An Introduction to Copland

The Mac™ OS Foundation for the Next Generation of Personal Computers

Copland is the development name for the next major release of the Mac™ OS from Apple® Computer, Inc. This document introduces Copland's new architecture, its capabilities, and the benefits it will deliver to individuals and organizations.

Product Primer

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Welcome

During the past decade, Apple has dramatically changed the way people and organizations use personal computers. The Apple® Macintosh® computer and its 32-bit operating system—known today as the Mac™ OS—have brought innovative, cost-effective computing solutions to millions of people, enabling them to successfully apply the power of personal computers to individual as well as organizational goals.

The Macintosh computer and the Mac OS have set the standards by which productivity is defined—and which the industry has been trying to match for the past ten years. Not only do Macintosh computers and the Mac OS deliver the highest levels of productivity in the industry[1], they do it at a lower cost of ownership than any other personal computer platform.[2]

This is possible because Macintosh computers and the Mac OS provide:

- The highest performance of any personal computing platform, thanks to PowerPC™ reduced instruction set computing (RISC) microprocessors
- The easiest-to-use computing interface, made popular with the Apple Macintosh computer and refined over the past decade
- Plug-and-play connectivity to networks since 1985
- Plug-and-play connections to peripherals since 1987
- The richest graphics and multimedia environment of any personal computer
- Built-in capabilities for workgroup collaboration and multivendor network integration
- Integrated tools for data exchange with DOS and Windows™-based PCs via networks, floppy disks, or hard drives

Apple has channeled more than a decade of experience into the next major release of Apple's operating system. Its development name is Copland. While significantly improving system performance, Copland provides advanced computing capabilities that help everyone work more productively.

In the pages that follow, you'll learn how Copland can improve the computing experience of all users, and how it enables new and better ways of working.

Perhaps most important, however, you'll see why Copland—in the same way as its Mac OS predecessors—is setting new standards that the computer industry will be trying to match well into the next century.

It would not be an exaggeration to describe the history of the computer industry for the past decade as a massive effort to keep up with Apple. In 1984, critics derided the Mac for its appliance-like simplicity, but it went on to pioneer or popularize almost every innovation in personal computing: the GUI, desktop publishing, built-in networking, plug and play, integrated multimedia....
—BYTE Magazine, Dec. 1994

[1]A detailed study by Arthur D. Little on user productivity found that people using Macintosh computers are 44 percent more productive than people using Windows 3.1. Not only did the Macintosh users finish the task faster than the Windows users, but they also did them more accurately.

[2]In its expanded application benchmark study in 1994, Ingram Laboratories found that Apple's latest Power Macintosh computers were 39 percent faster than equivalent Pentium-based PCs. The Power Macintosh 8100/110 was 45 percent faster overall than a comparable PC. And in graphics and publishing applications, some Power Macintosh systems were almost twice as fast as equivalent PCs.

Introducing Copland: Foundation for the Future

Today customers know more about technology than ever before. They expect more from their investments. They're demanding more powerful systems that can be integrated into enterprise-wide networks. And they know that standards are still evolving to provide what they need today and tomorrow. That's why, in 1993, Apple's research and development teams began working on the powerful operating system called Copland. Copland not only gives people the power to work more productively and interdependently today, but it also allows them to work in new ways tomorrow.

Copland: The Next Step Toward Apple's Vision for the Mac OS

From the beginning, the Mac OS has played a key role in implementing Apple's primary vision: To provide personal computer solutions that empower individuals to do their best work.

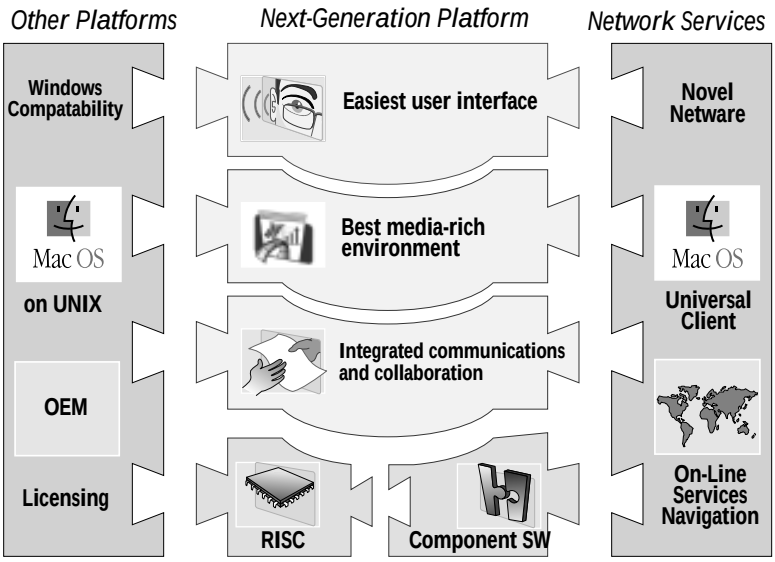
As the next major milestone toward that vision, Copland is designed to meet these specific customer needs:

