covered most of the issues and problems involving these upgrade cards in Chapter 2.

Logic board upgrades are nearly identical to comparable 6100, 7100, and 8100 boxed systems. So, if you've had one of these logic boards installed in your older, 68K Mac, just consider that you've got a true 6100, 7100, or 8100 system and that the material in this chapter applies to your system.

So this chapter is for you if you want more technical information about the 6100, 7100, 8100 systems and logic board upgrades. I try to avoid covering basic information that you can find easily in your Macintosh *Reference* and *Getting Started* manuals—unless in my judgment the information in those publications is difficult to find or to understand. For the truly hardcore hardware junkies, I've included a few technical reference diagrams and tables. If you're not interested in this level of technical arcanery, you might want to skip these discussions.

The Power Macintosh Logic Board

The logic board (also called the motherboard) on all 6100, 7100, and 8100 non-AV systems are really very similar. Differences are mainly in the CPU's clock speed (60, 66, or 80, 100, and 110 MHz at this writing) and expansion capabilities. A block diagram (which shows the functional parts of a logic board without technical detail) for the Power Macintosh logic board is shown in Figure 5.1. Most of the remaining sections in this chapter describe the capabilities of these functional parts.

Each major functional area of the logic board has a number in Figure 5.1. (Some numbers correspond to more than one discrete unit on the logic board, but all of the units are integrated in some manner to provide a single function.) The next several section headings include these numbers to help you match the descriptions with the appropriate parts of the logic board. Where it's relevant to do so, I'll explain how a particular part of the logic board differs for 6100, 7100, or 8100 systems. Figure 5.2 is a photo-

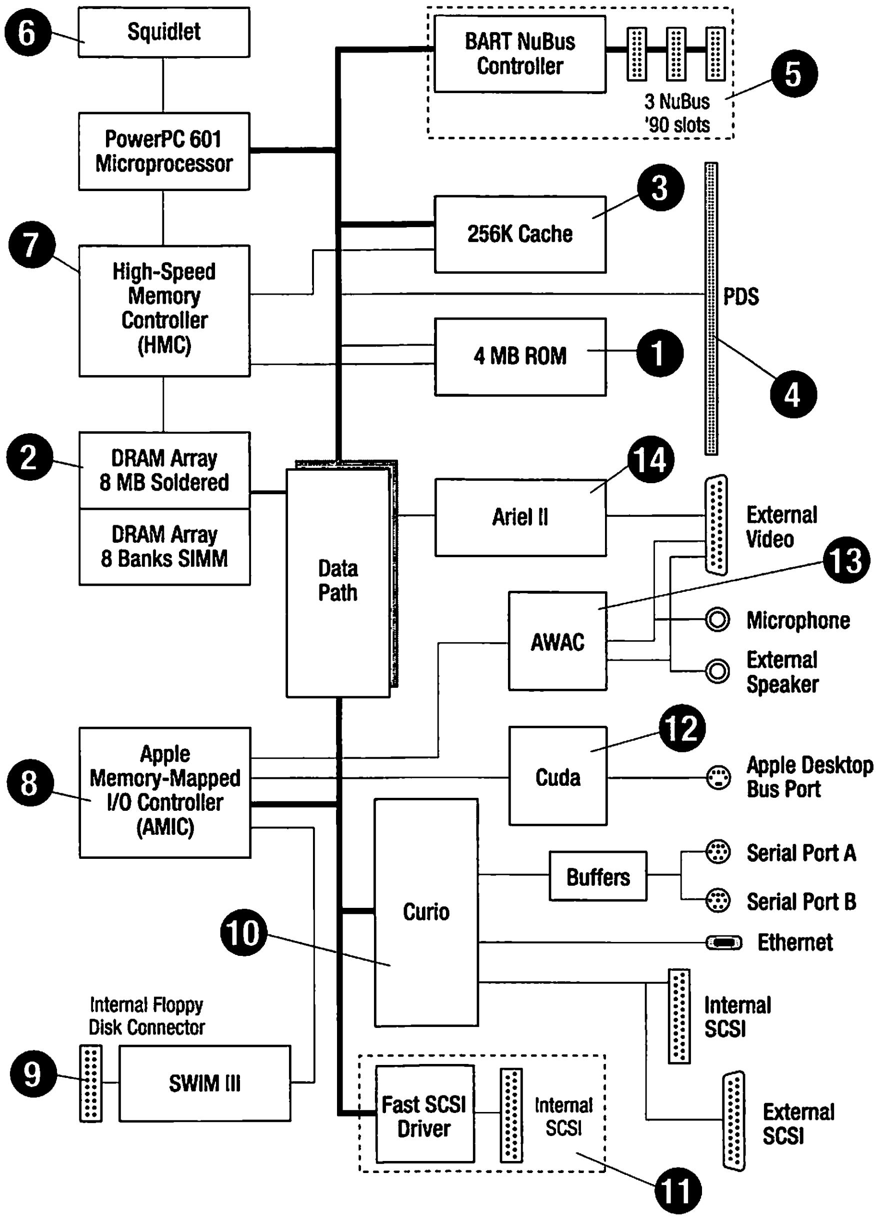


Figure 5.1 The Power Macintosh logic board

graph of the logic board of an 8100 system, with selected components annotated to help you identify them more easily. Compare this photograph with the drawing in Figure 5.1.

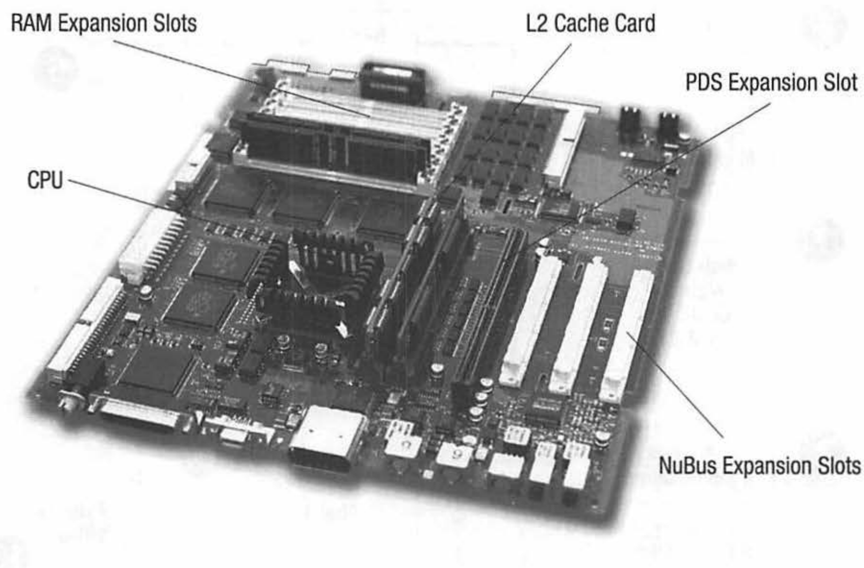


Figure 5.2 The Power Macintosh 8100 Logic Board

1. Understanding ROM (4 MB)

The built-in read-only memory (ROM) stores the portion of System 7 that is common to all Power Macintosh systems. When you power-on your system, the Start Manager is loaded from ROM and performs startup tests on all components of the logic board, including all I/O ports.

If the Start Manager doesn't identify any problems, it passes control to the operating system itself. The operating system sets up a partition in memory (RAM) for its sole use. The basic portion of the operating system is then loaded into the system partition. Other portions of the system partition are reserved for other operating system services that can be loaded later to provide functionality for applications. Other disk-based portions of the operating system, including resource files, control panels, extensions (including System 7.5 extensions), and the Finder, are then loaded into the system partition from disk. For more information on System 7.5 and the Mac OS in general, please see Chapters 10 and 11.

HOT TIP

The Evolution of Enablers

Until System 7 was released, the ROM portion of the Macintosh operating system had to be customized to support the unique hardware configuration of each new Macintosh model. System 7, on the other hand, incorporates the machine-specific startup code for all Macintoshes produced prior to the release of System 7. For any Macintosh model released after System 7 was developed, you must provide an enabler file that provides hardware information about the specific model you are using.

The disk portion of System 7.1.2 or System 7.5 that came with your Power Macintosh includes a single PowerPC enabler (stored in the System folder) that the ROM portion of the operating system loads and uses to detect and configure your specific Power Macintosh model. The enabler sets a machine identification code in one of the PowerPC 601's general-purpose registers. Application installation routines and expansion cards can use this ID code to determine whether you are running a 6100, 7100, or 8100 system.

Unfortunately, there are already more than three versions of the PowerPC enabler available. Each version overcomes some minor hardware (ROM-based) problems that were not addressed in the previous enabler version. It's always a good idea to contact Apple to identify and receive the most current PowerPC enabler available.

2. DRAM

All Power Macintoshes ship with 8 MB of 80 ns (or faster), 72-pin dynamic RAM (DRAM) chips soldered onto the logic board. Most of the 8100 systems include an additional 8 MB of built-in memory installed as removable SIMMs. (The discontinued 8100 system that shipped with a 250 MB hard drive is the exception, containing only 8 MB of built-in RAM.) The soldered-on chips should be replaced only if they're defective, and then only by an authorized repair facility.

RAM is installed via 72-pin single in-line memory modules (SIMMs). As I mentioned in Chapter 2, all RAM in Power Macs must have an access time of 80 ns or faster. A SIMM is essentially a small expansion card that contains DRAM chips soldered onto the card, a design that makes it easy for users to install additional memory themselves. Figure 5.3 shows a pair of Power Mac SIMMs.

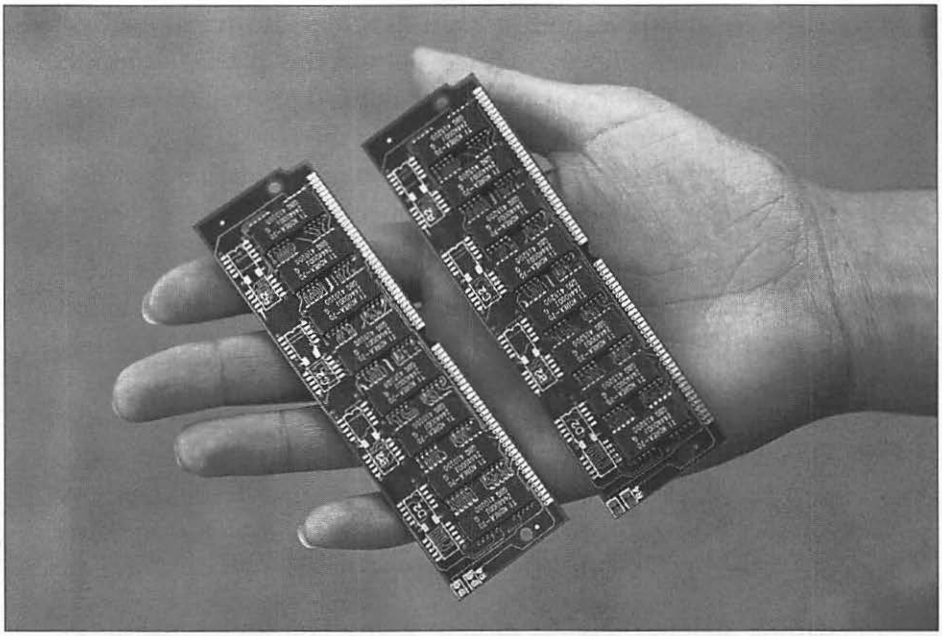


Figure 5.3 Power Macintosh SIMMs must be installed in pairs

I'll explain how to install DRAM SIMMs in Chapter 7. The following systems use the standard 72-pin size, and require SIMMs rated at 80 ns or faster. The SIMMs from any of these systems can be used in Power Macs:

- LC III
- Performa 450
- Centris 610

Many other Macintosh systems, including Quadra systems and other Centris systems, can use 72-pin SIMMs, but do not require them. However, since all Quadra and Centris systems require SIMMs rated at 80 ns or faster, 72-pin SIMMs installed in these systems will usually work in Power Macs.

All Power Macs provide expansion slots (banks) that you can use to upgrade the RAM in your system. However, maximum RAM expansion is not the same for all Power Mac logic boards. The number of expansion slots varies, and consequently so does the maximum amount of RAM that the different systems can accept. Table 5.1 shows the maximum RAM capacity for 6100, 7100, and 8100 systems. Maximum RAM assumes that 32 MB SIMMs are used in all expansion slots. Again, keep in mind that the discon-

Table 5.1 Maximum RAM Expansion Capacities

Model	Built-in Expansion Slots	Installed RAM	+ Max Expansion RAM	Total Maximum
6100	2	8	64 MB	72 MB
7100	4	8	124 MB	136 MB
8100	8	16	248 MB	264 MB

tinued 8100 catalog #M1884LL/A system only comes with 8 MB of built-in RAM, so it's only expandable to 256 MB.

I've mentioned that the SIMMs you installed must be "standard" in size. But what does that really mean? One of the major reasons Apple switched to 72-pin SIMMs was to standardize with the Intel-based PC world. Since there are far more hardware suppliers for PCs, the competition is keener and prices are often more competitive in the PC realm than for hardware that works only in Macs. Apple has been moving gradually (painfully so, it too often seems) toward using more industry-standard hardware in its systems to bring down the cost of system sales and upgrades.

When you purchase 72-pin SIMMs, aside from the access time rating, make sure that you are buying noncomposite, fast-paged RAM. Composite RAM SIMMs will not fit in the Power Macs' SIMM expansion slots.

HOT TIP

Swapping RAM onto a Logic Board Upgrade

The Apple Logic Board Upgrade also comes with 8 MB of 70 ns soldered-on RAM. Apple advertises that the logic board can use the RAM already installed in the Mac system you are upgrading—provided that your previous logic board used 72-pin, 80 ns or faster RAM.

The good news: All Macs that are compatible with the logic board upgrade require RAM that is 80 ns or faster. The bad news: Many of these systems support multiple SIMM types and some don't require SIMMs to be installed in pairs. If you have 30-pin SIMMs installed in your Mac and you upgrade via the Power Macintosh logic board, these older SIMMs can't be reused on the new logic board. If you have a non-paired 72-pin SIMM on your older Mac, you'll have to purchase a partner chip in order for this loner chip to be usable in your Power Mac logic board. (By the way, *pairing* means that the *same size* SIMM must be used in both, parallel SIMM slots.)

Another good tip: Even if the RAM on your older Macintosh isn't rated 80 ns or faster, you can try installing the RAM in your Power Mac (as long it's 72-pin and you install in pairs) to see whether the SIMMs work. You won't do any harm by trying this, although if you receive startup, memory, or other frequent error messages, you'll know the memory isn't working.

Slower RAM often works in machines that require faster RAM because chip manufacturers don't make SIMMs that only run at one speed. The speed rating is simply the *slowest* that the chip is guaranteed to run—based on tests of a given manufactured batch of SIMMs. Many chips will run faster than the tested rating. For instance, 80 MHz SIMMs often will run at 50 or 55 ns It's not unusual for 90 or 100 MHz SIMMs to run at 80 MHz or faster. So give it a try. You can always uninstall the SIMMs if they fail.

3. Level 2 (L2) Cache

The L2 cache slot provides expansion capabilities for a 256K or larger cache card. The cache slot accepts a 160-pin SIMM. Although some of Apple's product literature states that the cache slot can support a SIMM of up to 256K, much larger cache expansions are possible (potentially up to 1 MB). Apple probably mentions a 256K limit not to be deceptive but because its own PowerPC L2 cache card is a 256K SIMM. Apple's 256K cache card comes standard with all 8100 systems, some 6100 and 7100 systems, and is available as an option for all other 6100 and 7100 systems. I'll describe some great cache expansion opportunities in Chapter 7.

Why It Won't Work: Type 11 Errors

With the initial shipment of Power Macintoshes, a relatively small number of Apple 256K cache cards contained a bug that caused memory management problems for some users. The problems were reported on-screen as a "Type 11 Error" and seemed to occur in an almost random fashion. Most of these cards are now out of circulation, having been replaced by a bug-free card. Apple provided the new card and the labor installation free of charge to users who reported the complaint.

If you experience a "Type 11 Error" (or other memory management errors), it does not necessarily mean that you have a faulty cache card. One of your applications or utilities might be using an extension that does not work with System 7.1.2. A good way to test this possibility is to boot your system while holding down the Shift key to disable all extensions.

If your system behaves stably after you've tried this, the problem lies with your software, and you'll need to identify the troublemaker. First, you need to identify the extensions that have most recently been installed on your system. (Make a mental note of the applications and utilities you've installed most recently.) Try using the Extension Manager to turn off the newest extensions one at a time (and rebooting after each extension has been turned off), until your system behaves reliably. Admittedly, this approach can take hours or even days, but that's better than living through many months of system crashes. Testing extensions in this manner is generally the best way to troubleshoot system crashes.

To double-check your troubleshooting effort, turn on the most currently turned-off extension and make sure your system develops errors again. You'll need to contact the vendor to find out if an updated version is available.

If you still receive Type 11 or other memory-related error messages after you've tried this tactic and your system has a 256K cache card supplied by Apple, the card could be the source of the problem.

4. The Processor Direct Slot (PDS)

The PDS is a fast, local-bus expansion design that was first made available with the Mac SE. The local-bus design basically means that the PDS card has direct access to the CPU's control, address, and data bus lines. By contrast, a

NuBus card follows a more traditional bus architecture, where it must go through some intermediate processing steps before it can access the CPU.

To gain control of the 601 bus, a PDS card must check one of the bus's signal pins, called the bus request line, to gain access to the CPU bus. Next to the CPU itself, the PDS is lowest on the totem pole in requesting access to the bus. DRAM refresh, video refresh, and I/O direct memory access (DMA) requests all have a higher priority when multiple requests for bus control are made. Even so, the PDS local-bus design is much faster than NuBus slots. A NuBus expansion card can access RAM or system ROM directly, but not the CPU.

The PDS design has only limited use as an expansion card option, mainly because only one PDS slot is available per system. Another problem is that, because the PDS accesses a CPU directly, the PDS design varies from system to system. In other words, there is not much standardization among PDS cards.

The PDS has been popular for high-end users who want to add a high-speed cache or processor upgrade card. But as a widely used expansion bus for mainstream Mac users, most third-party vendors have shunned the PDS in favor of the slower NuBus design. It makes sense: NuBus-based Macs typically have from three to six NuBus slots available. That means users have more options in selecting from available NuBus cards on the market.

Although all Power Macs come with one PDS, the slot is already used on all but the non-AV 6100 systems. For AV systems, the PDS is filled with Apple's AV card. I'll provide an in-depth discussion of this card and its capabilities in Chapter 6.

The 7100 and 8100 VRAM Expansion Cards

For non-AV 7100 and 8100 systems, the PDS is preinstalled with a video RAM (VRAM) expansion card. The standard video capability for all Power Macintoshes uses up to 640K of system RAM to buffer (store) video frames. This standard DRAM capacity limits 14" and 15" monitors to 32,768 colors, 16" and 17" monitors to 256 colors, and does not support 20" and 21" monitors.

The expansion card bundled with 7100 and 8100 systems uses separate VRAM for enhanced color support and includes an unused SIMM slot so that you can install additional VRAM. (When the video expansion card is installed, the system will not use system DRAM for video memory.)

The video expansion card also includes a DB-15 output connector for a second video monitor. Table 5.2 describes the standard VRAM and corresponding color depth available for 7100 and 8100 systems. The left side of Figure 5.3 shows the DB-15 video monitor connector available at the back of the VRAM expansion card. This connector is compatible with most Apple monitors. However, most third-party monitors use a different three-row 15-pin connector, as shown in the right side of Figure 5.3.

You can connect most third-party VGA, SVGA, and other high-resolution monitors to this port by using a 15-pin D-shell input to DB-15 output adapter cable. Several vendors, including NEC, sell these cables for a nominal cost. Additional VRAM expansion capabilities are available for 7100 and 8100 systems, which I'll describe in more depth in Chapter 6.

PDS Expansion for the 6100 Systems

The only system that can actually use the PDS as an expansion slot is a non-AV 6100. (The 6100AV has the AV card preinstalled in the PDS.) You can upgrade your 6100 system to an 6100AV by purchasing the AV card from Apple ($495) and then plugging the card into the empty PDS. That's about the only use you'll find for the PDS right now. Few vendors make PDS cards designed specifically for the Power Macs, opting instead to make cards for the more popular NuBus expansion slots.

Table 5.2 VRAM Provided on the VRAM Expansion Card in 7100 and 8100 Systems

			Color Density		
Monitor Size	**7100**	**7100**	**7100AV**	**8100/8100AV**	**8100/8100AV**
	1 MB VRAM	2 MB VRAM	1 MB VRAM	2 MB VRAM	4 MB VRAM
14" and 15"	32,768	16.7 million	16.7 million	16.7 million	16.7 million
16" and 17"	32,768	16.7 million	16.7 million	16.7 million	16.7 million
20" and 21"	N/A	32,768	32,768	32,768	16.7 million

Another note about that 6100 PDS: The 6100 Power Macs do not provide any built-in NuBus expansion slots. However, in a non-AV 6100 Power Mac, you can add one short (4" x 7") NuBus card via Apple's PDS-to-NuBus adapter card. The trick is to plug the adapter card into the PDS slot and then plug the NuBus expansion card into the NuBus adapter. (In Chapter 7, I'll explain more about this adapter card and how to use it to install a NuBus card in a 6100 Power Mac.) You can't install a full-size (4" x 13") NuBus card in a 6100 system.

5. NuBus Expansion Capabilities in 7100 and 8100 Systems

All 7100 and 8100 systems have three NuBus slots, which provide the main expansion capabilities for these systems. All three NuBus slots are empty when the 7100 and 8100 systems ship from the warehouse.

Unlike a PDS card, a NuBus card cannot directly access the CPU bus. Instead, the signals to and from a NuBus card travel along separate NuBus lines, which in turn make requests for CPU bus through a Versatile Interface Adapter (VIA) chip. The NuBus technology provides a true expansion bus technology, which is one of the major reasons a NuBus card can't directly access the CPU. Since a single Macintosh system can support several NuBus cards, some technology must be in place to control traffic and to determine which NuBus card gets access to the CPU at any given time.

In Power Macintosh systems, data transfer between NuBus cards and the CPU bus are managed and buffered by the BART controller chip, which is built into the logic board of all 7100 and 8100 systems. The BART controller is one of several chips that can act as a *bus master.* A bus master requests total control of the CPU bus in order to send or receive data, shutting out access to the bus, even to the CPU itself, until it is finished using the bus.

When the CPU or some other bus master relinquishes control of the bus lines, the logic board's high-speed memory controller (HMC) chip determines which of the bus master devices (that have made requests through a VIA channel) has highest priority to access the CPU bus.

When CPU bus priority passes to the BART controller, the BART allows the requesting NuBus card to access the CPU bus. But the card itself does not have control of the CPU bus, the BART chip does. The NuBus card in use does have control of the NuBus lines, but after the card has finished sending or receiving data, it relinquishes control to the BART. In this way, the BART controller can manage and switch between multiple NuBus cards that request access to the CPU. Figure 5.4 illustrates the flow of control and data to and from NuBus cards.

The NuBus design is owned by Texas Instruments and conforms to the industry-defined IEEE Standard 1196-1990 (called NuBus-90 for short). This standardized design requires that a NuBus card contain self-configuring code stored in ROM on the card. The System 7.5 Slot Manager, which examines all PDS and NuBus slots at boot time, uses this self-configuration information to identify different cards and to manage data sent to and from expansion slots. A NuBus-90 card contains 96 pins, in three rows of 32 pins. Power Macs can usually accept NuBus cards designed for the Macintosh II family of computers.

One of the major benefits of the NuBus design over the expansion card designs traditionally used in Intel-based PCs is that standardization makes it unnecessary for the user to set DIP switches or jumpers, or to make other technical adjustments to the card or the logic board. You simply plug the card in a NuBus slot, reboot the system, and the card is ready to use. The NuBus design, then, is a forerunner to the PCI (peripheral component interface) plug-and-play local bus architecture that was designed by Intel. PCI mixes the best of the fast PDS local-bus architecture (using a buffering

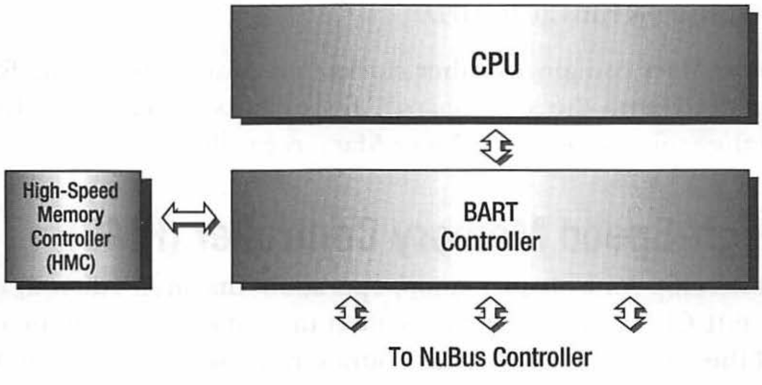


Figure 5.4 Control passes from NuBus lines to the BART Chip, which communicates with the HMC to determine when to access the CPU

technique to resolve device contention) with the plug-and-play capabilities of NuBus. PCI will be the expansion bus design used in the next generation of Power Macintoshes.

6. Squidlet

The Squidlet chip synchronizes the operations of the different clocks used within Power Macs to control the CPU and subsystems on the logic board.

All computers require at least two clocks: The system clock and the CPU bus clock. The system clock controls the rate of execution of instructions with the CPU itself, and the CPU bus clock controls the rate of data transfer across the system bus.

The system clock on all Power Macs is a CMOS chip powered by a removable/replaceable lithium battery. As you might already realize, though, the system clock is set differently on 6100, 7100, and 8100 systems, which all use different-speed CPUs.

For 6100/60 systems, the system clock runs (fires pulses) at a frequency of 60 MHz (60 million cycles, or pulses, per second); for 7100/66 systems, the system clock runs at 66 MHz, and for 8100/80 systems, the system clock runs at 80 MHz (keep in mind that all three systems are available with faster chips).

The CPU bus clock on Power Macs runs at half the frequency of the system clock. So, the CPU bus clock on the 6100/60 systems runs at 30 MHz, the bus clock on the 7100/66 systems runs at 33 MHz, and the bus clock on the 8100/80 systems runs at 40 MHz.

All Power Macs contain six other clocks that control the timing for other built-in devices on the logic board. All six clocks, described in Table 5.3, run at the same speed on all Power Macs, regardless of model.

7. High-Speed Memory Controller (HMC)

The HMC chip controls all memory operations that aren't directly handled by the 601 CPU's memory-management unit, and as I mentioned earlier, one of the jobs of the HMC is to arbitrate requests for control of the CPU bus. The HMC manages data transfers to and from RAM, to and from an L2 cache, and from ROM. The HMC also provides built-in support for

Table 5.3 Power Macintosh Clocks Controlled by Squidlet

Clock	Frequency (MHz)	Provides Timing for:
Cuda	.0320	Real-time clock
Dot	57.2832	16" monitor
Ethernet	20	Ethernet and SCSI
I/O	31.3344	I/O components, serial communications, and 12" monitor
Sound	44.1584	Sound sampling rate
VGA	25.1570	VGA monitor

memory I/O features that are specific to the PowerPC 601 chip. The specific memory management operations of the HMC (other than bus arbitration) are really beyond the technical scope of this book.

8. Apple Memory-Mapped I/O Controller (AMIC)

The Power Macintoshes support some very sophisticated direct memory access (DMA) services for most I/O devices. DMA allows a DMA-compliant device to transfer data to and from memory without involving the CPU. For instance, with DMA on a SCSI disk device, whenever you save a file, the application can send the data directly to the disk without the need for the CPU to perform any I/O instructions. Most I/O devices today include circuitry to support DMA, but this support must also be available on the logic board.

In Power Macintoshes, DMA I/O is supported by the AMIC chip, which works in conjunction with the HMC chip to transfer data between memory and DMA devices. The AMIC performs DMA I/O for the following:

- Ethernet port
- Floppy disk drives via the SWIM floppy drive controller
- Internal speaker and sound port
- Monitor ports
- Serial ports via the Serial Communications Controller (SCC)
- SCSI devices

The AMIC chip also handles I/O requests received from VIA channels (such as NuBus card requests).

9. SWIM III

The SWIM III floppy drive controller, as I mentioned in the previous section, supports DMA I/O. DMA is one of the main new features over its predecessor, the SWIM II controller used in the Centris 650 and Quadra 800 systems. A second important addition is the built-in ability of the controller to support the Modified Frequency Modulation (MFM) storage format used by DOS diskettes. PC Exchange software is still required to support the use of DOS diskettes, but the SWIM III controller provides more of this support as a built-in feature. Of course, Apple's Group Code Recording (GCR) storage format is also supported.

10. Curio

The Curio I/O chip provides an interface between several I/O ports and the AMIC I/O controller chip. Specifically, the Curio chip contains these three built-in controllers:

- A Media Access Controller for Ethernet (MACE) support
- A Serial Communications Controller (SCC) for serial communications support
- A SCSI controller for internal and external SCSI device support

The following sections explain the functions and roles of these three types of external devices.

Ethernet Support

For any computer, whether it's a Mac or a PC, networking capabilities require that a network interface must be included with the system's hardware, either via a *network interface card (NIC)* or via built-in hardware. In addition, software must be used to drive the hardware and to establish communication and file transfer *protocols* (which essentially are just common rules that all networked computers abide by to ensure compatibility of data transferred across the network).

Networking support among Macintoshes has (almost) always been available via built-in hardware and software support. In most older Macs, the hardware interface for networking has been the built-in LocalTalk capabilities. LocalTalk provides support for accessing networked computers and printers (both networked and local printers). Software support for LocalTalk networks, the Apple Talk Manager, is built into the Mac operating system's ROM.

One problem with LocalTalk has always been speed. The LocalTalk interface is fine for connecting a few computers and printers in relatively close proximity. However, when dozens or even hundreds of computers are added, when network cables span distances of hundreds or thousands of feet, or when high-speed printing services are required, LocalTalk can seem unacceptably sluggish.

For high-speed networking, many companies prefer a hardware interface that can transfer data at a much faster rate than is available with LocalTalk. The hardware interface of choice in recent years has been Ethernet, which in fact has been built into some Macintoshes prior to the Power Macs or is available as an adapter card that can be plugged into a NuBus slot.

Ethernet can be as much as 40 times faster than LocalTalk: Ethernet can transfer data at about 10 megabits per second (Mbps), while LocalTalk transfers data at slightly less than .25 Mbps, although LocalTalk can support data transfers up to 2.048 Mbps when an external clock is used.

Like all other Macs, Power Macintoshes include built-in LocalTalk, but also include built-in Ethernet I/O subsystems, including the 14-pin AAUI Ethernet port shown in Figure 5.5. However, to connect to a standard BNC coaxial-cabled Ethernet network, you will need to obtain an Ethernet 10baseT transceiver, as shown in Figure 5.6. The appropriate adapter is available from most Apple resellers and from numerous mail-order companies, at a cost of between $50 and $100.

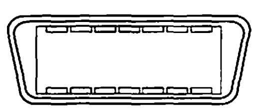


Figure 5.5 The Ethernet port provided on all Power Macs

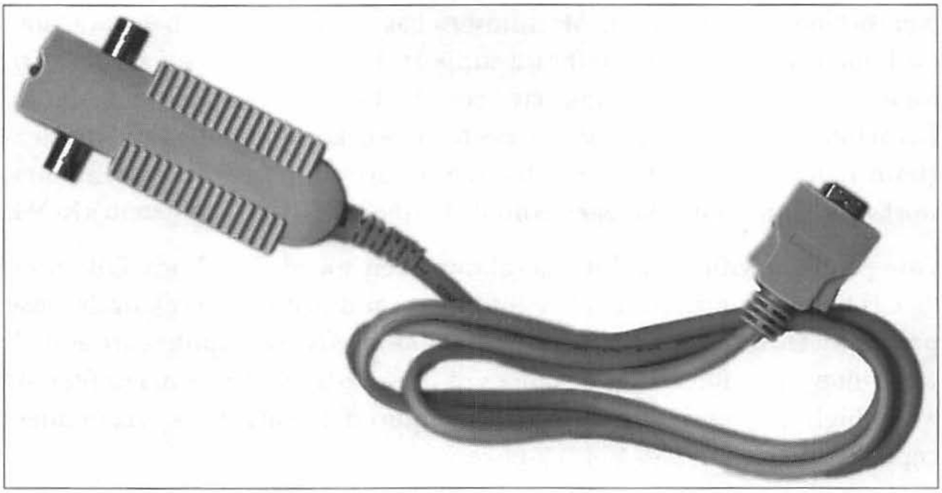


Figure 5.6 An Ethernet 10baseT transceiver required to connect a Power Mac to most Ethernet networks

Software support for Ethernet is handled by two extensions: EtherTalk Prep and EtherTalk Phase 2. Both of these files are automatically copied to the Extensions folder when you install system software for your Power Mac. Assuming you are cabled to an Ethernet network, you can access the network simply by choosing **Network** from the Control Panel and then choosing **Ethernet**.

HOT TIP

An AAUI Transceiver Doubles as a Network Terminator

One nice feature about an AAUI transceiver is that it serves as a terminator. Normally, if you were to disconnect your Mac from an existing peer-to-peer network, the entire network would go down, because you've unplugged a critical link in the circle. With an AAUI Transceiver, you can disconnect your Power Mac from an Ethernet network (great if you need to take your machine in for servicing) without disrupting the network loop simply by unplugging the transceiver from the back of the Ethernet port. But make sure you leave the transceiver connected to the Ethernet cables themselves—if you don't, you *will* send the Ethernet network crashing to the floor.

Serial Communications

The SCC controller on the Curio chip performs I/O for the two GeoPort serial ports provided on every Power Macintosh. The 9-pin GeoPort connector for each of these ports is shown in Figure 5.7. The SCC controller can support AppleTalk (printing/networking) or GeoPort (fax/modem) communications for both ports.

Aside from the basic serial communications of this port, the term "GeoPort" refers to the enhanced telecommunications capabilities that can be supported when a GeoPort Telecom Adapter is connected to the system as well as to speech recognition capabilities.

One of the benefits of GeoPort technology is that, as higher speed modem standards—such as V.Fast or ISDN—emerge, you can upgrade immediately to the new standard via software; the Telecom Adapter is essentially speed independent in this regard.

HOT TIP

Why It Won't Work: That Flakey GeoPort Telecom Adapter

If you purchased your Power Mac and the Telecom Adapter (fax/modem) back when 7.1.2 was the operating system that shipped with the Power Macs, you might have noticed some erratic behavior when using the fax and modeming capabilities—specifically, very slow performance of other applications when the GeoPort software is running or printer failure, and GeoPort failure during faxing.

The problem apparently stems from a buggy fax extension initially supplied with the GeoPort fax software. Most users who experienced problems reported that the problems ceased when the fax extension was turned off. Apple has since fixed this problem with an updated fax extension. If you have a GeoPort Telecom Adapter and are experiencing similar problems, contact Apple to obtain the upgrade. Do note, though that this problem does not occur with other modems and is not an inherent problem with either the Telecom Adapter or the GeoPort logic built into the logic board.

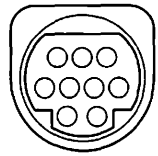


Figure 5.7 The GeoPort serial port connector

SCSI Support

All Power Macs provide support for both external and internal SCSI devices. The Curio chip manages I/O for both external and internal SCSI devices on all Power Macs. However, the 8100 systems provide a separate SCSI controller for a second fast external SCSI connection. The 8100's fast SCSI external port is explained in the next section (11). Here, I'll confine the discussion to the standard SCSI bus available on all Power Macs.

An internal SCSI device is one that fits into a Power Mac drive bay. (All floppy, CD-ROM, and hard disk drives must be SCSI drives.) Internal SCSI devices are linked via a 50-pin ribbon connector. An external SCSI device is one that is linked to the SCSI bus via a cable plugged into the SCSI port at the back of your Power Mac.

If you are familiar with SCSI bus architecture, you probably already know that a single SCSI bus can support multiple SCSI devices that are chained together along the bus. The SCSI bus on the Power Macs can support up to seven external and internal SCSI devices.

The SCSI controller knows where to find the beginning and end of the chain by identifying terminators at both ends of the bus. On Power Macintoshes, both the internal SCSI ribbon and the external SCSI cables are connected by a SCSI bus printed onto your logic board. In other words, the SCSI bus is a single connection starting with the first internal drive and ending with the last external drive, as shown in Figure 5.8. Again the total combined number of internal and external SCSI devices cannot exceed seven.

HOT TIP

Terminate Internal Drives Correctly

Typically on a Power Mac, the internal SCSI chain is terminated by an internal hard disk (by default, the last device on the internal end of the chain). In other words, the last hard

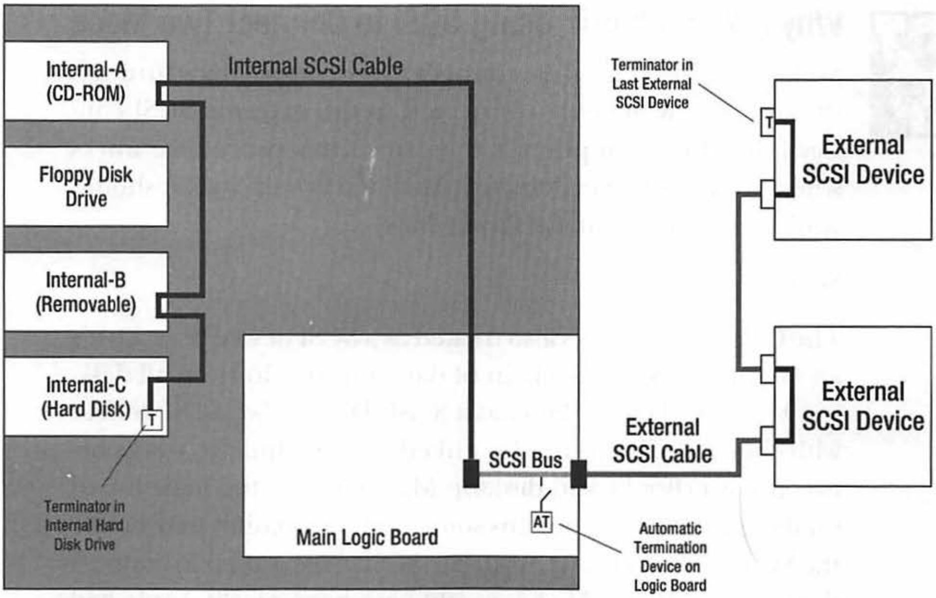


Figure 5.8 The SCSI bus and chained devices

disk on each Power Mac contains a built-in terminator. However, depending on your system model and depending on the options that you purchased, you may have empty bays that you can use to install additional internal SCSI drives.

If you install a drive in an empty bay on your Power Mac (A and B in Figure 5.8), you must make sure you remove its terminator if one is connected. Failure to remove the terminator can lead to logic board failure and can even cause damage to the logic board.

If you connect one or more SCSI devices to the external port, you must provide a terminator on the last device in the external portion of the chain. Power Macintoshes automatically terminate at the external SCSI port if no devices are cabled to it. So, you only need to place a terminator at the external end of the chain if you have one or more devices attached to the external SCSI port.

Why It Won't Work: Using SCSI to Connect Two Macs

Some users have tried to connect two desktop Macs through the use of a SCSI cable connected to the external SCSI connection. The assumption is that, since this procedure works when linking a PowerBook to a Mac or a Power Mac, it should work to link a Mac and a Power Mac.

Sorry.

The CPU (surprise, it's also treated as a SCSI device because it's an essential link in the chain of data transmission) on all desktop Macs and Power Macs has a SCSI ID of 7. Two SCSI devices with the same ID cannot be linked. The technique works between PowerBooks and desktop Macs because the logic board on these notebooks contains some built-in circuitry to override the SCSI ID when the appropriate SCSI cable is used to connect the PowerBook to a Mac. It would have been nice if Apple had built this same feature into Power Macs, but *c'est la vie.*

11. Fast SCSI Support (8100 Systems Only)

The 8100 systems are all equipped with the internal SCSI ribbon described in the previous section, along with a second, identical 50-pin ribbon that connects to a fast (double-speed) SCSI interface. Any internal SCSI drive can be connected to either the standard SCSI ribbon or the fast SCSI ribbon.

The 8100s are shipped with the internal hard disk connected to the fast SCSI cable. An advantage of the fast SCSI interface is its ability to support a 1 GB hard drive (1 gigabyte is 1,000 megabytes). The 8100 includes bays for an optional removable 3.5" device and for a double-height 3.5" device. Both devices can be connected to the fast-SCSI ribbon.

12. Cuda

The Cuda chip is responsible for managing the 4-pin Apple Desktop Bus (ADB) serial port. As most longtime Mac users know, the keyboard connects to the ADB port, and all Macintosh-compatible keyboards include an ADB connection that allows the mouse to be chained to the ADB. However, the

ADB port can support up to three chained ADB devices (for instance, the addition of a joystick via an ADB adapter chained to the keyboard).

The Cuda chip on Power Macintoshes also manages several other miscellaneous functions, including powering the system on and off and managing reset commands.

HOT TIP

Why It Won't Work: The Debug Bug

If you're not careful in the use of the keyboard Reset key (also called the Power-On key for 7100 and 8100 users), your Power Mac system might exhibit some unusual behavior—that is, if you're still using System 7.1.2 with your Power Mac. The potential problem seems to stem from a design quirk within the Cuda chip, which can be traced back to Quadra systems.

On all Power Mac systems running System 7.1.2, the problem will exhibit itself if you press Ctrl+Command+Reset to reboot your computer, but don't release the Reset key quickly enough. Considering the speed of the PowerPC 601, this is not terribly hard to do, although I admit you've got to be somewhat of a sluggard to hold down the keys for so long.

Anyway, here's what happens. Your system will reboot normally; however, as soon as you press the Command key to initiate an action, the debugger window appears, which basically is an empty window with a single prompt symbol and no cursor. It's used for programming purposes, and isn't something that most Macintosh users have ever seen. When this window appears, you will lose access to your mouse and your system will appear to be locked. To exit the debugger, just type **G** and press Enter. Whew! You're back in the Finder.

On 7100 and 8100 systems running System 7.1.2, there's another way to experience this problem. If you press the Reset key to power-on your system from the keyboard, and if you hold the Reset key down until the startup chord sounds, your system will boot normally. However, as soon as you press the Command key to initiate an action, the debugger window will appear.

The problem occurs because the Cuda chip stores the additional signal from the Reset key. Since the command to open the debug window on all Power Macs is Command+Reset, when you press the Command key following startup or restart, the Cuda chip interprets this to mean you want to start the debugger. Just type G and press Enter to close the debugger window. Apple has corrected this problem in System 7.5. Your system won't restart until you release the Reset key, so it's impossible for you to make this error with newer versions of the operating system. And System 7.5.1 lets you use the Reset key to turn off the system.

13. The AWAC Chip

The Audio Waveform Amplifier and Converter (AWAC) chip is responsible for managing stereo sound I/O in all Power Macs. The AWAC supports 16-bit stereo sampling. A sample is just another term for digital sound transferred as a package, or frame, of bits. When digital sound is decoded into waveforms, it is measured in kilohertz (thousands of cycles per second). Power Macs support sample rates of 44.1 and 22.05 KHz, which can be selected from the Sound Out dialog box accessed from the Sound Control Panel.

If you're an audiophile, you'll want to know that the AWAC supports sound I/O across a bandwidth of 10 Hz to 19 KHz, with less than .05 percent harmonic distortion. The signal-to-noise ratio (SNR) for input sound is 82 decibels, while the SNR for output is 85 dB.

Digital sound provides a great way to store sound on disk and to process sounds within the computer. However, since digital sound is nothing more than a representation of data bits, the bits must be converted to analog sine waves in order to be output through speakers. The AWAC performs the analog-to-digital encoding for sound input from a microphone or other sound source, and performs the digital-to-analog decoding function required to output sound through speakers. The combination of encoding and decoding I/O functions is called codec. Sound I/O is supported at the software level by System 7.5's Sound Manager.

Every Power Mac includes two mini-plug sound jacks: an input jack for a microphone and an output jack for stereo speakers. If you purchased an Apple AudioVision monitor, stereo speakers are built into the monitor housing, and sound is sent directly to the speakers via the 45-pin AudioVision connector. Your Power Mac also includes a built-in speaker. However, due to the PowerPC chip's low power output, it isn't capable of providing much in the way of sound amplification. That's why, to produce good sound, as well as stereo, you need speakers that include built-in amplifiers.

I/O for all of sound devices is controlled by the AWAC chip. Sound input and output volume levels can be adjusted by choosing the Sound Control Panel, selecting Volume, and then adjusting the volume level for both the built-in speaker and the built-in headphones. If you're using external speakers, the built-in headphones volume setting controls these speakers. Volume can also be controlled by other sound software, such as the CD Remote or CD Player software packages bundled with Power Mac configurations that include a CD-ROM drive.

HOT TIP

Why It Won't Work: Sound-In Settings Are Not Saved

On Some Power Macs under 7.1.2, the Sound Control Panel will not save the Internal CD settings for Sound In when you exit. Normally, to play audio CDs through your speakers, you simply select **Options** from the Sound In dialog box (accessed from the Sound Control Panel), turn on the Internal CD button, and click on the Play-through box to indicate that you want the sound to be transferred to (played through) the external speakers.

This approach works fine for your current work session, but if you turn off your Power Mac and restart it later, you might discover that the Sound In Options defaults back to the Microphone, and that the Play-through box will no longer be turned on. You can't save these settings permanently. You must reset the Sound In Options each time you start your system.

If you have AppleScript, though, you can work around this problem by creating an AppleScript that turns on your CD sound whenever you start your computer. To do this, just start up AppleScript, and then work through the steps required to turn on sound for your CD. Then, make the Script part of your System Startup routine. The only negative effect of this approach is that AppleScript will be loaded every time you start your system, adding a bit of memory overhead to your system environment until you close AppleScript. Unfortunately, you can't include a step within an AppleScript telling it to close itself.

This problem won't occur if you're running System 7.5, because this version of the Mac OS installs this System 3.0 Update patch, which corrects the problem.

14. The Ariel II Chip

The Ariel II chip provides much of the built-in video capabilities for the high-density 45-pin AudioVision monitor port on all Power Macs. Other circuitry and subsystems on the logic board assist in providing the full range of built-in video capabilities.

This built-in monitor port is designed to support the Apple AudioVision 14" monitor, which integrates video input and audio (sound) input and output. The AudioVision monitor includes built-in speakers and a built-in Apple PlainTalk microphone for sound input.

However, as I've explained in Chapter 2, you can connect most other monitors to the AudioVision port if you have the appropriate adapters. All 6100 Power Macs ship with an adapter cable that plugs into the AudioVision port at one end and has a DB-15 video connector at the other end.

The DB-15 connector is compatible with most other Apple monitors, but won't work for most VGA, SVGA, and other high-resolution monitors. Most of these other monitors use a 15-pin D-shell connector that's common on Intel-based PCs. To use one of these monitors, you must connect a 15-pin D-shell input to DB-15 output adapter cable between the monitor cable and the DB-15 connector. Several vendors, including NEC, sell these adapter cables for a nominal charge.

A Close-Up View of Power Mac Logic Boards

I've included Figure 5.1 and the previous explanations to help you get a good conceptual picture of how the Macintosh hardware peripherals, ports, bus connections, and other logic board functional units are integrated. But to perform do-it-yourself expansions and upgrades, you'll probably want a more authentic view of your motherboard. For this purpose, use Figure 5.2 as a guide. Even though this photograph shows an 8100 system, it provides a reasonable guide for all Power Macintosh owners, since the PDS, NuBus, and DRAM slots look the same on all Power Macs. The annotations in Figure 5.2 should also help you in discerning logic board differences among the three basic Power Mac models.

HOT TIP

Technical Information

Most of the information in this chapter is designed to help you understand the basic hardware operations of your system. However, for troubleshooting purposes, you might find it helpful to examine the technical specifications in greater depth. For instance, as you expand and upgrade your system, you'll want to make sure that added devices do not exceed maximum power draw limitations.

Apple has tucked an informative *Technical Information* booklet inside what appears to be a cardboard throwaway called the *Apple Resource Guide.* The *Resource Guide* itself contains a few valuable numbers for contacting Apple product support, hardware repair assistance, and other services. However, the *Technical Information* booklet is the real keeper in this packet. This booklet contains technical specifications for all monitors, the audio system, hardware interfaces, line input and output limitations, power requirements for various devices, acceptable operating and storage temperatures, and much more. Don't toss this booklet!

CHAPTER

6

The AV Power Macs

Multimedia, Movies, and More

Even though Macintosh AV technology has been available for years, it is still very misunderstood and either under-used or inefficiently used. I've listened to and read many questions and complaints from users about the Power Mac AV technology, and I've noticed that these issues tend to fall into two categories, depending on the user:

- Complaints from novice AV users who don't understand some of the technology (very common and understandable)
- Complaints from experienced AV users who want the Power Mac AVs to perform better than they're capable (less common but also understandable)

There's a third category of questions—one that I touched on in Chapter 2—that can probably be summed up with a single, broad questions: Should you buy a non-AV or an AV Power Mac? (AV logic board upgrades are virtually the same as buying a Power Mac AV.) As I explained in Chapter 2, the "V" in "AV" is more meaningful than the "A" for Power Macs. Consider that, on older non-AV Macintosh models, audio (sound) input and output sampling rates are limited to 22 KHz. CD-quality sound is recorded at 44.1 KHz, so older Macs can't play CDs at true recorded-quality levels. Also, many Macs require additional hardware and software to record or play anything more than brief, low-quality sound clips.

Thanks chiefly to the PowerPC 601 chip's powerful instruction set, which includes several DSP-like instructions, high-quality sound can be supported easily on all Power Macs. Specifically, all Power Macs support built-in sound

I/O at 44.1 KHz sampling rates. If you purchased a Power Mac with a CD-ROM drive, that means you can play audio CDs or multimedia CD sound at professional, CD-quality levels.

Where audio is concerned, the major difference between AV Power Macs and non-AV Power Macs is that the AV models come bundled with a PlainTalk microphone and the PlainTalk system extension. However, you can purchase these separately for use in a non-AV Power Mac. The microphone plugs into the sound-in port available on every Power Mac.

So, video is what really differentiates an AV Power Mac from a non-AV Power Mac. In this sense, *video* means motion-picture video, not just the still images typically displayed on a video monitor. But for many users, only the video-in capabilities of the AV Power Macs will seem to be a distinguishing feature over non-AV Power Macs. That's because the standard video output sent from an AV card to a Macintosh monitor is generally the same as the output sent to a monitor on non-AV systems. (I need to hedge a bit here. Color depth support varies depending on whether your Power Mac comes equipped with a video expansion card and depending on the amount of VRAM on this card. But these capabilities are independent of the built-in features of the Power Mac AV card.)

In other words, most movies that you play on an AV Power Mac can be played at the same (and even sometimes better) quality on non-AV Power Macs. Video output performance variables have more to do with the amount of DRAM and VRAM you have installed on your system, as well as your CPU and hard disk speed, than it does with the presence or absence of an AV card. In other words, standard RGB output isn't really affected positively by the presence of an AV card.

That's not to say the AV Power Macs don't offer any video output advantages. They do. But these advantages mostly involve the formats available for video output and to the range of devices to which you can output video. I'm just pointing out that the quality of video output to a Macintosh monitor is relatively the same for both non-AV and AV Power Macs.

The major benefit of an AV Power Mac is the ability to input (capture) video via a VCR or camcorder (or still pictures via a camera) for output or processing via the Mac. Much of what I discuss in this chapter focuses on this capability.

There's no sense in belaboring the differences between AV and non-AV Power Macs any further. If you've already purchased an AV Power Mac (or AV board upgrade), you'll want to know what its full capabilities are and you'll want to know how to resolve potential problems. That's what the remainder of this chapter is about.

HOT TIP

The AV Card Provides Less Expansion Capability than the HPV Card

The high-performance video (HPV) expansion card that comes with all non-AV 8100 systems provides more VRAM expansion capabilities than the AV card. For all Power Mac AV models, the AV card comes with 2 MB of VRAM soldered onto the card, and doesn't include any additional VRAM expansion slots. By contrast, the HPVs on non-AV 8100 systems comes with 2 MB soldered on the card and provides expansion for an additional 2 MB of VRAM. For this reason, it's not unusual for movies to play faster on non-AV 8100 systems that have 4 MB of VRAM than on 8100AVs.

The video expansion card on non-AV 7100 systems comes with 1 MB of VRAM soldered on the card and supports the addition of another 1 MB. Since the total VRAM capacity on the 7100 HPV card is 2 MB, the 7100AV card offers the same VRAM capacity as a maxed-out HPV card.

You can add a separate NuBus video capture card, though, provided you have a 7100AV or 8100AV system. A separate video capture card can overcome the VRAM limitations of the AV card. I'll explain more about these other AV upgrades later in the chapter.

One other consideration: The AV cards have a 32-bit data bus, while the HPV cards have a 64-bit data bus. Data is data, regardless of whether it is text, graphics, sound, or video. The HPV card's wide 64-bit data bus provides for faster and better playback of video than is possible with the AV cards.

How Motion Video Works

You'll want to read this section if you're a little fuzzy about how video works. Any device that can accept broadcast video—such as a television, a VCR, or even a computer—needs to "know" how to convert or store incoming video waves, which you can't see, in a way that can be output as motion video, which you can see. Basically, the idea is to synchronize, or *sync* different waves so they can be combined correctly to form pictures.

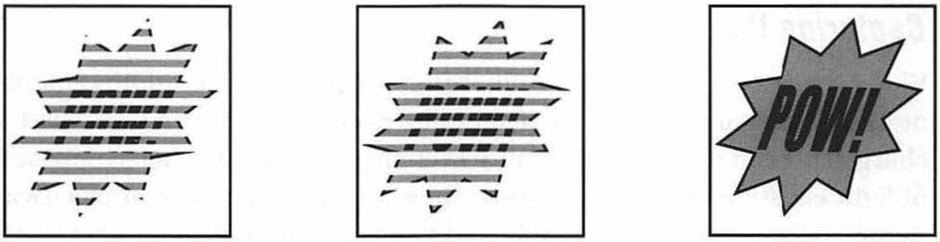
Since there are many possible ways to broadcast and receive video, some standard needs to be in place so that all broadcast equipment and all receiving equipment are in sync. In the U.S., broadcast video input and output standards are defined by the National Television Standards Committee, or NTSC for short. So the video format used in the U.S. and elsewhere in North America is called NTSC video. NTSC video is also used in Japan and a few other regions. (The two other common formats used in other parts of the world, which I'll explain later, are called PAL and SECAM.)

