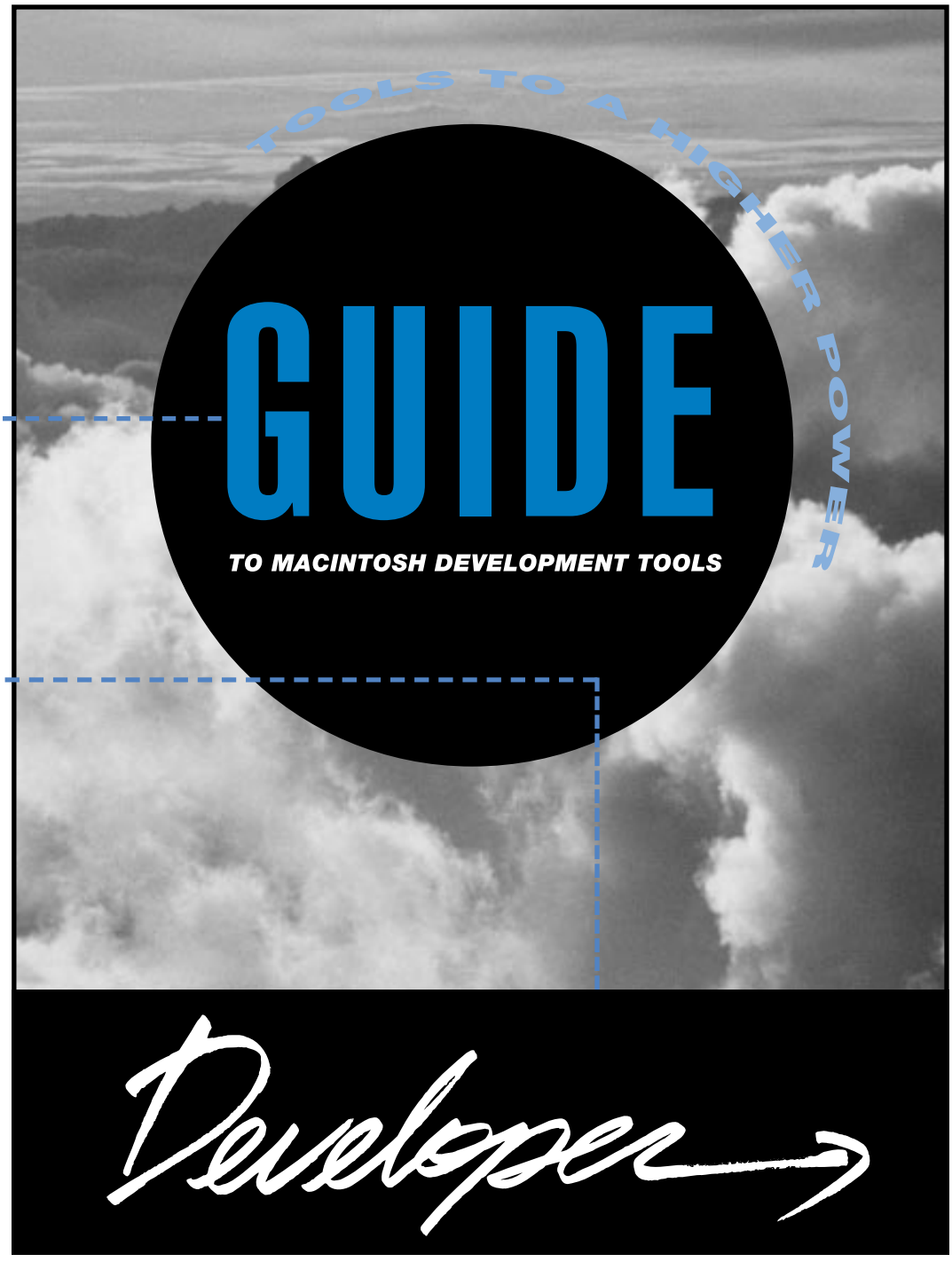
TOOLS TO A HIGHER POWER
GUIDE
TO MACINTOSH DEVELOPMENT TOOLS
Developer

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If you'd like your product information included in the next edition, please e-mail a 50-word or less description to zivkovic@applelink.apple.com.

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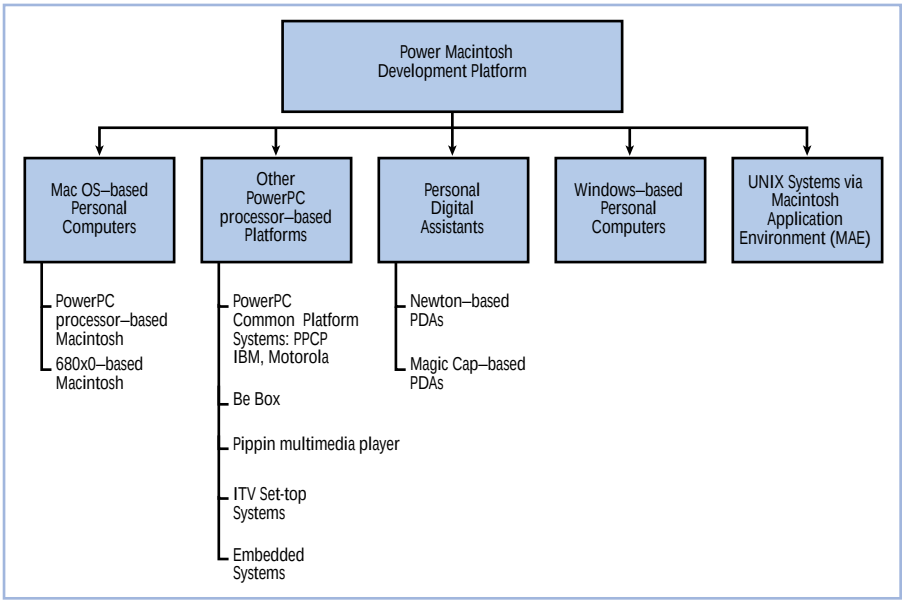
Introduction

Since 1984, Apple Computer, Inc., has been revolutionizing the way that users interact with computers, making it easier for people to get their work done faster and better. In recent years, Apple has also been working hard to improve the productivity of its third-party developers through investments in four areas:

- RISC-based PowerPC hardware
- a next-generation operating system (code-named Copland)
- the OpenDoc component software architecture
- a better and broader selection of development tools

The combination of these advancements, along with the proliferation of great third-party tools, has made the Power Macintosh the most productive development platform in the industry.

From a standpoint of raw speed, the Apple Power Macintosh 9500/132 is currently the world's fastest and most powerful personal computer. Recent tests by *Byte* magazine (October 1995) found that this CPU ran the magazine's Native Performance Benchmark integer test 87 percent faster than an equivalent 133-MHz Pentium-based PC. Later this year, Apple will further widen this performance gap by introducing multiprocessor systems that use dual 200-MHz PowerPC 604e microprocessors. This speed, of course, means programmers can spend less time waiting for compiles and more time writing code.



The proliferation of great cross-platform tools is making it easier than ever to deploy your software from the Power Macintosh to other platforms..

Beyond speed, there's another advantage to developing on PowerPC-based Macintosh computers—leverage. As more PowerPC microprocessors are designed into other computer platforms, your opportunities to reach new markets will multiply. Today, with the help of cross-platform tools such as Metrowerks CodeWarrior, you can easily move your software to platforms such as Windows, Be Box, and Magic Cap. In the near future, the growing number of PowerPC Common Platform (PPCP) computers shipping will enable you to further leverage your programming investments.Finally, there are other often overlooked reasons to develop on Power Macintosh computers. Its integrated multimedia and networking help your programmers work more efficiently. Its built-in support for multiple monitors lets your programmers more efficiently organize work across multiple monitors. And the localization facilities built into the Mac OS provide you with the fastest way to prepare your products for international markets.

Developer tools addressed in this guide

Apple technology investments are improving the depth and breadth of tools available to third-party developers. Today you'll find a wide selection of Mac OS tools that meet the needs of all types of developers, including:

- object-oriented programming tools that let you reuse code and modularize your software (examples: MacApp and the OpenDoc Development Framework)
- Internet tools that let you to quickly set up Internet servers and publish information on the World Wide Web (examples: PageMill, Cyberdog, and AppleScript)
- cross-platform tools to help you quickly move programs to and from Mac OS and Windows platforms (examples: Metrowerks CodeWarrior, Willows Twin APIW, and Altura Mac2Win)
- visual development tools that allow you to more quickly visualize, design, and debug programs (examples: HyperCard, Oracle Power Objects, and Prograph CPX)
- dynamic languages that enable you to rapidly develop and evolve code (examples: AppleScript, Prograph CPX, and SmallTalk Agents)
- client/server, database, and solutions tools that make it easier for you to develop custom Mac OS–based software for use in multiplatform environments (examples: Oracle Power Objects, Forté Development Environment, Peregrine Client/Server Environment, and JYACC JAM)
- multimedia authoring tools that provide both novice and expert computer users with more productive ways to create high-quality multimedia content (examples: Apple Media Tool and HyperCard)

Type of Development	Application/ Component	Internet	Client/Server & Database	Solutions & Integration	Multimedia Authoring
Requirements	Speed, power, cross-platform, and object-oriented capabilities	Quick Internet publishing, scalability	Scalable applications, multiplatform interoperability	Rapid, visual, custom development	Easy integration of sound, video, animation, and graphics

This guide provides you with an overview of a wide variety of Mac OS–compatible development tools.

Other tools innovations have occurred “under the hood” of the Mac OS. Within the Mac OS you’ll find hundreds of efficient toolbox routines that you can use to do everything from drawing graphics images (QuickDraw GX) to playing video clips (QuickTime) to rotating 3-D images (QuickDraw 3D)—each with a single line of code. The OpenDoc component software architecture is another software innovation that will create new business opportunities for you, enabling you to develop small application components that can be used within any OpenDoc-savvy application. (For example, you’ll be able to add Internet connectivity to an application, simply by dropping in an OpenDoc-compatible Internet component.) All of these extensions provide your programs with a standardized set of calls that remain constant, even when the underlying Macintosh code or hardware changes.

In this document, we discuss the advantages of developing on the Mac OS platform and provide you with an overview of Mac OS development tools. Whether you’re an application developer, solution integrator, Internet “webmaster,” client/server developer, or multimedia author, this guide provides you with information to help you make informed decisions on tools purchases—decisions that will ultimately result in faster development and better software.

The Mac OS Developer Advantage

From a market, technology, and tools perspective, there's never been a better time to develop for the Mac OS platform. And while there are as many reasons to develop Mac OS software as there are different types of developers, three universal advantages make the Mac OS platform the best investment for your development dollars:

- Lucrative business proposition
- Technology leadership
- Powerful development platform and tools

On the market side of the Mac OS business, Apple is in the midst of a focused effort to grow the Macintosh installed base in publishing, new media, engineering/scientific, home/education, and business markets. Apple shipped a record 4.5 million computers in 1995, and as of March 1996, the installed base of Mac OS computers topped 23 million. On the development side of the business, enhancements to the Mac OS platform, along with great new tools, are making it easier and faster to develop great software solutions.

The business proposition—A better R.O.I.

Apple's business proposition to Mac OS developers is simple—you get a better return-on-investment in the Macintosh market than in the PC market. This proposition is supported by a September 1995 International Data Corporation (IDC) study that finds that the Macintosh developer opportunity compares favorably to Microsoft Windows development in several areas:

- *Higher revenues per user.* Macintosh systems generate 73 percent more software revenues than Windows software–based systems.
- *More efficient development.* Windows application development costs 50 percent more on average, per dollar of revenues, than Mac OS development.
- *Less expensive marketing.* Marketing costs for Windows–based products average 54 percent higher than for Mac OS products.
- *Attractive growth outlook.* IDC expects the Macintosh installed base to double during the next five years, growing as fast as the Windows base.

The revenues-per-user data confirms what developers have observed for years: Mac OS computers are easier and more fun to use, so owners tend to buy more software—in fact, 30 percent more, says IDC. Add to this IDC's observation that Mac OS developers typically sell software at slightly higher prices than Windows software, and it results in the 73 percent Mac OS advantage over Windows–based development.

Bit Jugglers on Lower Mac Marketing Costs

"As a small developer, it's easier and less expensive to sell Mac OS products than Windows products because of the strong Mac OS mail-order channel. With two phone calls I can reach the two resellers who own 75 percent of the Mac OS mail-order business."

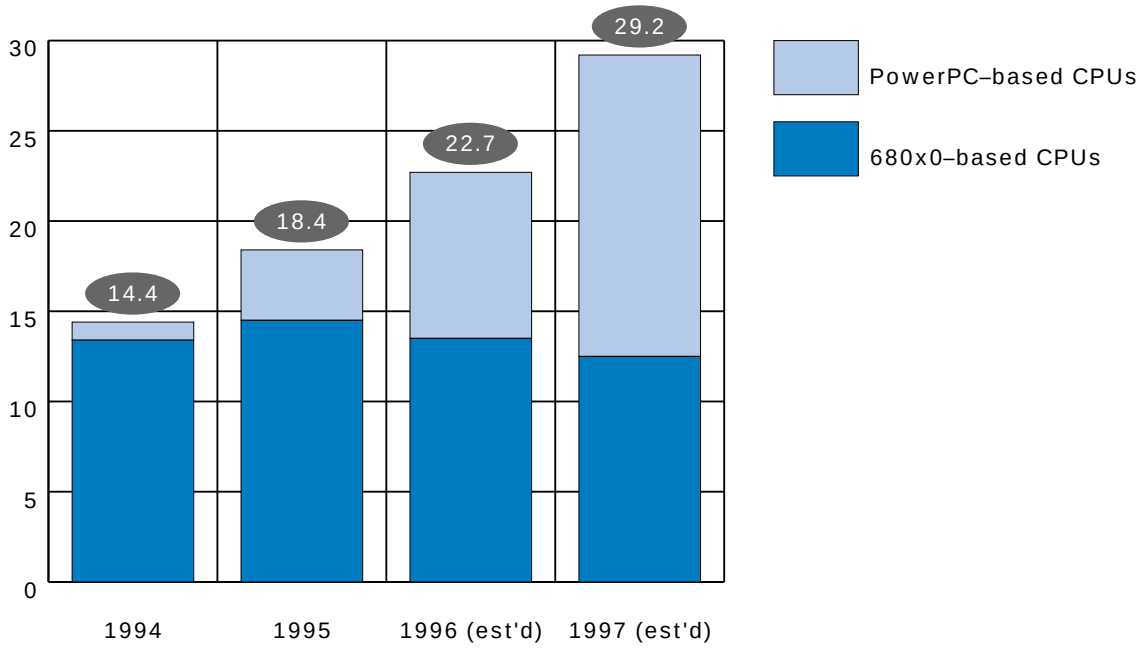
—Chris Calande, Bit Jugglers

IDC also reports that it's less expensive to develop and market Mac OS products. The Windows market may have more users than the Macintosh market, but the Windows market is much more competitive. After subtracting out revenues from categories dominated by Microsoft and other large software companies (word processors, spreadsheets, and office suites), IDC reported, "the value of software sold per Macintosh jumps to three and a half times that sold per Wintel machine." Clearly, the Macintosh market is far more valuable to developers than market share alone would indicate.

Apple Computer is well positioned to maintain a steady level of growth in the coming year, and from 1994 to 1995 Macintosh shipments grew more than 15 percent. One of the driving factors behind this success is Apple's transition to a RISC (reduced instruction set computing) architecture. Apple expects to ship more than 5 million RISC-based Power Macintosh computers in 1996 alone.

Mac OS–Compatible Installed Base

Annual worldwide installed base by processor type (in millions)*



Source: Pieter Hartsook's "Macintosh Market Review and Forecast Report 1991–1999," #6, February 1996
*Includes Mac OS compatibles

Looking to the future, licensing of the Mac OS to other computer manufacturers will significantly increase both the installed base of Apple computers and the opportunities for addressing new markets. Apple is working with IBM and Motorola on a PowerPC processor–based common hardware reference platform (CHRP or PPCP) that will enlarge the Mac OS software market. And recent Apple alliances and investments aim to provide you with an easy path to two emerging platforms: the Pippin multimedia/Internet platform and interactive television.

Strong market positions

Other Mac OS platform attributes that you can leverage are Apple's strong customer brand loyalty and vertical market positions. For example, with 90 percent of existing customers intent on buying a Macintosh for their next purchase (Apple internal research), you can count on a steady upgrade revenue stream for years to come. Also, independent market data shows that Apple holds advantageous market positions in the following segments:

- *Internet.* Nineteen percent of all Internet users have Mac OS computers (Source: Dataquest, May 1995) and 41 percent of Internet administrators use Mac OS computers to create Web page graphics.
- *Publishing.* 91 percent of graphic designers use Mac OS computers in their businesses (*Graphic Design:USA* magazine, May 1995). The Macintosh also holds 76.2 percent of the color prepress market (Griffin Dix Research Associates, 1995) and 40 percent of the worldwide commercial desktop publishing market.
- *Entertainment/New Media.* 73 percent of multimedia developers prefer to create content on Mac OS computers (GISTICS, 1995). And the Macintosh is the number-one multimedia authoring platform worldwide (Dataquest).
- *Home/Education.* This year Apple's share of U.S. school PCs grew four share points to 63 percent (Quality Education Data 1995-96). Last year, the Macintosh was rated as the top home computer, followed by IBM and Packard Bell systems (Global IT Survey, IDC).
- *Engineering/Scientific.* Apple holds a 50 percent share of chemical, pharmaceutical, biotechnology, scientific, and engineering markets (Griffin Dix Research Associates).

Lower support costs

Because of the Mac OS platform's tightly integrated system and its ease of use, most Mac OS developers benefit from the industry's lowest testing and support costs. In an October 1995 Gartner Group study comparing costs of Mac OS and Windows corporate technical support, it was reported that:

- support costs for Mac OS computers are about 25 percent lower than those for Windows
- the higher the percentage of Macintosh computers in a company, the lower the technical support costs
- there are no incremental costs for companies supporting dual-platform computers versus the cost of supporting Windows alone

As Apple focuses more attention on selling systems into the business market, value-added resellers, contract programmers, and solutions providers will benefit from these support advantages.

Bungie on the User Experience

"As a game developer, we sink or swim by the speed, graphics quality, and ease of use the consumer experiences with our software. We're a Mac-only developer because the Power Mac dominates on the first two points, and it's a breeze for us to provide technical support for the Mac."

—Doug Zartman, PR director, Bungie Software

A springboard to new technologies

One of the strongest reasons to develop on the Mac OS platform is that Apple consistently delivers innovations that help you differentiate your products and services. *Byte* magazine backed this claim in its December 1994 cover story, saying: "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." Throughout its 19-year history, Apple has pioneered or popularized an amazing number of innovations. The list includes the graphical user interface (GUI), visual programming, built-in networking, plug-and-play peripherals, API-based software development, integrated multimedia, built-in color calibration, and QuickTime VR, to name a few. Not only have these innovations made computers accessible to more users, but they've upped the technology ante in the personal computer industry.

The technologies that Apple has brought to market have created entirely new markets and business opportunities. For example, the introduction of the first LaserWriter printer, with the help of Aldus and Adobe, helped get the

desktop publishing market started. Apple continues to extend the Mac OS software architecture and "share the wealth" with developers. Apple's investments in emerging technologies and platforms will provide developers with new opportunities in the areas of personal digital assistants, intelligent agents, 3-D graphics, videoconferencing, interactive television access, and Internet navigation facilities.

Nisus on Mac Technology

"Nisus users continually look to the best computing tools for challenges like multilingual communication, information management, and Internet editing. We've always agreed—it doesn't make sense to build on a bad foundation. That's why we made the shift to the Mac OS in 1994, and why we're enthusiastic about our Macintosh future with Power Macs, OpenDoc, and Copland."

—Jerzy Lewak, CEO, Nisus Software

A powerful development platform

The Power Macintosh computer's impressive RISC performance, its superbly integrated hardware and software capabilities, and the wide selection of development tools available, make it the most productive development platform for the money. From a standpoint of raw speed, it's anticipated that the top-of-the-line Power Macintosh will ship with dual 200-MHz microprocessors this year, making it the world's fastest and most powerful personal computer. This means that programmers will be able to spend less time waiting for compiles and more time writing code.

The upcoming version of the Mac OS, code-named Copland, will further increase programming efficiencies and the speed in which you can deliver innovative, world-ready software. (See the text box on page 9 for details.)

The Mac OS also provides a rich foundation for the creation of powerful and easy-to-use network-based software solutions. Capabilities built into the Mac OS make it easy for developers to support connectivity in such diverse environments as DEC, IBM, OSI, TCP/IP, DOS, and the AppleTalk network system. Now *Open Transport,* Apple's new client-networking architecture, makes it even easier for Macintosh users to add new networking protocols and file sharing on TCP/IP networks.

Another feature, no less important, is the Macintosh computer's plug-and-play compatibility. And connecting mass storage and other Macintosh systems or PCs is fast and simple, making it easier for teams to collaborate.

Apple and third-party vendors offer developers a variety of mature, innovative Mac OS development tools, including object-oriented frameworks, integrated development environments, Internet tools, client/server development tools, solution tools, and multimedia authoring tools. There's also a growing number of cross-platform development tools available, making it easier than ever to "develop once and deploy to many."

No other computer company has technologically advanced a platform so significantly, with so little disruption to its installed base. With the transition to a RISC architecture, innovations to the Mac OS, and efforts to make it easier to develop software, the Mac OS provides you with more opportunities than ever. No matter what claims are made by competing platforms, the Mac OS offers an easy-to-use, robust foundation for innovation today, with a promising outlook for the future. Stated simply, the Mac OS platform provides you with a great market, great technology, and great tools. And all of this adds up to a great development proposition to you, whether you're a commercial developer, a solutions provider, or an in-house developer.

Copland Advantages at a Glance

Feature	Developer Advantage
Improved Market Growth	
• 6 million Copland-capable computers during launch year	• Early-adopter upgrade revenues
• Easier Mac OS licensing	• Accelerated market growth
More Productive Development	
• RISC-optimized routines	• Full access to PowerPC performance
• Preemptive multitasking	• Higher performance
• Improved I/O structure	• Fewer system crashes, simpler device driver development
• Protected memory tomer	• Fewer memory conflicts, lower cus- support costs
• Integrated WorldScript, Unicode, and Text Objects APIs	• Easiest platform to deliver “world-ready” software
• Improved virtual memory	• Less system RAM required, improved customer satisfaction
• HI Toolbox	• Easier to create visually-appealing, consistent human interfaces
Opportunities for Innovation	
• OpenDoc integration	• Code reuse efficiencies, new development opportunities
• Built-in technologies, e.g. Open Transport, QuickTime 3D, QuickTime VR, Assistance, Internet utilities	• Product innovation and differentiation

Internet Development

The Internet enables businesses of any size to market their products and services directly to computer users around the globe. While setting up shop on the Internet previously required costly servers and complex networking software, today, with the help of a Mac OS computer and the wide variety of Internet tools available, you can get a World Wide Web server site (the graphically rich segment of the Internet) operational in as little as 30 minutes. Apple Computer provides the best platform for using the Internet, whether you need to create interactive Web content, to set up an Internet server, or to simply gain client access to information. Because of the importance of this new technology area, Apple is committed to providing its customers with the best Internet solutions on the market.

Macintosh as an Internet client

Today, users of Mac OS computers make up 26 to 40 percent of the people accessing the World Wide Web (Mika Rissa & Co.). One of the reasons that these personal computers are so popular as Internet clients (i.e., Web access systems) is because of their ease of use. There are also many compatible graphical browsers available, such as Netscape Navigator, Mosaic Spyglass, and Microsoft Explorer.