- Make computers easier to learn and use—even as applications and network systems become more sophisticated. Individuals will realize more benefits from their systems, and organizations will be able to reduce the cost of supporting their users.
- Make it easier than ever before for individuals and organizations alike to increase the impact of their visual, printed, and interactive communications.
- Simplify information access and management. Though personal computers, networks, and servers have made information creation and dissemination easy, the task of organizing and collecting information has become more complex.
- Raise organizational productivity through higher-performance computers which can streamline processes.
- Break down cross-platform barriers by enhancing the flexibility and compatibility of system solutions.

Creating Copland: Apple's Four-Point Plan for the Mac OS

To meet these goals, Apple adopted a four-point product plan for the Mac OS that serves as the technological framework for the development of Copland.

1. *Advanced foundation technologies.* Adopt RISC technology and the OpenDoc™ component software architecture as the key foundation technologies to design and develop an openly licensable operating system (OS) platform.
2. *Next-generation platform.* Widen the Mac OS advantage with the easiest-to-use human interface, the richest environment for graphics and multimedia, and the most extensive communication and collaboration capabilities.
3. *Support for other platforms.* Ensure Mac OS interoperability with DOS and Windows-based computers, and openly license the Mac OS to system vendors to encourage the development of a wide variety of Mac OS–compatible systems.
4. *Network services.* Ensure that the Mac OS integrates seamlessly with leading industry-standard network services and server platforms; make Mac OS–based systems the best network clients.



Mac OS Four-Point Plan

The Copland Advantage

It's no coincidence that every new operating system in the industry tries to look more and more like the Mac OS. For more than ten years, the Mac OS has offered the most elegant, most intuitive, and easiest way of interacting with the computer—one that insulates users from the computer's complexities yet gives them access to all of its power.

With its new levels of functionality, usability, and performance, Copland offers the following advantages both to individuals and organizations:

- *Unmatched ease of use.* Copland makes the easiest-to-use personal computer even easier to use and support with automatic, intelligent assistance; with more intuitive ways to find, organize, and save information on local hard drives or networked servers; and with a customizable interface to match each person's level of computer expertise.
- *Highest system performance and stability.* Copland is fully optimized to take advantage of the power of PowerPC RISC processors, resulting in high overall system performance and stability. Additionally, Copland's new system foundation delivers advanced multitasking, memory protection capabilities, and room to grow in the future.
- *New and more effective ways of working.* Copland enables users and organizations to work in new and more effective ways by providing international type and text services, advanced simulation, conferencing, and three-dimensional graphic capabilities. Additionally, Copland builds on the Mac OS's industry-leading strengths in the areas of graphics, multimedia, and communication and collaboration by adding powerful capabilities while continuing to optimize for performance and system requirements.

Summary

As the next step toward Apple's vision for the Mac OS, Copland will accomplish two major objectives. First, it will give people the power to work more productively and interdependently by offering easier and faster access to the computer's advanced capabilities. Second, Copland's architecture and advanced levels of functionality will allow people to work in new and better ways in the future.

Setting New Standards for Ease of Use: The Copland User Interface

The Macintosh was the first personal computer to offer a graphical user interface. It set the industry standard for ease of use, popularizing now-standard features such as pull-down menus, icons, and windows. "Mac-like" became the ultimate accolade as other computer companies rushed to build their own graphical user interfaces.

One of the first comments people make is that Windows [95] finally looks like the Macintosh. It doesn't. Yes, there are folders, icons, and a desktop…. The truth is that the new UI still has no consistent metaphor.
—InfoWorld, May 1994

But graphical user interfaces are only one aspect of ease of use. For personal computers to be truly easy to use today, they must connect easily to networks, run multiple software applications concurrently, and provide easier ways to sort through the virtual mountains of information residing on local and networked resources. The Mac OS delivers all of these capabilities today.

