Blueprint for the Decade

In the 1990s, Apple will expand its role in both personal computing and enterprise computing. This will be driven by a focused product strategy that provides:

- Rapid advances in our System 7 software architecture
- Breakthroughs in how people interact with computers, fostered by the power of RISC
- Enterprisewide client/server integration and A/UX-based open Macintosh computers and servers
- An object-oriented operating system that will revolutionize the economics of software development for enterprise computing, code-named "Pink."

Our goal is to help people, individually and in organizations, transform the way they work, learn, and communicate by offering exceptional computing products and customer services. Apple will continue to be known as the company that leads the industry by providing powerful, innovative technologies that are easy to use.

Our product strategy begins, as always, with Macintosh. The new products will complement and coexist with our current products, sharing data, networks, printers, file servers, and application software. A smooth migration path is a fundamental part of each new product development effort.

We think that these new products will be important to the entire industry. Apple believes that its role is to develop rich platforms upon which powerful and easy-to-use applications software can be created by other companies.

As the computer industry increasingly requires complex interdependencies for the development of new industry standards, Apple will no longer go the distance alone. Whenever technologies can best be developed and marketed through partnerships, alliances, and licensing arrangements, we will do so. We expect to work closely with other major industry players.

In the following pages, we offer a glimpse of our product strategy for the coming decade. We welcome comments from customers, developers, resellers, and shareholders.

John Sculley
Chairman and CEO

Michael Spindler
President and COO

October 1991

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System Strategy Overview

Our personal computing product strategy is to give people powerful and easy-to-use tools that help them to work, learn, and communicate better and faster. Our enterprise computing product strategy is designed to provide organizations with advanced connectivity, open-systems platforms, and high-performance workgroup servers, so that project teams, departments, and organizations can communicate and work together more effectively. A joint venture between Apple and IBM is working to complete the development of a new object-oriented operating system that will revolutionize the economics of software development for enterprise computing.

As a systems company, we have the unique ability to make both independent and parallel advancements in our hardware and system software platforms to benefit both new and existing customers. Software advances independent of hardware changes allow us to offer existing customers more capabilities with the hardware they already own; recent examples include System 7 and QuickTime.™ When the development of new applications demands changes in hardware, we are able to respond with a parallel advance of software and hardware to offer a complete solution; the sound-input capabilities on the Macintosh® LC and IIsi models offer one recent example.

To review the technology that supports this system strategy, please read the following sections on our personal and enterprise computing product strategies.

The Future of System 7

The Macintosh operating system, hereafter referred to as System 7, will advance rapidly in the 1990s. Year after year, improvements to the basic operating system, Toolbox layers, and the desktop environment will make Macintosh even easier to use and foster innovative new applications. With more than half of Apple's R&D budget devoted to software, our development efforts will extend our lead over competitive systems.

System 7 was designed to allow us to advance our software platform quickly. Whereas in the past, major advances in system software meant the release of an entirely new version, Apple now plans to deliver many new technologies as modular extensions to the System 7 base. There are numerous advantages to this modular approach. For Apple, it means that we can develop new technologies and ship them quickly. Developers benefit because they are able to integrate these new technologies into their applications more rapidly. Customers enjoy the productive benefits of new technology without disruption of their base system. The upcoming delivery of QuickTime, our architecture for time-based data including video, is one of the first examples of this modularity.

Major system software initiatives under way include:

- Greater ease of use
- Enriched applications software
- Application integration
- Open Collaborative Computing Environment
- Enhanced operating system

Greater Ease of Use

Apple continues to focus its development efforts on people first and technology second, which is why we will remain the uncontested leader in providing powerful technologies that are easy to use. This philosophical commitment is backed by a team of some of the world's leading talents in human interface design. To us, ease of use means not merely a graphic display, but a natural, intuitive, and consistent model that ordinary people can grasp with a minimum of training. Examples of future product enhancements include:

Enhanced Navigation

With large hard disks and numerous network connections becoming commonplace, we see the need for file and information access facilities that give users more power to access information quickly. Future versions of the Finder™ will extend the Find facility to include access by content in addition to file name. This will be supported by expanded file format standards and integrated file translation facilities.

Improved Help

Help systems still need help themselves to reduce the need for user training and support. Expanded help systems under development build on System 7 Balloon Help™ and provide context-sensitive "How do I…?" and "Why…?" help, in addition to shortcuts and power-user tips. Authoring systems will allow in-house developers to add their own help to the standard facilities. Integration of QuickTime technology will permit on-screen video training and step-by-step animated guidance.

DOS/Windows Data Exchange

To enhance data exchange, we will offer the ability to directly view and manipulate DOS/Windows floppy disks on the Macintosh desktop. Cross-platform data interchange standards and integrated translation facilities will make file exchange transparent.