In the future, the OpenDoc component software architecture will play a key role in Internet-based software businesses. The Mac OS version of the OpenDoc standard, supported by Apple, IBM, Oracle, and others, will enable developers to build smaller, more targeted applications that can be distributed inexpensively over the Internet. The first OpenDoc Internet client architecture, Cyberdog, enables you to drop Internet functionality into your programs so you can easily create custom Internet applications and solutions.

Web Developer on Cyberdog

". . . Cyberdog is far more than just another set of Internet applications. It is an advertisement for OpenDoc and an invitation to developers."

—Ross Scott Rubin, *Web Developer Online*

Macintosh as an Internet server

Though the original Internet servers were UNIX-based systems, the difficulty of setting up and maintaining these systems motivated Internet administrators to look for simpler solutions: For many users, Macintosh computers (running Mac OS or AIX) are providing this much needed simplicity, hiding difficult-to-use UNIX screens behind friendly Mac OS interfaces. Internet "webmasters," as well as Internet clients, benefit from the fact that the Mac OS includes built-in support for TCP/IP protocols—the basic language of the Internet.

First appearing as MacTCP in System 7.5, today Mac OS 7.5.3 includes the latest in TCP/IP technology with Apple Open Transport, the modern communication technology based on UNIX and open system standards. Open Transport/TCP provides a high-performance, robust implementation of TCP/IP that is accelerated for PowerPC, and that complies with the latest Internet standards, such as Dynamic Host Configuration Protocol (DHCP) and IP Multicast. Another important reason to use a Mac OS system as an Internet server is the price: Power Macintosh computers are much less expensive than equivalent UNIX-based solutions.

The Macintosh for Internet authoring and development

The platform attributes that make the Macintosh the best multimedia authoring platform also make it the best Web development platform. One of the most compelling reasons is the wide variety of multimedia and object-oriented development tools available for this platform. All major tools vendors—including Metrowerks, Pictorius, and Symantec—are shipping Macintosh-compatible versions of their Internet-related tool suites.

What's more, Apple software technologies, such as QuickTime and QuickTime VR, are helping bring sophisticated video and 3-D effects to the Internet. (Netscape Communications is bundling AppleScript and these technologies into a future release of their Netscape Navigator browser.) Apple's QuickTime Conferencing APIs opens developer opportunities for new "live" chat and videoconferencing applications. And representatives from Apple, Adobe, and Netscape are working to establish a standard for high-quality fonts on the Web.

Two of the most exciting Internet developments are Java and JavaScript, the open, cross-platform, object-oriented Internet programming languages developed by Sun Microsystems and Netscape Communications, respectively. Java programs, called applets, can be transmitted over a network and can run on any client, providing interactive content over Internet and Intranet networks. The platform-independence of this widely supported programming language represents an important step in the evolution of the Internet, empowering developers to create a whole new class of interactive and multimedia-rich Internet solutions. Already a plethora of small, innovative, object-oriented Internet applications have been released as Netscape "drop-ins" or Java "applets." Today Natural Intelligence, Symantec, and Metrowerks are shipping Java development environments, and more vendors are sure to follow.

Metrowerks on Macintosh and the Internet

"The Macintosh is the ideal platform for developers and users to launch into the exciting and media-rich new frontier of the World Wide Web."

—Greg Galanos, president and CEO, Metrowerks

Apple Internet solutions

Apple now offers a wide range of Internet solutions that serve a variety of user needs—from organizations looking for easy-to-use Internet client tools to traditional publishers, retailers, consultants, and educators who want to publish on the World Wide Web. Apple currently offers these Internet product bundles:

- Apple Internet Connection Kit (AICK)

  This kit provides Mac OS users with a way to gain direct access to the Internet in as little as 30 minutes. It comes with the Apple Internet Dialer, software designed to make it simpler for Mac OS customers to register with a qualified Internet Service Provider (ISP); Apple Guide intelligent on-line assistance; and a number of third-party Internet tools, including Netscape Navigator.

- Apple Internet Server Solution (AISS)

  This all-in-one server solution provides users with an Apple Workgroup Server and all the software needed to set up a Web server. It includes WebSTAR software, Adobe PageMill, MacDNS, a HyperText Markup Language (HTML) editor, browsers, and common gateway interfaces (CGIs) to a variety of back-end databases. It also includes customizable Web pages, so you can quickly get your own home page up and running. And best of all, it's less than half the price of an equivalent UNIX-based workstation.

- AIX Servers from Apple Computer

  Designed from the ground up as high-performance servers for demanding departmental networks, Network Server 500 and 700 are the fastest, most powerful, reliable, and expandable servers ever developed by Apple. These servers run AIX for Apple Network Servers, a robust version of IBM's industry-standard AIX operating system. AIX has an established track record running on IBM servers and is supported by thousands of software applications. To deliver superior performance, Apple has tuned AIX for these servers and has tightly integrated the servers running AIX with Mac OS desktop computers.

- Cyberdog (code name) from Apple Computer

  Cyberdog, Apple's integrated suite of Internet tools, includes a Web browser, e-mail, a newsgroup reader, the Gopher browser, FTP, Telnet, utilities for organizing Internet information, and security facilities. For developers, Cyberdog is important because of its OpenDoc-based Internet development tools, which make it easy to add Internet connectivity to mainstream applications.

Java development tools

- Java by Sun Microsystems

  Java is an object-oriented programming language that operates independently of any operating system. Using Java, developers can enable expert graphics rendering and real-time interaction with users, live information updating, and instant interaction with servers on the Internet. Java is available to developers free (http://java.sun.com). Source code can be licensed for a fee.

- JavaScript by Netscape Communications

  This easy-to-use object scripting language is designed for creating live online applications that link together objects and resources on both clients and servers. While Java is designed for programmers, JavaScript is designed for use by HTML page authors and enterprise applications developers to dynamically script the behavior of objects running on either clients or servers.

- Café from Symantec

  Café is a 32-bit Java development tool that allows developers to create interactive programs and embed them into Web pages on the Internet. These applets will run unmodified on any computer supported by the Java runtime virtual machine.

- Discover Programming with Java from Metrowerks

  This attractively priced CD will provide novice programmers with Java development tools and a wide range of learning resources.

- FlashNote from Farallon Computing

  This Java applet, which is based on Farallon's Timbuktu product, enables the sending of files with annotated messages, efficiently bypassing servers.

- JFactory from RogueWave

  This powerful application generator is designed for rapid Java application and applet development. It enables you to visually design Java applications and applets, test your interfaces, and quickly generate Java source code.

- Roaster from Natural Intelligence

  Use this kit to develop Java-compatible applets, mini-applications that can be launched from within any "Java-aware" Web browser, such as Sun Microsystem's HotJava Browser or Netscape Navigator. Using Sun's Java Programming Language, you'll be able to create platform-independent applets that enable users to access

advanced features, from 3-D animated graphics to network management. This kit includes a hierarchical project window; a powerful source code editor; and a Java compiler, debugger, and run-time engine. Roaster also features a run-time environment for testing your applets.

- Roaster Professional from Natural Intelligence

  This integrated development environment for Java-based applications will be the first integrated environment for developing full-fledged Java applications, not just Java applets. Roaster Professional builds upon Roaster by adding three key components: the first-ever Java class library specifically designed for creating stand-alone cross-platform applications, a visual screen builder for rapid prototyping and interface construction, and native compilers that transform Java byte-codes into fast native code.

- CodeWarrior from Metrowerks

  Metrowerks has announced it will ship a developer release of Java tools for the Macintosh in May 1996.

Internet authoring tools

Internet authoring tools help you design and set up Web pages. At a minimum, these tools enable you to convert text files into HyperText Markup Language (HTML) files, the format used on the World Wide Web. On the high end, more sophisticated authoring tools help you add high-quality graphics and interactivity to your Web pages.

- Adobe PageMill from Adobe

  This Web page authoring software is designed for non technical people who want to create and maintain content on the Web. It lets you edit Web pages, preview pages, create links without typing in pathnames, and create interactive forms.

- Adobe Acrobat Pro from Adobe

  This product contains everything a professional designer, writer, or publisher needs to create and distribute electronic documents on the Internet. It also enables you to add security controls, hypertext links, and movie clips to Web pages.

- BBEdit from Bare Bones Software

  This powerful interactive text editor offers integrated HTML editing. Its support for HTML 3 and HTML spell checking have made it an essential tool for many webmasters.

- Digital BillBoard from PowerProduction Software

  This product enables you to create interactive Java-powered applets without programming. Digital BillBoard allows Macintosh users to drag and drop images into a frame, as well as use pop-up menus to create interactivity such as rollover buttons, clickable buttons, path-based animations, links to URLs, conditional branching, and sounds for all Web browsers that support Java.

- HoTMetaL Pro from SoftQuad

  Winner of *PC Magazine*'s Editor's Choice Award, this HTML/Web authoring tool enables you to easily import and convert documents created in MS Word, WordPerfect and Lotus AMI Pro. Features include point-and-click markup and linking, and powerful word-processing tools.

- Internet Publishing Kit from Ventana

  This kit includes everything you need to put together a professional Web site. It includes software tools such as Netscape Navigator and HoTMetaL Pro, as well as step-by-step instructions on how to create winning pages.

- InterServer Publisher from InterCon

  Create unique Web pages easily by using the HTML Pro editor that's included with this product. This product also features built-in form support, clickable maps without CGI, server administration from a single application, and support for all the major Web browsers.

- FrontPage from Microsoft

  This visual client/server Web publishing tool provides users with a fast way to develop and maintain Web sites without programming. Designed for both individual users and collaborative work environments, FrontPage's client/server architecture supports authoring, scripting, and Web site management from a user's desktop, across corporate LANs, or over the Internet. The client portion of the software, which is currently available for Windows, will be available for the Macintosh later in 1996.

- NaviPress Web Authoring Kit from NaviSoft

  This browsing and authoring tool is designed for users who want a fast, creative presence on the Web with WYSIWYG control over content. It provides seamless access to local and remote file systems, with graphical site management tools for Web page shifts and page change tracking.

- PowerMedia from RadMedia

  This visual authoring software enables business communicators to author and deliver exciting multimedia and Web-based marketing, sales, training, service and advertising applications in minutes. Without the restrictions of text-based HTML editing tools, PowerMedia gives you the native Web support, hyperlinking, and professional graphic design power that you need to deliver stunning multimedia applications online.

- WebDoor Publishing Systems from Open Door Networks

  If you use this product, Open Door Networks claims that you can create, proof, and publish a Web page in just under an hour. The latest release includes one-button publishing through FTP (File Transfer Protocol), in addition to Apple Remote Access (ARA).

- WebMaker from Harlequin

  This powerful, easy-to-use Web publishing solution enables the creation of full-featured Web pages from FrameMaker documents. Advanced conversion capabilities allow you to convert FrameMaker documents and books to the HTML format, complete with graphics, tables, and equations.

- Web Weaver from Best Enterprises

  This tag-based Web publishing product was created using Prograph. The editor uses floating palettes so you can quickly apply tables. It supports forms, lists, and other popular HTML features.

Tools for dynamic web applications

Behind the scenes of the World Wide Web, a quiet revolution is occurring on the back-end or "server" side of the Internet. Great advances are being made in the areas of Internet server setup and connections to high-powered databases. Dynamic Web applications enable users to access databases that house data that is constantly in flux. CGIs, or common gateway interfaces, are scripts external to the Web server that help this type of communication occur. Though CGIs are slower than server plug-ins, since they reside externally from the server, they are more universal and are simpler to create using a scripting language such as AppleScript or MacPerl.

- AppleScript Software Development Toolkit from Apple Computer

  This kit contains everything you need to write CGI scripts for the Internet. It includes the AppleScript language, a script editor, FaceSpan, tools, sample code, and more.

- BusinessWEB from Management Science Associates

  This product enables companies to access OLAP database information in a Web HTML-based environment. Reports and graphs from multidimensional databases can be embedded in Web pages and viewed with the BusinessWEB browser.

- Forté Web SDK from Forté Software

  This developers' kit includes new extensions that allow organizations to rapidly deploy Web-accessible business-critical applications, such as order processing. The Forté Web SDK is an optional product that complements the Forté Application Environment, an integrated set of object-oriented tools for building, deploying, and managing high-end client/server applications. It's designed to support thousands of concurrent users with high levels of reliability and manageability.

- Frontier CGI Framework from UserLand

  This product includes a collection of scripts and a structure to help you customize your Web server with interactive CGI scripts. The CGI Framework handles communication between Frontier, the Web server suite, and related AppleEvent handlers.

- Entrada Authoring Tool from Pictorius

  This add-on to the client/server development tool kit allows users to build interactive, flexible, client/server based applications that run over the Internet. IATK is a powerful, fully integrated environment with editors, customizable classes, and database design/access features. It enables you to go from a "connect the boxes" form of development to programming in the powerful Prograph development environment.

- JAM/WEB (Web Enterprise Builder) from JYACC

  This new rapid development environment makes it easy to build and deploy sophisticated database applications for the Web. Unlike client-centric tools, JAM/WEB eliminates the need for tedious HTML, C++, and Perl coding. By extending JAM's client/server and three-tier technology to the Internet, it offers developers a complete enterprise development strategy and tool set.

- MacPerl

  MacPerl is a port of Larry Wall's Practical Extraction and Report Language (Perl). This shareware product can be downloaded from the Internet (http://err.ethz.ch/members/neeri/macintosh/perl-qa.html).

- Marionet from Allegiant

  This Internet scripting kit allows developers to create completely custom applications that access and manage information across the Internet. It's designed to work in conjunction with popular authoring tools and AppleScript-aware productivity applications.

- SiteEdit from Pacific Coast Software

  SiteEdit is a Web server–based CGI that allows remote listing, editing, and creation of HTML pages from any standard Web browser.

- SuperNova from Purity Software

  This multiuser database server is designed specifically for use in online services environments. It is intended to provide convenient, persistent data storage for CGIs and other multiuser applications written in C/C++, AppleScript, and other languages. This product is currently in Beta testing.

- Tango from EveryWare Development

  This full-featured visual development tool integrates Butler SQL, EveryWare's client/server relational database management system, with StarNine's WebSTAR Web server. Tango lets Web administrators rapidly create Web pages that access Butler SQL, without having to write any SQL or HTML code. A new ODBC version supports connections to database servers such as Oracle, Sybase, and Informix.

- Tango for FileMaker Pro from EveryWare Development

  This product is a rapid application development (RAD) environment for Internet/intranet applications that require connectivity to relational databases such as Oracle, Sybase, and Butler SQL. Tango for FileMaker Pro is the ideal way to provide Web connectivity for FileMaker Pro databases.

- WEB FM from Web Broadcasting Company

  This common gateway interface (CGI) links Claris FileMaker Pro databases with StarNine's WebSTAR server software, enabling you to put a Web interface on existing dynamic FileMaker Pro databases.

- VBScript from Microsoft

  Microsoft Visual Basic Scripting edition is a scripting language that helps you create active content for the Internet and allows you to link and automate a wide variety of objects in Web pages, including ActiveX Controls and applets created using the Java programming language. (Beta version available from the Microsoft Web page.)

- VisualWave from ParcPlace-Digitalk

  This object-oriented development environment enables you create "live" Web sites. It automatically generates HTML and CGI Web interfaces and lets you set up intelligent sessions, where customers can have two-way dialogs with developer applications.

- PowerBrowser from Oracle

  A cross-platform Web HTML browser PowerBrowser is more than a standard Web browser. It also includes a Web server, an integrated BASIC scripting environment, and support for third-party applications called Network Loadable Objects. It also features hierarchical bookmarks and multiple simultaneous open pages.

Internet server utilities and add-ons

These utilities enhance the functionality of your Web servers.

- CalendarSet/CGI from Foresight Technology

  This Web server application runs an ACGI (Asynchronous Common Gateway Interface) and lets you display clickable calendars on any HTML Web page. Beta copies are currently available.

- Internet ToolKit (ITK) from Foresight Technology

  This complete set of routines can be used with all 4D products or provide complete TCP/IP connectivity for your 4D application. You can use ITK to implement FTP servers, e-mail (using SMTP) servers, news servers, mailing list servers, and Web (HTTP) servers. You can even design your own custom TCP/IP protocols to implement application-to-application communication.

- ListSTAR from StarNine

  StarNine's ListSTAR is an automated e-mail processor for the Macintosh that allows you to create and maintain Internet-style mailing lists (list servers), automated e-mail response, and direct mailing lists on the Internet and Macintosh e-mail systems. The underlying technology is an e-mail "rules engine" specifically designed to perform automated mail services which, until now, required a UNIX or mainframe computer.

- NetCloak from Maxum

  NetCloak is a Web server add-on that gives you more than 30 new commands that let you add features such as access counts, security options, and custom greetings, to your HTML documents. These commands are executed on your server at the time your document is sent to the client, allowing you to create dynamic, conditional HTML pages.

- NetForms from Maxum

  This Macintosh Web server add-on lets your users add information to your Web site.

- Web Crossing from Lunden & Associates

  With this interactive messaging software, users can read conversation, post messages, and interact with others using standard Web browsers.

Internet commerce and security tools

The Internet will be used increasingly for commerce as the electronic monetary exchange and security standards are established. With the large number of easy-to-use Macintosh computers installed in homes, the Macintosh is well positioned to become the home-shopping computer of choice.

- Commerce Toolkit From StarNine

- CyberCash Wallet from CyberCash

  CyberCash enables electronic commerce by providing a safe, convenient, and secure payment service for the Internet. This means consumers can purchase goods and services found on the Internet with CyberCash Wallet software and have the bill debited to their credit cards.

- DogPatch from Main Event

  DogPatch is an Apple event dispatcher that can be used to control the flow of Apple event messages between sources and destinations; enforce first-in/first-out message handling for AppleScript CGIs; allow simulated multithreading for AppleScript CGIs; and allow all CGIs (both AppleScript and others) to be run on a computer other than the Web server.

- First Virtual

  This financial service transfers payments from buyers to sellers and keeps track of accounts. Their Internet Payment System technology enables the buying and selling of information in the electronic marketplace.

- NetLock from Hughes Advanced Systems

  This affordable, completely transparent security solution provides webmasters with automatic end-system authentication, integrity, and encryption of all data on the network.

- MacAuthorize and MacAuthorize*Hub from Tellan Software

  This software enables you to connect directly with American Express, so you can lower bank fees for credit card transactions. MacAuthorize*Hub eliminates all your credit terminals by integrating and centralizing your credit authorization, saving hundreds of dollars in terminal rental fees, phone lines, and time.

- WebCommerce Solution from Pacific Coast Software

- WebLock from Maxum

  This security extension for WebSTAR servers allows you to control access to your Web pages based on file-sharing privileges you set in the Finder. To obtain a Beta copy, visit Maxum's Web page.

- WebSTAR/SSL Security Toolkit from StarNine

  This toolkit adds security features to any Web site, enabling companies to offer secure Web transactions and document transfers. It includes WebSTAR/SSL, an encryption-enabled version of StarNine's industry-leading Web server for Macintosh, and the utilities necessary for creating a server digital ID.

Internet administration tools

Internet administrators, often referred to as "webmasters," need a variety of tools to keep Internet servers running efficiently, to diagnose system problems, to update information, to build live links to other Web sites, and to collect browser statistics.

- Adobe SiteMill from Adobe

  This Web site management and authoring software lets you view all your site resources, shows warnings for unreachable resources, and automatically fixes links when files are renamed or moved. It also includes all the Web page authoring features found in Adobe PageMill.

- Bolero from EveryWare Development

  This application tracks Web site activity and stores user data in an SQL database, making it available for real-time reporting and analysis. Its advanced tracking capabilities can dynamically track the number of users accessing your Web site.

- PageSentry from Maxum

  PageSentry monitors your Web server and warns you at the first moment a problem is detected, sending a message to your SMTP/POP mailserver or an AppleEvent to an application of your choosing.

- PhotoMill from Pacific Coast Software

  PhotoMill is a Macintosh image browsing application that scans any drive or folder you specify to catalog images in all the major file formats. It supports TIFF, EPS, PICT, JPEG, GIF, PhotoCD, and others, as well as the ability to use Claris XTND filters for files in other formats.

- RushHour from Maxum

  This Web graphics accelerator helps keep your Internet server running at peak efficiency with a high-performance cache, the elimination of redundant security checks, and other speed-enhancing tricks. It's now Open Transport native.

- SiteCheck from Pacific Coast Software

  SiteCheck is a Macintosh application that provides a fast and convenient way to check all the hypertext links within a Web site.

- WebMaster Pro from HeyerTech

  This integrated relational database system for design, testing, and maintenance of Web sites also manages workgroup development. It can import, analyze, and archive the contents of any Web site in minutes.

- WebSTAR from StarNine

  Use this MacHTTP-based application to put any Macintosh file on the Web, including GIF images, JPEG images, and QuickTime movies. As easy to use as AppleShare and faster than many UNIX-based Web servers, WebSTAR is completely compatible with all Web clients including Mosaic, Netscape Navigator, and Prodigy. It supports forms, clickable maps, popular Macintosh and SQL databases, and AppleScript.

Internet multimedia plug-ins

Many leading Web browsers, such as Netscape Navigator, support plug-ins, which enable you to provide additional functionality and deliver rich multimedia content through Internet sites. Technically speaking, plug-ins are code modules that call the browser APIs. With these add-ons, Web users are able to view animated or interactive content without having to launch external "helper" applications on their local hard disks. In the near future, Java-based plug-ins, called "applets" will be the preferred way to deliver added functionality, since applets are platform-independent.

- Acrobat Amber Reader from Adobe Systems

  This Netscape plug-in for the Acrobat Reader lets you view, navigate, and print Portable Document Format (PDF) files within your Navigator window. (PDF files are extremely compact, platform-independent, and easy to create.)

- Chemscape Chime from MDL Information Systems

  The Chemscape Chime plug-in lets scientists display 2-D and 3-D chemical structures within an HTML page or table. (Available for the Macintosh soon.)

- Crescendo from Live Update

  Live Update's new Crescendo plug-in for Netscape Navigator enhances Web pages with MIDI music. With Crescendo and Navigator running on your Macintosh or MPC sound card–equipped PC, you can enjoy background music as you surf the Web.

- Envoy Plug-In from Tumbleweed Software

  The Envoy plug-in lets users view documents on the Internet exactly as they were designed: rich with different fonts, graphics, and layouts. Envoy works with documents from within Netscape Navigator on Windows 3.1, Windows 95, and Mac OS systems.

- Formula One/Net from Visual Components

  Formula One/Net is the first Excel-compatible spreadsheet with built-in Internet functionality. Worksheets can include live charts, links to URLs, formatted text and numbers, calculations, and clickable buttons and controls.

- Fractal Viewer from Iterated Systems

  Fractal Viewer enables the in-line use of fractal images on the Web. Iterated's Fractal Image Format provides a means of representing digitized photographs and other bit-map images in a highly compressed and resolution-independent form.

- Lightning Strike from Infinet Op

  Ever wonder if there is anything better then JPEG to compress your Web pages? Lightning Strike is an optimized wavelet image codec ready to plug in to Netscape 2.0. It provides higher compression ratios, smaller image files, faster transmissions, and improved image quality. Macintosh 68K/PPC and Windows 3.1/95/NT plug-ins are now available.

- Live3D from Netscape

  A high-performance 3-D VRML platform that lets you fly through virtual worlds on the Web and run interactive, multiuser VRML applications written in Java. Netscape Live3D features 3-D text, background images, texture animation, morphing, viewpoints, collision detection, gravity, and RealAudio streaming sound.

- Look@Me from Farallon Computing

  This Navigator plug-in gives you the ability to view another Look@Me user's screen anywhere in the world in real time. From within Navigator, you can view a remote computer screen and watch the activity taking place. Based on Farallon's award-winning Timbuktu Pro software, Look@Me is a free Internet collaboration tool that allows you to do things like edit documents, review presentations, or provide just-in-time training and support.