As technology continues to evolve, computers will continue to become more versatile tools—but at the price of complexity. That's why Apple is moving beyond what the Mac OS delivers today, and is raising new ease-of-use standards with the following breakthrough user interface advances.

Automating Routine Tasks: From "Show Me" to "Do It for Me"

When it comes to human interface, Apple's vision for computing is simple: The computer should actively assist people with their work and help them be more productive.

Apple's first step toward meeting this vision was Apple Guide. Introduced with Macintosh System 7.5, Apple Guide provides interactive, on-screen help that goes far beyond static help systems to actually walk users, step by step, through complex tasks. The Apple Guide training-on-demand approach makes it easy for users to combine learning with doing.

Copland extends this "show me" technology to automatically perform tasks specified by the user. With Copland's "do it for me" active assistance, users can automate virtually any routine system task—such as setting up a shared hard disk on a network, or compiling and distributing a weekly status report. Tasks can even be delegated according to a predefined schedule or event. For example, a small business owner can automate the task of preparing reminder notices for overdue customers. The owner schedules a computer assistant to automatically launch an invoicing system, find customers whose payments are overdue, and mail-merge their records with a reminder notice. Every week, the assistant generates and prints reminder notices automatically, streamlining processes, and—by freeing up the owner's time to run the business—improving productivity.

An assistant can also automate tasks triggered by specific events. For example, a marketing manager can use a computer assistant to retrieve budget information from a server each time it is updated. After retrieving the information, the assistant can combine the results with a marketing report and automatically e-mail it to a marketing team distribution list.

Active assistance works across both applications and networks, so the computer does the work of opening, manipulating, and integrating information from multiple applications to accomplish a single task.

The impact of active assistance goes beyond the enhanced efficiencies provided any individual user. For organizations supporting large numbers of people, Copland's benefits multiply. Copland reduces training time and support costs and enables the development of customized training-on-demand help. Individuals can receive guidance or assistance as they need it, while learning new capabilities or delegating tasks and routine functions in any application. Copland makes the computer work harder so the user doesn't have to.

Managing Information Overload

Copland also helps people use and manage information more effectively by providing new search tools that offer fast, transparent access to information—no matter where it resides. With improved methods for opening and saving documents, enhanced folder navigation, and innovative features for reducing desktop clutter, it's easier to organize, find, and store information on local systems as well as network servers.

While competing operating systems are only beginning to introduce features that were delivered on the Macintosh platform over a decade ago (such as long file names and nested folders), Copland offers new and innovative ways of searching for, viewing, and manipulating information. For example, Copland allows users to organize information by attribute—for instance, "everything modified yesterday"—instead of by location, which is what the folder model of 1984 presented. In a world of gigabyte hard disks and distributed network servers, new models for information access are required. Copland delivers.

Personalizing the Work Environment

As personal computing approaches its third decade, two competing forces are shaping the needs of computer users. At one extreme is the tremendous growth in demand for personal computers among users that aren't very computer literate—or who don't want to be. At the other extreme are experienced computer users with an insatiable appetite for the full range of the computer's capabilities. Often, these different types of users share one machine. Copland addresses this phenomenon by including the industry's only scalable, fully customizable, multi-user interface.

Imagine a computer interface as simple as a single button on the computer screen. Clicking that button launches a favorite application. This interface is simple, direct, understandable, and usable by anyone—from a novice to the most advanced and sophisticated user. But it also is limited in functionality.

The desktop environment for an advanced user might include all of the features and functionality that have made the Macintosh the most satisfying and easy-to-use personal computer—plus advanced or customized features tailored to individual needs. This environment—which could intimidate or overwhelm a beginning or less experienced user—provides dramatic and powerful benefits to advanced users.

These are the two extremes on a spectrum of user functionality. Copland provides the interface for both of these points as well as multiple points in between. And because each level builds on the skills and experiences of the previous level, users can start with basic features and add functionality as needed—without having to learn completely new interface metaphors.

In addition to providing a customizable interface, Copland gives users unparalleled control over how their machine looks, sounds, and acts—while retaining, at its core, the Macintosh experience. With Copland, for example, a business person might choose the standard Macintosh look—nothing too fancy, somewhat conservative and classic, appropriate for a business environment. A graphic designer, on the other hand, might choose a dramatic interface that includes sounds, bright colors, and animated menus. An industrial

designer might want a more high-tech look, one reminiscent of custom, sleek, modular home-entertainment equipment.