"World Ready" System Software

As more of our customers do business on a global level, we believe that it is important for Macintosh to become even more international in nature. Future versions of System 7 will be completely international in the base system, making localized software available in a more timely manner and giving users the ability to select from any localized system language. The addition of the Line Layout manager and Unicode worldwide character code standard will allow users to mix left-to-right, right-to-left, and vertical scripts in a single document.

Speech Integration

Text-to-speech and speech-recognition capabilities will augment the visual interface. Concurrent usage of direct manipulation and speech input will allow users to "steer" more precisely and to eliminate steps. These technologies will also make possible remote telephone access to desktop resources.

Privacy

We will make it easy for users to protect sensitive information from unauthorized access.

Enriched Applications Software

By continuing to enrich the base software layers, Apple provides the means to advance the state of all applications. Multimedia and imaging are two areas in which we are making major near-term advances.

Multimedia Enhancements

Multimedia is the ability to integrate multiple data types in a single document. In the past, this was limited to text and graphics. Now as video and animation become prevalent in everyday communications media, the notion of multimedia is expanding.

QuickTime, scheduled to ship in 1991, is Apple's architecture for dynamic or time-based media including sound, video, and animation. QuickTime is a software extension that works with all color-capable (68020 or later) systems without add-on hardware.

With QuickTime, applications such as word processors, spreadsheets, and databases can incorporate video clips, animations, or high-resolution still images. This would enable, for example, the creation of an electronic annual report with video demonstrations showing the company's products in use, as well as customers' reactions. Other applications made possible by QuickTime include audio and animated "Post-it" notes, video messages, and presentations with animated charts and graphics.

QuickTime features a built-in expansion path. New compression schemes (such as Group 3 Fax or MPEG), add-on hardware (such as digitizer boards), and other media peripherals can be added to the system in a "plug-and-play" fashion, without modification to the user's applications.

Imaging

We believe that an important breakthrough in color publishing is just around the corner—a breakthrough similar in scope to the desktop publishing revolution launched by the confluence of Macintosh graphics, Adobe PostScript,® Aldus PageMaker page-layout software, and the Apple® LaserWriter® printer.

The costs for color printing, scanning, copying, and display technologies are dropping quickly. Color-inkjet printers have dropped to the $2,000 price range and color thermal transfer printers are now available for less than $7,000. Prices for color laser printers are expected to be under $10,000 by mid-1992 and to fall below $7,500 by early 1994. Display hardware is delivering 24/32-bit image manipulation at acceptable price/performance points today. These displays, combined with color calibration and matching, deliver the realm of prepress, high-end publishing to today's desktop. Digital photography, while in its infancy, will also become an important extension to the desktop.

Affordable color hardware, supported by a new underlying graphics system, will deliver color WYSIWYG solutions from camera or scanner to screen or printer. Along with these core graphics enhancements, we will deliver additional

type, type-layout, and printing capabilities. Display and printing of Adobe Type 1 outline fonts will be supported directly. The new Line Layout Manager and enhancements to TrueType™ font technology will provide typographic-quality text layout to all applications software. A new architecture for printing will simplify the user interface and allow output-device vendors to develop high-quality device drivers (for printers, plotters, videotape recorders, and so on) that integrate seamlessly with the rest of the system.

Later, when three-dimensional imaging capabilities are incorporated into the Macintosh imaging system, applications will deliver even more realistic graphic content. In support of this vision, we are taking several steps now. First, we are developing data standards to facilitate interchange of three-dimensional models between documents. Second, we are working on new human interface guidelines to ease the creation, editing, and manipulation of three-dimensional objects. Third, we are developing an open architecture to support third-party rendering software such as Doré and RenderMan.

Application Integration

The interapplication communications (IAC) architecture provides a means for individual applications to work together on one computer and over networks. This integration of applications will help people to work together more closely, provide a means to easily construct custom software solutions, and give users a greater ability to choose the right application tool for the job. Applications supporting IAC get network access by default. In addition, Apple events provides a standard communications language, which enables applications developed by different vendors to work together without special arrangements. IAC allows the following:

Linked/Embedded Documents

Using the Edition Manager (publish and subscribe), applications can share document content. For example, a financial analyst can "publish" spreadsheet-based cash flow data from Lotus 1-2-3 while a manager can "subscribe" to the information over the network to use in a word processing document with automatic updates. If the manager wants to edit the original embedded cash flow spreadsheet (and has been granted security access), he or she can retrieve it directly over the network.

Client/Server Processing

Using the Apple Event Manager, applications can dispatch processing to more powerful computers over the network. For example, using Apple's MPW® development environment and ToolServer, a programmer on a Macintosh LC can delegate a lengthy compile/link to a more powerful Macintosh Quadra™ series computer.

