The NeXT Computer: Upping the Ante for Desktop Computing

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Through his choice of name, Steve Jobs has made it difficult to predict anything less than a bright future for the NeXT computer. The computer's combination of innovative hardware features and a sophisticated software strategy lend credibility to its presumptuous nomenclature.

The Revolutionary Strikes Again

When Jobs introduced the Macintosh in 1984, he revolutionized the way people use computers. Character-oriented personal computers (the only choice, prior to Macintosh) required users to know cryptic commands and to understand the organization of the computer. The icon-based Macintosh interface — together with its superior graphics — allowed users to work with more intuitive actions, like pointing, and operate on familiar objects, such as files and folders.

After three years of top-secret development — and with the curiosity of the computing community piqued — Jobs is leading a new revolution. This time, the message to users is more subtle, because it will take time to bring the full power of the NeXT computer to a mass market, but the end result — changing what people can do with computers — is no less grand.

The original Macintosh made using a computer simple; the NeXT computer enables users to create intelligent, multimedia applications. While the NeXT software environment is likely to attract developers, the NeXT computer will not see widespread use until a critical mass of commercial applications is available.

Bulletin

DATE:	November 1988
IDC #:	3803
FILE UNDER:	Technical Computing
VOLUME:	1
TAB:	November

Issued under other IDC programs

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A Computer for Academics

The NeXT computer is initially targeted at the higher education market. The product evolved from the wish list of NeXT's advisory board, which is made up of representatives of 23 U.S. universities. This list included:

- An easy-to-use version of Unix
- 5 MIPS, fast floating point, array processing
- 8 MB RAM, 100+ MB disk
- A unified imaging model (for display and printing)
- High-resolution display
- Fast, transparent networking
- Sound
- Expandable into the 90s
- Small, cool, quiet, and reliable

To make these educators' dreams come true, Jobs unveiled a "personal workstation" with impressive features: erasable optical storage, CD-quality sound, and a PostScript imaging model used by both the display and the printer.

Two custom VLSI chips support these hardware features by offloading memory transfers from the CPU. This design approach, adapted from mainframe architecture, dramatically increases total system throughput, and allows the CPU to operate closer to its highest MIPS rating.

A Look Inside The Cube

The new computer system from NeXT, Inc. uses three Motorola chips, each running at 25 MHz: the 68030 CPU, 68882 floating-point unit, and 56001 digital signal processor, which supports compute-intensive processes such as sound synthesis (see Table 1).

Also standard with the system are 8MB RAM (expandable to 16MB), and a 256MB erasable optical disk, which is controlled by a custom VLSI chip called the Optical Storage Controller. These components are connected through the Integrated Channel Processor, a VLSI chip that provides 12 direct memory access (DMA) channels to manage input and output for the system. Together, NeXT claims these two chips allow the computer to achieve system throughput of 32 MB/second.

The product features a 17″ high-resolution display with CD-quality sound built into the monitor. A 400dpi laser printer and Winchester disk drives (330MB and 660MB) are optional to the system.

The Rolls Royce Of System Software

The operating system for the NeXT computer is Mach, a Berkeley-compatible Unix variant originally developed at Carnegie-Mellon University. Mach, chosen for its strength in interprocess communication, together with Sun's NFS, provides the foundation on which the computer's window-based, object-oriented user environment is built.

This environment, called NextStep, provides a friendly interface for users and sophisticated tools for developers. NextStep is a modular, tightly integrated environment that encompasses the layers of software architecture between the Operating System/File System and the Application (see Figure 1).

The Window Server, like X Windows, is based on a client-server architecture. It features a built-in PostScript interpreter, which provides true WYSIWYG (What You See Is What You Get) — images on the screen look like printed images. The Application Kit contains the objects from which sophisticated applications can be built. This kit can be augmented with objects created by a programmer using the object-oriented programming lan-

Table 1

NeXT Inc.'s Standard Product Features and Pricing

Standard Features		
CPU	MC68030	(25 MHz)
Floating Point	MC68882	(25 MHz)
Digital Signal Processor	MC56001	(25 MHz)
Main Memory	8-16 MB	
Optical Disk Storage	256 MB	
Integer Performance*	5 MIPS	
System Throughput	32 MB/sec	
Monitor Size	17″ Monochrome	
Expansion Bus	NuBus**	
Sound	44.1kHz, 16-Bit Two-Channel	
Audio		
Other Features:		
Integrated Channel Processor with 12 DMA channels		
Optical Storage Processor		
Built-in SCSI Controller		
Software Availability***		
Release 0.8	10/88	
Release 0.9	1Q/89	
Release 1.0	2Q/89	
Pricing	$6,500†	
Options		
400 dpi Laser Printer	$2,000†	
330 MB Winchester††	$2,000†	
660 MB Winchester††	$4,000†	