Regardless of its appearance, the basic interface elements work the same and are located in the same place. Users choose how to work with the computer in the same way they choose how to decorate an office, or what kind of music to listen to. And, no matter what the appearance of the interface, users always know how to scroll a page, resize or close a window, or make a menu selection.

Copland's features, functionality, and style can be adjusted for any individual user. But Copland also allows users to apply these capabilities, along with basic privacy and security features, to a computer shared among multiple users. Each user can define a unique working environment with features and style that suit individual needs and taste. For example, the owners of a home-based business might set up their working environment. On the same machine, students might have their own working—or, as the case may be, playing—environment. It provides the right features for their skill level; a fun, stylized interface; and protection from accidental damage of or access to their parents' business files.

Summary

The industry's only scalable, customizable interface. "Do it for me" active assistance. Improved methods for organizing, finding, and storing information. These are just three ways that Copland's advanced interface will enhance ease of use for everyone. Users can count on continued ease of use, even as their systems grow in functionality.

Improving on Superior Performance: Copland's System Foundation

Copland's advanced interface design rests on an operating system foundation that has been rearchitected from the ground up. By taking full advantage of the power of RISC processing and OpenDoc component software architecture, Copland delivers a high-performance, extensible computing platform that's unmatched in price/performance value.

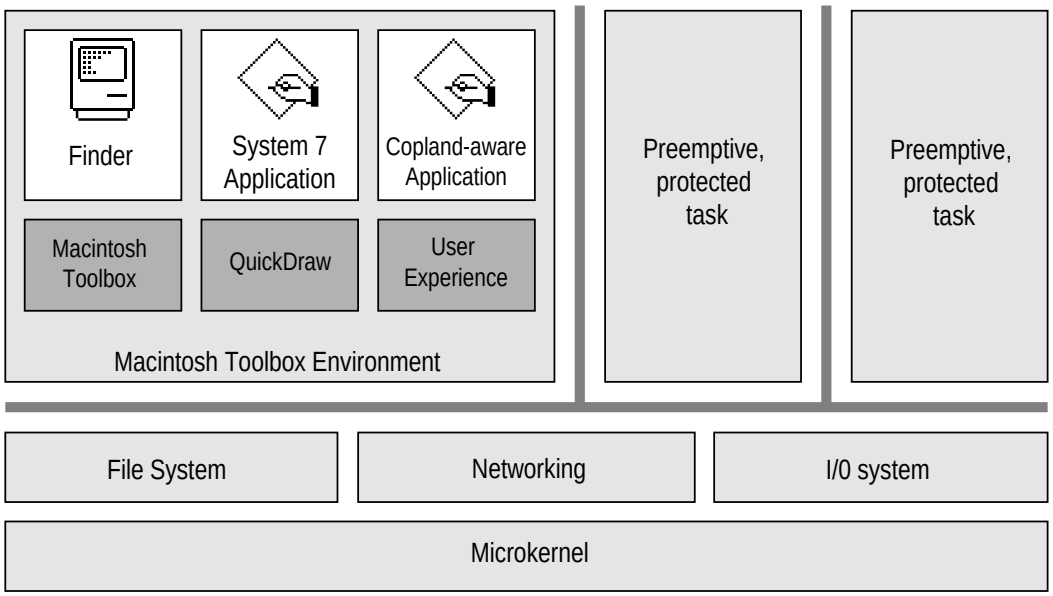
Copland OS Foundation

At the core of Copland is a radically redesigned operating system foundation based on a microkernel technology. Though most users will never know—or care—about the microkernel, the capabilities that it delivers will serve them well for many years. In fact, it's primarily through the microkernel design that Copland delivers:

- Higher overall system performance through native software, preemptive multitasking services, and algorithmic improvements for performance-critical areas such as the I/O and file system
- Improved system stability through protected memory
- A more efficient memory model that reduces requirements for RAM
- A better way for software developers to add functionality through a highly refined and robust mechanism (system extensions)
- A broader choice of computers for customers through a hardware abstraction layer that enables hardware vendors to more easily design and deliver Mac OS–compatible systems

When combined with other improvements, Copland also makes possible:

- Greater ease in setting up, using, and administering network services by offering improved communications features and plug-and-play access to major networks
- Software applications that are easier to use, develop, manage, and support through an industry-standard multiplatform component software architecture



Copland's System Architecture

Exploiting the Power of RISC for Higher Performance

When Apple introduced the Power Macintosh platform in 1994, the Mac OS became the first mainstream, RISC-based operating system for personal computers. Copland fully exploits the power of RISC to provide the horsepower needed to run today's and tomorrow's applications—from disk-intensive multimedia applications, to math-intensive business applications, to graphics-intensive publishing applications.

