NeXTstep Release 3.0:
Strengthening NeXT's Object-Oriented Leadership
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Object-oriented software systems qualify as the first revolution in desktop computing technology since the graphical user interface. While everyone in the industry talks about object-oriented programming, only one object-oriented system — NeXT Computer, Inc.'s NeXTstep — is shipping today.

NeXTstep's object-oriented environment dramatically simplifies the development and delivery of custom and commercial applications, including revolutionary applications never before possible.

NeXT created its combined graphical user interface (GUI) and application development environment specifically to speed the development of commercial, "shrink-wrapped" software applications for the NeXT platform. This strategy has worked as planned: More than 240 high-quality productivity applications are currently shipping.

The company discovered, however, that corporate and government customers will not switch to NeXT computers simply for off-the-shelf application software, even if it is twice as good as what they currently use, but that large numbers of them have switched to NeXT for its unsurpassed environment for creating mission-critical custom applications.

With NeXTstep, in-house programmers are quickly developing sophisticated applications specifically tailored to their company and industry — applications that provide a true competitive edge — up to 10 times faster than possible with other platforms, and thus with less investment. For example, many Wall Street financial organizations have embraced NeXT and NeXTstep as a competitive weapon in an industry where fast decisions and actions are fundamental to success. (Please refer to the document "Who Buys NeXT Computers?" for more information on specific NeXT customers.)

The combination of quickly developed and widely deployed custom applications, plus great off-the-shelf productivity applications running alongside the custom applications, provides NeXT's compelling advantage in commercial markets today.

NeXTstep has been entirely object-oriented from its inception. Release 1.0 began shipping in October 1989, in conjunction with the original NeXT Computer, and Release 2.0 followed in December of 1990 and coincided with NeXT's introduction of NeXTstation, NeXTstation Color, NeXTcube and NeXTdimension.

NeXT has announced Release 3.0 of its NeXTstep object-oriented system software, with significant enhancements to its already broad capabilities for connectivity/communications, custom application development, interpersonal computing and usability, and global computing. This new release of NeXTstep is important not only for its actual capabilities, but also for what it implies about NeXTstep's preeminence among object-oriented systems.

Why Do Object-oriented Programming and Systems Matter?

While computer hardware performance has nearly doubled every two years, software improvements have inched along at a comparative snail's pace. New hardware power remains untapped because software cannot take advantage of it. This disparity has been called the "software gap."

Graphical user interfaces let people with essentially no computer experience take advantage of sophisticated hardware technology. In that sense, they have revolutionized computing. Creating these easy-to-use GUIs, however, has put an enormous burden on software developers and in-house programmers. It takes commercial developers longer to get their products to market, and in-house programmers amass backlogs of requests for custom applications that their companies need to remain competitive. The difficulty of creating applications with GUIs has widened the software gap.

Object-oriented programming is a revolution for the software business. For programmers, it replaces line after line of procedural code with chunks of discrete code — "objects" — that perform specific functions. For example, NeXT's Application Kit contains more than 100 objects, including a Window Object, Menu Object, Text Object, PrintPanel Object, FontManager Object, Fax Object, Color Chooser Object, Image Object, Sound Object and many others. For users, object-oriented development leads to consistent interfaces, more reliable software and the faster introduction of new features.

Often, people confuse object-oriented systems with icon-based "objects" on a computer screen, but in fact most GUIs popular today were developed with traditional, procedural programming. The objects in object-oriented programming are "building blocks" used by programmers in developing applications. Software objects are best described as entities with responsibilities and behavior, including the ability to send messages to one another. By manipulating groups of objects, rather than by writing individual lines of code, programmers create any kind of application they can imagine. Put another way, objects provide developers with larger and more sophisticated building blocks with which to create programs.

Object-oriented programming releases programmers from "reinventing the wheel" with each new application. Instead, developers can spend their time working on the quality and behavior of the application to make it competitively distinctive. The result is more sophisticated programs with better user interfaces, built up to 10 times faster than with procedural-oriented programming.