NTSC Video and Interlacing

NTSC video, then, is the U.S. format used by televisions, camcorders, VCRs and other video equipment. On a television screen, the electron guns behind the screen actually create two images: One image for odd-numbered scan lines and a second image for even-numbered scan lines. The first pass that the guns make across the screen illuminates the phosphor on the odd-numbered scan lines and the second pass illuminates the phosphor on the even-numbered lines.

In NTSC terminology, the illumination of one line of pixels on a screen is called a *field* (as in "field of vision") and the combined odd-and-even fields are said to be *interlaced* together to form a complete *frame*. On most TVs, a screen is refreshed 60 times per second (60 Hz). The frame rate for NTSC video, then, is 30 frames per second (fps) and consists of 60 fields. Figure 6.1 illustrates this interlacing process.

It might seem like interlaced video at 30 fps would be a big blur—or at least would have an irritating flicker. Interestingly, interlaced NTSC video was introduced to *reduce* flicker. The key here is to remember that your computer screen is coated with a layer of phosphor, with different "dots" of the



This image takes 1/60th of a second to scan.

This image takes another 1/60th of a second to scan.

The human eye sees the combined effect of both frames, and perceives frame changes as motion pictures (video).

Figure 6.1 NTSC video creates a single image (frame) by interlacing two sets of fields

phosphor capable of being illuminated by firings of your monitor's electron guns. Phosphor glows, so the effect of a complete scan of the electron guns remains on screen while the next scan draws a new phosphor image. At 60 Hz, the top portion of your screen begins to fade while the bottom portion is being scanned, and vice versa—or so it might seem. Actually, you wouldn't notice a fading effect—the human eye isn't that sensitive; the screen would just appear to flicker. And do note: This interlace effect has nothing to do with whether you have an interlaced or non-interlaced monitor. The interlacing effect I'm describing is simply the approach that your TV uses to display images.

When half of the screen is being refreshed on a continual basis, through interlacing, the human eye can no longer detect individual scans, so both the scanning and the interlacing go unnoticed. Since the difference between two video frames is minimal, the eye is tricked into viewing two frames as a single image—ever so slightly out of focus, but not noticeably so (until high-definition TV becomes the de facto standard—*then* you'll notice what you've been missing). Ironically, video and film cameras *can* pick up the interlacing effect of NTSC video because video capture is different than video output.

That's why, when you see a TV screen on a TV show or in a movie, the image appears to flicker. The camera was recording electrons, or light waves, at a much higher frequency than the field playback rate of the screen, so the image appears to flicker. That point leads me to the next topic.

Capturing Video

Video cameras, regardless of whether they are professional studio cameras or home use camcorders, use a special device that senses light, called a charge-coupled device (CCD). A CCD creates an optical image composed of light emissions and then converts these into analog waves, or electrical signals. That's as far as we would need to go if we were dealing solely with television signals, but we're not. We want to store these electrical signals in a format that can be retrieved later for playback. *Video capture* is this process of converting electrical signals from a video device into digital signals that can be stored on tape or disk for playback.

Capturing Color

Most video cameras today are color, as are most televisions. Color adds another level of complexity to the process of capturing video. Since the U.S. standard for capturing and playing back color signals is NTSC, that's the one I'll deal with here. NTSC video cameras interpret color as various combinations of the primary additives red, green, and blue. The separate red, green, and blue additives that make up a single video image are then combined into a single, *composite* signal that can be broadcast in wave form or stored digitally.

However, it's not possible to view a composite signal. To do so, it's first necessary to *decode* the signal into separate red, green, and blue components that can be scanned across a screen. With NTSC video, there are 486 "lines" of red, green, and blue picture elements (pixels) that make up a single screen, with 720 pixels per line. So the total number of pixels in a full frame of NTSC video is 349,920. Each pixel actually is composed of three overlapping red, green, and blue components that can be lit in different combinations to form other colors.

Although a frame of NTSC video is technically 720×486, most computer monitors aren't oriented toward this resolution. The basic color resolution capability on Power Mac monitors up to 15" is 640×480. So, full-frame (that is, full screen) video on a Macintosh monitor is considered to be 640×480. Larger monitors, of course, can support higher resolutions, but you can't display NTSC video at these resolutions without distortion of the images.

Using S-Video to Capture Video

Some video recorders, camcorders, and VCRs support a refinement of the composite encoding approach used with NTSC video capture. Under this approach, called S-video, chrominance (essentially color) and brightness signals are encoded and stored separately. Decoding S-video signals leads to a truer playback image of the original, captured image.

HOT TIP

Taking Advantage of S-Video

If you find yourself getting serious about motion video on your AV Power Mac, you might want to consider the purchase of S-video components. Hi8 camcorders support S-video recordings, and VCRs rated for S-VHS also support S-video input and output. You'll pay dearly for such high-tech equipment, but if you're a true dyed-in-the-wool audiophile, you'll no doubt find the performance of S-video components to be a significant cut above NTSC-based equipment.

Analog-to-Digital and Back

Life would be much simpler if video and sound were broadcast in the same formats that computers can process—that is, digitally. True, video and sound can be *stored* as digital data (essentially magnetically encoded binary digits, as is used on a CD or other disk), but they can't be broadcast that way. They need to be sent through the air as a series of compressed waves, or electrical frequencies. TV cameras, of course, record light as well as sound, but all of these signals are combined into high-frequency radio waves for broadcasting.

A television set, of course, only needs to decode the broadcast signals it receives, whereas VCRs and AV cards in computers must be able to encode (capture) signals and decode (playback) the signals. I'll explain these two processes separately.

To capture video and sound, your Power Mac needs a way to convert analog waves into digital signals that can move through its logic circuits. The conversion of analog to digital is referred to by the acronym *ADC* (for analog-digital-conversion, of course). As I'll explain later in the chapter, the Power Mac AV card contains several chips that manage this conversion.

Now, these digital video signals need to be converted back to analog in order to be displayed on a monitor. VGA and all higher-resolution monitors accept analog input, whereas older CGA and EGA monitors use digital input. That's one reason why you need at least a VGA-quality monitor with a Power Mac. And, of course, digital video signals that are to be output to a television must be converted into analog. The digital-to-analog conversion process is known by the acronym *DAC*.

Earlier, I explained that the frame capture rates for NTSC video is 30 fps. But that's an analog measure used to describe output to a monitor. It's also necessary to define a data transfer rate for digital video as it passes through the various subsystems of your Power Mac. These internal transfer rates have to be measured digitally—that is, in bytes per second. Specifically, NTSC video moves through the AV card at 18.43 MB per second. PAL video (one of the standards used in Europe) is transferred through the card at 22.12 MB per second. These transfer rates don't take into account the compression/decompression typically used with video images.

Storing Video on Hard Disk: It's a Problem

Earlier I mentioned that a full frame, or full screen, of video on a Power Mac monitor is considered to be 640×480 pixels in resolution, for a total of 307,200 pixels. To display this frame, the computer must store and manage digital information for each pixel. With 24-bit color depth, the computer stores eight bits for each red, green, and blue portion of a pixel (24 bits per pixel total, or 3 bytes). By multiplying 3 bytes by 307,200 pixels, you can see that almost 1 MB of storage space is required to represent a single frame. At 30 frames per second, a 1-minute video would require 1800 frames, which in turn would require over 160 MB of hard disk storage! And that assumes that the video does not include sound. When sound sampling is added, the demand for storage space increases significantly.

As you can see, these storage requirements are unacceptable, even for CD-ROMs, if you want to capture and playback movies that have any degree of color depth or length. Some method needs to be in place to squeeze the data into much, much less space. Enter QuickTime.

QuickTime and Video Compression

QuickTime is not a built-in part of the Macintosh 7.1.2 operating system, although it is supplied with System 7.5 (as QuickTime 2.0). For System 7.1.2, QuickTime was available as a separately acquired system extension containing program routines for use in recording and playing movies. In any case, video-based applications can hook into QuickTime routines to support the creation, editing, and viewing of movies. An application that uses QuickTime for these purposes is said to support QuickTime movies. One of the benefits of QuickTime is that any application that uses QuickTime can play and edit movies created by a different QuickTime-based application.

Again, one problem with movies, regardless of whether they are created with QuickTime, is the heavy demand they make on storage space. To overcome this storage resource problem, QuickTime includes built-in compressor/decompressor (codec) resources. A QuickTime application can use codecs to compress video on disk in as much as 1/16th the space required for the uncompressed version. The codec can then be used to uncompress the video for playback—on the fly. In fact, both compression and decompression operate on the fly. That is, when you record a movie, you don't need to specify that you want to compress it. The video capture application will automatically use one of QuickTime's codecs to compress the video. Similarly, when you play back compressed video, the application uses a codec routine to uncompress and play the movie automatically.

Understanding Space-Based and Time-Based Compression

Codecs use two basic compression approaches: space-based and time-based. Sounds weird, huh? Well, it helps to know that a codec might use only one of these approaches or will combine the two. But it helps even more to understand the distinction between the two.

Under space-based compression, a codec determines which portions of an image are the same and which are different. Images that contain repeated data (such as a blue sky) can be compressed so that the codec only needs to record the starting and ending portion of the repeated data. Blue is blue. So, QuickTime only needs to know the spatial relationship between the start of the blue sky and the end of the sky. It doesn't need to store bits for each pixel of blue sky. It can fill these pixels in (in other words, it can

In this image, the sky would be the easiest portion of the image to compress spatially, because several thousand pixels would be identical. QuickTime needs to record and store only the start and end points of the sky; the other pixels can be "filled in" when the movie is played.

Figure 6.2 Space-based compression

"uncompress the sky") when the image is displayed—again, as long as it knows the spatial relationship to use in filling in the missing blue pixels. Figure 6.2 illustrates this process.

Time-based compression is useful in videos because it records only the differences between frames. This approach is often called "frame differentiation." Consider a shadow moving across a wall. Under time-based compression, most of the wall remains the same from frame to frame. Only the shadow moves. So the compressor only needs to store the movement of the shadow from frame to frame. The wall can be stored onetime only and then repeated for each frame during decompression. Figure 6.3 illustrates this process.

In this image, much of the wall can be time-compressed, since a large portion of the wall remains the same from image to image.

Figure 6.3 Time-based compression

Although you don't need to know the detailed operations of codecs, you should be aware that there are different types of time and space codecs and an application will often ask you to select the one you want to use for compression. (You don't have any choice with decompression; video will be decompressed from whatever format was used to compress it.) Different codecs offer different compression ratios and are designed for different uses. Here's a quick review (no pun intended) of QuickTime's codecs:

Animation: Use this compressor for graphics and computer-generated video (but not camera-generated movies). This compression works well when you create a movie from several still images (essentially animation). The animation compressor offers several settings; the tradeoff is that higher compression ratios yield lower-quality video.

Graphics: This compressor offers the highest compression ratio for graphics, but you'll notice significant loss of video quality if you store movies with this compressor. Use the graphics compressor solely for 8-bit still graphics (camera shots) unless your system is starved for storage space and you don't mind some very noticeable degradation in video playback quality.

Photo/JPEG: Use this compressor for 16-bit or higher-resolution still graphics (camera shots), which will then be stored in JPEG format. JPEG stands for Joint Photographic Experts Group, the consortium that defined this compression standard.

Video: This is the preferred codec for digitized movies. Although the compression ratio isn't exceptional, this codec supports decompression at rates that are unnoticeable during movie playback.

Component-YUV: This codec stores data in Apple's YUV 4:2:2 format, at a very high compression rate. This compression was first added with version 1.6 of QuickTime.

CinePak: This is considered to be an "asymmetrical compressor," because it takes much longer to compress a frame than it takes to play it back. This codec is useful for playing movies from CD-ROMs, since CD-ROM drives often have limited data transfer rates.

Frame Sizes and Frame Rates

When Apple announced QuickTime 2.0, they vaguely stated that QuickTime 2.0 would support larger frame sizes and faster frame rates. AV Mac users have been scratching their heads over this ever since. Most Power Mac users who've installed QuickTime 2.0 have discovered they still can't capture full-frame, full-motion video without an additional video-capture board and a high-capacity (which means faster) hard disk. With earlier versions of QuickTime, it was not possible to capture or play full-frame, full-motion video on *any* Mac. But with the advent of the Power Mac and QuickTime 2.0, AV users had hoped and expected this situation to change.

However, the Power Mac AVs use an updated Phillips DAC that provides slightly better frame rate and quality than the 660AV, but overall frame performance is still limited by this Phillips chipset. Even under optimal situations (capturing to RAM or a fast disk array, for instance) the best you are going to see from any of the current Power Macintosh hardware is about 17 fps at 320×240 resolution. However, you can improve performance by adding a second video capture card. For instance, Video Vision Studio will provide 640×480 frame size at 30 fps with image quality far superior to that provided by the Power Mac's built-in AV hardware. So, QuickTime 2.0 is not really the issue here; it's a hardware limitation.

I won't say much more on this topic in this chapter, except to point out that experiments in achieving larger movie frame sizes and faster frame rates are a major aggravation for AV users. I'll provide several tips on achieving optimal frame size and rate in Chapter 9 when I provide a more technical, in-depth discussion of QuickTime 2.0. If you're an AV Power Mac user, and you want to capture and/or play movies, this section of Chapter 9 is essential reading.

HOT TIP

Codec Doesn't Always Mean Codec

The term *codec* is used in three different ways with Macintosh systems. As I've already explained, QuickTime codecs perform compression and decompression for storing and retrieving video and graphics. Other, similar codecs are available for storing and retrieving sound files. But Macintosh hardware also includes codec chips that don't perform any compression/decompression. These chips actually perform the analog-to-digital conversion (ADC) and digital-to-analog conversion (DAC) required to input and output video. In this sense, "codec" means "code/decode." Just thought you'd want to be aware of the difference.

The AV Mac Package

So what, precisely, do you get when you buy an AV Power Mac or an AV upgrade? Well, you get the AV card itself. (You also get the native Power Mac version of QuickTime, currently QuickTime 2.0, but this system extension is provided with all Power Macs.) And I've already mentioned that the system comes bundled with a PlainTalk microphone and PlainTalk system software, which allows you to record sound and use speech recognition capabilities to apply spoken commands.

The AV package also comes with VideoFusion's FusionRecorder software, which allows you to capture video and save it to disk as QuickTime movies, via a camcorder or VCR. FusionRecorder also plays back (outputs) QuickTime movies to an output device that you select. Apple has licensed and supplied FusionRecorder for several years with Quadra and Centris AV systems. However, the version of FusionRecorder on Power Macs has been recompiled into native Power Mac code, and relies heavily on the PowerPC 601's native floating-point instructions to supply fast video-in and video-out capabilities. FusionRecorder will run on non-AV Power Macs, but you can only use it to play movies; you can't capture video without the AV card.

Apple's Video Monitor program is also included with the AV package. (Actually, the Apple CD that ships with all Power Mac models includes both the Video Monitor and FusionRecorder applications.) You can use Video Monitor to view input and to store a single frame of video at a time. Unlike FusionRecorder, Video Monitor won't run on non-AV Power Macs. Video Monitor also allows you to view TV in a window on your Power Mac. The typical way to do this is to connect the video-out cable from a VCR (which, after all, is a TV receiver without a screen) to the video-in plug on the AV card.

Putting FusionRecorder to Use

Although Video Monitor provides an easy and convenient way to view video input, it isn't really designed to record and store video. For that purpose, you'll want to use FusionRecorder. Curiously, the Apple Documentation makes no mention of FusionRecorder. The *Getting Started* manual simply states that "You can purchase application programs that allow you to record, play, and edit video segments." While that's true, why purchase? You can put FusionRecorder to work immediately, because it comes free with all Power Macs. Figure 6.4 shows the FusionRecorder.

Even if you don't have an AV Power Mac, you can still use FusionRecorder to play and even edit QuickTime movies. FusionRecord's editing capabilities are quite limited, though. For more robust editing features, you'll want to purchase a package like VideoFusion 1.6 and/or QuickFlix. Both programs run native on Power Mac systems. These and other video applications are reviewed in Chapter 10. Other AV utilities are included on your *Power Mac Book!* CD.

The AV package also includes two adapter cables. An input cable connects a standard RCA socket to the AV card's 7-pin S-video input connector. An

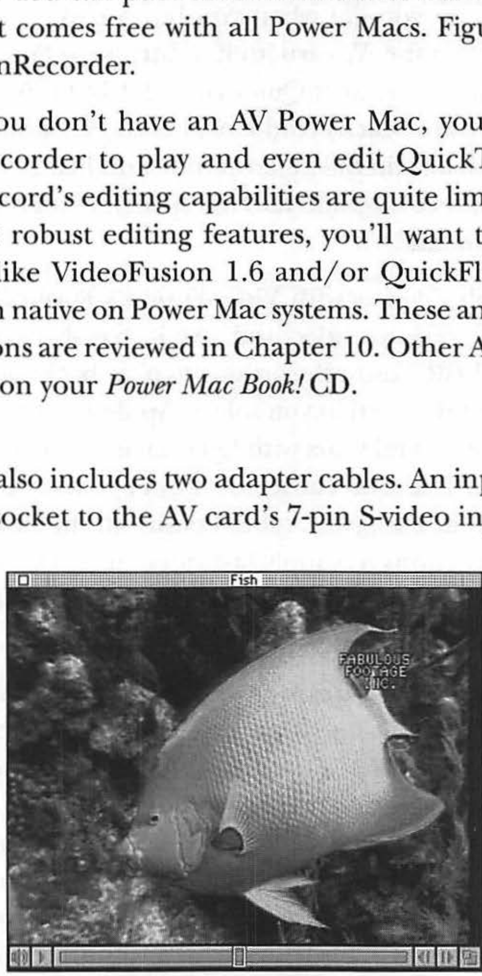


Figure 6.4 Use FusionRecorder to record, store, and play back movies

output cable performs the reverse function; that is, it connects the AV card's S-video output to an RCA socket. An RCA connector is identical to the plugs that you would use to connect different input and output devices that are part of your stereo system or VCR.

An AV Glossary

For most of the later sections in this chapter, I need to toss around AV-related terms that you may or may not already know. To make sure we're on the same page, I've included the following terms and definitions to help uncloud some of the mysteries that seem to surround AV capabilities. Some of these terms are explained elsewhere in the chapter, but they're provided together here for convenient reference. If you're a veteran Macintosh AV user, you'll no doubt find most of these terms rudimentary. If so, by all means skip to the next section in the chapter.

ADC: The conversion (encoding) of analog wave frequencies to digital (binary) signals. ADC is performed by one or more sound or video controller chips.

Codec: Any process that encodes analog-to-digital signals or decodes to digital-to-analog signals. Encoding and decoding of sound is handled by chips on the logic board for all Power Macs. Encoding and decoding of video is managed by chips on the Power Mac logic board and (if available) subsystem chips on the AV card. Codec also refers to the compression/uncompression techniques that QuickTime uses to store and play movies.

Color depth: The number of bits used to activate the available color for each pixel on a monitor. Color depth, then, is measured in bits per pixel (bpp). Higher color depths provide more subtle color variations.

Composite video: A video signal that originates as a combination of picture and color signals and timing (synchronicity or "synch") signals, and then is combined into a single, composite signal. Composite video is commonly used in TVs and VCRs.

Convolution: The process of converting the two fields (odd and even scan lines) expected for an interlaced display into a single, continuous, non-interlaced output. TVs are interlaced devices, whereas monitors used on Power Macs are non-interlaced. See also *interlaced* and *non-interlaced.*

Cyclone Integrated Video Interface Controller (CIVIC): A chip on the Power Mac AV cards that performs synchronization of video signals, convolutes signals when necessary, and manages VRAM on the AV card. This chip is discussed in more depth later in this chapter.

DAC: The digital-to-analog signal conversion performed by one or more sound or video chips to provide analog (waveform) output.

DAV: The 60-pin digital audio/video plug-in interface provided on Power Mac AV cards. This interface is provided so that compatible NuBus cards can access audio/visual channels on the AV card directly, via a ribbon cable running from a NuBus card to the DAV connector. Such NuBus cards are useful for providing accelerated video input/output on AV Macs.

Full-Frame Video: Movies that can be displayed full screen at 640¥480 resolution.

Full-Motion Video: Movies that can run at 30 frames per second with no lossyness.

Lossy: When a movie cannot be played back at the same rate as the audio is played, QuickTime skips (loses) frames occasionally to keep the video and audio in sync. This results in jerky (lossy) playback.

NTSC video: Video output signals that conform to the National Television Standards Committee. NTSC-formatted video is the standard used to output video signals to televisions in North America, Japan, and portions of South America. Full-frame video is the computer-based equivalent of NTSC video. Both standards display video at 640 x 480 pixels.

PAL: An acronym for phased alternate lines, a television signal format used in much of Western Europe, some portions of South America, Australia, Africa, and much of Asia.

RGB: Red-green-blue video, which is the output format used to display motion video on Macintosh monitors. RGB signals encode red, green, and blue values for each screen pixel on separate wires to provide better color depth than is available through composite video. The superior resolution of RGB video typically is not available for TV displays. (See also *composite video.*)

Sebastian: A chip on the Power Mac AV cards that manages color and performs DAC conversions.

SECAM: A French acronym that describes the format used for television signals in France, Eastern Europe, the Baltic Region, and former French colonies.

SMPTE timecode: Refers to the process that QuickTime and other video equipment uses to keep track of frames and audio. Specifically, timecode provides a way to locate the starting and ending point of each frame and to keep frames and audio in sync. QuickTime 2.0 uses a timecode standard adopted by the Society of Motion Picture and Television Engineers (SMPTE).

S-Video: A video format in which chroma (color) and luminance (brightness) signals are transmitted along separate wires. With the appropriate hardware and software, S-video can be output to TVs and offers higher-quality video output than composite video.

YUV: A Macintosh-compatible video encoding format in which each pixel of a color display is represented by values derived from its original red, green, and blue emanations.

Components of the Power Mac AV Card

An AV Power Mac is really just a Power Mac with a separate AV card plugged into the system's PDS. As such, the AV card can actually be plugged into any Power Mac, since all Power Macs include a PDS.

The back of the AV card includes S-video input, S-video output, and Apple DB-15 connectors. As I already mentioned, each AV package includes two adapter cables—one for S-video input and another for S-video output. I'm not going to explain how to set up video input and output equipment for use with the AV card, nor am I going to explain how to use Video Monitor to view video input. All of these topics are explained well in Chapter 8 of your *Getting Started* handbook. Documentation for FusionRecorder is provided on a Read Me file stored in the Audio/Video Capture folder, so there's no point in rehashing that application here. Instead, I intend to explain *how* the AV system works and offer some insight into the AV card's capabilities and limitations.

The AV card includes several chips and other circuitry that combine to provide enhanced video I/O, and includes video I/O connectors not available on other Power Macs. Figure 6.5 shows a block diagram of the components of the AV card. (I'll explain more about the major components of this card a bit later in the chapter.)

DAV Expansion

As Figure 6.6 shows, the card also includes a DAV expansion connector that can be used to connect a NuBus card directly to the AV card. To support this connection, the NuBus card must include a ribbon cable that's compatible with the DAV. When the Power Macs began shipping, no such NuBus cards existed. However, a few manufacturers now sell NuBus cards that can boost the performance of video I/O by connecting directly to the AV card's DAV. Super Mac was one of the first to sell such a card; theirs currently retails for about $1,000.

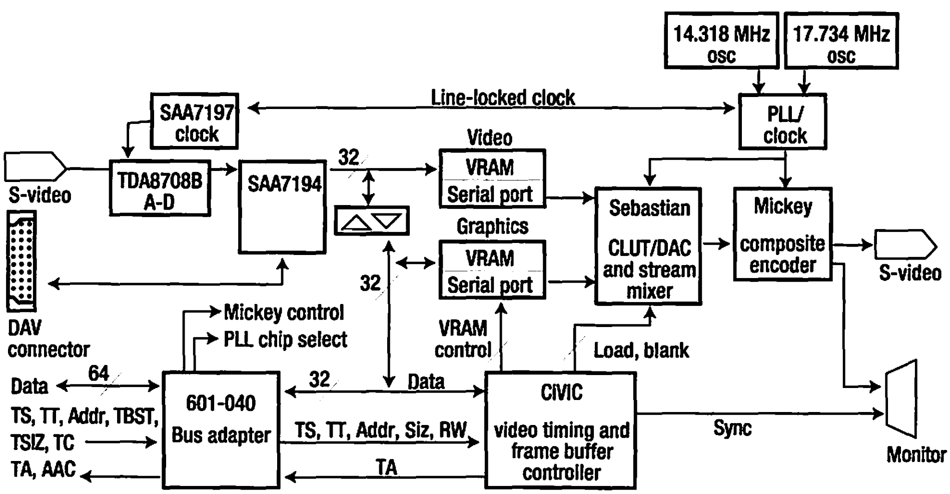


Figure 6.5 A diagram of the AV card's components

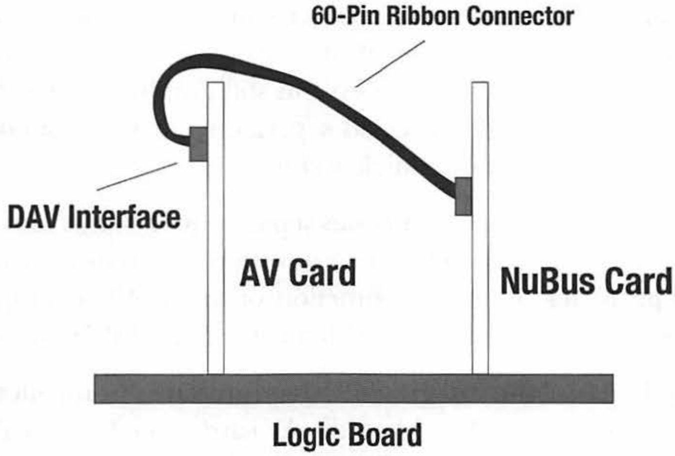


Figure 6.6 A DAV card attaches to the AV card via a bridge adapter

With a NuBus video capture card designed specifically for Power Macs and connected to the DAV, the NuBus card can access the AV card's video input signals directly and can access audio from the AWAC chip (via the PDS). Keep in mind that NuBus video capture cards are not available for 6100AV systems since no NuBus expansion slots are available. (And the PDS is occupied by the AV card, so there's no way to add a NuBus adapter.) Figure 6.6 shows how a NuBus video capture card and the AV card interconnect.

The AV card has four major chips that are responsible for providing video I/O:

TDA8708 Chip: This chip performs the ADC (analog-to-digital conversion) function for input NTSC, PAL, or SECAM video. In other words, the TDA8708 chip converts S-video or composite analog waves into digital signals. These digital samples are then sent to the SAA7194 chip.

SAA7194 Decoder: This chip converts NTSC, PAL, or SECAM digital signals (which have already been converted from analog via the TDA8708 chip into 8-bit grayscale or 15-bit RGB or 16-bit YUV digital color. The converted signals are then sent to VRAM and then to the Sebastian chip for DAC and color processing.

Sebastian Chip: Sebastian is a color palette chip, but also performs DAC by converting digital input from VRAM into analog waves. The chip includes separate color lookup tables for video and still graphics, which allows the two types of images to be processed separately but simultaneously. The analog RGB is then sent to the Mickey chip.

Mickey chip: The Mickey chip encodes separate RGB waves into NTSC or PAL formats for output to a TV screen or outputs RGB directly to a monitor. Mickey performs the reverse function of the SAA7194 chip and can output either S-video or composite video (or standard RGB, of course).

CIVIC chip: The Cyclone Integrated Video Interfaces Controller (CIVIC) chip manages the 2 MB of VRAM on the AV card. Specifically, CIVIC manages data transfers from the SAA7194 and Sebastian chips to VRAM and provides the timing signals for NTSC and PAL formats. Under control of applications, CIVIC can treat the VRAM in one of two ways. The VRAM itself is composed of four banks of chips, with each bank supplying .5 MB of memory. CIVIC can divide these banks into two sections, using 1 MB for still graphics and 1 MB for motion video. For applications that use only still graphics, the VRAM can be configured as a single bank, providing 2 MB of storage for graphics.

AV Configuration Recommendations

Since video recording and playback exacts a significant performance penalty, it's a good idea to make sure your Power Mac hardware matches or exceeds the performance requirements of your video hardware and software. If you expect to capture more than a few seconds of video, 16 MB is a *minimum* RAM requirement, and 32 MB is recommended. The faster the SIMM chips you purchase, the better.

Video playback can also be severely affected by the speed of your hard disk. And, of course, disk space limitations are also an issue. If you plan to do intensive or frequent video capture, editing, and playback, consider purchasing a high-capacity hard disk. In fact, this could be the single most important upgrade in achieving faster and larger movies. As I've indicated earlier, movies require extensive storage capacities. However, larger disk drives also tend to provide faster data transfer rates—essential in achieving continuous capture and playback of lengthy and large videos. Micropolis makes several 1 to 4 gigabyte disk drives designed specifically to support AV operations. I'll have more to say on achieving optimal frame size and frame rate in Chapter 10 when I discuss QuickTime in more detail.

For NTSC input/output, buy RCA adapter cables that have gold leads. These cables support much higher audio and video quality than standard adapters.

AV Capabilities and Limitations

This section describes some miscellaneous features, quirks, and downright problems with the Power Mac AV cards.

I've heard a lot of moaning from users about the absence of a DSP (digital signal processor) chip on the Power Macs, especially since earlier AV Macs included a DSP chip. A DSP chip essentially contains hard-coded instructions for performing calculations for video, sound, and graphics functions.

The PowerPC 601 (and all other PowerPC chips) provides several DSP-like instructions within its instruction set. Applications that code directly to a DSP chip need to know a lot of details about the specific DSP chip being used as well as other hardware subsystems that are involved in audio and video I/O. By contrast, an application that codes directly to a PowerPC chip can implement DSP-like instructions independent of the hardware involved.

That's the two-minute, condensed explanation of this issue, but it should suffice. Developers for Power Mac systems can code directly to the PowerPC chip far more easily than they could code to a DSP, and the code is guaranteed to run on all Power Mac systems. High-end video applications have been among the first to be converted to native Power Mac code. So, if you've been moaning over the absence of the DSP on Power Macs, now's the time to throw in the towel. The DSP's not necessary, and it's not even wanted.

Also, if you've tried porting older PlainTalk software to your Power Mac version and noticed problems, the DSP issues explains why. Non-Power Mac versions of PlainTalk require the presence of a DSP. If you try to run these versions of PlainTalk on Power Macs, you'll be rebuffed because a DSP is not available. Always use the native Power Mac PlainTalk extension supplied with your Power Mac. You especially need to heed this advice if you want to do speech recognition via your PlainTalk microphone on Power Macs.

Why It Doesn't Work: Running the "Making of Myst"

Myst is one of the most popular games that can be run on a Mac, and is understandably also popular among Power Mac users. But many users have noted an interesting problem that occurs when they try to run the "Making of Myst" CD video. Specifically, users report severe hesitations, sound dropouts, and out-of-synch audio and video when they try to play this CD on a Power Mac. Here's the problem: The "Making of Myst" software runs in emulation, and the Power Mac's 68K emulator stores code within the application's heap space. This can force Myst to swap its code and data to and from RAM as needed, which effectively strips QuickTime of its performance features.

Until Brøderbund software releases a Power Mac-native version of Myst (which might already exist by the time you read this), the best way to resolve this problem is to copy the program to your hard drive and then increase its memory allocation from the default of 384K to 1200K.

Why It Doesn't Work: QuickTime Videos on Power Mac Systems

Your Power Mac is really quite a sensitive device. Although most applications that you once ran on your 68K-based Mac will still usually run on a Power Mac, some 68K-based video applications behave miserably on Power Macs.

For instance, if you're trying to run a QuickTime video on your Power Mac and you notice significant performance degradation, check the following:

- Make sure you're running QuickTime 1.6.2 or later (2.0 is the preferred version).
- Make sure Sound Manager 3.0 *is not* in your Extensions folder (sound applications try to install Sound Manager 3.0, which disrupts the built-in sound capabilities of Power Macs).
- Make sure your Sound Control Panel is version 8.0.2 or later.

Updating Your Updates

There are several situations where the AV software provided with your Power Mac might not be the most current software available.

For instance, QuickTime running native on most Power Macs was at version 1.6 (or interim versions 1.6.1 or 1.6.2) when the initial Power Mac systems were released (with System 7.1.2). However, a QuickTime 2.0 extension has long since been available and more current extensions might be available by the time you read this. The major benefit of QuickTime 2.0 is its support for MPEG compression (with an MPEG board attached), which offers much better replay quality over JPEG. Version 2.0 also supports higher frame sizes and faster frame rates, as well as MIDI compatibility (with some limitations). I'll provide an in-depth discussion of QuickTime, along with several tips for using it, in Chapter 9.

Why It Won't Work: !YTC and the Update Game

When the first Power Macs were shipped, many AV cards were delivered from the factory in an uninitialized state. What this means essentially is that these cards don't input or output video reliably. Apple tried to rectify this problem by shipping all subsequent systems with an extension called !YTC. Apple also revised its PowerPC enabler to resolve all hardware problems reported by users in the early shipments of Power Macs. The PowerPC enabler 1.0.1 supersedes the !YTC system software extension. The most recent version (at this writing) of the PowerPC enable is version 1.0.3. If you're having problems displaying video on your monitor, contact Apple to obtain the most recent version of the PowerPC enabler.

CHAPTER

7

Bells and Whistles

Enhancing Your Power Macintosh

This chapter focuses on products that are currently available for improving the performance of your Power Macintosh, either through hardware upgrades and additions or through the use of hardware utilities.

I'm intentionally ignoring applications in this chapter, because native PowerPC applications are rapidly increasing in number and breadth. They really deserve a chapter of their own. In fact, Chapter 12 focuses exclusively on native Power Mac applications.

So this chapter is chiefly hardware related. However, I will address software-based solutions that are designed specifically for use in optimizing or diagnosing Power Mac hardware. To help you identify opportunities that are designed specifically for the Power Mac or have at least been enhanced to take advantage of Power Mac capabilities, I'm going to ignore most hardware-based enhancements that are identical for 68K-based Macs and for Power Macs. Most of these products are well known and have been available for years. You can find reviews of these products in dozens of books and hundreds of periodicals.

Instead, I want to call your attention to the new breed of hardware, hardware utilities, and system extensions that have been designed or optimized specifically for use by Power Mac systems. Also, I don't pretend that the products I mention here represent an exhaustive list of hardware upgrades and tools for Power Macs. New products are being announced weekly, so to some unfortunate degree this chapter will be obsolete the day after it's published.

And a brief disclaimer: The products mentioned in this chapter are included mainly to let you know about availability and basic features. I've evaluated most of these products; however, as you no doubt know, products that work well on one system might not work well (or at all) on another. I can't guarantee the reliability of any of these products. And please don't consider a product mention to be a product endorsement. If I endorse a particular product, I'll say so directly.

RAM Upgrades

One of the easiest and most effective ways to improve the performance of your Power Mac is to add RAM. As I explained in Chapter 5, all Power Macs include 8 MB of DRAM soldered onto the logic board. However, 16 MB-and-beyond configurations are available for all Power Mac systems and are available via the installation of SIMMs in expansion slots.

It doesn't matter if SIMM slots are currently filled with SIMMs. You can still use those slots to expand your system's RAM capacity. For instance, if you purchased a 6100 Power Mac with 16 MB, the additional 8 MB will be installed as a pair of 4 MB SIMMs—which fill both expansion slots. Power Macs can all accept SIMMs up to the currently available 32 MB size (in other words, one or more pairs of 32 MB SIMMs). So even though a pair of SIMM slots are occupied, you can still swap out these SIMM with faster or larger capacity SIMMs.

When You Think RAM, Think in Pairs

The keyword to remember whenever you consider swapping or adding RAM is *pair*. In Power Macs, SIMMs must be installed in pairs, in parallel slots. The reason has to do with the advanced data bus of all PowerPC processors, including the 601 chip. The data bus can transfer 64 bits of data at a time to and from the CPU. But current 72-pin SIMMs are only 32-bit in nature. So, to support the 64-bit data-transfer capabilities of Power Macs, you have to supply memory as 32-bit pairs. You can't just install one 32-bit SIMM. If you try to do so, the system won't recognize the memory. Also, *both* SIMMs in a pair must be the same capacity and speed.

Upgrade Now or Upgrade Later?

To avoid buying memory that will quickly become obsolete, it's a good idea to consider your long-term RAM needs before you buy your Power Mac—assuming that's not too late. If some or all of the SIMM slots on your Power Mac are filled, and you want to upgrade the RAM capacity of your system, you might have to replace existing SIMMs with modules that have larger capacities. So what do you do with the RAM you've been forced to remove to make room for the higher-capacity SIMMs? Many companies buy used DRAM SIMMs, but you won't get more than a small fraction of what you originally paid for the memory.

Obviously, RAM requirements vary for different users, and of course your requirements will chiefly depend on the applications you run and how fast you expect to run them. As a general rule, though, the minimum RAM requirement for current versions of applications tends to double about every two years.

At this writing, most native Power Macintosh applications require or suggest a minimum of 8 MB of RAM. That means by early 1996, the most current upgrades of these applications will require a minimum of 16 MB of RAM. Again, that's a *minimum.* If you're in the habit of keeping two or more applications open simultaneously, the current minimum of 8 MB might be unacceptable to you *today.* You're more likely to require at least 16 MB. That means in two years you'll need at least 32 MB of RAM to support the way you like to work.

There are several other factors to consider. For instance, do you expect to be working more heavily with high-resolution graphics or multimedia packages in the future—perhaps for audio/video conferencing, presentation graphics, or more professional desktop publishing? If so, you might find that your current RAM requirements don't even come close to providing room for these applications to run at reasonable speeds.

I say "reasonable speeds" because memory-hungry applications can use virtual memory—essentially hard disk space that the operating system treats as an array of virtual DRAM addresses—to run. But heavy use of virtual memory means frequent disk access. Accessing program instructions and data from your hard disk can be more than 10 times slower than accessing those same instructions and data from DRAM. I'll explain more about virtual memory in Chapter 10.

Another factor to consider is the current cost of DRAM. At this writing, DRAM is still somewhat more expensive than it was a few years ago, when a fire destroyed one of the largest DRAM manufacturing plants in Japan. That single event caused DRAM prices to soar, even though this event was little more than an excuse to raise prices.

The Great RAM Shortage Hoax

The story begins with the destruction-by-fire of a Sumitomo resin factory in 1992. In response to this disaster, Wall Street and other foreign trading markets assessed the situation and revalued the stock of chipmakers upward, assuming that chip shortages would allow chipmakers to command much higher prices. The chipmakers responded to this speculation by doing just that—raising their chip prices significantly. A 1993 survey later showed that RAM chipmakers had a significant stockpile of chips; the Sumitomo fire never threatened their inventories.

However, speculation that benefits manufacturers often leads to greedy behavior by manufacturers. When prices for goods skyrocket, why should manufacturers admit that the whole affair is bogus and lower their prices back to realistic levels? The profit motive is usually too strong to resist. The same situation occurred during the OPEC oil embargo during the mid-1970s; statistics now show that there never was a shortage of oil in the U.S., but the speculative fears that raised prices to ridiculous levels encouraged oil refineries to keep prices high and to restrict product supply in order to realize unheard-of profit windfalls.

Despite artificially-reduced product inventory by manufacturers, DRAM prices *are* coming down. It might not seem like this is happening because DRAM required for contemporary systems requires faster access times than the DRAM used a few years ago. So, although DRAM might not seem to cost less on a Kbit-for-Kbit basis than DRAM chip prices of a few years ago, the DRAM SIMMs sold today are generally much faster and easier to install. You get more value for your dollar with these newer chips.

At any rate, if you can afford to wait for DRAM prices to fall even further (which *will* happen), it might make sense to do so. But it doesn't make sense to wait for falling prices if your applications run poorly now.

The RAM upgrade strategy you take will also depend on the RAM expansion capabilities of your Power Mac system. As I explained in Chapter 5, the 6100, 7100, and 8100 systems have a different number of available expansion slots and consequently different RAM capacities. In general, the fewer expansion slots available on a system, the more likely you'll want to purchase large-capacity (8, 16, or 32 MB) SIMMs to fill these slots. For your convenience, I've repeated some of this previously explained information here as Table 7.1.

RAM Purchasing Options

Apple and several third-party vendors sell 72-pin SIMMs in kits of 4, 8, 16, and 32 MB. (A 4 MB kit includes a pair of 2 MB SIMMs; an 8 MB kit includes a pair of 4 MB SIMMs; and so on.) So, as Table 7.1 suggests, it isn't always possible to upgrade different models with the same amount of RAM.

For instance, suppose you want to upgrade a 6100 system to 48 MB. Since only two expansion slots are available, and you must install SIMMs in pairs, the closest you can come (without going over that amount) is to add a pair of 16 MB SIMMs. That adds 32 MB of memory to the 8 MB of permanently soldered DRAM, for a total of 40 MB.

On the other hand, you could upgrade a 7100 to 48 MB by adding a pair of 16 MB SIMMs and a pair of 4 MB SIMMs in the four available expansion slots. You could also upgrade an 8100 to 48 MB by adding a pair of pair of 16 MB SIMMs to the existing base of 16 MB.

Table 7.1 Maximum RAM Expansion Capacities

Model	Built-in Expansion Slots	Expansion RAM	+ Max Installed RAM	Total Maximum RAM
6100	2	8	64 MB	72 MB
7100	4	8	124 MB	136 MB
8100	8	16	248 MB	264 MB

The bottom line is that you'll need to do a bit of simple math to ensure that the total amount of RAM you want can be achieved with the kits and expansion slots available to you.

Apple versus Third-Party Vendors

Apple sells its own Power Mac RAM upgrade kits (see the file Power Macintosh Accessories that's stored in the Apple Extras folder on your hard disk). But if you quickly flip through a current issue of *MacWorld* or *MacUser*, you'll notice that dozens of other vendors are eager to sell you Power Mac RAM upgrade kits at much lower costs than Apple advertises.

In general, it's my feeling that mail-order RAM is a better deal than Apple's kits or the kits available from major Apple reseller outlets. Not only can you find better prices from mail-order vendors, but many are also willing to give you a trade-in rebate for your current SIMMs. However, there are some tradeoffs to consider. I've already mentioned that many vendors buy used RAM. Unscrupulous vendors will sometimes repackage these used SIMMs and sell them as new stock. Unlike used cars, there's no odometer on used RAM SIMMs, so it's difficult to know if you're being schnookered.

Generally, though, you'll be in good shape if you use an established, reputable vendor like MacConnection, MacWarehouse, or Computer Discount Warehouse. If you do choose to buy through a third party, especially a mail-order company, your best bet is to make sure the RAM kits come with at least a one-year warranty.

A second consideration is that, when you buy RAM from a mail-order vendor, you have to install it yourself. By contrast, if you take your Macintosh to an authorized Apple dealer, the RAM upgrade will be installed for you (although you can be sure the cost of labor will be built into the price of RAM).

If you're a bit klutzy or if installing hardware makes you nervous, you're probably better off having RAM installed by an authorized Apple reseller. But you also ought to know that SIMMs are much easier to install these days than they used to be—as long as you remember the rule about installing SIMMs in same-size pairs.

On some older Macs, the release clips (which secure a SIMM to the logic board) were made of plastic and were easy to break. If you broke one or more release clips (easy to do), the SIMM often wouldn't seat and that expansion slot became permanently unusable.

The SIMM slots on all Power Macs include sturdy metal release clips. It's far more difficult to break or damage these clips. But if you have a 7100 system, you'll probably find that the configuration of the case makes it nearly impossible to install SIMMs on you own. You'll probably want an experienced reseller to do this for you.

If you elect to purchase a RAM upgrade kit, make sure you specify 72-pin DRAMs with access speeds of 80 ns or faster (the lower the number, the faster the chip), and make sure the kit is a pair of SIMMs, with both SIMMs identical in capacity and speed. I know I've already mentioned these requirements repeatedly. But you shouldn't assume a phone sales clerk will automatically know your requirements just because you specify that you want a SIMM kit for a Power Mac. Many clerks will sell you what you ask for, but what you ask for might not be precisely what you need.

If you buy 72-pin SIMMs from a vendor that has a reputable history in selling Macintosh products, you'll probably get what you want. However, most, but not all, 72-pin SIMMs fit within the dimensions shown in Figure 7.1. There are many oddball SIMM cards floating around the market. Your SIMMs must correspond with the dimensions in Figure 7.1 in order to fit within your Power Mac's expansion slots.

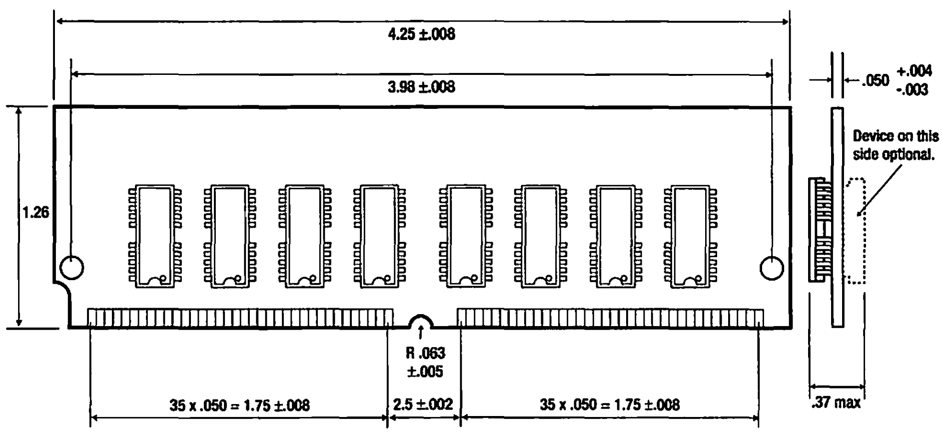


Figure 7.1 Dimensions of a standard 72-pin SIMM used in a Power Mac memory expansion slot

And contrary to popular belief, many 72-pin SIMMs for PCs *will* work in Power Macs, provided they are the proper speed. The major difference between Mac SIMMs and PC SIMMs is the use of an additional parity bit. Power Mac SIMMs use 8-bit DRAM chips, while PC SIMMs use 9-bit DRAM chips. But if you install PC SIMMs in a Power Mac, the Mac will just ignore the extra parity bit.

HOT TIP

User Installation Doesn't Automatically Void the Apple Warranty

Some Apple dealers have been telling buyers that Apple will void your warranty if you install SIMMs yourself. I'm not sure whether they are spreading this misinformation out of ignorance or unscrupulousness. (Unscrupulous dealers might tell you this in order to make money from installation labor charges.)

In any case, the truth is that Apple will void your warranty only if you cause system damage when you attempt to install SIMMs. If you successfully install SIMMs in your system, your warranty is still valid. However, if you damage your system by shocking the logic board with static electricity or by damaging surrounding parts through sheer clumsiness, your warranty is void.

The easiest way to avoid damaging your system is to ground yourself (by touching a piece of metal that's not part of your system) in order to discharge any static electricity from your body before touching any parts inside your logic board. Also, use a 72-pin chip-pulling tool instead of a screwdriver or other edge to release the clips on the RAM expansion slots. Even better, buy a chip-pulling tool that includes a groundstrap (sometimes called a static-charge strap). Cheap but effective versions of these tools sell for as little as a few dollars to even 50 cents.

It probably goes without saying, but I'll say it anyway. Always turn off your system (unplugging the power cord is safest) before working with your logic board.

Installing RAM

I'm going to walk you through the technique to use in installing SIMMs one pair at a time. It's very simple—actually a no-brainer— if you've already installed RAM in other Macs. But if you haven't done so, the procedure can be daunting—if only because you'll worry (for the most part, needlessly) about the potential for damaging the chips or your logic board.

Anyway, if this is the first time you've installed SIMMs, you can do it with confidence if you follow these *very* basic steps:

1. Make sure your system is turned off.
2. Follow the directions in Chapter 5 of your *Getting Started* manual for removing the cover.
3. Locate the empty DRAM expansion slots. The number of RAM slots varies for different systems. Figure 5.2 in Chapter 5 provides the basic location of SIMM slots on Power Mac systems.
4. Remove the SIMMs from their protective wrapping *only* after you have grounded yourself. If you are swapping a SIMM from an older Mac, ground yourself before you remove the SIMM from the Mac's logic board.

HOT TIP

The SIMM installation Order Can Make a Difference

You'll find it easiest to install the first SIMM in a pair by placing it in the slot that's closest to you. If you install the first SIMM in the slot that's farthest from you, it's more difficult to view and work with the slot in front of it, due to the angle you need to use to pop the chips in.

5. Locate the beveled bottom edge of the SIMM card (as shown in Figure 7.1). If you're facing the front of the system, this edge should be on the left side of the card.
6. Find the metal release clips at the opposite ends of the expansion bank, and press them outward. You might need a pen or a chip-pulling tool to do this.

7. Insert the SIMM in the socket, pushing down and forward by exerting moderate downward pressure on the top edges of the card. (Never push on the chips themselves.) If the SIMM refuses to seat, it might be in backwards or perhaps you haven't opened the spring releases far enough. However, some SIMMs require quite a bit of pressure in order to seat. Don't be afraid to push fairly aggressively. Of course, if the SIMM is the wrong size, it won't seat no matter what you do, so make sure you never try to force a SIMM into its seat. (There's a difference between pushing aggressively and pushing violently; if you're uncomfortable about your ability to tell the difference, now is the time to take your system and your SIMMs to a service shop.)
8. Repeat this procedure for the second SIMM in the pair and for any other pairs of SIMMs you want to install.
9. Replace the cover and power-on your system to test the memory.
10. Open the Control Panel folders and choose the Memory icon. Check the "Available built-in memory" line to make sure the system recognizes all of the memory you've installed.

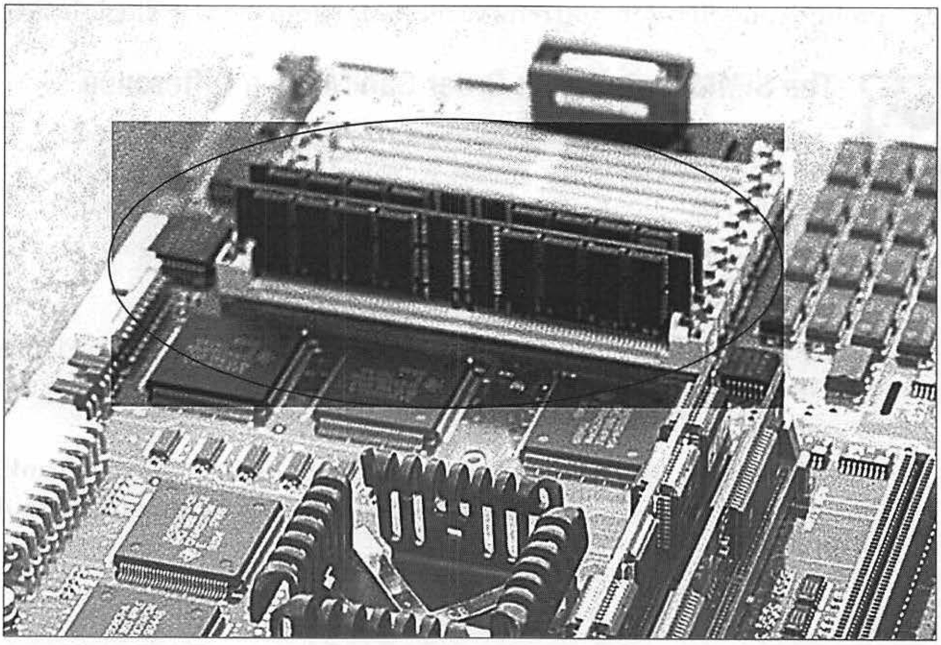


Figure 7.2 Install SIMMs in pairs, as shown here

Why It Doesn't Work: SIMM Failure

If your system fails to recognize all or some of the SIMMs you've installed, one of these problems might be the culprit:

- One or more SIMMs are not seated
- You did not install the SIMMs in pairs or in parallel slots
- The access time on one or more SIMMs is greater than 80 ns
- You damaged one or more SIMMs during or prior to installation
- One or more SIMMs is defective

The first two problems are easy to correct. Turn off your system, remove the cover, and check the seating and placement of the chips.

The third and fourth problems can't really be corrected, except by purchasing new SIMMs. If you know that the SIMMs you have installed are 80 ns or faster and that you didn't do any damage to them during installation, suspect a defective chip or module. You'll probably have to return the SIMMs to the manufacturer for replacement.

The Amazing RAM Doubler

Connectix Corporation recently introduced one of the most ingenious Macintosh products that I've ever seen or used. It's called RAM Doubler, and it does just that. It literally doubles the capacity of your RAM. Of course, you won't physically have more RAM—even that miracle is beyond the capability of RAM Doubler. However, the software will actually use the memory that you do have much more efficiently than System 7.5 does.

RAM Doubler works largely by overcoming some of the memory-reserving quirks of the Macintosh operating system. As Figure 7.3 shows, most applications reserve much more memory upon startup than they ever actually use. In this figure, only the operating system itself is using all of its reserved memory. Most of the other applications are using less than half. However, reserved memory is considered to be unavailable memory to all but the application that reserved it. So, your system might report that it is out of memory when, in fact, about half of your physical memory is idle.

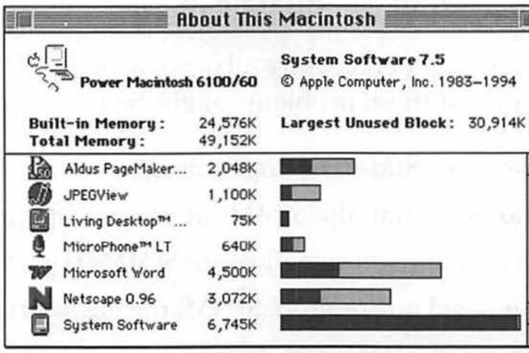


Figure 7.3 This "About This Macintosh" screen shows that most applications are hogging about twice as much memory as they're actually using

It's this reserved-yet-empty memory that RAM Doubler finds and uses for other applications. RAM Doubler performs its tricks by diverting the operating system's virtual memory routines. (Virtual memory, in case you don't already know, is hard disk space that the operating system treats as RAM to provide additional memory capacity when the physical RAM is "full.") Instead of looking for virtual memory on your hard disk, the system peeks through unused blocks of RAM and assigns this RAM to other applications as though it were virtual memory. Voila! Your memory is doubled.

RAM Doubler was first announced at the MacWorld Expo in 1993 and has since been ported to a native Power Mac version. It's a simple system extension that takes literally five seconds to install. Since RAM Doubler uses the operating system's virtual memory routines to perform its tricks, you can't run RAM Doubler when virtual memory is turned on. Nor would you want to. Applications that require virtual memory will still find it—the only difference is that the virtual memory will be under the control of RAM Doubler rather than the Mac OS.