To improve overall system responsiveness—yet maintain compatibility with the thousands of applications available for Mac OS today—Copland uses a combination of cooperative and preemptive multitasking to perform many operations concurrently, such as writing and reading files, and retrieving or sending information over LANs or WANs.

Copland employs preemptive multitasking for application subprocesses and low-level operating system services such as the I/O system, file system, networking services, and system extensions, while maintaining a cooperative processing model to provide backward compatibility for existing applications. This approach preserves the majority of a user's investment in existing software while delivering advances in multitasking that offer immediate benefits—at the operating system level.

Memory Protection for Better System Reliability

To increase system reliability, Copland introduces a new memory protection model that insulates the microkernel and other critical OS services (such as the file system, I/O, and networking services) from interfering with applications that are currently running. Software applications can exploit this protection mechanism to spinoff tasks—for instance, calculating number-intensive statistical simulations—that run in the background in their own protected memory spaces.

Copland's memory protection model translates directly to improved overall system reliability. With Copland, users will be less likely to lose data or network connections should an application crash unexpectedly.

A More Efficient—and Cost Effective—Memory Model

Copland delivers advanced capabilities that will ultimately lead to dramatic improvements to overall user productivity. And it delivers them without the cost normally associated with new features: increased RAM requirements.

Copland introduces an important new approach to minimizing memory requirements through two techniques. First, Copland loads into RAM just the applications that the user needs at any given time. Second, it loads only the small parts of the application that the user needs in order to complete an operation. So, even though an application may be 5MB in size, Copland will only load small kilobyte segments instead of megabyte segments, and only load them as needed. This means that users can exploit the full richness of the Mac OS without worrying about RAM.

Easier System Extension

One of the most significant advantages that the Mac OS offers is that it gives Apple and independent software vendors (ISVs)—and, ultimately, users—a much easier and more cost-effective way to add new system functionality. In Copland, Apple provides a dramatically improved and very robust mechanism to add functionality through system extensions. Extensions can be created more easily that operate more predictably on a wide variety of Mac OS–compatible systems.

More Options Through Hardware Abstraction

Finally, perhaps the most significant contribution of the microkernel is its hardware abstraction layer. Hardware abstraction allows any computer vendor to more easily design new and unique Mac OS–compatible systems, knowing that all Mac OS–compatible applications will run smoothly on them.

Though Mac OS–compatible applications run on Apple's Macintosh systems and the systems from several Mac OS licensees today, Copland will permit a virtually limitless variety of systems from multiple vendors in the future. That means much greater choice for customers, who will be able to purchase systems that meet their exacting specifications.

Improvements in Networking

Copland offers greater ease in setting up, using, and administering network services. The Open Transport architecture (Copland's modern networking and communications model) shields applications from network protocols and integrates local area, wide area, modem serial, and remote dial-up networking. Through the Open Transport architecture, Copland extends Apple's history of built-in networking by providing two important new capabilities: built-in support for AppleTalk®, TCP/IP, and IPX/SPX® networks; and an open mechanism for vendors to add additional protocols. It is based on three key open standards:

- X/Open Transport Interface
- UNIX® System V STREAMS
- Data Link Provider Interface from X/Open Group

The Open Transport architecture provides improved and more transparent access to different networks. Users will find it easier to collaborate and share documents over multiple networks, because they can work with any application that supports the Open Transport architecture without having to know what network they are connected to. Also, the Open Transport architecture makes it possible for users to transparently switch from one network to another without having to reset network connections. This transparent network access will be especially useful to mobile professionals who need network access from a variety of locations.

Open Transport fully exploits the microkernel's preemptive multitasking and memory protection services in Copland so that network transactions are optimized for performance and overall system stability. To help users navigate more easily and efficiently, Copland also provides improved browsing tools for easier access to network resources such as file servers, printers, multi-user calendars, and mail systems. System administrators also will benefit from Open Transport, because it allows them to update, reroute, or replace networking systems without disrupting users' applications while improving overall network configuration administration.

OpenDoc: Component Software for Innovative Solutions

Copland also incorporates OpenDoc, an industry-standard multiplatform component software architecture that dramatically simplifies the use, development, management, and support of software applications.