Combined Application Capabilities

Using the Apple Event Manager, applications can work together flexibly. For example, rather than building forms processing capabilities into its Accountant Inc. package, SoftSync/Bloc uses IAC to treat Shana's InFormed forms processing software as an easy-to-use front end. This approach allows departments from production to order processing to use the forms they are familiar with in conjunction with the main accounting system.

Customization and Scripting

Building on top of the IAC and Apple event foundation, we have created the Open Scripting Architecture. The open architecture supports a wide variety of scripting system choices, from Command-key assignment utilities (such as CE Software's QuickKeys) to programming environments (such as Simple Software's ControlTower, UserLand's Frontier, and Apple's future AppleScript™).

With scripts, applications can be used as building blocks to automate work flow, perform unattended maintenance or processing, and facilitate standard network administration. For example, a script could be created that would automatically aggregate on a monthly basis all open purchase orders for departments within a division. The script could create and distribute management summaries and send electronic-mail messages to all managers whose purchase

orders have exceeded the original approval level.

The Future of IAC

IAC will become a fundamental building block for applications and documents. We plan to enlarge the scope of Apple events and we will incorporate new object storage frameworks and data translation facilities, so that users can more easily integrate and manipulate a wide range of media and content.

Open Collaborative Computing Environment

A new set of services will further enhance the use of Macintosh computers for interpersonal communication.

The Open Collaborative Computing Environment is a set of APIs, foundation services, servers, and user-level capabilities that support the development of products that foster collaborative activity including electronic mail. Our goal is to provide users and applications with a consistent and uniform way of accessing services, regardless of the underlying technologies used.

The foundation services will extend IAC to include messaging, directory, security, digital signature, and mail. The collaboration environment is designed as an extensible and open system with a comprehensive gateway architecture that provides connectivity to other mail, messaging, and directory systems.

Enhanced Operating System

We are at work on new operating-system services that will complement the multitasking capabilities in System 7 and give users smoother operation and greater reliability. Services planned include preemptive multitasking, multithreaded routines, memory protection at the process and kernel level, and asynchronous and concurrent I/O.

Macintosh on RISC

By combining the power of the RISC PowerPC architecture and compatibility with existing Macintosh applications, Apple's new RISC products will create a profound transformation in the ways personal computers are used.

Apple has always pioneered in the science of human interface. But at Apple, we believe that our job has just begun. Today's Macintosh interface is only a starting point. Many new power-consuming technologies—speech, handwriting, and gesture recognition, text-to-speech capabilities, and natural language syntaxes—will be possible on an affordable RISC Macintosh.

New PowerPC Architecture

Apple's RISC-based Macintosh computer family will be based on the PowerPC architecture, which is being collaboratively developed by Apple, IBM, and Motorola. This new architecture is derived from IBM's POWER (Performance Optimization with Enhanced RISC) architecture. The PowerPC architecture will be optimized for the cost, size, and power needs of a personal computer. Apple selected PowerPC as the RISC architecture for Macintosh because of its many technical and business strengths.

High-Performance Capabilities

Today's POWER systems deliver up to 56 MIPS and 23 MFLOPS. The extraordinary design and production expertise of Motorola, Apple, and IBM ensures that future PowerPC systems will greatly exceed these specifications.

Building on Established Commercial Success

In the short period since its introduction, the POWER architecture has earned a 5 to 10 percent market share in the demanding engineering workstation market-place. Thousands of applications that support this architecture are already available.

World-class Semiconductor Technology

IBM owns some of the world's most advanced semiconductor facilities. Its strength in process technology will be complemented by Motorola's high-volume manufacturing expertise, long familiar to Apple from the 680x0-based chips used in the Macintosh.

Financial Strength for Multiple Design Efforts

The combined efforts of Apple, IBM, and future licensees will enable large R&D outlays to maintain our lead in chip technology. IBM and Motorola are creating a joint design center in Austin, Texas, with a team of more than 300 engineers. The center's investment—initially developing three separate design points for the PowerPC family—will lead to a broad family of PowerPC products. (By comparison, most competitive architectures primarily rely on only one main design effort at a time.)

Support for "Open" Systems

The PowerPC architecture will also be supported by the new PowerOpen software reference standard, which integrates Apple's A/UX,® IBM's AIX, and the OSF/1 UNIX kernel (see page 14). This ensures that PowerPC will have a commercially viable and recognized "open" environment. Other hardware platform vendors will be encouraged to use the PowerPC processor family to increase the availability of this open environment.