Will Your System Benefit from RAM Doubler?

Not everybody will want to use RAM Doubler, although I suspect a majority of users will find it useful. Connectix reports that your system will exact a 2 to 4 percent performance hit when RAM Doubler is installed. But since RAM Doubler replaces virtual memory, it frees up that section of your hard disk that had been reserved for virtual memory use. And when you consider the relatively slow data transfer rate of a hard disk compared to the rapid transfer rate between the CPU and RAM, that 2 to 4 percent performance hit begins to look pretty good. In fact, such a small performance penalty will go unnoticed by most users—especially if you have an L2 cache card installed. (RAM Doubler only slows down RAM/CPU transfers—it doesn't affect the cache.)

RAM Doubler is useful chiefly for Mac users who tend to keep several applications open and running at any given time. If you typically only run one application at a time, you won't see much benefit from RAM Doubler. In fact, if you're using a cache- and RAM-busting application like PhotoShop or Adobe Premiere, RAM Doubler can slow the performance of the software significantly. In any event, if you decide you want to uninstall RAM Doubler, the install routine on the RAM Doubler diskette lets you do this easily.

If you would like a copy of RAM Doubler, contact Connectix at 800-950-5880. The current version (1.5) retails for $99. Before you install RAM Doubler, remember to turn off virtual memory. (RAM Doubler will notify you to do this if you forget.)

Adding an L2 Cache to 6100 and 7100 Systems

It's debatable whether you can get the biggest performance boost for your Power Mac by installing RAM or by adding an L2 cache card. Several independent benchmark studies have been conducted on the benefits of an L2 cache, with some striking results. For instance, performance on a 6100 that's equipped with a 256K cache card outperforms a 7100 system that doesn't have a cache card. The performance of a 7100 can be boosted by as much as 50 percent with the addition of an L2 cache card, but this speed increase won't rival the performance of even the most basic 8100 system configuration, because all 8100s are sold with an L2 cache card preinstalled.

The Value of L2 Cache

Cache cards typically use a form of RAM, called *Static Ram (SRAM)* that's much faster than even the fastest DRAM chips. But the materials and manufacturing processes used in making SRAM are also far more expensive than DRAM materials and processes. Consider this: One mail-order company sells a 4 MB 72-pin SIMM upgrade kit (for Power Macs) for $145. By contrast, a 256K cache card retails from $199 to more than $300, depending on who you purchase the card from. The 4 MB SIMM upgrade kit provides

16 times as much memory as the cache card, but the cache card can cost twice as much as the SIMM kit.

Even so, an L2 cache can be vital if you run a lot of 68K applications on a Power Mac and require high-performance results. Here's why: When 68K code is first loaded, the LC68040 emulator converts the 68K code to native PowerPC code and then executes the instructions.

If an L2 cache is available, the converted native code is stored in the cache for possible reuse. If the cached instructions are reused by the CPU, the code does not have to be emulated again; it is already available as native PowerPC instructions. So, not only do you gain the standard benefit of caching (that is, instructions and data can be accessed from fast SRAM rather than DRAM), but your system receives an extra performance boost because 68K emulation is not required after code has been cached.

Although Apple's product literature indicates that the L2 cache slot will hold a 160-pin SIMM with a maximum of 256K of memory, that's not quite true. A few other companies make 256K cache cards for the Power Mac as well as larger cache cards—up to 1 MB in size.

In the past, users who've purchased cache cards often have reported that a 512K card is the upper limit used by most applications, even during multitasking, and that a 1 MB cache card only make sense for graphics-intensive applications like ArchiCad or PhotoShop. That "512K cache barrier" might be coming down, though, for PowerPC applications. In any event, the performance improvement of a 512K cache over a 256K cache is about 8 percent. So a 256K cache is the wiser investment for most users. Figure 7.4 shows a 256K cache card.

Installing an L2 Cache Card

Cache cards have been available for Macintoshes for many years through third-party vendors. But until the PowerPC, cache cards typically had to be plugged into the PDS. So, if you wanted to add a cache card, you lost the use of the PDS for any other card you might want to add in that slot (typically a fast video adapter card).

With a 6100 or 7100 PowerMac, adding an L2 cache card is as easy as dropping the card into the available cache slot, which is located near the PDS. (Turn the system power off first, of course.) If you need to make sure you are plugging a cache card into the correct slot, refer back to Figure 5.2,

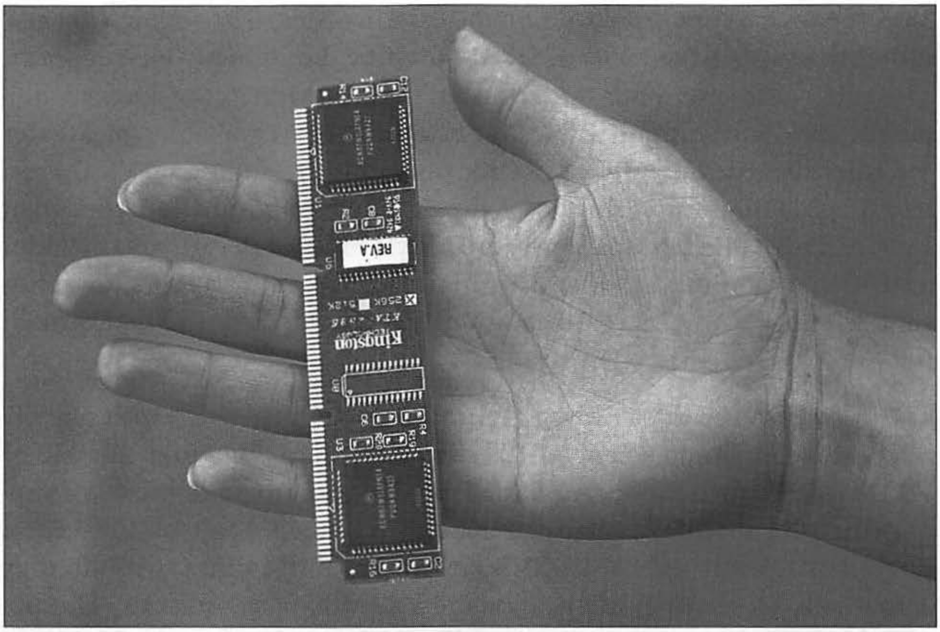


Figure 7.4 A 256K cache card

which provides an annotated photograph of an 8100 logic board (with the cache card already installed).

After you have plugged in the cache card, restart your Mac. Here's a good way to verify that the cache has been installed successfully: In the Memory Control Panel, set the Disk Cache to 32K. Then open a program that's about the same size as your cache card. The After Dark and Desktop Patterns Control Panels are good candidates for this test. GIF, JPEG, and other graphics viewers are also typically the right size.

Then, exit the application or Control Panel and restart it. Most or all of the program code should already be in the cache. So, when you restart the program, it should load within a fraction of the time that it took originally. If you don't notice any performance improvement, turn off your system and check to make sure the cache card is completely seated in the slot.

Expanding VRAM on 7100 and 8100 Systems

All non-AV 7100 and 8100 systems ship with a VRAM expansion card preinstalled in the PDS. When a video expansion card is plugged into a Power

Mac, the system uses the VRAM on the card in order to store video images, rather than using the 640K of DRAM used by the built-in video support. The VRAM cards for both the 7100 and 8100 provide expansion capabilities for installing additional VRAM. The more VRAM available, the greater the color density that will be available on monitors. Additional VRAM can be especially important for larger monitors (those monitors larger than 15"). As I explained in Chapter 5, the VRAM expansion card also includes a DB-15 pin monitor port that you can use to connect a second monitor to your system. Figure 7.5 is a diagram of the VRAM card supplied with all non-AV 8100 systems.

The 7100 VRAM card shown in Figure 7.5 comes preloaded with one 68-pin SIMM containing a bank of 128 Kbit×8 bit chips, for a total of 1 MB of VRAM. Also notice the vacant SIMM slot. You can upgrade the color support for your monitor by purchasing and installing Apple's 7100 VRAM upgrade kit (order part #M5953LL/A) in this SIMM slot. Currently, only Apple sells VRAM upgrade kits for the VRAM expansion cards. The upgrade kit provides an additional 1 MB of VRAM, for a total of 2 MB of VRAM. Table 7.2 shows the difference in color densities on various monitors before and after the upgrade kit is installed.

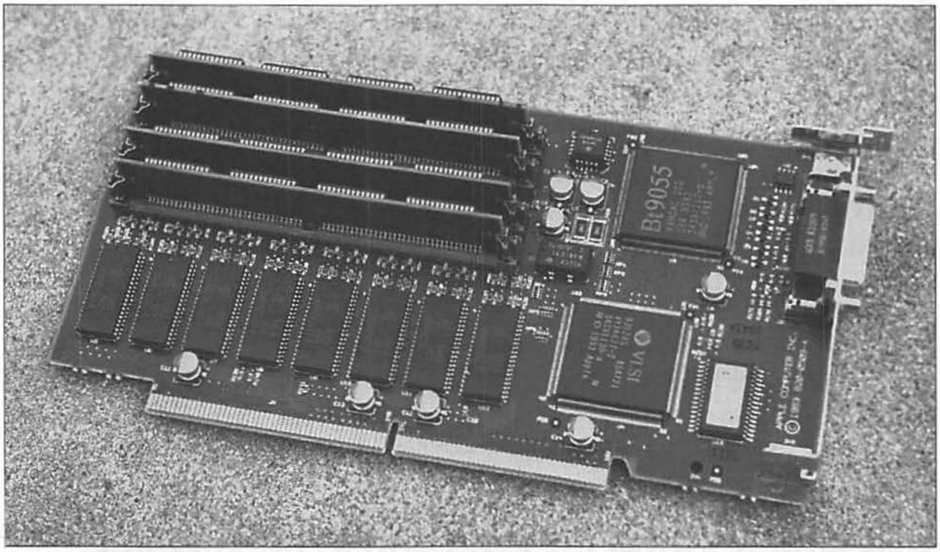


Figure 7.5 The VRAM expansion card used in the 8100 Power Mac system

Table 7.2 Color Density Differences before and after Installing Additional VRAM on the VRAM Expansion Card

Monitor Size	7100/66 1 MB VRAM Standard	7100/66 2 MB VRAM via 1 MB Upgrade Kit
14-inch and 15-inch	32,768 colors	16.7 million colors
16-inch and 17-inch	32,768 colors	16.7 million colors
20-inch and 21-inch	256 colors	32,768 colors

The VRAM expansion card preinstalled in all non-AV 8100 systems is similar to the 7100 expansion card, except it comes standard with one 68-pin SIMM that contains two banks of 128 Kbit×8 bit chips, for a total of 2 MB of standard VRAM. The expansion card also includes a vacant 68-pin SIMM slot. You can improve your monitor's color support by purchasing and installing Apple's 8100 VRAM upgrade kit (order part #M2976LL/A) in this SIMM slot.

The 8100 VRAM upgrade kit comes with 2 MB of VRAM chips, providing a total of 4 MB of VRAM. Table 7.3 shows the color density differences available for different monitors before and after installing the 8100 VRAM upgrade kit.

HOT TIP

The 8100 BART Chip is Buggy

The BART NuBus controller chip on 8100 systems has a strange bug that flushes the CPU cache, which in turn slows down performance of NuBus video cards plugged into the 8100. The end result is timing jitter with a few NuBus video cards installed on 8100 systems. The problem was uncovered within the first few months of Power Mac sales, and threatened to stall the sales of the 8100 systems. At the time, Apple insisted that the problem was not a bug; it was just a typical situation in which older, legacy cards would need to be upgraded to the new Power Mac Standard. Video card manufacturers cried "Foul!" when they heard this. Third-party card manufacturers insisted that the problem lay with Apple. Although Apple never admitted error, they did revise the NuBus BART chip design for the 8100/110 system. So, the BART chip on the 8100/110 corrects the jitter problem that earlier 8100 systems sometimes experience when video cards are installed.

Table 7.3 Color Density Differences before and after Installing Additional VRAM on the VRAM Expansion Card

Monitor Size	8100/80 Standard 2 MB VRAM	8100/80 4 MB VRAM
14-inch and 15-inch	16.7 million colors	16.7 million colors
16-inch and 17-inch	16.7 million colors	16.7 million colors
20-inch and 21-inch	32,768 colors	16.7 million colors

HOT TIP

Why It Won't Work: Font Management with Adobe Type Manager

Adobe Type Manager (ATM) has been used for years on Macintosh systems to display scalable Postscript fonts on screen. ATM still works on Power Macs, but some users have reported unstable behavior when older versions of ATM are used on Power Mac systems.

If you want to use ATM with your Power Mac, make sure you upgrade to at least version 3.6, which is the required version for compatibility with the Power Mac's built-in video. However, even version 3.6 will behave unstably if you install 32 MB SIMMs in the RAM expansion slots. An update, ATM 3.8, is now available and resolves this problem.

CPU Boosters

One of the easiest and most cost-effective ways to boost the performance of your Power Mac is to purchase a clock upgrade, also called a CPU booster, which actually increases the clock speed of the PowerPC CPU in your Power Mac. CPU boosters are possible because CPUs, like DRAM chips, are tested only for a certain speed rating. Often, they will run successfully at faster speeds. For instance, users have reported boosting the clock speed of 6100 systems from 60 MHz to 80 MHz or even 84 MHz by installing a CPU booster. And all CPUs are timed based on the incremental firing of pulses by the CPU clock. The faster the clock fires pulses, the faster the CPU will try to process instructions.

CPU boosting was a genuine hazard on older Macs. But the Power Macs use a ceramic clock crystal that's easy to work with, because the booster can be clipped right to the clock. When you clip the booster to the clock, it shorts out a few of the pins that send signals to the CPU, which allows the booster to fire its own oscillator signals to the CPU.

I'm aware of two CPU boosters available for Power Macs: PowerClip, manufactured by Newer Technologies, and the Alacrity PM 6100, manufactured by KS Labs. Both boosters work with the 6100 and 7100 systems. The PowerClip is more expensive than the PM 6100, but offers more versatility because you can reset DIP switches on the booster incrementally to try different CPU speeds. This is an important feature because, again, there's no guarantee that a booster will work at any speed above the minimum rating of the CPU itself. With the PowerClip, though, you can adjust the speed in 4 MHz increments, from 64 MHz up to 100 MHz; although I haven't heard of anybody clocking a 60 or 66 MHz chip higher than 84 MHz. But with the PowerClip, it's always worth a try.

With the PowerClip, you also don't need to worry that you'll damage your system, although Apple does warn that you void your Power Macintosh warranty if you install a CPU booster of any kind. You can install the PowerClip backward without any permanent effect on your system. The PM 6100, on the other hand, can permanently disable your logic board if you install it incorrectly.

Both the PowerClip and the PM 6100 are shipped with easy-to-install cooling fans, a requirement since the increased speed of the 601 chip results in increased heat dissipation. The PowerClip is available from Newer Technologies for $145. Call 800-840-2212. The PM 6100 is available from KS Labs for $99. Call 614-374-5665. With the combination of a CPU booster and a 256K cache card, it's not uncommon for a 6100 to perform at 8100 speeds. Figure 7.7 shows the PowerClip installed on the clock in a 6100 system.

A Few Fixes for the Incredibly Incompetent 6100 Case

The 6100 case has some design flaws—specifically, three flaws that I hear about from users repeatedly. First, the CD-ROM eject button is located *beneath* the CD-ROM tray, which means you have to move your hand *fast* after you've pressed the button. There's no way around this problem.

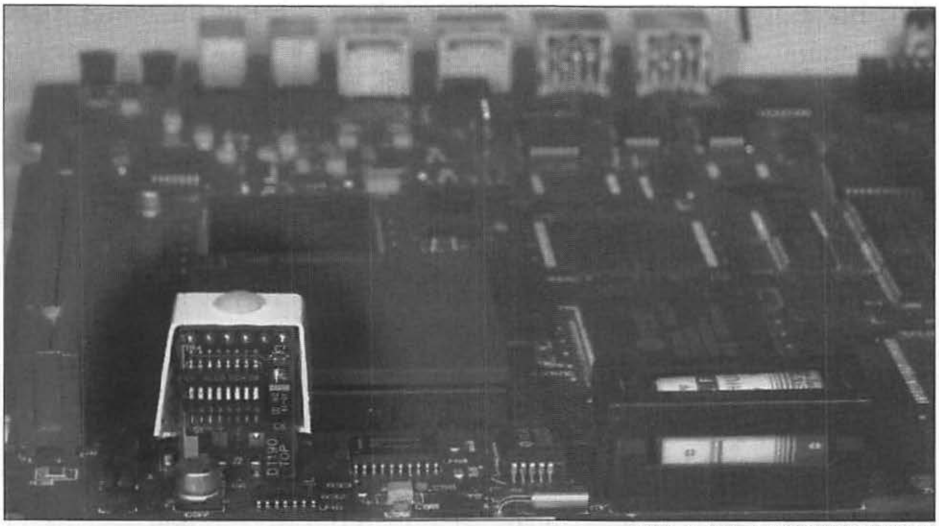


Photo Courtesy of Newer Technologies

Figure 7.7 The PowerClip CPU booster installed in a 6100 system

The second problem is the CD-ROM button itself, which tends to jiggle away from its rod so that you have to press *really hard* on one side of the button or the other to get the CD tray to eject. You can correct this problem, but you need to be a bit adept with your hands. (It's not all that hard, really.) You can move the CD drive forward ever so slightly by removing the metal shielding in the front, popping up the front end of the CD drive, sliding it slightly forward, and then snapping the shielding back into place. By sliding the drive forward you get a much better response from the plastic eject button.

The third problem is a sticky attenuator rod for the main 6100 power on/off switch under the diskette drive. What happens is that the button pushes in too far and gets stuck behind the case. There are actually several ways to correct this problem. You can call Apple to complain, and they'll send a service technician to your location to fix the attenuator rod free of charge.

A quick workaround to this problem (admittedly an unacceptable workaround) is to push the button in halfway; that will be enough distance to switch the power supply off, but won't be enough to cause the button to get stuck behind the cover.

A more permanent fix, and one you can do yourself, is to apply a light coat of LubriPlate with a small acid brush between the rod and lower chassis.

On the other hand, you probably don't have any LubriPlate or an acid brush lying around....

That leads me to a final complaint that users have about the 6100—and this problem is an easy one to solve. The problem: It's insulting to many Power Mac users that they have to use an on/off switch at all. The Power Off/Reset keys have been available for Macintosh systems since 1987. So why should one of the new, top-of-the-line systems not be fitted with this feature?

It's important to remember that the Power Mac 6100 was built around an existing Centris design—one that also did not support a Power Off key. The 6100 was meant to be an entry-level lost-cost RISC system, and any attempt to redesign the basic system would have meant retooling the factories and passing along the cost to consumers.

But there's a way out: Purchase PowerKey, manufactured by Sophisticated Circuits and available from many Apple resellers and mail-order outlets. PowerKey allows you to turn on the computer and three other accessories (for instance, your monitor, printer, and modem) with the touch of the keyboard Restart button.

With PowerKey installed, just use the Shut Down command from the Special menu to turn off all of the devices immediately. You can even have PowerKey pause the shutdown for a specified number of seconds so you can change your mind (great for those occasions when you absentmindedly select Shut Down instead of Empty Trash).

To support these and other user customizing options, PowerKey comes with a Control Panel. You can use the Control Panel to define precise times when you want your system to turn on and off automatically. The PowerKey control panel will also allow you to execute QuicKey shortcuts at specified times. PowerKey is available for about $75, depending on where you purchase it.

Utilities

Several native Power Macintosh tools are available for managing hard disk space and other hardware resources, and for performing backup, recovery, and disk diagnostics and repair. I'll describe a few of these products in the next sections. Keep in mind that other native Power Mac applications, those that aren't hardware-related tools, are listed and described in Chapter 12.

MacTools 3.0

The Popular MacTools utility package is now native for the Power Macintosh. Version 3.0 includes the following utilities:

- **DiskFix**: Analyzes and repairs hard-disk and floppy-disk problems.
- **Undelete** and **Trashback**: Undelete searches for files that you've deleted and lists them so that you can identify and select files that you want to recover. Trashback keeps track of deleted files. Undelete and Trashback track deleted files even after you've emptied the Macintosh Trash can.
- **Backup** and **Recovery**: Automated routines for backing up or recovering your entire hard disk or selected contents of your hard disk. Backup can backup to floppies, to a network volume, to Apple 40 MB and WangDAT 1300 and 2600 tape drives, Bernoulli and Syquest removable drives, and other mountable, non-read-only drives.
- **Anti-Virus**: Checks your hard disk and floppies for the presence of viruses. Central Point also provides a Continuous Anti-Virus Protection (CAP) service that provides you with regular updates for new viruses.
- **Optimizer**: Identifies and corrects bad blocks on your hard disk and defragments your hard disk to provide more contiguous hard disk space. Disk optimization reduces the access time required to retrieve files from your hard disk.

For more information on Central Point Tools 3.0, call 1-800-359-4920.

Norton Utilities

Symantec and Central Point have long been competitors in the tools and utilities market. Symantec recently announced native Power Mac versions of the Norton Utilities (3.0) and Symantec AntiVirus (3.0). Although I have not had an opportunity to review these products, I have always found the Norton and Central Point utilities to be comparable in quality, with each vendor offering a few unique features.

Symantec has also announced a native Power Mac version of its DiskDoubler software, which you can use to automatically or manually compress and uncompress files as you read them from or write them to hard disk. The new version, called Norton DiskDoubler Pro 1.1, integrates the DiskDoubler, AutoDoubler, and CopyDoubler utilities in a single package. For more information about Symantec's native Power Mac products, call 1-800-441-7234.

Dantz Utilities

Dantz Development Corp. has released two native Power Mac utilities: Retrospect and Retrospect Remote 2.1. Retrospect is a popular hard disk backup utility, and allows you to make immediate backups or to set your system up for automatic, unattended backups.

Retrospect Remote provides automatic, centralized data backup and archiving for networked Macintosh computers. Retrospect Remote allows both incremental backup to protect daily work, and true archiving to move inactive files from a hard disk to a storage device.

Adding Hard Drives

You can add both internal and external hard drives to your SCSI chain, up to a maximum of seven devices. If you add a drive to an empty internal bay on your Power Mac, make sure you remove the terminator or disable the terminator if it is internal. The internal portion of the SCSI bus is terminated automatically at the built-in hard drive that comes with the system. If more than one internal devices have terminators, your system will malfunction and you could damage your logic board.

If you purchase a non-Apple SCSI drive, make sure the driver software (if any) that comes with the disk drive does not override the SCSI 4.3 extension required for all Power Macs. If the SCSI 4.3 extension gets overwritten, one recourse is to purchase FWB, Inc.'s Hard Disk ToolKit 1.5.1. The ToolKit includes diagnostics tools for managing your hard disk, and also includes a SCSI 4.3-compatible extension. Version 1.5.1 runs natively on the Power Mac systems. For more information, call FWB, Inc. at 1-415-474-8055 X1.

Monitoring Network Traffic

Neon Software has made two of its popular network management tools native for Power Macs: LANsurveyor and NetMinder Ethernet 3.1.

LANsurveyor graphically documents the network, provides real-time troubleshooting capabilities, and profiles and monitors network devices. LANsurveyor also tests the network for responsiveness and alerts managers to problems.

NetMinder Ethernet 3.1 is a protocol analyzer for Ethernet networks. It captures and decodes packets on the network, enabling you to detect media errors, traffic bottlenecks, and other network problems. You can also use NetMinder to analyze network traffic in mixed-protocol environments, including AppleTalk, TCP/IP, NetWare, DECnet, LAT, XNS, Banyan VINES, and SNMP. I'll have much more to say about networking in Chapter 11.

Many other diagnostic and performance software utilities—such as native Power Mac versions of Speedometer, Conflict Catcher, and Power Peek—are available as shareware. For more information on these and other shareware programs, see Chapter 12.

Other Upgrade Options

There are literally hundreds of other options for upgrading your hardware. Most of these options aren't specific to Power Macs but are generic across a wide range of Macintosh systems, so they're not mentioned in this chapter.

Many other hardware upgrades pertain to specific AV capabilities or to running DOS/Windows applications. I've covered some of the more popular AV upgrade options in Chapter 6, and I'll provide a detailed look at hardware and software DOS/Windows solutions in Chapter 9.

Other system extension updates that are required to get older peripherals running correctly when connected to Power Macs, especially problems that relate to LaserWriter printers, are well documented in the Read Me file that was copied to your hard disk when you installed System 7.1.2 or 7.5 on your Power Mac. It's always wise to read this file, and at least print it for further reference before you delete it from your hard disk. The user's manual that comes with your printer might instruct you to use a printer driver other than the one specified in the Read Me file. Usually the Read Me file is correct, while the printer user's manual is referring to a driver that works on older Macintoshes. If the driver you select doesn't work with your Power Mac, try either the LaserWriter 8 or the LaserWriter 300 driver. One of these two drivers will typically work when others fail. I'll describe more operating-system information on printing in Chapter 11.

CHAPTER

8

The Internet and Your Power Mac

Connecting to Cyberspace, the Web, and Beyond

For the most part, I've tried to limit the contents of this book to topics and issues that are specific to the Power Macintosh systems. But I need to make an exception in this chapter. The Internet is by no means limited to Power Macintosh users, or even to general Macintosh users. In fact, no user, regardless of his or her system, is locked out of the Internet—provided he or she knows how to get connected and knows what to do from that point on.

But I'm inundated with questions about the Internet so frequently that it has become clear to me that this is a major area of interest to all Macintosh users, and to Power Mac users particularly. Since the Internet is one of the hottest topics of the '90s, and the Power Macintosh and System 7.5 technologies make it easier than ever to get connected to the Internet, I decided to devote this chapter to the online world.

Even though it's *easier* than ever to get connected to the Internet and the World Wide Web (I'll explain both of these terms shortly), it's not always *easy*. Problems and pitfalls are in abundance with this emerging view of the world—from getting connected to finding an Internet provider to finding information on the Internet to getting lost in Cyberspace to successfully downloading and decoding files and images to....

You get the idea.

This chapter is devoted to the various topics you'll need to understand to get online and to make the most of the Internet. Even if you're an experienced Internet and Web surfer, you'll still probably find several good tips and new Mac-related sites mentioned in this chapter.

The Internet and the Web: What They Are and How You Can Use Them

Even though the Internet is in the news on a regular basis, many people are still confused about what the term means. And an even newer technology, the World Wide Web, is also a mystery to a lot of users. So I'll begin by explaining these terms and explaining the basic difference between the Internet and the World Wide Web. If you're a pro Internet surfer, you might want to skip these sections.

The Roots of the Internet

If you've ever wondered whether anything good has come out of the Cold War, you can disengage your brain now. The Internet is a direct product of the Cold War shivers. I'll spare you the lengthy history lesson and just point out a few of the basics: In the 1960s, several individuals in the U.S. Government—chiefly the Advanced Research Projects Agency (ARPA) arm of the Defense department—concocted a plan to safeguard military data—and the access to it—stored on various computers around the country in the event of one or more nuclear strikes by the Evil Empire. I know that to some users this now sounds paranoid, but the free flow of sensitive information was a major concern during the Cold War.

The result was ARPANET, a network that linked hundreds of computers in government and academic research institutes as one, common network. The network was designed so that, if any given link in the network was destroyed via nuclear attack, the other computers in the network would still be able to communicate.

To make such a network work, if I can coin a phrase, it had to be open—that is, easily accessible to anybody who wanted to link to it. For a Department of Defense project, that doesn't sound very secure. Actually, though, it is. Individual network sites could still restrict access by requiring password entry, but the general network protocol itself was open to everybody.

The end result was that just about everybody wanted to join up. ARPANET as a formal government program was eventually discontinued, but the communications protocol (the basic communication rules and other details that all computers linked to the network must adhere to) has remained and forms the backbone of the ARPANET's successor, the Internet. In fact, that's *all* the Internet really is—*a set of communications and networking parameters that any computer facility can adopt in order to link with other computers that have adopted these same standard communications parameters.*

The bottom line is that the Internet is no longer regulated by the U.S. Government, although many government agencies both in the U.S. and worldwide continue to use and exploit the Internet. So, governments worldwide have a vested interest in making sure the Internet continues as an open environment for networking. They've got an interest, but they don't have a controlling interest. In fact, the Internet isn't controlled or regulated at all—a fact that makes for the largest, most disorganized, and most diverse collection of information ever assembled in history. It's also what makes the Internet so much fun to use.

The Problem with UNIX

One of the biggest problems with the Internet has been that much of the Internet Protocol (IP) communications rules that govern it were designed for use with the UNIX operating system. Even today, most of the Internet host computers around the world still run UNIX. And if you know anything about UNIX, you know that it is a complex, unfriendly, unwieldy beast of an operating system. In fact, if there's such a thing as a mirror universe, UNIX would be the anti-image of the Macintosh OS.

Even though UNIX rules the Internet roost, you don't have to run UNIX in order to connect to and use the Internet. But, until recently, you did have to navigate through Cyberspace by using UNIX commands and the text-based UNIX interface—a proposition that most casual users, especially Macintosh users, found to be a bit overwhelming.

Today, there are still a few UNIX rules involved in using the Internet—the major rule being that Internet and Web addresses are case-sensitive—but for the most part the underlying operating system at an Internet host site can be made transparent to users.

The easiest way to make the Internet more friendly is through the use of a *browser*, a term that refers to any of a number of software utilities that transform the Internet into a point-and-click graphical interface. Browsers are essentially the keys that unlock the World Wide Web.

The Origin of Browsers and the Web

The World Wide Web traces its roots to the late 1960s when an individual named Ted Nelson came up with the idea of attaching documents via *hypertext*, a system in which documents stored on computers contained links to other documents. By having their documents linked together, users could more actively determine what to read or not read depending on the information they were looking for.

The concept of hypertext allowed users to break through the frustrating barrier of being forced to read a document linearly. Instead, readers could follow a seemingly infinite number of threads, changing paths and steering through documents depending on what information they were interested in finding.

An example of hypertext you're probably familiar with is the help screens used in Macintosh applications. When you read a Mac help screen, you see words that are underlined and usually in a different color than the other text. By clicking on one of these words, you're instantly taken to another help screen via a hypertext link. In this way, you can find the information you're looking for quickly and easily, saving you from having to pore through pages of superfluous documentation.

The basic concept behind the World Wide Web is no different, except instead of linking documents stored on your computer, it links millions of documents, programs, sound bites, movies, and more stored on thousands of computers around the world.

Vive la France!

Tim Berners-Lee, working at the European Particle Physics Laboratory (CERN—and yes, I know the acronym doesn't match the lab name, but it's from the French version of the name) in Geneva, Switzerland, was largely responsible for this giant step forward in hypertext technology. Instead of limiting the use of links to documents stored on one computer, he surmised, why not use hypertext to link documents on many different computers to provide researchers and academia with an easy way to search for and exchange data on ongoing projects?

The outgrowth of this idea was a set of hypertext tools, created by Tim at CERN and by others elsewhere, now called *browsers* because they made it possible to search through lists or other collections of information *links*, rather than sift through the information itself. It was an astonishingly simple approach to providing organized and extensive information access.

Early browsers were strictly character-based, with sound and video little more than an extension based on the kernel of a science fiction dream. Still, having a way to locate information quickly through hypertext was a tremendous advance. The groundwork had been laid for the fun and free stuff you can explore today. But there's more to this tale.

Enter Marc Andreessen. As an undergrad at the University of Illinois at Urbana-Champaign in 1992, Marc was working part-time at the National Center for Supercomputing Applications (NCSA, an acronym that *does* make sense) when he started toying with the development of a graphical interface to access the growing Web (still a new term at the time) of hypertext documents. He quickly saw the potential for what he was onto, and the result of his resourcefulness, insight, and marathon all-nighters was Mosaic for UNIX, the first widely available point-and-click interface to the World Wide Web. Published in April 1993, versions for Windows and the Macintosh soon followed. So, the Web, as it exists today, is only about one year older than the Power Mac systems.

Understanding the Relationship between the Internet and the Web

I realize I still haven't explained the precise difference between the Internet and the Web and how they're related, but I needed to lay some groundwork first. This is a good point to tie up some loose threads.

Think of an automobile and its engine. (Stay with me for a moment even if you know nothing about cars.) Conceptually, the difference between the two is the same as the difference between the Web and the Internet. You can wrap several different auto bodies around the same engine, but it's always the engine that makes the car go. Did you know that the Ford Taurus and the Mercury Sable have identical engines? And General Motors, as another big example, has built a billion-dollar business around the practice of putting different auto bodies around the same engine.

Now think about the Web and the Internet. The Web is essentially a great looking body wrapped around a high-performance engine—the Internet. Although you could argue that the Web is a physical collection of hypertext documents stored worldwide, the true function of the Web today is as a graphical interface. You can use the Web to drive and control the Internet, but the Internet is still providing all the horsepower.

Actually, the Web as it exists today has been built by individual users who create *Web pages*—or Internet sites (auto bodies, of a sort) that all use the same technique to create graphics, text, and most important, the hypertext links that make it easy for you to leap from one Web page to another with the click of your mouse.

The use of the word "page" is unfortunate, because each Web "page" actually can contain dozens or even hundreds of screens (or pages) of information. So think of a "Web page" as a "Web site," and you'll be better served for the effort. In any event, the starting point for any Web site is called its *home page.* A Web site's home page typically contains the hypertext links to other pages, which in turn contain links to still other pages, and on and on. Figure 8.1 shows a typical home page.

The common organizational approach that all Web pages share is something called *Hyper Text Markup Language*, or *HTML* for short. HTML sounds complicated, but it's actually not much more than a glorified word processor that uses *tags* to format and define the text, graphics, and hypertext components that make up a Web page. For instance, if I want to put *something in italics* on a Web page, I just do this: <i>something in italics</i>. Pretty simple, huh?

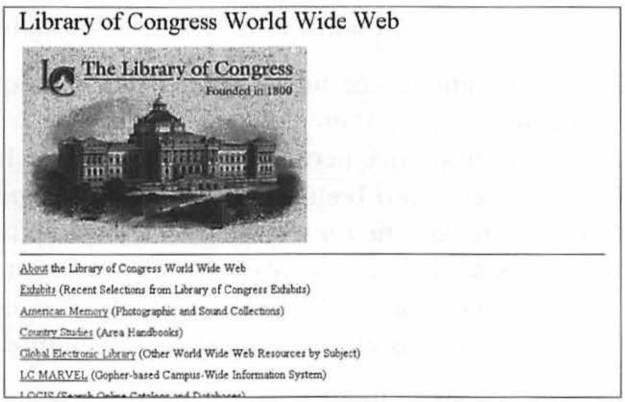


Figure 8.1 The Library of Congress home page

It really is about that simple. In fact, everybody who creates a Web site uses the same set of HTML tags or codes like the italics tags that I've just shown; that's how all the thousands of Web sites are linked together seamlessly.

And guess what? All you need to know about HTML is what you just finished reading in the previous paragraphs. In fact, you really didn't even need to know *that* much, but a passing knowledge of HTML can help you to conceptually understand how the Web works and how it's different from the Internet.

Getting Your Own Web Browser

The bottom line is that Web sites are part of the Internet. But just because you have access to the Internet doesn't automatically mean you can access Web sites. With a few exceptions, *you can't access Web pages without a Web browser* like Mosaic, Netscape, or MacWeb. The reason is simple: A Web browser translates the HTML at a Web site into the graphical images, text, and hypertext links that you see on screen. Without a Web browser, your computer doesn't know how to "see" a Web site's HTML, even though it knows how to "talk" to your Internet service provider. A Web page is really just one great big graphics image that gets displayed on your screen.

The best part about Web browsers is that most of them are free. Even the commercial Web browsers are typically distributed as a freebie by your Internet service provider or by Internet services that want your business and want to provide an easy way for you to do business with them.

Mosaic, still the most popular Web browser (although Netscape is superior and gaining in popularity), is not a commercial browser because technically it was created at NCSA. And because NCSA is funded by the National Science Foundation, a government agency, the software tools it creates are considered public domain. Needless to say, computer users by the hundreds of thousands have been scrambling to download free copies of Mosaic.

But there's a catch with Mosaic—a small one, but a catch nevertheless.

Mosaic, even at this writing, is a work in progress. Technically, you could consider it to be "beta" software, an unfinished version. When you use Mosaic, you'll notice some inconsistencies in its features and, as you get more experienced, you'll quickly identify features that you think should be part of the software but aren't. Even so, Mosaic is a remarkably stable piece of software. And most important, Mosaic has given birth to a litter of copycats.

Everybody Wants to Get Into the Act

The copycats are shareware and commercial spin-offs of Mosaic, and now include MacWeb, Mosaic for the Macintosh, and Netscape, among other Windows-based and UNIX-based browsers. Native Power Mac versions of MacWeb and Netscape are available.

HOT TIP

Using Internet and Web Addresses

There are a number of different "types" of sites on the Internet, each of which uses a different set of communications protocols for getting online. Some Internet sites are Gopher servers, while others are FTP servers, while others use Telnet, and still others (the most important category for you) require a Web browser. When you use a Web browser, you specify the type of site you're accessing by entering the protocol followed by its Internet address. This long, hieroglyphic-like statement is called a *Uniform Resource Locator* (or *URL* for short).

For this chapter, I'm assuming you're using (or plan to use) a Web browser, in which case you initially access any Internet location by entering its protocol followed by the appropriate Internet address. For Web sites, the protocol is HTTP, which stands for Hyper Text Transfer Protocol. So a typical Web site address might look like this:

```
http://www.law.uc.edu/Diana
```

Here, the "http://" designation tells your Web browser that this is a Web, or hypertext-based, site. Your browser then knows how to handle the Internet address that follows. And by the way, since you're accessing a UNIX host system, you need to match the case of all characters in a URL. In this case, that means you must enter the capital "D" in "Diana."

Here's an example of an FTP address:

```
ftp://einet.net/einet/nac/macweb
```

This Internet address will take you to an FTP site that provides the MacWeb browser for downloading.

Whatever your Web interest, you must enter the appropriate URL address in the dialog box that your Web browser supplies for this purpose. For Mosaic and MacWeb users, click on **File|Open URL** to display the dialog box shown in Figure 8.2. For Netscape users, click on **File|Open Location** to display the dialog box shown in Figure 8.3 If you're using some other Web browser, you'll probably find that the addressable dialog box is available by clicking on **File** and then some type of **Open** command. After you've opened the appropriate dialog box, just enter the address, but remember: *All Internet addresses are case sensitive.*

If you're already connected to the Internet (I'll explain the basics involved in getting connected a bit later), you'll want to download a Web browser. For the rest of this chapter, I'll assume you're using Netscape, but you might prefer some other browser. Even if you already have a Web browser, you'll want to make sure it's the most current version. Here are the three most popular Macintosh Web browsers and the sites where you can locate them:

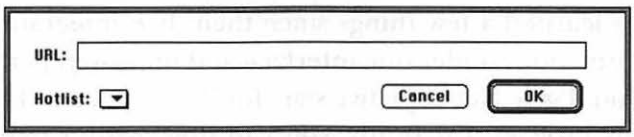


Figure 8.2 File|Open URL from MacWeb and Mosaic

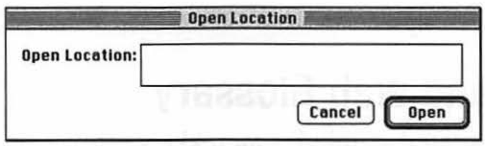


Figure 8.3 File|Open Location from Netscape

- **EINet MacWeb**: A full-featured Web browser, the latest version of MacWeb is now Power Mac native. To use MacWeb, your Macintosh must be running System 7 and at least MacTCP 2.0.2 (though MacTCP 2.0.4 is recommended). Use StuffIt Expander (or an equivalent program) to de-BinHex and expand the archive. The EINet folder may be located anywhere on your hard disk. You can get a copy of MacWeb from **ftp.einet.net/einet/mac/macweb/macweb.latest.sea.hqx**.
- **Mosaic for Macintosh**: Developed at NCSA by the people who *know* Mosaic, Mosaic for the Macintosh is a full-featured Web browser that will run on any machine using at least System 7, MacTCP 2.0.2 (though 2.0.4 or later is recommended), and 4 MB of RAM. It also requires a partition of at least 2 MB of hard-disk space (though Mosaic itself takes less than 1 MB). While Mosaic will run with earlier versions of MacTCP, bugs in those versions cause memory usage for each document loaded to increase by 12K. Eventually, memory will run out, and either Mosaic, your computer, or your heart will need to be restarted. The latest version of NCSA Mosaic for the Power Macintosh can be found compressed with StuffIt and encoded with BinHex at **ftp.ncsa.uiuc.edu/Mosaic/Mac**. Make sure you download the native Power Mac version.
- **Netscape Navigator**: Netscape Navigator 1.0 combines the latest in point-and-click interface design with lightning-fast performance. Developed by much of the same team that developed Mosaic, including Mr. Andreessen (the creator of Mosaic), Netscape Navigator shows that these guys have learned a few things since then, like integrating all major Internet functions under one interface and improved performance at 14.4K baud. I give Netscape five stars for its design, and highly recommend this browser. Currently, you can download a free copy from **ftp.mcom.com/netscape/**. Make sure you download the native Power Mac version.

An Internet and Web Glossary

The Internet was created *by* tekkies *for* tekkies, so you might suspect that a host of jargon has emerged to label various features of the Internet. And your suspicions would be right. Even the Internet's friendlier offspring, the World Wide Web, is rife with jargon. So, here's a brief glossary of terms designed to help you become an instant Internet insider. I'll use many of these terms later in the chapter, so this glossary is useful if you're new to the Internet and want to understand other concepts in this chapter more fully.

Anonymous FTP: A simple technique for downloading files from an FTP site of which you do not have a logon ID (in other words, a privileged account). Many (but by no means all) FTP servers make their file archives accessible to all Internet users, which means you can access the site by logging in using the ID "anonymous." When you access an FTP site via Mosaic, Netscape, or most other Web browsers, you're automatically logged in anonymously.

Bookmark: This is the term used in Netscape to add a URL to the Bookmarks menu for easy, repeated access. After you've created a Bookmark, you don't have to enter the URL again; just click on the Bookmark and Netscape will connect you to the appropriate Internet or Web site.

Direct Connection: An Internet connection in which you have your own IP address and connect physically and directly to the Internet via a dedicated line leased to you by your phone company. This is a *very expensive* way to get connected.

DNS: The acronym stands for Domain Name Server, which is the UNIX software required by a service provider to keep track of Internet host systems and domain addresses.

Domain: A portion of a URL address that identifies a host system or a part of the system dedicated to a specific user group. In the URL "oak.oakland.edu", "oakland.edu" is the domain for the "oak" system. The domain description provides a human-language technique for specifying a host system's IP address. Essentially, it's just a friendlier, easier-to-remember way of identifying a system than using the numbers that make up its IP address (such as 141.130.188.2).

Finger: A command that displays a brief file of information about an Internet user. The finger command is actually a search utility available on the Internet; it is not a built-in part of most browsers, although many browsers provide a finger site address in one of their menus.

FTP: This acronym stands for File Transfer Protocol, which defines the communications standards used to upload and download files to and from an FTP server.

GIF: This acronym stands for Graphic Interchange Format, a highly compressed format for storing and transferring graphic images. The GIF format was created by CompuServe to speed the time required to download graphics, but has since been absconded by Internet users and is currently the most widely used graphic format on the Internet and the Web, although it's rapidly being replaced by the superior JPEG format.

Gopher: A text search and retrieval system named after the mascot of the University of Minnesota, where Gopher was created. A Gopher server treats the hierarchy of Internet databases, directories, and files as a series of menus, which you can browse through to find specific information. You can typically access Gopher by selecting a Gopher site from one of your Web browser's menus, or by typing a Gopher URL in your browser's **Open|URL** (with Mosaic and MacWeb) menus or **Open|Location** (with Netscape).

Home Page: The starting point (first screen) in a Web page.

Host: A computer—usually one with a fast processor or multiple processors and some whopping big hard disk space—that can provide a physical link to the Internet. A host computer is identified via its system and domain names. The system name is just that: It's simply what the computer's users have labeled the system for purposes of network identification. The domain provides information about the location or function of the computer within an organization (such as a university or research facility). In the URL "oak.oakland.edu", "oak" is the system name and ".oakland.edu" is the domain. The terms *host*, *site*, and *server* all essentially are the same.

Hotlink: An underlined word, phrase, or address that you can click on to jump to other information about the linked phrase or to jump to a related Web page.

Hotlist: A list of frequently accessed Web sites, which you can create using the Mosaic or Mac Web **Add to Current Hotlist** function. In Netscape, bookmarks serve the identical function.

HTML: This acronym stands for Hyper Text Markup Language, which is a standardized method for defining formatting, links, and other special handling of text, images, and objects within a Web page. You need to learn HTML only if you plan on creating your own Web page, although a basic understanding of HTML can be helpful in interpreting some HTML-laden text documents you might download from Web servers.

HTTP: This acronym stands for Hyper Text Transfer Protocol, and is a bona fide resource type used to locate a Web server directly from within Mosaic.

JPEG: This acronym stands for Joint Photographic Experts Group, which defined a standard compression format for high-resolution color images. JPEG is rapidly replacing GIF as the format of choice for images stored on Internet and Web sites.

MPEG: This acronym stands for Motion Pictures Experts Group, which defined a standard compression format for video and sound used to display and hear online movies. Although QuickTime 2.0 supports MPEG, you still must install a separate MPEG video board in order to view MPEG movies on Power Mac systems. However, utilities are available for viewing MPEG movies on the Power Mac (as QuickTime movies). You can download a copy of one of these converter/viewers at **http://www.astro.nwu.edu/lentz/mac/net/mac-web.html**.

PPP: This acronym stands for Point to Point Protocol, a more sophisticated and alternative protocol connection to SLIP (see the *SLIP* glossary entry). Like SLIP, PPP establishes the initial connection between your computer and your service provider's host system, but includes a far more robust set of protocols than SLIP. For this reason, PPP is more efficient than SLIP, especially when you're using a high-speed modem. MacPPP provides PPP support on Power Macs and is available free from several sites.

Resource Type: Defines the type of transfer protocol, server, or database to be used in making a connection to a host. The resource type is always the first portion of a URL and is followed by a colon and two slashes, as in http://, ftp://, gopher://, telnet://, and file://.

Server: Essentially means the same as "host;" however, in Cyberspace, the term "server" has come to take on a separate connotation in which "server" is preceded by an adjective that identifies the type of Internet service it provides—for instance, you can connect to a Web server, an FTP server or a Gopher server.

Service Provider: The place that takes all your money. Unless you're set up with direct access to the Internet (which generally requires the help of a rocket scientist and the budget of Wayne Newton), you need to pay startup and monthly fees to a service provider, which "provides" you with the initial host connection to the rest of the Internet. Having paid your money, yell (politely) at your provider loud and long whenever you need to have a network-related problem solved, because that's the job you're paying them to do.

SLIP: This acronym stands for Serial Line Internet Protocol, and is a standard method for connecting to a service provider via telephone lines. Since your computer (most likely) does not have its own IP address, your modem needs some way of making itself known to the TCP/IP world. SLIP software provides this connection so that the Internet treats your computer as though it were your service provider's host system. Increasingly, service providers are replacing SLIP with the more sophisticated and versatile PPP protocol. Eventually, even PPP will be replaced by ISDN, T1, and other high-speed connections.

Socket: A generic term used to refer to the initial connection and handshaking details your system must carry out to connect to an Internet host. A socket is really the same as a TCP/IP script used to connect you to your Internet provider. For instance, MacPPP is an example of a "socket" because it "plugs" your system into the host system (thereby providing a socket).

Tag: Any of a number of intimidating-looking formatting codes (such as <B>Jenni</B> or <A NAME="My Page">) used in HTML to indicate special handling of text, images, or other objects within a Web page displayed by Mosaic, Netscape, MacWeb, or some other Web browser. HTML tags are placed within angle brackets and are usually paired, which means there is a starting tag, followed by the object being coded, and then an ending tag. Tags are used to specify font characteristics, hypertext links, image handling, and many other format characteristics.

TCP/IP: This acronym stands for Transmission Control Protocol/Internet Protocol, which defines the communications standards for passing information back and forth across the Internet. TCP/IP is actually a collection of more than 100 transmission protocols and can seem complex to new and even experienced network users. Think of TCP/IP as the common language that controls all communications hardware linked to the Internet, thereby helping to avoid communications conflicts and "misunderstandings" when data is shuttled among computers. On your Power Mac, MacTCP serves this function and comes standard with System 7.5.

Telnet: A powerful networking tool that could use a serious overhaul. Essentially, Telnet is a utility that allows your computer to emulate a terminal connected to a particular network. Unlike FTP, which only allows you to access files from a remote computer, Telnet actually allows you to log into a network and run programs and other services available on the network. Telnet, at this writing, is still text-based, which is why I say it's in sore need of a graphical facelift.

Transfer Protocol: In a URL, this identifies the set of standard transfer procedures that will be used to access and exchange information on the Internet and the Web. Examples of transfer protocols are "http" and "ftp." A transfer protocol is an example of a resource type. Most transfer protocols need to be followed by two slashes. I don't understand why this distinction exists, but I'm sure Mark Andreesen and his minions will make it clear to us in the coming months and years.

URL: This acronym stands for Uniform Resource Locator (also called Universal Resource Locator, depending on whom you ask). A URL is essentially the address and path that Mosaic uses to find a Web site. A URL contains the resource type, followed by the system and domain names, and optionally, the name of a database or file stored on a Web server.

USENET: A massive (really massive) networked collection of newsgroups, which in turn refers to special-interest forums where Internet users gather to discuss, well, their special interests. To access USENET from a Web browser, simply begin the URL with news: (no slashes) followed by the domain of the newsgroup (such as alt.barney.die.die.die, one of my personal favorites).

Veronica: Internet gossip has it that this actually stands for Very Easy Rodent-Oriented Network Index to Computerized Archives, but that's beside the point. More simply put, Veronica is an index of all Gopher menu items. Since a Veronica search is based on the name of a menu rather than keywords within databases, these searches tend to be less reliable than other methods.

WAIS: This acronym stands for Wide Area Information Server, which is an Internet text search and retrieval system that works much like Gopher in that you use keywords to locate items within an online database. Unlike Gopher, though, WAIS searches are limited to keyword searches; you can't navigate databases through a series of menus. However, many WAIS utilities are Web-based, so they include hypertext links that you can use to jump to other Web servers.

Web Page: Typically used to refer to a site on the Internet that uses HTML as its interface. Web pages can only be viewed with an HTML-based browser like Netscape, MacWeb, or Mosaic.

Getting Connected

Connecting to the Internet is really the only significant hurdle you need to leap in order to make full use of the Internet and the World Wide Web. Once you're connected, you're home free (except for those monthly charges). But again, the steps you need to follow to get connected can sometimes be a technical nightmare.

Fortunately—thanks to some built-in features of System 7.5—establishing an Internet connection is much easier on Macintoshes than it is on Wintel platforms. (Take pity on Windows users; connecting to the Internet for them is akin to inviting Freddie Kreuger over for dinner.)

Choosing a Provider

If you're a member of a company or university that either has its own Internet server or has an existing Internet account, you don't need to concern yourself with the tribulations of finding a provider. You've already got one. But for the rest of the world, choosing a provider can be a major issue.

There are thousands of Internet providers worldwide, but that fact won't do you much good because you'll want to subscribe to a *local* provider. If you use a provider whose server is out of your local dialing area, you'll have to pay long-distance charges over and above the monthly and other user fees that your provider will charge. Ouch.

The best way to find and evaluate local Internet providers is to inquire at companies, universities, or government agencies in your area that are already connected to the Internet. Yes, that can be a pain, but yes, it's also the best way to determine whether a given Internet provider is right for you. In any event, *never* subscribe to the first local provider you hear about; get a variety of opinions from several different sources.

Here's why. As recently as a year ago, many providers were small companies that consisted of maybe four people in a basement and an overburdened UNIX workstation with lots of modems hung off of it. What these small companies typically did (and still do) is buy a fast connection to the Internet through a national common carrier like Sprint, or else from a local university or research center that's already on the Internet. They then sell connections into their machine to individual users like yourself or to other companies.

This kind of bargain-basement Internet service is certainly a legitimate business, not a scam. But this approach is often less than satisfactory for many Internet customers. Commonly, small providers like the ones I've just described fail to upgrade their equipment quite as rapidly as they need to as their number of subscribers grows, and too often customers receive busy signals when they try to dial in.

With the advent of the World Wide Web, though, providing Internet service has mushroomed into a big business. Major companies have been formed or spun off from parent companies specifically to provide Internet service to local-service communities. Of course, some companies are more on the ball than others. Since the competition among Internet providers is becoming intense, it makes sense to take advantage of this fact and shop around carefully.

If you live in a rural area, you might be out of luck in terms of selecting a truly local provider. But as a rural user, if you have to spend money on long-distance Internet-connection charges anyway, make sure you spend it with the best service. Nearby cities will typically have multiple providers, so it's a good idea to find out which service has the best reputation.

When you're shopping for a service provider, there are a few important issues to keep in mind. When you call a sales representative for a provider, ask them how many Macintosh users they support. This question is important because most providers include a number of utilities that their customers can download for free. You'll want to subscribe to an Internet provider that offers lots of Macintosh utilities as well as technical support for Macintosh users.

Also, ask if the service provider uses SLIP or PPP (see the glossary in this chapter for more information) as the connection protocol. Although SLIP is an acceptable approach, PPP is more sophisticated and, in general, faster. If a service provider is still using SLIP exclusively, that's a good indication that the service hasn't upgraded its equipment to stay current. Many providers offer both SLIP and PPP connections in order to support long-standing SLIP customers as well as newer PPP customer accounts. For the remainder of this chapter, I'll assume that you're going to connect to the Internet using PPP. If your area offers the even faster ISDN or T1 connectivity technologies, take advantage of them.

And one more thing: Make sure you request the names and phone numbers of users from a provider's existing customer base. *Take this recommendation seriously.* Some providers give you a physical Internet connection, but do little if anything to help users configure their systems for Internet and Web access. A good Internet provider will make available an online help file that contains step-by-step information for connecting your Macintosh to the host system, along with dedicated technical phone support in case you need somebody to walk you through the connection steps. Good technical support is also essential because even the most sophisticated Internet users periodically encounter problems and bugs that require expert help to solve.