Software based on OpenDoc gives users a much simpler and more natural way to work because it lets them focus on specific tasks rather than on software applications. With OpenDoc, smaller applications, known as components, focus on specific tasks. These can be mixed and matched like building blocks to provide functions a person needs in any document, whether it is text, graphics, or database information. For example, within a single document, users can edit text using a word processor, access a database with an SQL client, edit graphics, and perform spreadsheet functions without having to manage four different applications.

With OpenDoc, organizations also can easily create custom solutions by relying primarily on off-the-shelf components to deliver specific capabilities with minimal custom development. In addition, organizations will benefit from smaller and easier-to-manage upgrades that can be distributed on a network and/or centrally managed on a server.

OpenDoc is a multiplatform, open standard under development for the Mac OS, Windows, OS/2®, and UNIX operating systems. OpenDoc also provides full interoperability with other component software architectures, such as Microsoft® OLE 2.0 (Object Linking and Embedding). With OpenDoc as part of Copland, organizations can easily standardize on the same software across platforms, and choose parts and services from different vendors.

Through OpenDoc, Copland enables individuals and organizations to choose the specific features they need, without having to learn and support multiple applications. At the same time, organizations can standardize on a cross-platform architecture for development and deployment of commercial and custom software.

Summary

Copland's radically redesigned, microkernel-based operating system lays a solid foundation that not only delivers superior system performance and stability, but also provides unprecedented flexibility and headroom for growth. With Copland, it's easier to add functionality. Easier to use, develop, and support applications. Easier to communicate over any major network. And easier to choose exactly the features that meet individual needs. Copland assures customers of the best value in price and performance of any personal computer.

Enabling New Ways to Work

A computer's versatility is determined by the different ways it allows people to work and become more productive. Whether people work with graphics, create or use multimedia, manage networking and data communications, or support users around the world, Copland enables people to work in ways that were never before possible.

Increasing the Impact of Information

Today's Macintosh computers give users the power to combine text and graphics as a means of expressing ideas more effectively. Copland gives users new opportunities to harness the power of animation, video, and color. With Copland, Apple extends its leadership in graphics and multimedia by delivering new functionality in the areas of type and graphics, professional color management, multimedia, and visualization and simulation.

Copland's professional-quality publishing capabilities. The original Macintosh computer did something that no other computer could do—it integrated high-quality formatted text and graphics in a single document and printed the results with uncanny accuracy on a wide variety of output devices. Desktop publishing was born.

Today, the Macintosh computer remains the preferred platform for publishers who aim to achieve the highest possible standards for output quality, color, and type. For business communications users, the Macintosh remains the highest-productivity platform, with integrated font management, print capabilities, and an intuitive and consistent interface shared among popular word processing, page-layout, and presentation applications.

With Copland, professional-quality publishing capabilities are accessible to anyone. Copland's graphics and imaging model is based on a refined and optimized version of QuickDraw™ GX, the industry's most advanced graphics architecture for personal computers. It provides next-generation type, graphics, color, and printing capabilities.

QuickDraw GX can offer applications that allow the user to work in any language in any document in any application; fonts that can automatically typeset themselves, including complex combinations (such as fractions, ligatures, and special swash characters); and graphics applications that let the user work in real time in any color model (such as ink or light). Today QuickDraw GX is already enabling developers to create these products and more: next-generation word processing, graphics, page-layout, and presentation applications, as well as advanced fonts and printing extensions.

Users will benefit from these features in a number of important ways. For example, users can create documents containing multiple languages, work with fonts that can automatically typeset themselves, or work with graphics applications that accurately mimic the real-world behaviors of ink and light.

Automatic color-matching and synchronization. With Copland, anyone can easily produce professional-quality, color documents. Copland provides consistent and predictable color input, display, and output through the latest version of ColorSync® software, Apple's industry-standard color-matching technology. Everyone can create graphics, illustrations, presentations, and publications to the most exacting color specifications quickly and confidently without having to know anything about color matching.

Cost-effective multimedia support. Multimedia is difficult to produce—and Macintosh makes it easy. In fact, Dataquest has shown that multimedia consumers prefer the Macintosh platform over IBM and workstations, and that 65 to 70 percent of multimedia developers use Macintosh computers, making Macintosh the authoring system platform of choice for multimedia-rich applications. No other computing platform offers multimedia capabilities that are as affordable and easy to use, and that offer so wide a range of software tools and plug-and-play peripherals. With Copland, Apple extends its lead in this rapidly growing area thanks to its performance-enhanced operating system foundation and QuickTime® software, the industry standard for digital video and audio.