Object-oriented programs are more reliable and flexible, too. Once an object is perfected it can be used over and over again in many applications. In addition, reusable objects are inherently more reliable than code that must be rewritten anew each time: The objects' well-defined semantics stay constant and predictable regardless of the circumstances in which they are used. Repairs to "broken" software are easier when one object can be isolated and fixed without disrupting the entire program.

Similarly, developers can make changes to a program during development without incurring huge time delays, simply by modifying certain functions of an object or by changing the way objects in the program interact and communicate. Object-oriented design also simplifies management of the development process, because it is much easier to keep track of discrete objects than hundreds or thousands of lines of procedural code.

The benefits to users are just as important. Object-oriented programming leads to better-quality applications that reach the marketplace faster; more refined, easier-to-use interfaces that are consistent among all the applications on a platform; and applications that can more easily "talk" to one another. It also makes custom application development possible for a greater number of in-house programmers.

Object-oriented system software transfers all the benefits of object-oriented programming to the entire system. Object-oriented system software integrates the object-oriented paradigm into the whole framework of a computer's software architecture.

What Is NeXTstep?

There are a number of object-oriented programming languages available today — e.g., NeXT chose Objective C as its object-oriented language — but NeXTstep is the only object-oriented system software currently shipping, where system software encompasses all the software needed to use or develop applications, except the applications themselves.

For both users and developers, NeXTstep makes complex things simple and "impossible" things possible. It has always played a dual role, as a user interface that masks the underlying complexity of the operating system and as a complete application development environment. All its components are well-integrated and compatible, and it naturally leads to the development of applications with a consistent user interface. It is a truly flexible system, in that it can be changed at will to meet the specific needs of developers and the users of their applications.

To understand NeXTstep, it is best to begin with the **Application Kit**. This rich set of powerful software building blocks contains objects for the functionality that is common to most NeXTstep applications, regardless of their function. The nearly 100 classes of objects in the Application Kit are for managing windows, menus, text, fonts, buttons, copying and pasting between applications, printing, saving and so on, and for creating the core of the application itself.

The Application Kit provides a fleshed-out framework as a starting point for development. Developers can pick and choose among the suite of objects, adding only the objects they need to provide an application's specific functionality. The Application Kit framework is so sophisticated and complete that a NeXTstep application can be up and running — complete with windows, buttons, editing of rich text, cutting/pasting between applications and so on — before the developer writes a single line of code.

Application Kit objects greatly simplify application development because they allow commonly used features to work without the developer having to write every line of code. Instead, developers can think at a higher level about what they want their applications to do, and make the applications easy to use with very little extra effort.

NeXTstep's Application Kit objects also help make NeXTstep independent of the hardware on which it runs. Many of the objects provide hardware-independent access to various media, such as sound, video and graphics, and NeXTstep runs in a protected virtual-memory environment. As a result, applications built under NeXTstep are usually completely hardware-independent.

Interface Builder manipulates objects in the Application Kit, allowing developers to edit the objects and create applications graphically, with little or no software code. These applications can range from a simple calculator to a sophisticated SYBASE or Oracle relational database program for managing the personnel files of a multinational corporation.

Developers can also use Interface Builder to graphically connect and edit objects that they create themselves (whether or not they are user-interface objects) or that are part of additional object kits provided by NeXT or third-party companies.

Interface Builder also lets developers create, test and maintain consistent graphical user interfaces for NeXTstep applications. Unlike most graphical interface creation tools, Interface Builder allows developers to edit the actual objects that will be used in their applications.

Although **Objective C** is the primary object-oriented programming language for NeXTstep, the development environment also supports other object-oriented languages, notably C++, another popular C-based object-oriented programming language.

Objective C offers some distinct advantages, however, including its simplicity and its support of dynamic, or run-time, binding. With dynamic binding, objects do not have to know what other objects they must communicate with until the application is actually running, rather than when it is being compiled. This lets programmers generalize programs to handle a wide variety of potential objects, without knowing all the possibilities ahead of time. A good example of the benefit of this flexibility is Interface Builder, which manipulates many different object types, very few of which existed when Interface Builder was originally constructed.