- MovieStar from Intelligence At Large

  The MovieStar plug-in gives your Windows or Macintosh Netscape Navigator 2.0 browser the ability to view QuickTime movies from a Web site. Using the MovieStar Maker, a multimedia editing application also available for download, webmasters can optimize QuickTime movies so that Navigator users can view the movies while they download.

- QuickServer from Wayfarer Communications

  Wayfarer's QuickServer is for high-performance intranet and Internet client/server applications developed with Visual Basic, PowerBuilder, C++, and Java. Download StockWatcher, a demo application in Visual Basic using Wayfarer's plug-in, to see live, dynamic stock quotes inside Netscape Navigator.

- QuickTime Netscape Plug-in from Apple Computer

  With more and more developers incorporating digital video and sound into Internet sites, the Apple QuickTime plug-in allows users to experience true multimedia content. (Will ship soon.)

- RealAudio from Progressive Networks

  RealAudio provides live and on-demand real-time audio over 14.4 Kbps or faster connections to the Internet. RealAudio Version 2.0 is available for download now, with a powerful plug-in for Netscape that allows you to easily customize and deliver audio from your Web site.

- Shockwave for Director from Macromedia

  Shockwave for Director enables the playback of high-impact multimedia on the Web. This Director add-on transforms Web pages into dynamic, interactive multimedia productions that load as quickly as static images. It's currently supported by the Netscape Navigator 2.0 browser.

- Sizzler from Totally Hip

  This multimedia plug-in for Netscape Navigator 2.0 enables you to create and display Web animations. It takes regular PICS files or QuickTime movies and converts them into sprite files that play on your Web site as they're transmitted over your modem. It's available for Macintosh and Windows environments.

- Talker Plug-In from MVP Solutions

  Now your Web sites can talk to Macintosh users with MVP Solutions' free Talker plug-in. The speech synthesis technology of the Talker Plug-In uses much less bandwidth than recorded audio. You can change the words your Web page speaks simply by editing a text file. The new version of Talker lets Web pages talk (and sing) using many different voices.

- ToolVox from VoxWare

  Add high-quality speech audio to your Web pages. With ToolVox, it's as easy as embedding a graphic: Your existing HTTP server can stream audio. ToolVox delivers 53:1 compression ratios—more than three times smaller than first-generation real-time Internet voice products.

- VDOLive from VDONet

  VDOLive compresses video images without compromising quality on the receiving end. The speed of your connection determines the frame delivery rate: With a 28.8 Kbps modem, VDOLive runs in real time at 10 to 15 frames per second.

- ViewMovie QuickTime Plug-In from Ivçn Cavero Belaònde

  ViewMovie is a Netscape Navigator 2.0 plug-in that supports the viewing and embedding of Apple QuickTime movies in Web pages, including the use of movies as link anchors and image maps.

- VR Scout VRML Plug-In from Chaco Communications

  Fly through 3-D graphical scenes with Chaco's VR Scout VRML plug-in. Chaco's extremely fast viewers implement the full VRML 1.0 standard.

- VRealm from Integrated Data Systems

  VRealm, the VRML plug-in for Netscape 2.0 from Integrated Data Systems and Portable Graphics, fully supports VRML and adds features such as object behaviors, gravity, collision detection, autopilot, and multimedia. Download VRealm and immerse yourself in 3-D worlds.

- Wavelet Image Viewer from Summus

  Experience the latest in advanced image compression technology. Our wavelet-based image compression plug-in provides superior image quality, compression ratios, and speed.

- Word Viewer Plug-In from Inso Corporation

  View any Microsoft Word 6.0 or Microsoft Word 7.0 document from inside Netscape Navigator 2.0 with Inso's Word Viewer Plug-in. Based on Inso's Quick View Plus viewing technology, this plug-in also lets you copy and print Word documents with all original formatting intact.

Application and Component Development

For mainstream commercial software development, the Power Macintosh is not only the highest-performance development platform, but also a platform that brings out the best in your products. From a purely technical standpoint, seating your development team behind Power Macintosh computers results in more efficient programming because of three factors—power hardware, power innovation, and power tools.

- Powerful RISC-based Power Macintosh hardware. Programmers using Power Macintosh systems spend significantly less time waiting for programs to recompile than Pentium-using peers.
- Fast innovation. Apple has a decade-long track record of rapid delivery of new technologies through the Mac OS Toolbox. Toolbox extensions such as QuickTime (time-based media), QuickDraw 3D (3-D graphics), QuickTime Conferencing (videoconferencing), and Apple Guide (intelligent help system) are providing you with more ways to improve and differentiate your products. You'll soon be able to create more ground-breaking software using Copland, the upcoming version of the Mac OS. This next-generation software foundation will provide you with new "assistance" facilities, the richest environment for graphics and multimedia, and the most extensive communication and collaboration capabilities.
- Best cross-platform development tools. Apple's effort to increase the number of cross-platform technologies and tools is making it easier and more economical for Mac OS developers to port products to and from other computer platforms. One of the most important cross-platform advancements is Apple's recently released OpenDoc Component Software Toolkit. (For more detailed information on OpenDoc, see the next section.)

In a recent Apple-sponsored survey of multiplatform developers, almost three-fourths expressed a conviction that the Mac OS platform results in superior products for end users. The reasons behind this belief are twofold. First, the rich set of capabilities built into even low-end Mac OS computers enables developers to raise the quality level of software. Every Mac OS computer has a GUI, high-resolution color graphic capabilities, and built-in multimedia playback capabilities. Second, because of the Mac OS platform's well-documented user interface guidelines, it's easier to design a user interface that really works.

And finally, Apple's focused effort to bring a wider variety of tools to the platform is making it easier for you to efficiently deliver applications to your customers on multiple platforms. An overview of the diverse selection of Mac OS application and component tools available follows.

Development environments

Application development environments are programs in which developers perform all the tasks essential to developing applications, including editing, compiling, and debugging. Apple has been working internally, as well as with third-party tools vendors, to bring a variety of powerful Mac OS development environments and related tools to the market.

- E•T•O from Apple Computer

  Essentials•Tools•Objects, or E•T•O, is a set of core development tools designed for professional Macintosh developers. It includes Macintosh Programmer's Workshop (MPW), a general-purpose development environment that comes with C, C++, and assembly-language compilers for creating both 68K and Power Macintosh

applications. The package also includes the MacApp application framework, debuggers, testing tools, performance tools, and OpenDoc tools. Many of these tools may be used with popular third-party C/C++ development enviornments, including Symantec C++ and CodeWarrior.

- Symantec C++ for Power Macintosh from Symantec

  This product combines a fast C/C++ compiler with Symantec's popular integrated development environment. It features fast compilation time, scriptability and recordability, and two-byte language support. The Visual Architect interface builder includes a graphical screen designer and code generator, and lets developers take advantage of powerful visual development tools. Symantec C++ enables the development of native PowerPC applications, as well as 680x0 programs. Symantec is now shipping a Java Programming Language compiler that is hosted in the same environment.

- CodeWarrior from Metrowerks

  This product is an integrated, fast-turnaround development environment for C, C++, and Pascal programming. It runs in native mode on both 680x0-based and Power Macintosh systems, and it includes a high-performance Intel x86 compiler, so you can develop Mac OS and Windows applications on a Power Macintosh. A Java compiler is expected to ship in May 1996. CodeWarrior also supports OpenDoc, ToolServer, and SourceServer, allowing programmers to take advantage of the wealth of development utilities supplied with MPW.

- SmallTalkAgents Professional from Quasar Knowledge Systems (QKS)

  This dynamic, object-oriented Smalltalk development environment provides you with tools for designing, developing, and managing frameworks, classes, and objects. (As a dynamic environment, this product lets you edit code in real time, without having to recompile.) It includes visual tools for creating sophisticated graphic user interfaces using Drag and Drop, as well as a complete set of application building blocks. SmalltalkAgents' External Code Linking Toolkit supports easy linking of C libraries created with MPW C, Symantec C, and Metrowerks CodeWarrior C, enabling access to existing C code from Smalltalk applications.

- Oberon/F from Oberon Microsystems

  Oberon/F is an integrated development environment for rapid component creation and integration. It contains a visual designer, an extensible word processor, a multiplatform component framework, and a fast native-code compiler. The language Oberon is a component-oriented refinement of Pascal.

- Prograph CPX from Pictorius

  This award-winning development environment enables completely visual application development using object-oriented and visual programming tools. Its interactive operation enables one-stop design, coding, testing, and debugging; and it has an extensible editor for instant GUI-building. It also provides facilities for calling C code, enabling programmers to use existing code from other applications. Prograph CPX can create both 680x0 and PowerPC executables. (A Windows beta version is now available, enabling cross-platform development. The final version will be shipped mid-1996.)

Frameworks

Traditional programming techniques developed during the last 20 years have brought about major improvements in software quality, but there are several areas where new approaches are needed: Using traditional methods, extending and maintaining large programs have proven to be difficult.

These limitations have motivated developers to use object-oriented application frameworks, because of their potential to increase developer productivity and innovation. Because object-oriented programming "compartmentalizes" sub programs into modular, callable blocks, developers are better able to reuse code and minimize the global effects of bugs.

An *application framework* is a collection of software libraries and interconnections that provide an infrastructure for creating software applications. In other words, it's a template that provides a foundation for the default behavior required in an application, providing you with default implementations for things such as windows, scroll bars, menus, printing, and other system-level services. Using a framework, you can dramatically decrease the amount of code that you need to write, test, and debug. This means you'll be able to build programs faster and create final products that are better structured and more reliable.

Another major benefit of using a framework is that you're able to more easily take advantage of new technology APIs than you could using traditional programming techniques.

A note from the Developer Tools Group: In response to developer feedback, Apple is implementing a new product release strategy for frameworks products. These products will now be released at regular intervals, with modules of the frameworks being identified as alpha, beta, or GM. This will meet developers' requirements for early access to framework support of new or complex technologies. This will take effect with OpenDoc Development Framework ODF Release 1, and MacApp Release 10 on E•T•O 20.

MacTech on MacApp

"The main advantage [of MacApp] is that the developer can leverage tens of programmer-years of work and have instant support for Apple events, the Scrap Manager, window management, event handling, printing and other modules...Our application was written in only a few days and contains less than a thousand lines of source code."

—Matthew Clark, "Documentation Viewer Lite," *MacTech Magazine*, April 1996

- MacApp from Apple Computer

  This object-oriented application framework can be used to develop native applications for both 680x0-based and Power Macintosh systems. MacApp 3.3 includes support for several key Mac OS technologies, including AppleScript, Drag and Drop, and PowerTalk. Future releases of MacApp will include support for Copland, modularity, support for OpenDoc (enabling developers to embed OpenDoc components into their applications), and other new Apple technologies. MacApp is available as part of E•T•O. Apple has also licensed this product to Fortner Research, Metrowerks, and Symantec for integration with their development environments.

- OpenDoc Development Framework (ODF) from Apple Computer

  This object-oriented component framework provides you with the best way to develop component software based on OpenDoc. Developers can create robust cross-platform OpenDoc components editors for Mac OS, Windows, and other platforms as OpenDoc becomes available on them. Developed in C++, this framework is modular and extensible. By using ODF, developers will be able to create multiplatform component-based applications faster; update and enhance their products more easily; and lower their software development, maintenance, and revision costs. The first release of OpenDoc Development Framework, ODF Release 1, will be available in mid-April 1996. Beginning with ODF Release 1, component developers are guaranteed RRBC (Release-to-Release Binary Compatibility).

- Think Class Library from Symantec

  This visual, object-oriented framework and library, which is bundled with Symantec C++, makes it easy to implement standard Mac OS user interface components and behaviors, as well as create scriptable and recordable applications.

- Prograph CPX from Pictorius

  For information on Prograph CPX, see the description in the previous "Development environments" section. The highly interactive, visual front-end and high-level abstraction make Prograph CPX an excellent tool for producing applications rapidly.

- PowerPlant from Metrowerks

  This C++ application framework, which is bundled with Metrowerks CodeWarrior, supports new Mac OS system enhancements, including Drag and Drop, AppleScript, and OpenDoc.

- OM++ from ICE

  This C++ framework enables the creation of cross-platform (DOS, Windows, and Mac OS) applications. It provides object classes for memory management and GUI-building, allowing your final product to share a single application source base. OM++ also includes utilities to help assist in porting DOS or Windows C++ code to a native Mac OS environment.

UI builders

User interface (UI) builders are applications or software libraries that a programmer uses to create graphical user interface (GUI) code for applications.

- Open Interface from Neuron Data

  This software library produces code for computer systems that have a C++ API. The software comes with a GUI builder that includes a script language that can coexist with C or C++. Open Interface also includes Neuron's Power Widgets collections: business graphics (bar, pie, and line charts), images (all standard formats), a hypertext widget, and context-sensitive hypertext help.

- Galaxy from Visix Software

  This cross-platform framework is designed specifically for constructing MIS systems and other large-scale commercial applications. Galaxy provides ANSI C++ cross-compiled portability for Mac OS, Windows, Windows NT, OS/2, HP/UX, AIX, Sun, and VMS platforms. It has a GUI tool called Visual Resource Editor that generates cross-platform GUI resources. Galaxy includes a GUI API, a networking API, a client/server API, and an operating system interfaces API.

- XVT Development Solution for C++ from XVT

  The XVT framework aids in the development of object-oriented applications for more than 20 different platforms, including Mac OS, Windows, Windows NT, OS/2, and OSF/Motif. The product also comes with XVT-Architect, a visual interface builder that assists in the creation of GUIs for XVT applications.

- Zinc 4.0 from Zinc Software

  This cross-platform framework facilitates native look-and-feel application development for Mac OS, Windows, OS/2, UNIX (text and Motif), NextStep, DOS (text and graphics), and other platforms. Applications built with Zinc 4.0 are automatically global-ready because the framework has run-time loadable support for single-byte and double-byte characters, international date and time formats, and 13 different languages. It also includes Zinc Designer, a collection of visual development tools.

Visual programming

Many new development tools use a visual interface that reduces or eliminates the need for programmers to write code in traditional languages such as C or C++. Using API-like calls or icons, developers are able to more quickly build, visualize, and debug programs.

- Prograph CPX from Pictorius

  See previous description.

- AppMaker from Bowers Development

  This visual programming assistant makes it faster and easier to develop Mac OS user interfaces. It includes a source code generator, resource generator, and user interface editor, which can generate code for a wide variety of languages, frameworks, and, in the future, platforms. It supports most development environments, including CodeWarrior PowerPlant, Symantec C++, Metrowerks Pascal, Fortner Research Pascal, and MPW C or C++.

- AppWare from Network Multimedia

  This visual programming tool allows developers to graphically design and implement custom business solutions without writing a single line of code or syntax. It will support OpenDoc as a cross-platform development tool for the Mac OS in early 1996 and Windows–based computers by mid-1996.

- FutureBASIC II from STAZ Software

  FutureBASIC II is a Macintosh-specific BASIC Language compiler that allows users to prototype and develop double-clickable Macintosh applications quickly. Features include development of XCMDs, XFCNs, INITs, CDEVs, MDEFs, and DAs; and support for Macintosh Communications Toolbox calls.

Programming languages

Over and above the C- or C++-based tools listed above, there are also a variety of traditional programming language options available. These Mac OS–compatible products include:

- MrC/MrCpp from Apple Computer

  These highly optimizing C and C++ compilers can be used to create native Power Macintosh applications with very fast run-time performance. They are also now available as drop-ins for Symantec and Metrowerks development environments, enabling developers to combine the best of both worlds—the fast turnaround of a development environment and the fast runtime performance of this code compiler.

- FORTRAN 77 SDK for Power Macintosh from Absoft

  This easy-to-use SDK includes a native compiler, debugger, linker, MRWE application framework, graphics libraries, and a subset of the latest release of Apple's MPW. This product's multiplatform compiler lets you take a FORTRAN application developed on Windows 95 or Windows NT and move it to the Mac OS platform with a simple recompile. Absoft will begin shipping a beta version of its FORTRAN 90 system in April 1996. This first FORTRAN 90 compiler for the Power Macintosh includes technology developed by Cray Research and licensed by Sun.

- Java from Sun Microsystems

  For a detailed description of the Java object-oriented programming language, see the "Internet Development" section.

- Macintosh Common Lisp from Digitool

  This object-oriented, dynamic language includes an incremental Common Lisp compiler, a rich set of Lisp programming tools, and an extensive library of Common Lisp Object System (CLOS) objects, including Mac OS user interface objects.

- LS FORTRAN from Fortner Research

  This ANSI-standard FORTRAN 77 provides developers with many VAX extensions, including structures, nested includes, DO WHILE, IMPLICIT NONE, and all VAX intrinsic functions and data types.

- LS Object Pascal from Fortner Research

  LS Object Pascal is a complete programming environment for 680x0-based and Power Macintosh computers that includes source-level debuggers, visual interface and source code generators, a native porting kit for MacApp 2.0, and full support for Symantec Project Manager 8.0.

- MicroFocus COBOL from MicroFocus

  This product is a full-featured COBOL compiler that works in conjunction with Apple's MPW. It provides all the facilities needed to port existing COBOL applications to the Mac OS platform.

- VisualWorks from ParcPlace

  This object-oriented application development environment, designed for corporate developers creating GUI-based client/server applications, is completely portable across PC, Mac OS, and UNIX platforms. It puts years of Smalltalk programming expertise on every corporate developer's desktop through a powerful interface builder that employs a visual "paint-and-build" approach for GUI construction. Multiple inspectors and browsers, a symbolic debugger, and an application delivery optimizer, help improve productivity.

- THINK Pascal from Symantec

  This fully integrated version of Pascal includes rapid turnaround time, support for large projects, the enhanced THINK Class Library, and smart linking.

- True BASIC from True Basic

  True BASIC is a structured version of the BASIC language, offering an all-purpose programming environment useful for a wide range of development projects. This cross-platform product is available for Mac OS–, Windows–, DOS-, and UNIX-based computers.

- VIP-C and VIP-BASIC from Mainstay

  VIP products integrate an application framework, automatic source-code flowchart generation, resource editors, and an optimizing interpreter with a source-code generator. You can develop applications in standard languages using its intelligent, interactive programming environment to quickly create stand-alone, full-featured 68K and Power Macintosh applications.

- FutureBASIC from Zedcor

  This advanced BASIC language compiler/editor contains all the tools you need to create Mac OS applications. It features an interactive editor/compiler, a program generator, fast compilation and execution speeds, complete Toolbox support, and hundreds of example programs.

Development utilities

A wide variety of utility programs can help developers with specific aspects of Mac OS programming. Some popular Mac OS programming utilities include:

- MrPlus from Apple Computer

  This performance-tuning environment helps you accelerate native Power Macintosh applications. It can monitor the run-time execution of an application, then rearrange code for optimal use of PowerPC instruction caches, and reduce the number of page faults in a system with virtual memory enabled. A developer release of this utility ships with E•T•O.

- MrProf from Apple Computer

  MrProf is companion tool to MrPlus. It provides you with tabular and graphic presentations of data collected when executing programs that are optimized by MrPlus. The graphical output is a call graph for all the routines in the analyzed program, and, for each routine, a diagram of the intraroutine branches.

- Object Master from ACI

  This utility helps you write, organize, and navigate through object-oriented or procedural source code on Mac OS and Windows systems. Object Master parses all of the source files in each project and creates a data dictionary of all functions, procedures, classes, data structures, and variables. The dictionary gives programmers immediate access to a wealth of information about a project. In addition, Object Master supplies sophisticated editing facilities for quickly modifying code.

- MacsBug from Apple Computer

  Apple's assembly language debugger for the Mac OS is ideal for programmers who want powerful, expandable, and reliable utility for professional application development. Once MacsBug has been invoked, you can enter commands to display and set memory and registers, disassemble memory, set execution breakpoints, step and trace through both RAM and ROM, monitor system traps, and check heaps.

- ResEdit from Apple Computer

  This graphical resource editor lets developers create and modify Mac OS user interface elements such as menus, windows, icons, and dialog boxes. It can be used with any development system.

- Virtual User from Apple Computer

  Virtual User is a user-emulation test tool with which you can program multiple "virtual users" interacting with their respective applications. VU is script-driven, in that each simulated user gets its direction from a script written in the VU scripting language.

- BBEdit from Bare Bones Software

  The powerful, interactive text editor offers integrated support for THINK C, THINK Reference 2.0, Metrowerks CodeWarrior, ToolServer, Macintosh Programmer's Toolbox Assistant, and the Power Macintosh.

- The Debugger from Jasik Designs

  This low- and high-level symbolic debugger runs in a full multiwindow Mac OS environment. You can trace program execution and view the values of variables for both 68K and Power Macintosh programs.

- Resorcerer from Mathemæsthetics

  This award-winning resource editor enables fast, Macintosh resource editing with features such as icon family editing, color pixel anti-aliasing, complete PICT reassembly, and resource sorting/browsing.

- TMON Professional from MindVision

  This multiwindow montior/debugger is a powerful tool for debugging code and examining details of your system's inner workings. TMON Pro is invoked by any system error or breakpoint, or via the programmer's switch interrupt.

Team development

One of the challenges of managing large software projects is coordinating the efforts of multiple programmers. Steps must be taken to ensure that each person is working on the latest code version and that a shared base of code isn't accidentally overwritten by another team member. *Team development tools* have emerged to help manage this process, as well as to help programmers track project revisions and rebuild past versions.

- ToolServer from Apple Computer

  This application is designed to execute MPW commands in the background (or on another Mac OS system) in response to requests sent to it by other development environments, including MPW. As a result, these environments gain easy access to MPW's powerful tool set. ToolServer is supported by several environments, including Symantec C++ and Metrowerks CodeWarrior.

- SourceServer from Apple Computer

  This full-featured Mac OS source code control system enables teams of programmers to work safely and efficiently on a shared base of source code. With its simple AppleEvent-based API, it easily integrates into Mac OS development environments, such as Symantec C++ and Metrowerks CodeWarrior.

- CodeManager from Metrowerks

  CodeManager is a project-oriented version control system that offers four principal benefits to developers who have to manage large code databases: developer coordination, history tracking, hierarchical projects, and cross-platform support. It also prevents developers, who are working together on one project, from overwriting each other's changes.

- MKS Source Integrity from MKS

  MKS Source Integrity is a complete project-oriented version control and build system. It automates the difficult task of managing your source files through the entire development life cycle—from the first day of coding to post-release maintenance. MKS Source Integrity solves the tough issue of cross-platform configuration management, with support for all popular operating systems.

The Transition to OpenDoc

As the computer industry evolves, so must software development. The growing need for custom software and Internet solutions will catalyze dramatic changes in the way software is created, updated, and used. On the development side of the industry, these transitions are being driven by the following factors:

- Increased application complexity
- Proliferation of system software APIs
- Multiplatform delivery
- Need for more efficient programming
- Increased importance of Internet solutions

One approach that can minimize the problems associated with these trends is the "componentization" of software—in other words, the creation of industry-wide standards that enable software to be developed as modular, compatible building blocks. Widespread adoption of such a standard will make it easier for developers to create new products, deliver software updates at a faster rate, keep up with advancements in software APIs, and deploy content to multiple platforms. The component standard that Apple, IBM, and other industry leaders have developed is OpenDoc, a software architecture that enables modular, multiplatform component software development.

The OpenDoc standard is being defined and supported through an industry-wide consortium, CI Labs, whose membership includes Apple, Novell, IBM, Oracle, Borland, and Sun, among others. Apple's role in this alliance is to create the Mac OS–specific implementation of OpenDoc. IBM is porting OpenDoc to OS/2, Windows, and AIX platforms. OpenDoc components will be able to run on Mac OS, Windows, and OS/2 systems. OpenDoc provides interoperability with Microsoft ActiveX, allowing OpenDoc-aware applications and components to integrate seamlessly with Microsoft-compatible software components.

In addition, the Object Management Group (OMG) has just adopted the OpenDoc specification as the industry standard for distributed component software. This alliance will facilitate the collaboration between server-based CORBA developers and client-based OpenDoc developers, creating a powerful client/server distributed component development platform. (See the "OpenDoc technologies" section for additional information on CORBA compliance.)