Source: International Data Corporation, 1988

*Based on performance of MC68030

**NuBus operates at 25 MHz.

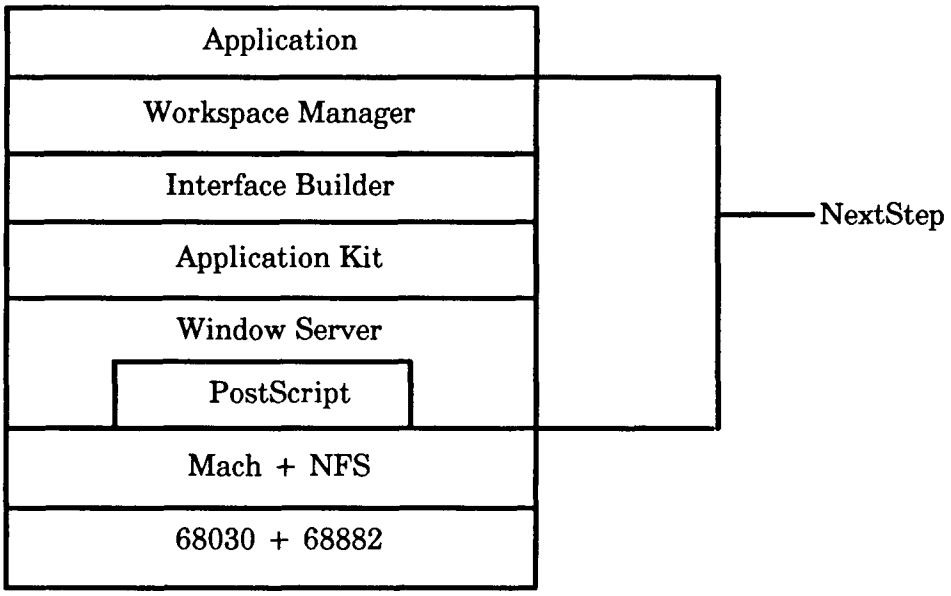
***Available to key customers and developers 4th quarter 1988

†Prices quoted are for higher education

††380 MB and 760 MB unformatted

Figure 1

Software Architecture of the NeXT Computer



Source: International Data Corporation, 1988

guage, Objective-C, from Stepstone Corporation, of Sandy Hook, CT.

The Interface Builder allows a user to graphically define relationships between objects (from the Application Kit or programmer-defined) and operations that may be performed on those objects, thus providing an intuitive way to create sophisticated programs.

The Workspace Manager provides the means for a user to navigate painlessly through the file system, masking the traditional Unix interface. Although the user interface itself provides no major breakthroughs in ease of launching and using applications, it does provide the software developer with a much friendlier environment, where clean, object-oriented design is a must and objects (meaning data and code) are continually reused.

The Application Kit, from which user interfaces for most applications can be built, allows programmers to create a highly functional application user interface using only 18 objects. This is considerably simpler than learning the 400 subroutines necessary to do the same on the Macintosh. By making the computer easy to program, Jobs is hoping to bring market momentum to the NeXT development platform.

Will The Real User Interface Please Pop Up?

Future user interfaces will likely be object-oriented, like the Macintosh, but, unlike the Macintosh, they will be tightly integrated into the operating system and development environment. The NeXT computer, with its consistent user and application interface, is the first to present such a high degree of integration; it will likely be emulated.

Perhaps NeXT has upped the ante for user interfaces. IBM, for example, has licensed NextStep. This could result in IBM's AIX machines looking like the the NeXT computer

down to, and possibly including, its proprietary window server. Considering IBM's sponsorship of the Open Software Foundation, this raises important ramifications for OSF and its intent to provide a standard user environment component (including X Windows) for Unix. IDC's Unix Program will follow these issues closely in the coming months.

Will NeXT's next step be to license NextStep liberally, thereby trying to create a de facto industry standard? Or does NeXT plan to share NextStep with IBM only?

What's NeXT For Applications?