Another important NeXTstep component is the **Window Server**, which routes signals from the keyboard and mouse to the appropriate applications, processes drawing commands from applications and manages overlapping on-screen windows. In the multitasking environment of the UNIX operating system, the Window Server ensures that multiple applications can make use of the window-based resources without affecting each other.

At the heart of the Window Server is the **Display PostScript** system, a version of the standard PostScript page description language developed by Adobe Systems and NeXT specifically for interactive screen displays. All drawing of text and images in NeXTstep is done through the PostScript language, whether that drawing appears in a window on the computer screen or on printed output. This unified imaging model means that users can see their work on the screen just as it will appear when printed.

Users are most familiar with NeXTstep's **workspace** — all the graphical file and application management features that appear on the display screen. The workspace is controlled by the **Workspace Manager**, which displays document and application icons, launches applications, allows users to copy and delete files, and manages the computer's multi-layered file system.

The Workspace Manager shields the user from direct interaction with UNIX commands, although users who choose to interact directly with the UNIX shell can do so easily in a separate window. The Workspace Manager includes a "docking" feature, whereby users can place icons for frequently used applications along the right-hand side of the computer screen, for easy access.

NeXTstep was developed on top of the **Mach** operating system. Mach contains important "messaging" capabilities that allow objects to communicate with each other not only within the same application, but also between applications and among different computers on a network.

Mach is compatible with Berkeley 4.3 UNIX, a widely used standard version of UNIX. Although the version of Mach used by NeXTstep has been refined to an extremely efficient form, existing programs written for Berkeley 4.3 UNIX are source code-compatible with Mach, and standard UNIX applications can run in NeXTstep via the terminal emulator that ships with the system.

Berkeley 4.3 UNIX is only one of the many standards to which NeXTstep conforms. Others include the PostScript language; a number of data interchange formats including Encapsulated PostScript (EPS), Rich Text Format (RTF), ASCII text and TIFF (a standard for bitmap images); and a full range of networking and communications standards, including NFS, Ethernet and TCP/IP. NeXTstep provides an ideal combination of standard and innovative features: enough standards for NeXTstep users to connect easily with the rest of the computing world, yet the innovations needed to provide real value.

It took NeXT five years to establish NeXTstep's foundation. The fact that it was object-oriented from the very beginning is important now that NeXTstep is gaining in both sophistication and market acceptance. It means that NeXTstep's smooth progression will not be stalled by the need to go back and "fix" part of it, and that the software's technology lead will not soon be threatened.

One important characteristic of object-oriented systems is that once established, their functionality can be extended exponentially. Now that its foundation has been proven solid, NeXTstep will continue to improve and grow rapidly. In fact, its capabilities are beginning to explode with Release 3.0, as demonstrated by such additions as entirely new toolkits of software objects.

NeXTstep Release 3.0

NeXTstep Release 3.0 is a new generation of NeXTstep object-oriented system software. Its enhancements meet the continually evolving needs of work groups, developers and system administrators. Significantly, any application written under NeXTstep Release 2.x will not only run in Release 3.0, but due to NeXTstep's object-orientation will automatically take advantage of many Release 3.0 features. This compatibility is an important consideration for all existing NeXTstep users and developers.

Release 3.0's advancements show most vividly in its improvements to connectivity/communications, client-server computing, color, usability, global computing and better-than-ever custom application development capabilities. The new capabilities of Release 3.0 build upon those in Release 2.x.

<u>Connectivity/Communications</u>

NeXTstep Release 2.0 supported TCP/IP, NFS and Ethernet networking (both thin and twisted-pair Ethernet), which allowed NeXT computers to communicate easily with other UNIX workstations and with a variety of networks.

Release 3.0 takes NeXTstep much further toward its goal of communicating with everything. In fact, NeXT leads the UNIX market in connecting outside the

UNIX environment. Now NeXTstep users can share data with DOS, OS/2, Windows, Macintosh and UNIX computers, as well as a number of local-area networks (LANs) and wide-area networks (WANs). As a result, customers can preserve their current investments in hardware, software and information as work groups make the transition to NeXTstep computers.

