Desktop Technology Frontier: Deploying an Office of NeXT Workstations as the Administrator's Workstation of the Future

Noam H. Arzt, *Data Communications & Computing Services*
M. Katie McGee, *School of Arts and Sciences*
University of Pennsylvania
Philadelphia, PA

December 4, 1992

The NeXT workstation represents the state of the art in graphical user interfaces for desktop computing. The University of Pennsylvania's School of Arts and Sciences recently deployed NeXTstation in the Office of the Dean for the dean and her staff. In conjunction with the Office of Information Systems and Computing, Penn's central computing division, the School of Arts and Sciences evaluated Macintosh and DOS-based desktops and decided that NeXT represented the best environment for this strategic office. This presentation will review the planning and implementation process, as well as provide a live demonstration of this ground-breaking software environment.

Introduction

The University of Pennsylvania (Penn) is a large private research University located in Philadelphia, Pennsylvania. The University consists of 12 schools (enrolling over 22,000 students), 5 resource centers, and a number of administrative centers. The University employs approximately 17,000 faculty, administrative staff and other workers, and is the largest private employer in Philadelphia. Its annual operating budget exceeds $1.5 billion.

Computing at Penn is decentralized due in part to the technological trends as well as Penn's responsibility center approach to budgeting. Both the central administration and the schools provide technology services to their clients. Centrally, Information Systems and Computing (ISC) provides enterprise-wide leadership and services to the University community. Operationally, ISC is responsible for maintaining critical services such as the network backbone, enterprise wide transactional systems such as payroll, and the library's electronic card catalog. Initiatives for improving research, instruction, and administration both "bubble up" from the schools and "bubble down" from the ISC. The formal and informal initiative process often results in vendor relationships such as site licensing, conferences and product show-casing.

At the school level, the mission of Arts and Science Computing is to promote the use of information technologies to help the School achieve its educational and research goals. The School of Arts and Sciences (SAS) is the largest school at Penn. It has 28 academic departments several academic programs, over 700 faculty members, and more than 10,000 undergraduate, graduate, and continuing education students.

Under the direction of the Associate Dean for Academic Computing and the Associate Dean for Administration, SAS Computing provides centralized academic and administrative support for the school. This organization supports faculty, staff and students in the areas of research, instruction, and administrative computing. Because of the size of the School, SAS Computing mirrors many of the central computing services. One of the computing services within the School is provided by Technology Integration Services (TIS). The function of this organization is to provide the School with project management, office automation and business re-engineering functions that take advantage of changes in technology.

Penn has a commitment to Total Quality Management. This systematic approach seeks to achieve the highest level of quality and competitiveness through the ongoing improvement of services. Business re-engineering employs a similar methodology but services different functions. As defined by James Martin, business re-engineering is "the fundamental analysis and radical redesign of the business processes, jobs, structure and control to achieve dramatic performance improvement in cost, quality, service and speed."[1] This methodology provides a vehicle to restructure what we do and evaluate what information we keep. The benefits are improved customer satisfaction, improved efficiency, and higher quality work.

[1] James Martin & Co., *Business Re-engineering Overview: Student Guide* (July, 1992), p. 2-8.

The Problem Defined

Earlier in the year, the Office of Technology Integration Service was asked to assist the Dean's Office in determining its technology needs and improving work flow and communication in the office. The personnel in the office consist of the dean, three associate deans, an executive assistant, an office manager, and five secretaries. All the support staff and several of the administrators had computers on their desktops at the time of the review. These were IBM-compatible machines that were asynchronously connected to PennNet, the campus network, but did not participate in a work group network. The asynchronous connections provided them access to University and School services such as Student Records, Library and host-based electronic mail.

One of the first tasks TIS undertook was a client assessment. This evaluation assessed the clients' needs, their use of technology, and the level of comfort they had with their current computing environment. The following areas were determined to be the most troublesome: inter-office communications; document sharing; paper mail processing; calendaring and event scheduling; and document retrieval.