Configuring MacTCP

In the next few sections, I'll walk you through the basic steps you need to follow to get connected to the Internet. (Once you're connected to the Internet you are by default also connected to the Web; you simply need to install a Web browser to view Web sites.) For this example, I'll assume you're using a PPP connection. But please keep this fact in mind: *This is an example only. The specific steps you'll need to take will vary depending on your provider and the type of service you purchase.*

If you're not already running System 7.5, I suggest you install it before you try to connect to the Internet. System 7.5 comes with the MacTCP extension and Control Panel built in, which you must have in order to connect your Macintosh with an Internet provider's host system. If you don't have MacTCP (which means you're not running System 7.5), you can purchase it from Apple for $59 (or less, depending on when you order it).

MacTCP is essentially useless for Internet access until you install a SLIP or PPP extension. For PPP, you can use MacPPP, which your Internet provider should make available for free. MacPPP contains two files: the Config PPP Control Panel and the PPP system extension itself. After you've obtained these files, drop both of them into your System folder and reboot your system.

Figure 8.4 shows the main MacTCP Control Panel dialog box that will appear after you've installed MacPPP. If you don't see the PPP icon in your Control Panel, you either haven't installed MacPPP or you haven't installed it correctly.

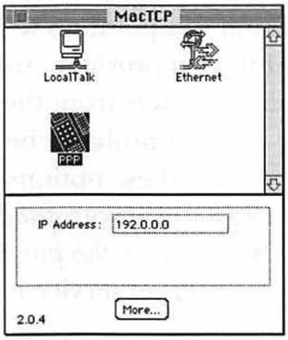


Figure 8.4 The first MacTCP screen

To view and configure MacTCP, follow these steps:

1. Select **Control Panels** from the Apple menu, then select **MacTCP**. The upper part of the MacTCP window should show at least two icons: LocalTalk and PPP (but on Power Macs, Ethernet will also appear if the Ethernet extension is enabled).
2. Click on the "PPP" icon so that it is highlighted.
3. Click on the "More..." button in the lower part of the window.
4. Now you're in the MacTCP configuration dialog box, as shown in Figure 8.5.

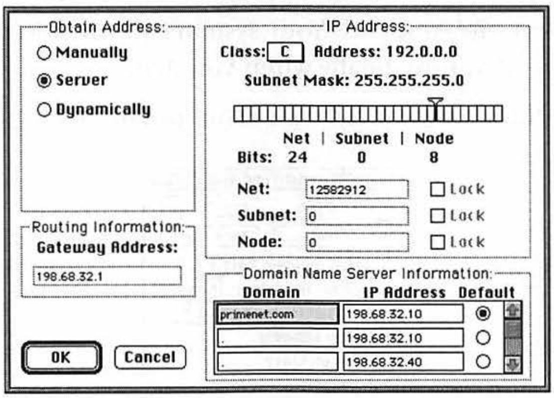


Figure 8.5 The MacTCP configuration dialog box

The steps you follow from this point on will depend on the configuration requirements of your Internet provider. And therein lies the critical factor that separates excellent providers from the rest of the crowd: Most of the options in this dialog box will probably be foreign to you, and you really shouldn't have to know what these options do; that's the role of your provider. If your provider can't give you *detailed* steps to follow in filling all portions of this dialog box, *find another provider.* It's better to jump ship now than to do so when your Internet service is sinking at sea.

After you've finished configuring MacTCP, you need to configure MacPPP. Again, your provider should be able to detail the steps you need to follow. Here are the basic steps:

1. In the list of Control Panels, select **Config PPP** to display the dialog box shown in Figure 8.6.
2. Set "Port Name" to "Modem Port."
3. Click on the "New" button. Put a name in the "PPP Server" box (for instance, the name of your Internet provider).
4. Click on the "Config" button to display the configuration dialog box shown in Figure 8.7.
5. Set "Port Speed" to the speed of your modem. (Note: The Mac OS Communications Toolbox does not directly support some modem speeds, including 14.4K baud. If the speed of your modem is not shown, select the next *highest* speed. Your system will throttle down to the appropriate speed automatically when you dial.)
6. Set "Phone Num" to your local Internet provider's number.

Figure 8.6 The Config PPP dialog box

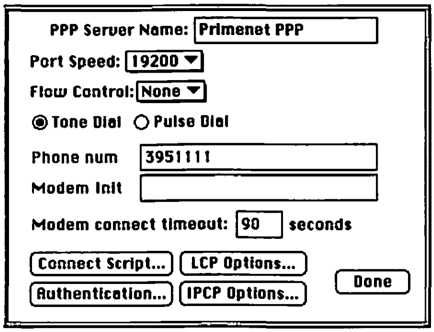


Figure 8.7 The PPP configuration dialog box

7. Click on the "Authentication" button.
8. In the "Auth. ID" box, put the name of your PPP account. This will typically be a capital "P" followed immediately (no space) by your account name, probably in all lowercase characters.
9. You can put your password in the password box, but this is not recommended (although it is more convenient than entering your password each time you want to access your account). If you omit your password, PPP will prompt you for it whenever you try to log on.
10. Click on "OK."
11. Click on "Done."

Barring any startup or configuration bugs, you should now be ready to go Internet surfing. To start your connection, you can either click the "Open" button in the Config PPP dialog box or you can just open up your Web browser like Mosaic, Netscape, Eudora, or Gopher. (The browser will hook into the PPP extension automatically.) When you are finished using software that needs a PPP connection, you can close the connection by clicking on the "Hard Close" button in the Config PPP dialog box. Don't forget to do this; exiting your browser does not close the modem connection between your system and the host.

Some Netscape Features and Tips

Since Netscape is the latest and greatest Web browser, I'll offer some strategies here for making full use of this powerful tool. If you're still using

Mosaic, MacWeb, or some other Web browser, I strongly suggest you upgrade to Netscape for the Power Mac. Netscape is so much more efficient than these other browsers that you'll literally save hours in Internet access and download time by using it.

Like most Macintosh applications, Netscape doesn't require that you learn much about it in order to use its basic features. I'll assume that you'll find it easy to learn basic navigation techniques (going Home, Forward, and Back) on your own. But there are a handful of other lesser known features that are essential knowledge if you want to surf the Web efficiently. I'll describe these features next.

Netscape's "Load As You Go" Feature

One annoying fact about most Web browsers is that they won't display a home page or image until they've finished loading it in its entirety. Not so with Netscape. When Netscape has loaded a portion of a page, it will display some of it immediately, and then will continue to load the remaining section of the page. With graphics, Netscape will first load the graphic at a low resolution so you can see it in rough form immediately, and then will continue to rescan the graphic until the image has been loaded at its highest resolution. You don't waste time sitting idle with Netscape.

If you begin to load a page and then change your mind, click on the flashing N near the upper-right corner of the window. Netscape will sometimes cancel its load operate and return you to the previous page. The current version of Netscape (still technically a beta) isn't reliable about this, though. During loading, you might get locked out, in which case will Netscape will continue the load until it has finished.

Using Bookmarks

Earlier in this chapter, I explained that you type a URL address by clicking on **File|Open Location**, then typing in the URL. But because URLs are typically lengthy and clumsy, you'll want to avoid entering URLs repeatedly. After you've entered a URL and Netscape has taken you to the appropriate site, simply click on **Bookmarks|Add Bookmark**. The bookmark will be added to your list of bookmarks. The next time you want to go to this site, launch Netscape, then select the bookmark from the list. Netscape "remembers" the URL and takes you directly to that location.

You Can Save Multiple Bookmark Files

I hear oohs and ahhs almost every time I show this feature to a Netscape user: You can save multiple lists of bookmarks and access any bookmark list easily. You'll want to do this when your current bookmark list grows to be so lengthy that it becomes annoying to scroll through the entire list (an easy-to-do event if you spend a lot of time on the 'Net).

To save a bookmark list, just follow these steps:

1. Select **Bookmarks|View Bookmarks** to display the dialog box shown in Figure 8.8.
2. Click on the "Export..." button to display the Save dialog box.
3. Give the current bookmark list an appropriate name, then click on the "Save" button. (You might also want to change the destination folder where the bookmark file will be stored.)

That's all there is to it. Now you can use the View Bookmarks dialog box to delete all or some of the bookmarks, and then start from scratch. You can access your stored bookmark list either by double-clicking on the filename in the appropriate folder, or using **File|Open File** in the Netscape menu to open

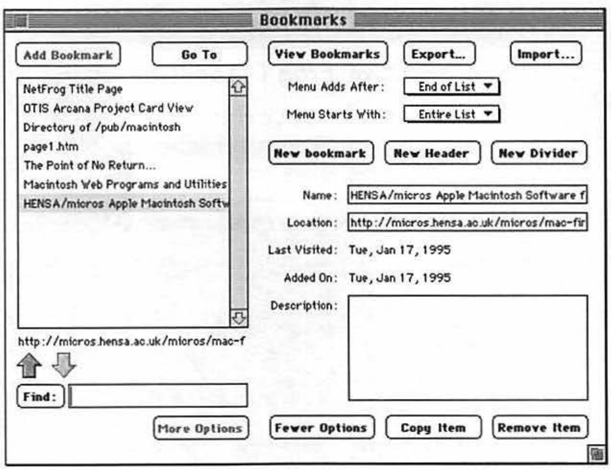


Figure 8.8 The Bookmarks dialog box

the file. After you've opened the file, you'll notice that all of your bookmarks are stored as hypertext links. To go to any location, just click on the hypertext link. It's fast and it's fun.

Saving and storing multiple bookmark lists is also a great way to organize and categorize your bookmarks. You can create bookmarks for several related sites, then export them to a bookmark file, delete all existing bookmarks, and start over by creating a new category of bookmarks. Netscape is reportedly enhancing the bookmark list feature, so look for these features to change.

Working with HTML-Encoded Files

I've already mentioned that you don't need to learn HTML unless you plan on creating your own home page. However, you might still want to learn a little HTML on the side, and there are some other important uses for an HTML source file.

In any event, you can view the HTML-encoded source file for a Web page at any time by choosing **View|Source** (MacWeb also supports this feature). Figure 8.9 shows a Web page as you would typically view it. Figure 8.10 shows the HTML source file for this same web page.

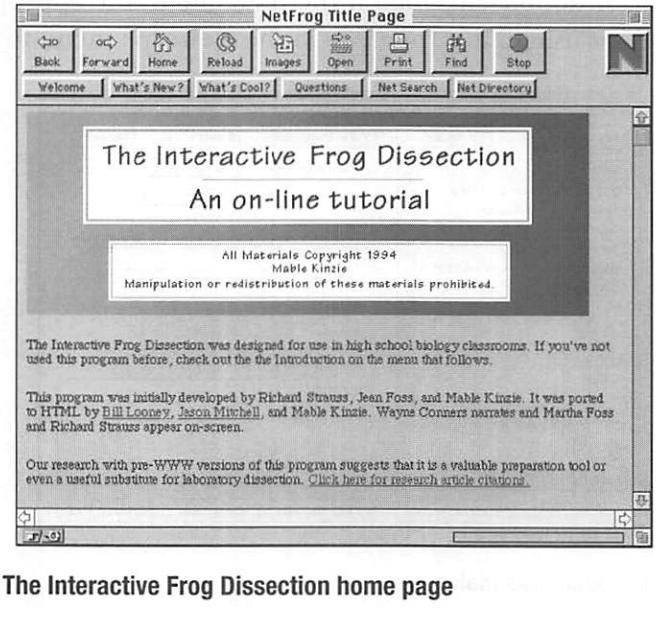
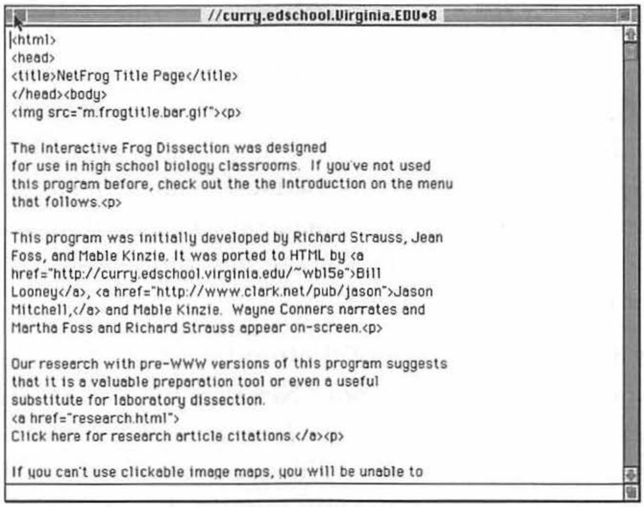


Figure 8.9 The Interactive Frog Dissection home page



//curry.edschool.Virginia.EDU•8

```
<html>
<head>
<title>NetFrog Title Page</title>
</head><body>
<img src="m.frogtitle.bar.gif"><p>

The Interactive Frog Dissection was designed
for use in high school biology classrooms.  If you've not used
this program before, check out the the Introduction on the menu
that follows.<p>

This program was initially developed by Richard Strauss, Jean
Foss, and Mable Kinzie. It was ported to HTML by <a
href="http://curry.edschool.virginia.edu/~wb15e">Bill
Looney</a>, <a href="http://www.clark.net/pub/jason">Jason
Mitchell,</a> and Mable Kinzie.  Wayne Conners narrates and
Martha Foss and Richard Strauss appear on-screen.<p>

Our research with pre-WWW versions of this program suggests
that it is a valuable preparation tool or even a useful
substitute for laboratory dissection.
<a href="research.html">
Click here for research article citations.</a><p>

If you can't use clickable image maps, you will be unable to
```

Figure 8.10 The Interactive Frog Dissection page source file

It's an interesting learning experience to see the HTML tags that make up a Web page, but viewing a source file has a more important benefit: You can download Web pages if they're in source format. Normally, you can't save a Web page to disk—you can only save files that are stored in folders at a Web site. (Strictly speaking, you *can* save a Web page, but since there's technically no text in a Web page—it's one big graphic image—Netscape will save it as a text file ØK in length; in other words, an empty file.) But you *can* save a Web page source file. Here's how:

1. Display the Web page that you want to save.
2. Select **View|Source** to capture the page as a text file with HTML tags.
3. Select **File|Save As**, assign a name to the file, and then click on "Save."
4. Close the text viewer to return to the home page.

You can now open the saved page and view it *without* its tags by selecting **File|Open File**, and then opening the source file that you saved. Netscape will use the HTML tags to convert the file to its original Web page appearance. This approach is great for saving pages off-line that have lots of useful information, such as online newsletters or lists of hypertext links. After you've saved the file, you can use Netscape to view the file off-line at your leisure.

Using "What's Cool"

It has long been obvious to me that the creators of the Macintosh, the Macintosh OS, and the PowerPC technology all were engaged in a labor of love. It shows in the quality of their products. That's what I also like about the folks at Netscape. They seem obsessed with quality. In fact, the Netscape group is extremely selective about which companies and sites they allow to distribute the Netscape software. They're also quite selective about what they consider to be "cool" Web sites.

That's why I like the "What's Cool" button built into the Netscape interface. When you click on "What's Cool," Netscape takes you to its own home page of hypertext links to some of the best sites on the Web. Figure 8.11 shows the What's Cool home page. This page is updated weekly, and displays links for the current and previous months. If you want to keep up to date and what's being added to the World Wide Web, check out the What's Cool home page periodically.

Using "Net Directory"

The "Net Directory" button is another great value-added feature of Netscape. When you click on this button, Netscape takes you to a home page that is

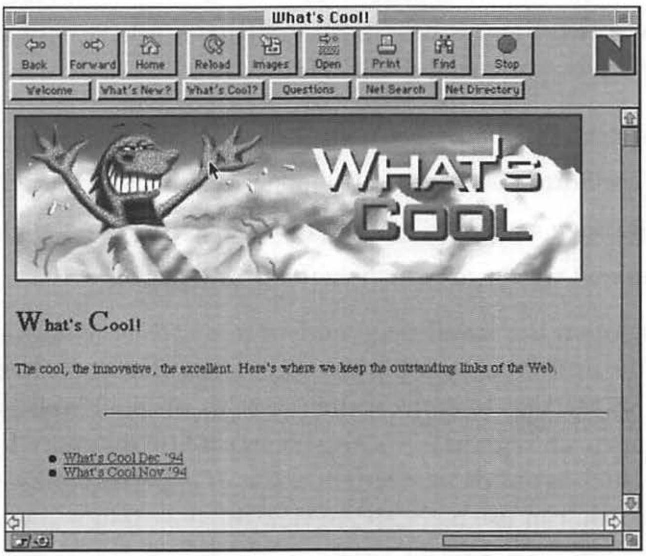


Figure 8.11 The What's Cool home page

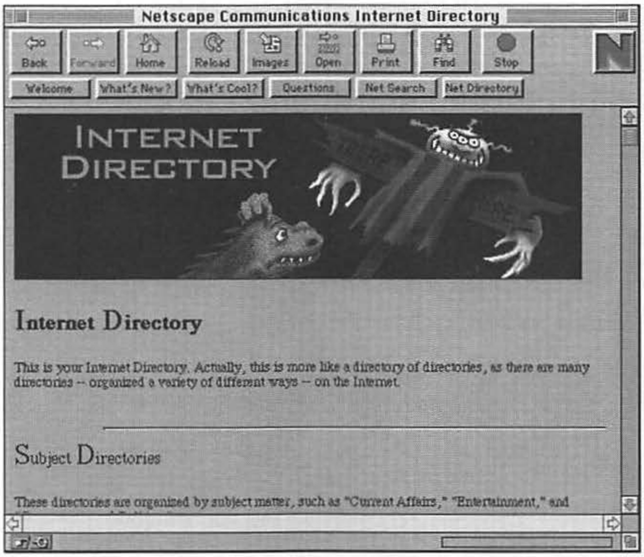


Figure 8.12 The Internet Directory home page

rich in directories of different categories of Web sites. Figure 8.12 shows the Internet Directory home page. If you're new to the Web, this is a great place to begin your search for Web sites that are of interest to you.

Using "Net Search"

If there's a particular file or topic that you want to find on the Web, but don't know where to look, your best bet is to click on the "Net Search" button. The Internet Search home page that appears, as shown in Figure 8.13, is a collection of hypertext links to the best search utilities available on the Web. These various utilities all produce different search results, so if you try using one search utility and come up empty, try a different utility.

Other Useful Internet Utilities

As useful as Netscape and other Web browsers can be, they still have limitations. So, you'll want to download other utilities to round out your set of Internet access tools. In this section, I'll review a few of what I consider to be essential software utilities for Power Macintosh Internet/Web users.

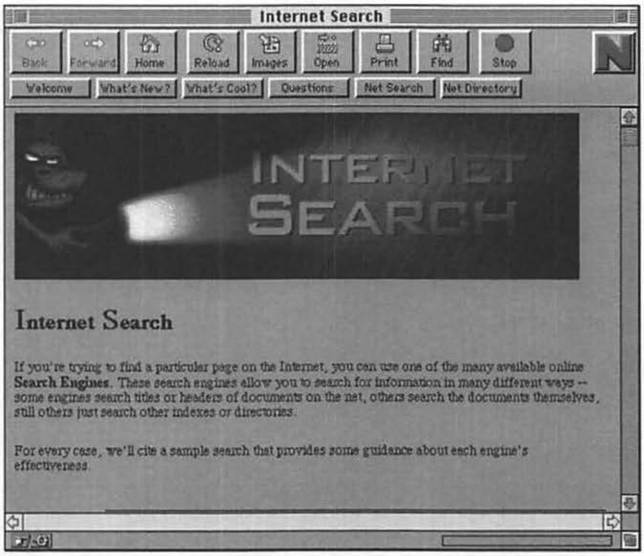


Figure 8.13 The Internet Search home page

E-mail It to Eudora

Currently, none of the major Web browsers support E-mail capabilities—other than the ability to leave a message for the creator of a particular home page or to send a message to a newsgroup or newsgroup subscriber. If you want to send and receive E-mail across the Internet, your best bet is get the current version of Eudora (1.5 at this writing).

Using Eudora is a no-brainer, so I won't elaborate on its features here. But you will need to know how to configure Eudora to work with your account and your service provider. To configure Eudora, select **Special|Configuration** to display the configuration dialog box shown in Figure 8.14.

Only the POP, Real Name, Connection Method, SMTP Server, and Return Address entries are required; the other entries are optional. You'll probably need to have your Internet provider help you in creating these entries, although you might be successful by using Figure 8.14 as a guide and replacing my user names and Internet provider names with your own. You can download the current version of Eudora from **ftp.qualcomm.com/mac/**. You can also find complete documentation for Eudora at **http://www.soc.staffs.ac.uk/eudora/contents.html**.

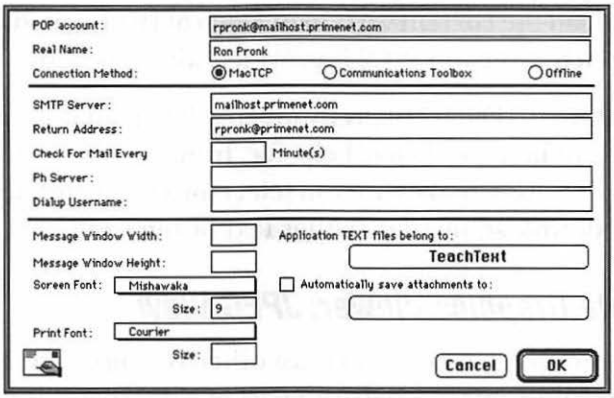


Figure 8.14 The Eudora configuration dialog box

FTP with Fetch

If you want to download files from an FTP site via "anonymous FTP," Netscape and most other Web browsers will handle the task automatically, logging you into the FTP site as "anonymous" and downloading any files you request. However, there might be times where you need to access a privileged FTP site, in which case you'll need to enter an appropriate login name and password.

Web browsers currently don't support non-anonymous FTP capabilities. To FTP files that require a logon ID and password, you can use the excellent shareware Macintosh FTP utility called Fetch (currently version 2.1.2). With Fetch, you only need to enter the FTP address of the host system, your user ID name (which would have been supplied to you by the host site), and the password, as shown in Figure 8.15. The directory is optional.

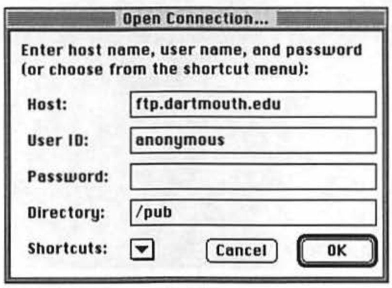


Figure 8.15 Fetch's Open Connection dialog box

You can download the current version of Fetch at **ftp://gated.cornell.edu/pub/video/Fetch/**. Version 2.1.2 is provided with this book.

The other features of Fetch are pretty much self explanatory, although you might want to obtain the Fetch help file from the same FTP location I mentioned above. Also, make sure you select the correct mode when you're uploading or downloading files (either text or binary).

The Ultimate Graphics Viewer: JPEG View

When you're online, Netscape and most other Web browsers will automatically display graphics images that are a part of a Web page. But if you download graphics files, you won't be able to use your Web browser to view these downloads. For that, you need to acquire a separate graphics viewer.

For the Power Mac systems, the best graphics viewer by far is JPEG View (currently version 3.3.1). Figure 8.16 shows a graphic displayed by JPEG View.

I've talked to many users who've never bothered to download or use JPEG View because they believe it can only display images that are in JPEG format. Wrong!

In fact, JPEG has one of the most robust set of filters of any graphics viewer I've encountered for the Mac. And since JPEG View 3.3.1 is available as a native Power Mac application, it's an ideal utility for Power Mac users. JPEG View can open, display, and size GIFs, TIFFs, JPEGs, PICTs, BMP images, and Macintosh startup screens. JPEG View 3.3.1 is supplied free with the CD-ROM that comes with this book.

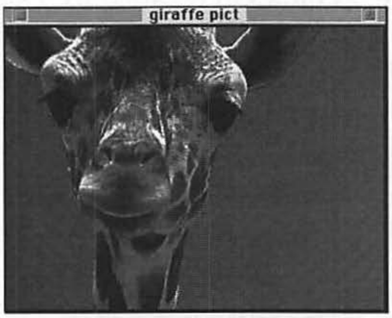


Figure 8.15 JPEG View displays GIFs, JPEGs, TIFFs, and BMP images

JPEG View 3.3.1 also allows you to crop and zoom images, and resize images, so it's clearly much more than a simple viewer. JPEG View was created by Aaron Giles, who calls the product "postcardware." He asks you to send him a postcard if you use and like the software. You can find Aaron's address in the JPEG View Help window.

Working with UUEncoded Files

One of the most perplexing Internet problems for new users lies in understanding and decoding files that are UUEncoded. When files pass across the various UNIX gateways on the way from their Internet host to your humble Power Mac, the file integrity has to be maintained, which means that the file has to be in some format that UNIX can work with. Although UNIX machines can transfer the binary data stored in ZIP, Disk Doubler, or StuffIt compressed format, these aren't common compression formats for UNIX. And since UNIX is still the boss where the Internet is concerned, many sites require that files be uploaded in a simple UNIX text format.

The file conversion of choice for this purpose is UUEncode/UUDecode, which is typically used to convert graphics files into a universally recognized text format, often for posting to a newsgroup. When you view a UUEncoded file, all you'll see is a jumble of text similar to this:

```
BEGIN – CUT HERE – Cut Here – cut here –
begin 644 kevin.gif
M1TE&.#—A@'+@'?<""""'$"'@'+'PO+'P()"@H"!'@+'PP+'PH("@D4"@81
M%A("`Q`+`QO+`Q$(#!@#`!P#`!D#"A@+`QP(`!P,!!D)"A@2!A8.%@4A%@H=
M)2$"'B'('"'(!"',+'RO,'R,+"BD"!"@+'RP+'RD•"BD(%C'•'S,)"#D)!C(•
M%R,3"2H1'B@3"RP3"RH:!B,5$BD4$#(3'3$2"#$;"#(;##@3'#P3'#L8'3H2
M"3O4%C,3("@@!34A"2DB%3(D$SDE%#DS%S@M(C-•2DO•!T,4"%47!T87$U,:
M%VO5#48E!T<A%48I%T<S%EOG"5OE$E4E&EOU%V4H%V8U%WOW&D\:(T8F(E4
M)D<U)E$U)%HT)%<V,V'<(&8G)&$V)FDW)V8U,G,J)W$V)7HU)G4W-78WOE1#
M&55%)E5'-&M$&F9&)F9&-6—3-W5)•'9%-755-G-B.%-22F931G541DA@6G1D
.
.
.
```

No need to panic. You can (relatively) easily convert any UUEncoded graphic file or set of files into their GIF, JPEG, or other original format. But first you need to acquire a utility that decodes UUEncoded files. The CD-

ROM disk that comes with this book includes UUTool 232.1, which is one of the most widely used utilities for encoding and decoding UU files on Macintosh systems.

Before you try decoding UU files, you first need to know that many users encode a large graphic file by splitting it into several smaller files. UUEncoded files can be quite large, but file splitting is commonplace because a lot of Internet sites will fail on large data transfers; uploading and downloading files in segments makes it possible to transfer an entire image in a more fail-safe manner. If one file transfer fails, the user who is uploading or downloading the file only needs to re-transfer that one component—it isn't necessary to re-transfer the entire image.

If you want to decode and piece together all parts of a UUEncode graphics file, you must first download all of the file parts (for instance a file named File1.gif might be split into three files, which would typically be stored with names like file1.gif 1/3, file1.gof 2/3, and file1.gif 3/3).

After you've downloaded all parts of an encoded file, you next need to join them into a single text file. With UUTool, you do this by selecting **File|Segment|Join**, and then selecting all the files to be joined. UUTool will attempt to strip out all superfluous header and ending information in each file and retain only the necessary data required to join the file back to its original content.

I need to emphasize the word *attempt* here. UUTool and other UUDecode utilities aren't very reliable; in fact, you'll find that join operations fail more often than they succeed. When you're met with failure, your only recourse is to use a text editor to manually remove heading and ending matter from all of the file segments. Don't rely on the built-in Simple Text program for this, since it can't read files larger than 60K. A better bet is to use Word—just remember to save the joined files as a text (not Word-formatted) file.

Here's how to join UUEncoded files manually. For this demonstration, I'll assume that we're joining three files named file1.gif 1/3, file1.fig 2/3, and file1.gif 3/3:

1. Open the first file, file1.gif 1/3.
2. Delete all information up to (but not including) the "begin" line—which will read something like "begin 644 File1.gif." After you've deleted

the header information, the begin line should be the first line in the file.

3. Scroll to the end of the file.
4. If you find a line that reads

   END -------- CUT HERE ---------------

   or something similar, delete all text from the start of this line to the end of the file.
5. Open the second file, file1.gif 2/3.
6. Delete all text up to *and including* the line that reads similar to this one:

   BEGIN ------ CUT HERE ---------------

   There might not be any header information in this file, so you might not have to cut any text from the top of the file.
7. Scroll to the end of the file.
8. If you find a line that reads

   END -------- CUT HERE ---------------

   or something similar, delete all text from the start of this line to the end of the file.
9. Select all of the text in file1.gif 2/3, copy it to the Clipboard, then paste it to the end of file1.gif 1/3.
10. Close file1.gif 2/3 with or without saving changes.
11. Open file1.gif 3/3.
12. Delete all text up to *and including* the line that reads similar to this one:

    BEGIN ------ CUT HERE ---------------

    There might not be any header information in this file, so you might not have to cut any text from the top of the file.
13. Scroll to the end of the file.
14. Find the line that contains the single word *end* in lowercase. Delete all text after (but not including) this line.
15. Select all text in file1.gif 3/3, copy it to the Clipboard, then paste it to the end of file1.gif 2/3.
16. Close file1.gif 3/3 with or without saving changes.
17. Save file1.gif 1.3, then close it.

18. Start UUTool or your own UU decode utility.
19. In UUTool, choose **Uucode|decode** to display the Files dialog box. Select file1.gif 1.3, then click on "Okay." UUTool will ask you to confirm that the filename embedded in the "begin" line of the text file is the filename to use in saving the decoded file. You'll usually want to retain this filename. After UUTool has finished decoding the file, it is ready to be viewed by JPEG View or your graphics viewer of choice.

Great Internet and Web Sites for Power Mac Users

Sometimes it seems like the DOS/Windows world controls the Internet; at other times, it seems like the UNIX crowd is in charge. But the truth is that Macintosh users and user groups are very well represented on the 'Net. There are numerous sites devoted specifically to Macintosh and Power Macintosh software or to Macintosh issues. The following sections provide a sampling of some of the best sites to check out for software, files, images, and other information regarding the Macintosh and Power Mac systems.

http://www.apple.com/

If you want technical material on the Power Mac or the Macintosh, this is one of the best sources; it's Apple's Web site, so you're basically going straight to the horse's mouth when you look here. You won't find any new shareware sites mentioned, but if you want technical support, copies of Apple's white papers, or other technical documentation, this is the place to look. Figure 8.17 shows the Apple home page.

Site: http://www.astro.nwu.edu/lentz/mac/net/mac-web.html

This is Robert Lentz's home page, and it's a good source for up-to-date versions of Web browsers, graphics viewers, file converters, and other utilities for the Mac. You won't find an extensive collection of shareware here, but it's a good place to find the latest and greatest in Macintosh and Power Mac utilities. Figure 8.18 shows Lentz's home page.

Site: ftp://sumex-aim.stanford.edu/info-mac

This repository at Stanford University arguably contains the largest collection of Macintosh shareware and information of any site on the Internet

Figure 8.17 Apple's home page

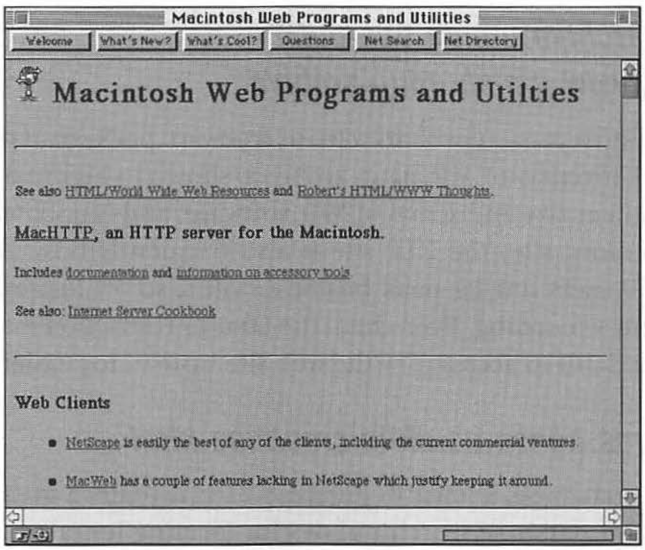


Figure 8.18 Rober Lentz's home page (fix the misspelling please, Robert)

and Web. If you don't find what you're looking for here, it probably doesn't exist (unless it's at the University of Michigan archives, which is the next section). This is a crowded site, so try to access it in the evening, late night, or early morning for best results. Figure 8.19 shows a partial list of the Macintosh software archives at Stanford.

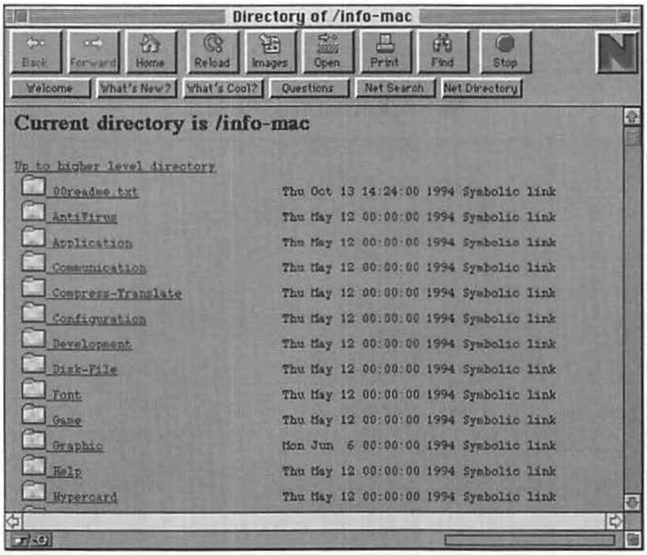


Figure 8.19 A partial list of Macintosh software available at the Stanford archives

ftp://mac.archive.umich.edu/mac/ (or) http://www.umich.edu/~archive

If you can't find a particular shareware or freeware package at the Stanford site, try the University of Michigan archives, shown in Figure 8.20. It rivals Stanford in sheer size and scope of Mac software, and is updated regularly. Like the Stanford site, the FTP site is also frequently busy. Access is restricted to 60 users during peak business hours, so try logging on in the evening or early morning. Even then, the 60-user restriction makes this site extremely difficult to access. Try the web site instead for easier access.

http://micros.hensa.ac.uk/micros/mac.html

The HENSA database, shown in Figure 8.21 is actually a great set of Gopher and other database search utilities for locating literally thousands of Macintosh freeware and shareware programs. The HENSA database divides its contents into "Finder Software" (whatever that means—it has absolutely nothing to do with the Mac OS Finder) and HyperCard stacks. When you click on either of these hypertext links, you'll be given additional options for downloading software.

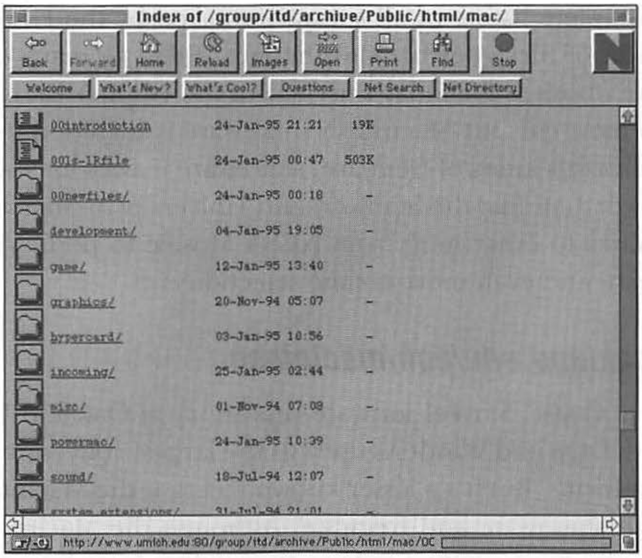


Figure 8.20 A partial list of Macintosh software at the University of Michigan archives

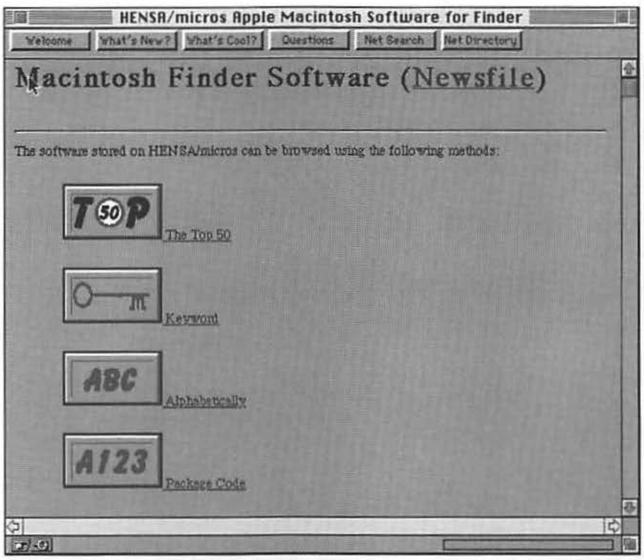


Figure 8.21 One of many possible starting points for finding software tracked by HENSA

But your best bet is to click on Finder Software and then click on the "Package Code" icon to get a Gopher list of all software folders tracked by the HENSA site. Then read the Full index list file (the first file on the Gopher list) for a complete listing of all software tracked by the HENSA system. The collection of files goes back to the late 1980s, so many of the listed programs are obsolete for today's users. But the Gopher list is kept up-to-date, so the most current Macintosh shareware is included in the index. Frankly, I think this index of freeware/shareware is awesome—and the site is rarely crowded, unlike the Stanford and University of Michigan servers. You'll find links to everything from NCSA Mosaic to JPEG View 3.3.1 to recipe software and even more arcane selections.

ftp://oak.oakland.edu/pub/macintosh

The "Coast to Coast" SimTel software repository at Oakland University is well known to DOS and Windows users as the largest collection of software for those platforms. But it's a lesser known fact that the Macintosh archive is also rich in shareware and freeware. Although the Macintosh archive, shown in part in Figure 8.22, has long since fallen into disuse, it still contains hundreds of fun programs and utilities. (You won't find any native Power Mac programs, though.)

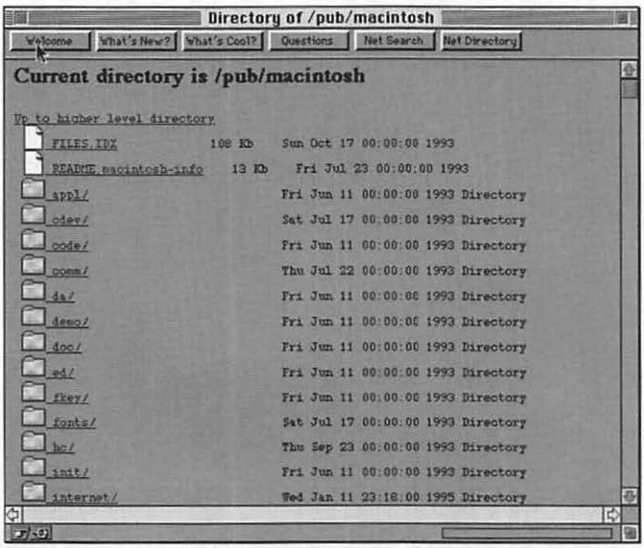


Figure 8.22 A partial listing of Macintosh software archived at the SimTel repository

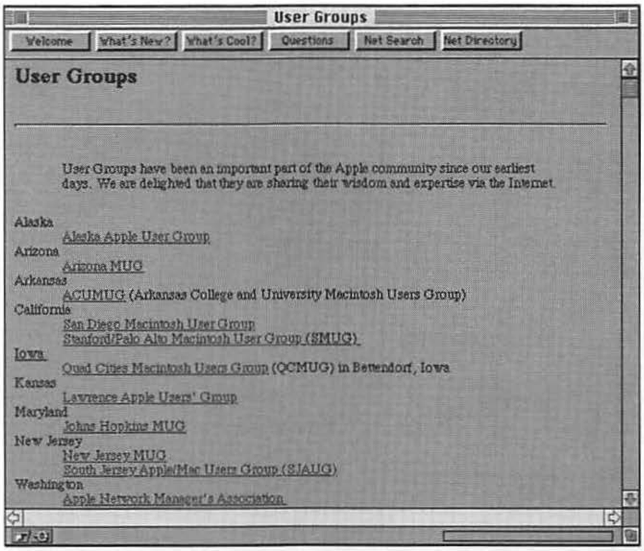


Figure 8.23 Apple's hotlinks to Macintosh user groups

http://www.apple.com/documents/usergroups.html

This is an offshoot of Apple's web server, and provides one of the best sources for Macintosh newsgroups worldwide. The hotlinks allow you to leap to most newsgroups with the click of your mouse. Figure 8.23 shows a partial listing of the user group hotlinks available at this site.

http://www.ziff.com/~macweek/

This is the Web site for Ziff/Davis' *MacWEEK* weekly publication of the goings-on in the Apple community. You'll find the complete contents of the current *MacWEEK* issue here, as well as selected articles from past issues. Figure 8.24 shows the *MacWEEK* home page. This page also includes a link to Ziff/Davis' commercial web site.

http://www.macuser.ziff.com/~macuser/

This is the Web site for Ziff/Davis' *MacUser* weekly publication. You'll find the complete contents of the current *MacUser* issue here, as well as selected articles from past issues. Ziff/Davis also stores the most recent version of

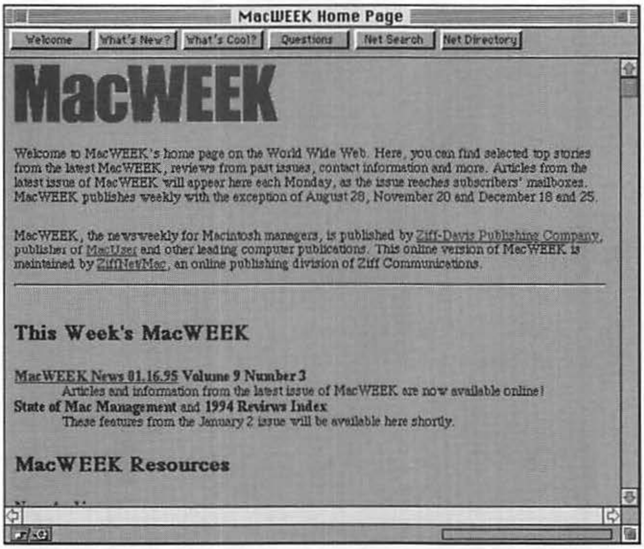


Figure 8.24 The *MacWEEK* home page

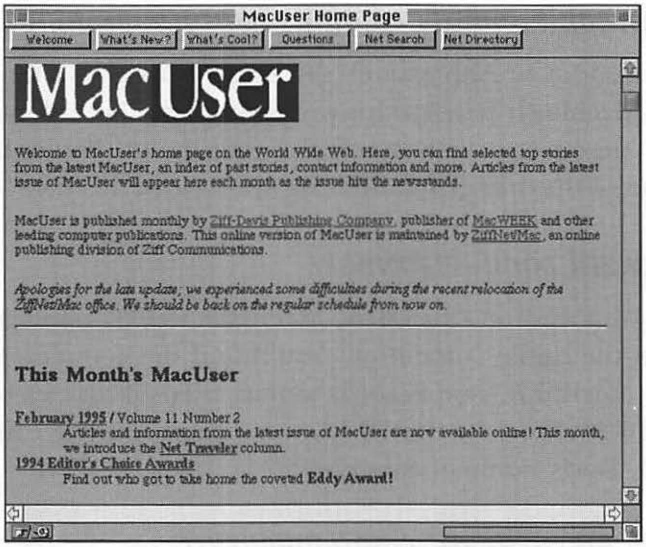


Figure 8.25 The *MacUser* home page

MacBench here (currently version 2.0), so you can download MacBench for free if you want to test the speed of your Power Mac and Power Mac applications. Figure 8.25 shows the *MacUser* home page. This page also includes a link to Ziff/Davis' commercial web site.

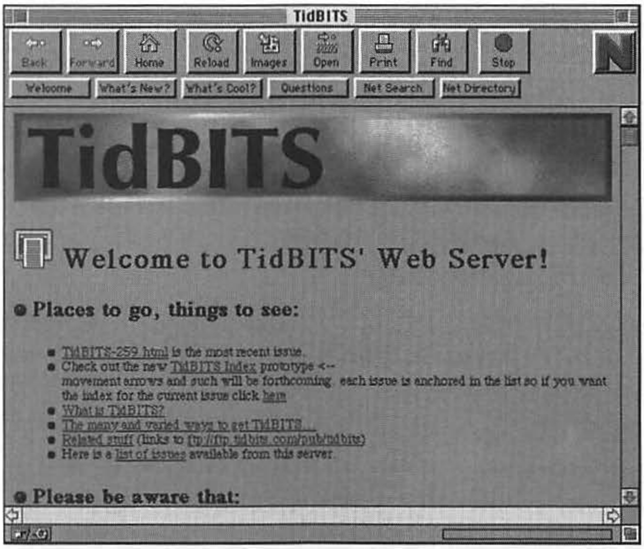


Figure 8.26 The *TidBITS* home page

http://www.dartmouth.edu/pages/TidBITS/TidBITS.html

This is the Web page for the well written online newsletter *TidBITS*, which focuses on insider information regarding Macintosh hardware, applications, and industry happenings. *TidBITS* recently has been providing extensive coverage of the Power Mac systems and native Power Mac applications. If you want to stay up to date on Power Mac hardware and software, this is the place to look. Figure 8.26 shows the *TidBITS* home page.

http://power.globalnews.com/

This site in the United Kingdom offers a biweekly newsletter that reports on all things PowerPC. *PowerPC News* covers the Power Mac systems, but its editorial mission is much broader; it reports on breaking information that affects the entire PowerPC technology, including PowerPC happenings from IBM, Motorola, and even Wintel-related information that could impact the acceptance of the PowerPC chips and systems. I thought I had the inside track on most of this information, but these guys often manage to ferret out insider information that even the major trade publications seem to miss. This newsletter is free, but if its editors wanted to charge $100 per year for a subscription, I would pay it. (But please don't, guys.) Figure 8.27 shows the *PowerPC News* home page.

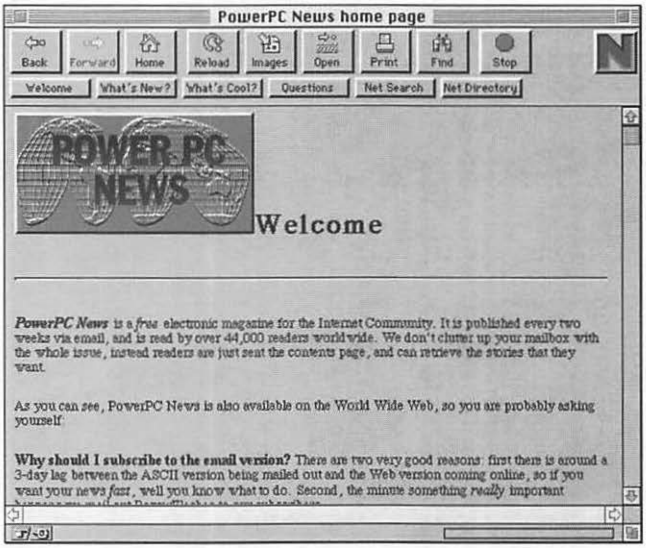


Figure 8.27 The *PowerPC News* home page

Other Macintosh Sites

Many third-party software and hardware Macintosh and Power Mac vendors maintain Internet or Web sites. For instance, you can access the Claris Web page at **http://www.claris.com/** or the Kaleida site at **http://web.kaleida.com/**. Your best bet is to use one of Netscape's online search engines to search for a company or product name of interest.

Hundreds of other Internet and Web sites provide files and information that are of interest to Macintosh users, even though they aren't specifically Mac oriented. A good example is the Washington University at St. Louis archive, which contains the largest collection of GIF and JPEG images available on the Internet. You can access this site at **ftp://wuarchive.wustl.edu/pub/pics/**.

Many other sites focus on some particular hardware or software niche for the Macintosh community. One of the best resources for Macintosh-related sites is available by subscribing to the online magazine *Netsurfer Digest* and then downloading their January 7, 1995 issue, which is devoted to Macintosh sites on the Internet. You can access *Netsurfer Digest* at **http://www.netsurf.com/nsd/**.

CHAPTER

9

Windows on the Power Mac

Software and Hardware Solutions

In earlier chapters, I touched on some basic facts about SoftWindows 1.0; chiefly, I mentioned that SoftWindows is a remarkably reliable product, but since it doesn't always live up to its 486 speed and because it can't run enhanced mode (32-bit) Windows applications, many users have expressed disappointment in the product.

The good news is that other alternatives are available for running Windows on a Power Mac. At the hardware level, the solution is Apple's DOS Compatibility Card, which includes a 66-MHz 486DX2 CPU on the card. I'll describe this card in more depth later in the chapter. Unfortunately, the DOS Compatibility Card is currently only available for the 6100 systems (including the Performa 6100s), and Apple is not making promises about delivering cards for the 7100 and 8100 systems.

At the software level, the major alternative is SoftWindows 2.0. This upgrade is fully compatible with the Intel 80486 instruction set, which means you can run all enhanced-mode Windows applications with SoftWindows 2.0. As I write this, SoftWindows 2.0 is not yet available nor have I been able to test it. However, SoftWindows' creator, Insignia Solutions, has allowed me to publish information about the feature set in SoftWindows 2.0, which is currently scheduled for release during the second quarter of 1995. First, though, I need to provide a more in-depth discussion of SoftWindows 1.0.

Inside SoftWindows 1.0

It's important to stress at the outset that the phrase "Windows emulation" is an incorrect way to describe SoftWindows' operations. True, SoftWindows is an emulator, but it doesn't emulate Windows. Insignia has licensed Windows code from Microsoft and for the most part runs it "as is" under SoftWindows—with some code optimization added to boost performance while running in tandem with the Mac OS environment. But there's no conversion or emulation involved.

SoftWindows actually performs two major types of non-Windows emulation. The first, and most significant, is the emulation of the 286 Intel CPU instruction set. In this sense, SoftWindows should more accurately be called "SoftDOS" because Windows 3.1 is basically just a graphical interface that runs on top of DOS. In a few situations, Windows 3.1 does bypass DOS to request I/O services directly. That situation will change with Windows 95, which is a full-blown operating system that doesn't require DOS.

So SoftWindows' major job is to trap routines that DOS or (in a few instances) Windows sends to the CPU and then convert these 286 chip instructions to PowerPC chip instructions. SoftWindows isn't converting (emulating) Windows code to native System 7 code; it's just converting 286 CPU and BIOS instructions into native PowerPC instructions. It's a CPU emulation that really has very little to do with the operating systems involved. By the way, SoftWindows can also emulate the 80287 math co-processor instruction set.

HOT TIP

Why It Won't Work: Ejecting Disks with SoftWindows

It seems as though nobody likes to read manuals, because most of the questions I hear about SoftWindows are clearly answered there. But I also recognize that many SoftWindows users don't even have the SoftWindows user manual. So I guess it shouldn't surprise me that the most often asked question about SoftWindows is: "How do you eject diskettes when you're in Windows?" When I provide the answer, users' next question is typically: "Why can't SoftWindows automatically eject diskettes like System 7 does?"

Macintosh users are easily spoiled by some of the features of the Mac OS, and in turn quickly get stumped when their Mac starts to behave like a PC. But that's one of the hurdles you'll need to jump when you put a PC environment like Windows on a Mac.

The quick answer to the question about ejecting diskettes: Just click on **Setup|Eject|Superdrive** and SoftWindows will cough up your diskette. You can also use the standard **Command+Shift+1** Macintosh keyboard command.

A more technical answer is required to explain why SoftWindows doesn't automatically eject diskettes—for instance, when you're installing a Windows program and the install program asks you to insert the next diskette in sequence. You can't insert the next diskette if your system won't eject the diskette that's currently in the drive.

With Macintosh applications, installation programs automatically hook into a Mac OS routine that ejects a diskette when the next diskette is required. And, of course, when you drag a diskette icon to the Trash, the Mac OS responds by ejecting it.

Life is not so simple in the SoftWindows world. Windows does not have a built-in routine for ejecting diskettes, because PC diskette drives don't have this feature. It's impossible for SoftWindows to identify when a Windows install program needs a new diskette. Remember, SoftWindows is *running* Windows, not *emulating* it. There's no single Windows command that SoftWindows can look for in order to determine when to eject a diskette, because this is not a PC or Windows type of feature. So, if you're running SoftWindows and you need to eject a diskette, you need to choose **Setup|Eject|Superdrive**. You'll find that SoftWindows 2.0 also requires that you do this. It's annoying, yes, but it's a fact of life when you're running an alien platform on a Mac.

Installing SoftWindows and Creating a Hard Disk

For the most part, installing SoftWindows is much the same as installing any Macintosh program. It's so easy you really don't need to give much thought to the process. Basically you just let the install program do its thing while you swap out diskettes when you're requested to do so. Figure 9.1 shows the SoftWindows DOS screen that appears after you install SoftWindows and then click on the SoftWindows icon.

But there's a significant exception involved in letting SoftWindows make all installation decisions for you. SoftWindows asks you to define the size of the file that SoftWindows will use as its hard disk. You have a lot of options here, and some of these options are not explained in the SoftWindows user's manual and aren't mentioned in any of the install screens.

The major consideration in determining a hard disk size lies in the number and kinds of Windows applications you expect to run. SoftWindows insists on a minimum C: hard disk size of 20 MB, but recommends at least 30 MB if you're going to run other Windows applications (which, of course, is probably the reason you want to use SoftWindows in the first place).

It's been my experience, though, that most SoftWindows users need to run only one or two Windows applications, or just require SoftWindows to support network connectivity. For these users, it's not necessary to reserve a lot of hard disk space for Windows applications. However, it is important to estimate the maximum size carefully, mainly because it's a bit tedious to

Figure 9.1 The SoftWindows startup screen

add or reduce the C: hard disk size later, and if you overestimate the size of the Windows hard disk, you'll lose that portion of your hard disk for use by your Macintosh applications.

I can't provide any simple rule of thumb for determining the desired Windows hard disk size because this variable is too subjective; it depends completely on the number and sizes of Windows applications you plan to install. The important consideration lies in figuring how to minimize the hard disk overhead penalty that SoftWindows enforces on your hard disk.

Compressing Your Windows Hard Disk with DoubleSpace

Many users don't realize this, but a SoftWindows hard disk file appears to DOS as an actual hard disk partition. The Mac OS views it as a single file, but DOS sees it as a physical disk. For this reason, you can successfully use DOS hard disk compression software to double the size of your SoftWindows hard disk file.