Release 3.0 opens up the computing worlds of two important personal computer-based network systems, Novell (IBM PC/compatibles) and AppleShare (Macintosh). It bundles **Novell Client** software, for access to files and PostScript printers on Novell NetWare networks, and **AppleShare Client** software, which allows NeXTstep computers to access files and PostScript printers on Apple's AppleTalk networks. NetWare and AppleShare dominate the markets for IBM PC/compatible and Macintosh networks. In Release 3.0, Novell and AppleShare file servers appear in the NeXT browser much as NFS servers currently do, making their files and network resources readily available to NeXTstep users.

Bundling these NetWare and EtherTalk capabilities into NeXTstep represents a number of firsts: the first UNIX Novell Client ever; the first bundled Novell Client from any OEM; and the first bundled AppleShare Client on any platform other than the Macintosh.

Release 3.0 also adds **Macintosh file system** support to its existing DOS file system support. In other words, a Macintosh floppy disk inserted into a NeXT floppy drive, or any Macintosh SCSI-based disk (including a CD-ROM) connected to a NeXT system, automatically mounts and appears in the NeXT browser, integrated within the UNIX file system. NeXTstep users can then edit and manipulate these files as easily as any other files in the browser.

Through a new **PhoneKit** and a partnership between NeXT and Hayes Microcomputer Products, Inc., NeXTstep Release 3.0 makes it easier for developers to create applications that take advantage of the latest communications technologies. Hayes has introduced a telecommunication network interface module for NeXT workstations that provides ISDN Basic Rate Access, in addition to POTS (plain old telephone service) connectivity. The Hayes product can be used for remote LAN connections plus high-speed, digitized voice, data and multimedia applications.

ISDN, or Integrated Services Digital Network, is a high-speed, multi-channel system that can carry both voice and data information simultaneously over the same line. It extends the benefits of local-area networking to global, on-demand wide-area networking.

The PhoneKit included in NeXTstep Release 3.0 provides simple access to the Hayes interface hardware's telephone voice and data functions. With the PhoneKit, developers can quickly and easily build a new generation of telephone-based applications, such as answering machines and speed dialers, that are controlled entirely through a NeXTstep computer. Besides requiring no additional telephone hardware, these NeXTstep applications can work with both POTS and ISDN technology, automatically.

Client-Server Computing

One part of the connectivity story that NeXT itself does not offer is a complete, dedicated server. Servers are much more than just a computer with a big hard disk; they include custom hardware and software to provide files and resources across a network and to run server-based applications such as databases. Many well-established hardware companies, however — including Auspex, DEC, Hewlett-Packard, IBM, Pyramid, Sequent, Sun and Teradata — provide high-quality servers, and NeXTstep works seamlessly as a client to all of them.

Instead of expending resources developing and producing server hardware, NeXT has chosen to focus on building the best desktop computers and system software in the industry. An important facet of this commitment to the desktop is enabling NeXTstep customers to take advantage of existing servers from within their Release 3.0 environment.

A crucial connectivity capability of Release 3.0 is at the database software level. NeXTstep works seamlessly with the most popular commercial databases available today, such as those from Oracle, Sybase and Teradata.

In addition, Release 3.0 introduces the NeXT **Database Kit**, which extends the power of NeXTstep's object-oriented capabilities to the development of database applications. Database Kit (DBKit) provides a single, consistent interface to databases from multiple vendors, so that NeXTstep programmers can create their own database-driven applications five to ten times faster than developers using other development environments, such as Sun.

DBKit is designed to work with many different types of database (e.g., SQL, hierarchical) and any kind of data (e.g., traditional text and numbers, as well as multimedia images, sound and rich text). DBKit consists of an impressive suite of software objects and methods that radically shorten the time required to design and implement database applications that have graphical user interfaces.