The NeXT system includes system software, application development tools, the NextStep environment, and application kits for sound and music. Additionally, the system ships with a number of applications (see Table 2) and a Digital Library, including Webster's dictionary and the complete works of Shakespeare. On the commercial side, several ISVs (including Lotus) have announced intentions to create products on the NeXT platform.

First "Knowledge Navigator"

The NeXT Computer System has eclipsed much of the work Apple is involved in today. Steve Jobs' company has beaten Apple to the punch in announcing the industry's first "Knowledge Navigator."

The Navigator, imagined a few years ago by Apple, was John Sculley's concept for a multimedia system that combined graphics, text, sound, animation, and video. While Apple and its third-party developers have clearly made much progress with HyperCard and CD-ROM on the Macintosh, Apple has not yet combined all five elements into one integrated system. However, IDC believes Apple may be able to counter with a product similar to NeXT's in the mid-to-late 1989 timeframe. Other companies, such as Sun, may also provide similar products in late 1989.

Virtually all of the "insanely great" features of the NeXT Computer System are available on other systems today; the two hitches are the pricetag (much higher from other vendors) and the difficulty of configuring such a multimedia system from disparate sources. IDC concurs with NeXT on this

Table 2

Software Applications Bundled with the NeXT Computer

Application	Developer
Digital Librarian	NeXT
Electronic Mail	NeXT
Jot	NeXT
WriteNow*	NeXT
Mathematica	Wolfram Research Inc.
NeXT SQL Database Server	Sybase, Inc.
Allegro CL Common Lisp	Franz, Inc.

Source: International Data Corporation, 1988

*The Macintosh version of this program is marketed and distributed by T/MAKER of Mountain View, CA.

point at least: the whole is indeed greater than the sum of its parts.

You've Gotten our Attention!

While the $6,500 pricetag is clearly too high for students to pay for themselves, it is remarkably aggressive for the functionality delivered. IDC has chosen to contrast the NeXT Computer System with systems from Apple and Sun, for two reasons:

1. Apple and Sun have large installed bases and well-defined distribution strategies for the education segment.
2. Both Apple and Sun offer ease-of-use features similar to NeXT's, so that academics are likely to evaluate them side-by-side.

List price comparisons show NeXT costing anywhere from one-third to two-thirds the price of comparably configured Mac IIs and Suns — a dollar savings that could enable universities to purchase two NeXT systems for the price of one Apple Mac IIx or Sun386i Model 250.

However, to be fair, IDC feels compelled to make two observations regarding price points:

1. NeXT's quoted price assumes at least a partial university discount, while Apple and Sun prices are list prices for end-users, and therefore could be slashed as much as 30-50% for university users. Consequently, Apple's Mac II could conceivably cost less than Steve Jobs' newest computer (see Table 3).
2. NeXT offers greater entry-level disk storage (256MB) than either Sun or Apple. The corresponding risk for NeXT, of course, is that the storage medium is so revolutionary, there's no floppy — 3-1/2″, 5-1/4″, or otherwise.

   That strategy certainly encourages the use of networks (no more "sneakernet"!), but it also makes software distribution tricky. NeXT's founders are betting that the company can set a new standard in software distribution and storage technology. It's conceivable that software vendors of the 1990s will distribute their software on erasable magneto-optical disk drives (MODD), not much different than the one NeXT debuted with its system.

Focus, Focus, Focus

It doesn't seem possible for any company offering this set of functionality for such a low price to turn much of a profit short-term, but with its financial backing, NeXT can afford to plant seeds for the future.

NeXT has identified these targets in higher education:

- **3,330 Academic Institutions**, including junior colleges, four-year liberal arts universities, and primary research institutions (i.e., those which grant PhDs). NeXT figures an average of 13+ departments within each institution, for a total of 45,000 groups.
- **More than 12 million students**, and 600,000 faculty members.
- Plus, an unquantified number of **independent researchers, hospitals, and national laboratories**.

NeXT's limited target market makes it impossible to achieve the high unit volumes currently enjoyed by companies like Apple and Sun Microsystems. Considering the availability of system software (Release 1.0 scheduled for second quarter 1989), IDC figures the company will ship no more than 20,000 systems total during calendar 1989. Compared to the Macintosh's first year shipments (230,000 in 1984), the NeXT computer is a slow starter.