In other words, you can use Stacker or the DOS 6 DoubleSpace utility to compress your hard disk content and uncompress it at run time, just as you would do if you installed Stacker or DoubleSpace on a Wintel-platform PC system (or Stacker for the Mac). DoubleSpace is not provided with the version of DOS 6 (6.21) installed with SoftWindows. The Stac Corporation successfully sued Microsoft, claiming that Microsoft illegally pilfered the Stacker disk compression code in creating their own DoubleSpace utility.

The result is that DoubleSpace is only available if you can find a PC user who previously installed DOS 6.0 or 6.2. These users should still have the DBLSPACE files on their hard disk, even if they've upgraded to DOS 6.6 or even Windows 95. If you find such a PC, simply copy these four files, located in the DOS subdirectory:

```
DBLSPACE.000
DBLSPACE.BIN
DBLSPACE.EXE
DBLSPACE.INI
```

Then, copy these files to the DOS directory of your SoftWindows C: drive. (You have to start SoftWindows to do this.)

Before I promote the use of DoubleSpace, Stacker, or any other DOS hard-disk compression utility, I should note that Insignia recommends that you not do this. But the reason really has little to do with instability between SoftWindows and DOS compression. The problem can occur when you use a Macintosh backup/restore utility to backup your entire hard drive. The backup will typically perform okay, but the SoftWindows Hard Disk File C might not restore correctly if it is compressed with a DOS disk compression utility. If you backup your C: drive from within DOS or Windows, you should not have this problem.

Having issued that caveat, I'll walk you briefly through the steps to follow in installing DoubleSpace.

1. At the DOS prompt, type **dblspace** and press **Return**.
2. Follow the instructions that appear on screen. DoubleSpace will call two other DOS utilities, ScanDisk and Defrag, but both of these utilities are provided with SoftWindows. ScanDisk tests your hard disk for any physical or logical errors; Defrag optimizes hard disk performance by moving fragments of a file to contiguous (adjoining) locations on the hard disk—allowing the disk drive heads to access files faster.

Figure 9.2 shows the Info box for a SoftWindows C: drive, indicating that a 30 MB hard drive was created by the SoftWindows install program. Figure 9.3 provides a DoubleSpace utility screen showing that this same 30 MB SoftWindows C: drive has been compressed and now has a capacity of 48.63

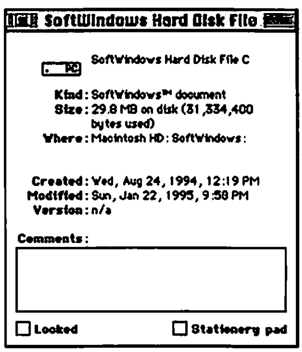


Figure 9.2 This Get Info box shows the size of the drive C: file, as reported by the Mac OS

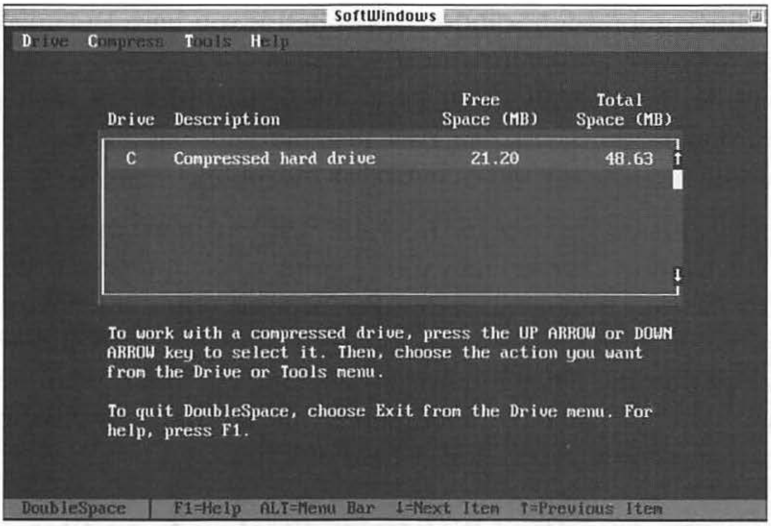


Figure 9.3 This DoubleSpace screen shows the same drive C: as shown in Figure 9.2, but here the file's data has been compressed to provide a larger hard disk size

MB. It doesn't take a math whiz to realize that this is not a 2:1 compression ratio. But DoubleSpace only estimates the storage capacity of a compressed drive. Some files, such as graphics files, typically compress to a 8:1 ratio or even higher. So, it would not be unusual for DoubleSpace to fit more that 60 MB of data and program files into this estimated 48.63 MB of estimated space.

It's important to stress that the physical size of your C: hard drive (typically the file called SoftWindows Hard Disk File C and stored in your SoftWindows folder) does not change when you use DoubleSpace or some other run-time compression utility. That's one reason why it's important to estimate the desired size of your C: drive in advance: If you tell SoftWindows to create a 60 MB hard drive when you install it, the Mac OS will see that file as 60 MB in size even after you run DoubleSpace or some other compressor. On the other hand, if you know you'll want a maximum of 60 MB of storage space for your Windows applications, *and* you know you'll be compressing your C: drive, tell SoftWindows to create a 30 MB hard drive. You'll still get about 60 MB of storage space, but the Mac OS will only "see" the hard drive file as 30 MB in size.

So, the disk compression solution works best if you have DOS disk compression software available, and if you plan for this *before* you install SoftWindows. It's possible to create a new C: hard disk file after you've installed SoftWindows, copy all your program and data files to the new disk, and then delete the old C: hard disk file, but it's a pain to do this.

It's much better to make plans for your Windows hard disk before you install SoftWindows. If you know you're going to compress your Windows hard disk file with DoubleSpace, Stacker, or some other disk compression package, consider this factor when you determine your SoftWindows hard disk size during the SoftWindows installation. The point: Plan for your Windows hard disk size in advance, and if you can compress this file, keep this fact in mind when you set your hard disk size.

Compressing your Hard Disk Using Stacker, SuperStor, DoubleSpeed, or Other Utilities

The DoubleSpace example I've provided suggests just one of several disk compression utilities that you can use to compress your SoftWindows hard disk file. I elected to describe DoubleSpace because it's the cheapest solution (it's free if you can copy the DoubleSpace files from the DOS directory of a PC) and it's one of the most effective. DoubleSpace received a lot of bad press due to user complaints that it caused their hard disks to lock. Almost all of these complaints were from users who had old hard disk drives. Since DoubleSpace taxes the mechanical capabilities of disk drive arms, it quickly wore out some of these older parts. You won't have this problem with the hard drive installed in your Power Mac.

DoubleSpace isn't the only disk compression solution, though. Stacker (including Stacker for the Macintosh), DoubleSpeed, SuperStor, and other commercial disk compression utilities should all work for this purpose.

Clever users might wonder, at this point, whether it's possible to compress the SoftWindows C: drive file with DoubleSpace or Stacker, and *then* compress the compressed drive with the StuffIt Compress utility. (This utility performs a type of run-time compression.)

Sorry, it won't work. In fact, *don't stuff or StuffIt-compress* any SoftWindows hard disk file. Users report poor file integrity when the file is unstuffed or uncompressed.

You Can Move Your SoftWindows Hard Disk to a Removable Drive

Guess what? Your SoftWindows hard disk file doesn't actually need to reside on your Power Mac hard disk. If you have a Syquest drive or other removable drive, you can install or move your SoftWindows hard disk file there (provided your removable drive cartridge can store the capacity of your SoftWindows hard disk file). If you haven't yet installed SoftWindows, you can do this by specifying your removable drive as the location of your Windows hard disk when the SoftWindows installation program prompts you for a file size and location.

If you've already installed SoftWindows and you decide that the SoftWindows hard disk file has become a burden on your hard disk's overall capacity, you can move this file just as easily as you would move any other Macintosh file. Just drag the **SoftWindows Hard Disk File C** icon to an external drive, and then delete the corresponding hard disk file from your hard disk. When you restart SoftWindows, it won't find your hard disk because the existing settings file still records your Macintosh hard disk location as the site of your hard disk file, but it will ask you to specify the new location of the hard disk file. Just specify this new location and SoftWindows will use this destination from that point on. Of course, you can also move the SoftWindows program itself to removable media. Figure 9.4 shows the contents of a Syquest disk after all SoftWindows files have been moved there, thus freeing up 30 MB of hard disk space for use by Macintosh applications.

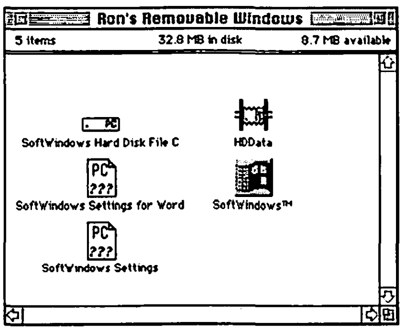


Figure 9.4 In this window, the SoftWindows hard disk file and all other Soft Windows files have been moved to removable media

Increasing Your Hard Disk File Size

If you want to increase your SoftWindows hard disk space and you don't have the installation diskettes handy, or if you don't want to destroy applications and data that you've already placed on your existing C: drive, your best approach is to create a D: drive. When you create a D: drive, you're essentially creating a separate file for storing additional Windows applications and data.

To create a D: drive, follow these simple steps:

1. Start SoftWindows and choose **Setup|PC Hard Disks**.
2. In the D: drive drop-down menu, select **Create new "D:" drive**. Select the location (typically the SoftWindows folder) and the size of the drive, then click on **OK**.
3. After SoftWindows creates the D: drive, you must restart SoftWindows for the changes to take affect. To do so, click on **Reset**.

HOT TIP

What's the Meaning of the "Create Bootable" option?

Many users get confused by the "Create Bootable" check box that appears when they try to resize their C: or D: drives. In my view, Insignia should not show this check box when you try to resize your C: drive because it's not an option. Your C: drive *must* be bootable. In other words, SoftWindows has to create a "boot sector" on your hard disk file that stores the files required to boot DOS.

On the other hand, when you create a D: drive, you have the option to determine whether the drive will be "bootable"—that is, whether you'll be able to use this drive to start DOS and Windows. Normally, if you're creating a D: drive, you'll want to turn this box off, since your C: drive will most likely be your bootable drive.

Macs Emulating PCs

The second major type of emulation that SoftWindows performs is also hardware-related, because it involves the various port connections located at the back of your Power Mac, as well as other hardware components on your Power Mac logic board. A PC motherboard and all its various add-on cards bear little resemblance to a Power Macintosh logic board and its own hardware interfaces.

So, if you want to input and output Windows files and data on your Power Mac, some method has to be in place to "trick" Windows and DOS into treating your Macintosh hardware ports as though they were PC ports.

Much of the port emulation capabilities of SoftWindows are executed by default, so in many cases, you won't need to do anything to view files, input files, output files, connect to a remote location via your modem, print files, or network with other computers when you're in SoftWindows. But there are some significant exceptions.

When you're tempted to complain that SoftWindows isn't performing as seamlessly as you would like, try to keep in mind that making Windows applications run flawlessly on a Power Mac is a lot like trying to sew an ape's head onto a goat and get the goat to walk, behave, and think like an ape. In other words, it's a clumsy and awkward bit of surgery, no matter how well Insignia and Apple try to make it work.

I should repeat something that I mentioned in earlier chapters—Insignia, when it released SoftWindows 1.0, made claims about performance and speed that misled many users and that frankly led to expectations that the software could not meet. But Insignia Solutions today is not the same company that it was one year ago. Several management changes have been made, and the new management, in my view, seems far more willing to stick to realistic claims about SoftWindows 1.0 and the forthcoming SoftWindows 2.0 upgrade, and in providing excellent technical support for existing SoftWindows users.

The SoftWindows Setup Menu

All hardware configuration settings are made by using the SoftWindows Setup menu, shown in Figure 9.5. All of the options on this menu tell Windows how to work with the hardware provided on your Power Mac. Again, this essentially involves some tricks that make DOS and Windows view your Macintosh hardware as though it were PC hardware. I won't describe the

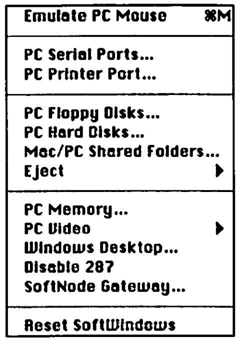


Figure 9.5 The SoftWindows Setup menu

basic features of each Setup option, because the SoftWindows user's manual does a good job of that. Instead, I'll focus on problems you might have related to hardware setup and additional technical information that might be useful to you.

Emulate PC Mouse

You'll typically only need to use this option if you're running a DOS application that uses a mouse. (Windows applications don't require that you use this option.) When you run a DOS application under SoftWindows, you'll find that your mouse, by default, is disabled. To get your mouse to work with DOS applications, you can either press **Control+M** or select **Setup| Emulate PC Mouse**.

When you use either one of these commands, SoftWindows allows your Apple mouse to emulate a Microsoft bus mouse. The emulation capability will vary, though, depending on the DOS application you're running. The DOS Edit application is notoriously poor in this regard—tracking is much slower than the actual mouse movements. Insignia says there is little they can do about the problem—it is a problem inherent in DOS applications. Although it's true that mouse tracking in DOS programs is not great, it's not nearly as bad as it is in SoftWindows. I suspect the problem lies in the delay time required to code-emulate the Microsoft mouse. Perhaps this is an area that Insignia can address in its next version of SoftWindows. Any optimization here would be helpful.

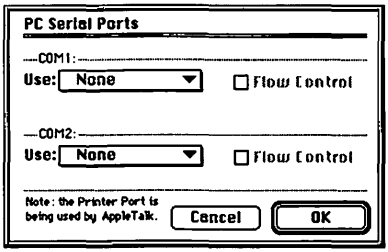


Figure 9.6 The PC Serial Ports dialog box

When you turn on PC mouse emulation, you lose access to the SoftWindows menu bar. If you want to return to the menu bar and consequently lose control of your PC mouse, press **Control+M**. If you just want to access the menu bar without losing control of your PC mouse, just press **Control**.

PC Serial Ports

Usually, you won't need to adjust the settings for serial ports, but there are a few exceptions. The PC Serial Ports dialog box is shown in Figure 9.6. All Power Macs provide two serial ports—the modem port and the printer port. (The fact that they're now called GeoPorts is irrelevant to SoftWindows.) Normally, you'll use these ports precisely as they're intended, in which case a modem will be connected to your modem port and your printer will be connected to the printer port.

If you're using a modem with Macintosh applications and you notice conflicts when SoftWindows is running, try setting the COM1 port to **None**. This will prevent device contention between Macintosh modem software and SoftWindows. Of course, it will also prevent you from using your modem within DOS or Windows. Also, in a few printing situations, printing will fail if the COM1 port is set to **Modem**. If your DOS or Windows application fails to print, try setting the COM1 port to **None**.

Using a Modem in SoftWindows

If you have problems using your modem in SoftWindows, try these possible solutions:

1. If you are using the GeoPort Telecom Adapter software, make sure the Express Modem Control Panel is set to **Use Express Modem**. To do this:

2. Select an appropriate 9600 baud or 14,400 baud modem if there is a selection of manufacturer's modems in your PC modem or fax/modem program. Selecting different modems will send different initialization strings to the GeoPort. If your modem software uses the wrong initialization string, it might not be able to detect that any modem is connected to the COM1 port.

PC Printer Port

Printing under SoftWindows is usually a seamless affair, but after talking with users, I realized that some recurring issues are the result of some confusion about how printing works under SoftWindows.

Much of the confusion arises from users' misunderstanding of why SoftWindows doesn't support the same large set of printer drivers supplied with Windows 3.1. Here's how printing works under SoftWindows.

SoftWindows looks to the Setup menu for information on how to handle a print job. If you've selected PostScript from the PC Printer Port menu, then SoftWindows assumes any print data sent to the emulated Parallel Port (LPT1) is PostScript code and simply passes it to the Macintosh printing system. If, however, LQ-2500 is selected, SoftWindows assumes the print data is Epson LQ-2500-compatible code and translates it into QuickDraw print data. QuickDraw can be printed on any Macintosh-compatible printer, including Macintosh PostScript printers.

Your PC application running under SoftWindows should be set to print to either an Epson LQ-2500 compatible printer or PostScript. If you have a PostScript choice in your DOS application and you have a PostScript printer, choose PostScript. In a Windows application, the problem is less likely to occur since the program will typically use the default Windows printer (which you should establish as PostScript for PostScript printers or Epson LQ-2500 for non-PostScript printers).

In other words, in SoftWindows, you're limited to generic printing options. Most printer drivers in Windows address specific features, like tray loading, paper size, labels, and so forth. When you print from a Windows application in SoftWindows, you'll lose most of these features.

An exception lies in font selection for Epson-compatible (all non-PostScript) printers. In the Setup menu, select **PC Printer Port**, then select **Epson LQ-2500** and choose Options. Figure 9.7 shows the dialog box that appears. You can select point size for both monospace and proportional space printing. If you cannot select the desired fonts, copy the two font files, Insignia LQ Bitmapped and Insignia LQ TrueType, on top of the System folder. These files are on your SoftWindows installation disks. System 7 will put these two files in the correct place. Then start SoftWindows and select the fonts in the correct size.

PC Floppy Disks

In almost a year of conversing with SoftWindows users, I have yet to hear anybody raise an issue regarding the PC Floppy Disks dialog box. But "because it's there," I'll address it briefly. Insignia reports that SoftWindows cannot determine the correct drive capacity for some third-party diskette drives. If you've installed a third-party floppy drive (why *are* we still calling 3.5" diskettes floppies, anyway?), and SoftWindows is unable to read the diskettes you insert, use the PC Floppy Disk Drives dialog box to manually set the size of your diskette drive.

PC Hard Disks

Most SoftWindows users I've communicated with express a need to make changes to their C: or D: hard disk files, but are a bit confused about how to go about this. I've already discussed these issues in earlier sections, so I won't rehash them here. I should note, though, that modifying the size of your C: drive (or creating a new C: drive) requires that you have the

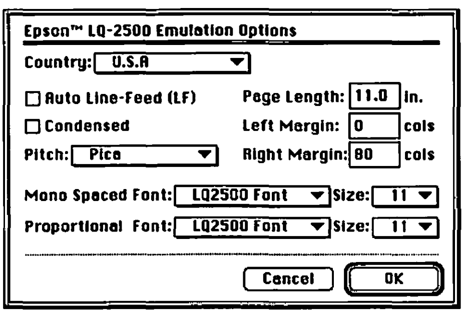


Figure 9.7 Use this dialog box to configure settings for Epson LQ-2500 emulation

SoftWindows install diskettes handy, because you have to reinstall the HDData files required to support a bootable C: drive. And don't try to copy the HDData file from your existing SoftWindows folder; that won't work. As I've mentioned earlier, you don't need the installation diskettes to create an additional D: drive. Also, SoftWindows 2.0 will include a hard disk expander utility that will allow you to compress and expand your hard drive.

Using DOS/Windows CDs in Your Macintosh CD-ROM Drive

Many CDs contain both Windows and Mac versions on the same disk, so you might not need to use SoftWindows to read and work with some CDs. But for CDs that only run under DOS/Windows, you'll need to make some adjustments in order to get SoftWindows to "mount" your CD-ROM drive. Here are the steps to follow:

1. Start SoftWindows with the CD drive empty.
2. At the C:\> prompt, type **USECD** and press **Return**.
3. Put the CD disk in the drive and type **f:** and press **Return**.
4. Type **dir** and press **Return**.

This should mount the CD-ROM disk and give you a view of the directory of the CD disk.

If this does not work, the CD disk might be mounted on the desktop (normally it gets unmounted when you type **USECD** to run the SoftWindows batch file). In these cases, do not use the USECD command. Instead, make the disk available as a network drive F: *after* resetting SoftWindows from the Setup menu (select **Setup|Mac/PC Shared Folders**).

Mac/PC Shared Folders

This feature is well represented in the SoftWindows user's manual, so I won't dwell on it in too much depth here, except to mention a few facts that aren't mentioned. Basically, this dialog box allows you to store DOS files in the Macintosh environment and lets you access them from within SoftWindows as though they were stored on a DOS-formatted floppy or hard disk.

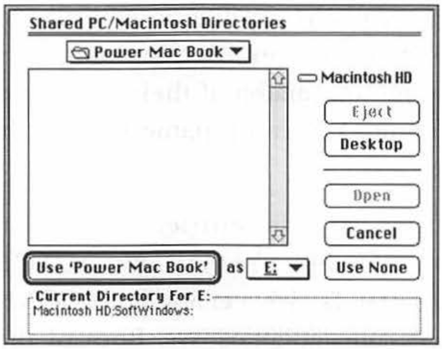


Figure 9.8 You use this dialog box to specify a shared directory for Macintosh and DOS files

There's an important benefit to using this feature. If your SoftWindows Hard Disk File C is already loaded to the gills with application and data files, the shared folders option allows you to move applications and data to a standard Mac folder. To create a shared folder, choose **Setup|Mac/PC Shared Folders**, as shown in Figure 9.8, and then select the folder you want to use for sharing files between PC and Mac applications. You can also select a drive letter to use for the shared folder.

Once you've done this, your Mac applications will also be able to view and open (if the appropriate filters are supported) and work with these DOS/ Windows files. Figure 9.9 shows the DOS screen for a shared directory. Note that any Mac files that you store in this directory have to be viewed in DOS and Windows under the DOS eight-character/three-character exten-

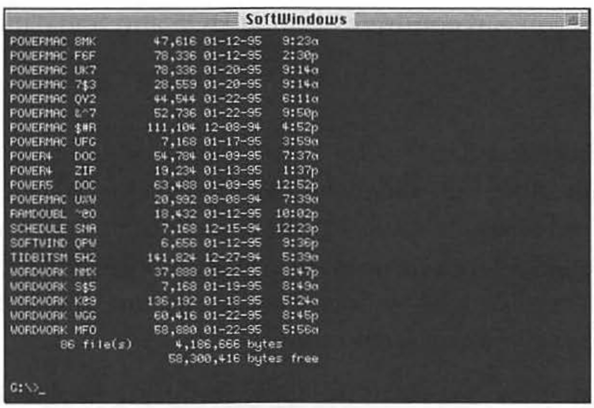


Figure 9.9 This DOS directory is shared by both the Mac and DOS environments

sion filename rule. SoftWindows will automatically convert existing Mac filenames to valid DOS names; however, in doing so, you might find that some filenames become unavailable if their first eleven characters duplicate an existing filename. You can rename files on the Macintosh side if this problem occurs.

In order to share files, specific entries must exist within both your AUTOEXEC.BAT and CONFIG.SYS files. Your AUTOEXEC.BAT file must contain the line **c:\insignia\fsadrive e:** and your CONFIG.SYS file must include the line **device=c:\insignia\host.sys**. Both of these lines are added when you install SoftWindows. However, if you or some DOS or Windows install program removes one or both of these lines, you will need to add them before you can share files between the PC and Mac environments.

Make sure these lines are present and enabled (not commented out with REM), reboot DOS if necessary, and the "Mac/PC Shared Folder" item under the Setup menu should then be accessible.

Eject

There's not much to explain about this option. As I've already mentioned, if you want to eject a diskette from your Mac floppy drive, choose **Setup|Eject|Superdrive** (or press **Command+Shift+1**), and out it will come.

One interesting note: If you have a PC diskette in your A: (SuperDrive) drive when you launch SoftWindows, DOS will see it as a non-system diskette and will display an error during startup. You will need to eject the diskette before you can continue booting DOS and SoftWindows.

PC Memory

After you've installed SoftWindows, you might notice that some of your Windows applications run sluggishly. As a general rule, you shouldn't expect your Windows applications to run as fast under SoftWindows as they did under your PC system. But often, you can boost the performance of your Windows applications by boosting the amount of extended memory that you make available to SoftWindows.

Adjusting PC memory is one of the most confusing problems I hear from SoftWindows users, but making memory changes really is a simple process.

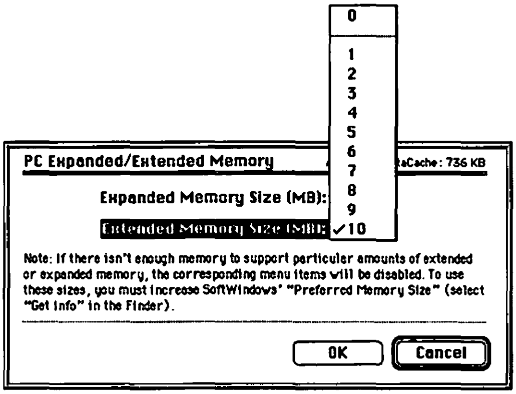


Figure 9.10 You can use this dialog to change the size of extended memory, if you've already provided SoftWindows with enough "Preferred" memory

The complaint I hear most is that users choose **Setup|PC Memory** to display the dialog box shown in Figure 9.10, try to add to the Extended memory size, and find that the dialog box doesn't provide them with any option for increasing the existing extended memory size.

The problem is easy to explain and easy to resolve. The available memory sizes provided from the PC Memory dialog box depend on the total amount of "Preferred" memory that has already been defined. You initially defined this memory size when you installed SoftWindows, but you can easily change it after the fact.

If you want to increase the amount of extended memory available to your Windows applications, you first need to increase the overall, Preferred memory size for SoftWindows. To make this change, you need to highlight the SoftWindows icon, then select **Get Info** from the Finder's File menu, as shown in Figure 9.11. Note that you can't change the "Preferred" memory size if SoftWindows is running. You must quit SoftWindows before you attempt to change this value.

After you increase the "Preferred" memory size, you can restart SoftWindows and then use **Setup|PC Memory** to increase the expanded or extended memory available for DOS and Windows applications. However, SoftWindows reserves 5 to 6 megabytes of memory for its own use and allocates the remaining memory for use by applications. So not all of the "Preferred" memory will be available for use as extended or ex-

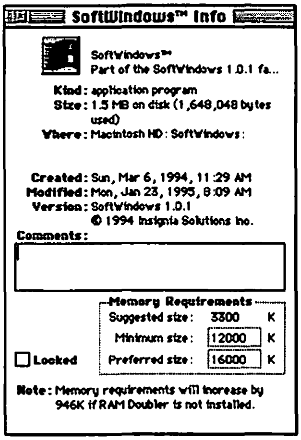


Figure 9.11 This Info box shows the available memory for SoftWindows' use

panded memory. For instance, if you set the "Preferred" memory size to 16 MB, you'll probably only be able to allocate a maximum of 10 MB as extended memory.

You Can Create Different Settings Files for Different Applications

Different applications and SoftWindows sessions might require or suggest different memory, video screen size, port, or other custom settings. For these situations, it isn't necessary to create custom settings each time you want to use a different SoftWindows environment. Simply make the desired Setup changes you want for a particular environment, and then click on **File|Save Settings** as shown in Figure 9.12. Give the settings a descriptive name so that you remember what they are designed for. Later, when you want to use these custom settings, double-click on the appropriate "settings" file in your SoftWindows directory to start SoftWindows using these custom settings.

PC Video

You might never need to change these settings, unless you are running an older DOS application that only runs in CGA or EGA video mode. (This

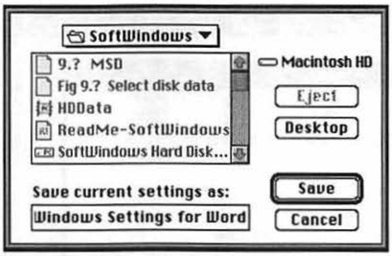


Figure 9.12 Use this dialog box to create different settings files

problem rarely occurs with Windows applications.) If you are trying to run a DOS application and it won't display properly, trying changing the Video setting to EGA first; if that doesn't work, change the setting to CGA.

Also note that standard 640×480 VGA is the highest resolution currently supported by SoftWindows, even if your monitor supports higher resolutions. That's why SoftWindows will not display in full screen on 16" and larger monitors. The next version of SoftWindows (2.0) will support higher SVGA resolutions.

Windows Desktop

You can try reducing the size of your Windows Desktop if your DOS or Windows display seems blurry or if you simply want it to occupy less of your screen. I actually prefer to display the Windows Desktop at slightly less than full screen, as shown in Figure 9.13, so that I can switch between the Windows and Mac environments without having to access the Setup menu. To resize your Windows Desktop, choose **Setup|Windows Desktop**, and then click and drag the window until it is the desired size. You will need to restart SoftWindows for the change to take effect.

If you want to make the new Windows desktop size permanent, save it to a separate settings file (choose **Setup|File|Save Settings**), as shown in Figure 9.14. You might also want to resize the Program Manager and File Manager sizes to fit within your new desktop size. You can resize the Program Manager or File Manager permanently, by moving and resizing it, then pressing down **Shift** while clicking on **File|Exit**. Windows will save the new window sizes without actually exiting the Program Manager or File Manager.

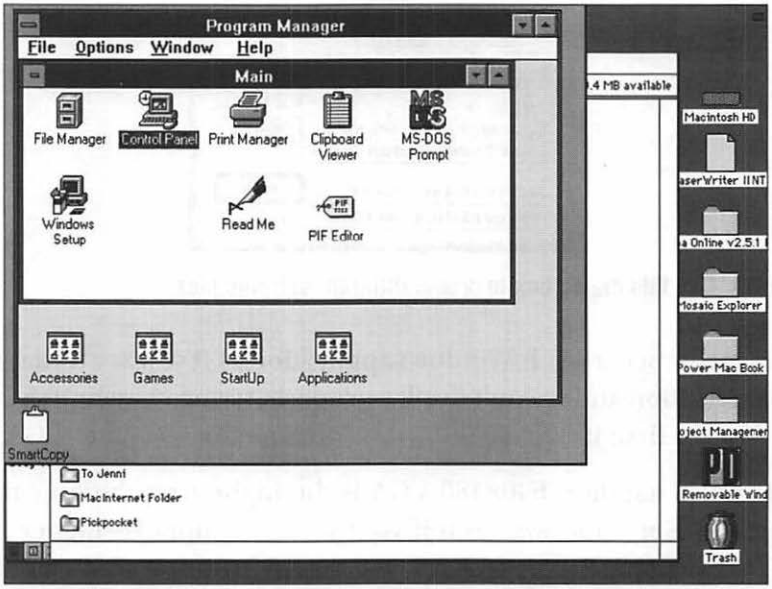


Figure 9.13 You can reduce the size of your Windows desktop, either to view the Macintosh desktop in the background or to improve screen resolution

Disable 287

The 80287 is the Intel math co-processor chip that works with the 80286 chip to perform floating-point calculations. Very few DOS and Windows applications use the 287 co-processor, so you'll rarely, if ever, need to change this setting.

However, if you do find yourself running a DOS or Windows applications that use the 287 co-processor and these applications run poorly or unreliably,

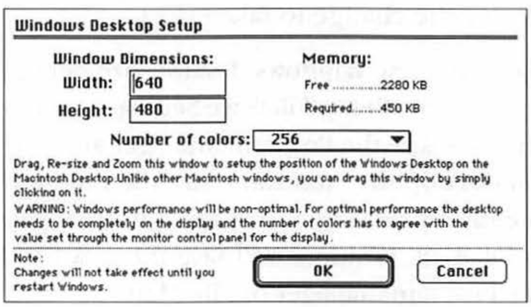


Figure 9.14 Drag this window to change the size of your Windows desktop

try disabling the 287 chip emulation. The floating-point instruction set uses a different precision than the 287 chip instruction set, which is typically the cause of these problems. Most applications that use floating-point calculations will default to their own built-in math routines if they can't find the 287 chip, so they'll usually still run if the 287 chip emulation is turned off.

SoftNode Gateway

You can use the SoftNode Gateway to connect to an Ethernet network, even if your Power Mac does not have an Ethernet connection, by using another Ethernet-enabled Macintosh as a gateway to the Ethernet. You can do this if you are connected physically to the gateway via LocalTalk. Since the steps to follow in connecting to different networks vary, and the SoftWindows user's guide covers this topic well (pages 110-120), I won't rehash the steps here.

Other SoftWindows Optimization Tips

If you want further optimization tips on using SoftWindows, you can request Document 305, "SoftWindows Speed Tips," from Insignia's automated Fax Response Service. Call 1-800-8-SOFTPC from your touch-tone phone and follow the voice prompts to get to the document index and to request this fax.

Other SoftWindows Problems

The single biggest category of complaints I hear deals with SoftWindows' 286 instruction-set limitation. If a particular DOS or Windows program will not run under SoftWindows, it probably is a 32-bit program that requires a 386 or higher processor.

Some programs that require a 386 will install in SoftWindows, but will not run. Other 32-bit programs will run under SoftWindows until 32-bit code is encountered, at which time the program crashes. Many DOS and Windows game programs that come on CD-ROM are 32-bit and thus will not run under SoftWindows.

PowerTalk and SoftWindows

The System 7.5 PowerTalk extension can significantly slow the performance of SoftWindows. If you do not need any of PowerTalk's networking features, try turning off this extension to improve the performance of SoftWindows.

PC Exchange and AccessPC Problems

PC Exchange, an extension that comes with the system software, may conflict with SoftWindows at times, since both programs try to do the same thing when you insert and try to read a DOS diskette. If your system crashes or behaves unreliably when you try to use DOS diskettes, try disabling the PC Exchange extension. If you still want access to DOS diskettes in the Mac environment, you can use AccessPC, which is compatible with SoftWindows. However, you will first need to install a patch that allows you to use AccessPC. On the first install disk of SoftWindows, you will find a small application called "Patch AccessPC." Run this patch and it will modify AccessPC to work with SoftWindows.

Right Shift Key Failure

If you notice that the right Shift key on your keyboard does not work when you are in SoftWindows, you are probably using the new Apple Design keyboard. The mapping for the right shift key on this keyboard is different than the standard mapping that SoftWindows expects. Apple has corrected this problem on Apple Design keyboards currently shipping. If you encounter this problem, return the keyboard to your reseller for an exchange.

CD and Other Audio Failures

SoftWindows only supports the PC speaker; it does not support Windows WAV or SoundBlaster capability. This limitation typically manifests itself when you try to run a DOS or Windows multimedia application from CD-ROM, but it can occur with any program that requires certain sound capabilities.

If your application *requires* the use of a sound card, it will not run under SoftWindows. Other programs will use the PC speaker if no sound card is present or will simply not play their audio track when you run the program. Insignia will support the WAV sound format in SoftWindows 2.0;

however, SoundBlaster emulation will not be provided. If you want to run DOS and Windows applications that require SoundBlaster card capability, you will need to install Apple's DOS Compatibility Card.

SoftWindows 2.0: A Preview

Insignia currently plans to release SoftWindows 2.0 in the second quarter of 1995. However, the company has allowed me to preview the features that will be made available in this newer version. The most important feature, of course, is support for 386 enhanced-mode Windows applications. SoftWindows 2.0 will run Windows 3.11, not 3.1; however, you can also install Windows 95 to run on top of SoftWindows 2.0. Insignia plans to release an optimized Windows 95 version of SoftWindows about three months after Windows 95 itself is released by Microsoft. Until that time, you can still install Windows 95 under SoftWindows 2.0, but performance is unlikely to be as high as it will be when Insignia releases its optimized Windows 95 version of SoftWindows. Figure 9.15 shows WordPerfect 6.0 for Windows running under SoftWindows 2.0. WordPerfect 6.0 is a 32-bit application that requires enhanced-mode Windows.

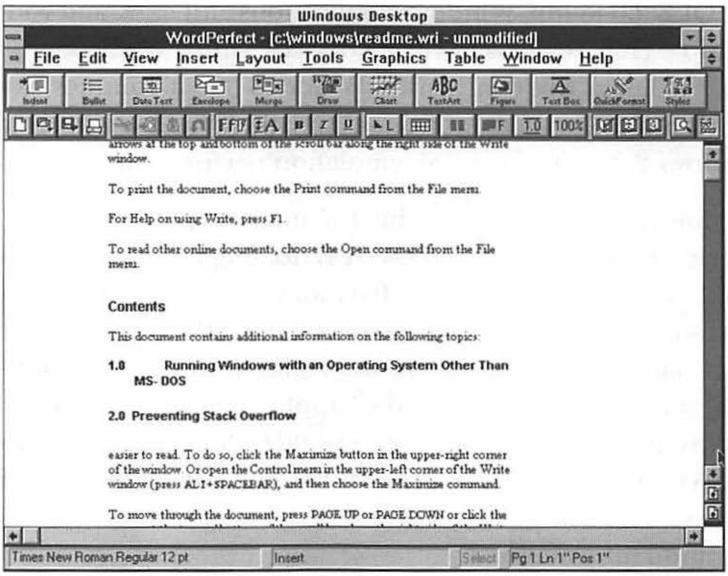


Figure 9.15 With SoftWindows 2.0, you can run applications that require 386 enhanced mode

Here's a brief list of new features available in SoftWindows 2.0:

- Intel 486 processor emulation
- Microsoft Windows 3.11 pre-installed
- Windows sound (WAV format) integrated with Mac sound and microphone for Windows multimedia
- Simultaneous Mac and PC access to TCP/IP networks
- Advanced Mac/PC integration features using Apple Events and AppleScript
- Improved installation and configuration
- Improved hardware support, including SVGA video resolution
- Smart SoftWindows 1.0-to-2.0 upgrade installer

I'll explain many of these features in more depth in the following sections.

486 Processor Emulation

The addition of 486 processor emulation in SoftWindows 2.0 not only means you can run enhanced-mode applications, but you will also have full support for OLE 2.0 to link Windows applications and data, and you'll able to run multiple DOS sessions as virtual devices within Windows. In addition, Insignia has taken frequently used Windows 32-bit routines, recompiled them into native PowerPC routines, and then built these routines into SoftWindows 2.0 to improve 486 emulation performance.

SoftWindows 2.0 also emulates the 487 math co-processor by converting 487 chip instructions to native PowerPC floating-point code. As is the case with the 287 co-processor with SoftWindows 1.0, you can disable the 487 co-processor emulation in SoftWindows 2.0. By the way, SoftWindows will report its hardware configuration information to the Microsoft Diagnostics program, so you can use the MSD application (it's bundled with DOS) to diagnose hardware problems. Figure 9.16 shows the MSD information that SoftWindows reports with version 1.0. For version 2.0, you will see the 486 processor and co-processor identified, along with other SoftWindows configuration information.

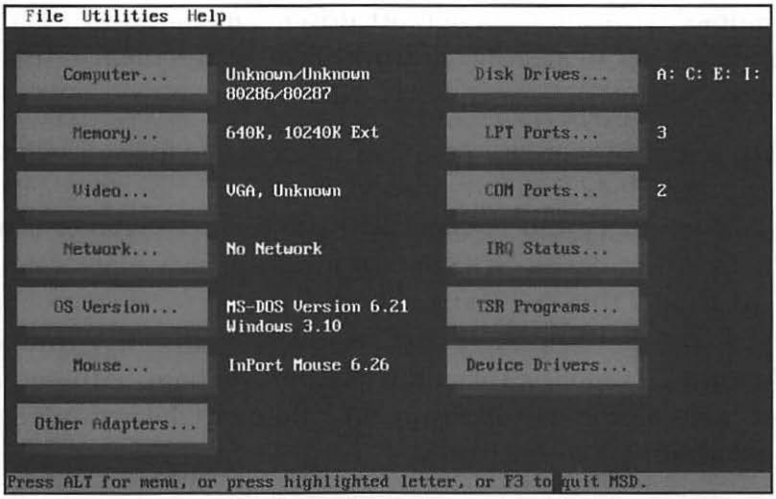


Figure 9.16 Microsoft Diagnostics (MSD) reports SoftWindows' configuration information in both versions 1.0 and 2.0

Using Other Versions of Windows with SoftWindows 2.0

Although SoftWindows 2.0 will come with Windows 3.11 pre-installed, other versions of Windows can be installed. I've already mentioned that you can install Windows 95 with SoftWindows 2.0. You can also install Windows for Workgroups 3.11 if you want to take advantage of Windows for Workgroups networking features.

However, you don't need to install Windows for Workgroups 3.11 simply to take advantage of its 32-bit file access capabilities, as many users now do. The same 32-bit file system services are already built into the Macintosh operating system and are used by SoftWindows automatically.

You will not be able to install OS/2, OS/2 for Windows, or Windows NT with SoftWindows 2.0.

Network Support in SoftWindows 2.0

SoftWindows supports Novell Netware, DEC Pathworks, Windows for Workgroups, LAN Manager, Banyan VINEs, and TCP/IP networks. In addition, multiple networking protocols can be used simultaneously. SoftWindows 2.0 networking is based on the Open Datalink Interface (ODI) standard, which enables multiple transport protocols to be used simultaneously.

SoftWindows' ODI-compliant network driver communicates with the Mac OS network driver to allow PC network clients to use the networking services in the Macintosh instead of a PC NIC card.

However, not all PC network protocols are designed to work with ODI or the Microsoft-defined standard called NDIS, and some are designed to work with NDIS only. If a protocol normally works with NDIS rather than ODI, SoftWindows provides an NDIS-to-ODI translator that enables the protocol to work with ODI. This feature allows Windows for Workgroups, LAN Manager, and Banyan VINEs to also work with SoftWindows 2.0. SoftWindows 2.0 supports Token Ring networks at both 4 MB/sec. and 16 MB/sec. transmission speeds. Figure 9.17 illustrates the networking architecture that SoftWindows 2.0 uses.

Simultaneous Mac and PC TCP/IP Connections via WinSock

SoftWindows 2.0 adds support for other MacTCP network services to provide concurrent TCP/IP sessions for both Macintosh and Windows applications. Windows shares the Macintosh TCP connection transparently by using the WinSock standard for TCP/IP connections. Winsock (Windows Socket Services) is a high-level API (application program interface) used to access TCP/IP networks (including the Internet and World Wide Web and access to UNIX servers) from within Windows applications. Table 9.1 shows the networks and the transport protocols that SoftWindows 2.0 uses to support PC networking.

Table 9.1 SoftWindows 2.0-Supported Networks and their Protocols

Supported Networks	IPX	NETBEUI	TCP/IP	VINEs-IP	DECnet
Banyan VINEs				•	
DEC Pathworks		•			•
Microsoft LAN Manager		•	•		
Microsoft NT Advanced Server		•	•		
Microsoft Windows for Workgroups		•	•		
Novell Netware S.X, 3.X, 4.X	•				
UNIX File Servers			•		
Internet Services			•		

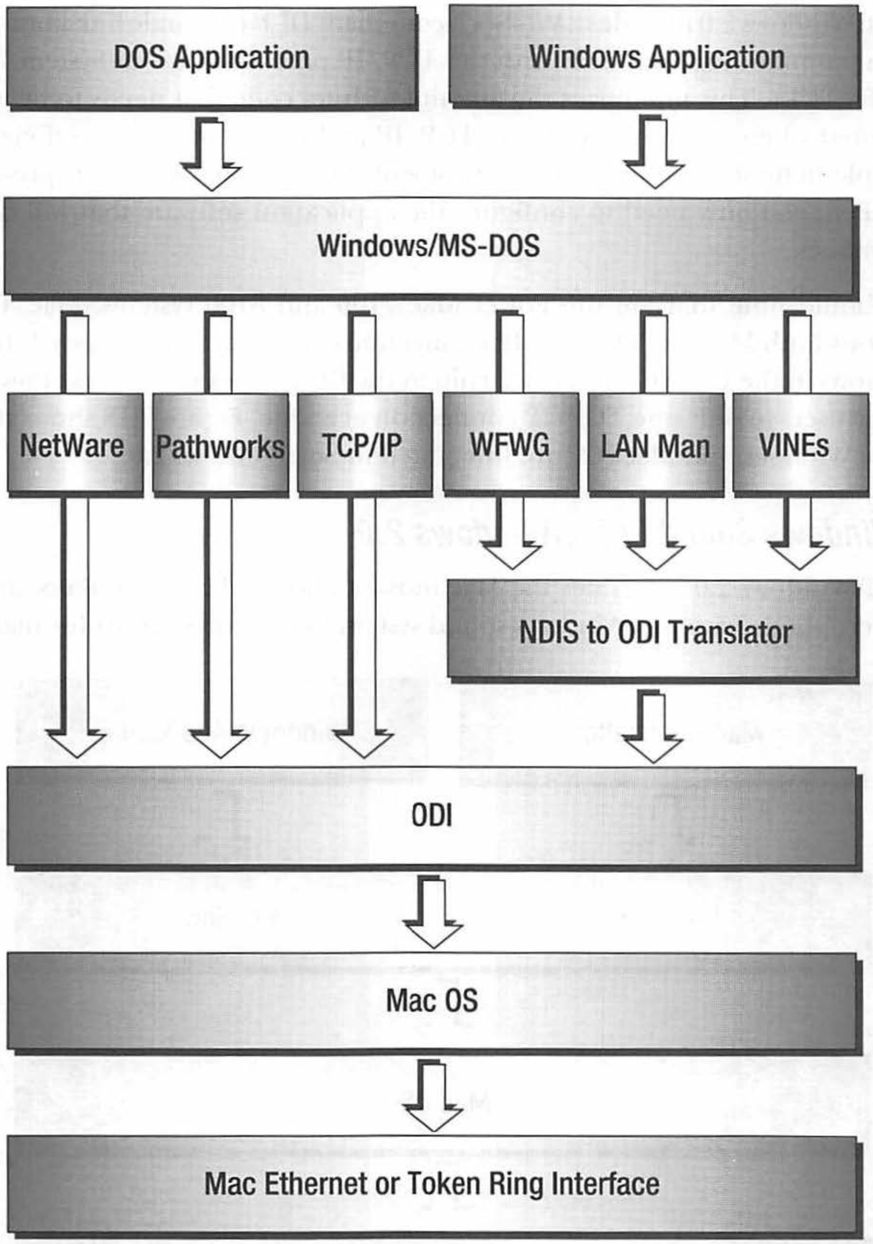


Figure 9.17 The universal PC network architecture used by SoftWindows 2.0

SoftWindows 2.0 includes a WinSock-compliant DLL (dynamic link library) that communicates directly with the TCP/IP protocol stack in System 7.5 (MacTCP). This minimizes the amount of Intel code that needs to be executed when communicating via TCP/IP and results in a more efficient implementation of the WinSock protocol. The WINSOCK DLL is pre-installed; you only need to configure the application software that will call WinSock.

I should note that, on the Power Mac 7100 and 8100 systems, MacTCP allows both Mac and PC TCP/IP connections to run simultaneously. Limitations in the Ethernet interface chip in the 6100 series limits these Power Mac users to only one TCP/IP connection at a time. Figure 9.18 shows the way WinSock and MacTCP are integrated in SoftWindows 2.0.

Windows Sound in SoftWindows 2.0

SoftWindows 2.0 integrates the Macintosh audio hardware, speakers, and microphone with the Windows sound system to provide support for many

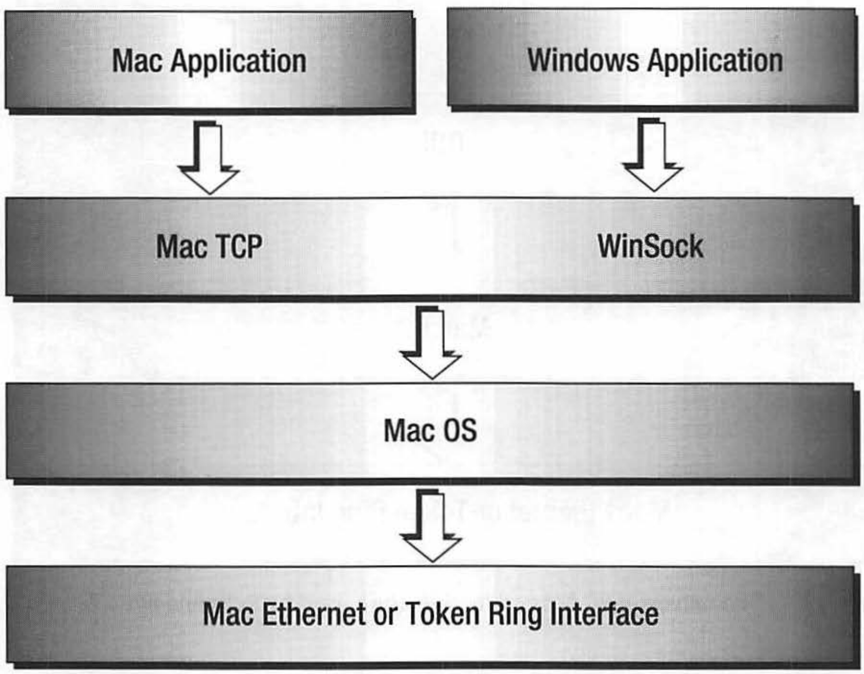


Figure 9.18 WinSock/MacTCP integration in SoftWindows 2.0.

multimedia applications and CD-ROMs. However, applications that require SoundBlaster compatibility (chiefly DOS games) are not supported.

In a multimedia PC, applications provide their own code to use sound functions from different sound cards. Windows supplies a standard way to get sound functions through the Windows sound system API. Windows multimedia applications work with this API to play sounds for video, animation, games, and other sound output. SoftWindows 2.0 provides support for the Windows sound system to enable full multimedia support under Windows.

Windows applications—including Lotus Notes, Word, and Excel—provide an option for recording sound as an annotation to data in files. SoftWindows 2.0 provides audio input as well as output, using the standard Macintosh microphone or any other Macintosh-compatible input source. SoftWindows stores sound input in WAV file format.

AppleScript Support

SoftWindows 2.0 makes the emulated PC controllable by other Macintosh applications, Apple Script scripts, and macro programs like QuicKeys. Commands can be exchanged with a compatible application via Apple Events or in an AppleScript script. So you can create scripts that automatically launch specific PC applications and services.

If program sharing is enabled on both sending and receiving Macintosh computers, SoftWindows 2.0 can even be controlled by another Macintosh via Apple Remote Access. In other words, SoftWindows 2.0 can use AppleScript to run PC software remotely.

Enhanced Video Support

SoftWindows 1.0 currently supports 640×480 video resolution, which prevents you from viewing Windows applications full-screen on large monitors. SoftWindows 2.0 will support SVGA graphics for DOS applications and up to 1280×1024 (256 colors) resolution for Windows applications. In Windows applications, SoftWindows' own Windows display driver is used to pass graphics calls directly to QuickDraw. This exploits the Power Macintosh's graphics speed and allows Windows display resolution up to and beyond the resolution achievable by SVGA with DOS applications.

The DOS Compatibility Card

If you need to run DOS and Windows and the SoftWindows solution does not meet your needs, the DOS Compatibility Card hardware option might be available to you. I say "might" because Apple currently only provides a card that works in the Power Mac and Performa 6100 systems (but not on the Performa 5200), and hasn't announced plans to make a similar card for the 7100 and 8100 systems. Also, since the DOS Compatibility Card plugs into the processor-direct slot on the 6100, you can't use both the AV card and the DOS Compatibility Card. You'll have to choose one or the other. In the following sections, I'll provide a more in-depth look at this card and its features. Figure 9.19 shows the DOS Compatibility Card.

The card sports a 66-MHz 486DX2 processor. So, unlike SoftWindows, there's no issue about whether you can run Windows applications at 486 speeds. With this card, you *are* running a 486—no CPU emulation is necessary. According to benchmark tests performed by Ziff/Davis Labs, the card is only slightly faster than an 8100/80 running SoftWindows, and is only about one-sixth as fast as an actual standalone 486 DX2 system with 8 MB of RAM.

But when you add at least 8 MB of RAM to the single SIMM slot on the card, performance skyrockets. The card then runs Windows applications at twice the speed of SoftWindows running on an 8100/80 system, and achieves about half the performance of similarly equipped 486 DX2 sys-

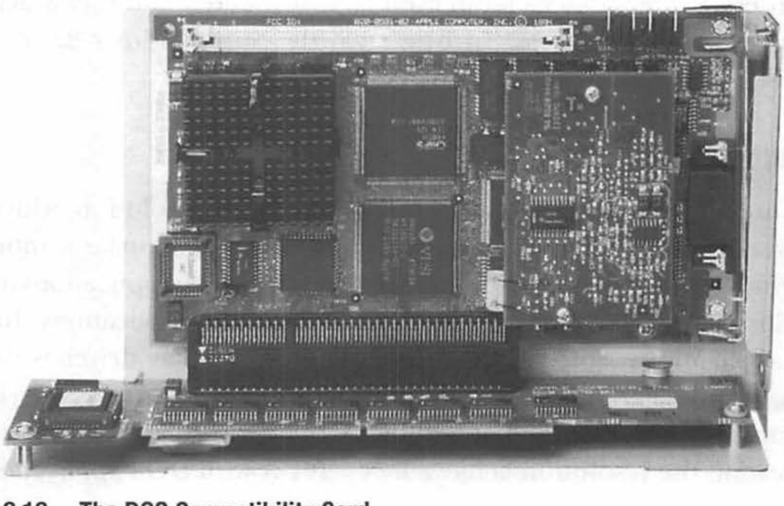


Figure 9.19 The DOS Compatibility Card

tems. The card ships with Windows 3.1 and DOS 6.22 and can be easily installed by users. (Apple actually encourages this; you won't void your 6100 system's warranty when you install the card.) Apple's announced retail price for the card is $699, but like most Apple products, you can usually find it for significantly less cost at many reseller and mail-order locations.

The DOS Compatibility Card's Feature Set

As I indicated earlier, the card includes one SIMM slot, which is empty when you buy the card. To take advantage of the card's performance capability, add at least an 8 MB SIMM to this slot. The card will use the RAM on your 6100 logic board, but traveling the bus to access memory off the card significantly slows down the card's performance—no matter how much RAM you have on your 6100 logic board. The card is upgradeable to 32 MB of RAM. Without additional memory, you might also see a degradation in performance of your Mac applications while the Compatibility Card is running.

One feature that the DOS Compatibility Card has that's unavailable with SoftWindows is SoundBlaster support via a daughtercard that's on the Compatibility Card itself. The card even includes a PC game port.

Like SoftWindows, the DOS Compatibility Card uses a software interface to emulate PC ports and to allow you to switch back and forth between the Mac environment and the PC/Windows environment. (You can run both environments simultaneously.) The software interface is shown in Figure 9.20.

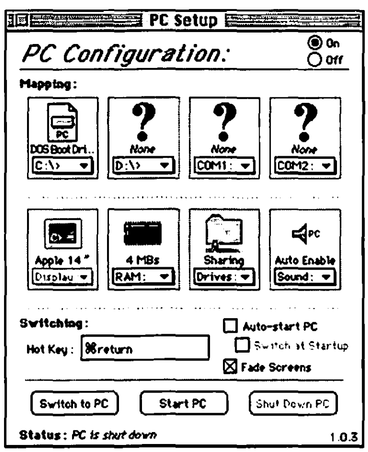


Figure 9.20 The DOS Compatibility Card Software Interface

With the Setup dialog for the DOS Compatibility Card, you can emulate serial, hard disk, printer, and network ports, and you can cut and paste text and graphics between the Mac and Windows environments, and you can share files, directories, and folders between the two environments. The software for the card includes an ODI driver for Novell Netware, and TCP/IP for DOS and Windows.