The OpenDoc component architecture will also play a key role in the Internet-based software business. First, by supporting OpenDoc, you'll be able to add Internet functionality to your application simply by dropping in any of a number of Internet-related OpenDoc components. Second, OpenDoc will enable you to build smaller, more targeted applications and components that can be distributed inexpensively over the Internet. And third, Apple's own set of Internet-related OpenDoc components, code-named Cyberdog, will enable Web users to create links between any desktop application that supports OpenDoc and the Internet, paving the way for automatic software updates and new information-based services. Finally, Apple's own components will give your applications access to Apple's most advanced APIs.

OpenDoc technologies

OpenDoc is based upon several important industry technologies: SOM, DSOM, CORBA, BENTO, AND OSA. SOM (System Object Model) is a software technology created by IBM for developing and packaging object-oriented software. Its primary advantage over other approaches is that it's truly platform- and language-independent, so other people can use your software without having to load your source code on their hard disks. (You give them *object* code instead.)

It's also important to note that SOM is a CORBA-compliant object request broker. CORBA (Common Object Request Broker Architecture) is a standard interface backed by the influential standards consortium, OMG. Because OpenDoc complies with the CORBA standard, any software object created with it will work with any other CORBA-compliant object, even if it was created using different tools, computers, or operating systems.

SOM contributes greatly to making OpenDoc component software usable in the real world. Without SOM, all OpenDoc components would have to be created in one language, C++, and everyone would have to use the same compiler for code to interoperate. SOM also provides dynamic linking for its objects.

Distributed SOM (DSOM) is a component of SOM that supports access to objects across a network. Using DSOM, you can more easily create an object anywhere on a network, and you can invoke any method on any object without knowing where the object is located. (DSOM for Macintosh will be available in the future.)

Here are the key Macintosh-specific technologies that enable OpenDoc development:

- OpenDoc Component Software Toolkit from Apple Computer

  This software developers' kit includes CFM-68K, SOMobjects for Mac OS, and other tools to help you create OpenDoc components, containers, and extensions. You can download this kit from the latest Developer CD Series or the OpenDoc Web site (http://opendoc.apple.com/opendoc/).

- Code Fragment Manager from Apple Computer

  This run-time software for Macintosh computers supports the development of shared libraries, drop-in code modules, and dynamic linking—functions needed for developing and running OpenDoc-based applications. For 68K development, CFM-68K is available on Apple's OpenDoc Web site and with E•T•O.

- SOMobjects for Mac OS from Apple Computer

  SOMobjects for Mac OS is Apple's implementation of IBM's System Object Model for the Mac OS. This SOM implementation is a "fat binary," containing the Power Macintosh and 68K versions. SOMobjects is layered on top of the Mac OS Code Fragment Manager, and OpenDoc accesses it directly. An implementation of SOMobjects is available on Apple's OpenDoc Web site and the E•T•O CD.

OpenDoc benefits

There are incremental steps that developers can take to reap immediate benefits from OpenDoc and to start making the move to a full OpenDoc-based development strategy. Even if you start slowly—for example, by enabling your existing application to embed OpenDoc components—you'll see numerous technical and business rewards. Here are a few of these OpenDoc benefits:

- Easy technology adoption. OpenDoc lets your users immediately adopt new technologies, without having to revise your current OpenDoc component or container (a container is an application where users can drop in other OpenDoc components). For example, if Apple provides a new technology as an OpenDoc component, every OpenDoc-savvy component or container will be able to use it immediately. This means there will be no pressure for you to change your application every time Apple, Microsoft, or any other company introduces new technologies.

- Core competency focus. OpenDoc lets you concentrate on the programming that your company does best. You don't have to spend time supporting other functions that users want but that aren't within your area of expertise (for example, text editors, chart-graphing programs, spelling checkers, paint programs, or multimedia document support) because OpenDoc lets your users "drop in" components from different vendors to create software solutions that meet their unique needs.
- Quick Internet functionality. By developing or purchasing Internet-related components, you'll be able to simply drag and drop Internet features into any or all of your applications. For example, you could add modules that enable customers to automatically logon to the Internet to register or to download demos from your Web site.
- Faster development cycles. Your OpenDoc component editors will be smaller and simpler than the equivalent components within monolithic applications. For your technical people, this means software that is easier to design, program, debug, maintain, and document. And since the new versions of a component can be small, you may be able to distribute them electronically, saving considerable materials, postage, and administrative expense.
- Easier innovation. OpenDoc also allows you to start a new product with fewer resources and less money. This means you can do more creative things without staking your financial well-being on just one or two large products or projects. In many ways OpenDoc levels the playing field for all developers. No matter how small you are, you can create an OpenDoc component or two without a huge investment of time and programmers.
- New business opportunities. When you break your application into OpenDoc components, you can create new products (especially for vertical markets) by bundling different subsets of your components. And because OpenDoc is scriptable (using AppleScript, UserLand Frontier, or other scripting systems), you may find that there's money to be made providing customized solutions to businesses. This would also increase your company's stability by providing multiple sources of income. You can either license your components to others or license components from someone else to bring your OpenDoc-based products to market.

Deciding on a development strategy

In considering OpenDoc, one of the first decisions you'll have to make is when to retrofit existing software and whether to fundamentally change your current product design strategy. Fortunately, OpenDoc was designed to make it easy to modify existing code. For developers who already support AppleEvents, AppleScript, and the Drag Manager, it will be even simpler. In most cases, creating completely new solutions enabled by OpenDoc will be a little easier than creating a large application of today. Here are the three levels of OpenDoc support that you should consider:

- OpenDoc interoperability. At a minimum, if your software supports AppleScript, the Clipboard, and Drag and Drop, your application will be able to exchange data with other OpenDoc-savvy software.
- OpenDoc container design. Many developers will chose to convert existing applications to container applications—a relatively simple task from a programming standpoint. This will allow the embedding of additional functionality inside your container application.
- OpenDoc component editor or service design. You can create component editors or services that can be dropped into third-party container applications. There are several levels of compatibility that you can build into your component: You can allow your component's data to be saved in an industry-standard format; you can create a viewer that enables viewing capabilities for your specific type of data; or you can create a static representation of your component, allowing users to drop it into a container with the native format and capabilities of the original component.

OpenDoc development tools

OpenDoc will enable developers to create and market smaller, more task-focused applications. Some developers will focus on specific market niches, while others will choose to offer a broad selection of general-purpose components. Systems integrators, VARs, and even end users will be able to put together custom solutions from preferred components, with the assurance that components from all sources will work together smoothly.

The next generation of the Mac OS, code-named Copland, will integrate OpenDoc component support into Power Macintosh computers. From a development standpoint, it will also include system extensions that facilitate the creation of OpenDoc components and containers.

To further help you with the development of OpenDoc components and containers, Apple and third-party developers are currently in the process of building a portfolio of tools. Tools vendors who have announced their support for OpenDoc development are listed below. Apple is also working with tools vendors such as Oracle, Pictorius, and QKS to ensure that they provide OpenDoc support in their development tools.

Development environments

(For more details on these products, see the "Application and Component Development" section.)

- MPW (Macintosh Programmer's Workshop) from Apple Computer

  Apple is providing current MPW users with a set of tools for OpenDoc development. Available through E•T•O, the current version also includes OpenDoc-compatible compilers (68K and PowerPC), debuggers, and frameworks. The next release of the MrC compiler for Power Macintosh will provide Direct-to-SOM support, making it easier to develop SOM-based components and shared libraries. Apple is working with third-party tools vendors to ensure that Direct-to-SOM support is also available in their compilers.

- Symantec C++ 8.0 for Power Macintosh from Symantec

  This product currently supports OpenDoc part and container development.

- CodeWarrior from Metrowerks

  The current version of CodeWarrior supports the building of OpenDoc component editors, and future releases will continue to incorporate the latest OpenDoc technology, including support for CFM-68K and OpenDoc development with the Metrowerks 68K compiler.

Frameworks

(For more details on these products, see the "Application and Component Development" section.)

- OpenDoc Development Framework (ODF) from Apple Computer

  This framework enables the creation of commercial-quality OpenDoc components for both the Mac OS and Windows operating system with one development effort. (Support for other OpenDoc platforms, such as OS/2 and AIX, are under consideration.) For commercial OpenDoc development, Apple strongly recommends the use of the ODF, because it provides the increased productivity of a framework and cross-platform development capabilities. ODF works with all major Macintosh and Windows compilers and development environments. It can be downloaded from the Apple Web site, and it is also available on the OpenDoc Software Toolkit CD.

- MacApp from Apple Computer

  The next version of MacApp, due out in 1996, will include support for OpenDoc containers, enabling developers to embed OpenDoc components into their applications. For current MacApp users, the next version will provide a smooth transition to OpenDoc development. (A pre-release version of this product is available through the Apple Web site and E•T•O.)

- PowerPlant from Metrowerks

  This product includes classes that support OpenDoc component development and compiles of OpenDoc shared libraries.

Other OpenDoc tools

- Denali (code name) from Apple Computer

  Denali is a cross-platform development tool, currently under development by Apple, that will allow users to integrate industry-standard components using a powerful language syntax compatible with Visual Basic. It will support OpenDoc and allow users to integrate components (such as Cyberdog) to create powerful OpenDoc-based applications and custom solutions. Denali uses the IBM System Object Model (SOM) language-neutral, object-structured protocol and provides access to open database connectivity (ODBC) services.

- dtF Database Toolkit from dtF Americas

  The dtF Database Toolkit provides a suite of highly integrated, interacting OpenDoc parts to incorporate data from relational databases in productivity applications like word processors, spreadsheets, graphics, or DTP.

- Power Macintosh Debugger

  A pre-release version of this OpenDoc-compatible debugger is available with E•T•O and on the *Developer CD Series.* This debugger provides developers with an improved user interface that can be used to debug locally and remotely, and to support CFM, SOM, and OpenDoc.

OpenDoc development resources

There are numerous Internet resources and publications available to those interested in learning more about OpenDoc development. Here are a few resources that you can use to get up-to-speed.

Internet resources

- *Apple's OpenDoc Web site* (http://opendoc.apple.com/opendoc/) is where you can download the latest version of OpenDoc and other resources to help you create OpenDoc components, containers, and extensions.
- *CI Labs Web site* (http://www.cilabs.org) is run by Component Integration Laboratories, Inc. (CI Labs), the non-profit organization administering OpenDoc specifications and foundation technologies.
- *The Object Management Group (OMG) Web site* (http://www.omg.org) is run by a nonprofit consortium dedicated to promoting the theory and practice of object technology.
- *IBM's Object Technology Web site* (http://www.torolab.ibm.com/objects/) is a place to find out more about IBM's OpenDoc-related products and programs and sign up for IBM's Macintosh OpenDoc organization, Club OpenDoc.
- *News:news:comp.soft-sys.middleware.opendoc* is an Internet newsgroup that can keep you informed of the latest component software news.

Publications

- "Demystifying DSOM," *Apple Directions*, January 1996. Gregg Williams, *Apple Directions'* software maven, eloquently explains CORBA, SOM, DSOM, and how they improve client/server design.
- "The Business Case for Component Software," *Apple Directions,* February 1996. The CEO of Pharos Technologies explains why he thinks component-based software will dramatically reduce the time, costs, and development risks associated with custom software development.

- *The Essential Distributed Object Survival Guide* by Robert Orfali, Dan Harkey, and Jeri Edwards, ISBN 0-471-12993. This is a very comprehensive book about every significant distributed object system as of early 1995. It devotes five chapters to the mechanics of OpenDoc and Microsoft's Object Linking and Embedding (OLE) standard.
- *Object-Oriented Programming Using SOM and DSOM* by Christina Lau, ISBN 0-442-01948-3. This book explains how SOM and DSOM work in the creation of software objects, but doesn't mention OpenDoc.
- *The Essential CORBA: System Integration Using Distributed Objects* by Thomas J. Mowbray and Ron Zahavi, ISBN 0-471-10611-9.

Cross-Platform Development

Today more developers are offering software and services to users on multiple computer platforms as a way to minimize risks and leverage development costs. Recognizing the importance of this business reality, Apple has invested in four key areas to help you more easily "develop once and deploy to many":

- Cross-platform Mac OS technologies
- The industry-standard OpenDoc component software architecture
- Development tools that help you leverage code across multiple-platform markets
- Mac OS licensing and the PowerPC Common Platform (PPCP)

For multimedia and Internet developers, Apple's cross-platform operating system toolbox—which includes QuickTime, QuickTime VR, and QuickDraw 3-D—helps you deploy your multimedia content to Mac OS, Windows, and Internet users. In the near future, Apple will introduce Windows playback capabilities for other key technologies, such as QuickTime Conferencing. (These technologies are described on page 26.)

The widespread adoption of the OpenDoc component software architecture will significantly improve the ability of all developers to reuse code and deploy applications across a wide variety of platforms. In the near term, the compatibility between Macintosh, Windows, and OS/2 components will be enabled. Further down the road, as the CORBA (Common Object Request Broker Architecture), SOM (System Object Model), and DSOM (Distributed System Object Model) platform-independent technologies are firmly established, it will be easier for developers to leverage code created on the Mac OS platform for use on UNIX, AS/400, and even mainframe enterprise systems. These enterprise market opportunities are further strengthened with the recent Object Management Group adoption of the OpenDoc standard. (See the OpenDoc section for more details on these standards.)

One important trend that has made cross-platform development infinitely easier is the recent proliferation of Macintosh-compatible cross-platform development tools. Tools such as the OpenDoc Development Framework, Apple Media Tool, Metrowerks CodeWarrior, and Oracle Power Objects, to name a few, have made the Power Macintosh platform the "path of least resistance" for developers dedicated to multiplatform development.

The newest, and perhaps most revolutionary development breakthrough is Java, an open, cross-platform Internet programming language developed by Sun Microsystems. With the popularity of the Macintosh as a Web authoring tool and client-side browser—and the fact that Java is a truly platform-independent development language—there is a tremendous opportunity for developers interested in creating Internet-related products. (For an extensive overview of Internet tools, see the next chapter.)

Looking further into the future, another significant cross-platform opportunity for Mac OS developers is a result of Apple's recent shift to the industry-standard, RISC-based PowerPC microprocessor. As Apple, IBM, Motorola, and other major hardware vendors move towards a common PowerPC-based hardware platform, the use of the Mac OS operating system should dramatically increase, growing the market for the applications and services that Mac OS developers provide.

Three development approaches

In general, there are three different approaches that developers can take in cross-platform development. The cross-platform tool that you choose depends on the development strategy you take.

- Common code approach. Using this approach, developers work on a common, shared-code base for the key functionality of their product, then "port" the code to individual platforms in stages. User interfaces, of course, should be designed separately. Most developers find that it's easier to implement the more powerful Mac OS interface first, then simplify and move the graphical components of this interface to other platforms. (Mac OS interfaces generally have higher-resolution graphics and more structure.)
- Tool-specific approach. Many solutions and content developers use a high-level programming tool to do much of the work of cross-platform deployment. For example, many multimedia developers use a rich set of multimedia tools on the Mac OS to create their title, then use Apple Media Tool to create a Windows version, in many cases, sharing media elements between the two versions. Cross-platform frameworks, such as XVT Development Solution for C++, have software libraries that provide an infrastructure for creating software applications for multiple platforms. With default implementations for things such as windows, scroll bars, menus, printing, and other system-level services, you're able to dramatically decrease the amount of code that you need to write, test, and debug. There are also many client/server and database tools, such as Oracle Power Objects (OPO), with similar cross-platform capabilities.
- OpenDoc approach. Many developers are already developing OpenDoc components and are structuring their current applications to take advantage of this cross-platform technology. For this approach, Apple strongly recommends the use of the OpenDoc Development Framework (ODF). See the OpenDoc section for product details.

Apple has made a long-term commitment to help developers deploy products to multiple platforms. The information below provides an overview of the Apple and third-party cross-platform technologies and tools available to developers today.

Cross-platform tools chart

This chart provides a snapshot of tools available for specific cross-platform development needs. Use the index in the back of this guide for more details about these products.

Development Platform	Tool Type	Products
Mac OS, deploying to Windows	Cross-compilers	CodeWarrior, Symantec Café, NI Roaster, Java
	Cross-platform frameworks	ODF, XVT, Zinc, OM++, Prograph CPX
	Porting tools	Mac2Win
	Multiplatform authoring	Apple Media Tool, Oracle Media Objects, Director
	Multiplatform client/server	Oracle Power Objects, Forte, JYACC JAM, Omnis 7[3], PowerBuilder, Uniface, Unify
Windows, deploying to Mac OS	Porting tools	Willows Twin, MS Visual C++ Cross Dev't, ICE OM++
Mac OS/Windows simultaneously	Multiplatform compilers	Java, Symantec C++, Prograph, MicroFocus COBOL, True BASIC, Visual Works
	Multiplatform client/server	Oracle Power Objects, Forte, Omnis 7[3], PowerBuilder, Uniface, Unify, JYACC JAM
	Multiplatform GUI builders	XVT Dev't Sol'n, Neuron Data Open Interface, Galaxy, Zinc
Mac OS, deploying to Newton	Application and content tools	Newton Toolkit, Newton Book Maker, Newton Press
	Forms tools	Wright Strategies' FormLogic, Healthcare Comm's PowerForms, Shana's Informed Designer, Apple's Desktop Integration Libraries
Mac OS, deploying to Magic Cap	Cross-platform compilers	CodeWarrior
Mac OS, deploying to UNIX/RISC platforms	Porting tools	Latitude
Mac OS, deploying to Be Box	Cross-platform compilers	CodeWarrior
Mac OS, deploying to Pippin	Cross-platform compilers	Most Mac OS tools

Cross-platform technologies

- QuickDraw 3D

  This system software extension helps you create and manipulate 3-D graphics. QuickDraw 3D consists of human interface guidelines, a high-level modeling tool kit, a "plug in" shading and rendering architecture, a device and acceleration manager for hardware acceleration, and the 3DMF platform-independent file format. (Windows version will be available in 1996.)

- QuickTime

  QuickTime is a system software extension that helps developers work with time-based data such as sound, video, and animation. QuickTime 2.0 for Windows offers developers a cross-platform standard for creating, using, and sharing multimedia content between Mac OS- and Windows–based computers. In addition, it offers consumers of Windows–based PCs higher-quality video and other multimedia features not currently possible with other Windows multimedia software.

- QuickTime Conferencing

  This cross-platform conferencing, collaboration, and multimedia communications technology allows computer users to share real-time information, images, and sound anywhere in the world. It can be used by any number of simultaneous users to conduct cross-platform videoconferencing connectivity and to broadcast and view multimedia content. This system software extension will enable application developers, communications providers, and hardware vendors to easily develop multiplatform solutions. (Windows version availability TBD.)

- QuickTime VR

  Another cross-platform system software extension, QuickTime VR, extends QuickTime with virtual reality capabilities. It lets users view and interact with photographic or rendered versions of scenes. Users can explore 360-degree scenes and interact with objects. QuickTime VR is the first mainstream technology to enable "virtual" 3-D experiences based on real-world scenes. (Currently has Windows playback capabilities.)

Porting tools

- guideWorks Translator from guideWorks

  This product helps you move your Apple Guide source files to a WinHelp format. It creates a WinHelp project from your Apple Guide files, which you can then compile into a WinHelp help file using the Windows Help Project Editor.

- Latitude from Latitude Group

  Latitude enables Macintosh developers to port their applications to UNIX/RISC platforms. When Macintosh developers compile their code on UNIX platforms and link with Latitude's library of more than 1,200 Macintosh Toolbox API calls, a native X/Motif application is produced, which attains the native performance and appearance of the UNIX platform. Latitude is currently available for HP-UX, IRIX, and Solaris UNIX/RISC platforms.

- Mac2Win from Altura Software

  Mac2Win is a porting technology that allows Macintosh applications to be ported to Windows in one-third to one-half the time of traditional approaches. With Mac2Win, a single focused development team can build a Windows version from a single set of native Macintosh source code and a resource file.

- Microsoft Visual C++ Cross Development from Microsoft

  With MS VC++ you can use up to 90 percent of your code from MFC-based Windows applications to create the same applications for the Macintosh.

- PortAsm from MicroAPL

  This assembly-language translation tool converts 680x0 assembler code to optimized PowerPC assembly-language source. It carries out an extensive analysis of the original 680x0 code; produces an efficient, optimized translation, and automatically adapts the code to fit into the run-time environment of the Power Macintosh.

- TWIN APIW Porting Kit from Willows Software

  This set of tools and libraries extends the number of platforms upon which Windows API-based applications may be developed. With the TWIN APIW, developers may use a single set of sources to develop and deploy applications for Windows, UNIX, and the Macintosh. In addition, Willows provides an emulator technology that allows Windows applications to run in a Macintosh window without any changes in the existing Windows application.

Solution Development

Solution tools enable in-house developers, consultants, systems integrators, and value-added resellers to create custom software for customers. Solution developers need tools to rapidly model and prototype customer tasks, then turn those models into easy-to-use, high-performance applications. Integration of off-the-shelf applications with custom code is important in this type of development, since many solutions require the assimilation and management of disparate information across a variety of networks and computer platforms.

The use of Mac OS computers in solution development benefits both solution developers and their customers. Here are just a few of these benefits:

- Great visual development tools. The visual nature of the Mac OS—with its bit-mapped graphics and what-you-see-is-what-you-get (WYSIWYG) implementation—has fostered the development of visual tools that help developers create custom solutions more quickly. Innovative new visual tools, such as FaceSpan and Oracle Power Objects, are significantly increasing the productivity of solutions providers.
- New OpenDoc-based business opportunities. Solution developers who embrace OpenDoc technology will discover new business possibilities, such as the licensing of OpenDoc components to other developers and efficient software customization through use of in-house component libraries. Working with OpenDoc components will dramatically reduce the time, cost, and development risks normally associated with custom software development.
- Built-in scripting language. AppleScript, Apple's easy-to-use systemwide scripting language, enables developers to integrate off-the-shelf commercial applications—hundreds of applications are scriptable today—to create custom solutions. This ability to leverage existing applications frees developers to focus resources on value-added aspects of specific projects.
- Opportunities for mobile solutions. Apple's investments in Macintosh PowerBook computers, Newton personal digital assistants, and remote and wireless communication technologies provide solution developers with opportunities to create mobile solutions that work in harmony with Mac OS–based desktop solutions.

In addition to the benefits listed above, there are many excellent solution tools available from Apple and third parties to help developers rapidly create custom solutions. An overview of some of these Mac OS solution tools follows.

Scripting

Scripting languages are high-level, easy-to-use languages that enable users to create programs without an in-depth knowledge of programming. The most convenient and useful scripting asset available to Mac OS developers is AppleScript, Apple's systemwide scripting language. This language enables developers and users to automate repetitive tasks, search for information within documents, format and create reports, control the Mac OS Finder, launch applications, and control files over a network. Although there are hundreds of applications that support AppleScript today, some key "building block" applications that are commonly used in business solutions are:

- HyperCard (visual development tool)
- Claris FileMaker Pro (database management)
- MacProject Pro (project management)
- Microsoft Word 6 (word processor)

- Microsoft Excel (spreadsheet)
- Quark XPress (publishing)
- Oracle Power Objects (visual database development)

In business, information frequently resides at locations remote from the desktop. AppleScript enables you to easily set up query and transaction front ends to Oracle, Sybase, ODBC, and other database systems. And because of the object-oriented nature of AppleScript, remote access solutions can be reused in other applications, helping solution developers improve productivity.

For solution providers with global projects, it's important to note that AppleScript is a universal scripting language. This means developers can support native-language scripting, from Hangul to Japanese, with minimal additional AppleScript support work.