The next task was to ascertain what were the most important tools required to perform their jobs. In addition to the basic tools like word processing and spreadsheet, it was determined that the office would benefit most from group software that would allow them to exchange and share information in a quick and easy fashion. It was found that their work flow could best be improved by finding appropriate products for electronic mail, electronic calendaring, and database management systems. Additionally, it was determined that significant advances in the ability to retrieve information could be made through the use of document imaging technology. This would also provide them with a vehicle to track work that both came into and flowed out of the office.

The general underlining requirement for all of these products was that they had to be easy to use and easily be integrated with one another. Any knowledge that could be transfered from the use of one product to another would be an added and welcome benefit. The introduction of a GUI (Graphical User Interface) environment was encouraged because it would make the technology easier to learn and use.

Organizationally, the support staff reported to the Office Manager and she was responsible for the delegation and review of all work assignments. The reason for central work distribution was to enable the office to track the progress of work. Since the support staff worked as a pool, assignments were often initiated by one individual, reviewed by a second, and finalized by a third. As part of the work flow analysis, it was essential to determine how the work was currently handled. This step by step flow of the work allowed the client to inspect the number of participants in the process, to determine the number of workers necessary to complete a task, and to make recommendations on how to change and properly automate the work.

We chose the NeXTstation and NeXTstep as the solution for the Dean's Office. These are some of the specific challenges we faced:

Inter-office communications: Because of the demanding schedules of the dean and the associate deans it was often difficult for them to discuss problems and share information. They were looking for an easy and reliable way to communicate with a minimum of meetings and scheduled appointments. At the time of the review, two of the associate deans and a few of the support staff were using electronic mail while the others either had not been introduced to the technology or had been frightened away due to the complexity or unfriendliness of prior systems. The basic requirements for electronic mail were, therefore, that it had to be easy to use, allow for printing of documents, and be accessible from home as well as from the office.

Network services: Since the office did not participate in a work group network, network services were not being utilized. All typing was saved on diskettes and most were purged after two months. This prohibited the sharing of text from one document to the next and resulted in substantially more typing.

Calendaring: The dean and associate deans each had a secretary assigned to maintain their calendar. Calendars were maintained in appointment books. Each individual secretary was responsible for arranging and canceling appointments and making copies of the weekly and daily calendar for their assigned dean. The time needed for this task ranged from a few hours a week to a full-time responsibility and did not provide the deans with the flexibility they desired.

Paper Mail Processing: Approximately 70 pieces of mail were delivered to the Dean's Office each day. This mail was date stamped, logged in a notebook, placed in a folder, and then sent to the office manager who sorted and read all the mail before placing it in an appropriate folder. The mail was then forwarded to the Executive Assistant for review who made any necessary changes to the routing and work assignments before giving it to the Dean. After the Dean completed her review, the mail was returned to the Office Manager for distribution and re-logging via the Executive Assistant. A minimum of four people were involved in the processing of mail before action was taken and the process took up to one and one-half days for a given item.

Looking for a Solution

Three different operating system environments were considered for deployment in the Dean's Office: Microsoft Windows (version 3.1) running on an Intel microprocessor; Apple's MacOS Operating System (version 7.0.1) running on a Motorola-based Macintosh; and NeXT's NeXTstep operating system (version 2.2) running on a Motorola-based NeXTstation. While all three of these systems presented graphical user interfaces to the user, they were strikingly different in quite a number of ways.

A careful comparison of a standard set of attributes was done. These attributes included issues of system functionality, "friendliness" to the user, server attributes in a work group environment, networking functionality, system administration, and cost. The following discussion highlights the major factors that were examined and compared between these platforms and forms the basis of the decision that was reached to deploy NeXTstations for this office.

		MS-Windows PC	Apple Macintosh	NeXT
Typical Applications	Word Processing	**Better**	**Better**	**Good**
	Electronic Mail Interface	**Better**	**Better**	**Best**
	Spreadsheet	**Good**	**Good**	**Best**
	Work Group Database	**Better**	**Better**	**Good**
	Desktop Publishing/Compound Documents	**Good**	**Better**	**Better**
	Group Calendar Management	**Better**	**Better**	**Good**
	Document Imaging	**Good**	**Good**	**Good**
	Multimedia	**Good**	**Good**	**Good**

Figure 1: Comparison of Typical Applications

The first comparison focused on typical end-user office productivity applications. All three platforms clearly performed the basic office functions well (word processing, electronic mail, spreadsheet, database). NeXT, however, offered a clearly superior set of applications in electronic mail and spreadsheet. NeXTmail is the best of its kind in multimedia mail, with drag and drop enclosures, sound editing, and easy to use menus and filing. Lotus Improv, only now in beta test under MS-Windows, offers the state of the art in financial modeling with its multi-dimensional, fluid approach. For more conventional "rows and columns" users, Wingz and Mesa (a NeXTstep-only product with Lotus 1-2-3 macro support) are also available.