As with all NeXTstep objects, the objects in DBKit can be used "as is" or can be customized for a particular need. As a result, DBKit-based applications are both flexible and extensible, and they do not restrict developers to only those capabilities that a given database vendor provides. Developers can concentrate on *what* their database application should do, rather than *how* it needs to work.

Applications created with DBKit objects can cut, copy and paste data from other NeXTstep applications. In addition, they can request Services from other applications, such as the Digital Webster (Webster's Ninth New Collegiate Dictionary and Collegiate Thesaurus), Digital Librarian or NeXTmail. Developers can easily construct sophisticated DBKit database applications to access mathematical models in *Mathematica*, to send numerical information to Lotus Improv for charting or analysis, or to tie into similar capabilities of other NeXTstep applications.

The DBKit architecture includes separate layers for user interface and data access, as well as adaptors that translate data source-independent queries into function calls for a specific vendor's database. This layered architecture, with only one layer that is dependent on a specific database, allows applications to access new data sources without rewriting user interfaces or application logic. Also, within an application users can gain access to multiple data sources simultaneously. Release 3.0 ships adaptors that allow connections to any Oracle or Sybase database, as well as customizable tools for creating adaptors for other databases.

Color

Color is important to increasing numbers of NeXTstep users, and Release 3.0 includes a number of new state-of-the-art color capabilities. For example, it uses true color — i.e., full 24-bit color — throughout the system. Icons and other information in the **workspace** now appear in color on MegaPixel Color Display monitors, and all third-party and custom applications can gain access to true-color capabilities automatically.

Release 3.0 completely integrates Adobe's newest PostScript release, known as Level 2. To the original PostScript page description language, the **PostScript**

Level 2 language adds support for calibrated color output, imaging filters for faster printing and pattern support. In this way, the same language draws color images to the screen for display and to a color printer for hard-copy output, bringing consistent color output to users. NeXTstep is the first shipping implementation of a Level 2 Display PostScript interpreter.

NeXTstep's use of PostScript Level 2 capabilities is backwards-compatible with all PostScript devices, meaning that NeXTstep users can automatically print both to PostScript Level 1 output devices and to Level 2 devices such as NeXT's newly introduced color printer.

To further aid users in selecting device-independent colors, NeXTstep Release 3.0 bundles the **Pantone Matching System**, the premier standard for specifying colors in printed output. As with the support for Level 2 calibrated colors, support for the Pantone System is available in all NeXT applications through the standard NeXTstep Color Panel.

Another important new object-based kit in NeXTstep Release 3.0 is the **3D Graphics Kit** (3DKit). Based on the **RenderMan** standard, 3DKit lets developers easily add three-dimensional graphics to existing NeXTstep applications, without becoming 3D experts. At the same time, it provides the necessary object and rendering framework for building sophisticated 3D applications from scratch.

Pixar's RenderMan software provides the industry standard for creating computer-based pictures that contain all the qualities of real life, such as shadings, reflections, texture and motion blur. NeXTstep Release 3.0 incorporates two components of Pixar's complete family of RenderMan products: full PhotoRealistic RenderMan and Interactive RenderMan.

PhotoRealistic RenderMan creates photographic-quality images on both the computer screen and in hard-copy output. It is a rendering technology, where rendering refers to the process of generating a computer image of a three-dimensional model from a description of its geometry and other characteristics. The PhotoRealistic RenderMan bundled in Release 3.0 is the same software used to render Pixar's Academy Award-winning film, *Tin Toy*, and other groundbreaking computer animation films.

Interactive RenderMan provides a unified imaging model for 3D, just as the Display PostScript language does for 2D. Application programmers can describe their 3D scene in the same way whether the scene is being drawn interactively on the screen or rendered photorealistically for output on paper or to a film recorder. The NeXTstep software automatically supports printing from applications incorporating 3D graphics.

With RenderMan as its base, 3DKit can render 3D images both interactively and photorealistically to the screen. Its unified 3D imaging model, coordinating between on-screen and printed images, is especially important in the 3D graphics world, where what you see is rarely what you get.