In addition to AppleScript, many other excellent third-party scripting tools are available, including:

- AppleScript Software Development Toolkit from Apple Computer

  This kit contains everything you need to write AppleScript scripts or to make your application scriptable. It includes the AppleScript language, a script editor, FaceSpan, tools, sample code, and more.

A Solutions Developer on AppleScript

"The beauty of AppleScript is that its syntax is simple to master. Once you take the open architecture of an application like QuarkXPress and couple it with AppleScript's syntax, you've got a winning combination."

—William Buckingham, president of XChange

- BasicScript from Summit

  BasicScript Toolkit offers developers a complete embeddable scripting language toolkit that's compatible with Microsoft's Visual Basic for Applications.

- Database Scripting Kit from Graphical Business Interfaces

  The Database Scripting Kit provides Data Access Language (DAL) and Data Access Manager (DAM) services within any AppleEvents–aware or Open Scripting Architecture (OSA)–compliant application. (OSA is part of the OpenDoc scripting facility.)

- DataScript from General Knowledge

  Whether you're creating client/server applications for vertical markets with FaceSpan or automating database publishing with QuarkXPress, DataScript can help you seamlessly flow information from Oracle, Sybase, DAL, dtF, or SequeLink database servers into documents created by any AppleScript scriptable application.

- FaceSpan from Software Designs Unlimited

  This extensible Rapid Application Designer (RAD), with its unique visual interface, helps developers create applications quickly and easily. It combines an interactive, visual interface design environment with the object-oriented power of AppleScript or any other OSA language. Best of all, FaceSpan allows developers to easily integrate the capability of any scriptable program into a custom application.

  A Solutions Provider on FaceSpan

  "I'm definitely a FaceSpan fan! I use it for just about all the AppleScript scripts I write and for prototyping as well. The ability to control other scriptable applications and the Macintosh Finder makes it much more powerful than Visual Basic."

  —Paul Otmanski, R.R. Donnelley & Sons

- Frontier CGI Framework from UserLand

  See the full description of this Web server scripting product in the Internet section.

- JavaScript from Netscape Communications

  See the full description of this product in the Internet section.

- PreFab Player from PreFab Software

  While hundreds of application are scriptable, there are many older applications or control panels that are not, and even scriptable applications can leave gaps in what functions can be recorded and played back. PreFab Player fills this gap by allowing an AppleScript to control individual menus, buttons, and user interface elements.

- Scripter and ScriptBase from Main Event Software

  Scripter is a script generation/development tool that helps a wide range of scripters, from novices to solution providers, write scripts. Using Scripter's point-and-click interface, developers can create a script by manipulating objects corresponding to scripting elements. The new version includes features to help you write, debug, and test AppleScript CGIs. ScriptBase provides AppleScript developers with a database where global persistent data can be stored and made available to any script at any time.

- ScriptIt from FaceWare

  This tool supports editing and execution of AppleScript scripts from within programs. It extends AppleScript to support true record structures, access to all FaceWare modules, and program-specific extensions to AppleScript.

- ScriptWizard from Full Moon Software

  ScriptWizard is an intuitive script-editing and debugging tool. With true single-step script execution, variable-watching, and a host of other professional editing features, this product significantly speeds up script development.

- VBScript from Microsoft

  See the full description of this active Internet content scripting product in the Internet section. (The Beta version is available from the Microsoft Web page.)

Scriptable applications

Here are some of the Macintosh applications which support AppleScript today. For the most recent list, as well as contact information, check out the ScriptWeb site (http//www.scriptweb.com).

Telecom, Networks

Eudora/Qualcomm

Netscape/Netscape Communications

Fetch/Dartmouth

Anarchie/Peter Lewis

Tango/EveryWare Development Corp.

SITComm/Aladdin

Black Night/Christopher Swan

Text, Publishing

QuarkXPress 3.2 & beyond/Quark

WordPerfect 3.1/Novell/WordPerfect

Microsoft Word 6/Microsoft

MacWrite Pro 1.5/Claris

BBEdit/Bare Bones Software

Sonar Professional/Virginia Systems

Acrobat 2.01/Adobe Systems

Spellswell 7/Working Software

Utilities

StuffIt Lite & Deluxe/Aladdin Systems

PowerAGENT/SouthBeach Software

Synchronize!/Qdea

Numbers

Microsoft Excel 4 & 5/Microsoft

Sum Total/Concurrent Engineering Tools

JMP/SAS Institute

MacP&L/Start Accounting

Graphics

PhotoFlash/Apple Computer

Picture Press 2.5/Storm Technology

DeltaGraph/DeltaPoint

SerePlot 2.0/Scientific Visions

clip2gif/Yves Piguet

JPEGView 3.0/Aaron Giles

EasyPlay/Leptonic Systems

PhotoCapture 1.1/Scott Gruby

Cumulus/Canto Software

Kudo Image Browser & Publisher/Imspace Systems

Database, PIM, Projects

FileMaker Pro/Claris

Butler SQL/EveryWare Development

InfoDepot 2.0/Chena Software

MacProject Pro/Claris

Informed/Shana

Office Tracker Pro/Milum

Oracle Power Objects/Oracle

Science & Engineering

CS ChemDraw/CambridgeSoft

CS Chem3D/CambridgeSoft

CS ChemFinder/CambridgeSoft

CS ChemOffice/CambridgeSoft

Developer Tools

Symantec Project Manager/Symantec

Visual solution builders

Visual solution builders enable developers to create custom solutions using "preassembled" program building blocks, often represented by visual icons, to build solutions. HyperCard was the first visual solution tool that included a GUI builder, scripting language, and extensibility via external commands and external functions. What was unique about this product was its accessibility: Users without any programming experience could create attractive, effective solutions in a matter of hours.

Mac OS development tools for visual solutions include:

- HyperCard from Apple Computer

  HyperCard is a powerful, versatile visual solution tool that's used by more than a million developers worldwide. It now includes features such as color support, AppleScript integration, enhanced navigation, interface control, media control, and network capabilities. Combined with the systemwide scripting capabilities of AppleScript, HyperCard has evolved into a powerful rapid-prototyping and deployment tool. The object-oriented technology of HyperCard makes it extensible through external commands (XCMDs) and utilities. Using these "hooks," many customers have created excellent enhancements to the HyperCard environment.

- FaceSpan from Software Designs Unlimited

  See description in "Scripting" section.

- Oracle Power Objects from Oracle

  Oracle Power Objects (OPO) enables developers to rapidly build client/server and database applications for workgroups and departments. Applications developed on Macintosh can be run on a Windows platform, and vice versa. OPO automates most database work and uses an industry-standard BASIC language. It provides high-performance native connectivity to Oracle7 and SQL Server. With OPO, you create object classes visually, and data objects and custom controls such as buttons are dropped onto a class "form."

A Developer on OPO

"Oracle Power Objects uses a visual application development paradigm which decreases the learning curve and increases productivity. Objects such as database tables, fields, views, and indexes can be created and dragged into screen forms by using simple mouse actions."

—Richard Finkelstein, Performance Computing

- Third-party XCMDs for HyperCard

  These XCMDs, available from Apple and third parties, allow HyperCard applications to control VCRs and CD players, capture recorded sound, build forms, and so on.

- AppWare from Network Multimedia

  AppWare is an easy-to-use, component-based tool for building Macintosh or Windows applications and multimedia applets for the Internet. AppWare facilitates rapid development, but doesn't require the user to have experience in programming languages such as C++ to be productive. Available components support client/server databases, NetWare, multimedia, imaging, communications, Newton, XCMDs, and more.

- Denali (code name) from Apple Computer

  Denali is a cross-platform development tool, currently under development by Apple, that will allow users to integrate industry-standard components using a powerful language syntax compatible with Visual Basic. It will support OpenDoc and allow users to integrate components (such as Cyberdog) to create powerful OpenDoc-based solutions. Denali uses the IBM System Object Model (SOM) language-neutral, object-structured protocol and provides access to open database connectivity (ODBC) services.

Power Objects components

Here are some of the Oracle Power Objects available from Oracle's "Object Marketplace," an on-line source for software components. For the most recent list, check out the Oracle Web site (http://objects.us.oracle.com).

Small Calculator Library
The Small Calculator Library provides an easy mechanism for including basic calculation capability in Power Objects.

Common Dialog API
This class utilizes the Windows Common Dialog API to display the Open and Save standard dialog boxes.

Curtain Library
This library is a Curtain class that can be used when opening up the screen of your applications.

Drag and Drop Calculator Library
The Drag and Drop Calculator Library keeps all of the basic functions of the Small Calculator Library and adds the functionality of drag and drop.

Drag and Drop Library
The Drag and Drop Library gives developers a powerful tool to add drag-and-drop functionality to OPO forms.

Horizontal Slider
This object provides a drop-in horizontal slider object that can be used to display values graphically and changing values by dragging the pointer along the scale.

HTML Advertisement Builder Application
The HTML Advertisement Builder Application constructs submission-ready files that can be put into your submission package.

MultiState Button Library
The MultiState Button class library is designed to give developers the ability to present icon-based selections in a 24-pixel by 24-pixel space.

Messagebox Utility
This utility provides a friendly interface to build a Messagebox by pointing and clicking different elements.

Moving Title Banner
The Moving Title Banner provides a way to display a title for a wide variety of applications.

List Box Processing Library
The List Box Processing Library contains all of the classes you will need to quickly and effectively utilize list boxes in data entry windows.

Number Translator
This class translates a number into its English equivalent.

Percent Bar
This class allows you to graphically display a value on a percent bar within a range of values.

Personal Name Library
This library includes quick-entry classes, display classes, and plenty of cute tricks to jump-start any development that involves the capturing of a person's name.

Simple Code Table Library
If you have Code Tables sequenced and with a description, here is the fastest way to build a maintenance window on the table.

Thermometer
The Thermometer class is a thermometer-like widget that is used for both displaying values graphically and changing values by dragging the mercury along the glass tube.

BitMap Library
This library allows image-mapping functionality.

Video Pane Library
This class utilizes the Media Control Interface (MCI) to display Audio/Video Interleaved (AVI) format files.

Spin Controls
This class has support for Long, Double, and Date data types. Data entry is either through mouse or keyboard. It includes automatic data validation and error display.

Multimedia Authoring

Apple pioneered the multimedia market, and its Macintosh line continues to be the leading platform for multimedia authoring. The platform's success can be attributed to four key factors.

- Most tightly integrated multimedia-ready systems. Mac OS hardware and software are designed from the ground up for multimedia, complete with built-in speakers, digital sound, and high-performance graphics. This unique integration makes it easier to design, create, and support interactive multimedia titles.
- Best multimedia authoring tools. Most of the tools used to create media objects (videos, sounds, animations, and graphics) are developed and released on the Mac OS platform first. The Mac OS platform also offers the widest range of content tools, enabling both professionals and nonprogrammers to create compelling multimedia content. These tools, combined with Apple's ongoing popularity in design and creative departments, make Mac OS the creative professional's authoring platform of choice.
- Leader in cross-platform multimedia technologies. The Mac OS platform's emphasis on innovative, cross-platform multimedia technologies has helped it become an industry favorite: Dataquest estimates that 63 percent of all developers create their multimedia content on Mac OS computers, and in *New Media* magazine's February 1995 analysis of multimedia development platforms, the Power Macintosh won top honors, beating out Pentium-based and Sun systems. Today Apple Media Tool, QuickTime, and OpenDoc can help you deploy your multimedia content to both Mac OS and Windows users. What's more, Silicon Graphics and Apple are currently collaborating on a media asset management system that helps computers control, manage, and manipulate large amounts of digital content.
- Lower support costs. Because every Mac OS system is sold "multimedia-ready" and the system is so easy to set up and use, developers report that their Mac OS versions cost significantly less to support than versions written for other platforms.

Playback technologies

"Run-time" or "playback" software enables users to run multimedia programs without having to have complete multimedia authoring applications installed on their hard disks. Apple is actively helping the industry move from proprietary run-time engines to "open" run-time standards that are supported by multiple tool vendors. Apple's multimedia playback technologies include:

- QuickTime

  Apple's run-time technology for the playback of dynamic data (animations, video, sounds, and music) is QuickTime. It's an open standard supported by hundreds of tools, and it provides developers with the ability to play back on both Mac OS and Windows platforms.

- QuickTime VR

  QuickTime VR extends QuickTime with virtual reality capabilities. It lets users view and interact with photographic or rendered versions of scenes. Users can explore 360-degree scenes and interact with objects. QuickTime VR is the first mainstream technology to enable "virtual" experiences based on real-world scenes. It recently won the Software Publishers Association's 1996 "Best Programming Tool" Codie Award and Computer Graphics World's 1995 Technology Award.

- QuickDraw 3D

  This new system software extension makes real-time, workstation-class 3-D graphics as easy to use as text and 2-D graphics. A broad range of Apple developers have announced plans to support QuickDraw 3D in forthcoming releases of their products. This technology was named *MacUser* magazine's 1995 "Breakthrough Technology of the Year."

Macromedia on QuickDraw 3D

"Apple's QuickDraw 3D will have a significant impact on the graphics and multimedia markets. Macromedia expects to support QuickDraw 3D in future versions of our key products, including our new 3-D software."

—Miles Walsh, VP of marketing, Macromedia—

Multimedia tools

Multimedia authoring tools are used to assemble media elements, which are created with specialized "craft" programs such as Adobe Photoshop and Illustrator, into a finished, interactive software product. Many of these authoring environments enable content creators to add special effects, create navigation elements for users, and compile their products for multiple platforms.

- Apple Game Sprockets and QuickDraw 3D RAVE from Apple Computer

  This new, software development kit (SDK) enables you to create advanced multimedia and Internet-enabled games for Mac OS-based computers. Using this SDK, all Mac OS-compatible games can feature real-time 3-D graphics, 3-D sound, Internet support, speech recognition, and input device/monitor control. Game Sprockets includes the final release of QuickDraw 3D RAVE (Rendering Acceleration Virtual Engine), a multi-platform technology that enables game developers to incorporate plug-and-play 3-D acceleration hardware. RAVE is an optimized hardware abstraction layer that lets you code directly to 3-D hardware for maximum performance and also provides specific functionality for software rendering and texture mapping. Both Mac OS and Windows software that supports this cross-platform API gain access to the power of 3-D graphics accelerator cards that include special RAVE drivers. It's available royalty-free to all developers.

- QuickTime VR Authoring Tools Suite from Apple Computer

  QuickTime VR enables you to create virtual walkthroughs and rotate 3-D objects in space. There are several configurations of the QTVR Authoring Tools Suite available, but the MPW Pro bundle is recommended if you don't already have MPW.

- QTVR Pano and Make QTVR Object from Apple Computer

  These utilities help you create QuickTime VR content from the output of panoramic cameras, regular cameras (objects only), and computer graphics programs. You can download these tools from the Apple Web site. (Beta version available.)

- Apple Media Tool (AMT) from Apple Computer

  Winner of *MacUser* magazine's 1993 "Best New Multimedia Product" Eddy Award, this product is an object-based, cross-platform multimedia development tool that uses a familiar screen-map storyboard metaphor. It allows users to quickly and easily drag and drop QuickTime VR, QuickTime movies, PICT, text (RTF) files, and sound files into a storyboard, then add interactivity through a visual, nonscripting interface. Version 2.0 includes more than 30 new features, including QuickTime VR support, variable run-time bit depths, custom color palettes, flipbook animation, and hypertext linking. AMT features and projects can be customized by the Apple Media Tool Programming Environment. Titles created with these products can be distributed royalty-free.

Interactive Music Developer on Apple Media Tool

"Apple Media Tool allows our designers to prototype quickly and easily for look-and-feel, without having to know too much techie stuff."

—Bill Pierce, technical director, Graphix Zone

- Apple Media Tool Programming Environment (AMTPE) from Apple Computer

  This object-oriented language and application framework allows programmers to customize features used within the Apple Media Tool authoring environment and add functionality to interactive projects created with Apple Media Tool. All code written with this product compiles for both Macintosh and Windows platforms. The new 2.0 version includes an expanded Apple Media Language class library; incremental compiling and linking of Apple Media Language code; improved and faster debugging facilities; and enhanced documentation written from an AMTPE developer's perspective.

Interactive Music Developer on AMTPE

"If you write all your code in the Apple Media Tool Programming Environment (without writing in C), it takes about ten minutes to port your content over to the Windows platform."

—Sean Dunn, technical manager, Graphix Zone

- AuthorWare from Macromedia

  This multimedia authoring software is designed for the needs of trainers and educators. It uses an icon-and-flowchart metaphor and is optimized for the creation of courseware and training materials. Visual programming allows nontechnical users to build applications without scripting. It also provides a full range of sound, animation, and video in applications.

- Digital Box Office from Power Production Software

  This no-scripting cross-platform interactive authoring tool is useful for quick-turnaround projects. You can create links, motion, animation, movies, sounds, and effects without scripting. It supports 32-bit color, QuickTime, QuickTime VR, QuickDraw 3D, Drag and Drop, XCMDs, unlimited animations, layers, and frames. It also provides print tracking and breakdown reports. Mac OS, Windows, and Java content can be distributed royalty-free with the run-time players included.

- Director from Macromedia

  This animation and authoring tool enables end users and developers to create high-quality, multimedia presentations, animations, and interactive applications. Users can integrate graphics, text, and animations with audio and video; add full interactivity with buttons and scripts; author, edit, play back, and manipulate QuickTime movies; and add interactivity to QuickTime movies with its Lingo scripting language. Users can incorporate 3-D models from Swivel 3D, animation from Macromedia Three-D, sounds from MacRecorder, and all standard Mac OS file formats.

- HyperCard from Apple Computer

  This versatile tool enables both novices and professionals to develop multimedia solutions. Enhanced features such as color support, AppleScript integration, navigation elements, interface control, and network capabilities have enabled the creation of many sophisticated multimedia titles such as Broderbund's Myst.

- HyperStudio from Roger Wagner Publishing

  Now used in tens of thousands of schools, this award-winning product is an ideal multimedia environment for children and education. The product includes built-in paint tools, animation, and the ability to use QuickTime movies and sounds. Versions of HyperStudio support both Mac OS and Apple IIGS computers.

- mTropolis from mFactory

  This cross-platform authoring application combines high-performance graphics and animation with a drag-and-drop interface that allows media and logic to be shared among teams of programmers and artists. Behavior modules, which are developed with a scripting language, can be directly pasted onto media sets. The mTropolis real-time kernel enables high-performance playback and minimal memory requirements.

- Oracle Media Objects from Oracle

  Oracle Media Objects (OMO) is an object-oriented multimedia authoring tool that allows developers to create content for personal computers, CD-ROM discs, and interactive television. It uses a HyperCard-like interface and a HyperTalk-like language. OMO includes basic editing tools for graphics and animation and is easily extensible by dropping in additional objects (specialized content editors created by third-party developers). Titles developed with OMO on a Mac OS system can also be played on Windows–computers and television set-top boxes.

- SceneSlate from Learning Systems Consultants

  This easy-to-use multimedia authoring tool is used primarily in schools, but because of its nice storyboarding features, many movie studios use it for production planning. It features a visual storyboard grid, simple scripting, production tips, windows for audio notes, HyperCard export/import capabilities, and 16-bit color support.

- SuperCard from Allegiant

  This interactive multimedia and custom application tool provides solution developers with tools for interactivity and graphical control. Designed from the ground up to support color, SuperCard is the only multimedia authoring tool that offers direct script control over bit-mapped and draw graphics. This permits animations, simulations, and interactivity that are difficult or impossible to achieve with other tools.

Other Useful Publications

The Apple New Media Library is a collection of books and CD-ROMs endorsed by the Apple Multimedia Program (AMP) and published by Random House and *New Media* magazine. A few of these books are listed below. For a complete listing, see the AMP home page (http://www.amp.apple.com).

- *Multimedia Demystified* by Apple Computer, Inc., is the definitive introduction to multimedia that covers each stage of a typical multimedia project—conception, planning, design, production, testing mastering, duplication, and distribution. Available at bookstores. ISBN 0-679-75603-5.
- *Multimedia Music and Sound Studio* by Jeff Essex is designed for professionals and hobbyists alike. This book expertly blends technical data with a how-to approach, providing developers with a one-stop source for successfully integrating music, narration, and sound effects into any application. Available at bookstores. ISBN 0-679-76191-8.
- *The Enhanced CD Fact Book* by Josh Warner provides you with an overview of enhanced CD formats, advice on presenting project ideas to record labels, and technical tips on creating interactive music titles. This publication is posted on the AMP Web site (http://www.amp.apple.com/program/imt.html).
- *Desktop Video Studio* by Andrew Soderberg and Tom Hudson is packed with authoritative information, tutorials, real-world techniques, valuable utilities, and libraries of video special effects and clip media. This book has everything you need to create professional-quality video productions. Available at bookstores. ISBN 0679-75784-8.
- *The Macintosh Solutions and Multimedia Developers Guide* is a resource for locating solutions- and multimedia-related hardware, software, publications, and consultants. Available through the Apple Web site or Joint Solutions Marketing at (408) 378-2444.

Client/Server and Database Development

The simplest definition of client/server computing is computing that involves more than a single computer. In the most common client/server scenario, an enterprise maintains a central database on a shared computer, and users access it through their personal computers, with part of the database application's logic and interface being executed on the personal computers. Client/server solutions are particularly useful in accessing geographically distributed systems that serve different functions.

Today, client/server systems range from two-person accounting systems to fully distributed applications used by thousands of enterprise employees. From the smallest workgroup to the largest corporation, workgroup and database applications are increasingly migrating to a client/server architecture.

There are many reasons why the Mac OS is well-suited for client/server applications. Following are the primary advantages:

- Lower installation and ownership costs. The easy-to-use, plug-and-play, and scalable networking built into every Mac OS computer significantly lowers the installation and support costs of client-side computers. This has been quantified by Gartner Group of Stamford, Connecticut, who found that the five-year cost of owning a Macintosh is nearly $6,500 less than a comparable Windows–based computer.
- Improved efficiency and decreased risk through OpenDoc. Just as OpenDoc simplifies development of software components by reducing the number of issues a programmer must deal with, distributed objects simplify client/server software development by allowing clients to treat servers as local objects with an application-specific interface. This means that programmers are freed from the task of coding to network and middleware APIs, so they can concentrate on higher-level application issues.
- Cross-platform accessibility. The increasing availability of cross-platform client/server tools and middleware, along with the fact that Macintosh users can now run DOS/Windows applications, share multiplatform peripherals, and access the same databases, makes it easier than ever to incorporate Mac OS computers into heterogeneous client/server environments.
- Advanced system-level services. The Mac OS is especially suited to client/server computing because of its mature and robust client communications subsystems. The Macintosh Communication Toolbox and Apple's Open Transport architecture enable multiple, simultaneous connections to a wide variety of server and host data sources.
- Flexible Graphical User Interface (GUI). The essence of an effective client/server solution is the GUI at the client desktop. The mature Mac OS and Finder is easy to customize, easy to use, and the best foundation for a good client GUI.
- Powerful RISC-based computers and servers. The outstanding performance of Apple's Power Macintosh computers makes it an excellent client, as well as server, for use in client/server solutions.

In addition to the built-in system-level services that the Mac OS provides, there are many tools available to help client/server developers scale applications to meet the needs of an entire organization's users, integrate a growing body of legacy code, and reuse code as efficiently as possible. A list of these tools follows.

Client databases

Databases available for Mac OS computers include popular and easy-to-use "flat-file" products such as Claris FileMaker Pro, object-oriented databases such as POET Software, and server-based relational databases such as ACI's 4th Dimension. Most Mac OS database tools are cross-platform, enabling developers to deliver applications on Windows and other systems. Mac OS tools for developing database applications include:

- CXBase Pro from TSE International

  This native ANSI-C source code database engine can be incorporated into any application and can be used for any kind of storage scheme (from flat-file systems to complex relational databases). It was developed especially for Mac 68K and Power Macintosh systems (native and optimized). It has a small memory requirement, and it is cross-platform.