Superior Development Tools

The POWER and PowerPC architectures are supported by the AIX-based optimizing compilers for languages such as C and FORTRAN. IBM has more than 30 years of experience in designing and delivering commercial-grade optimizing compilers, and these tools are widely recognized as some of the best available on any platform.

Powerful Native Environment

Macintosh system software is being extensively enhanced for the PowerPC architecture with new system software technologies that will be released over a period of several years to offer third-party developers a broad platform.

The combination of the raw power of RISC and an expanded Toolbox will change how people interact with computers in the following ways:

- With 50 to 100 MIPS available, speaker-independent speech recognition with a large vocabulary size will be possible without add-on hardware.
- Language technologies such as foreign-language translation, syntax, and semantic analysis will provide on-line writing support. Combined with speech recognition, these technologies will lead to support for dictation.
- New power-consuming applications not previously available to mainstream personal computer users, such as three-dimensional graphics and simulation applications with real-time compression/decompression and real-time three-dimensional data manipulation, will become available.
- Standard applications such as word processors and databases will go beyond text and graphics to routinely include real-time acquisition and editing of new media such as sound, 24-bit graphics and digital video.
- New classes of workgroup applications, including telephony and video conferencing, will be facilitated.

New Products for Apple Customers

When we introduce our RISC-based Macintosh in the next two to three years, we expect it to offer the best price/performance in the personal computer market, especially when compared with computers using Intel's 80x86 processors. Shortly thereafter, Apple and other hardware vendors will scale this architecture over a wide range of products, including desktops, laptops, notebooks, workstations, and servers. Large organizations will be able to integrate the PowerPC architecture across their enterprise computing environment.

Smooth Migration Path

For customers who choose these new products, Apple will offer a smooth path between today's 680x0 environment and the PowerPC platform. By providing backward compatibility, we will preserve customers' extensive investments in applications and data.

The root of this compatibility is a system of 680x0 emulation that will be a standard element of all RISC-based Macintosh computers. This emulation technology will allow users to run their existing 680x0 applications while taking immediate advantage of the new hardware.

Characteristics of the emulation include:

- 680x0 binary code compatibility, so that unmodified Macintosh 680x0 applications will run on a RISC-based Macintosh.
- Conversion of frequently used 680x0 instruction routines into native RISC to significantly increase performance. Performance equal to or exceeding that of similarly priced 680x0 Macintosh models is expected.
- Symmetric support for 680x0 code emulation and native code execution, so that native and emulated applications can coexist at the desktop level.
- Compatible interface with existing Macintosh I/O and peripherals, so that access to peripherals from a 680x0 application running on a RISC-based Macintosh will be completely transparent.

CISC and RISC Coexistence

Many Apple customers will find that their computing needs are sufficiently met by the 680x0 CISC architecture and built-in capabilities of the System 7 Macintosh. That is why we clearly anticipate introducing new 680x0 desktop, portable, and low-cost systems well after the initial release of RISC-based systems. Because we are committed to the coexistence of the two platforms, we are ensuring that work environments and networks can routinely mix 680x0- and

RISC-based Macintosh models. Users will be able to move disks, files, data, and applications easily and seamlessly between the two environments. The current Macintosh Toolbox will remain available, to preserve compatibility and the unique Macintosh “look and feel.” Despite the excitement surrounding the introduction of a RISC-based Macintosh, 680x0-based Macintosh computers will remain viable for many years to come.

MacApp—
Speeding Application Development

New system software and new hardware are only as good as an application's ability to take advantage of them. MacApp,® Apple's object-oriented application framework for Macintosh, has become a key part of the mainstream Macintosh development environment, because it both speeds application development and provides a path to rapid integration of new system software features as they become available.

Introduced in 1985, MacApp is a fully mature object-oriented class library. MacApp 3.0, which began shipping in August 1991 (beta release), supports both C++ and Object Pascal and includes support for System 7 features including IAC and Balloon Help.

Apple is absolutely committed to object-oriented programming and pioneered the use of this technology, beginning in 1981 with Smalltalk-80 on the Lisa.® In 1983, we developed the first object-oriented Pascal, called Classcal. We led the development of the Object Pascal language, and we've contributed to the evolution of C++ and Common LISP. MacApp is now the most advanced object-oriented framework in the industry.

MacApp provides a user interface framework upon which application-specific features are built. MacApp supplies the application main-event loop and code for all of the basic Macintosh features, including the Apple, File, and Edit menus; Clipboard support; standard windows and scroll bars; printing support; Edition Manager; and Apple events. Applications written in MacApp inherit the capabilities of the object-oriented framework by default, thus saving one-half to two-thirds of the time required for traditional procedural programming techniques. Object-oriented design also speeds development of application-specific code by promoting reuse of code and independent module development and testing, and by enabling changes to be incorporated quickly and reliably.