Applications based on 3DKit will allow 3D graphics to blend seamlessly into a user's environment. Users will be able to do everything with 3DKit-based applications that they can do with 2D: cut, copy, paste, mail, print, use Services, draw, modify and so on. Integrated 3D graphics, as made possible by NeXTstep Release 3.0, will greatly enrich the communication potential for every NeXTstep individual and work group.

NeXT's new 360 dpi, four-color **Color Printer** is completely integrated into NeXTstep's printing software, including the PrintPanel Object, which is part of the Application Kit. As a result, NeXTstep applications need do nothing extra to generate color printed output. In fact, because NeXTstep's color capabilities are not tied directly to the display screen, even users with monochrome NeXT computers and displays can specify colors in their work and print in color to any color printer supported through NeXTstep.

General Usability and Interpersonal Computing

With NeXTstep, users having no familiarity with the UNIX operating system can comfortably navigate NeXT's UNIX-based system. They can take advantage of interpersonal computing capabilities, which in NeXT's parlance means a computing environment that promotes group, as opposed to individual, productivity. These capabilities are a direct result of NeXTstep's object-oriented nature, which makes all the features available automatically to any developer writing an application for NeXTstep.

The cornerstone of this group productivity is NeXTmail, an integrated, multimedia electronic mail system that lets NeXTstep users send anything they can create on their computers to any other networked NeXTstep user. Recipients can use the received message on their own computers just as they would any other application, document, sound, image or other information. Using simple text-based contents, NeXTmail users can also communicate through their computers with users of other platforms and mail systems, including UNIX Mail, MCI Mail and many more.

NeXTstep Release 2.x introduced a new approach to faxing documents from the computer — making it as easy as printing a document — as well as a range of other ease-of-use features inherent in the sophisticated GUI.

NeXTstep Release 3.0 takes all its predecessor's interpersonal computing and usability features and pushes them one step further.

Release 3.0 expands the ability to **share files, printers (from various vendors), fax modems and CD-ROM drives among networked users**. For example, incoming faxes residing on a fax server can be viewed by multiple users, rather than only by the user at the machine actually connected to the fax modem. NeXTfax software now includes the ability to create separate cover sheets for each recipient on a distribution list. Release 3.0 also lets networks of NeXTstep users share a single CD-ROM drive, which makes NeXT's CD-ROM distribution of system software a very cost-effective approach.

In addition to the two NeXT printers (the 400dpi Laser Printer and the new Color Printer) and generic PostScript printers, NeXTstep Release 3.0 will support additional popular printers, including Epson and IBM ProPrinter dot matrix printers.

NeXTstep Release 3.0 introduces an integrated, multimedia on-line hypertext **Help** system. This Help feature can provide instant assistance in Release 3.0-compliant versions of NeXTstep applications; users simply click on anything in the application and request Help, and a standard panel appears, offering context-sensitive information. The Help system lets users learn new applications as they work, without taking time out for training.

The new NeXTstep workspace supports both **encryption** and **compression**, for concealing the contents of files or for squeezing them so they take up less disk space. The compression feature, which compresses files into an average of half the space, appears as a selection in the workspace File menu. Encryption is supported in the workspace and in NeXTmail.

Release 3.0's public key encryption capabilities will be especially useful for NeXTmail messages, which often pass through various servers en route to a final destination. In the past, at each stop anyone with access to the mail system could theoretically have read the contents of mail messages. For messages containing sensitive or secure information, electronic mail delivery posed a potential privacy problem.

The public key encryption method works as follows: Users wanting to send sensitive information to one person only, without risking unauthorized access, encrypt the message using the recipient's published "public key." The recipient maintains a completely secret "private key" — a password — that is associated with this public key and that is necessary for decrypting the received file. The machine will only decrypt the message and make it readable for someone who inputs the private key.

System administrators will also see improvements in NeXTstep Release 3.0. In addition to the system administration applications provided in NeXTstep Release 2.x, the new release has *Simple Network Starter*, an application that allows non-expert system administrators to set up a small- to medium-sized NeXT-only network quickly and easily. This new application can configure a computer as a server of mail, home directory files, Local Applications and so on, and allows additional client machines to be connected to the network with no extra configuration.