- FileMaker Pro from Claris Corporation

  This database manager enables fast, easy database design, quick information access, automation of repetitive tasks, and data sharing over networks. FileMaker Pro Server is a powerful network server version that delivers multiuser performance and centralized network management tools across AppleTalk and Novell IPX networks.

- 4th Dimension from ACI

  This relational database management system (RDBMS) is intuitive enough for first-time database users to learn, yet powerful enough to meet the sophisticated demands of professional developers. Its programming language enables developers to add functionality, such as bar-code reading, telephone dialing, and QuickTime video controls to applications.

- Inside Out II from Sierra Software Innovations

  Inside Out II is a high-performance database engine for Macintosh developers. It adds high-end data management and file handling support to Pascal, C, or C++ applications. The main component of Inside Out II is a library of more than 200 procedures and functions that are called as required by applications in order to manipulate a database.

- Microsoft FoxPro v2.6 from Microsoft

  This product provides easy access to relational features for users, and raw power for developers. Advanced tools for developers make it easy to create applications without limits.

- NeoAccess from NeoLogic Systems

  NeoAccess uses a frameworks approach to database technology that greatly simplifies the development of data-intensive applications. It consists of a set of C++ classes with full source code. Low-level capabilities of the system include a powerful object persistence mechanism that brings objects and variable-length BLOBs of data into memory on demand. NeoAccess includes a relational query engine that provides fast access to objects. It extends MetroWerks' PowerPlant, Symantec's THINK Class Library, and Apple's MacApp. NeoAccess-based documents are binary-compatible across platforms.

- Objectivity/DB from Objectivity

  Objectivity is the leading supplier of object databases to software and equipment manufacturers designing mission-critical applications. Objectivity customer applications include real-time system control and engineering data management. Objectivity/DB is a scalable, high-availability, high-performance object database available on 18 platforms.

- Personal Oracle7 from Oracle

  This database can support all your users, whether they're on-site, mobile, or remote. Personal Oracle7, release 7.1, gives you access to a distributed databases anytime, anywhere with Macintosh ease and Oracle power. Providing the full feature set of Oracle7, Personal Oracle7 empowers you to develop and deploy distributed databases where and when you want.

- VERSANT ODBMS from Versant Object Technology

  This high-performance ODBMS specifically designed to support multi-user, production applications in distributed environments. VERSANT is architected with a scalable distributed architecture providing features such as transparent data distribution, object-level locking, dynamic schema evolution, built-in workgroup computing support, and a full suite of database administration utilities.

- OMNIS Database from Blyth Software

  Blyth Software's OMNIS SQL Client Database can be used for prototyping, local data storage, or mobile computing applications.

- Omniscience ORDBMS from Omniscience Object Technology

  Omniscience develops and markets Omniscience Object-Relational Database Management System (ORDBMS), a production-quality and relational database that is robust in functionality, lightweight, supports native SQL, and complies with standards (ANSI SQL-92, ODMG-93, and ODBC 2.0) for today's database applications.

- POET 3.0 from POET Software

  POET is a C++ Object DBMS that supports encapsulation, inheritance, and polymorphism. POET features include object querying, sorting, indexing, transactions, class versioning, container classes, variable length, and binary large object blocks. POET comes as Personal Edition (single user) and Professional Edition (client/server enabled).

Server databases

- 4D Server from ACI US

  4D Server is a client/server relational database that combines a professional-strength programming language and intuitive interface with platform independence. 4D Server databases can run interchangeably on both Macintosh and Windows platforms without modification. For rapid application development, 4D Server allows multiple developers to build and modify databases simultaneously.

- Butler SQL from EveryWare Development

  Butler SQL is a feature-rich, client/server relational database management system for the Macintosh and Power Macintosh that supports access via Microsoft's Open Database Connectivity (ODBC) interface.

- dtF from dtF Americas

  dtF is a relational database system especially suitable for workgroup client/server database application development. It offers high-performance SQL; full transaction control; error recovery; binary large objects; and a separate, true stand-alone version. dtF can be used from all major development environments like AppleScript, HyperCard, SuperCard, Peregrine, SmalltalkAgents, and all major C/C++ compilers.

- FairCom Server from FairCom Corporation

  FairCom Server features full heterogeneous network support. Connect dissimilar clients concurrently to any FairCom Server. Multithreading permits previously unused time waiting for locks and I/O operations to be used processing other users' requests.

- The OMNIS Server Edition from Blyth Software

  This product is targeted at developers building departmental applications for a single server platform. It will support the Oracle, Informix, and Sybase platforms. The Server Edition provides a complete client development environment and includes data access modules that enable high-speed native access to both the target server platform and the OMNIS Database.

- SNAP IMPACT from SNAP Innovation

  SNAP IMPACT is a fully relational, professional DBMS and DAL server combined. It supports MacOS, SunOS, Solaris, IBM AIX, Windows 95 & NT platforms, multiple standards (SQL, DAL and ODBC), and multiple protocols (including ADSP and TCP/IP). It implements a unique variation of the client/server model, known as the intelligent client/server paradigm.

CASE tools

Computer-aided software engineering (CASE) tools can be used in any and all phases of information system development, from analysis to design to programming. This type of tool is used to define, design, document, and communicate an overall system that will be created using traditional structured programming techniques. Mac OS CASE tools include:

- Aide-De-Camp/Pro from True Software

  This product is an object-based Software Configuration Management (SCM) tool that provides built-in change management and tracking, comprehensive software release control and audits, and an open architecture for ease of interfacing or integration with existing solutions.

- ANATOOL from Model System Consultants

  ANATOOL is a computer-aided software engineering tool that implements structured systems analysis. It creates a document containing hierarchical data flow diagrams, a data dictionary, and pseudo-code specifications.

- Aut2 from Model System Consultants

  Aut2 is a CASE tool targeted at the analysis, specification, and logical design stages of information system projects. It contains a number of diagramming tools for a variety of model types and notations, and will build a supporting database of model detail.

- DEFT Designer DEFT from Sybase

  This a CASE solution for RDBMS environments that is easy to learn and easy to use. It offers developers rapid prototyping, reduced development and maintenance costs, and increased quality through error reduction.

- DESIGN/CPN from Meta Software

  This product provides simulation capabilities for designing and analyzing real-time systems, complex transaction processing, and enterprise modeling. The product combines the design features of CASE tools with the ability to execute simulation technology and rests on the formal principles of hierarchical colored Petri nets (CP-nets).

- Design/IDEF from Meta Software

  Design/IDEF "automates graphical modeling for Business Process Redesign/Reengineering and supports the IDEF methodology for both process and data modeling. Design/IDEF is easily used to depict complex business processes, and supports an integrated glossary and data dictionary, Activity Based Costing, links to CASE, the import/export of information, and links to simulation.

- Design/OA from Meta Software

  Design/OA facilitates the rapid implementation of diagram-based applications. Design/OA combines a pre-engineered GUI with a system modeling application, based on the well-known diagramming tool, MetaDesign. Applications are built easily by writing C programs that incorporate and extend the OA kernel to integrate the user's desired look-and-feel, diagramming vocabulary, and semantics and syntax.

- ICONIX PowerTools from Iconix Software

  ICONIX PowerTools is a CASE package that offers full life-cycle support for software development. Its ten modules encourage analysts to use object-oriented, structured, and information-engineering approaches for software development. PowerTools allows real-time problems to be partitioned into smaller pieces and then modeled by creating a graphic representation of tasks, flows, processes, states, events, and actions.

- MacA&D 5.0 from Excel Software

  MacA&D is a software engineering tool for object-oriented or structured analysis and design, real-time extensions, data and screen modeling, multitask design, code browsing, requirements traceability, and multi-user dictionary.

- MacAnalyst from Excel Software

  MacAnalyst is a CASE tool for system analysis and software design that supports industry-standard, structured analysis techniques. The software supports Yourdon/DeMarco and Gane and Sarson data and control flow diagrams, process specifications, and a data dictionary.

- MacDesigner from Excel Software

  MacDesigner supports structured and object-oriented design of software systems. Structured design techniques supported include structure charts, module descriptions, tree diagrams, data dictionary, and requirement database with traceability. Object-oriented design is supported with interaction diagrams, object communication diagrams, and a data dictionary that supports inheritance.

- QASE RT from Advance System Technologies

  QASE RT is a performance analysis tool that uses the graphical interface to visually describe the components of a proposed system and estimate the system performance. It provides a framework for analyzing application system designs. The user can specify a complete operating environment for an application, including hardware, software, network architecture, and workload estimates.

- SILVERRUN Professional from Computer Systems Advisers

  SILVERRUN Professional is an integrated business process and data modeling workbench for next-generation client/server development. There are four modules that are part of the Professional Series, which can be integrated or used separately for the analysis of applications development. The four modules are Entity Relationship Expert (ERX), Relational Data Modeler (RDM), Business Process Modeler (BPM), and Workgroup Repository Manager (WRM).

- Translator 1.0 from Excel Software

  The Translator utility automates the generation of diagrams with MacAnalyst and MacDesigner tools from existing source code. The Translator scans source code and extracts information into a text file that can be imported into MacAnalyst and MacDesigner.

- TurboCASE from StructSoft

  TurboCASE 4.0 is an integrated, multiwindow front-end CASE tool that supports both structured and object-oriented software development. TurboCASE supports structured analysis with real-time extensions, data modeling with object-oriented analysis, structured design, and object-oriented design.

- WorkFlow Analyzer from MetaSoftware

  WorkFlow Analyzer enables business people to analyze and simulate business processes to achieve improved organizational performance. Existing workflows are automatically translated into simulation models to facilitate "what-if" analysis and test the effects of process changes.

Client/server applications

- Maconomy from Maconomy

  Maconomy is a high-end accounting and business management solution, developed on the Macintosh, and providing multiplatform clients for both Mac and Windows operating environments. Besides traditional financial reporting, the system uses a multidimensional general ledger concept that allows for cross-departmental reporting based on project work.

- PeopleSoft Distribution from PeopleSoft

  PeopleSoft Distribution redefines the disciplines of materials management, logistics, and distribution. Providing optimal visibility across the supply chain, PeopleSoft Distribution accurately tracks consumption of internal and external goods and services.

- PeopleSoft Financials from PeopleSoft

  PeopleSoft Financials is a software package that focuses on the operational and management aspects of accounting. This suite of products packs new approaches to financial management into tightly integrated systems that span all aspects of accounting.

- PeopleSoft HRMS from PeopleSoft

  PeopleSoft HRMS enables you to manage your most valuable and expensive resource–your people. It extends the role of traditional HRMS systems to focus not only on data collection, but also on providing a comprehensive knowledge base for tracking, understanding, and deploying the skills of your collective employee base.

- PeopleSoft Manufacturing from PeopleSoft

  PeopleSoft Manufacturing supports and enhances the core processes of comprehensive, global supply chain management for assemble-to-order, make-to-order, make-to-stock, repetitive, or mixed-mode manufacturing operations.

- R/3 SAP GUI from SAP America

  This product is the graphical user interface of the R/3 System. It has been optimized for dealing with typical business routines such as logistics or financial management.

- SAP GUI from SAP America

  SAP GUI for Macintosh takes into account the special technologies and features of the Macintosh system such as AppleScript, BalloonHelp, QuickHelp, and the use of several monitor screens. It also supports the native Macintosh "look and feel."

- The Solution Series/ST from Cyborg Systems

  The Solution Series/ST is a client/server-based Human Resource Management System (HRMS), Payroll, Benefits, and Time and Attendance software suite. It gives organizations the freedom to choose the technology mix that best fits their information environment and business requirements.

- The Virtual Meeting from RTZ Software

  The Virtual Meeting is a toolkit for developing and deploying client/server-based real-time conferencing applications that can be used to conduct presentations, meetings, lectures, and classes between participants in many geographically dispersed locations.

Client/server utilities

- AppleScript Scripter's Tool Kit from Apple Computer

  AppleScript allows you to integrate the functionality of third-party applications to better meet your needs, streamline your work, or develop custom solutions. A language-independent syntax and useful script editor make AppleScript a productive solutions tool—scripts can be written in the native language of your choice and generated either by typing simple words and statements or by recording actions directly. It also includes the FaceSpan interface builder.

- Change Management System (CMS) from Blyth Software

  This product eases maintenance and extends the development life cycle of distributed OMNIS applications. The CMS repository automatically compares application changes to the prior version and stores only the differences.

- DataScript from General Knowledge

  DataScript 3.0 is an SQL client application that makes solutions created using OSA-compliant scripting languages such as AppleScript or Frontier database aware in a flash. DataScript runs on 680x0 & Power Macintosh systems and provides direct connections to RDBMS/MiddleWare from Oracle, Sybase, Butler, dtF, SequeLink, and ODBC.

- FileWave and FileWave Enterprise Edition from Wave Research

  FileWave is a smart software server for Macintosh computers on AppleTalk network systems: It automates software distribution and provides true concurrent-use license information. Using the Finder, an administrator can model the user community into structured groups, copy file sets into a repository, and assign them to user groups. The software is unobtrusively dispatched to users.

Client/server tools

Client/server tools enable the development of Mac OS applications and other clients that can communicate to databases such as Oracle, Sybase, Informix, and IBM's DB2. The client application talks to the database over the network using an SQL language and appropriate database middleware. There's a variety of robust client/server tools available for Mac OS computers, including Oracle Power Objects, Omnis 7^{3}, and Powersoft's PowerBuilder. All these tools are available on multiple platforms, allowing developers to easily create cross-platform client/server solutions. Tools for developing Mac OS client/server applications include:

- AppleScript with DataScript from General Knowledge

  AppleScript can be used with DataScript database access extensions (from General Knowledge) to easily create highly functional client/server applications. Extensions are currently available for Oracle, Sybase, ODBC, and other databases.

- 4D Passport from ACI

  This client/server solution enables developers to create graphical Mac OS client applications that connect to DAL, Oracle, Sybase, and other SQL database servers.

- Omnis 7^3 from Blyth Software

  This application environment facilitates the development and deployment of enterprise wide client/server applications. With this product, developers can create an application on Mac OS or Windows, then deploy it with native GUIs across a wide range of platforms, server RDBMSs, and legacy data sources.

- Enterprise Desktop Manager (EDM) from Novodigm

  This scalable, object-oriented tool enables developers to deploy and configure client/server applications over diverse networks, including the World Wide Web.

- Entrada Client/Server Environment from Pictorius

  This completely visual and object oriented development environment enables rapid development of client/server and database applications. It uses the standard Entity Relationship Diagramming technology to build the database schema. Peregrine includes Prograph CPX visual development environment, dtF relational database, and native database connectivity to Oracle7, Sybase and Microsoft SQL Server, and ITI's DAL. (In February 1996 this product will support ODBC.)

- JAM from JYACC

  This cross-platform tool enables users to build client/server and three-tier enterprise applications. It's unique in that it lets users build applications easily without sacrificing control in complex and performance-critical areas. It also supports transaction processing monitors such as Novell's TUXEDO. JAM applications can run unmodified on a wide range of platforms and operating environments, including Mac OS, Windows, Motif, OS/2 Warp, VAX/VMS, and many UNIX implementations.

- SAS System (SAS/AF) from SAS Institute

  SAS System is a modular, integrated, and hardware-independent system for enterprisewide data access, management, analysis, and presentation. Its development environment can be addressed through a task-oriented end-user interface, as well as a powerful programming interface.

- Uniface Six from Uniface.

  This graphical client-server development environment enables complex systems to be built quickly, with minimum maintenance costs. Its unique model-driven development technology allows commercial and corporate developers to define their applications logic at a high level, making it easier to extend and enhance an application. Applications built with Uniface adopt the same look and feel of standard Mac OS software.

- Unify Vision from Unify

  This graphical client/server development tool is for the rapid development, deployment, and management of complex business applications. It's fully scalable architecture ensures that applications can grow to thousands of users without performance degradation.

- Sapiens Ideo from SmartStar

  This object-oriented software product for dynamic cross-platform, SQL application development provides a distributed client/server environment with executable code for both the client and the server. Applications can be developed on any supported workstation with its native GUI, and then be deployed to the desktop without compiling or linking.

- C/S Elements from Neuron Data

  This object-oriented, cross-platform development tool includes GUI development and extensible script language facilities, and provides transparent access to any flat-file or relational database. It enables developers to mix and match data from Oracle, Sybase, Informix, and ODBC-compliant databases. It also enables the building of enterprisewide client/server applications that are portable on more than 40 platforms.

- Developer/2000 from Oracle

  This product suite enables you to rapidly develop sophisticated and robust applications that scale from workgroups to large organizations. It includes a common repository, flexible modeling, and methodology support, as well as a unified client and server development environment for easy application partitioning. It provides team development support for code reusability, configuration management, and interfaces to different source-code control packages. (Availability is expected in Q1 ’96.)

- PowerBuilder from Powersoft

  This leading client/server tool combines an intuitive graphical interface with an extensible object-oriented programming language. Its advanced object library and source manager introduce binary-format compatibility across multiple platforms. Included is Watcom SQL database, AppleScript support, native connectivity to leading databases, and MacODBC support.

- NS-DK/1 FROM Nat Systemes

  This cross-platform tool supports graphical construction of two- and three-tier applications to be deployed using Novell’s TUXEDO transaction monitor.

- Galaxy VDB from Visix

  This tool provides you with a comprehensive framework for building complex cross-platform applications. It offers class libraries, visual tools, and services to build large-scale, distributed applications. Client/Server Utilites Databases available for Mac OS computers include popular and easy-to-use “flat-file.”

Managed query tools

Ad hoc query and browsing tools enable users to access the database information they need for decision support. These tools usually provide easy-to-use visual environments that automatically generate SQL queries (SQL code) and allow visual formatting of the retrieved data. Visual query tools were pioneered on the Mac OS, then provided on the Windows platform, enabling developers to target multiple platforms. Query tools—such as Andyne’s GQL (Graphical Query Language) and BrioQuery—support AppleScript, allowing developers to automate operations such as reporting and analysis. Query and browsing tools available for Mac OS systems include:

- BrioQuery from Brio Technology

  BrioQuery is a complete, cross-platform, ad hoc visual query and analysis tool with built-in cross-tabs and easy reporting. BrioQuery places a lightning-fast multidimensional analysis tool at the heart of an advanced ad hoc SQL query system, and features an optional Data Model Repository for central management of shared queries, as well as ADR for automatic distribution and version control. BrioQuery is available in three configurations: Designer, Navigator, and Explorer.

- CLEAR:Access from Sterling Software

  CLEAR:Access is an easy-to-use query and reporting tool that lets end users access enterprise information. Users can access more than 70 types of databases from a Macintosh or Windows desktop, using all popular middleware products.

- GeoQuery from GeoQuery Corporation

  GeoQuery is the most popular Macintosh software for presenting and analyzing business information on interactive maps. Common uses include sales, marketing, and field service management systems. It provides System 7–based direct links to databases, spreadsheets, contact managers, and in-house applications (such as ACT!, FileMaker Pro, 4th Dimension, Microsoft Excel, and others).

- GQL (Graphical Query Language) from Andyne Computing

  This product provides a multiplatform solution to managing end-user access to SQL database information. GQL supports both executive push button and ad hoc query facilities, and features an intuitive, point-and-click interface with built-in reporting and data analysis capabilities. The system provides transparent integration with applications such as Microsoft Excel.

Decision support and business intelligence

These tools turn host data into useful information, by providing users with the capability to reformat and graph this information. Most of these tools are cross-platform. Some (including the SAS JMP statistical visualization package) support AppleScript, allowing routine operations to be automated. Mac OS development tools for decision support and report writing include:

- BusinessObjects from Business Objects

  BusinessObjects is the leading client/server support (DSS) tool for mainstream end users. It delivers query, reporting, and analysis capabilities without requiring specialized computer skills or database knowledge. It delivers the autonomy end users need for effective decision making, while giving MIS departments the centralized control they require to efficiently manage the data.

- Analysis Server and Essbase Application Tools from Arbor Software

  Analysis Server and Essbase Application Tools comprise the leading multidimensional analysis solution for enterprise systems. Essbase enables managers and business analysts to rapidly access, share, update, and analyze large volumes of enterprise performance data directly from spreadsheets or customized applications. Typical Essbase applications include budgeting, forecasting, product profitability, customer profitability, sales analysis, and financial consolidations.

- Gentium from Planning Sciences

  Gentium is a client/server tool for the development of Decision Support Systems and Enterprisewide Information Systems (DSS/EIS). Gentium's object-oriented design provides for rapid application development and deployment of mission-critical business applications. Gentium also employs code-free integration of multi-dimensional (OLAP), relational, and textual data using its Connections Mapper along with a distributed agent-based architecture.

- Holos from Holistic Systems

  Holos is a client/server application development environment for business intelligence applications. Holos provides a tight integration with most popular relational database management systems, including Informix, Ingres, Oracle RDB, Sybase, and ODBC-compliant databases.

- PaBLO from Andyne Computing

  PaBLO is a multidimensional data analysis and reporting tool that provides decision makers with transparent access to local and remote information resources. PaBLO's report layout and data navigation facilities manage end-user access to information stored on desktop computers, mainframes, and network servers.

- PowerPlay for Macintosh from Cognos

  This product is a sophisticated, multidimensional reporting and analysis tool (OLAP) that transforms and presents standard data as direct reflection of the user's actual business organization. It gives managers a comprehensive graphical perspective on their business without the need for custom programming.

- Process Vision from Antares Alliance Group

  Process Vision is a robust Business Process Reengineering tool. It leverages the Macintosh look and feel to capture process information in an easy-to-understand graphical format, and allows users to create varying levels of process detail. Consistency and logic checking are utilized to produce an accurate cross-functional organization perspective.

- SAS System from SAS Institute

  The SAS System—an integrated suite of information delivery software for business decision making–provides organizations with tools to access, manage, analyze, and present their data within an application development environment. The SAS System can access over 50 different local and remote data sources including relational, non relational, and system files. ANSI-standard Structured Query Language (SQL) is supported for end-user queries. Capabilities within the SAS System include EIS, data applications development, graphics, data analysis, report writing, quality improvement, project management, decision support, and more.

- Voyant from Brossco Systems

  Voyant is a powerful client data access and graphical reporting tool running on Macintosh and Power Macintosh systems that provides easy access to information in an SQL database. Voyant provides a comprehensive up-to-date overview of your data and presents this information in the form of powerful graphics. Voyant is extremely easy and intuitive, and requires minimal training.

Workgroup client/server

- HELIX Express from Helix Technologies

  HELIX Express 3.5 is a database application development system based on client/server and document management technology, all within a fully relational database environment. Used to produce powerful information and document management solutions (including images and multimedia files), HELIX has an intuitive point-and-click graphical programming environment that uses icons and plain English.

- SAPIENS Ideo from Sapiens

  SAPIENS Ideo is a database- and platform-independent client/server, rapid application development tool. Object palettes and GUI tools allow customization of user interface. Object-oriented 4GL adds powerful scripting capabilities.

- The OMNIS Workgroup Edition from Blyth Software

  The OMNIS Workgroup Edition is designed for organizations seeking to create and deploy LAN client/server applications. The product provides a complete developer kit, including prototyping and debugging tools, an interactive graphing tool, extensions to Lotus Notes and Microsoft Mail and a Data Access Module (DAM) that provides seamless connectivity to the OMNIS SQL Database.

Enterprise client/server

- Developer/2000 from Oracle

  The Developer/2000 interface uses a powerful and easy-to-learn combination of object navigators, tabbed dialogs and property palettes to make the creation of forms-based applications extremely simple. The Developer/2000 incorporates a set of advanced forms, reports, graphics, and online documentation tools, all built from the ground up to ensure the robustness and scalability that complex applications demand.

- DYNASTY from Dynasty Technologies

  DYNASTY is a new-generation enterprise-class, object-oriented, 4GL development environment. DYNASTY produces three-tier, partitioned, open, scalable, high-performance, cross-platform client/server applications for distributed environments. DYNASTY enables rapid development and deployment of dynamic, cross-functional event-driven business systems that support core business processes.