In some of the more advanced categories, MS-Windows began to wane. Desktop publishing/compound document creation has been in the Macintosh domain for several years now, despite the recent multimedia push under MS-Windows. NeXT has tried to maintain parity with Macintosh with its port of FrameMaker, the standard Unix workstation page layout product, and with new products like Pages and Create!. In some categories, Macintosh and MS-Windows showed their market leadership with more variety and more mature products than NeXT (database, group calendar). Document imaging and multimedia were not major focuses in the initial selection process, but were included as items of consideration. In the absence of more thorough analysis, it is sufficient to say that all three platforms are both imaging and multimedia enabled.

			MS-Windows PC	Apple Macintosh	NeXT
Networking	Internetworking	Remote host access	**Good**	**Better**	**Best**
		Access to data and services	**Poor**	**Better**	**Best**
	Access from Remote Locations		**Poor**	**Good**	**Good**

Figure 2: Comparison of Networking Attributes

The second set of attributes concerned networking functionality. The focus of this part of the analysis was on evaluating each workstation as a "window to the world," particularly the Internet. Additionally, it was important to see how easily this "window" could be "opened" from a remote (typically off-campus) location. Since the standard protocol of the Internet is TCP/IP, this section examined how the various workstations could function using TCP/IP protocol and products. The functions were divided into two groups: remote host access (using implementations of things like telnet and tn3270 emulation products); and access to Internet-based data and services (like Gopher, WAIS, other specialized data sources).

All three platforms performed remote terminal emulation, usually through the help of third-party software applications that are either available as free-ware or as commercial products. The NeXT stood out, however, in having both VT100 and 3270 emulation software built in, since the standard TCP/IP tools are part of the bundled implementation of Unix. Commercial products are also available where greater functionality is required.

In terms of access to specialized data services on the Internet, more differences appeared. Due to the lack of a "standard" TCP/IP implementation for DOS-based machines, what Internet client software that does exist for MS-Windows relies upon a variety of TCP/IP products, often requiring a reboot of the machine between using different products. Additionally, configuring an MS-Windows machine for network access is still very much an individual machine effort. Macintosh applications are almost uniformly written to run on top of MacTCP, Apple's implementation of TCP/IP that has been made available cheaply to colleges and universities in particular for several years. This has led to the creation of a number of good Internet clients that run uniformly on most Macintoshes. The NeXT ships with TCP/IP built in, so a standard has been set for which applications can be developed. Given the nature of the NeXT's true multitasking, and its implementation of a Graphical User Interface, the client applications written for the NeXT in this area tend to be well constructed, feature rich, and easy to use, even more so that their Macintosh counterparts.

Access from remote locations is primarily a requirement for those who want to work from home. In an ever-increasingly network-dependent world, this is usually summed up by users is one sentence, "I want to be able to do everything I do at work from home the same way I do it at work." For MS-Windows, there are no real choices to allow robust access to campus-based services from home. For Macintosh, two solutions exist, one based on Macintosh network protocols and one based on TCP/IP. The NeXT has the TCP/IP option only. Either way, the Macintosh and NeXT provided appropriate remote access functionality.