Switching between the Mac and Intel platforms is as easy as pressing Command+Return.

The DOS Compatibility Card has superior video capabilities over SoftWindows 1.0, but chiefly does this through hardware: The card includes a standard video port that allows you to connect a second monitor directly to your 6100. I find this to be one of the best features of the card, since it allows you to display your Mac and DOS/Windows on separate monitors—effectively giving you two computers. The video port supports VGA resolution at 640×480 at 256 colors, or 600×800 with 16 colors. The card includes 512K of video RAM built in.

Unlike SoftWindows, the DOS Compatibility Card uses PC Exchange to read and write DOS-formatted diskettes, so you can run PC Exchange under Windows with no ill effects.

PC Exchange running with the DOS Compatibility Card installed does have a few quirks, though. If you curently have Windows active and insert a Mac-formatted disk, PC Exchange will automatically eject the disk. You won't even have the opportunity to reformat it as a PC diskette.

Also, if you insert a diskette into the floppy drive while the Macintosh display is active, and then switch to the Windows display, Windows won't recognize the diskette, no matter how it's formatted. And, like SoftWindows, to eject a diskette while Windows is active, you need to press Command+E.

The DOS Compatible System

Apple now sells a complete 6100/66 system that includes the DOS Compatibility Card and DOS/Windows already installed. Different configurations are available for different hard disk sizes and for an optional CD-ROM drive. Other than the addition of the card, the Power Macintosh 6100/66 DOS Compatible system is identical to other 6100/66 systems—from the case down to the logic board.

CHAPTER

10

Inside System 7.5

Basic Features, Tips, and Tricks

System 7.5, like most versions of the Macintosh operating system, is easy to learn. But Apple added dozens of new features in System 7.5 and then decided not to publish a user's manual, other than a summary of some of the basic additions. That has left some users less than satisfied. Who has time to spend hours experimenting with new features, new extensions, new Control Panels, new utilities, and new bugs?

You probably don't, but fortunately I get paid to do precisely that. So, in this chapter, I'll unveil most of the new features and capabilities of System 7.5, including some detailed explanations about how the underlying technology works. This won't be a tutorial, though. Instead, I'll focus on practical ways to use the new features and utilities provided with System 7. I recognize there are tens of thousands of Power Mac users who still haven't upgraded to System 7.5 and are wondering whether they should. If you're in this camp, consider this chapter (and the next) your reveille wake-up call.

All Those Utilities

I've heard complaints from some Power Mac users that System 7.5 is "just System 7 with a bunch of bells and whistles added." System 7.5 is much more than that, although the sheer number of new utilities available in System 7.5 does tend to overwhelm the other features. Apple basically took a look at the more popular shareware and third-party extensions and Control Panels that users were adding to they systems, and decided to incorporate many of them into System 7.5.

Again, the new utilities by no means represent the extent of the new features in System 7.5, but they do provide a good place to begin. So, in the next several sections, I'll introduce you to many of these new add-ons and explain how you might find them useful. If you're tempted to mutter something like "What's the big deal? I've got that feature in my <fill in the blank> utility," resist the temptation until I've shown you the full range of features and functionality that have been added to the Mac OS. And that means you'll need to read Chapter 11 also.

The New File Finder

Speaking of finding, make sure you take a look at the new Find dialog box, which provides significantly better options for finding files on disk than were supplied with the older, aging Find utility used in earlier versions of the operating system. The Finder was due for a facelift, but Apple basically built it a whole new head. It's new one of the most powerful file-finding utilities I've seen from any operating system or application.

Figure 10.1 shows the old Find dialog box after it's been expanded to include all Find choices. (By the way, if you prefer this older Find utility, you can still access it within System 7.5 by pressing **Command+Shift+F.**) The problem with this dialog box is that it allows you to use only one set of search criteria. In other words, you can find a file that contains a particular text string in its name, or you can search for a file whose size is greater or less than a particular size, but you can't do both.

The new System 7.5 Find dialog box allows you to select multiple criteria in order to narrow or broaden the scope of the search in just about any way you want. Figure 10.2 shows the new Find dialog box with all search options expanded (an obsessive approach you'll probably never take, but it's useful for demonstration purposes). You'll probably never use more than

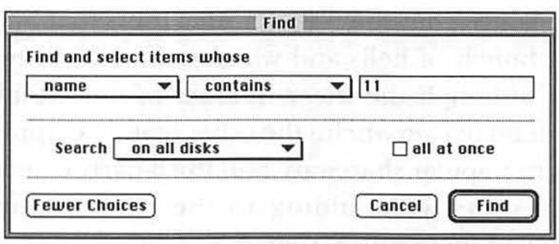


Figure 10.1 The old Find dialog box and its limited search options

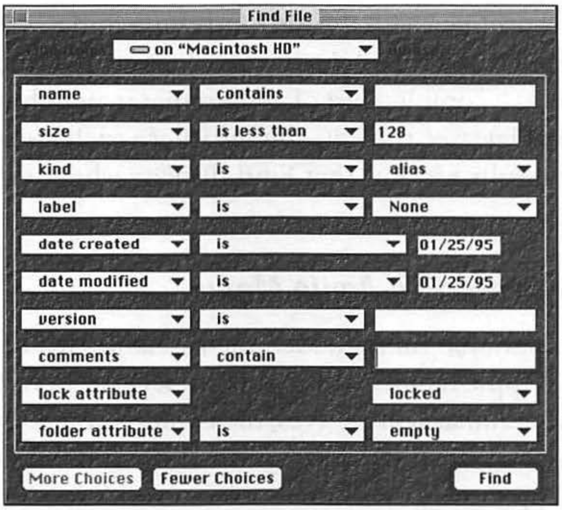


Figure 10.2 The new Find dialog box lets you select multiple search criteria and includes more search options

two or more search criteria at any given time, but the wide range of criteria offers you a lot of flexibility in looking for files.

For instance, you can have the Find utility search for a file that has certain characters in its name, that was created on February 20, 1995, and that is marked as a document. *All three* search criteria must be met in order for Find to retrieve a file. The options for date created and date modified have also been expanded to allow you to "guesstimate"—a useful feature if you know "about" when you created or last modified a file, but aren't 100 percent certain of the date. Figure 10.3 shows the options available for searching by creation date.

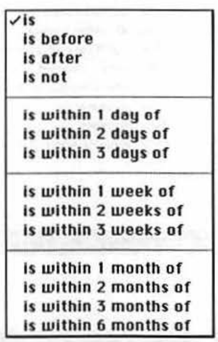


Figure 10.3 The date created and date modified options give you numerous alternatives to broaden or narrow the search for a file

The other major problem with the old Find command was that it only identified the first file that matched the specified search criteria. The new Find command displays a complete list of all files that match the search criteria, along with a List View tree that lets you see where each file is stored. Figure 10.4 shows the results window that Find displays when it locates multiple matching files.

The Cleverly Cascading Apple Menu

Apple, the company, has finally added the cascading feature to Apple, the menu. I suspect Apple felt pressed to do this because both OS/2 and Windows 95 include a similar feature (yes, the competition *does* do a few things better than Apple) and Apple didn't want to get left behind. In any case, the cascading Apple menu is a much welcome addition, not only because it's now easier to launch applications but because it helps prevent your desktop from becoming cluttered with open folders. Figure 10.5 shows an example of cascaded Apple menus.

One benefit of the new cascade feature, which Apple refers to as the display of "submenus," is that it makes it possible to cascade all of your Control Panels, as is shown in Figure 10.6. When you glance at this figure, you'll notice that several Control Panels have been added with System 7.5. (In fact, Figure 10.6 shows only a partial list of Control Panels.) I'll discuss these additions a bit later in the chapter.

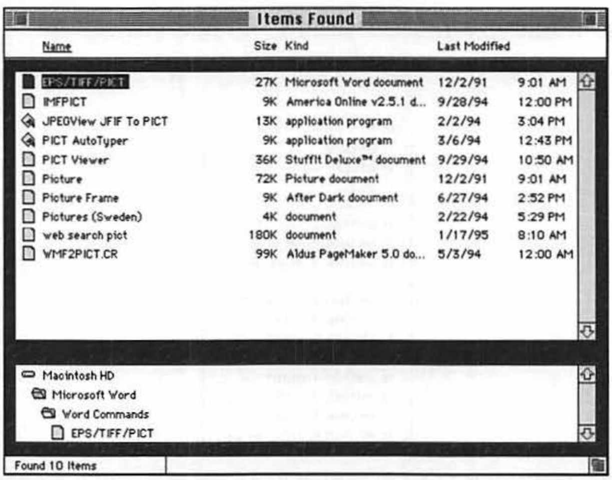


Figure 10.4 The new Find command displays a list of multiple matching files

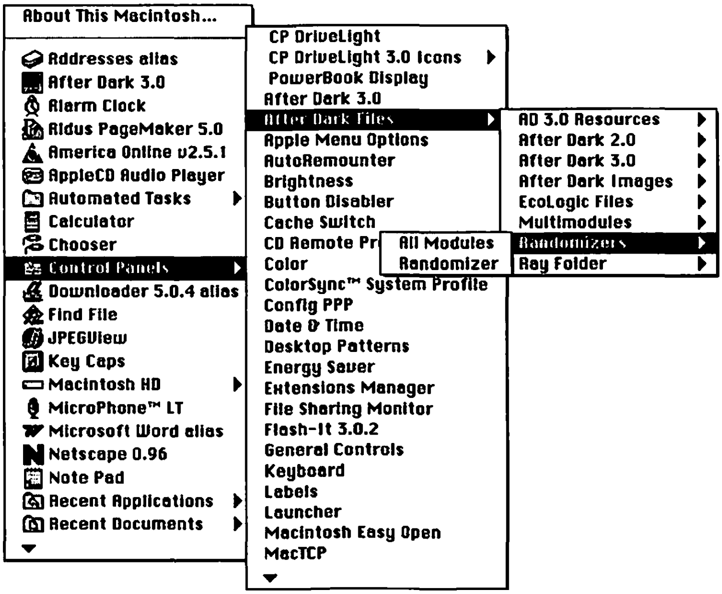


Figure 10.5 The cascade feature of the Apple menu makes it easier to find and launch your applications

Figure 10.6 In System 7.5, your Control Panels are all available from the Apple menu

The "Recently Used" Menus

Another benefit of Apple submenus is apparent when you try the new "recently used" menus shown in Figure 10.7. You access each of these menus from the "Recent Applications," "Recent Documents," and "Recent Servers" options, respectively. These menus, of course, provide a quick and convenient way to return to a previously used application, document, or network server.

The only quirk I've noticed in using these menus is the failure of the Recent Documents menu to add a document name to the list if you open the document but don't make any changes to it. When I open a document, I consider that I've "used" it, and therefore I think it should be added to the Recent Documents menu list. Apparently, Apple disagrees.

Customizing Recently Used Items

One nice feature about the recently used menus is the ability to customize their size. If you want to change the number of entries that appear in one of these menus, just select Apple Menu Options from the Control Panels list. Figure 10.8 shows the dialog box that will appear. I prefer to set the Documents value to 9 or more because I work with many, many different documents. The number of Servers you select will vary, of course, depending on the number of networked Macs you have access to and the number of these that you connect to on a regular basis. Notice, too, that you can use the Apple Menu Options dialog box to turn off the cascading (submenus) feature.

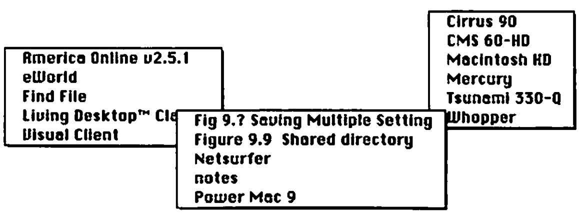


Figure 10.7 The Recent Applications, Recent Documents, and Recent Servers menus, available from the Apple menu

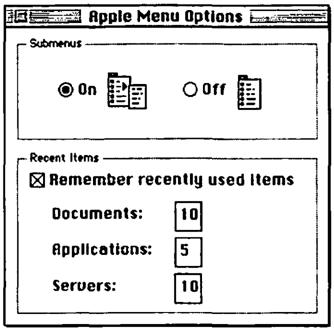


Figure 10.8 Use the Apple Menu Options dialog box to set the number of recently used items you want to appear in menus

Using Automated Tasks

Automated Tasks are a set of built in AppleScript scripts that are available from the Apple menu. (I'll explain more about AppleScript later.) To use any of the Automated Tasks, just highlight **Automated Tasks** in the Apple menu, and then highlight the task that you want to use, as shown in Figure 10.9. If you want descriptions of the full set of Automated Tasks, just click on **About Automated Tasks**.

The task you'll use most is Add Alias to Apple Menu, which provides an easier way to add programs and documents to the Apple Menu than was possible with previous versions of System 7. (Aliases were introduced with the first release of System 7.) To add an alias item to the Apple menu, just click on the item in its folder, then select **Automated Tasks|Add Alias to Apple Menu**.

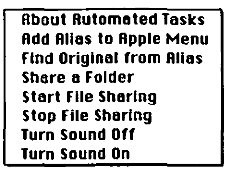


Figure 10.9 Use this menu to access the built-in Automated Tasks

Add All Your Programs and Documents to the Apple Menu

The discussion of the Add Alias to Apple Menu script leads to my favorite feature of the new Apple submenus: You can add all programs and files on your hard disk to the Apple menu by treating the hard disk as an alias. At first blush, it might seem like this would add a lot of complexity and disorganization to your submenus, but I find it to be a wonderful timesaver in finding and loading applications and documents. Figure 10.10 shows an example of some of the programs and files that are cascaded when you add the contents of your hard disk to the Apple menu. To add your hard disk content to the Apple menu, simply click on your hard disk icon, and then select **Automated Tasks|Add Alias to Apple Menu.** That's it.

You can also add any scripts that you create to the Automated Tasks submenu. (I'll explain how to create scripts a bit later.) Unfortunately, none of the Automated Tasks provide an easy way to delete an item from the Apple menu. To do so, you need to open the System Folder, then the Apple Menu Items folder, and trash the item that you want to delete.

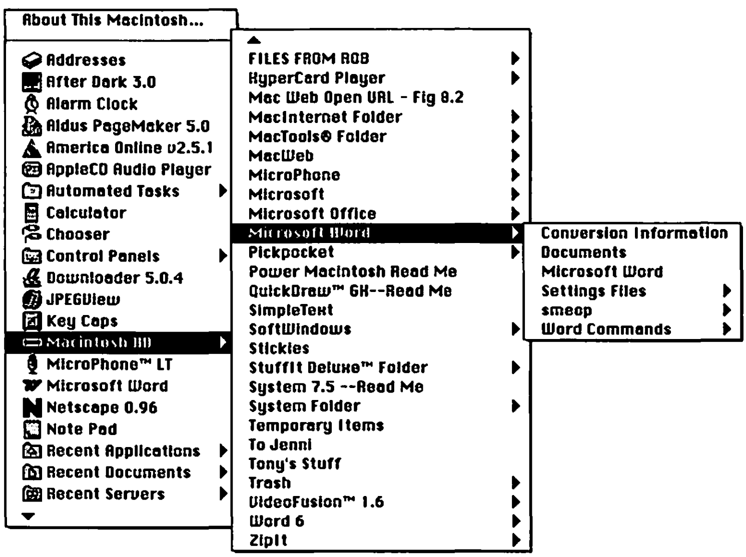


Figure 10.10 Adding the contents of your hard disk to the Apple Menu

Hierarchical File and Folder Display (List View)

As another bow to Windows and OS/2, Apple has added the capability to view folders and files in a hierarchical tree. Before I explain, let me add a slice of history. It's ironic that nested folders—that is, the ability to place folders within folders—has long been one of the Mac OS's greatest triumphs over PC operating systems, but it also creates one of the most problematic viewing situations. You can't see, at a glance, the complete contents of nested folders without opening each folder, one at a time, which can quickly make a mess of your desktop.

To remedy this situation, System 7.5 allows you to view the contents of nested folders as a hierarchical tree, as shown in Figure 10.11. Apple calls this new feature "List View." To use this feature, you need to select "by Name," "by Size," "by Kind," "by Label," or "by Date" from the View menu. If you've selected "by Small Icon" or "by Icon," you won't be able to use List View.

Basically, to view the tree structure of a folder, just click on the right-pointing triangle next to the folder name. Appropriately enough, that's called "expanding" the folder. To "collapse" a folder that's been expanded, just click on the downward-pointing triangle next to the folder name. I won't describe all of the options for using List View. You can find these out yourself by clicking on **Shortcuts** from the help menu, and clicking on **Working with list view.**

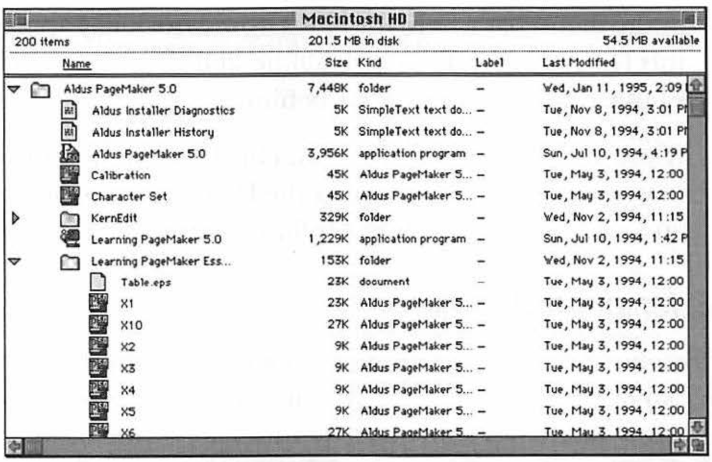


Figure 10.11 Use List View to view the hierarchical contents of a folder

Shut Down

Apple has added only one new desk accessory with System 7.5, and frankly, it's an addition whose benefit is questionable. There's a new Shut Down accessory that appears at the end of the Apple menu. If you're already in the Finder, there's no reason to use this menu item, since it's actually harder to get to than the Shut Down item in the Special menu. If you're in an application, though, it does provide a quicker way to shut your system down.

There's another difference between Shut Down from the Special menu and the Shut Down desk accessory. When you use the Shut Down command from the Special menu, any scripts or programs that you've put in the Shutdown Items folder (inside the System Folder) are automatically invoked before the system shuts down. If you use the Shutdown desk accessory from the Apple Items menu, your shutdown scripts and programs will not run.

HOT TIP

The Incredible Disappearing Clock Trick

You might already know that you can switch from the Clock's time display to the momentary date display by holding down **Command** and clicking on the clock. But you probably didn't know that you can also hide the clock in System 7.5 by holding down **Option** and then clicking on the clock display. To return the clock, just hold down **Option** and click on the location in the menu bar where the clock would normally appear. I use this feature when I'm on deadline and don't want to be constantly reminded of how far behind I am.

If you haven't already done so, check out some of the other new clock options by opening the Date & Time Control Panel and clicking on the **Clock Options** button.

The Extensions Manager

Until System 7.5, Apple did not supply a way to selectively determine which system extensions to use during system bootup. Since the selective use of extensions is mandatory for most sophisticated Mac users and for most troubleshooting efforts, it's not surprising that a spate of extension managers appeared on the market, including INITPicker, the Startup Manager in

Now Utilities, Extensions Manager (the freeware program from Ricardo Batista), Conflict Catcher, and more.

Apple finally succumbed to its user base by purchasing version 3.0 of Batista's Extensions Manager, modifying it, and supplying it with System 7.5. The Extensions Manager Control Panel is shown in Figure 10.12. You can turn extensions on or off simply by clicking on them in the list, and you can save custom sets of system extensions.

With System 7.5, Extensions Manager is especially valuable because the install program adds several extensions and Control Panels that you probably won't ever use or that you *can't* even use. (Some extensions only work with specific hardware configurations, including PowerBooks and 68040 Macs.) There's no sense in loading up memory and adding to your bootup time by allowing System 7.5 to run extensions and Control Panels that you don't need. Take a look at the descriptions of the new Control Panels in the following sections to determine which ones you can remove from your system.

The New Control Panels

Many of the new System 7.5 extensions have their own Control Panels to allow you to configure them. In the next several sections, I'll briefly describe the new Control Panels and how they're used (with the exception of the Apple Menu Items and Extensions Manager Control Panels, which I've already discussed).

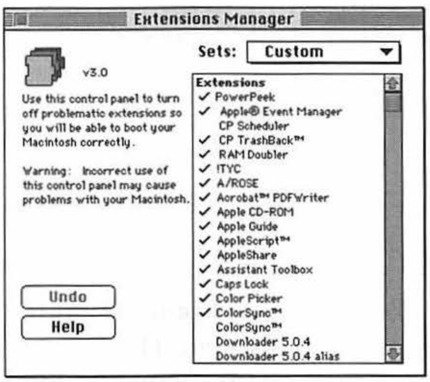


Figure 10.12 The Extensions Manager provided with System 7.5

Here's a list of the new Control Panels that are unique to System 7.5:

- Auto Power On/Off
- AutoRemounter
- Apple Menu Items
- Brightness
- Button Disabler
- Cache Switch
- Color
- ColorSync System Profile
- Config PPP
- Desktop Patterns
- Energy Saver
- Extensions Manager
- Launcher
- Macintosh Easy Open
- MacTCP
- Numbers
- ODBC Setup
- PC Exchange
- Power Macintosh Card
- Serial Switch
- Text
- Token Ring
- Trackpad
- WindowShade

Auto Power On/Off: You can use this Control Panel to specify times when you want System 7.5 to power off your system. This Control Panel is only available to 7100 and 8100 Power Mac users. Trash this if you own a 6100 Power Mac.

AutoRemounter: This Control Panel lets you define settings for automatically mounting a remote Mac's hard disk so that a PowerBook can use it after you've reawakened your PowerBook from its sleep mode.

Brightness: This Control Panel is totally useless on Power Macs, since it's designed to adjust the brightness on black-and-white Mac Classics. Trash it.

Cache Switch: This Control Panel is only available for 68040 Macs, which use a split-cache architecture, and is not available to Power Mac users. Trash it.

Close View: This utility allows you to magnify portions of the screen and to reverse the standard black text-on-white background view. You'll probably only need this feature if you or a member of your family is visually impaired. If your eyesight's fine, you can trash this Control Panel.

ColorSync System Profile: This Control Panel allows you to change the color settings for situations where the colors of your monitor don't match the colors that are printed on a color printer or that are input from a color scanner. ColorSync System Profiles are also installed automatically with the software that comes with some monitors. Unless you're doing sophisticated color processing, you'll probably never use this Control Panel. If you do need it, the ColorSync System Profile files are located in a folder within the Preferences folder, which of course is within the System folder. Apple does make life difficult sometimes....

Control Strip: This is another Control Panel for PowerBook users only. It provides some great options for configuring PowerBook options, but if you're using a Power Mac, this level of greatness is utterly worthless. Trash it.

CPU Energy Saver: This Control Panel is available on any Mac that can power itself off with the Restart button (which, for Power Macs, means 7100 and 8100 systems). You can use this Control Panel to set the time when your system should be powered off each day.

Desktop Patterns: System 7.1 included 42 desktop patterns that you could set from the General Controls Control Panel. In System 7.5, 64 desktop patterns are supported, and the new Desktop Patterns Control Panel offers you a better view of how these patterns will actually look on your desktop. Figure 10.13 shows the Desktop Patterns Control Panel.

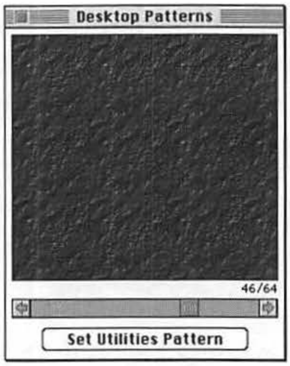


Figure 10.13 The new Desktop Patterns Control Panel

Easy Access: The Easy Access Control Panel makes it possible for disabled individuals who can only use one hand to work with their Mac. Easy Access functions by assigning the 5 key on the numeric keypad as the mouse button, while the arrow keys that surround this key allow the user to move the mouse pointer up, down, left, and right. For more information on using Easy Access, use the Macintosh Guide menu to select **Easy Access** Control Panel from the index. If you're not disabled, you can trash this Control Panel.

Energy Saver: You can use this Control Panel to power down your monitor after a preset period of inactivity, but *only* if you have a monitor that meets the EPA's Energy Star specifications (look for the Energy Star logo on the box your monitor was shipped in). Figure 10.14 shows the Energy Saver Control Panel.

General Controls: You're probably wondering why I've included this Control Panel, since it's been around since the inception of the Macintosh. Answer: The General Controls Control Panel is different in System 7.5, with most of the changes designed to prevent children, new users, and other clumsy folk from making basic desktop errors. The new General Controls Control Panel is shown in Figure 10.15.

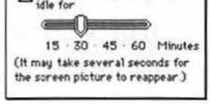


Figure 10.14 You can use the Energy Saver Control Panel to power down your monitor during periods of inactivity

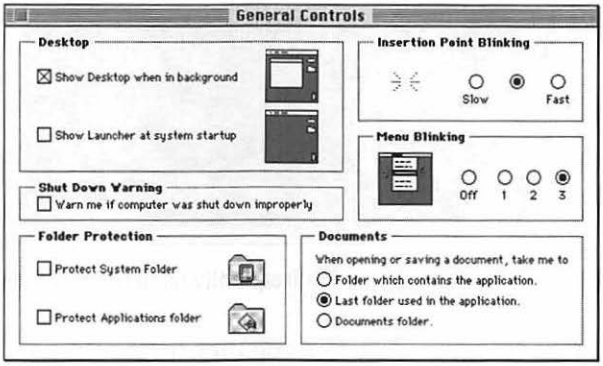


Figure 10.15 The General Controls Control Panel offers additional features that help new users and children work with the Macintosh

If you turn off the "Show Desktop when in background" option, you won't have access to icons on your desktop. This feature is intended to prevent users from accidentally switching away from an open application and thereby becoming confused. If you're an experienced Macintosh user, you'll want to keep this option turned on.

Turn on the "Show Launcher at system startup" if you want to use the Launcher to load frequently used applications. If you find the Launcher to be an annoyance, turn off this option. (I'll explain the Launcher next.)

The Folder Protection check boxes are designed to prevent children from dragging important files from their original locations, and the Documents buttons are designed to make it easier to locate the folder where documents are located.

Launcher: The new Launcher serves a function similar to the Startup Items folder (which is still available in System 7.5), except it gives you a bit more control over items that you want to run when you boot your system. Specifically, aliases that you place in the Launcher don't actually start up automatically when you boot your system, but the Launcher does. This allows you to add frequently used applications and documents to the Launcher so that you can easily select items that you want to launch. I suspect the new Launcher in System 7.5 has been added to help children gain easy access to their favorite programs. Experienced users might find it to be a waste.

In any case, Launcher is an actual application, so once it's loaded, it's available from the Finder menu at any time. In this way, you can keep frequently used

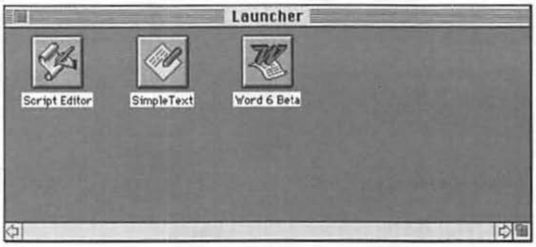


Figure 10.16 Use the Launcher to launch frequently used applications and documents

applications in the Launcher window, and then access the Launcher whenever you want to run an application or load a document that appears there. Figure 10.16 shows the Launcher. If you need assistance on using the Launcher, select **Macintosh Guide** from the Finder menu, then select **Launcher**.

Macintosh Easy Open: This Control Panel and its accompanying system extension allows System 7.5 to keep track of applications to be used in opening documents of different types. Easy Open automatically tracks and links file types and their applications based on your patterns of use, and then makes guesses about which application should be used to open a particular file type. Figure 10.17 shows the dialog box that Easy Open displays when it's not sure which application you want to open when you click on a particular type of file.

MacTCP: This Control Panel allows you to select and configure TCP/IP for use with a TCP/IP network. For more information on using and configuring MacTCP, see Chapter 8.

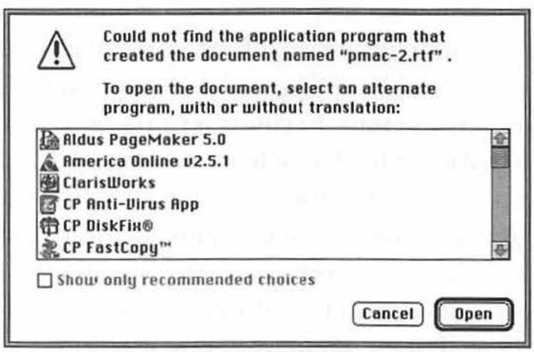


Figure 10.17 Easy Open displays this dialog box when it tries to guess which application to link with a particular file type

Find Out Who Helped Develop the Memory Subsystem in System 7.5

I haven't included the Memory Control Panel in this list because it hasn't changed from the System 7.1 version. But I would like to call your attention to a fun (and otherwise useless) feature of the Memory Control Panel. If you turn on Virtual Memory, and then hold down **Option** while clicking on the **Select Hard Disk** list box, you'll see a list of programmers who worked on the memory subsystem of System 7.5, and the additional popup menus contain their own brief, lunatic descriptions of themselves, as shown in Figure 10.18.

Try Adjusting the Gamma Setting from Your Monitors Control Panel

I've also neglected to describe the Monitors Control Panel here, because it's no different from its system 7.1 predecessor. However, there is an interesting trick you can perform from this Control Panel, and it's often a useful trick. Specifically, you can adjust the gamma (essentially the brightness) setting for your monitor by displaying the Monitors Control Panel, then holding down **Option**, and clicking on either the **Options** button or double-clicking on the Happy Mac face that appears in the monitors window. You'll then see the screen shown in Figure 10.19.

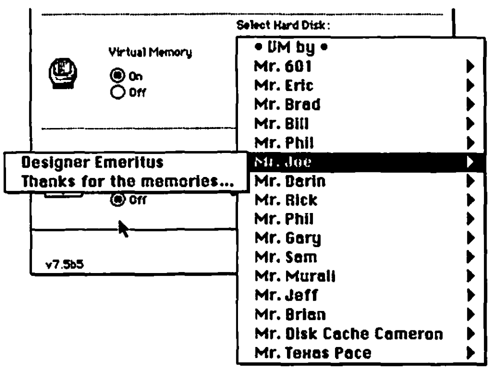


Figure 10.18 The list of credits for the programmers of the System 7.5 memory subsystem

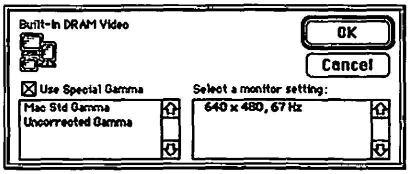


Figure 10.19 Use this undocumented screen to set the gamma level (brightness) for your monitor

Some creative types at Apple apparently felt like the "Uncorrected Gamma" setting (which is actually the true gamma setting) for most VGA and SVGA monitors was too dim, so they wrote a routine that boosts the brightness of monitors. They call this new gamma setting the "Mac Std Gamma."

You might want to try resetting your monitor to the "Uncorrected Gamma" setting to see if you prefer it. To test this setting, turn on the **Use Special Gamma** check box, select **Uncorrected Gamma**, and then click on **OK**. You'll immediately see the difference in your display.

I live in Arizona, and the harsh sun shines through my window even when my blinds are closed. As a result, I find that Apple's "Mac Std Gamma" setting is too washed out for my taste, so I use the "Uncorrected Gamma" setting. If you have a 16" or larger monitor, the dialog box shown in Figure 10.19 might contain other Gamma and resolution options. If so, try out the different options to see what you like best. You won't cause any harm to your monitor or your system by doing this, and you can always return to the default if you decide that you prefer that setting.

ODBC Setup: This is the Open Database Connectivity (ODBC) configuration manager that selects an ODBC driver and data sources for ODBC-compliant database management systems, which include dBASE, Clipper, FoxBase, and FoxPro. If you're not using an ODBC-compliant database system, you can trash this Control Panel.

PC Exchange: Use this Control Panel to link DOS file extensions (suffixes) with a particular Macintosh application. Figure 10.20 shows the PC Ex-

Figure 10.20 The PC Exchange Control Panel

change Control Panel. Use the **Add** button to define extensions and link them to applications.

Also, be sure to read the System 7.5—Read Me File that gets installed in the main folder of your hard disk. This file contains important information about using PC Exchange, along with information about known incompatibilities. At present, I don't consider PC Exchange to be a stable DOS diskette utility, so I highly recommend that you read this file if you're having any problems with your applications.

Power Macintosh Card: Use this Control Panel to turn you Power Macintosh Upgrade Card on or off. (You might want to turn it off if you're only using 68040 applications, a situation that's getting quite rare these days as native Power Mac applications increase in number.) This Control Panel is only available on Macintosh 68040 systems that have the Macintosh Upgrade Card installed. If you have an actual Power Mac system or a logic board upgrade, trash this Control Panel.

Serial Switch: For Power Mac users, this is another utterly useless Control Panel that should immediately be trashed. The Serial Switch Control Panel changes the modem port settings for Mac IIfx systems, so dump it.

Sound: The Sound Control Panel has been around as long as the Mac has been in existence, but it's been given an overhaul in System 7.1.2 and 7.5. You can now use the drop-down menu at the top of the dialog box, shown in Figure 10.21, to specify how you want to use Sound-In recording and Sound-Out playback.

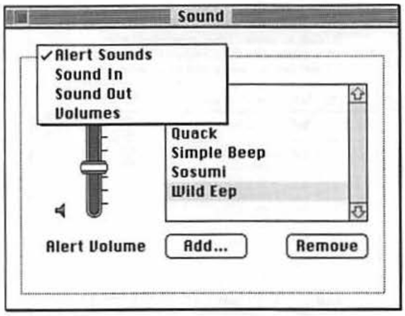


Figure 10.21 Use this drop-down menu to set Sound In and Sound Out defaults

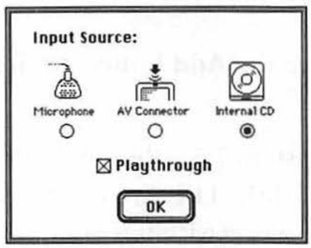


Figure 10.22 Use this dialog box to select Sound In settings for your Power Mac

Figure 10.22 shows the Input Source dialog box that appears when you select **Sound In** from the Sound dialog box's drop-down menu, and then select **Options**. If you want to input sound from a PlainTalk microphone connected to your Power Mac's Sound-In port, then leave the "Microphone" default setting in place. If you want sound to be input from your AV card (assuming you have one), you'll want to choose the "AV Connector" button.

If you want sound to be input from your CD-ROM drive, choose the "Internal CD" button. For all Sound-In options, if you want sound to play through your stereo speakers instead of through your built-in Mac speaker, turn on the **Playthrough** box.

For output sound, you can select **Sound Out** from the drop-down list in the Sound dialog box to display the Sound Out dialog box shown in Figure 10.23. You can change the sampling rate from 44.1 KHz to 22.05 sampling used by some older sound applications.

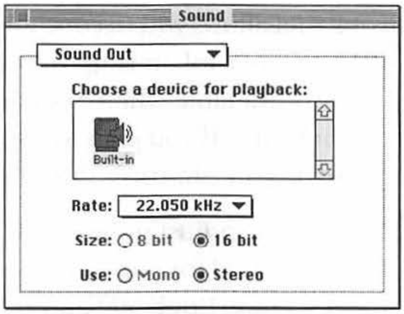


Figure 10.23 Use this dialog box to specify Sound Out settings

View and Listen to the Credits by the Sound Programmers

You can view the credit list of the programmers who participated in the System 7.5 sound subsystem development by holding down **Option** and clicking on the drop-down menu. You'll hear a '50's hipster utter "Wowwww!" and you'll then see the credits screen shown in Figure 10.24. It does make you wonder about the sanity of this Apple bunch. Bob Johnson couldn't even spell his name right.

Text: You can use this Control Panel to change the way sort order and case conversion operate within the Finder. You'll probably want to use this Control Panel if you live in a non-English speaking country that uses different sorting and case-sensitivity standards. Otherwise, trash this puppy.

Figure 10.24 Apple's sound developers' credit screen

Token Ring: This Control Panel allows you to configure settings to connect your Power Mac to an IBM or other token-ring topology network. Options in this Control Panel are only available when System 7.5 detects the presence of a Token Ring network card. If you plan to use an Ethernet network and/or an AppleTalk network, you can trash this one.

Trackpad: This Panel allows you to adjust pointer tracking on PowerBooks, and is not an available Control Panel for current Power Mac users. You can trash this, unless you've got a PowerBook 500 and plan on upgrading it to a Power Mac version. Even then, you're probably safe in trashing this Control Panel, since the software that will come with a Power Mac PowerBook upgrade will almost certainly include it.

WindowShade: This is one of my favorite new features in System 7.5. By default, if you double-click on the title bar of any window, System 7.5 will hide the window and keep only the title bar displayed—a great feature for selecting hiding and unhiding multiple windows that are on your desktop. Figure 10.25 shows the WindowShade Control Panel. Note that you can change the "hide" option from two mouse clicks to one click or three clicks. You can also set the hot key you use to hide and unhide windows and to produce a sound when you use WindowShade. Figure 10.26 shows several windows that have been reduced to their title bars only.

Macintosh Guide Help

With System 7.5, Apple introduced a new level of interactive help that is genuinely useful (unlike their Balloon Help, which I and most other users find to be an annoyance). Having offered that congratulations, I now need to chastise Apple for giving this same feature two different names—something that will only serve to *confuse* new users, not *help* them.

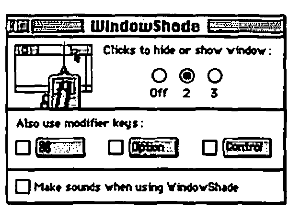


Figure 10.25 The WindowShade Control Panel

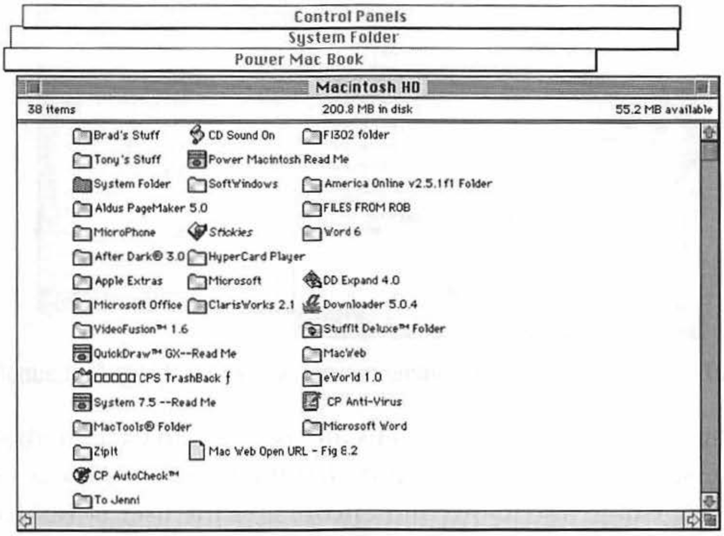


Figure 10.26 Several Windows with their "shades drawn" to make room for the current Window being used

The new help feature is called Macintosh Guide, or Apple Guide, depending on which dialog box you're looking at. I would think it shouldn't have been too difficult for Apple to pick one name and stick with it throughout the operating system, but never mind. Macintosh Guide or Apple Guide (I'll just call it Guide) is a great way to bring new Macintosh users up to speed.

The basic concept behind the new Guide system is to offer as much help as a user needs, and then, if the user doesn't feel comfortable in carrying out the instructions that the Guide provides, Guide executes the instructions for the user, explaining each step of the way what is happening and how it happens. If you're an experienced Macintosh user, you'll probably find most of the Guide features to be an irritant. That's okay. The Guide system wasn't designed for you; it was created to help new users function on the Macintosh with little or no assistance by providing interactive, online help in a manner that can substitute for a basic (and usually boring) tutorial system.

With the Guide, new users can select topics that they want help with, and then have the Guide display step-by-step screens that walk the user through procedures for completing the specified activity. Figure 10.27 shows a Guide dialog box that appears when a user asks for help on using the Launcher.

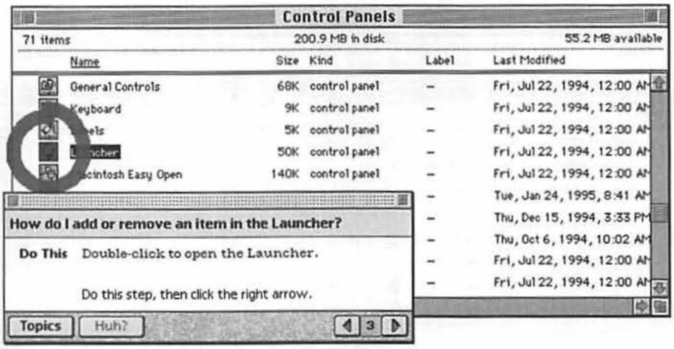


Figure 10.27 This Guide dialog box appears when you request help for Launcher

You'll note that the Guide system tells the user how to execute the step for him or herself, and circles the option that the user should select to carry out the step. Guide also allows and encourages the user to do just that—carry out the step for him or herself. If the user doesn't feel comfortable in executing the step, he or she can click on the Next arrow in the bottom-right portion of the screen. Guide interprets this to mean that the user is unsure about what to do next, and carries out the next step automatically, to show the user how it's done, as is shown in Figure 10.28.

That's the long and the short of it for the basic utilities—the extensions and Control Panels—that are new or different in System 7.5. The next chapter details some of the technical features that help make System 7.5 a truly prime-time operating system, including QuickTime 2.0, QuickDraw GX, and PowerTalk. Of course, no new operating system is a perfect one. So, in the next chapter, I'll also describe bugs and other problems you might have with System 7.5. Stay tuned....

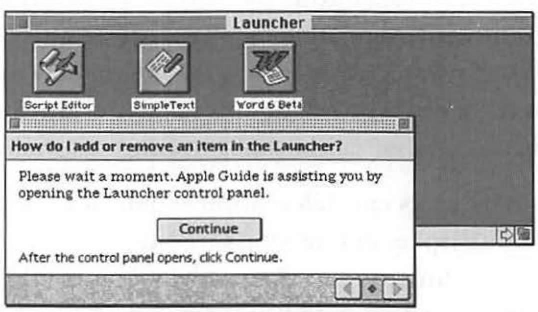


Figure 10.28 The Guide system will perform an operation for you if you're not sure how to do it yourself

CHAPTER

11

Power Mac System Software

The Technology and Its Future

Although the Power Macintosh operating system is currently System 7.5, it had its roots as System 7.1.2 and its future lies in a version that will no longer use the word "System" in its name. In this chapter, I would like to provide you with a technical view of the Power Mac operating system—from its inception to the present, and into the future.

From System 7.1 to System 7.1.2

When System 7.0 was first released in 1991, it marked the first major revision of the Macintosh operating system in many years, and for most users it was a very welcome revision. At the time, I was invited to a preview of System 7 at Apple's sales offices in Phoenix, Arizona. The demonstrations I saw were impressive. Apple had managed to completely revamp many significant components of the operating system, including improved file and memory management, better AppleTalk networking (although the networking interface was and still is clumsy), and better desktop navigation. And Apple pulled this off without significantly altering the look and feel of the Finder and the rest of the Macintosh graphical interface.

In mid-1993, when Apple software engineers were busy revamping System 7.1 (a minor upgrade to System 7.0 that mostly fixed bugs), their biggest challenge lay in pulling off the same stunt again, except the stakes were higher this time, and the marching orders were more complex: Revise the operating system for a completely new CPU instruction set without changing the look and feel of the existing operating system *and* allow all Motorola 68K-based Macintosh applications to run 100 percent cleanly.

That second requirement still makes me wary, even though it's been almost a year since the introduction of the first Power Mac systems, and it has become clear that Apple has been successful in its effort, with only a few incompatibilities that are too minor even to mention. And here's what is even more impressive: In determining how to revise System 7.1.2 to run native on the Power Macs and to support 68K applications in emulation, Apple employed a few strategies that actually *improved* the performance of System 7.1.2 over System 7.0 and 7.1.

Here's the story behind the technology.

Inside System 7.1.2: The First Native PowerPC Operating System

When Apple released System 7.1.2 during the rollout of the Power Mac systems in the Spring of 1994, they successfully achieved a milestone that IBM had expected to reach first—that is, to develop the first personal-computer operating system for the PowerPC architecture. It's true that IBM had already shipped a PowerPC 601-based workstation. But this system ran IBM's version of UNIX, which required very little conversion for the 601 chip since the instruction set of the 601 and the POWER RISC architecture are very similar. And UNIX is a workstation operating system; in general, unsuitable for the scaled-down hardware capabilities in Intel-compatible PCs and Macintoshes (aside from the Apple Workgroup Servers).

So why wasn't IBM, the creator of the PowerPC RISC architecture, able to develop a PowerPC operating system for its own Power Personal systems before Apple did so for its Power Macs? In part, the answer has to do with some ongoing bureaucratic nightmares and power plays within IBM management. But the broader answer lies in the different strategies taken by IBM and Apple.

IBM decided to rebuild its OS/2 operating system from the ground up, complete with a new microkernel architecture, hardware abstraction, support for symmetrical multiprocessor systems, and other advanced operating system features. In taking this approach, IBMers collectively bit off more than they could chew. As I write this, the world is still waiting for the announcement of even a beta version of OS/2 for PowerPC.

On the other hand, Apple chose to make the *minimum* number of changes required to run System 7 natively on the Power Mac platform. Apple's strategy proved to be the correct one, because even these "minimal" changes required more than 5,000 human hours of development and testing effort. If Apple had taken IBM's approach, you would still be waiting for the announcement of the first Power Mac systems.

Converting System 7 to Native PowerPC Code

I've already explained in earlier chapters that only about 10 percent of the Toolbox—the collection of routines that applications call to perform common processing functions—was converted to native code. I won't belabor that point here, except to stress that this 10 percent section of the Toolbox accounts for about 90 percent of the calls that applications make to the Mac OS. Aside from the Toolbox, the only other major conversion requirement was to make the *nanokernel* code run native on Power Macs. The nanokernel is a collection of assembly language routines that provide the basic instructions to the PowerPC CPU (currently the 601 chip for all Power Macs).

For this reason, nanokernel code had to consist of 100 percent native PowerPC instructions. 68K instructions fed directly into a PowerPC chip are like feeding antifreeze to your dog. Instant death. Only native PowerPC instructions can reside in the most privileged, supervisory level of a 601 chip.

There were some processor-dependent issues involved in revising the nanokernel for the PowerPC architecture, such as the number of interrupt levels supported by the architecture (one) compared to the number supported in the Motorola 68K architecture (eight). But these kinds of issues did not prove to be a serious problem. In rewriting the nanokernel, though, Apple engineers took the opportunity to correct a shortcoming in existing versions of the Macintosh operating system, one that derived from a limitation in early versions of the Motorola 68K architecture.

The Value of Fragments

System 7.1 and all other earlier versions of the operating system for 68K Macs allow applications to store code in memory only in 32K *segments* at a time. This limitation in turn severely restricts the way developers can pass variables and other data between different segments of a program, resulting in less than optimal program performance. The PowerPC architecture, on the other hand, does not limit the size of a particular block of code or data that can be stored in memory.

In optimizing the nanokernel and System 7 in general for the new PowerPC architecture, Apple changed the way memory management is performed. In System 7.1.2, code and *global data* (that is, data that can be used by any portion of a program and passed to any other portion of code) could be read into memory in units called *fragments*, rather than segments. A fragment can be any size, as long as a system's combined RAM and virtual memory can support it. And the optimal size of code and data fragments is determined by application developers, *not* by the operating system itself. This approach frees programmers to design applications that load and run faster and more efficiently.

The use of unlimited-size fragments instead of segments required changes to be made in the memory management capabilities of System 7.1.2. Consequently, several major alterations were made to System 7's Virtual Memory Manager, a component that many users have come to know and hate, because the use of the Virtual Memory Manager tends to slow the performance of applications.

The new PowerPC Virtual Memory Manager uses a *file mapping* technique to map an application's fragment into memory and to track the fragment's original location on disk. File mapping is controlled by a new system software module called the Code Fragment Manager. And the operations of this new module is one of the single most important, but one of the most misunderstood, benefits of System 7.1.2 and System 7.5.

With the earlier 68K version of the System 7, reusable segments of code are by default written to a "backing store" file that gets stored on your hard disk if Virtual Memory is enabled. Since virtual memory space is hard disk space—not the much faster RAM space—this often results in significantly slower performance of applications when virtual memory is turned on. If virtual memory is not enabled on a 68K Mac, the operating system only loads code segments when they are needed and then discards them (erases them from memory) when they are no longer needed.

With System 7.1.2 and System 7.5 for Power Macs, the new file mapping feature allows different segments to be swapped in and out of memory as they are needed. Physical RAM can store as many segments as will fit there (although that's based in part on the amount of RAM that an application reserves at startup time). When different segments are required to perform processing, they're often already currently resident in memory, whereas in 68K versions of System 7 (under virtual memory) they would be swapped out (back stored) to hard disk.

This entire process is possible because file mapping keeps track of a segment's storage location on the hard disk; if a particular segment of code has to be purged from physical RAM to make room for incoming code, it can be purged from RAM without having to swap it out to virtual memory. If this code segment is needed again by the application, the file mapping capability can find it quickly on your hard disk and retrieve it again.

HOT TIP

Forget What You've Heard: On Power Macs, Always Turn On Virtual Memory

I've heard from many, many Power Mac users who recommend that you turn off virtual memory (from the Memory Control Panel) because virtual memory slows down the performance of your Power Mac. This is very rarely true. On 68K Macs, virtual memory does provide a performance hit of 10 percent or more, for reasons I've described earlier. The performance penalty occurs regardless of the size of virtual memory on 68K Macs.

But the file mapping feature of the Power Mac operating system makes it possible to reduce the amount of swapping that needs to be made between physical memory and virtual memory. On Power Macs, when virtual memory is enabled, your system only loads and stores those code sections that are immediately needed for processing, an approach that's nearly identical to the one used on 68K Macs when virtual memory is *not* enabled. If a reusable code segment is loaded and then is no longer needed, your Power Mac OS tracks its location on hard disk, and then discards it rather than storing it to virtual memory as is done under the virtual memory scheme used with 68K Macs.

The bottom line is that you should always enable virtual memory on your Power Mac. If you experience a slowdown in performance with virtual memory enabled, just reduce the size of virtual memory to the lowest possible (1 MB) setting. By doing so, you'll still benefit from your Power Mac operating system's memory-management features without incurring any performance hit that might occur from maintaining a larger virtual memory hard-disk file.

There *are* a few applications and extensions that are not compliant with the Virtual Memory Manager, and might lead to system crashes from time to time. This is a problem with the applications or extensions themselves, though, and is not caused by the Virtual Memory Manager. However, if you identify that a particular required application or extension causes your system to lock with virtual memory turned on, you might have no other recourse than to turn off virtual memory. You can also selectively turn off virtual memory when you boot by holding down Command key during startup. However, this approach will not work if you have RAM Doubler installed.

For the most comprehensive collection of technical information regarding System 7.5, including problems and troubleshooting tips, get on the Internet and use your Web browser to go to **http://www.info.apple.com/til.html**. This is Apple's own Tech Info Library. Search on "System 7.5" to locate bugs and other technical reports on the operating system. The Tech Info Library is also available through AppleLink, eWorld, and CompuServe.

68K Emulation and the Mixed Mode Manager

As I've already suggested, the other major area of change required of System 7.1 for the Power Mac was the need to emulate Motorola 68K applications with 100 percent compatibility, and with as little performance degradation as possible. To support 68K emulation, Apple created a new system software component called the *Mixed Mode Manager*, which manages the mode switching required to support native PowerPC instructions and to emulate 68K application instructions in the PowerPC processor. I briefly described the Mixed Mode Manager in Chapter 1.

At the operating system level, the mode switching performed by the Mixed Mode Manager is fairly complex, but basically it works like this: If the Mixed Mode Manager encounters a 68K instruction, it "traps" it by preventing it from entering any of the CPU's instruction pipelines, switches to the 68K emulator, which converts the instructions to native PowerPC code, then passes the instructions back to the Mixed Mode Manager, which then inputs the native instructions to the CPU.

As you can imagine, this kind of mode switching exacts a performance penalty on a Power Mac because additional clock cycles are required to identify a 68K instruction. The CPU waits while the instruction is converted to native PowerPC code; these converted instructions are passed back to the Mixed Mode Manager, which then sends the native instructions to the CPU.

The bottom line is that few 68K applications run as fast on a Power Mac as they do on a comparably equipped 68K Macintosh. The good news is that few 68K Macs are "comparable" to the performance of *any* Power Mac. So you can run most 68K applications on your Power Mac without noticing any performance penalty; in fact, the application might actually run *faster* on your Power Mac if it mostly calls Toolbox routines that have been ported to native PowerPC code.

Apple developers did run into one interesting snafu, though, when they were designing the interface between the Mixed Mode Manager and the 68K emulator: Some Toolbox routines weren't called directly by applications, but were called instead as subroutines by other Toolbox routines that *had been* made native.

This situation defeated the advantages offered by the 68K emulator because a native Toolbox routine had to access the 68K emulator in order to run a non-native Toolbox routine, and of course switching time was involved in order to access the 68K emulator and then return to the native PowerPC environment.

To remedy this problem, Apple identified the subset of brief, seemingly obscure Toolbox routines that were being called frequently by native Toolbox routines, and converted them to native Power Mac machine code. The bottom line is that the vast majority of all System 7.1.2 code used to support both Power Mac and 68K applications had been ported to native PowerPC routines.

The end result was that the System 7.1.2 Mixed Mode Manager, designed specifically for Power Mac systems, was optimized to work with the 68K emulator designed and coded by Apple's Gary Davidian. And at this point, I need to reiterate that a Power Mac-optimized application is not necessarily exempt from calling the 68K emulator. In fact, many native Power Mac applications will require the use of the 68K emulator from time to time.

The reason is simple. If a Power Mac application calls a Toolbox routine that isn't PowerPC native, the routine needs to be emulated via the 68K emulator. So it's not unusual for the operating system to invoke the Mixed Mode Manager for both 68K applications and PowerPC applications. Figure 11.1 illustrates this procedure.

The LC68040 Emulator

The LC68040 emulator that's been built into all Power Mac's System ROM is the vehicle that allows 68K-based applications to run on PowerPC-based systems. The emulator itself is the portion of system ROM that converts 68K application code to native PowerPC code.