- Elements Environment from Neuron Data

  This product is a component-based development environment for building client/server applications that are fully portable to more than 35 hardware platforms and their native windowing environments including Macintosh, Windows, OS/2, OSF/Motif, and character mode. The Elements Environment extends the native widget set, allowing developers to create custom widgets or use power widgets to create diagrams or business graphics.

- Entera from Open Environment

  This intelligent middleware is for developing and managing enterprisewide distributed applications. It automates development of client/server communications code and business logic code, and combines application development tools, middleware, and distributed application management tools into a three-tiered framework. Entera supports a wide variety of programming languages, GUIs, and relational and legacy data sources.

- Forté Development Environment from Forté Software

  Forté allows developers to build client/server applications that support hundreds of on-line users. Forté consists of an object-oriented 4GL and a distributed execution environment. Forté supports the major hardware platforms, operating systems, networks, relational database management systems, graphic user interfaces, and, optionally, transaction processing monitors.

- JAM7 for Macintosh from JYACC

  JAM7 is a cross-platform tool for building client/server and three-tier enterprise applications. JAM is unique in letting you build applications quickly and easily while preserving the control you need in the most complex and performance-critical areas.

- PowerBuilder for Macintosh from Powersoft

  PowerBuilder is a comprehensive development environment for building high-performance client/server applications. PowerBuilder features the PowerScript programming language, exclusive DataWindow technology, desktop integration, configurable toolbars, developer assistance, and comprehensive Macintosh support.

- The OMNIS Enterprise Edition from Blyth Software

  The OMNIS Enterprise Edition is designed for IS departments creating large-scale solutions. A complete development environment, the Enterprise Edition features seamless access to all major SQL databases (over 80) and legacy data sources, and extensive cross-platform capabilities. The product's robust workbench environment encompasses version control, interactive debugging, object browsing, and 3GL extensions.

- UNIFACE from Compuware

  UNIFACE is a robust development environment offering customers tools to solve their business application problems today, while maintaining flexibility for future technological advances. Applications built with UNIFACE have simultaneous read/write access to numerous database and file management systems, including DB2, Oracle, Sybase, Informix, and others.

- Unify VISION from Unify

  Unify's VISION client/server application development environment marries the visual programming of first-generation C/S tools with the full scalability of second-generation tools. Unify VISION is an object-based open environment with native connectivity to Ingres, Informix, Oracle, and Sybase, as well as support for mainframe and PC databases.

Host program "front-ending" and terminal emulation

Front-end tools are used to create a friendly, graphical user interface (GUI) in front of the character-based application screens deployed on traditional host systems (minicomputers and mainframes). (They're often called "screen scrapers" because they intercept terminal data and place a GUI over it.) These tools provide an efficient and effective way of adding value to existing production systems without disruption. Mac OS "front-ending" can be particularly valuable when users have to interact with more than one production system, because the Mac OS tools are so easy to use. In the future, proliferation of object-oriented computing and component software based on OpenDoc will further improve code reusability and "encapsulation" of the legacy code. Programs for writing Mac OS front-end applications include:

- 5PM Pro from White Pine (formerly About Software)

  5PM is a multisession host communication application with full Macintosh Communications Toolbox support. In addition to standard terminal emulation, 5PM provides a front-end development environment with graphic interface objects controlled by a scripting language (5Talk) that is compatible with HyperTalk, including XCMD and XFCN support.

- A/TAxcess from Andrew Corporation

  A/TAxcess is designed to allow Macintosh computers to access an AS/400 through an AppleTalk network. With A/TAxcess, any Macintosh on your network can attach to the AS/400 for terminal services, print services, and file transfer. A/TAxcess uses the AppleTalk protocol to communicate with AS/400.

- BLACKSMITH from CEL Software

  BLACKSMITH is a cross-platform toolkit that allows remote control of mainframe and minicomputer applications from within 4GL environments such as Oracle Power Objects, 4th DIMENSION, Omnis 7, HyperCard, C++, PowerBuilder, Visual Basic, and others. BLACKSMITH appears to the host as a terminal and requires no special treatment by the host.

- Boxer from Andrew Corporation

  MacMidrange Boxer brings IBM 5250 emulation to a Macintosh computer when used with Andrew Corporation's TwinAccess Series II and Series III protocol converters. Connection between Series II and III protocol converters can be local or remote through asynchronous modems.

- ClientBuilder from ClientSoft

  ClientBuilder is a legacy extension and workflow reengineering development toolkit used for building desktop GUIs to host applications and deploying them on both Macintosh and Windows environments. ClientBuilder supports Macintosh, Windows, and OS/2 clients accessing mainframe, AS/400, and SQL data sources.

- FOUNDATION Graphics Toolbox from Menlo Business Systems

  This toolbox provides a Tandem Computer host-based management capability for Macintosh (or personal computer) compatible graphics, images, text, and other similar objects. The Toolbox enhances host applications, either existing or newly designed, to present objects simultaneously with normal on-line displays.

- LEGACYLINK from CEL Software

  This product's connectivity application allows organizations to tie their Web servers to legacy applications running on host mainframe and minicomputers. Secure, worldwide access is offered to both internal and external users. LEGACYLINK enables web browsers to initiate a CGI that uses various connection methods, including 3270, 5250, VT100, and TCP/IP, to remotely control legacy system applications.

- Mac RUMBA for the AS/400 from Wall Data

  This Macintosh connectivity solution is designed for users who need 5250 display, print, and file transfer through a simple, yet powerful graphical user interface. End-user productivity is enhanced with features such as QuickStep Pads, Highlighted Hotspots, Text Assist, Graphical Toolbar, Enhanced Macro Editor, and Customizable Graphical Interfaces.

- Mac RUMBA for the Mainframe from Wall Data

  Mac RUMBA for the Mainframe is the Macintosh connectivity solution for users who need 3270 display, print and file transfer through a simple, yet powerful graphical user interface. Connection methods are supported for three protocols: SNA, TCP/IP, and NetWare.

- MacEmulate from Cornerstone Data Systems

  MacEmulate is a full-featured terminal emulator that connects a Macintosh computer to multiuser computers using any of the following terminal types: Wyse 60, 50, 30; TeleVideo 905, 910+, 912, 920, 925, 950, 955; VT100, 220, 320; SCO Color Console; PC Term; Hazeltine 1500; ADDS Viewpoint; ADM 11; and Data General 200, 210, and 410.

- MacIRMA Mainframe from Attachmate

  This product acts as a software link between your Macintosh and the enterprise information on a IBM mainframe. A winner of three *MacworId* magazine World Class awards, it offers enormous functionality and flexibility. MacIRMA Mainframe is now bundled with MacIRMA Graphics and the MacIRMA API Toolkit.

- MacTwin and NetAxcess from Andrew Corporation

  MacTwin and NetAxcess allow Macintosh users to connect to the IBM midrange systems via a twinax connection. These two products allow any Macintosh on your network to attach to the AS/400 for terminal services, print services, and file transfer. MacTwin is a point-to-point connection and NetAxcess is a gateway connection.

- MitemView from MITEM

  MitemView is a client/server development environment for Macintosh and Windows applications. Cross-platform capability allows applications implementation in a mixed environment with concurrent access to multiple dissimilar hosts. MitemView supports SNA, Token Ring, TCP/IP, Async, and DECNet, interoperating with IBM, DEC, UNIX, and Tandem hosts.

- PacerTerm from AGE Logic

  PacerTerm is a general-purpose communications application for the Macintosh that provides support for multivendor connections for Macintosh computers in multiprotocol environments. The Macintosh ease-of-use is brought to the UNIX and VMS computing environments through an interface that is easy to configure, modify, and customize.

- Reflection 1 Plus from Walker Richer & Quinn

  Reflection 1 Plus connects your Macintosh to HP and Digital hosts with Power Macintosh acceleration, delivering precise text and emulation of HP 700/98, 700/96 VT220, 2393A, and 2623A terminals; and fast file transfers in ASCII, binary, MacBinary, VMS image, and HP label formats.

- Reflection 2 Plus from Walker Richer & Quinn

  Reflection 2 Plus connects your Macintosh to Digital and UNIX-based hosts with Power Macintosh acceleration, delivering precise text emulation of VT420, VT320, and VT102 terminals; and fast file transfers in ASCII, binary, MacBinary, and VMS image formats.

- Reflection 4 Plus from Walker Richer & Quinn

  Reflection 4 Plus connects your Macintosh to Digital and UNIX-based hosts with Power Macintosh acceleration, delivering precise text emulation of VT420 and VT320 terminals, as well as VT340 ReGIS, sixel, and Tektronix 4010/4014 graphics emulation.

- SimMac from Simware

  SimMac is a Macintosh-to-mainframe software integration solution that provides Macintosh users with a customizable, easy-to-use Macintosh interface to host computer applications. SimMac offers a powerful connection language, terminal emulation, and advanced file transfer services.

- TCPAxcess from Andrew Corporation

  TCPAxcess allows Macintosh computers to access an AS/400 through a TCP/IP network. With TCPAxcess, any Macintosh on your network can attach to the AS/400 for terminal services, print services, and file transfer.

- TokenAxcess-Client from Andrew Corporation

  TokenAxcess-Client is designed for sharing IBM workstation sessions among Macintosh computers on an AppleTalk network through Token Ring to the AS/400. With TokenAxcess-Client software, any Macintosh on your network can attach to the AS/400 for terminal services, print services, and file transfer.

- VersaTerm-PRO from Synergy Software

  VersaTerm-PRO v5.0 bundles a comprehensive suite of network connections with robust DEC VT100/VT220 and DG D210-D211 text terminal emulations, Tektronix 4014, 4105 color graphics emulations, and file transfer capabilities. VersaTerm-PRO supports Serial (including SLIP), LocalTalk, or Ethernet connections.

- VICOM Pro from VICOM Technology

  VICOM has a modular design that allows users to employ advanced features as requirements dictate. Separate files for hardware drivers and file transfer protocols are provided. These files are compiled scripts that run using VICOM's execution engine. Emulations are performed through a unique table-driven "emulation engine" that provides multiple and diverse emulations.

- XoftWare for Mac OS from AGE Logic

  This is AGE's enhanced X server for the native Power Macintosh and 68K Macintosh platforms. XoftWare offers many unique features that facilitate Macintosh-to-UNIX connectivity.

Middleware

Middleware is software that hides the details of the communications protocols needed for clients and servers to communicate. Middleware provides a library of functions that allows clients and servers to exchange requests and responses. The functions provided in the API correspond to the semantics of the services being accessed, and encapsulate the details of communications-level programming. As a result, client/server developers describe application logic in terms of services being accessed rather than operating system kernel or device-driver interactions. All of the middleware products described here are available on multiple platforms, ensuring application interoperability.

- MacODBC from Apple Computer

  ODBC 2.0 is a shared library that implements a generalized API for accessing databases. It consists of an ODBC Driver Manager, which presents the application API and invokes calls to selected database drivers and optional database translators; the ODBC Configuration Manager, which creates the connections between the application, the Driver Manager, the driver and translator, and the local or remote database; the ODBC Setup Control

Panel, which presents the user interface for selecting a driver and database; and a set of database drivers to connect to common databases.

- ACMS Desktop from Digital Equipment Corporation

  ACMS Desktop is a layered software product that enables desktop system users (clients) access to ACMS and ACMSxp host-based (server) transaction processing applications from the native desktop system environment. ACMS Desktop for Macintosh supports two server environments: ACMS for OpenVMS on VAX or Alpha systems.

- c-tree Plus from FairCom

  Based on today's most advanced B-tree routines available, c-tree Plus provides unprecedented control over file management needs. With unparalleled sophistication, c-tree Plus is the premier choice for commercial application development in over 100 environments. Develop single-user or multi-user non-server applications royalty-free.

- CICS from IBM

  CICS Clients are supported on OS/2, DOS, Windows, and Macintosh platforms, all connecting to a wide range of CICS application servers, from the host to the desktop. CICS Clients let you exploit the power of your desktop workstations by integrating them easily with CICS servers of all sizes.

- CrossAccess Data Delivery System from CROSS ACCESS

  This product gives you real-time transparent access to enterprisewide data with the industry's first nonproprietary solution for enterprise connectivity.

- Data Access Language (DAL) from BEA

  Data Access Language (DAL) provides both Macintosh and Windows access to any relational database management systems. A client/server technology, DAL supports any ODBC-compliant application (e.g., HyperCard, MS-Access, Excel, BrioQuery, and FoxPRO) with a direct high performance read/update data transport to the server environment.

- DataDirect ODBC DriverPack from Intersolv

  Intersolv is the first to provide a vendor-independent solution for building and deploying ODBC-compliant client/ server applications. With Intersolv's state-of-the-art approach, you can leverage your investment and provide complete and secure database access for client/server computing.

- dBinterface Rapid from Chatham Township Data

  dBinterface Rapid, a 4th DIMENSION module that converts data between 4th DIMENSION and dBASE data formats, was designed for users who need access to dBASE, FoxBASE/FoxPRO, and Clipper data on Macintosh computers and other personal computers.

- DCE Adapter from Open Environment Corporation

  While the OSF DCE standard offers a robust, vendor-neutral infrastructure for enterprise wide computing, several obstacles have delayed its acceptance: the size of the client software, cost of client run times, and platform support. Macintosh users in enterprises, government, and higher education can use DCE Adapter for Macintosh to gain access to DCE services.

- EZ-RPC from NobleNet

  EZ-RPC is a third-generation client/server development tool that uses remote procedure call (RPC) technology to simplify client/server programming. Programmers familiar with procedural coding can easily understand and use remote procedure calls with minimum networking knowledge. EZ-RPC provides client/server connectivity for applications running on Macintosh, Windows, NetWare, and UNIX systems.

- FOUNDATION BASYS from Menlo Business Systems

  BASYS is an application development toolbox and environment that covers all aspects of development and management for Tandem on-line transaction processing (OLTP) applications. It also provides OLTP application requirements, such as security, user registration and management, help facilities, and data validation.

- Lightspeed NVS for the Macintosh from MacSoft

  Lightspeed NVS software integrates Wang VS minicomputers with Apple Macintosh computers and local area networks. A dedicated DOS-compatible computer is used as a network gateway and bridges LocalTalk or Ethernet LANs to Wang's proprietary 928 communications protocol.

- MacAM from Tandem Computers

  The Macintosh Access Method (MacAM) provides application-level access to Tandem's TandemTalk product, which allows Tandem based applications seamless and transparent communication with Macintosh applications. MacAM is a multithreaded process that allows a network service class to be registered once to the AppleTalk network system, yet internally allows connections by many client processes.

- Macintosh APPC Developer's Toolkit from Wall Data

  APPC Developer's Toolkit provides programmers and developers with tools to support communications services between Macintosh computers and SNA networks by means of IBM's Advanced Program-to-Program Communication (APPC) facilities. SNA•ps APPC allows Macintosh computers to participate in peer-to-peer communications in mainstream SNA environments, and to distribute APPC services to an attached AppleTalk network.

- NetWare Development Tools from Novell

  NetWare Development Tools for the Macintosh provide Macintosh file, print, and routing services, and administrative utilities for the NetWare 3.11 (and later) network operating system. NetWare C Interface for Macintosh provides tools for using the NetWare operating system from Macintosh client-based applications.

- Open Client from Sybase

  The Sybase Open Client/C Developer's Kit allows developers to build client/server applications that can access Sybase SQL Server databases, other diverse data sources through the Sybase family of Enterprise CONNECT interoperability products, and custom applications built using Sybase Open Server.

- RemoteWare from XcelleNet

  RemoteWare is client/agent/server software for remote and mobile computing. RemoteWare provides Macintosh clients for remote and mobile users who need to exchange information with a central location.

- SNA•ps Folders 400 from Wall Data

  With SNA•ps Folders 400, Macintosh users can now create, share, and exchange data and files with other Macintosh, OS/2, and Windows users. This enables Macintosh users to review and revise spreadsheets, documents, and presentations in a cross-platform environment (PC Support for the Macintosh).

- SNA•ps Gateway from Wall Data

  The SNA•ps Gateway is a comprehensive solution for SNA access featuring flexibility, high performance, and multiple gateway capacities based on the number of LAN client users that need to be connected. Fully SAA compliant, the SNA•ps Gateway ensures interoperability with current and future IBM environments and applications.

- SQL Form Utilities for HyperCard–DAL Version from RTZ Software

  SQL Form Utilities is a set of HyperCard XCMDs that simplifies the creation of high-performance front-ends to relational database systems. These front-end applications may resemble electronic forms that can be filled out by the user and entered into a host database system.

- SQL*Net for Macintosh from Oracle

  SQL*Net is Oracle Corporation's remote data access software. It enables both client/server and server/server communications across any network. With SQL*Net, databases and their applications can reside on different computers and communicate as peer applications.

- Tandem DAL Server from Tandem

  The Data Access Language (DAL) Server software integrates Macintosh and Windows client applications with Tandem Non Stop SQL and Enscribe databases. The DAL Server software operates under Tandem's NonStop Kernel OS, which allows Macintosh and Windows users to view their data in an easy-to-understand, graphic format and manipulate it with a variety of applications.

- Visigenic ODBC DriverSet from Visigenic Software

  The Visigenic ODBC DriverSet for Macintosh provides high-performance database access to multiple SQL databases without the complexity of native database APIs. The ODBC DriverSet consists of a set of drivers that allows your application to access the most popular DBMSs, including Microsoft SQL Server, Oracle, Sybase, and Informix.

- X-IPC–Message-Oriented Middleware from Momentum Software

  X-IPC is a development tool that provides network-transparent Extended InterProcess Communications (IPC) facilities, enabling quick and cost-effective development of robust client/server and partitioned applications (two-tier and three-tier) that are high-performing and fully scalable.

Groupware

Groupware facilitates computer-based collaboration among people and teams based in geographically separate locations. The enabling Mac OS technology for groupware is Apple Open Collaboration Environment (AOCE). The first system software extensions to use AOCE were PowerTalk and PowerShare. PowerTalk, which is built into Mac OS System 7.5, enables individual users to exchange electronic mail and share information catalogs without a server. PowerShare extends the capabilities of PowerTalk-capable systems by providing distributed shared catalogs and shared gateways to external communications services (such as e-mail and fax systems). Apple is also making the AOCE specifications available to developers who want to implement it on other computer platforms. Products for creating Mac OS groupware solutions include:

- Hyperion Pillar from Hyperion Software Corporation

  Hyperion Pillar is an enterprise wide budgeting software solution, managing the collaborative process of corporate planning, forecasting, and analysis. Pillar manages the mechanics of bottoms-up budgeting and forecasting, and provides flexible top-down tools for analyzing different business scenarios. It runs on Macintosh, Power Macintosh, Microsoft Windows 3.1, and Windows NT platforms.

- Lotus Notes Release 4 from IBM

  Lotus Notes is a client/server platform for developing and deploying strategic groupware applications that help organizations communicate, collaborate, and coordinate strategic business processes within and beyond their organizational boundaries. Over 7,500 companies and 3 million people use Notes to improve key business processes such as customer service, sales and account management, and product development. Lotus Notes supports all major operating systems.

- PowerShare from Apple Computer

  This software provides PowerTalk users with server-based messaging, shared catalogs, and network security services on AppleTalk networks. The PowerShare Mail Server acts as a store-and-forward agent for PowerTalk messages, ensuring delivery even when the sender and recipient systems are on-line. With AppleTalk Remote Access, remote users can dial in at any time to send and retrieve messages. The PowerShare Catalog Server is a shared repository for collaborative information, such as employee databases and corporate directories. Multiple PowerShare servers can work together using distributed, replicated catalogs that provide higher performance and greater reliability.

- Lotus Notes from Lotus/IBM

  Notes is a scalable client/server platform for developing and deploying a whole new class of collaborative applications. Notes offers distributed and replicated object-oriented storage for compound documents, a standards-based messaging system, robust security, and open industry-standard APIs, through which a variety of Lotus and other popular applications can access Notes data and services.

- GroupWise from Novell

  This product combines the power of electronic mail, personal calendar management, and group scheduling into a single application. All messages, including e-mail messages, appointments, scheduled tasks, and notes, can be accessed and viewed through one customizable interface. GroupWise also includes rules-based message management, workflow automation, ordered distribution, task management, and global calendar functionality. This product ships with PerfectOffice Professional and PerfectOffice Standard.

- OpenMind from Attachmate

  OpenMind is a groupware application that allows companies to quickly set up a collaborative workspace combining group conferencing, document management, electronic publishing, and workgroup-enhanced Internet access. Based on a client/server architecture, OpenMind includes a client component for collection, organization, and presentation of information; and a server component for information security, storage, and searching.

- Collabra Share from Collabra Software

  This product provides an easy way for users or system administrators to set up internal forums that let users hold bulletin board discussions and share files.

- Informed Foundation from Shana

  This suite of forms processing applications enables solution providers to build a complete electronic forms system. Developers use Informed Designer to draw the forms and add data intelligence; Informed Manager fills them out and mails them to other users; Informed Revision Distributor automates the distribution of form revisions; and Informed Number Server automates the assignment of unique and sequential form numbers over the network as new forms are filled out.

For more client/server information

For more information on client/server technologies, please refer to the following documents:

- Client/Server Guide to Development Tools & Technologies
- Mac OS–Based Cross-Platform Client/Server Tools, Technologies, and Solutions — A Technical Brief

Both of these items can be downloaded from Apple's Web site (http://devtools.apple.com).

SAS on Macintosh in the Enterprise

"Business users should be free to select their client of choice for access to enterprise information. This philosophy led us to create the SAS system, a robust business analysis suite with consistent look and feel across all major computing platforms. This includes the Power Macintosh, which is an integral component of our users' enterprise solutions."

—Tom Cole, Mac R&D Mgr, SAS Institute

Apple Development Resources

Apple Computer publishes an extensive array of development resources through its Internet Web site and the Apple Developer Catalog. Here is a list of some of these resources.

On-line resources

- Apple's World Wide Web (WWW) site (http://dev.info.apple.com) is a centralized repository of essential developer business, technical, and program information. From the Apple Developer Services area within this site, you can download virtually all of the resources and publications listed in this section.
- Apple Developer Tools Web site (http://www.devtools.apple.com) is a repository of product information on developer tools from Apple and other tool vendors. It provides in-depth technical information, code samples, new tools, and many other hard-to-find materials.
- *Apple Directions Express* summarizes the latest information about new Apple products, market research, customer data, co-marketing opportunities, competitive analysis, and other Apple news that's important to your business. Using electronic pointers to Web sites, Apple Directions Express provides you with a quick way to stay on top of important Apple strategic and business developments. Subscribe by sending e-mail to adirections@thing1.info.apple.com, then in the body of your message, type the string 'subscribe <your real name>'.
- MacWay and Semper.Fi are informative and entertaining Internet mailing lists run by Apple fellow, Guy Kawasaki. MacWay is a one-way mailing list that enables Guy to distribute press releases, announcements, and special offers that support the Macintosh cause. Semper.Fi is a forum for developers to give feedback to Guy. Subscribe by sending e-mail to listproc@abs.apple.com, then in the body of your message, type the string 'subscribe macway <your real name>', or 'subscribe semper.fi <your real name>'.
- The OpenDoc home page (http://www.opendoc.apple.com) features the latest OpenDoc releases, documentation, tools, and the Developer Showcase, an area from which you can download and sample actual OpenDoc components.
- QuickTime On-line (http://quicktime.apple.com) is a Web site that interactive music developers, consumers interested in music, and amateur movie makers all over the world can access. The site offers QuickTime 2.0 for both Mac OS and Microsoft Windows, the latest interactive music information, music videos, and developer tools for downloading.
- The Apple Multimedia Program (AMP) home page (http://www.amp.apple.com) offers multimedia developers the latest information about Apple's multimedia technologies, links to multimedia resources, and the AMP Member Showcase, a searchable database of multimedia developers.