MacApp provides a timely way to incorporate new features when new versions of system software are introduced. When MacApp 3.0 began shipping, developers who had created their programs with MacApp 2.0 were able to gain full support for System 7 features in a matter of days instead of months.

MacApp will track advancements in the System 7 platform, including QuickTime, the Open Collaborative Computing Environment, and user interface enhancements. MacApp gives in-house and commercial software developers the ability to track these capabilities as well, while also providing a head start toward programming for Pink.

Macintosh Technology in New Forms

We foresee our technologies migrating to a range of new products that will benefit everyone, even people who have never used a computer before. Here are two examples:

Pen-Based Systems

We believe that pen-based systems can make computers easier to learn and more natural to use. The pen is such a fast and fluid way of performing certain tasks that a variety of new mainstream applications will emerge to take advantage of these strengths. Pen-based designs also offer enhanced mobility, since they can be used while sitting, standing, or walking—much like a notebook or clipboard. The comparatively small pen can serve the functions of a pointing device (mouse or trackball), allowing for a miniaturized, more portable product.

Apple's approach to pen-based systems is similar to our Macintosh development strategy. The user is our design point, so our pen-based products will be useful to and affordable by a broad range of users. Our technological development takes a system approach, so that the user interface, system software, and hardware enjoy seamless integration.

These pen-based computers will also integrate with keyboard-based computers, peripherals, and network services in powerful and intuitive ways.

"Multimedia Players"

As digital media and communications technologies become available in smaller forms and at lower costs, we expect that a new class of device, primarily used to play back information, will emerge. We believe that these "multimedia players" will proliferate rapidly, providing remote access to portable, prerecorded media-rich databases.

Although consumer and business information is increasingly available in digital form, access to such materials is, in general, limited to computer users. These new players will broaden access to a wider audience, and we anticipate that their high-quality graphics, sound, video, and animation will cause the entertainment and edu-cation segments of the technology market to grow rapidly, especially as prices drop.

The same trends that led to the general acceptance and usage of desktop publishing—powerful platforms, easy-to-use authoring tools, scalable technology, and lower cost—will encourage businesses to assemble their own multimedia databases to manage entertainment and information technology.

Multimedia Alliances and Joint Ventures

A broad selection of hardware is absolutely critical to a successful multimedia strategy. We have enlisted the support of several consumer electronics companies to produce differentiated product offerings targeting a variety of market segments. For these devices to be able to play a wide array of content, they must have a standard system software foundation. We refer to such enabling software as a runtime environment (RTE). It is Apple's intent to make this RTE widely available to consumer electronics manufacturers and PC makers alike.

Strong advocacy by an independent company is the best way to promote industry acceptance of new key technologies. The recently announced multimedia joint venture funded by Apple and IBM is chartered to make this RTE successful in the marketplace. The new company will develop, license, and sell to developers software that will promote the exchange of information in the form of sound, graphics, video, and animation across multiple computer systems and other electronic devices. Apple intends to incorporate this software into new, user-friendly hardware products.

Client/Server Computing and Enterprise Networks

Apple intends to be an industry leader in the transition to a new model of enterprise computing that links personal computers, workstations, and host systems in an enterprisewide client/server network. This new model will integrate computing resources at all levels, so that project teams, departments and organizations can communication and work together more effectively.

Apple's computer systems will offer excellent platforms for the personal systems and workgroup-server levels of the model. Apple's system software for those platforms will support the widest range of applications in the industry, and provide a "no compromise" combination of the best features of personal computers and personal workstations. We are committed to making our products the best-integrated in the overall enterprise computing environment and to providing a framework for developing and deploying distributed, cross-platform, client/server applications.

Apple Platforms for Client/Server Computing

Apple will offer a complete client/server product line at the personal-system and workgroup-server levels.

Personal Systems

Our personal systems form two complementary product families, defined by System 7 (see "The Future of System 7") and A/UX system software architectures. As clients, both systems offer a breadth of consistent applications, renowned ease of use, and a unique ability to exchange information between desktop and remote computing resources.

A/UX is the foundation for Apple's open-systems line of Macintosh personal workstations. A/UX provides the same user interface and runs the same applications as System 7, but with a UNIX foundation. As a result, it offers the benefits of both System 7 and UNIX (UNIX applications, development tools, multitasking, memory protection, security, and networking strength) in a single, integrated desktop environment.

Workgroup Servers

Today, we have System 7 and A/UX based workgroup servers. In the future, we will focus on A/UX as the workgroup-server platform for Apple's client/server architecture. With its standard POSIX-compliant API, A/UX is an ideal platform for LAN-based network services, such as database management, image management, and X Window System applications. And its user interface makes it easy to set up, operate, and administer workgroup servers.