The emulator does, in fact, emulate the instruction set of a Motorola 68040 CPU, except that it does not support the Motorola 68881 and 68882 floating-point instruction set. In fact, that's how the 68LC040 emulator got its name, since it is more similar in capability with the 68LC040 chip than with other Motorola 68040 CPUs. This can be a major debility when you run a few 68K applications on Power Mac systems. Applications that check for and require the presence of either a co-processor chip or an on-board 040 math co-processor may fail when they are run under the PowerPC operating system.

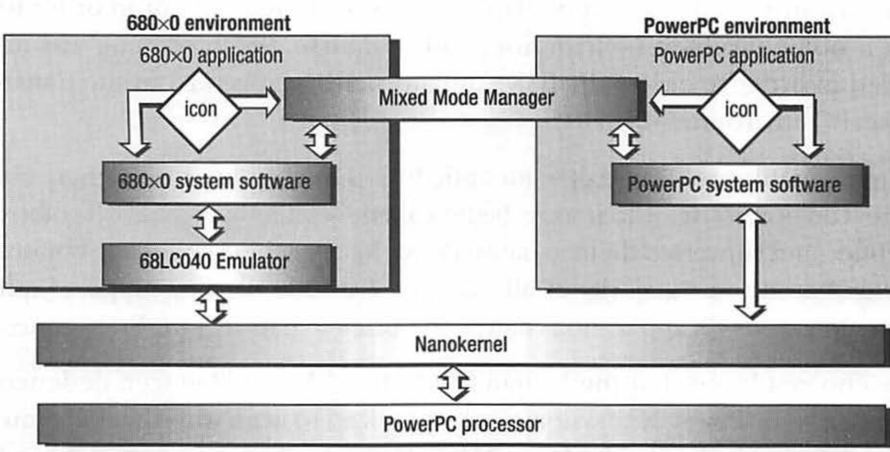


Figure 11.1 This diagram shows how 68K and Power Mac applications each invoke the LC68040 emulator

As I mentioned in Chapter 1, this problem will not affect the majority of Power Mac users because most 68K applications that can use a 68881 or 68882 floating-point unit will still execute their own built-in math libraries (or use the Apple SANE math library) if they don't detect the presence of an FPU. Only a few 68K applications actually fail if they detect the absence of an FPU (and these applications are looking for a 68881 or 68882 FPU, so they won't detect the FPU on the 601 chip). The only way to remedy this problem is to use a software patch, such as the one provided by John Neil & Associates (415-661-2943), which transforms your application's floating-point instructions into Motorola-native floating-point instructions. For more information on this product, see Chapter 7.

Other Emulation Issues

Most of the other differences between the 68LC040 emulator and true 68040 CPUs are either cosmetic or do not affect 99.99 percent of the 68K applications in use today. However, there are two emulation issues that are important to the operations of the Power Mac systems themselves:

- Clock timing
- Cache usage

I've talked to several users who are dubious about the speed capabilities of 68K emulation since even the fastest 68040 is much slower than even the slowest 601. This belief is untrue for two major reasons. First, most 68K applications operate independently of instruction timing, so execution of code is not linked to the speed of any particular processor or system clock limit. Second, the 68LC040 emulator submits instructions to the Mixed Mode Manager as fast as they can be accepted, which essentially means that the 68LC040 can operate as fast your Power Mac's system clock permits.

Cache usage by the 68LC040 emulator does present some problems for Power Macs, but not for the reasons that most users might think. In other words, the 68LC040 does not support the operations of the on-board cache unit on 68040 CPUs, but this by itself does not present a problem on Power Macs. The 68LC040 uses the on-board cache present in all PowerPC chips, so caching is still supported during emulation. On the 601, the 32K unified cache is generally sufficient for supporting 68K emulation.

However, because the 68LC040 emulator converts 68K code into native PowerPC code, the number of instructions issued to the CPU can mushroom into three or more times the number that would be issued on a 68K Mac. In many cases, there is no single corresponding PowerPC instruction for a 68K instruction; when no match is available, the emulator must convert the 68K instruction into a block of multiple PowerPC instructions.

For this reason, adding an L2 cache card to your 6100 or 7100 Power Mac (8100 systems all have L2 cache cards) is the single most important way to boost the performance of 68K applications. With 256K of additional cache space, more emulated code can be stored for reuse, which means that the emulator can spend less time re-emulating instructions whose native Power Mac blocks are already present in the cache.

The increase in instructions that the emulator produces severely crippled early versions of the 603 PowerPC chip. This chip contained a split cache, with an 8K instruction cache and an 8K data cache. With only 8K of space available for caching, the emulator had to work overtime re-emulating repeated instructions because there was no space for them to be cached. The 603 + chip overcomes much of this problem by boosting the size of the instruction cache to 16K (the data cache also is 16K in the 603 + chip).

The Future of 68K Emulation

68K code emulation will probably always be a necessity for most Power Mac users, simply because a lot of applications, extensions, and other software components will never be converted to native Power Mac versions. Their creators or vendors either no longer support the product with upgrades, or are out of business themselves.

Of course, as more 68K applications are recompiled and optimized into native Power Mac versions, 68K emulation will become less important. But for the time being it's important for Apple to make 68K emulation as fast as possible. When the 68K emulation performance problems of the 603 chip surfaced, Apple began conducting code traces to determine whether any areas of emulation could be improved. As it turns out, instructions that form a loop—that is, the set of instructions is executed repeatedly until a loop-ending instruction is encountered—were being re-emulated each time the loop was being executed.

In programming, there's a substantial difference between a subroutine and a loop—a subroutine is a section of code directly called by another instruction in the program. In an instruction cache, an instruction and any subroutines that it calls can be placed into the cache if room permits. On the other hand, a program treats a loop explicitly as instructions that need to be reissued, repeatedly. This distinction, duly followed by the 68LC040 emulator, means that each time a loop is executed, its instructions are reconverted to native PowerPC instructions—even if they already reside in the cache. If a loop gets executed 100 times, the continual mode switching and emulation slows performance significantly—and a larger cache does nothing to help this process.

Apple has reportedly been developing a revised 68LC040 emulator that overcomes this problem by converting a loop into a native PowerPC subroutine, and converting the instruction that starts the loop to a native instruction that calls the subroutine. In this way, the native instruction and the entire native subroutine can be cached and can be re-executed as native code, directly from the cache.

Satisfying the User: Upgrading System 7.1.2 to System 7.5

As I explained in Chapter 10, most of the new features in System 7.5 are the host of utilities that add user services to previous versions of the operating system. I've run through these pretty thoroughly in Chapter 10, so I'll stay away from that area here. But a few of the new features actually add functionality or performance enhancements that directly help applications run faster or do more. Here are the major changes that actually extend or modify the underlying architecture of System 7.1.2:

- Improved drag and drop
- Larger hard disk support
- DOS file support
- TCP/IP support
- Built-in scripting
- QuickDraw GX

- PowerTalk
- QuickTime 2.0

Improved Drag and Drop

The System 7.5 Toolbox now offers support for increased *drag-and-drop* functionality, a general term that's long been used to describe the ability to click and hold on text, graphics, or some object, and then drag it to a different location. Desktop drag and drop has been available on the Macintosh for years in the form of dragging icons from one location to another. But Apple has kept drag-and-drop capabilities curiously absent for cross application use or even for something as simple as dragging a file to a printer icon to instantly print the file.

System 7.5's new drag-and-drop capabilities now include the ability to drag text, data, and graphics from one application into another application—without having to use the intermediate steps of copying and pasting to and from the Clipboard. The only drawback with this new feature is that applications must be written to directly support the advanced drag and drop. And since most Macintosh applications were converted to native Power Mac versions before System 7.5 was released, few developers have incorporated drag and drop into their applications.

In fact, the only System 7.5 built-in utility that incorporates the new drag-and-drop capabilities is the Scrapbook. You can get a glimpse at how this feature works by opening the Scrapbook and then dragging a scrapbook item to the Desktop, as shown in Figure 11.2. In this figure, System 7.5 creates a new icon for the dragged and dropped object. Unfortunately, you probably won't be able to drag the icon into any application unless you have one of the few applications that is drag-and-drop compliant. It's nice to know this knew feature exists, but it won't be really useful until newer Power Mac native applications are upgraded to support it.

Large Hard Disk Support

There's not much to be said here, except that System 7.5 now supports hard drives that can store up to 4 GB of data. That's good news for AV users, who can achieve better movie storage and playback capabilities with custom AV hard drives, which are large by nature but can be even larger with System 7.5.

Figure 11.2 Applications that support drag and drop allow you to move them from the application to other drag-and-drop compliant applications or to the desktop, as shown here with the picture clipping removed from the Scrapbook

DOS/Windows File Support

I touched on this enhancement in Chapter 10 when I briefly discussed the new PC Exchange and Macintosh Easy Open dialog boxes. PC Exchange is the new built-in utility for reading DOS diskettes, displaying them on the desktop, and writing to and reading from these diskettes. This feature isn't new for many Mac users since it's been available through third-party vendors for years. But System 7.5 is the first operating system release that makes this feature available to all Macintosh users as a built-in facility.

Basically, PC Exchange translates the DOS diskette track-and-sector format, along with the file and directory structures, into a Macintosh-compatible format so that all Macintosh applications can access data from these diskettes transparently. PC Exchange also allows you to format DOS diskettes by using the Erase command from the Special menu in the Finder.

The other major DOS/Windows compatibility feature in System 7.5 is the increased support for data translation/conversion for Macintosh applications that support DOS/Windows document formats. I demonstrated the EasyOpen Control Panel in Chapter 10. Basically, this Control Panel allows you to associate DOS file extensions with Macintosh applications that support those file types. EasyOpen also tries to guess which Mac applications support a particular DOS/Windows file that you try to open from the desktop, and then gives you a list of potential applications. You can then select the one that you want to use to open the file.

TCP/IP Support

In Chapter 10, I also touched on TCP/IP support as it relates to the Mac TCP Control Panel that's now built into System 7.5. Basically, TCP/IP is a communications protocol stack (and stands for Transmission Control Protocol/Internet Protocol) that came into widespread use for UNIX servers and UNIX networks. Unlike most UNIX software, TCP/IP become popular for a reason that can be summed up in a single word: Internet. If you want to access the Internet, you have to begin with a TCP/IP stack that allows your Macintosh to handshake with the UNIX servers that basically dominate the Internet realm.

To provide TCP/IP and Internet support, Apple built its Mac TCP extension into System 7.5 so that Power Mac users have an easy route into the Internet and the World Wide Web. I showed you Mac TCP in Chapter 10 and provided an in-depth explanation of Internet and Web access using Mac TCP in Chapter 8, so for more information on this, you might want to look there. Also, Mac TCP is often essential for connecting your Power Mac to a UNIX server in your office, should that type of connection be of interest to you.

Built-In Scripting

In Chapter 10 I briefly touched on AppleScript, Apple's attempt to unseat QuicKeys as the predominant utility for creating and executing macros, or programs that launch other programs or execute a series of keystrokes, mouse clicks, and other commands. QuicKeys users whom I've talked to have been slow to look at, much less adopt, AppleScript, mainly because they're comfortable with QuicKeys.

But AppleScript is worth a look, even if you've grown accustomed to using a different macro or scripting utility. AppleScript is actually not new with System 7.5, but it was previously only available to developers and was in limited distribution on online services. I wanted to address AppleScript in more depth in this chapter because it really is more than a utility—it's a powerful language for automating frequently used tasks.

To use AppleScript, you need to open the AppleScript Utilities folder and choose **Script Editor**, which is the tool that creates and edits scripts. If the

AppleScript Utilities folder isn't in your hard disk folder, you probably need to install it. To do so, open the Apple Extras folder, then open the AppleScript 1.1 folder, open the AppleScript Setup folder, and run the AppleScript Installer.

When you run the Script Editor, you'll see a window like the one shown in Figure 11.3. Before you create a script, enter a brief description in the Description box. Then click on the **Record** button. You'll notice that the Script Editor is recording your actions because you'll see a flashing tape cassette icon in the menu bar, as shown in Figure 11.4.

To record your script, simply carry out the steps just as you would within the Finder or within other applications that support AppleScript. The AppleScript recorder will convert each command that you select into AppleScript language commands. When you are done recording a script,

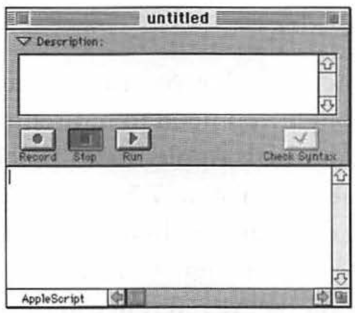


Figure 11.3 The Script Editor Dialog Box

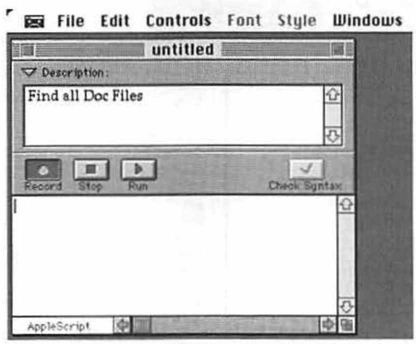


Figure 11.4 The Script recorder displays a flashing cassette icon whenever a script is being recorded

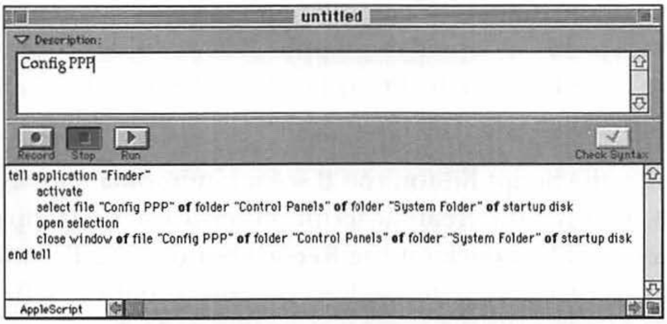


Figure 11.5 A completed script created by executing a series of mouse clicks

switch back to the AppleScript application and select the **Stop** button. The text will display the code that AppleScript uses whenever you run the script. Now save the script just as you would save any document. Figure 11.5 shows a brief script that I created to automatically use Config PPP to start my modem and dial my Internet provider.

A nice feature of AppleScript is that you can edit any script you create. Before you can do this, though, you need to have some understanding of the AppleScript language. Although Apple doesn't really provide a manual of the AppleScript language with System 7.5, they do provide you with several example scripts that you can run and then view with the Script Editor, along with a HyperCard stack called "Language at a Glance." This stack, shown in Figure 11.6, is an online interactive reference to the AppleScript commands,

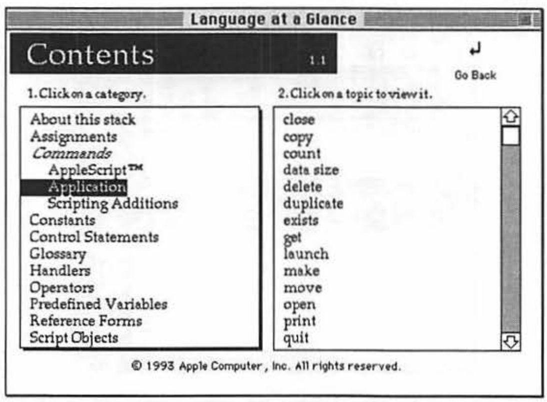


Figure 11.6 The HyperCard AppleScript "Language at a Glance" reference and interactive tutorial

including examples. Unfortunately, the stack is buried in the AppleScript Setup folder within your Apple Extras folder, so you have to look for it.

Add a Script to Your Automated Tasks for Easy Access

A script isn't very useful if it's difficult to find and run. After you save a script, I suggest you add it to your Automated Tasks folder (in the Apple Menu Items folder within the System folder). When you do this, the script will be available at any time from the Apple Menu. Figure 11.7 shows the Config PPP script after I've added it to the list of Automated Tasks.

Now all I need to do is select this item from the Apple Menu and run it. For this technique to work, though, you need to save the script as an Application, *not* as a Compiled Script. If you save the script as a Compiled Script, Apple will launch the Script Editor, and simply display the script. You can run it from there, of course, but the time required to launch the Script Editor defeats the purpose of running a script automatically. When you save a script as an application and then launch it, you'll see a dialog box similar to the one shown in Figure 11.8.

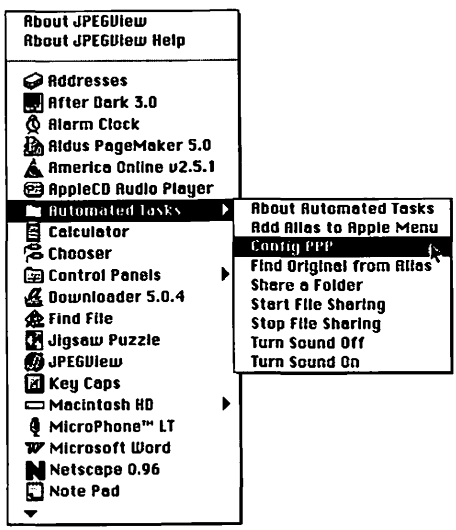


Figure 11.7 The Config PPP script added as an Automated Task to the Apple Menu

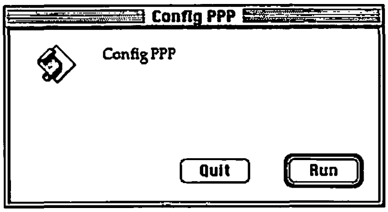


Figure 11.8 When you launch a script from the Automated Tasks menu, Apple displays a dialog box similar to this one

QuickDraw GX

Although QuickDraw is essentially an upgrade of the QuickDraw Toolbox used to drive QuickDraw laser printers, it is also much more. QuickDraw GX allows you to display and control selected printers via printer icons on the Macintosh desktop. To print a document, you can simply drag the file to a printer icon. Since you can have multiple printer icons on your desktop, you can choose to send a document to different printers. A new print dialog box lets the user select among multiple printers without having to use the Chooser.

QuickDraw GX's printer icons work much like a network print queue, and replace the Print Monitor. If you choose a printer icon, a print queue status window appears. You can then use the queue to reorder, postpone, or delete documents in the queue—you can even drag a document icon to a different printer icon to switch it to a different printer.

Another benefit of QuickDraw GX also supports a new *portable digital document* format, which makes it possible to print the document from a different Macintosh (assuming that it, too, is running QuickDraw GX), without requiring that the other Macintosh have the application or fonts used to create the application. This is especially useful in desktop publishing where applications like PageMaker normally make font substitutions when you move a document to a different system that doesn't have all of the original fonts. Instead of printing such a document from PageMaker and essentially creating a printed mess, you can save the document as a portable document so that any other QuickDraw GX-equipped Macintosh can print it in its correct format—fonts and all.

Other features of QuickDraw GX will require developer support, including improved font management, improved color matching between different input and output devices, and improved graphic routines for rotating, stretching, skewing, and drawing. Few applications currently support these features, although Adobe has released ATM GX, a new ATM (version 3.8) font engine that incorporates much of the new GX technology.

QuickDraw GX has its drawbacks, and some significant ones. First, it's a memory hog and adds about 2 MB to your System Software memory allocation. In fact, you can't even install QuickDraw GX on your system if you don't have at least 16 MB, and 24 MB is the preferred minimum.

Another problem is that Apple elected to release QuickDraw GX 1.0 even though many printer manufacturers do not yet have updated printer drivers available to support GX. The result is that many users have installed QuickDraw GX only to find that nothing prints or that garbage prints when they use their standard printer driver. In fact, QuickDraw GX is not compatible with Apple's own LaserWriter 8.1.1 driver that ships with System 7.5. Apple now makes an updated LaserWriter 8.2 driver that reportedly fixes these and other printing problems.

QuickDraw GX 1.0 also seems to be quite fussy about system extension problems, and crashes or misbehaves with even the most slightly flawed extension setup.

HOT TIP

Performing a Clean Install with System 7.5 Is Much Easier Than with Previous Versions

To remedy many QuickDraw GX compatibility problems, Apple recommends that you perform a "clean install" of System 7.5. The clean install procedure corrects many other chronic system errors. Performing a clean install on System 7.1.2 and earlier operating system versions was a pain because you had to manually copy your System Folder to a backup location before reinstalling the operating system.

In System 7.5, performing a clean installation is much easier. Launch the System 7.5 Install program from your System 7.5 CD or from your first install diskette. When the installer window is open, press **Command+Shift+K**. You'll then see the dialog box shown in Figure 11.9. Click on **New System Installation.**

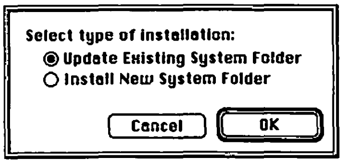


Figure 11.9 Select New System Installation to reinstall a clean version of the Macintosh extensions while creating a backup version of your existing System folder

The installer won't delete your existing System folder; instead, it will copy your existing extensions and Control Panels to a backup named "Previous System Folder." You can then try running the clean installation to make sure all of your applications behave properly. You can then reinstall QuickDraw GX or move your other non-Apple system extension into the system folder.

PowerTalk

PowerTalk was first released with System 7 Pro in October of 1993, and is most useful if you network or use online services heavily. PowerTalk provides you with a single mailbox and a single interface you can use to browse and search for information, regardless of the number of communications services you use. You can use your PowerTalk mailbox to store and send mail for all online services, many networks, and for faxing.

The PowerTalk AppleMain service also provides a mail option for applications so that mail can be attached to documents for easy viewing from an open application. However, applications must directly support this feature, and few do at present.

An additional feature of PowerTalk is built-in PowerShare client software. PowerShare extends the capabilities and features of AppleTalk networks, including improved network security and better consolidation of information catalogs and gateways on services. The PowerShare Collaboration Servers software is a separate product and is not provided with System 7.5, something that confuses many users. PowerTalk with System 7.5 gives you only the client side. You won't find PowerTalk to be of much use unless you are linked to a network that provides a PowerTalk server.

Much of PowerTalk is in its infancy, as is the Apple Open Collaboration Environment (AOCE) technology on which it is based. In 1995 and 1996, expect to see more cross-platform AOCE capabilities, including support for Windows clients (already announced). The end result of PowerTalk and AOCE will be improved cross-platform support for networks, especially between Macintosh client/server technologies and Windows client/server technologies.

Until then, though, I suspect that most Power Mac users will recognize few if any benefits from PowerTalk. Unless you are sure that you need or want PowerTalk, I do not recommend that you install it, since it can add 1 MB or more of System Software overhead to your RAM. PowerTalk, like QuickDraw GX, can only be installed on systems that have at least 16 MB, and a 24 MB minimum is recommended for optimal performance.

QuickTime 2.0

QuickTime 2.0 is an upgrade of the QuickTime 1.6 version that was made available with System 7.1.2. There has been some confusion about the new capabilities of QuickTime 2.0. I suspect that much of the confusion directly stems from the fact that QuickTime is a multiplatform technology, and Apple has been closely coupling its QuickTime 2.0 for the Macintosh marketing and sales material with QuickTime 2.0 for Windows materials. But the two versions have somewhat different capabilities, due largely to hardware differences built into the two platforms.

QuickTime 2.0 ships with System 7.5, and it is also available on a few online services and comes bundled with most Power Mac native video capture and editing software packages, such as Adobe Premiere for the Power Mac. New features in QuickTime 2.0 for the Macintosh include support for MIDI-compatible music tracks, 4:1 audio compression ratios, and interactive movie playback over networks. Although QuickTime 2.0 technology can play an MPEG movie, you need a MPEG video board to do this. The AV capabilities of Power Macs at present do not support MPEG output without this hardware addition.

However, you can work around this problem by obtaining Maynard Handley's freeware program called Sparkle (currently version 2.3). With Sparkle, you can play and convert MPEG movies with any additional hardware support. Sparkle 2.3 is a fat application, which means it contains both the 68K and native PowerPC code sections. You can find the most current version of Sparkle in the Power Mac archives at the University of Michigan's Internet and Web sites. (See Chapter 8 for more information.)

Although the QuickTime 2.0 compression algorithms are the same as those used in earlier versions of QuickTime, Apple improved QuickTime's data handlers so that the compression algorithms work more efficiently with the Macintosh OS. The new data handling technology is called Data Pipeline, and you'll notice its effectiveness mostly in the smoother playback of movies.

Although QuickTime 2.0 for Windows does support full-screen, full-motion video, QuickTime 2.0 for the Macintosh does not, but as I explained in Chapter 10, this is a hardware problem. Theoretically QuickTime 2.0 for the Macintosh does support full-frame, full-motion video, but you'll only get this level of performance when the new PCI-based Power Macs are introduced later in 1995. With current Power Macs, the best frame you'll probably be able to achieve is a 15 to 17 fps capture rate at full-screen display (640×480), or 30 fps at half screen (320×240). For playback, you can achieve rates as fast as 24 fps by tinkering with your video software settings.

Even with the improved frame rates that QuickTime 2.0 supports, you often won't be able to achieve this playback level with movies that were created under QuickTime 1.6 or earlier.

Movie Capture and Playback Tips with QuickTime 2.0

Although you might not get the frame capture and playback levels that you had expected, there is much you can do to improve the frame size and rate on Power Macs. Never set your monitor's color depth to millions of colors when playing or capturing movies. Use either the thousands setting, if that's available, or 256 colors. The millions of colors setting is useful for still graphics, but it seriously degrades the performance of QuickTime movies.

If you want to play movies to a TV monitor, you must first disable the RGB display mode used on your Macintosh monitor. To do this, start the Monitors Control Panel, select **Options**, and then choose **Display video on television**. When you do this, your Macintosh monitor will go dead and the video signals will be sent to the video-out port on the AV card.

If you want to achieve a higher frame rate on playback, and you don't mind a little jerkiness, set your video application to allow lossiness (this is called "frame skipping allowed" with StudioPro). You should also experiment with other playback settings for your movie software. For best results, purchase a JPEG video card if you have a 7100 or 8100 and an available NuBus slot. If you're playing back from a CD, try copying the movie to your hard disk instead, and play it back from there. CD-ROM drives are notoriously slow, and playback rates consequently can suffer.

For optimal video capture rates, there are several steps you can take. The best approach is to add a JPEG compression card because this removes the time required for QuickTime 2.0 to perform its compression algorithms. If your movie is short, you can try capturing it directly to RAM, which is almost always faster than capturing to hard disk. The key here, of course, is to supply as much RAM as possible. Also keep in mind that speed hits occur at all levels of a system. Turning off system extensions and unnecessary Control Panels will boost both video capture and playback rates, as will closing all other applications when capturing and playing back movies.

QuickTime VR

Apple is also working on a version of QuickTime, due out sometime in 1995, that will be able to take a collection of images and combine them into a 360-degree wraparound view to form what could become an awesome virtual-reality viewing system. Right now, Apple is saying little about QuickTime VR, so we'll have to see if its promises will be delivered.

Moving Toward MovieTalk

In early 1995, Apple plans to extend its video capabilities for System 7.5 by introducing MovieTalk, a set of plug-ins to QuickTime 2.0 that will provide built in videoconferencing features for all AV Macintosh users (or with any Macintosh system that uses a separate NuBus video board). MovieTalk will make it unnecessary for parties in different locations to use the same videoconferencing software because the features will be built into all Macintoshes that employ MovieTalk. And MovieTalk will include hooks to allow MovieTalk-aware applications to send and receive data, graphics, and even movies. For instance, users at different locations could view the same spreadsheet and whiteboard data and could collectively make changes to the data.

MovieTalk is expected to run over most networks, including Ethernet, AppleTalk, TCP/IP, and RTP networks. MovieTalk will also work with PowerTalk to extract and work with networking information catalogs and other networking data managed by PowerTalk.

Troubleshooting System 7.5

There are a few known bugs in System 7.5 aside from the problems that I've discussed in earlier sections. Here, I'll explain many of the more common problems and what you can do to solve them. In earlier chapters, I mentioned that the leading cause of System and application crashes in System 7.5 stem from incompatible third-party (non-Apple) drivers, extensions, Control Panels, and applications. In Chapter 10, I explained how to use the Extensions Manager, which is similar to INITPicker and other extension management software. One of the best packages for detecting system extension problems is Conflict Catcher, by Casady and Green. A limited-use version of Conflict Catcher for the Power Mac is provided on the CD-ROM with this book. With Conflict Catcher, you can save hours of time turning off extensions one at a time, rebooting your system, and on and on. I highly recommend it.

Some extensions cause memory conflicts when they vie for system resources during startup. Often, changing the load order of extensions can solve this problem. One solution that works is to assign one or more "Z" characters at the start of the extension name. Since Extension Manager loads extensions in alphabetical order, this will place the problematic extension at the end of the load order, reducing the chance that it will cause problems for other extensions, which have already been loaded. You can't rename extensions directly from within the Extensions Manager; you have to do it from the Extensions folder (within the System folder).

HOT TIP

Resetting Parameter RAM Often Removes Crashes and Conflicts

Parameter RAM (PRAM) is battery-controlled RAM that retains Chooser, Control Panel, and other startup settings. With System 7.5 on Power Macs, you can reset the parameter RAM easily by restarting your computer and holding down **Command+Option+p+r**. When the system encounters this key sequence, it will reboot again (you'll hear the startup chord a second time) and it will reset PRAM to its original state. Users who experience frequent application and system crashes often report that this eliminates the problem. Try this approach before you reinstall your system folder (as explained in an earlier Hot Tip in this chapter) since it's faster and sometimes more effective. If you get error messages in applications that report "No FPU Installed," resetting PRAM almost always works.

You Can Boot Up System 7.5 from Your CD-ROM Drive

There have been a lot of reports circulating that you can't use the System 7.5 CD to boot your system. That's true *only* if you are using System 7.5 on something other than a Power Mac. Currently, Power Macs provide the only CD-ROM driver that will allow System 7.5 to boot your system from the CD. So don't bother making an emergency startup diskette if you have a Power Mac, System 7.5 on CD-ROM, and a CD-ROM drive. Just keep your System 7.5 CD handy, for those rare Sad Mac crashes.

Do remember to remove the System 7.5 CD when you're ready to restart your computer using the system software installed on your hard disk. Since the Power Macs do not eject CDs automatically when you turn off your system, you might forget that the System 7.5 CD is in the drive; when you restart the system, it will start from the CD instead of from your hard disk—even if your StartUp Disk Control Panel is set to your Macintosh Hard Disk. (Makes you wonder why to even bother to include this Control Panel, doesn't it?) You can eject your CD-ROM during a restart by restarting the system while pushing in and holding the CD-ROM eject button until the drive opens.

Inside Copland

Before I close out this chapter, I want to provide you with a glimpse of Apple's next-generation operating system, currently code-named Copland. I'm always hesitant to describe something that doesn't currently exist, especially since Apple has changed the feature set and release date of Copland so many times. But I think it's worth a look so that you can see where Apple is heading.

The changes reported to be incorporated in this next-generation operating system (now slated for mid-1996) run the gamut from cosmetic ones to major overhauls to the lowest-level operations in the existing System 7.5.

Although Apple had originally promised Copland's final release for mid-1995, that time frame has been pushed back a year. Apple is discovering what both Microsoft and IBM have already learned: A major overhaul of an operating system requires hundreds of thousands of human resource hours for development and testing.

There are other reasons for the delay, though, the most substantial one being the need to get more of the Macintosh operating system and its I/O subsystems out of ROM and into software. This is essential for a successful cloning program, and to make it easier for AIM platform developers to design systems that can run multiple operating systems. I'll run down some of Copland's expected changes next, starting with the most cosmetic and progressing to the most substantial and technical ones.

What's in a Name?

Although Apple hasn't formally christened the new Copland operating system with a name, Apple has publicly announced that all future versions of the operating system will drop the System X.X nomenclature and will instead be known by the generic name, the "Mac OS." This makes sense since Apple will be licensing the operating system to third-party clonemakers for installation into their Mac clone systems. Apple wants the "Mac" name to be clearly associated with all later releases of its operating system. Even the current Macintosh System 7.5 package ships with the new Mac OS smiley face logo.

A New GUI for You

Apple is giving the Finder and Desktop graphical user interfaces a major facelift with Copland. You'll able to eject diskettes by dragging them to a "Put Away" icon rather than the Trash, and you'll be able to work in the background while your system performs lengthy file copy and backup operations. You'll probably have a lot of new options for the ways in which you can view, drag, name, and organize your folders and files.

The new user interface is currently slated to be called the Appearance Manager, and it will be highly customizable to support the way you want it to look and respond. You'll be able to decide how you want dialog boxes to appear, you'll be able to select colors for all different components of the desktop, and you'll be able to arrange where you want different icons, menu bars, and other components to appear. You'll probably also be able to change, distort, warp, and do pretty much what you want to the appearance of dialog boxes, from 3-D sculpted appearances to off-the-wall looks that even your mother couldn't appreciate. Of course, if you want the Appearance Manager to look exactly like System 7.5 looks now, you'll probably be able to do that, too. But if you want the new GUI to have your name and personal imprint all over it, that'll be a lot easier to do than it is now.

The user interface is now a vast collection of Toolbox routines that applications can call, and that approach will likely be the same one used in Copland, but an entire new suite of routines will be available to applications. That means you'll be able to customize much of the Finder and Desktop appearance when you install Copland right out of the box, but your applications might look pretty much the same as they always have. That's because your applications will probably have to be rewritten to take advantage of the new Toolbox routines.

For longtime Macintosh users, the Appearance Manager might seem like a minor, almost worthless addition. But keep in mind that Apple is trying to evangelize the Mac OS to the rest of the PC world, too, including Windows, OS/2, and even UNIX users. Don't be surprised if you have options to make the Mac OS look and behave more like these other operating systems. If you don't want to exercise these options, that's fine. But they're there for the asking.

Of course, supporting a new set of Toolbox routines and other APIs while maintaining the existing Toolbox means more hard disk and memory overhead. If Apple approaches this problem craftily, they'll allow you to throw away or suppress some routines from loading. That's a long-standing complaint of Macintosh users—they can't control the amount of RAM that System Software occupies, other than turning off extensions and Control Panels selectively. You really have no control over the code libraries that System 7.5 loads and makes available to applications.

More Native PowerPC Code, but Not Much

Reports are that many of the new system routines and hardware drivers are being written solely in native PowerPC code, and that the first release of Copland will be available only to Power Mac users. That seems fitting since

Apple can expect a majority of Macintosh users to have migrated to the Power Mac platform by mid-1996. You might also expect that a larger portion of the existing 68K Toolbox will be converted to native PowerPC routines. Some will, but most won't. There's just not enough performance gain to justify the trade-off of the thousands of human development hours that would be required to do this, and too many other, more important OS upgrade tasks have priority.

Preemptive Multitasking and Protected Memory

System 7.5 contains a Thread Manager that makes it easier to manage processes for multiple applications and their documents stored in memory. But the operating system still can't truly manage processing requests for two or more applications simultaneously, the way OS/2 and Windows can manage multiple processes. System 7.5 still uses a *cooperative multitasking* approach in which an application can voluntarily give up its processor time when it is idle. Other applications that are requesting access to the processor can then take over.

That's not as efficient as preemptive multitasking, where the operating system maintains control over processor time, and determines which applications get processor time (and when and how long they get it) based upon whether their current activity of the application is more processor-intensive than processes in other open applications. In a preemptive multitasking environment, the operating system can do just that: preempt an application's execution momentarily to allow another application to perform higher-priority processing.

For instance, the operating system can determine that your modem software is receiving packets from an external source fast and furiously, while your printer is leisurely composing a graphics page at the same time. The modem software could receive relatively more processor time than the printer because the modem "needs" the additional processor resources to operate effectively at high speeds, while the printer takes longer to time-out and can probably function well with less processor time.

Copland is expecting to move toward a true preemptive multitasking environment, but will continue to support cooperative multitasking for applications that expect this approach. So Copland will really be a hybrid of cooperative and preemptive multitasking.

One problem inherent in all preemptive multitasking systems is the need to isolate different running applications and their processes in memory so that they don't view for identical memory space. This type of protected memory approach has long been in use with Windows 3.1 and has been optimized for safer performance with IBM's OS/2.

With Copland, Apple is planning to take a different approach. Instead of isolating and protecting memory space for different applications, Copland will load the Toolbox into memory and protect that space. The idea is that memory conflicts are more likely to occur when two or more applications try to call the same Toolbox routine or try to access the same Toolbox memory space. By protecting the operating system code itself, Copland will prevent this type of memory contention.

The Microkernel Approach

Perhaps the single most ambitious approach Apple adopted in developing Copland was committing to a *microkernel* architecture. A bit of history is in order here.

The first microkernel-based operating system was developed in 1986 by a team of researchers, headed by Richard Rashid, at Carnegie-Mellon University. The Carnegie-Mellon team addressed several UNIX problems, but focused on two problems that have long plagued the UNIX community.

The first problem: New capabilities—typically to support new and more powerful applications—had to be added to UNIX in layers, with higher layers dependent on system services provided by lower layers. In theory, it was possible to remove one layer and replace it or update it with another layer, but in practice this approach often failed. Removal of a given layer of system services tended to send the entire system crashing to its knees. So UNIX, as originally designed, wasn't very *extensible* over time—that is, developers couldn't extend its capabilities easily and elegantly.

The second problem: Applications written for UNIX were not very *portable*. Every RISC architecture, and even some systems that share a specific RISC architecture, uses its own version, or flavor, of UNIX. The result is that applications written for one version of UNIX often don't run under other versions of UNIX—a major headache for application developers and for users.

The Carnegie-Mellon team solved both problems by creating a microkernel that runs in the most privileged state of the CPU, sometimes called the supervisor state or kernel because this state determines which process or software request can take control of the processor at any given time. In other words, the microkernel manages the CPU itself. Other system services, such as requests for control of a file, a hardware device, or a portion of memory, are written as separate routines that must call on the microkernel in order to gain access to the CPU.

The first cut of the Carnegie-Mellon microkernel operating system was called Mach 1. The Mach microkernel design is the basis for most other microkernel architectures in use today. The Mach microkernel design has come to be called a client/server architecture because the microkernel portion of the OS acts as the server for other operating system services, which are treated as server-dependent clients. Since all client services had to be implemented via the server (the microkernel architecture itself), it was possible to develop client services that were independent of one another. New "layers" of extended features really weren't layers at all—they were simply spokes around a microkernel hub.

Different services could communicate with each other, but all communications were routed through the microkernel—enforcing a uniform standard of interaction among servers. This approach made it easy to "grow the UNIX system" by plugging in servers that added functionality to the base system.

The Mac and the Microkernel: Is It a Good Marriage?

The concept of portability led Microsoft to develop one of the first microkernel operating systems outside of UNIX—Windows NT. Even though Mac users sometimes think that Bill Gates is out to get them, the truth is that Gates has always held a cover-the-earth approach to Windows. Any platform that wants it can have it. Thanks to Windows NT's microkernel approach, it has been easy for Microsoft, often with the help of third parties, to develop versions of NT for the Intel platform, for the PowerPC platform, and for other RISC architectures. More markets mean more sales, and Gates very well knows this.

In deciding to redesign its operating system around Copland, Apple was not really motivated by the portability concept. At the time, Apple was still planning on keeping its operating system proprietary—available only in Apple's own Macintosh systems. Apple was far more motivated by the concept of extendibility. Apple wanted future operating system designs to be less limited to hardware subsystems, "layers" if you will, and easier to adapt to new user demands and development trends.

Adapting an existing operating system to a microkernel architecture is tantamount to redesigning the OS from the ground up, so Apple's decision was a bold one. But Apple had already invested heavily in Taligent, a jointly held software venture with IBM and Hewlett-Packard, and a direct product of the initial Apple/IBM/Motorola agreement. The major goal of Taligent was to develop a collection of frameworks, or objects that could be mixed and matched in a way that allowed users to choose what services the application would perform.

Taligent is well on its way to releasing its application frameworks, which Apple wants to incorporate into Copland. Apple is developing its own set of framework-like objects, called "intelligent agents," which are similar to macros but are far more powerful. An intelligent agent can be set up to perform certain tasks when certain conditions are right—for instance, to check a user's E-mail, sort the mail by category, delete certain unwanted messages, and notify the user at given times throughout the day about the types of messages that have arrived and which ones should be read or responded to first.

The whole concept behind frameworks and agents is to allow users to build their own applications that reflect their individual work habits and personal requirements. But this approach is much easier to execute with a microkernel operating system architecture, rather than the linear, hierarchical approach currently used in System 7.5 and earlier versions.

Hardware Abstraction: The Final Link to the Outside World

An added benefit of a microkernel architecture is the ability to *abstract* hardware drivers outside of the microkernel and other operating system services. This kind of *hardware abstraction layering (HAL)* makes it possible for Apple to remove the long-standing close link between hardware I/O subsystems and the System 7 nanokernel. Until very recently, hardware abstraction has not been deemed essential to Copland. But Apple's new attitude about encouraging cloning and creating a common platform standard with IBM makes it almost essential. The more that hardware drivers can be unwound from the operating system core and made independent as versatile device drivers in software, rather than in ASICs (application-specific integrated circuit chips), the easier and more cheaply manufacturers can build clones.

Copland will almost certainly support hardware abstraction so that fewer subsystem chips will be required on the logic board and less of the operating system will need to be stored in ROM or be used in the nanokernel. Apple has their priorities straight and their objectives clear. The question now is whether they can deliver their next-generation, state-of-the-art product within a time frame that's competitive with Microsoft's release of Windows 95.

CHAPTER

12

The Power Mac Book! CD-ROM

Native Power Mac Software and More

This chapter in part describes the contents of the CD-ROM disk that comes with this book and is intended to help you install and use the software. But the chapter is more than just a tour of the CD-ROM disk. It will also provide you with some tips for evaluating, purchasing, and upgrading software, and I'll begin by providing you a list of native software commercially available at this writing.

When Apple began shipping the 6100, 7100, and 8100 Power Macs in the Spring of 1994, they announced that their objective was to sell 1 million Power Macintosh systems within one year. But a lot of naysayers in the media and from other walks of life gave the Power Macs little hope of rising to popularity. The word on the street was that Apple needed to convince hundreds of developers to write native Power Mac software, and the natively available software in the Spring of 1994 was a pretty meager lot.

The naysayers would have done well to remember the quote from *Field of Dreams:*

"Build it and they will come."

Well, Apple built their Power Macs and, sure enough, the native applications came to market. At first, they came in small numbers. Then, the field become more crowded, and now the commercially available native software packages for Power Macs number over 300. Table 12.1 at the end of this book is a list of the commercial packages that were available at the time

I wrote this. But the table is already obsolete, because developers are announcing and shipping new Power Mac applications almost every week.

The naysayers were right in one regard: The success of the Power Macs would rely on the number and quality of native Power Mac applications available to users. But they were wrong in thinking that developers would balk at porting their existing Macintosh or Windows applications to native Power Mac versions. There is no shortage of native Power Mac applications, as you can see by taking even a cursory glance at Table 12.1. The result? Apple sold its 1 millionth Power Mac in January, 1995—they reached their goal two months ahead of schedule.

And now everybody wants to get in the act. Developers of shareware and freeware programs for the Power Mac are everywhere, evidenced by the growing list of native software available from America Online, eWorld, CompuServe, the Internet, and from other online services. So, there's no shortage of native software for use on your Power Mac, and the partial proof is the CD-ROM supplied with this book.

Using the CD-ROM Disk

The Power Mac Book! CD-ROM is packed with software that will help you be more productive and gain more enjoyment from your Power Mac system. With a few exceptions that I'll explain, all of the software on this disk is Power Mac native, so these programs take advantage of the speed of your system. Also, I've tested and used all of these programs in an attempt to ensure the quality of the CD. If you have any problems with this CD or the software installed on it, please E-mail me at:

`rrpronk@aol.com`

I'll do my best to provide you with a prompt response. I have Internet, eWorld, and CompuServe addresses, too, but I spend most of my online time on America Online, so if you want a quick response, that's the best address to use.

Many of the programs are "fat binaries," which means that the program contains both 68K and PowerPC code; a fat binary identifies your machine type when you launch the program, so whenever you run a fat binary it will automatically run the PowerPC version on your Power Mac.

The Shareware Concept: Just a Reminder

Some of the programs on the CD are scaled-down or limited versions of their commercial parents. I've included several of these "demo" programs on the CD to help you evaluate whether you are interested in the commercial versions. If you like a demo program and decide to purchase the commercial version, I'll tell you who to contact to do so. In any case, the demo versions on the CD are yours to keep, free of charge.

A few programs on the CD are freeware or "postcardware," and don't cost you anything. (Postcardware authors typically ask you to drop them a line letting them know how you like the program.) Other programs are shareware, which means the authors request that you send them a small contribution for their effort—typically $5 to $50. If you like a particular program and you decide to use it, send the contribution. I do. Personally, I would hate to see the shareware concept die.

Neither I nor Coriolis Group Books profits from this CD and its contents (although the cost of manufacturing the CD is included in the purchase price of the book—hey, we gotta make a living, too). The software included here is intended to help you learn more about available Power Mac applications and to become more productive. If you want to pay for a particular shareware program, don't send the payment to me or to Coriolis Group Books. Send it to the people who put in the hours of mental and physical labor to bring you the products.

The next several sections describe each program you'll find on the CD-ROM and explain how to install or run the program.

From System 7.1 to System 7.1.2

All JPEG converts PICT files to QuickTime Photo-JPEG and other compression formats. This program is useful for including PICT images within your QuickTime movies. You can run All JPEG directly from the CD. Open the All JPEG1.0 fat folder and double-click on **All JPEG Fat 1.0** to run the program. When you open a PICT file, All JPEG automatically converts it to JPEG format and stores the converted image in the same folder as the original PICT file.

If you hold down **Option** while opening a PICT file, All JPEG will display the Compression Settings dialog box shown in Figure 12.1. You can use

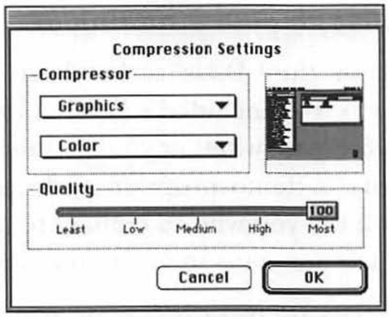


Figure 12.1 All JPEG's Compression Settings dialog box

this screen to change the compression format to Animation, CinePak, Component Video, Graphics, None, or Video. You can also use this dialog box to switch between Color and Grayscale and to determine the level of quality (resolution) you want to use for the image to be converted.

All JPEG is freeware and is written by Paul C.H. Ho.

All MIDI 1.1.2

All MIDI converts MIDI files to QuickTime 2.0 movies (audio). To start All MIDI, open the All MIDI 1.1.2 fat folder, and double-click on the **All MIDI Fat 1.1.2** icon. All MIDI is freeware and is written by Paul C.H. Ho, who also authored All JPEG, although All MIDI is a more robust application. For instructions on using this application, read the brief All MIDI 1.1.2 README file provided in the folder.

Apple's Scripting System

A few of the programs on the CD require these system libraries. You should copy these to your System folder only if you're still using System 7.1.2. If you're running System 7.5, these libraries are already part of your system.

Audiodeck 2.0.6

Audiodeck is an audio CD player for 68K Macs and Power Macs. The design of the CD player interface is as good as the AppleCD Audio Player supplied with all CD-ROM equipped Power Macs, but it is much more versatile than Apple's CD player. The Audiodeck interface is shown in Figure 12.2.

Figure 12.2 The Audiodeck CD player

Here are just a few of Audiodeck's features that are not supported by the AppleCD Audio Player:

- Can automatically play inserted CDs
- Can force internal CD input and enable playthrough
- Plays adjacent tracks in shuffle and program mode without skipping a beat
- Allows you to disable or enable individual tracks in shuffle mode
- Includes Balloon Help

Although you can run Audiodeck 2.0.6 from this book's CD disk, it doesn't make any sense to do so, since you won't be able to use it with any audio CDs! I suggest that you copy the Audiodeck 2.0.6 (FAT) icon into your Apple Menu Items folder (inside your System folder) and run it from there.

Audiodeck comes with extensive documentation, and is written by David Lebel. The program is "CDware," which means that David asks you to send him a CD of your choice to him if you like the program. You can send him a CD at:

David Lebel
2350 Édouard-Montpetit #14221
Montréal, Québec
Canada, H3T 1J4

BijouPlay 2.0

BijouPlay is a QuickTime movie player and takes advantage of many new features in System 7.5 and QuickTime 2.0. Here are a few of its features:

- Allows multiple open movies
- Allows you to edit and modify QuickTime Music tracks
- Lets you create Slide Shows of movies for presentations

- Includes a Print to Video feature for saving movies to videotape
- Includes a Find Text feature for movies that have Text tracks
- Uses the System 7.5 Thread Manager for improved playback
- Includes AppleGuide interactive online help

BijouPlay 2.0 is freeware and it can be run directly from the enclosed CD. However, if you want to use it to play movies stored on CD-ROM, you'll need to copy the BijouPlay 2.0 icon to your hard disk (along with the BijouPlay 2.0 Guide icon if you want Balloon Help for the program). Be sure to read the extensive README files supplied on the CD. They offer great tips on using the software.

Binary Pump 2.01

Binary Pump is a utility that performs two basic functions: Identifies binary files and places files into user-defined folders. The ability to easily identify binary files can be important if you frequently exchange files IBM PC, UNIX, or other non-Macintosh users. Binary Pump overcomes the problem you'll encounter when you try to open a file created by a non-Mac program, and the Macintosh can't identify the application to use to open the file. Binary Pump attempts to analyze the contents of these non-Mac files and sets their file type and creator correctly. Binary Pump is not a file format converter, so it won't alter the contents of binary files.

You can run Binary Pump from the CD, but I suggest that you add it to your desktop or to your hard disk. Then, you can simply select any files that you want to identify and drag them to the Binary Pump icon. (Of course, you can start Binary Pump, and then use the dialog box to open the files that you want to identify.)

Binary Pump is created Eric Shieh, and he requests $20 (or whatever you think it's worth) as payment. You can write to Eric at P.O. Box 1235, Danville, CA 94526.

Blue-Skies

Blue-Skies is a weather display system written by University of Michigan student Alan Stermberg under a National Science Foundation grant. Blue-

Skies is designed to provide an extremely user-friendly interface so that users with a minimal computer background (great for kids) can find weather information from around the world.

To use Blue-Skies, you need to have MacTCP configured (see Chapter 8), along with an Internet account, because the program accesses the Gopher server at the University of Minnesota. Blue-Skies provides access to interactive weather maps, weather animations, famous weather events, and information on air pollution.

You can run Blue-Skies directly from the CD. To use Blue-Skies, double-click on the **Window to Blue-Skies** icon to open the menu shown in Figure 12.3. Then click on the icon for the type of weather or other environmental information you want to access. This system was designed for K-12 students, but it's useful and fun for all ages.

CalConvert 1.2.1

CalConvert is a great utility for math students and for programmers. It converts integer values to different bases (any base between 2 and 32). You can run CalConvert directly from the CD simply by clicking on the CalConvert FAT icon. Figure 12.4 shows the CalConvert window, in this

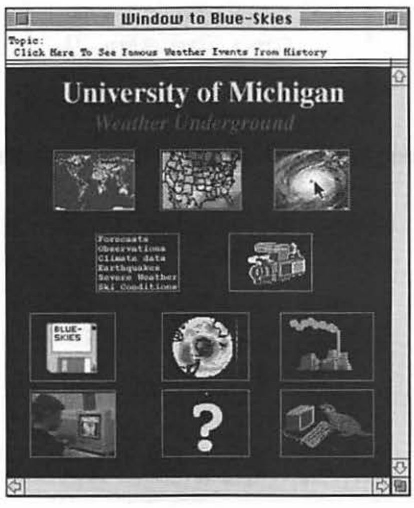


Figure 12.3 You can use this menu to access Blue-Skies' weather information system

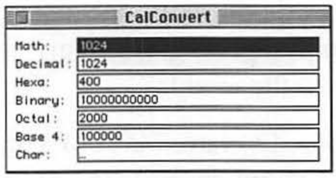


Figure 12.4 Use CalConvert to convert integers to other base numbering systems

example displaying the hexadecimal, binary, octal, and base 4 equivalents for the decimal value 1,024.

You can select the base equivalents to display (up to 8) by choosing **Options|Fields**, then designating the base value in the dialog box shown in Figure 12.5.

CalConvert also can convert mathematical expressions. You can obtain a list of valid operators by choosing **Help|Show Operators** from the menu. Figure 12.6 shows the operators you can use to create expressions in CalConvert.

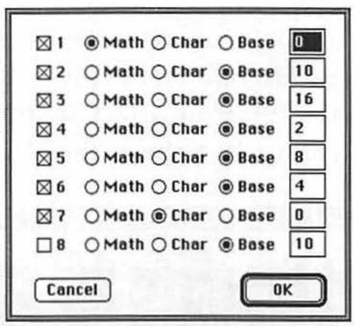


Figure 12.5 Use this dialog box to designate the base conversions you want to view

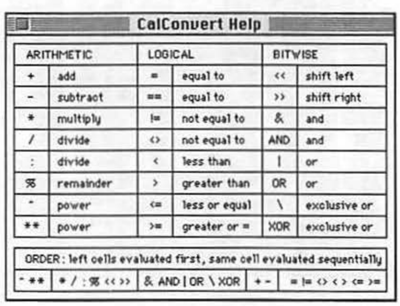


Figure 12.6 This help window shows the arithmetic, logical, and bitwise operators you can use in creating expressions

Compact Pro

Compact Pro is an extremely versatile utility for compressing and uncompressing files. Compact Pro supports segmented archives, self-extracting archives, BinHex4, and opens StuffIt archives. Compact Pro is shareware. You may use it free for up to 30 days. Beyond that, you must register the product. A single-user license is $25. A printable registration form is provided at the end of the Compact Pro User's Guide. You can run Compact Pro from the CD by clicking on the **Compact Pro** icon.

Conflict Catcher

This demo of Conflict Catcher II is a fully function version of the commercial version, except that it will only operate for 72 hours before it expires. For this reason, install it during a period when you know you'll be trying it.