NeXTstep Release 3.0 also includes an NFS Manager utility for helping administrators to manage exporting and mounting of NFS file systems.

International Capabilities

As the world's markets and communications continue to become global enterprises, computing tools must serve an increasingly international set of customers. In the past, computer vendors manufactured different computers for different languages, so that menus, instructions and other system software-based information would appear in German, French, Spanish and so on. This is how NeXTstep Release 2.x worked. Application developers were generally left to their own devices to "localize" their software for specific countries, and frequently this localized software was run on computers whose system software still "spoke" in English.

As a direct result of NeXTstep's object-oriented construction, NeXTstep Release 3.0 introduces a revolutionary advance in **global computing**: All applications shipped with NeXTstep computers can be set by the user for English, French, German, Italian, Spanish or Swedish. (In Japan, NeXT users will be able to work in both English and Japanese.) The choice is part of NeXTstep's standard Preferences menu, so users can switch back and forth at will among all the languages available. Users can even run multiple applications in different languages.

This capability means that menu items, panels, sounds and everything else users see and hear through NeXTstep will be internationalized. Except for the Japanese Kanji system, which will be distributed separately, the software required for this instant localization will be bundled with all NeXTstep systems.

NeXTstep Release 3.0 will also make it easier for application developers to localize their applications for different languages. New Interface Builder and Project Builder applications support localization activities, and a new object (NXBundle) and methods in the Application Kit support the access of localizable resources such as images, interface files and sounds.

Custom Application Development

With Release 2.x, NeXTstep's custom application development has already been hailed as the best in the industry. Most of the credit goes to the powerful and complete Application Kit objects and to Interface Builder, which lets developers graphically edit the objects in a software application using little or no programming.

NeXTstep's custom application capabilities are even stronger with Release 3.0's additional software object kits, described earlier in this document: Database Kit (DBKit), for quickly constructing graphical database applications that are independent of any specific database engine; 3D Graphics Kit (3DKit), based on Pixar's RenderMan standard, which provides photorealistic images and on-screen manipulation of three-dimensional objects; and PhoneKit, for taking advantage of high-speed voice and data transmission such as ISDN.

In a major extension of its object-oriented paradigm, NeXTstep Release 3.0 also introduces **Distributed Objects**. With the advent of Distributed Objects, developers can not only send messages between objects within a single application, but also send those same messages between different applications, machines and networks. As a result, a new generation of work group applications becomes possible.

Many features of Release 3.0, including the Workspace Manager, text objects, spell checking mechanism and others, rely extensively on Distributed Objects. In addition, Distributed Objects are the basis of **NeXTlinks**, a multimedia hyperlinking system that helps work groups share dynamic information. With NeXTlinks, documents can share information such that changes made in one document are automatically reflected in the linked document.

These powerful data links, made possible through Distributed Objects, make it easier for work groups to produce collaborative documents and to be sure that they are always working with the most current information.

Future Implications

For the past three years, NeXT has proven that object-oriented programming and object-oriented system software are not more pie-in-the-sky examples of industry hype. With Release 3.0, NeXT has once again raised the bar for the entire industry, setting a standard that others must follow to compete.

NeXT has also taken an important new step with its object-oriented system software: It has opened it up to platforms beyond its own through NeXTstep 486. NeXTstep 486 is a version of NeXTstep 3.0 that can run on computers based on Intel's 80486 processor, one of the most popular processors in the personal computer world. NeXTstep 486 takes all the application development and user capabilities that have made the object-oriented NeXTstep revolutionary, and opens them up to the huge installed base of 486 users. The implications of this move for the computer industry are dramatic.

As soon as programmers, both commercial and in-house custom application developers, discover first-hand how an object-oriented environment can revolutionize their lives, they never turn back willingly to the old ways. NeXT is committed to the continued improvement of NeXTstep to meet the evolving demands of end users and application developers.

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