Easy-to-use three-dimensional graphics. One of the most exciting capabilities Copland offers is QuickDraw 3D, which makes it as easy for people to work with three-dimensional objects as it has been for them to work with two-dimensional objects. QuickDraw 3D offers tremendous opportunities for deploying high-performance, cost-effective systems for modeling, industrial design, and visualizations.

Workgroups that incorporate 3D graphics into documents and simulations can easily exchange files with each other through a consistent, multiplatform file format. QuickDraw 3D eliminates many of the problems that have dogged 3D graphics by providing a consistent file format; a standard, extensible, cross-platform 3D API; and a set of 3D interface standards and guidelines.

For the first time ever, QuickDraw 3D makes creation and manipulation of 3D graphics easy for anyone, from business people who want to create simple presentations to industrial designers. And though other computing platforms support 3D, only Copland makes using 3D technology affordable and approachable, without compromising performance.

Bringing People Together: Improving Communication and Collaboration

Apple was the first personal computer vendor to recognize that networking was key to helping people and teams work together more effectively by providing built-in, plug-and-play networking in the Mac OS since 1985. AppleTalk® set the standard for ease of use in networking; millions of AppleTalk nodes are in use today. Apple also led the personal computer industry with support for the Internet's protocol, TCP/IP—and incorporated a robust, 32-bit version of TCP/IP into System 7.5.

In 1993 Apple delivered PowerTalk™ and PowerShare™ communication and collaboration services as part of the Mac OS. Apple was again the first to recognize the importance of a unified electronic mailbox for all electronic correspondence, integrated directory services for all network resources, encryption for secure data transmissions, and digital signatures for electronic document approval.

Copland extends these capabilities by making it easy to integrate, manage, and use communications capabilities. It provides:

- Transparent access to information using a variety of networks and network resources—including personal computers, legacy systems, workgroup servers, UNIX workstations, the Internet, commercial on-line services, and fax and e-mail systems
- Simplified network implementation and administration
- Improved networking performance and reliability

Multiple network connections. With connections to a variety of data networks, printing services, and communication servers, many individuals find themselves connecting and disconnecting cables or switching connections each time they want to retrieve e-mail, print, or share files.

Copland makes it possible to have multiple, simultaneous connections to different physical networks. For example, an individual whose computer is connected to a networked printer via LocalTalk® and to the organization's Ethernet network can now use both services simultaneously. A company that wants to offer Internet access to employees—yet maintain the security of its internal network—can now provide two separate physical connections, so that users can access resources on both networks without creating a connection between them. Copland makes it easier for network administrators to set up and maintain secure network access, while enabling individuals to use the services they need without manually switching between them.

Enhanced unified electronic mailbox. To help people manage their electronic communications, Copland builds on System 7.5, integrating virtually all communication and collaboration services. Connecting to corporate networks, public on-line services, or the Internet or faxing directly from a computer is as easy as pointing and clicking. Support for faxes, pagers, modems, public and private mail systems, the Internet, and on-line bulletin boards is provided. Individuals can connect to the electronic services they use with a single password and log-on ID. Copland eliminates the extra steps and time normally required to communicate efficiently online.

Copland also provides a robust universal mail client with an easy-to-use interface to any collaboration service. Regardless of whether a user prefers CompuServe®, eWorld™, the Internet, fax, X.400, Novell MHS, or any combination of these or other mail systems, they see the same consistent interface. And Copland provides the tools a user needs to organize electronic correspondence. Electronic mail, faxes, and even voice mail can be organized, searched, and stored in the same way as all the other information on a system or across a network.

Document and videoconferencing support. Today, organizations spend time and resources bringing people together to collaborate on projects. Copland empowers teams to work more productively by deploying cost-effective document and videoconferencing solutions based on the Mac OS. Through QuickTime® Conferencing, Copland allows individuals to exchange voice and data simultaneously over existing telephone lines; existing local area networks; and emerging network connections such as Internet, ISDN, and ATM networks.

Streamlined business processes. Personal computers have made substantial differences in individual productivity. Copland builds on system 7.5 capabilities to enable organizations to raise their overall efficiency by delivering a foundation for deploying process automation and workflow solutions. Copland provides an extensible directory service, for example, that simplifies directory maintenance and reduces administrative time and costs. Digital signature capability enables electronic document approval, which saves time required for routing documents and improves document security. Together these features enable users and organizations to generate documents such as purchase orders that can easily be routed for approval in the required order and dispatched—all electronically.