The Future of A/UX

A/UX-based systems range from low-cost desktop systems to high-performance desktop systems and workgroup servers. The design center for these systems is client/server environments, where a combination of database-oriented custom applications and personal productivity applications is needed.

A/UX 3.0 brings the full benefits of System 7 to a UNIX environment. It offers a familiar System 7 desktop as the user environment, and runs Macintosh System 7 binaries. A/UX 3.0 also takes advantage of the performance features of Motorola's powerful 68040 microprocessor.

Subsequent releases of A/UX 3.x will track enhancements in the Macintosh System 7 environment, and will support future 680x0-based Macintosh systems. A/UX 3.x will also include libraries from IBM's AIX system for future compatibility with A/UX 4.0.

The next major release, A/UX 4.0, will bring the benefits of A/UX to the PowerPC-based PowerOpen platform being created by a joint Apple and IBM effort. This major new open-systems platform combines the best technology from IBM's highly successful RS/6000 AIX family and Apple's A/UX. PowerOpen will have a highly scalable open-systems architecture, ranging from desktops to workgroup, department, and enterprise servers, all with a binary-compatible Applications Binary Interface (ABI). It will feature the broadest applications set of any open-systems platform, combining the complete Macintosh and AIX catalogs. Customers will receive three important benefits from the A/UX-PowerOpen combination:

- Enhanced price/performance:
  A/UX on the PowerPC architecture will provide the performance capabilities of today's high-end workstations and servers, at price points in the middle to high end of today's personal computer market.
- UNIX applications base:
  A/UX 4.0 will support the PowerOpen ABI, allowing the large library of AIX-based applications to run unmodified on A/UX workstations and servers.
- Standards compliance:
  A/UX 4.0 will be based on PowerOpen's OSF/1 UNIX kernel, providing compliance with an even broader range of open-systems standards, including POSIX, XPG3, and OSF's AES.

PowerOpen will form the basis for a family of compatible open systems, through selective licensing of the PowerOpen architecture, PowerOpen-compatible processors, and PowerOpen-compatible operating systems. In the resulting open-systems environment, customers will be able to purchase ABI-compatible desktop workstations in a broad range of performance levels and prices from a variety of vendors. Similarly, customer needs for workgroup, departmental, and enterprise servers will be satisfied by a range of ABI-compatible server systems from Apple and other vendors.

Apple Systems in Enterprise Networks

The major issue in the emerging enterprise client/server computing environment is the ability to successfully integrate systems from many different vendors into a unified enterprise network. Apple is committed to making its products the best-integrated in the industry, offering transparent connection and interoperability with a very broad range of network environments. Apple is pursuing this strategy through a combination of Apple product development, partnerships with major LAN and enterprise networking vendors, and cooperation with leading enterprise software vendors. Our recent alliance with IBM will strengthen Macintosh connectivity with IBM mainframe, midrange, and departmental networks.

Integration into LAN Environments

Macintosh is supported today in virtually every major LAN environment, including Novell Netware, Digital's Network Applications Support, UNIX, Microsoft Lan Manager, and Banyan's VINES (expected by late 1991). As part of the recent Apple/IBM alliance, AppleTalk® services will be made available on OS/2 servers. Basic LAN communications, filing and printing services, and SNA connectivity are available across a broad spectrum of environments. Many environments also provide database integration, X Window integration, or other APIs that support the development of client/server applications. Macintosh/LAN interoperability will be expanded into messaging, directory services, collaborative applications, transaction processing, and work-flow applications.

In addition to the breadth of Macintosh/LAN integration, the consistency of that integration is a key advantage of Macintosh. The Macintosh user accesses LAN resources in a uniform manner, regardless of the particular LAN environment. Apple will continue to provide seamless, cross-platform integration as new LAN services become available to Macintosh users. In particular, Apple plans to offer services from OSF's Distributed Computing Environment (DCE) as part of its A/UX client/server networking software.

The AppleTalk Network System—A Foundation for Collaboration

The Apple Talk Network System focuses on allowing applications and people to collaborate more effectively. AppleTalk is a complete network system built into every Apple system, and it is licensed to other computer, network, and software vendors to provide interoperability with a wide range of network environments and devices. AppleTalk operates over Ethernet, Token-Ring, and wide-area links and is supported on a wide range of media, including twisted-pair, coax, and fiber-optic cable. The AppleTalk protocols provide a dynamic, "plug-and-play" local-area network.

AppleTalk supports client/server capabilities, such as AppleShare® file serving, but it goes beyond strict client/server definitions to provide peer-to-peer collaborative services. AppleTalk applications can automatically become part of a broader platform that links all of the individuals in an organization. Apple will also provide extended network management capabilities for AppleTalk, based on industry-standard network management protocols. Apple believes that future breakthroughs in wireless networking can bring major benefits for collaborative computing, and is actively working on a variety of wireless LAN technologies, many using AppleTalk as an foundation.