To become a long-term computer supplier (which everyone knows means becoming a billion dollar company sometime in the 1990s), NeXT must clearly move beyond the

Table 3

Comparison of Monochrome Systems, NeXT vs. Apple and Sun

Feature	Apple Mac II	Apple Mac IIx	NeXT, Inc. NeXT	Sun 386i/250	Sun Sun-3/60
CPU Type	16MHz 68020	16MHz 68030	25MHz 68030	25MHz 80386	20MHz 68020
Floating Point	16MHz 68881	16MHz 68882	25MHz 68882	25MHz 80387	20MHz 68881
Dig. Signal Proc.	None	None	25MHz 56001	None	None
Main Memory (MB)	4-8	4-8	8-16	8-16	4-24
Disk Storage (MB)	40-1,000	80-1,000	256-1,300	91-981	71-1,300
Type of Disk	Magnetic	Magnetic	Magneto-optic	Magnetic	Magnetic
Floppy Disk	800KB	3.5", 1.44MB	None avail.	3.5", 1.44MB	IPC (opt.)[1]
Tape Storage (MB)	40 (opt.)	40 (opt.)	None[2]	60	60 (opt.)
Expansion Bus	NuBus	NuBus	NuBus	AT compat.	VMEbus
No. & type of slots	6 32-bit	6 32-bit	3 32-bit	3 16-; 1 8-bit	2 32-bit
Operating System	Mac OS[3]	Mac OS[3]	Mach (Unix)	SunOS (Unix)	SunOS (Unix)
Imaging Model	QuickDraw	QuickDraw	Disp. Post.	Postscript[5]	Postscript[5]
No. Apps Supported	2,500	2,500	7	250+	1,750+
Integer perf.[4]	2.0 MIPS	2.3 MIPS	5.0 MIPS	5.0+ MIPS	3.0 MIPS
First shipments	04/87	10/88	2Q/89[6]	07/88	10/87
Pricing[7]					
12" mono	$9,493[8]	12,699[8]	N/A	N/A	N/A
17" mono	N/A	N/A	6,500	N/A	N/A
19" mono	N/A	N/A	N/A	15,990	17,900
Est. Univ. Cost[9]	5,696	7,619	6,500	9,594	10,740

Source: International Data Corporation, 1988

[1]IPC is Sun's IBM PC AT-compatible coprocessor with optional floppy subsystem.

[2]Tape-like storage is offered by NeXT on the 256MB removable optical disk, although that is not a cartridge tape drive in the traditional sense.

[3]Apple offers A/UX (Unix) on Mac II systems; pricing is somewhat different.

[4]Vendor claims, or estimated by IDC.

[5]Sun did not license Postscript from Adobe Systems; their imaging model is Postscript-compatible.

[6]Available to key university customers and developers 4Q/88.

[7]Pricing is for diskfull configurations with minimum amount of disk storage (see above) and 8MB memory. All specs listed in table are considered standard for the price indicated, unless otherwise noted as an option. Education discounts range from 30-50% for both Apple and Sun; NeXT is unlikely to discount more than 15%.

[8]Apple pricing reflects an additional $2,399 for the 4MB Mac II memory expansion kit, to total 8MB memory.

[9]Estimated cost to universities assuming above configurations and 40% across-the-board discounts from Apple and Sun.

limited higher education market. To be successful, IDC believes NeXT must meet the following challenges:

1. **Distribution.** Sun and Apple are already installed in the nation's colleges and universities; can NeXT replace and/or complement those existing systems? Further, can the company target specific niches within higher education (junior colleges, for instance) that others may have missed?

2. **Applications software.** Like Apple, NeXT bundles a respectable amount of software with its system. But that's not enough. NeXT must reach a critical mass of software packages — judged not by **quantity**, but by **quality and type** of software available.

3. **Create a new standard** (or the perception of one). In today's computer market, where open systems and portability are key elements of product acceptance, NeXT must convince users that its technology is not **too** leading-edge. Bluntly put, NeXT has to set a new industry standard, and that means raising what Steve Jobs calls the lowest common denominator. Users in non-university environments must be confident in NeXT's ability to co-exist with other existing desktop systems, and to access the myriad of DOS and Mac applications used today.

IDC's predictions: Within the next 12-18 months this machine will be released to a salivating commercial market at double the stated university price. Expect further functionality to be added: facsimile and modem capability; color; and imaging and 3D graphics. And watch NeXT lead a wave of next-generation multimedia systems that redefine the meaning of computer.