One quirk of the Conflict Catcher Installer is that it must reside on diskette. So, to install the software, you must first copy the Conflict Catcher Installer to diskette, and then install to your hard disk from this diskette. This demo will fail to install on some systems. If you encounter problems, please email me at rrpronk@aol.com

After you've installed Conflict Catcher and rebooted your system, you'll see the screen shown in Figure 12.7. The program includes several nice features that aren't present in System 7.5's Extensions Manager, including the ability to reorder or sort the extensions. But perhaps the most valuable feature of Conflict Catcher is the ability to test for conflicts between exten-

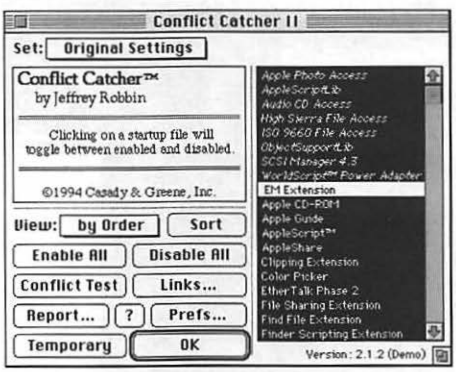


Figure 12.7 The Conflict Catcher dialog box

sions. Conflicts can often be solved simply be reordering the way extensions load. With all the extensions that I use and test, this feature is invaluable to me.

Debump

Debump shrinks and smooths graphic images during image reduction. When an image is reduced, some graphic information is discarded. Debump uses this information to smooth, or anti-alias, the image.

To use Debump, copy any graphic object from your graphics application to the Clipboard. Then run Debump (by double-clicking on the **Debump** icon). From within Debump, select **Edit|Paste Large Image**. You can then use the Anti-Alias menu to reduce the image and smooth it. When you're done, copy the small image back to the Clipboard, then paste it into your graphics application. Figure 12.8 shows the Debump window. Here the large pasted graphic appears in the bottom portion of the window. The smoothed and reduced image, appears in the upper-right portion of the window. You can compare the effectiveness of Debump by reducing the graphic image again, this time using QuickDraw (select the corresponding option from the QuickDraw menu).

Debump is shareware, and the author, John O'Fallon, requests $10 to register the product. You can send your registration fee to:

Maxum Development Corp.
2 White Fence Trail
Streamwood, IL 60107

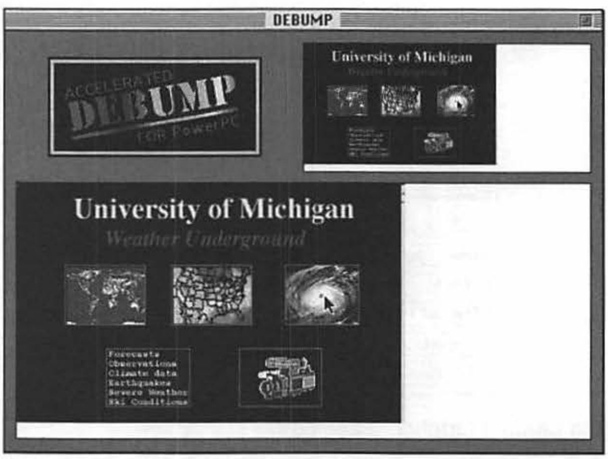


Figure 12.8 Use Debump to reduce and smooth graphic images

Delirium

Delirium is a science-fiction shoot-em-up game that I won't even *attempt* to explain, except to say that the graphics are quite good (although the text can be tough to read on some monitors) and the arcade sound quality is excellent. My screen capture wouldn't work when Delirium was running, so I can't give you a sample here. But I highly suggest you try it. The program works fine from the CD. Just click on the **Delirium** icon to start the program, read the explanation screen, and then click to get the next screen. To start playing, click the **Play** button. The Read Me instructions are also well written. This is a shareware program that looks like a professional one.

Warning: This program is addicting, especially for arcade-game lovers. Delirium is shareware and costs $15 to register. A printable registration form is provided in the Delirium folder. Send your registration fee to:

Tuan Huynh
15606 NE 40th St., Apt. Y-291
Redmond, WA 98052

Dr.Macinto 2.8

Dr.Macinto is a game in which the object is to remove all the viruses (smiling-face squares). The blocks can be removed by arranging them in sequences of four or more blocks of the same color, horizontally or vertically. Playing pills drop from the top and are comprised of two random colored blocks. Pills drop one at a time and may be moved left or right, or rotated. Dr.Macinto is shareware, with a registration fee of $5.00. Send your registration fee to the address shown in the About Dr. Macinto box.

Note: I've found that Dr.Macinto 2.8 runs fine on most Power Macs, but crashes on a few. I'm not sure why. Be forewarned. This *is* shareware.

DragAnyWindow 3.1

DragAnyWindow is a control panel that allows you to move any kind of window, including dialogs, alerts, and windows that normally won't budge from their anchored location. It has a few other features for small monitors, which aren't really useful for Power Mac owners. To install the program, drag the DragAnyWindow icon to the System folder and answer **OK** to the question. As with any Control Panel, you'll need to reboot your system for

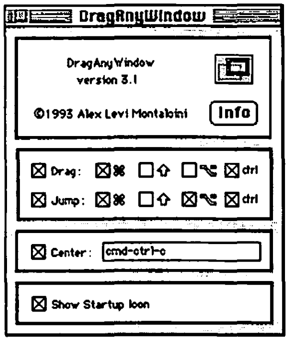


Figure 12.9 The DragAnyWindow Control Panel

it to take effect. The DragAnyWindow Control Panel is shown in Figure 12.9. Use this dialog box to configure the keys to use in dragging windows.

Enigma 2.4

Enigma helps you keep personal or other private files and folders away from prying eyes by encrypting into a single "vault" file and making the vault available on to you or anybody who knows your encryption key. You can run Enigma from the CD, but of course you can't encrypt any files on the CD since it is a locked disk. To use Enigma, create a new folder on your hard disk or on some other read/write disk media. Start Enigma and choose **File|New Vault**. Name the vault you want to create and save it to the folder you've created. When Enigma prompts you for a key, enter a password that only you will know. But remember it! You can't access a vault without this password, or key.

After you've created a vault, you can add files to it. The files become encrypted and disappear from view. (You can trash the originals; any files you put in a vault are copied within the vault file icon, but they're hidden from view.) Figure 12.10 shows two "vaults" that have been created in a folder called Secret Stuff. The folder shows no files except the two locked vaults, but there are actually several files stored in this folder.

Figure 12.11 shows the contents of the "Ron's stash" vault, indicating that two files have been encrypted there. I had to enter my encryption key to view this dialog box. Once you're in the vault, you can extract and view any file stored there.

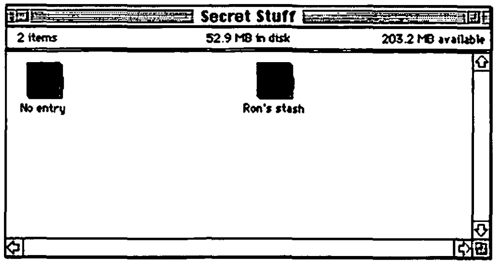


Figure 12.10 Enigma encrypts files and stores them in a vault that's accessible only to somebody who knows the correct access key

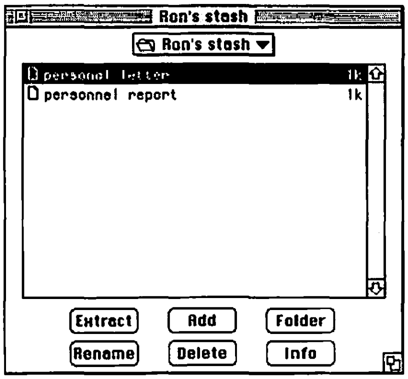


Figure 12.11 This dialog box shows that two files are stored in the "Ron's stash" vault

EPS Fixer 1.3

EPS Fixer is a utility that allows you to view the PICT preview resources that are present in most encapsulated PostScript (EPS) files. EPS Fixer can also change the file types between TEXT and EPSF to make it easier to import EPS files into word processing or desktop publishing applications. If you've ever tried to import an EPS file into Word, for instance, you'll quickly realize how valuable this little utility can be.

EPS Fixer is shareware and the author requests $10 for a single site license and $7 for each additional license. A printable registration form is stored in the EPS Fixer folder. Send your registration fee to:

David Schooley
200 26th St. NW. Apt N-203
Atlanta, GA 30309

Eudora 1.5.1

Eudora is the premier E-mail utility for the Internet. You can run Eudora 1.5.1 from the CD, but it's best to copy it to your hard drive. For more information on using and configuring Eudora, see Chapter 8. Version 1.5.1 of Eudora is freeware.

ExAminer 1.3

ExAminer is an extensions manager that's a bit more versatile than the one provided with System 7.5. With ExAminer, you can not only selectively turn on and off Control Panels and extensions, you can also selectively decide which Apple Menu Items, fonts, and Startup Items to open when you start your system, as shown in Figure 12.12. As is the case with the System 7.5 Extensions Manager, you can also save different settings files with ExAminer. Unlike Extensions Manager, ExAminer is a stand-alone utility. You don't need to add it to your Control Panels list. You can even run it directly from the CD, although I recommend adding it to the Apple Menu Items list. This is a nice utility.

ExAminer is shareware, and the author requests a $10 registration fee. Send your fee to:

Michael L. Weasner
2567 Plaza Del Amo #209
Torrance, CA 90503-7329

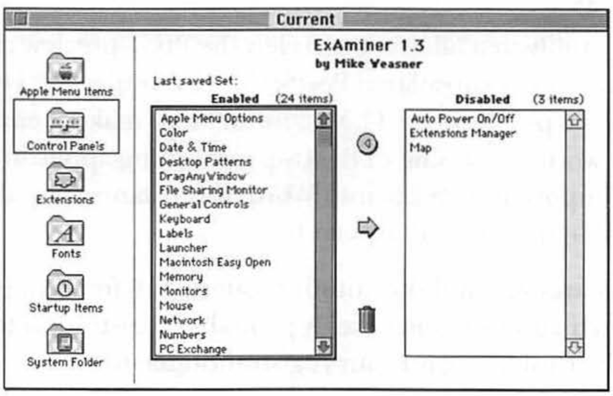


Figure 12.12 ExAminer's extension management dialog box allows you to selectively turn on or off Apple Menu Items, system extensions, Control Panels, Fonts, Startup Items, and more

Fetch 2.1.2

Fetch is the best utility I've seen for FTPing files on the Internet. Fetch is freeware, and you can run it directly from the CD if you want. For more information on using and configuring Fetch, see Chapter 8.

FlashStars II

FlashStars II is a commercial screen saver utility. This demo version works fine, but many options have been disabled. In fact, you have to start FlashStars manually. FlashStars II has some advantages of After Dark and some other commercial screen savers in that it's an application, not a Control Panel, so it won't conflict with any other Control Panels you've installed.

When you register your demo version for $10, Dragonsoft will send you the full-featured version of the software, which can load as a startup item. The authors elected to keep this screen saver as a 68K application to reduce memory overhead, but it works perfectly with Power Macs. To register FlashStars II and receive the full version, send $10 to:

603 E. Minor Dr. #101
Kansas City, MO 64131

Glider PRO

Glider PRO is a game where you try to "fly" a paper airplane through a room without knocking over items in the house and without crashing your paper airplane glider. This version of Glider PRO is a demo, but it's still fun. Glider PRO must be installed to your hard disk before you can run this demo. To install Glider Pro, just double-click on the **Glider PRO DEMO Installer** icon, and tell the installer to install to your main hard disk (the default) or to a different drive.

The Getting Started file explains how to control the plane and also explains the differences between this demo version and the commercial one. If you decide you want to buy the commercial version, you can call Casady & Greene at 1-800-359-4920.

HTML Grinder 1.2

If you decide you want to get serious about creating your own World Wide Web page, this is a great utility. This demo version of Grinder allows you to edit (find and replace) text in a collection of HTML-encoded documents. For instance, if you need to change a URL address and that address appears in several HTML documents, you can use Grinder to grab, or collect, all of the desired HTML documents, and then go through each document making replacements that you specify.

You can launch Grinder from the CD, but you'll probably only want to do so to test the Find and Replace capability of Grinder. If you want other Grinder Web page editing tools, you'll need to register the software. If you decide to register HTML Grinder to acquire the commercial version, send an E-mail message to Michael Herrick of Matterform Media at **http://www.nets.com/matterform** or to **matterform@nets.com.**

Janus 0.1

Janus is the native Power Mac equivalent of the ResEdit code editor used with 68K Macs. This is for programmers who want to find program traps to determine which portion of an application calls native PowerPC code and which portion calls 68040 emulated routines. If you're a Mac programmer, you'll probably find this utility quite handy. If you don't program, stay away from this application. The READ ME file stored in the Janus 0.1 folder provides a good walkthrough of Janus's capabilities and how it can be used.

JPEGView 3.3

This is probably the most popular graphics viewer used to display GIFs, JPEGs, bitmaps, TIFFs, and other few other common file formats found on the Internet and World Wide Web. To use JPEGView, just launch the **JPEGView 3.3** icon and select a folder containing your graphics images. If you want to view JPEGs and graphics from within any application, you need to put the JPEGView JFIF Preview file in your System folder. For more information on using JPEGView, see Chapter 8. JPEGView is postcardware. You can send the author a postcard at:

Aaron Giles
182 E. 95th St. 11E
New York, NY 10128

Koyn Fractal Studio

This is the demo version of Koyn Fractal Studio 2.1 published by Koy Software. The program allows to create fractal designs, patterns, textures, and backgrounds and incorporate them into your graphic design projects. This demo version includes all of the features of the complete, commercial version, except:

- Save, Save As, and Save Picture menu commands are disabled
- Page Setup and Print menu commands are disabled
- Copy Picture menu command is disabled
- The bit depth of a new or monochrome document cannot be set to color
- A reduced version of the Fractal Library is provided

You can run this demo from the CD. To start the Koyn Fractal Studio Demo, double-click on the icon and then select a file from The Fractal Library. Figure 12.13 shows a spiral fractal displayed by Koyn Fractal Studio.

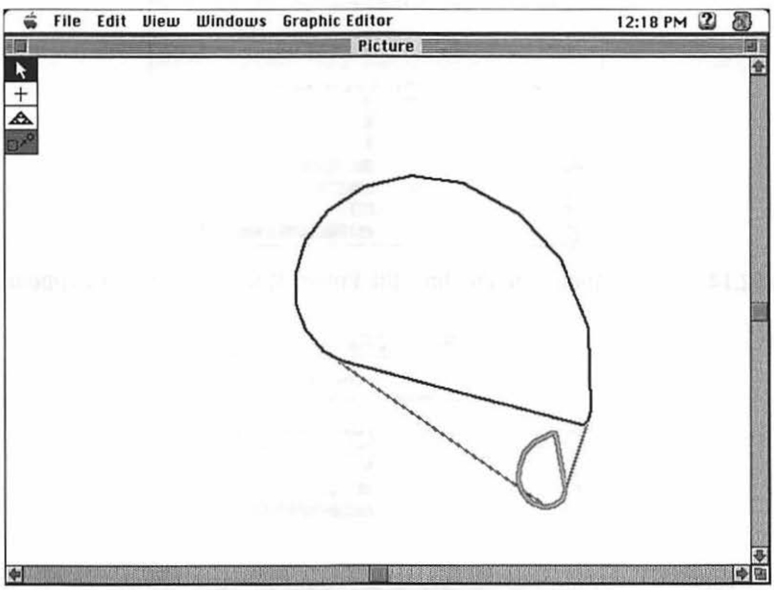


Figure 12.13 Koyn Fractal Studio lets you create, edit, and manipulate fractals

Mac Identifier

Mac Identifier is a handy utility that places your Power Mac system ID in the About Macintosh window. Although this isn't all that useful for those who have this information stamped on the case, it is useful for individuals who have upgrade cards, and for managers who have to keep track of a large number of Power Macs, upgraded Macs, and clones. Figure 12.14 shows an About... box before Mac Identifier is installed, and Figure 12.15 shows the contents after Mac Identifier is installed.

To use Mac Identifier, just drag the system extension to your System folder. You'll need to reboot, of course, for Mac Identifier to load. Mac Identifier is freeware.

MacHTTP

If you're planning on setting up a Web page, this package is for you. It contains all the software and documentation you need to set up your own Web site. The software and documentation can get complex, but that's only

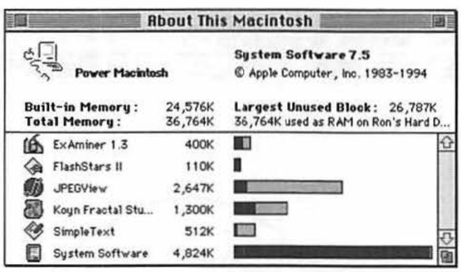


Figure 12.14 In this About... dialog box, the Power Mac model doesn't appear

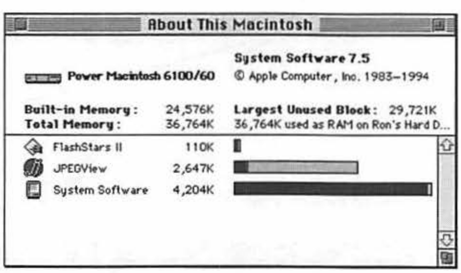


Figure 12.15 After Mac Identifier has been installed, the About... dialog box reports the Power Mac model and CPU speed

because setting up a Web page is hardly a no-brainer. For the most part, this is an excellent shareware package. If you plan on using MacHTTP to set up a web site for *any* kind of business purpose, the author instructs you to register the software. An order/registration form is provided in the Ordering Info file, along with the address to send your completed registration form. A single site license from $50 to $100, and multiuser licenses range from $500 to $1,000. To use MacHTTP, of course, you must have MacTCP configured, you must have access to the Internet, and you must have a Web browser.

MacMod Pro

MacMod Pro is a MOD file editor. MODS are song files similar to MIDI except the instruments are contained in the songs, you don't need additional hardware to play the instruments. Because MacMod stores all its settings internally, you can't run it from the CD. Copy the MacMod Pro folder to your hard drive, and you should be all set. To run MacMod Pro, just double-click on the MacMod Pro 3.15 icon. Figure 12.16 shows the MacMod interface. MacMod also imports MIDI files, and includes excellent online help.

MacMod Pro is shareware, and registration is $25. To register, choose **Register** from the Apple menu and select **Print Registration Form.**

Marathon

This is an interactive demo of the interactive Marathon game that you can play over networks. This demo version really works, but only uses a limited set of textures. The graphics are outstanding, as is the sound. You can run

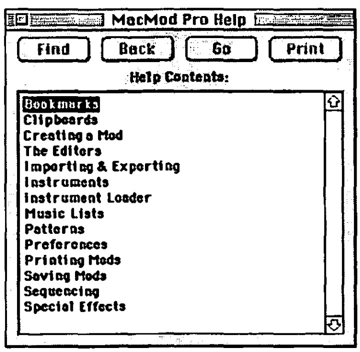


Figure 12.16 This is the MacMod interface, toolbar, and AppleGuide help menu

the demo from the CD, but I advise you to copy the Marathon folder to your hard disk for better performance. The "street price" of the commercial version of Marathon is $39 to $45. For more information on Marathon, call or write:

Bungie Software Products
P.O. Box 7877
Chicago, IL 60680-7877
(312)563-6200

Maven 2.0d23

Maven allows you to do audioconferencing over the Internet via your Power Mac's sound in and sound out ports. For sound in, of course, you need a microphone. This is an alpha release of the new version that works with Power Macs, so newer releases will be available soon. Look for them at the University of Michigan's Power Mac archive (see Chapter 8 for the FTP and URL addresses). The Maven README file is a Word file, so you need to have Microsoft Word or an application that can import Word files. Simply launch the **Maven** icon to start the program. The program will not run without MacTCP configured and an Internet provider available.

Microsoft Office 4.2

This is one of the few "slide show" (non-interactive) demos on the CD. (I've tried to avoid including these.) I elected to include this one mainly because it does provide a good overview of the features of Microsoft Office 4.2 and because I receive so many requests from users asking about the quality of the product.

As for product quality, you know doubt have heard that Word 6 is slow and unwieldy. Well, it's not *too* bad on Power Macs, but it's still much slower than Word 5.1. However, Microsoft has announced that it will be releasing an update of Word 6 for 68K and Power Macs that overcomes much of the slowness and corrects bugs and complaints that users have been waiting in line to make.

I'll repeat what I said in an earlier chapter. Microsoft is not "out to get" Apple. They've just given Macintosh users a low priority when it comes to software development. It doesn't surprise me that Microsoft is only now getting around to doing Word right for the Mac and Power Mac. By the

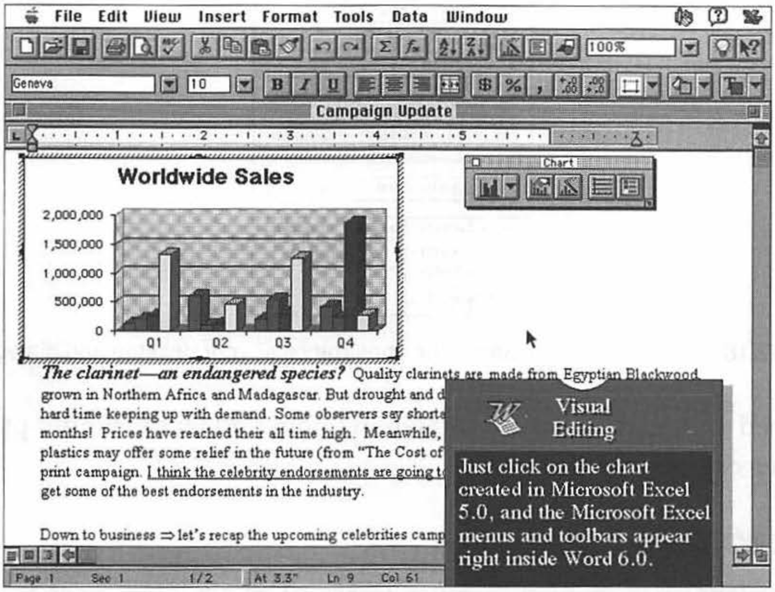


Figure 12.17 The Microsoft Office demo isn't interactive, but it does provide a good, detailed look at the suite of applications available in the product

way, all of the products within Microsoft Office 4.2 are now native for the Power Mac. Figure 12.17 is a sample screen from the Microsoft Office 4.2 demo. The demo will run for what seems like an eternity if you let it. You can press **Esc** at any time to exit the demo. (You might have to press **Esc** repeatedly to back out to the Finder.) You can run the demo from the CD simply by double-clicking on the **Microsoft Office 4.2 Complete** icon.

The More Great Stuff Folder

This folder contains five programs: PowerPeek, a system extension that tells you when your Power Mac is processing native PowerPC instructions and when it's running in 68K emulation; Disinfectant 3.5, a virus checker; KPT PowerPC Spheroids, a great demo of the capabilities of Kai's Power Tools; and NewLook 2.5, a Control Panel that lets you modify the way your desktop looks. Figure 12.18 shows the NewLook 2.5 Control Panel. Finally, the folder contains UUTool 232.1, a utility for encoding and decoding UUEncode files.

Most of the applications in this folder are self-explanatory. For more information on using UUTool, see Chapter 8. To use PowerPeek and NewLook,

Figure 12.18 NewLook 2.5 enhances the appearance of your desktop and dialog boxes

you need to drag them into your System folder and let the Finder put each file where it belongs.

NewsWatcher

NewsWatcher is a tool you can use to read USENET newsgroups on the Internet. USENET is the world's largest electronic bulletin board system, providing access to thousands of special-interest newsgroups. The documentation stresses that this is a beta version of the product. The final version will be made available at **ftp://ftp.acns.nwu.edu/pub/newswatcher/**. You will need to provide the name of your newsgroup server before you can use NewsWatcher to log onto USENET. Your Internet provide can give you this information. Newswatcher is freeware. Figure 12.19 shows the NewsWatcher Preferences dialog box.

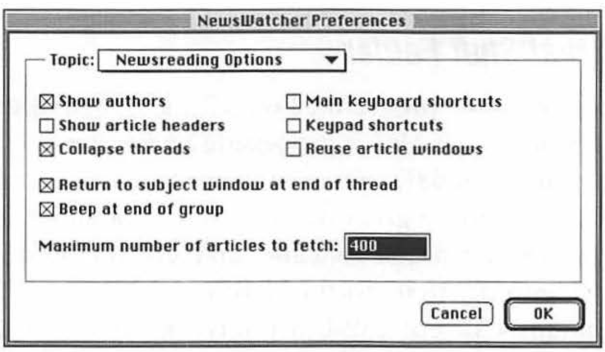


Figure 12.19 NewsWatcher provides you with flexibility in the way you view and work with information from newsgroups

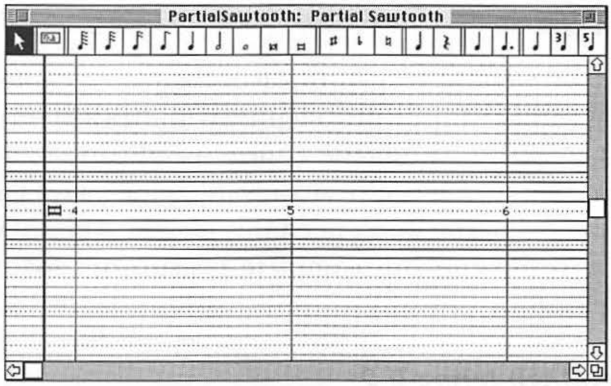


Figure 12.20 The OutofPhase Track Editor

OutofPhase 1.1

OutofPhase imports, records, and plays sound samples, including WAV files, up to a sampling rate of 44.1 KHz. You can also use OutofPhase to view and edit samples for specified instruments and tracks. Figure 12.20 is an example of the Track Editor, while Figure 12.21 shows the Play Parameters dialog box you can use to set sound playback options. You can run OutofPhase from the CD, but you'll have better results if you copy the folder, including the sample sounds, to your hard disk. To view the OutofPhase documentation, you need ClarisWorks or an application that can view ClarisWorks files. OutofPhase 1.1 is freeware.

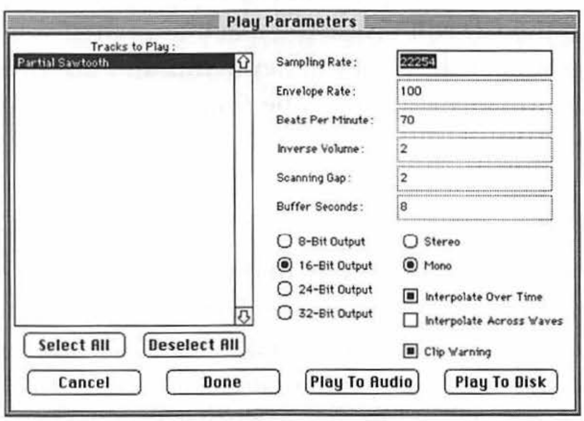


Figure 12.21 OutofPhase's Play Parameters dialog box

Photoshop Plug-in

The PowerPC Accelerator plug-in replaces the entire Photoshop 2.5 image-processing engine with a native engine. With this plug-in, Adobe states that Power Macintosh users should realize speed gains of 1.5 to 4 times over a Quadra computer. If you're already using the native Power Mac version of Photoshop 3.0, you won't need this plug-in. The "About PowerPC Accelerator" text file contains complete instructions for installing the PowerPC accelerator.

Power Macintosh Icons V.2

This is a modest set of icons that you can use to represent the Power Macintosh 6100, 7100, or 8100 systems; the PowerPC chip; the PowerPC logo; Motorola's batwing logo, IBM's logo, Apple Monitors; and your system specifications. Robert Friezo requests that you send $3 if you like the icons. Of course, he also claims he's 11 years old. Uh huh. Right, Robert. Anyway, you can send him your contribution at:

Robert Friezo
884 West Charing Cross Cir.
Lake Mary, FL 32746

PowerMac/CD Fix

This nice utility corrects Apple's oversight in allowing the PowerMac to shut down with the CD still inside the machine. When you install this fix, your CD will automatically eject whenever you shut down. Simple instructions for installing the software can be found in the READ ME! text file. This is freeware.

PowerExplorer

PowerExplorer is a wild little utility that tests the speed of your PowerPC CPU by drawing the Mandelbrot set and lets you explore it zooming in and out at will during the drawing. This is a good and fun test to use before and after you install a PowerClip or other clock booster. One interesting "bug" makes for some additional fun: If you display the image at 320×320, and then click on your desktop, the image freezes and changes the color of your desktop. The image effectively becomes your desktop pattern until you click on the image to start it up again. If you get tired of waiting for the drawing session to end, just press **Command+Q** to quit.

PPP Access

This folder contains the Config PPP Control Panel and the PPP system extension that you need to connect to a PPP Internet provider. Copy both files into your System folder and let the Finder put them where they belong. You'll need to reboot to make use of PPP. For more information on configuration and using PPP, see Chapter 8.

Ray Dream

The Ray Dream Gallery includes more than 40 high-resolution 3-D images created by professional artists using the Ray Dream Designer 3-D graphics creations and editing program. The gallery can be viewed in 16- or 8-bit color. The Gallery is a stunning collection of images, which are basically advertisements for the power of Ray Dream Designer; nevertheless, they are spectacular to look at as shown in Figures 12.22 and 12.23. I sometimes start the gallery and run it as a "screen saver" in the background when I know I'm not planning to use my system for awhile.

To start the gallery, open the Ray Dream folder, and then open the Macintosh folder. Next, open the RayDream(16-bit) folder and double-click on the **GALLERY (16 Bit)** icon. The Gallery display engine will take about 5 to 30 seconds to load, and then will allow you to select a language. Click on the appropriate language icon.

You will then have the opportunity to select the Self-Running Gallery or the Interactive Gallery. If you want to just sit back and watch, select the Self-Running Gallery. If you want to determine which categories of images and specific images to view, select **Self-Running Gallery**. You can quit the Gallery at any time by pressing **Command+Q**. The CD's background music is also outstanding.

Redshift

The Redshift folder contains two demos from Maris Multimedia. When you launch the Redshift Demo, you can select either the **Guided Tours** or the **Main Program** perspectives. As far as I can tell, both options are the

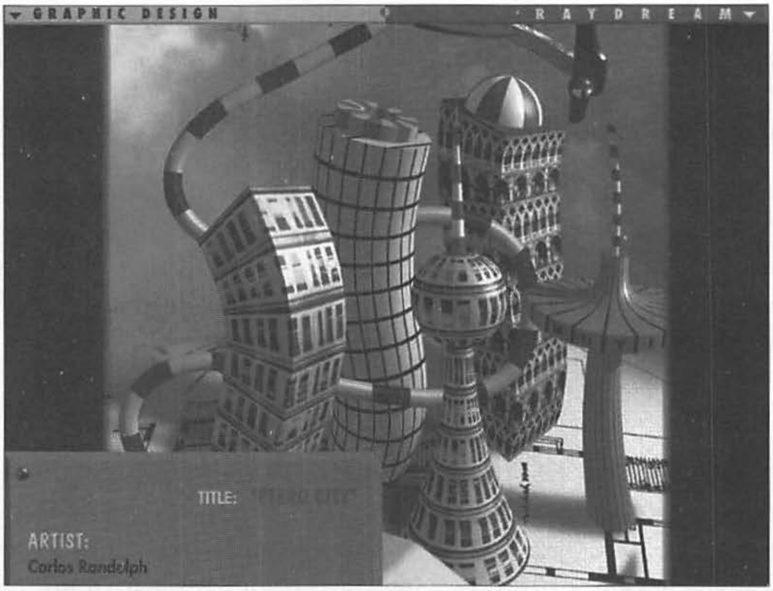


Figure 12.22

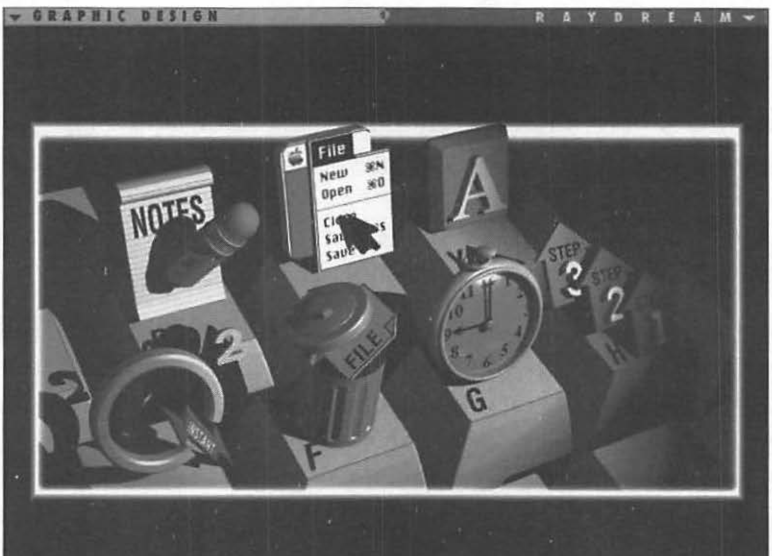


Figure 12.23 These two 3D graphics were created using Ray Dream Designer

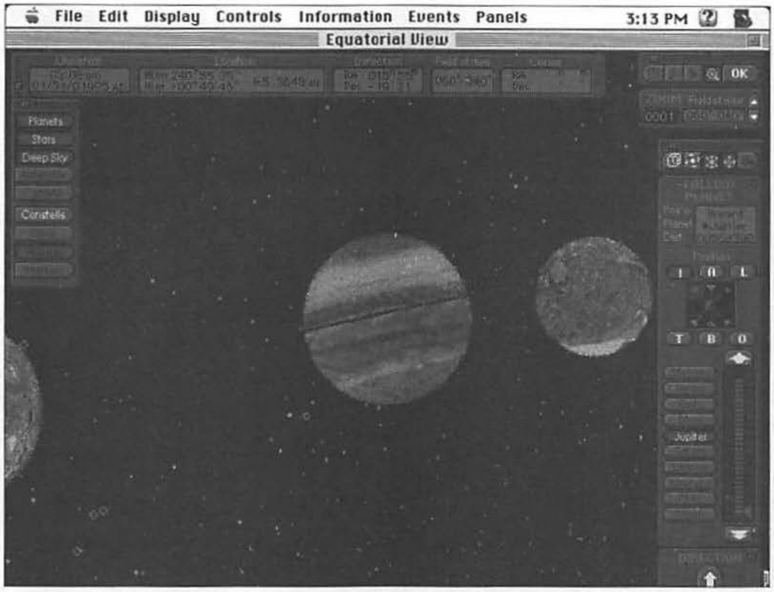


Figure 12.24 The RedShift planetary display

same for this demo, and in both you're free to select options and commands and explore the astronomical views and events provided by the program. Figure 12.24 provides a view of Redshift's interface, showing the position and orbit of Jupiter. Redshift also includes a built-in dictionary, making this a great educational tool.

To play the WARPDEMO encyclopedia of military aircraft, open the WARPDEMO folder and double-click on the WARPDEMO.MAC icon. You can then select either the AIRCRAFT DATA or the US NAVY operations buttons. All other buttons for this demo have been disabled. The audio with this encyclopedia is also impressive. A 1-800 number for ordering the full version of the WARPLANES encyclopedia CD appears when you exit the program. Figure 12.25 shows a sample screen from the WARPLANES encyclopedia.

SASIxp Guided Tour

I threw this one in for teachers and school administrators because it's perhaps the best student information system I've seen (and I used to work for a competing company that developed student information systems). This package admittedly has a limited audience, but for what it does, it does

Figure 12.25 The WARPLANES encylopedia demo

well. To run the demo, just open the SASIxp Guided Tour folder and double-click on the **SASIxp Guided Tour** icon

Spaceway 2000

To run the demo for this popular game, you first need to copy the Spaceway 2000 Demo.sit and Spaceway 2000 Demo.sit.2 files to your hard disk in the same folder. Then, double-click on the Spaceway 2000 Demo.sit icon to extract and install the program. After you've installed the program, open the Spaceway 2000 Demo folder on your hard disk, and then double-click on **Spaceway 2000**. You're on your own from here. Enjoy the game. Figure 12.26 provides a shot from the game.

Specular LogoMotion

This is a demo version of LogoMotion 1.5, which allows you create 3-D animations of text and logs for use in business presentations, desktop video, multimedia projects, or just for fun. You can also use LogoMotion to convert an EPS file or any TrueType or Postscript font into a 3-D flying logo made of chrome, gold, or having one of a variety of other surfaces. You can

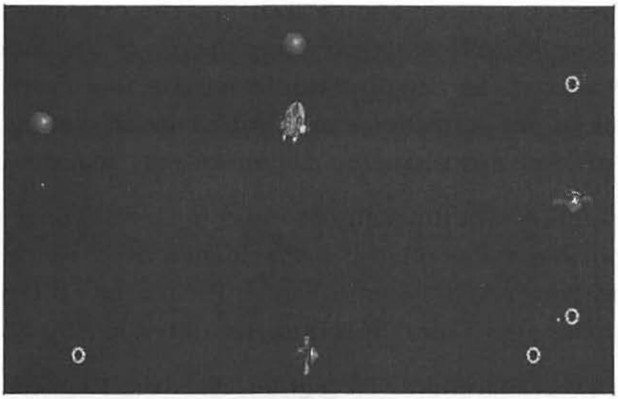


Figure 12.26 A view of Spaceway 2000 in action

run a limited version of LogoMotion by double-clicking on the **Specular LogoMotion 1.5** icon.

Figure 12.27 shows the Specular LogoMotion environment.

Speedometer

This is Scott Berfield's well known, versatile, and all-around excellent tool for evaluating the performance of Macintosh systems and for identifying system information. The current version, 4.0, is now native for the Power Mac. You can run Speedometer directly from the CD by double-clicking on the **Speedometer 4.0** icon. However, you'll need to save any test records to your hard disk or other storage media.

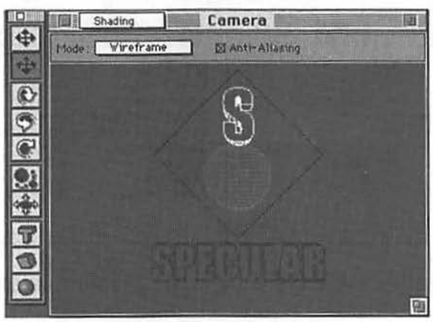


Figure 12.27 The LogoMotion 1.5 application lets you create and animate 3D logos for business or personal use

Figure 12.28 shows the information screens you can display when you click on one of the four icons that appear along the top of the Hardware Information box. Speedometer can display information about your logic board hardware, your sound and video capabilities, your operating system, and the presence of some miscellaneous system software features and utilities.

Figure 12.29 shows one of the many system comparisons Speedometer can display for you to see the relative performance capabilities of different Macintosh and Power Mac systems. Figure 12.30 shows the performance results that appear after I used Speedometer to test a 6100 system.

Speedometer 4.0 is shareware. To register, click the **Register** button that appears on the startup screen and fill out the printable registration form. Send the form and $30 to:

Scott Berfield
26043 Gushue St.
Hayward, CA 94544

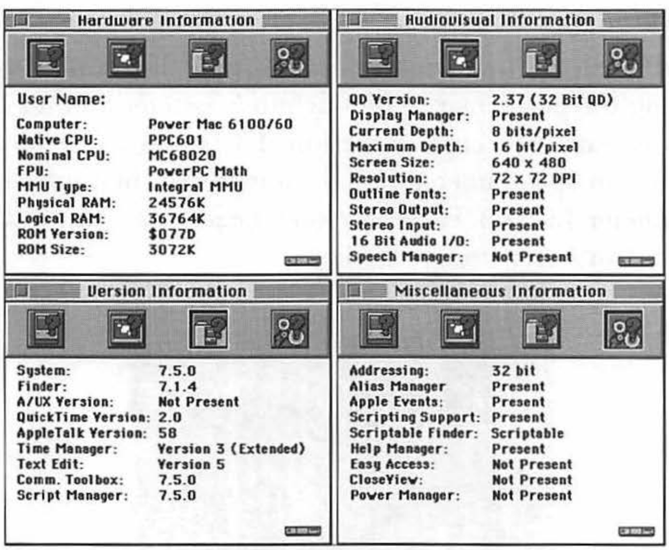


Figure 12.28 These screens show the wide range of information that Speedometer can identify on a Power Mac

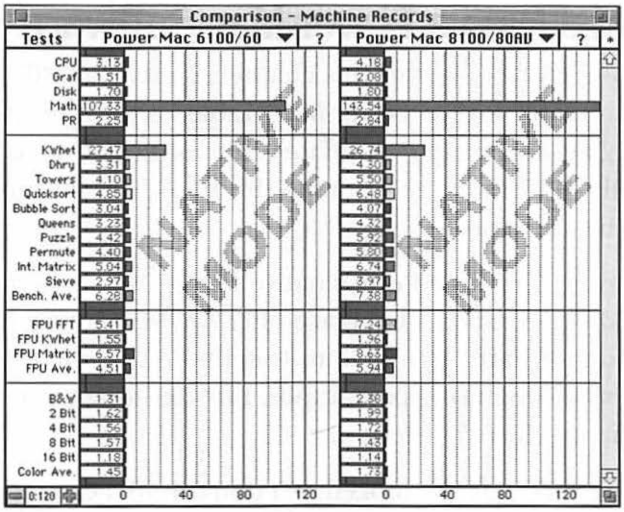


Figure 12.29 One of several bar-chart system comparisons that Speedometer can display

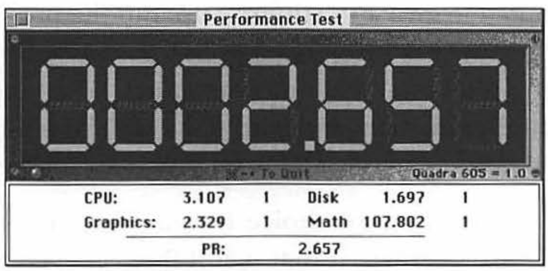


Figure 12.30 Benchmark results for a 6100/60 Power Mac

Symantec Product Suite Demonstration

The CD includes a multimedia demonstration of the Norton Utilities, Symantec AntiVirus for Macintosh (SAM), and the Norton DiskDoubler Pro file compression utility. To run the demo, extract the Symantec Demo.sea file onto your hard disk, then double-click on the **Symantec Demo** icon. (Be warned, though: this demo requires 3.1 MB of disk space.)

When the product-selection screen appears, click on the button for the product demonstration you want to view. This presentation is one of the few non-interactive demos that lets you control the pace of the slide show and that provides you with a simple way to exit from any slide For more information on these products, see Chapter 7.

Commercial Native Power Mac Software

As I mentioned at the outset of this chapter, more than 300 commercial products are available for the Power Mac. Table 12.1 lists most of the packages currently available. Apple updates this list about once every three months, you'll see by the time you read this book, dozens more packages will probably be available.

I would like to say I've tested every native Power Mac program available, but who would believe such a bald-faced lie? Anyway, during the course of writing this book, I have been able to test almost 100 or so of the native packages. So, in the following paragraphs, I'll offer some random thoughts on some of the products I've tested.

Of all the native products I've looked at, I don't think I can identify a single dud among the bunch, except perhaps for Microsoft Word 6.0. That's too bad, because this product has such a rich feature set and a good user interface that I'm tempted to give it the thumbs up. But the program is slow and it's a resource hog. Until Microsoft releases its 6.0a update (which should be available by press time), I can't really recommend it. When they speed up the program and reduce its memory and hard disk resource requirements, I venture to say it could become my favorite word processor for the Power Mac.

For now, the word processor of choice is—gasp!—a non-native one: Microsoft Word 5.1. It's so efficient that it still flies on even 6100/60 Power Macs. WordPerfect 3.0 for the Power Mac is good, too, and takes advantage of many of the Power Mac's native capabilities and uses some of the advanced features of System 7.5. But many users have reported incompatibilities in the user interface and feature changes that don't always make sense. I suspect that Novell might have taken a tactic from the Microsoft camp and borrowed too heavily from its Windows-based brother.

For desktop publishing, the native Power Mac versions of PageMaker, QuarkXPress, and FrameMaker are all outstanding. PageMaker and QuarkXPress have different strengths, though, and many desktop publishers I've talked to use both. For a combination word processor/desktop publishing package, FrameMaker has no peer. For photo and 2-D image editing, Photoshop is still the clear winner. In fact, Adobe is still the powerhouse in desktop publishing, offering excellent native Power Mac versions of After Effects, Color Central, Dimensions, Illustrator, Photoshop, and Adobe Type Manager.

Table 12.1 Current native Power Mac applications

Company	Phone	Product	List Price
2 Way Computing	619-452-3888	2Way Talker 2.2	$49
Abacus Concepts	510-540-1949	Statview 4.1	$595
About Software	408-725-4242	5PM Pro 2.2	$3545
		5PM Term 2.2	$249
Absoft	810-853-0050	Fortran 77 SDK[A]	$699
ACI US	408-252-4444	4D First 1.2	$99
		4D Server 1.2	$1195
		4th Dimension 3.2	$895
Adobe Systems	415-961-4400, 800-833-6687	After Effects 2.0.1	$1995
		After Effects Rendering Engine 2.0.1	$495
		Color Central 2.2	$3995
		Dimensions 2.0	$199
		Illustrator 5.5	$595
		PageMaker 5.0	$895
		Persuasion 3.0	$495
		Photoshop 3.01	$895
		Premiere 4.0	$795
		TrapWise 2.1	$4995
		Type Manager 3.8	$60
Aladdin Systems	408-761-6200	DropStuff with Expander Enhancer 3.5.2	$30
		StuffIt Deluxe 3.5	$130
		StuffIt Expander 3.5.2	free
		StuffIt Lite 3.5	$30
		StuffIt SpaceSaver 3.5	$80
Alias Research	416-362-9181, 800-447-2542	Alias Sketch 2.0	$695
Apple Computer	408-996-1010	Personal Diagnostics 1.1	$99
		PhotoFlash 2.0	$129
Artifice	503-345-7421	Design Workshop 1.2[A]	$695
Ashlar	408-746-1800	Vellum 3D 2.5	$2995
autodessys	614-488-9777	formZ 2.6	$1495
Avid	508-640-6789	VideoShop 3.0	$395
BAGH Technologies	514-273-0522	Architrion 5.8	$4500
Blyth Software	415-571-0222	Omnis(7^3)[A]	$5000

[A] *680X0 Mac and Power Mac versions sold seperately*

[B] *No 680X0 version available.*

(continued on next page)

Table 12.1 Current native Power Mac applications (Continued)

Company	Phone	Product	List Price
Bungie Software Products	312-563-6200	Pathways into Darkness 2.0	$70
CAChe Scientific	503-531-1800	WorkSystem 1.0[B]	$29,990
Caere	408-395-7000, 800-535-7226	OmniPage Professional 5.0	$695
Canto Software	415-431-6871	Cirrus PowerLite 2.1	$195
		Cirrus PowerPro 2.1	$495
		Cumulus PowerLite 2.0	$199
		Cumulus PowerPro 2.0	$1495
Casady & Greene	408-484-9228	Conflict Catcher II 2.1	$80
Central Point Software	503-690-8088, 800-278-6657	MacTools 4.0	$150
Changeling Software	203-292-5087, 800-769-2768	PegLeg 1.0.3	$40
Charles River Analytics	617-491-3474, 800-913-3535	Open Sesame 1.1	$59
Claris	408-987-7000	ClarisDraw 1.0	$399
		ClarisImpact 1.0v3	$399
		ClarisWorks 3.0	$129
		FileMaker Pro Server 1.0	$1499
		MacWrite Pro 1.5v3	$99
Common Knowledge	415-325-9000, 800-954-3800	Arrange 2.0	$349
Connectix	415-571-5100, 800-950-5880	RAM Doubler 1.5	$99
Dantz Development	510-253-3000	Retrospect 2.1	$249
		Retrospect Remote 2.1	$449
Data Description	607-257-1000	Data Desk 4.2	$595
DeltaPoint	408-648-4000	DeltaGraph Pro 3.5	$195
Deneba Software	305-596-5644, 800-733-6322	Canvas 3.5	$399
Domark Software	415-513-8929, 800-695-4263	Flying Nightmares 3.1	$49
		Out of the Sun 1.0	$50
Elastic Reality	608-273-9240	Elastic Reality 1.2	$349
Engineered Software	910-299-4843	PowerCADD 1.0[A]	$795
Equilibrium	415-332-4343	DeBalelizer 1.6	$399
Fractal Design	408-688-5300	Dabbler 1.0	$99
		Painter 3	$499

[A] *680X0 Mac and Power Mac versions sold seperately.*

(continued on next page)

Table 12.1 Current native Power Mac applications (Continued)

Company	Phone	Product	List Price
Frame Technology	408-975-6000	FrameMaker 4.0.4	$895
FWB	415-775-2125	CD-ROM Toolkit 1.1	$79
		Hard Disk Toolkit 1.6	$199
		Hard Disk Toolkit Personal Edition 1.6	$79
		RAID Toolkit 1.6	$499
Graphic Magic	408-464-1949	Multiframe 4D 1.0	$1995
		Multiframe 3D 2.0	$1495
Graphisoft	415-737-8665, 800-344-3468	ArchiCAD 4.5	$4450
Graphsoft	410-290-5114	Blueprint 5	$295
		MiniCad 5	$795
Gryphon Software	619-536-8815	Morph 2.5	$149
Hash	260-750-0042	Animation Master 2.08	$1049
HSC Software	805-566-6200	Kai's Power Tools 2.1	$199
		KPT Bryce 1.0	$199
		Live Picture 1.5.5	$3995
Insignia Solutions	415-694-7600, 800-848-7677	SoftWindows 1.0[A]	$499
Inspiration Software	503-245-9011	Inspiration 4.1	$195
Intercon Systems	703-709-5500, 800-468-7266	TCP/Connect II 2.0	$495
Kent Marsh	713-522-5625	FolderBolt Pro 1.0	$130
Macromedia	415-252-2000	Director 4.0	$1195
		Fontographer 4.1	$495
		FreeHand 4.0a[A]	$595
Mainstay	805-484-9400	VIP-C 1.5	$495
Micrsoft	206-882-8080, 800-426-9400	Excel 5.0	$339
		FoxPro 2.6	$99
		FoxPro Professional 2.6	$695
		PowerPoint 4.0[A]	$339
		Word 6.0[A]	$339
National Instruments	512-794-0100, 800-433-3488	HiQ 2.1	$695
John Neil & Associates	415-661-2943	SoftwareFPU 3.0	$20
Neon Software	510-283-9771, 800-334-6366	LANsurveyor 1.1	$395
		NetMinder Ethernet 3.2	$695

[A] *680X0 Mac and Power Mac versions sold seperately.*

(continued on next page)

Table 12.1 Current native Power Mac applications (Continued)

Company	Phone	Product	List Price
Novell Applications Group	801-225-5000	WordPerfect 3.1	$395
Now Software	503-274-2800	Contact 1.1	$99
		Now Utilities 5.0	$90
Npath Software	206-392-7745	Tableworks Plus 2.0	$299
Pixar	510-236-4000, 800-888-9856	Typestry 2.1	$299
PixelCraft	510-562-2480	ColorAccess drivers	varies
Quark	303-894-8888	QuarkXPress 3.31[A]	$895
Radius	408-541-6100,	QuickFlix 1.1	$149
	800-227-2795	VideoFusion 1.6.1	$649
Ray Dream	415-960-0768	Designer 3.1.1	$349
Sassafras Software	603-643-3351	KeyServer 4.0	$680
Signal Analytics	703-281-3277	IPLab Gel 1.5	$850
		IPLab Spectrum 2.5.5	$1200
SoftArc	905-415-7000, 800-364-1923	FirstClass 2.6	$95
Specular International	413-253-3100,	Collage 2.0.1	$399
	800-433-7732	Infini-D 2.6	$695
		LogoMotion 1.5	$149
		TextureScape 1.5	$195
Spider Island Software	714-669-9260	TeleFinder BBS 3.5	$425
Strata	801-628-5218,	StudioPro 1.5	$1495
	800-869-6855	StrataVision 3.1a	$695
Symantec	503-334-6054,	ACT 2.0	$250
	800-441-7234	Norton DiskDoubler Pro 1.1	$109
		Norton Utilities (NUM) 3.1	$149
		Symantec AntiVirus (SAM) 4.0	$99
Trillium Research	715-381-1900	Remus 1.2.5	$590
		Remus Limited 1.2.5	$295
usrEZ Software	714-756-5140,	ultraSecure 3.52	$239
	800-482-4622	ultraShield 2.52	$149
Virtus	919-467-9700,	Virtus VR 1.0.1	$99
	800-847-8871	Walkthrough Pro 2.0	$495
Wolfram Research	217-398-0700, 800-441-6284	Mathematica 2.2	$995
Xerox	415-813-6800, 800-248-6550	TextBridge 2.0	$99

[A] *680X0 Mac and Power Mac versions sold seperately.*

For professional 3-D graphics rendering, I should keep my mouth shut since I'm no designer. But I can say that Ray Dream Designer and Kai's Power Tools both seem to wow everybody who uses them. For 2-D rendering, designers I've talked to say that Adobe Illustrator and Aldus Freehand are pretty much neck-and-neck.

In the spreadsheet category, it's tough to beat Microsoft Excel 5.0. Microsoft got royally beat over the head for coming out with this package so late, but the product has been worth the wait. Microsoft is planning a 5.0a update that improves the load and run speeds of spreadsheets.

The spreadsheet in ClarisWorks is no slouch, though, but its feature set is much smaller than Excel's. But in the category of integrated applications, ClarisWorks offers seamless database, spreadsheet, communications, and word processing performance that's tough to beat. Claris also offers ClarisDraw, a nice drawing package for the Power Mac. Microsoft Office 4.2 beats ClarisWorks in terms of overall capability, but Office does not seem to me to be efficiently designed nor does it seem to be as integrated as it should. It ships as a 30-disk set (if there's a CD ROM installer, I haven't seen it), and has several redundant modules that make the install time and the hard disk requirements excessive. For cross-compatibility with Windows users, though, Microsoft Office makes a lot of sense.

In the database arena, FoxPro walks away with the prize for stand-alone use. For client/server databases, FileMaker Pro is the giant. Database offerings have always been slim pickings on Macintoshes, and that situation still remains true with Power Macs.

For presentation graphics, DeltaGraph Pro 3.5 is at the top of the list, with other 200 chart templates for engineering, marketing, research, and financial use. But Microsoft PowerPoint is a good runner-up, and wins points for its ease-of-use interface.

For utility software, it's a toss-up between Central Point's MacTools and Symantec's Norton Utilities. I like both, and if you ask me to choose one over the other, I couldn't do it. Experience tells me that users will select the one they've grown accustomed to. But if you haven't yet purchased a utilities package, you won't go wrong with either of these.

For movie capture, editing, and playback, Adobe Premiere is simply amazing. One thing that always impresses me about Adobe is their excellent documentation. The user guide for Adobe Premiere 4.0 is one of the best I've seen—ever. Radius's Video Fusion finishes a close second to Premiere, though, and many users may prefer its interface.

I know I've left out many, many native packages that are deserving of mention. But I'm not trying to be exhaustive in my descriptions here. I just want to give you a feel for what is available for Power Mac users today. And if I had to describe in a nutshell what's available, I would say that it's a large field with plenty of ripe wheat with very, very, little chaff. And new wheat is sprouting every week.

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