Integration into Enterprisewide Networks

Apple is committed to integrating Macintosh into four major enterprisewide network environments:

IBM SNA/APPN Networks

Apple's SNA•ps™ Gateway and third-party products link Macintosh users to SNA networks with 3270, 5250, and APPC/LU6.2 protocols. On this basic connectivity framework, Apple and independent software vendors provide value-added services, such as terminal emulation, file transfer, graphical front-ending tools, and host database access. Apple and IBM will enhance these links to include tighter integration of the Macintosh into SNA network management architectures (including NetView), additional support for Advanced Peer-to-Peer Networking (APPN) services, and additional integration with IBM midrange systems.

Digital DECnet Networks

The Apple/Digital alliance has resulted in an array of Macintosh/VAX integration products from Apple, Digital, and other vendors. The PATHWORKS for Macintosh product offers 13 different network services—including file and print services, database access, DECwindows support, an AppleTalk/DECnet™ gateway, and LAN interconnection over DECnet wide-area networks—in a single, integrated product. Other products provide integration between Apple and Digital electronic-mail environments and Macintosh client support for Digital's ACMS transaction processing monitor. Future directions include integration with Digital's OSI-based DECnet Phase V.

TCP/IP Networks

Apple's MacTCP® product provides a foundation for Macintosh TCP/IP connectivity, with value-added services such as database access, file transfer, and NFS support available from Apple and third parties. TCP/IP and NFS support is an integral part of A/UX products. Apple is investing in TCP/IP connectivity, and plans support for TCP-based network management and for OSF's DCE environment.

OSI Networks

Macintosh/OSI integration products are available from a range of independent software vendors, and selected products (such as one offering X.25 support) are currently available from Apple.

Client/Server Application Tools

Apple believes that client/server computing is not defined by a single architecture, such as database servers or X Window System display servers. Rather, we believe that different client/server technologies and tools are appropriate for different application environments and customer situations.

Terminal Emulation

The built-in features of the System 7 and A/UX Macintosh desktop allow the user to easily cut and paste information between host terminal sessions and personal productivity applications, such as spreadsheets or word processors.

Graphical Front-ending in a Desktop-driven Environment

When a Macintosh application, such as HyperCard,® is interposed between the user and the host or server, the

application presents an easy-to-use graphical interface, masking the complexity of the underlying communications. Using this technique, new user interfaces can be created without any modification to existing host applications and data.

Graphical Front-ending in a Host-driven Environment

In a host-driven environment, the host application is modified to communicate with the desktop environment using a graphical user interface protocol. Apple's MacX™ product supports the industry-standard X Window protocol. The AppleTalk Terminal Service (ATS) protocols offer a higher-level, cross-platform user interface protocol that reduces network traffic and improves application throughput.

Database Access

Apple's Data Access Language (DAL) is a key database access technology, providing SQL-based access from Macintosh, UNIX, DOS/Windows, and OS/2 desktop platforms to a wide range of mainframe, minicomputer, and LAN databases, including DB2, SQL/DS, ORACLE, Ingres, Sybase, Rdb, Informix, NonStopSQL, and Netware SQL. Apple licenses the DAL technology to system and database vendors to continually broaden the range of supported DAL environments. In addition to DAL, database vendors such as Sybase, Oracle, and Digital provide native SQL APIs on Apple platforms for high-performance access to their client/server database environments.

Cooperative Processing Between Host and Desktop

Tools in this environment range from basic peer-to-peer APPC protocols to specialized transaction-processing APIs, such as the client/server link from Macintosh to Digital's ACMS environment.

In each of these client/server architectures, Apple is actively working with independent software vendors to provide powerful, easy-to-use, cross-platform tools that let IS organizations and systems integrators quickly prototype and develop applications. Apple believes that the availability of tools that allow applications to be developed once and then deployed across multiple client and server platforms is critical to making a smooth transition into the new enterprise computing environment.

Object-Oriented Systems— A Revolution in Software Development

In a joint venture with IBM, Apple is developing what we believe will be the ideal enterprise computing platform of the future. It will have a networking and collaboration architecture integrated as a fundamental part of the programming model. It is completely object-oriented in nature and will provide a revolutionary change in the economics of custom software development. And it will be made available as an open industry standard on a variety of hardware platforms. This system is code-named "Pink."

Accelerating Software Development with Pink

Today's system, enterprise, and independent software vendors face a huge problem with software that is late (often years behind schedule), costly, and hard to maintain and evolve. Code written and designed for one purpose is inappropriate for another.