Working Worldwide: The International Computer

Personal computers have contributed greatly towards bringing organizations worldwide closer together and making them more competitive in their own markets or internationally. Multinational organizations, with employees, customers, and affiliates across the globe, want consistent, easily supportable solutions that work wherever they do business and need to improve the consistency of shared documents and files. Apple has long recognized these needs. In fact, Apple offers more than 35 localized versions of the Mac OS in over 140 countries worldwide today and is the best in the industry at providing support for the languages of the world.

Copland supports the needs of multiple writing systems.

In 1991, Apple introduced WorldScript®, an enabling technology for the processing of any international writing system. In Copland, Apple extends its leadership in international computing even further. Copland can support the features of any of the world's modern writing systems—those that use vertical writing, such as Chinese; languages that read from right to left, such as Arabic; as well as complex contextual languages, such as the writing systems of India. In addition to supporting all major world writing systems, Copland will enable customers with multiple language needs to seamlessly mix and print different writing systems within a single document or application, with any combination of supported languages—for instance, a multilingual warranty or owner's guide.

Copland also offers Unicode support. This international encoding standard ensures improved cross-platform compatibility, including across client/server applications. Users can exchange international documents with confidence that they will properly display, edit, and print on other computer platforms.

Copland will also provide enhanced support for market-specific features, including advanced support for Asian language input methods, user-defined character support, and an open font architecture, enabling multiple font formats to easily coexist. This means that individuals and organizations can rely on one world-ready version of the operating system that supports their writing systems and addresses their local needs.

Apple's commitment to the world's personal computer users is further enhanced through Copland. With Copland's unified international design, local language versions can be made available more quickly than ever. Additionally, users can expect their applications to be more quickly localized and better adapted to meet their needs because Copland makes it easier for ISVs to translate application software written in one language to any other language.

Finally, by providing multinational organizations with a single operating system, Copland reduces support costs and facilitates global document compatibility among diverse users.

Summary

The implications of Copland's leadership in user interface, graphics, multimedia, and communications and collaboration are far-reaching and are reflected in many new and better ways of working—some not even yet imagined. By advancing the type, graphics, and output capabilities of the system, Copland can provide new ways of working for publishers of all kinds of material, from traditional ink-on-paper publications to electronic documents delivered on disk or online.

By harnessing the power of animation, video, and color, Copland puts a new range of capabilities within reach of anyone: color publishing, multimedia, 3D simulations and visualizations, and video conferencing.

By raising the standard Apple set for ease of use with networking, Copland enables everyone to communicate electronically in a greater variety of ways.

And with its unified international encoding standard, Copland makes it easier for people everywhere to work comfortably with others who use diverse languages. No other operating system provides such comprehensive support for international computing.

All of these new ways of working are possible because of Copland's advanced user interface and its enhanced graphics, multimedia, and communications and collaboration capabilities—capabilities that Apple will continue to extend.

Upgrading to the Future

In the end, what differentiates Copland from other operating systems is what distinguished the first version of the Mac OS from its competitors: People who use the Mac OS accomplish tasks easier, quicker, and better.

Thanks to the work of many different independent research groups, there's proof. For instance, a 1994 Arthur D. Little study demonstrated that people using Mac OS are twice as productive as those who use Windows. Little concluded: "The Macintosh computer represents a more productive platform than comparable Windows-based systems."

Not only have the Macintosh computer and Mac OS been rated as the most productive system to use, they're also the computer people prefer to use. An Evans Research study found that people who use both Macintosh computers and Windows prefer the Macintosh computers 2 to 1.

And in a new, expanded application benchmark study carried out in 1994, Ingram Labs found that Power Macintosh systems are also the fastest—45 percent faster than comparable Windows PCs.

But the most convincing proof of the success of the Macintosh and the Mac OS is the millions of customers who use Apple's systems every day, and how the rest of the computer industry has recognized the Macintosh as the model of how personal computers systems should look, feel, interconnect, and operate. With Copland, our commitment is not simply to do everything that's now technically possible, our commitment is to turn what is technically possible into real-world solutions that work together to give our customers best-of-class tools they need to be competitive and productive.

The commitment is reflected in the fact that the Macintosh was the first personal computer to offer a graphical user interface. The first to set the industry standard for ease of use. The first to establish true plug-and-play connectivity to networks and peripherals. The first to bring publishing to the desktop. And now through Copland, Apple will redefine ease of use with automatic, intelligent assistance and the most adaptable user interface, deliver the highest system performance and stability, and enable new and more productive ways of working.