Essential periodicals

- *develop, the Apple Technical Journal* provides in-depth examinations of Apple technologies and advice on how to take advantage of them. This award-winning quarterly technical journal is "hands on" and provides the definitive answers to Mac OS development questions. Every issue includes the *develop Bookmark CD*, which includes all of the source code presented in that issue, electronic versions of all previous issues of *develop*, the source code to accompany all previous issues, and other valuable technical information. Available through the Apple Web site and the *Apple Developer Catalog*.

- *Apple Directions, The Developer Business Report*, is a monthly newsletter that covers Apple's business and strategic directions, news from Apple for developers, the current industry situation, and the latest resources available for developers. Available through the Apple Web site and the Apple Developer Catalog.

Technical documents and CD-ROMs

- *Inside Macintosh* is the authoritative source of information on the Mac OS. Volumes are available in print form and electronically as part of the Inside Macintosh CD-ROM and the Macintosh Programmer's Toolbox Assistant CD-ROM. Available through the Apple Web site and the Apple Developer Catalog.
- *Macintosh Programmer's Toolbox Assistant* is an invaluable CD-ROM database of data structures, resources, constants, and functions from Inside Macintosh. It provides instantaneous access to the information provided within Inside Macintosh, allowing developers to quickly access key programming information. Available through the Apple Web site and the Apple Developer Catalog.
- *Porting Windows Applications to Macintosh, A Technical Brief.* This technical document aims to help Windows developers developers who face a porting project (from Windows to the Mac OS, or vice versa) or who are working on a Windows/Mac OS client/server project. Specific sections help Windows developers plan their strategies for resource mapping, memory and file management, basic user interface design, managing dynamic events, organizing dynamic/shared library code, and so on. To obtain a copy, download it from the Apple Web site or contact Developer Support at (408) 974-4897.
- *The Developer CD Series* is sent to developers 12 times a year, providing them with the latest Apple technical information, system software, and development utilities. Each month, subscribers receive one of the following CD-ROMs: the Reference Library Edition, which includes electronic versions of key Apple technical documents; the Tool Chest Edition, which provides a wide range of development utilities for the Mac OS; or the System Software Edition, a collection of worldwide Mac OS software. Along with the System Software Editions delivered in January, April, July, and October, subscribers receive a collection of over 30 individual software developers kits (SDKs) on two CD-ROMs. Available through the Apple Developer Catalog and as part of the Macintosh Developer Program.
- *Macintosh Human Interface Guidelines* is the definitive guide to the human-computer interface for applications that will run on the Mac OS. It describes the process of designing, developing, and testing the human interface for Mac OS applications. Available through the Apple Developer Catalog.
- *Electronic Guide to Macintosh Human Interface Design* is a CD-ROM disc that provides interactive demonstrations on the principles and standards presented in the Macintosh Human Interface Guidelines. Available through the Apple Developer Catalog.
- *Macintosh Technical Notes* is a series of technical documents written by Apple Developer Technical Support. The notes provide timely updates and corrections to materials presented in *Inside Macintosh*. *Macintosh Technical Notes* are provided through a number of avenues, including the Developer CD Series, the Apple Web site, and the Apple Developer Catalog.

Other useful publications

- *Apple CD-ROM Handbook* is an easy-to-read, step-by-step guide on how to produce CD-ROM discs. Available through the Apple Web site.
- *Localization for Japan* is a book about designing, programming, translating, and republishing software for the Japanese market. Available through the Apple Web site.
- *The OpenDoc Technical Summary* contains a technical summary of the OpenDoc APIs and information about how to receive pre-release OpenDoc software. This 60-page document is a good starting place to learn more about the OpenDoc architecture. Available through the Apple Web site.

- *The Macintosh Internet Solutions Guide* is a catalog of Internet-related hardware, software, publications, events, and training for Mac OS users and developers. Using these products and services, you'll be able to make the most of the Internet—from providing prospects with up-to-date product information, to staying abreast of your competition, to more effectively supporting customers. Available through the Apple Web site or Joint Solutions Marketing at (408) 378-2444.

Tools and Training

- *The Apple Developer Catalog* offers convenient worldwide access to hundreds of Apple and third-party development tools, resources, and information for anyone interested in developing applications on Apple computer platforms. For a free copy of the *Apple Developer Catalog*, call 1-800-282-2732 (U.S.), 1-800-637-0029 (Canada), or (716) 871-6555 (International).
- Apple Developer University is the leading provider of instruction on Mac OS and Newton programming. This organization offers a broad range of courses and materials that meet professional developers' needs. The curriculum is delivered in the form of classroom training, as well as through self-paced training products. For more information on Developer University offerings, see Apple's Web site. To receive a catalog or register for a class, contact Developer University at (408) 974-6215.

Apple Developer Programs

Apple offers several programs that provide technical services, information, and support to developers of Apple-compatible products, solutions, and services.

Macintosh Developer Program

The Macintosh Developer Program is designed to provide members with ongoing Macintosh-related technical information and services. The Macintosh Developer Program includes:

- *Apple Developer Mailing.* This monthly mailing contains essential technical information from Apple, including the latest Apple strategies, product data, technical news, and marketing information.
- *The Developer CD Series.* This invaluable series provides all members with convenient access to system software and almost all the Mac OS software developers kits (SDKs) that Apple publishes. A typical SDK for a Macintosh software toolbox extension includes system software, programming interfaces, libraries, sample code, and technical documentation. These are the basic components that will enable you to understand and use a toolbox extension.
- *Macintosh Technology Seeding.* Seed packages on many key Mac OS technologies are sent to program members early in the development cycle, to help you bring new and innovative products to market sooner. Members also receive pre-release documentation for new hardware products. While we include seeding on most of our projects, there may be some projects with limited distribution.
- *Access to Apple's Technical Support Onsite Lab.* All program members will have access to intensive, consultative help porting applications. There are two labs located at Apple's Cupertino site. Upon scheduling a visit, you'll be paired up with a DTS engineer who will assist you with your programming efforts.
- *Programming-Level Technical Support Via Electronic Mail.* This is expert programming-level technical support for Macintosh technologies, products, and tools. Questions are submitted and answered via e-mail. Apple offers a number of options to developers that include varying levels of technical support.

Apple Multimedia Program

Designed for content developers and the creative community, the Apple Multimedia Program (AMP) offers a breadth of resources and information to help keep multimedia developers up-to-date on Apple's offerings for authoring and playback. Members receive quarterly mailings and access to a special members-only area on the AMP Web site (http://www.amp.apple.com), which provides insights on multimedia technologies, new media business directions, market research information, and self-help information on developing and marketing multimedia products.

In addition, members can find discounts on third-party software, hardware, training, and events. Members can also participate in co-marketing opportunities, such as the AMP Member Showcase, and product seeding.

The Interactive Music Track (IMT), an extension of the Apple Multimedia Program, is designed specifically to help musicians, music industry members, and interactive music developers with multimedia projects. More information on the IMT is available on the AMP Web site.

Newton Developer Program

The Newton Developer Program is designed to provide members with ongoing Newton-related technical information and services. Core features of all the Newton programs include:

- *Newton developer mailing*
- *Newton development class discounts*
- *Newton user interface guidelines*
- *Invitation to the Newton Developers' Conference*
- *Programming-Level Technical Support Via Electronic Mail.* This is expert programming-level technical support for Newton technologies, products, and tools. Questions are submitted and answered via e-mail. Apple offers a number of options to developers that include varying levels of technical support.

Apple's developer support programs vary on a country-by-country basis. For more information on any of Apple's developer support programs worldwide, please contact Developer Support via:

Telephone . . . . . (408) 974-4897

Fax . . . . . (408) 974-7683

E-mail . . . . . devsupport@applelink.apple.com

Vendor Directory and Index

Vendor	Phone Callers should add the prefix "1"	Fax	E-mail	Web site Add the prefix http://
Absoft	810/853-0500	810/853-0108	sales@absoft.com	www.absoft.com
ACI US	800/881-3466 408/252-4444	408/252-0831		www.aci-4d.com
Adamis Distribution	213/655-2920	818/893-6037		
Adobe Systems	800/411-8657	415/961-3796		www.adobe.com
Advance System Technologies	303/790-4242	303/790-2816		www.advsystech.com
AGE Logic	619/454-0565 800/742-5243	619/755-3998		www.age.com
Allegiant	619/587-0500	619/587-1314	info@allegiant.com	www.allegiant.com
Altura Software	408/655-8005	408/655-9663	mac2win@altura.com	
Andrew Corporation	512/301-8000 800/328-2696	512/301-8195		andrew.com
Andyne	800/267-0665	613/548-7801	sales@andyne.com	www.andyne.com
Antares Alliance Group	214/447-5500 800/416-2888	214/447-5783		aag.com
API Corporation	408/961-2177			
Apple Computer	408/996-1010 800/282-2732	716/871-6511		www.apple.com
Apple Developer Catalog (previously APDA)	800/282-2732 716/871-6555	716/871-6511	apda@applelink. apple.com	www.info.apple.com
Apple Developer Univ.	408/974-6215	408/974-0544		www.info.apple.com
Arbor Software	408/727-5800 800/858-1666	408/727-7140		www.arborsoft.com
Attachmate	206/644-4010 800/426-6283	206/747-9924		www.attachmate.com
Bare Bones	508/651-3561	508/651-7584	bbsw@barebones.com	www.barebones.com
BEA	510/249-0970	510/438-2034		www.beasys.inter.net
Best Enterprises				www.northnet.org/best/ web.weaver/ww.html

Vendor	Phone Callers should add the prefix "1"	Fax	E-mail	Web site Add the prefix http://
Blyth	800/346-6647 415/571-0222	415/571-1132		www.blyth.com
Bowers Development	508/369-8175	508/369-8224		
Brio Technology	800/486-2746	415/961-4572		www.brio.com
Brossco Systems	415/943-1330	415/961-8487	info@brossco.com	www.brossco.com
Business Objects	800/705-1515 408/973-9300	408/973-1057	support@busobj.com	www.businessobjects.com
CE Software	515/221-1801 800/523-7638	515/221-1806		cesoft.com
CEL Software	800/338-8491 403/463-9090	403/430-1153	info@celcorp.com	www.celcorp.com
Chaco Communications	408/996-1115	408/865-0571		www.chaco.com
Chatham Township Data	201/586-0700	201/586-1837		ctdata.com
Claris Corp.	800/735-7393 408/727-9054	408/987-7447		www.claris.com
ClientSoft	914/631-5365	914/631-6930	info@clientsoft.com	
Cognos WCB	613/738-1440	613/738-1440		www.cognos.com
Collabra Software				www.collabra.com
Computer Associates	516/342-5224			
Computer Systems Advisers	800/537-4262	201/391-2210	michael.farney@silverrun.com	www.compuware.com
Compuware	800/535-8707	510/748-6150		compuware.com/product/uniface
Continuuous	714/453-2200			www.continuuous.com
Cornerstone Data Systems	714/779-5811	714/779-3885		
Cross Access	602/840-7466	602/840-0794	sales@crossaccess.com	www.crossaccess.com
CyberCash	703/620-4200	703/620-4215	info@cybercash.com	www.cybercash.com
Cyborg Systems	312/454-1865	312/930-1033		www.cyborg.com
Data Systems	714/779-5811	714/779-3885		
Dev Support Center	408/974-4897			
Digital Equipment Corporation	800/344-4825	800/234-2298		www.digital.com
Digitool	617/441-5000	617/576-7680	info@digitool.com	www.digitool.com

Vendor	Phone Callers should add the prefix "1"	Fax	E-mail	Web site Add the prefix http://
dtF Americas	800/383-1790	510/828-8755	dtf@interramp.com	
Dynasty Technologies	708/769-8500	708/769-9903	nwilliams@dynasty.com	
EveryWare Dev't Corporation	905/819-1173	905/818-1172	info@everyware.com	www.everyware.com
Excel Software	515/752-5359	515/752-2435	casetools@aol.com	
FaceWare	217/328-5842	217/328-7876	faceware@aol.com	
FairCom Corporation	573/445-9698			www.faircom.com
Farallon Computing	510/814-5000			www.farallon.com
First Virtual	619/234-130		support@fv.com	www.firstvirtual.com
Foresight Technology	817/731-4444		support@fsti.com	www.fsti.com
Forté Software	510/869-3400	510/869-2091		www.forte.com
Fortner Research	800/252-6479 703/478-0181	703/689-9593	info@fortner.com	www.fortner.com
Frontier	508/244-4000	508/244-4004	rmon@frontier.com	cgiframework.html
Full Moon Software	44-162-866-0242	44-162-866-6084	sales@fullmoon.com	
General Knowledge	44-1-201-746026	44-1-202-715600	knowledgable @applelinkapple.com	
GeoQuery Corporation	800/541-0181	708/717-4254		
Gradient Technologies	508/624-9600	508/229-0338	info@gradient.com	www.gradient.com
Graphical Business Interfaces	317/255-8790		steve@gbi.com	www.gbi.com
guideWorks	408/556-1135	408/556-1136		www.guideworks.com
Harlequin	617/374-2400	617/252-6505		www.harlequin.com
Helix Technologies	708/465-0242 800/364-3549	708/465-0252		www.mcs.net/-hxtech
HeyerTech	415/325-8522			www.heyertech.com
Holistic Systems	303/790-7939	303/790-7522		www.holossys.com
Hughes	800/494-5548	714/446-2311	netlock@mls.hac.com	www.netlock.hac.com
Hyperion Software	203/321-3500	203/968-9319		www.hysoft.com
IBM	914/765-1900 800/426-3333	800/246-4329		www.ibm.com
ICE				www.ice.com

Vendor	Phone	Fax	E-mail	Web site
	Callers should add the prefix "1"			Add the prefix http://
Iconix	310/458-0092	310/396-3454	marketing@iconixsw.com	www.iconixsw.com
Independence Technologies	See BEA			
Infinet Op				developer.netscape.com /index.html
Information Builders	212/736-4433	212/967-6406	infor@ibi.com	www.ibi.com
Informix	415/926-6300			
Inso Corporation	617/753-6500	617/753-6666		www.inso.com
Integrated Data Systems				developer.netscape.com /index.html
Intelligence At Large				developer.netscape.com /index.html
InterCon	703/709-5500			www.intercon.com
Intersolv	800/582-1600 301/838-5000			www.intersolv.com
IONA	800/672-4948 508/460-6868		info@iona.com	www.iona.ie
Iterated Systems	800/437-2285		info@iterated.com	www.iterated.com
Ivçn Cavero Belaonde				developer.netscape.com /index.html
Jasik Designs	415/322-1386		macnosy@jasik.com	www.jasik.com
JYACC	212/267-7722	212/608-6753	sales@jyacc.com	www.jyacc.com
L Corporation	403/463-9090 800/338-8491	403/430-1153		celcorp.com
Language Systems	See Fortner Research			
Latitude Group	415/691-4083	415/691-4090		www.latgroup.com
Learning Systems Consultants	719/599-8966	719/599-8967	LSCI@aol.com	
LiveUpdate	800/333-0212	508/658-9972		www.liveupdate.com
Lotus/IBM	800/346-1305	617/693-3899		www.lotus.com
Maconomy	508/460-8337	508/460-6327		
Macromedia	415/252-2000	415/626-0554	See Web site	www.macromedia.com
MacSoft	805/324-4291	805/324-1437		
MacVONK	403/232-6545	403/232-6425	macovnk@ccinet.ab.ca	www.ccinet.ab.ca/macvonk
Main Event Software	202/298-9595 800/426-9400	800/727-3351		

Vendor	Phone	Fax	E-mail	Web site
	Callers should add the prefix "1"			Add the prefix http://
Management Science Associates	412-362-2000		info@msa.com	
Mathemaesthetics	303/440-0707	303/440-0504	resourcerer@aol.com	
Maxum	708/830-1113			www.maxum.com
MDL Information Systems				www.mdli.com
Menlo Business Systems	415/948-7920	415/949-6655		
Meta Software Corporation	617/576-6920	617/661-2008		
Metrowerks	800/377-5416	512/305-00440	sales@metrowerks.com	www.metrowerks.com
mFactory	415/548-0600	415/548-9249	info@mfactory.com	www.mfactory.com
MicroAPL	44-171-922-8866	44-171-928-1006	microapl@microapl.demon.co.uk	www.microapl.co.uk
MicroFocus				www.microfocus.com
Microsoft Corporation	206/882-8080 800/426-9400	206/936-7329		www.microsoft.com/devonly
MidCore Software	203/759-0906	203/596-2424	davidw@nai.net	
MindVision	402/477-3269	402/477-1395		www.mindvision.com
Mitem	800/826-4836 415/323-6164	415/322-8607	sales@mitem.com	www.mitem.com
MKS	519/884-2251 800/265-2797	519/884-8861		www.mks.com
Model System Consultants	44-171-627-5120	44-171-622-3139		
Momentum Software	800/767-1462 201/871-0077	201/871-0807	info@momsoft.com	www.momsoft.com
MVP Solutions				developer.netscape.com/index.html
Natural Intelligence	800/999-4649 617/876-4876	617/492-7425	info@natural.com	www.natural.com/
NaviSoft	800/879-6882			www.navisoft.com
NeoLogic Systems	800/919-6353	510/524-4501	neologic@neologic.com	www.neologic.com/~neologic

Vendor	Phone	Fax	E-mail	Web site
	Callers should add the prefix "1"			Add the prefix http://
Netscape Communications	415/528-2555			www.netscape.com
Network Multimedia	801/261-8232			
Neuron Data	800/876-4900 415/321-4488	415/943-2752	See Web Site	www.neurondata.com
NobleNet	800/809-8988 508/460-8222	508/460-3456	sales@noblenet.com	www.noblenet.com
Novadigm				www.novadigm.com
Novell	801/429-5281 800/733-9673	512/310-9105		www.novell.com
Oberon Microsystems	41-1-445-1751	41-1-445-1752		www.oberon.ch/
Objectivity	415/254-7141		info@objy.com	www.objectivity.com
Omniscience Object Technology	408/562-0799	408/562-0757	carol@oot.com	www.omniscience.com
Open Door Networks				opendoor.com
Open Environment Corporation	617/562-5857	617/562-5857	info@oec.com	www.openenv.com
Oracle	800/542-1170 415/506-7000	415/506-7804	torgo@us.oracle.com	www.us.oracle.com
Pacific Coast Software			info@pacific-coast.com	www.pacific-coast.com
ParcPlace	800/759-7272 408/481-9090			www.parcplace.com
PeerLogic	800/733-7601 415/626-4545	415/626-4710	info@peerlogic.com	www.peerlogic.com
PeopleSoft	510/225-3000 800/380-7638	510/225-3100		peoplesoft.com
Pictorius	800/927-4847 902/455-4446	902/455-2246	info@pictorius.com	www.pictorius.com
Planning Sciences	770/518-1971	770/643-9998		www.gentia.com
POET Software Corporation	800/950-8845 408/970-4640	415/286-4630	info@poet.com	www.poet.com
PowerProduction Software	310/937-4411			www.powerproduction.com
Powersoft	508/287-2000	508/287-1882	kquirk@powersoft.com	www.powersoft.com
Powersoft Corporation	508/287-1500 800/395-3525	508/287-1600		powersoft.com

Vendor	Phone Callers should add the prefix "1"	Fax	E-mail	Web site Add the prefix http://
PreFab Software				www.prefab.com
Progressive Networks				developer.netscape.com /index.html
Purity	512/892-2668		info@purity.com	www.purity.com
Quarterdeck	800/354-3222	310/309-4217	info@quarterdeck.com	www.quarterdeck.com
Quasar Knowledge Systems (QKS)	301/530-4853	301/530-5712	info@qks.com	www.qks.com
RadMedia, Inc.	415-617-9435	415-473-6826		www.radmedia.com
Roger Wagner Publishing	619/442-0522	619/442-0525	rwagnerinc@aol.com	www.hyperstudio.com
RogueWave			sales@roguewave.com	www.roguewave.com
RTZ Software	408/252-2946	408/257-5274		www.rtz.com
SAP America	610/725-4500	800/872-1727		www.sap.com
Sapiens USA	919/405-1500 800/677-7827 805/685-8000	919/405-1700		
SAS Institute	919/677-8000	919/677-4444	software@sas.sas.com	www.sas.com
Shana Corp.	403/433-3690	403/437-4381	info@shana.com	www.shana.com
Sierra Software Innovations	800/621-0631 702/832-0300	702/832-7753	sales@sierrasw.com	
Simware	613/727-1779 800/267-9991	613/727-3533		simware.com
SmartStar	See Sapiens			
SoftQuad	416/239-4801	416/239-7105	lucy@sq.com	www.sq.com
Software Designs Unlimited				
StarNine Technologies	510/649-4949	510/548-0393	See Web site	www.starnine.com
STAZ Software	601/255-7085	601/255-7086		
Sterling Software	515/472-7077 800/472-7077	515/472-7198		sterling.com
StructSoft	206/644-9834	206/644-7714		
Summit	315/445-9000	315/445-9567	info@summsoft.com	www.summsoft.com
Summus	803/781-5674	803-781-5679	wavelet@summus.com	www.summus.com
Sun Microsystems	415/960-1300			www.sun.com
Sybase	800/879-2273	510/922-3210	See Web site	www.sybase.com

Vendor	Phone Callers should add the prefix "1"	Fax	E-mail	Web site Add the prefix http://
Symantec	800/441-7234	800/554-4403	AOL keyword: symantec	www.symantec.com
Synergy Software	610/779-0522 800/876-8376	610/370-0548		synergy.com
Tandem Computers	408/285-6000 800/863-6329			www.tandem.com
TechGnosis	See intersolv			
Tellan Software	800/483-5526 4/08/274-1110			www.tellan.com
Totally Hip	604/685-6525	604/685-4057	info@totallyhip.com	www.totallyhip.com
True Basic	800/436-2111	800/436-3111 603/298-7015	john@truebasic.com	
True Software	508/369-7398 800/232-2244	508/369-8272		www.truesoft.com
TSE International			tse.int@applelink.apple.com	
Tumbleweed	800/696-1978 415-/63-7022			www.tumbleweed.com
Uniface	800/365-3608 510/748-6145	510/748-6150		www.compuware.com
Unify	800/248-6439 916/928-6400	916/928-6404		www.unify.com
VDONet				developer.netscape.com /index.html
Ventana	800/368-6338 520/325-822		info@ventana.com	www.vmedia.com
Vermeer	See Microsoft			
Versant Object Technology	415/329-7500	415/325-2380		www.versant.com
VICOM Technology	604/684-9517 800/818-4266	916/686-8314		vicomtech.com
Visigenic	415/286-2468	415/286-2464		www.visigenic.com
Visix Software	800/832-2815 703/758-8230	703/758-0233	galaxy@visix.com	www.visix.com
Visual Components				developer.netscape.com /index.html
VoxWare				www.voxware.com

Vendor	Phone Callers should add the prefix "1"	Fax	E-mail	Web site Add the prefix http://
Walker Richer & Quinn	206/217-7500 800/872-2829	206/217-0293		www.wrq.com
Wall Data	408/369-6900 800/487-8622	408/369-6909		www.walldata.com
Water's Edge Software	416/219-5628	905/847-1638	WaterEdgSW@aol.com	
Wave Research	510/704-3900	510/704-3950		waveresearch.com
Web Broadcasting	415/329-9676			macweb.com
White Pine Software	603/886-9050 408/446-1919	408/446-0666		wpine.com
Willows Software	408/777-1820	408/777-1827		oracle.willows.com
XcelleNet	770/804-8100 800/325-8188	770/804-8102		www.xcellenet.com
XVT	303/545-3120	303/443-0969	info@xvt.com	www.xvt.com
Zedcor	602/881-8101	800/482-4511		www.zedcor.co
Zinc Software	801/785-8900	801/785-8996		www.zinc.com

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