Historically, there has been only one way to address the shortcomings of existing code: rewrite it from scratch. Object technology addresses this problem in two ways:

- It encourages the development of small, self-contained units of functionality (objects) that can be verified independently of the rest of the system.
- It allows additional functionality to be added without breaking the system.

Thus, a developer need not rewrite an object that is almost exactly what is needed. The additional behavior may be added by "inheriting" from one class of objects and adding only the code that does what the original class did not. With object-oriented development, code reuse becomes the rule, not the exception.

Traditional operating systems provide a set of services that software developers can use to create their software. These software programs are very loosely integrated into the overall operating system environment.

For example, in MS-DOS, applications take over virtually the entire machine. As far as the user is concerned, the application *is* the operating system. In Macintosh, applications look and feel similar and support numerous features in common (such as cut and paste), but it is the developer's responsibility to provide that consistency. Program structure must abide by conventions, use of Toolbox managers must conform to published guidelines, and error handling is done on a case-by-case basis.

Pink presents a completely different model for software development. The basic features that are intended to be common across all applications are implemented as frameworks within which application-specific objects are integrated. It provides a totally object-oriented operating system and a dramatic increase in base system functionality. And Pink provides a model for software development rich in programming abstractions that directly match concepts in the user interface. The result will be the rapid development of sophisticated applications that are unusually easy to use.

Pink will revolutionize the economics of software development by allowing developers to concentrate on their area of expertise. For example, it will no longer be necessary for a developer writing a factory-floor layout application to be an expert on user interfaces, three-dimensional modeling and rendering, text processing, networking, and so forth. Software designers who are experts in a particular area will be able to develop an application for that market easily, with fewer resources.

The impact on large organizations will be profound. Pink will allow in-house developers to quickly create custom applications that are consistent, easy to test, and easy to use, and that exhibit extraordinarily high levels of inherent functionality. The ability to develop and deploy these custom tools rapidly will greatly improve organizational productivity and information management.

Understanding True Object Orientation

It is important to distinguish between the pervasive use of objects enabled by Pink and an approach that involves the

use of object layers. Most of the object-oriented environments commercially available today, such as MacApp for Macintosh and NeXTstep for NeXT, are layered on top of procedurally oriented systems. While these layered approaches provide value in accelerating some portions of the applications development process, such as creating user interface components, Pink extends the use of object-oriented frameworks throughout the system. The major shift in productivity derived from this approach is that developers and systems vendors can leverage object frameworks in every aspect of their business.

This means that the same productivity benefits that application writers enjoy are also available to system developers, including Apple and IBM, who can more rapidly adapt Pink to meet customers' demands. A Pink vendor or VAR can easily add new hardware and software extensions to differentiate a platform while providing complete compatibility with existing applications.

Design Partners and Development Team

Pink is object-oriented system software that is being developed by the joint venture company OBS JV, which is equally owned by Apple Computer and IBM. Both partners will be contributing significantly to the venture.

Apple brings to the Pink project considerable object-oriented development experience. In fact, Pink has its roots in the early implementations of object-based languages at Apple. These include the port of Smalltalk-80 to Lisa in 1981, the creation of the first object-oriented Pascal (Classcal) and the Lisa Toolkit in 1983, and a leading role in the development of the Object Pascal language in 1984, as well as contributions to the evolution of Common LISP and C++.

IBM is bringing its expertise in enterprise computing and vast research capabilities to OBS JV. IBM's clear understanding of large organizations' computing needs and its major presence in host computing assures that OBS JV will be able to assert that Pink is the new organizational computing standard at its introduction.

Building on the strengths of Apple Macintosh and IBM's Common User Access Technology, Apple and IBM will develop a common look and feel across their Pink products. OBS JV customers will easily adapt to this new user interface, which they will recognize as a direct descendant of the look and feel of Macintosh.

Apple and IBM intend to create a new industrywide organizational computing standard with OBS JV by openly licensing its technology to the entire industry. The Pink environment has true built-in portability; it can run on multiple industry-standard hardware architectures, including Motorola 680x0, Intel X80x86, and the PowerPC RISC platform. OBS JV systems will coexist in multivendor environments by supporting prevalent data and interoperability standards. The Pink technology will also be scalable all the way from notebooks to enterprise servers.

Coexistence and Migration

Computers running Pink will coexist with CISC- and RISC-based Macintosh computers as well as PowerOpen Macintosh (A/UX) computers. They will share network resources and exchange data bidirectionally. To preserve customer investment in Macintosh applications, training, and development expertise, Apple's Pink products will also include a Macintosh-compatible "personality" module that will enable them to run 680x0-based software and provide a smooth migration path. We expect to continue to develop Macintosh platforms long after the introduction of Pink.