			MS-Windows PC	Apple Macintosh	NeXT
Server Functions	File Sharing	Server-based	**Good**	**Good**	**Good**
		Peer-to-peer	**Developing**	**Better**	**Good**
	Printer Sharing	Server-based	**Good**	**Better**	**Better**
		Peer-to-peer	**Developing**	**Better**	**Better**
	Networked FAX Gateway		**Good**	**Developing**	**Best**

Figure 3: Comparison of Server Functionality

The third set of attributes is server functionality. This is divided up into three functions: file sharing, printer sharing, and shared, networked FAX gateway. Additionally, printer and file sharing are divided into two possible styles of implementation: server-based, where there is a central server that delivers the service to all the desktops; and peer-to-peer, where individual user workstations provide access to their own local disks and printers, and gain access to the local disks and printers of other workstations. The server technology for MS-Windows is presumed to be Novell NetWare; for Macintosh it is presumed to be AppleShare; for NeXT it is presumed to be the standard Unix NFS and LPR.

All three platforms can deliver reasonable good server-based file sharing. Performance differs to a degree between the three, but they are all reasonable implementations. Macintosh and NeXT far surpass MS-Windows in peer-to-peer networking available, which is especially critical for smaller or simpler installations. Windows for Workgroups hopes to narrow this gap, but it is too soon to tell. Macintosh has always come with AppleTalk built-in, and System 7 has extended the capability of any Macintosh to "publish" all or part of its disk to any other Macintosh (or NeXT) user with password protection. Printer sharing with Macintosh is even easier. NeXT relies on standard disk-sharing NFS and printer-sharing LPR, and has some management tools to make setup easy. This same set of protocols enables either server-based or peer-to-peer networking, and the NeXT has the added functionality of not only being a universal server to all these platforms (i.e. both Macintoshes and PC's can be NFS or LPR clients), but comes with NetWare and AppleShare clients built into NeXTstep.

Currently, MS-Windows and NeXTstep support shared FAX gateways. This allows a network of users on different workstations to share a single (or multiple) FAX's for sending and receiving. Shared network FAX gateways for Macintosh are just now coming to market.

		MS-Windows PC	Apple Macintosh	NeXT
General Attributes	Ease of Use of Typical Application	**Good**	**Better**	**Better**
	Application Integration	**Good**	**Good**	**Best**
	Cross-Platform Interoperability	**Poor**	**Better**	**Best**
	"Mainstream" Product	**Yes**	**Yes**	**No**
	Vendor-Independent Hardware	**Yes**	**No**	**Not for long**
	Vendor-Independent System Software	**No**	**No**	**Somewhat**

Figure 4: Comparison of General Attributes

The fourth set of attributes is a set of general attributes. These factors usually weigh in to a decision once a system meets the basic functional requirements. The MS-Windows PC does adequately when it comes to ease of use and application integration across the windowing environment, and the Macintosh a little better, but the NeXT surges forward in application integration (including the inter-application messaging that MS-Windows and System 7 are promising for the future). Macintoshes have for some time been carrying the burden of DOS-MacOS interoperability (through DOS diskette utilities, and products like SoftPC), but the

NeXT goes one step further by providing both Macintosh and DOS hard disk/diskette support, as well as NetWare and AppleShare file support across the network.

Probably the biggest problem NeXT has is that it is not perceived to be a "mainstream" product, largely due to market share. Like the Macintosh, the NeXT's software environment runs on proprietary hardware (though an Intel 486-based version of NeXTstep is in beta right now!). Being hardware dependent on a single vendor is even worse when one is also software dependent (Macintosh). MS-Windows will run on many vendors' hardware. NeXTstep, on the other hand, has a relatively standard version of Unix (BSD 4.3) at its core, making it much like other Unix systems.

		MS-Windows PC	Apple Macintosh	NeXT
Set-up and Administration	Stable and Reliable Software Environment	**No**	**Yes**	**Yes**
	Easy to Configure	**Hard**	**Easiest**	**Easy**
	Easy to Network	**Hard**	**Easy**	**Easy**
	Easy to Learn	**Harder**	**Easiest**	**Easy**
	Easy to Support	**Hard**	**Easiest**	**Easy**
	Easy to Administer	**Hard**	**Easiest**	**Easy**
	Ability of End-user to Control Desktop Resources	**n/a**	**Yes**	**Moderately**

Figure 5: Comparison of Set-up and Administration

The next set of attributes, set-up and administration, is even more striking. It becomes clear here that MS-Windows is hard to install, run, and maintain. It is relatively unstable compared to Macintosh and NeXT, and requires substantially more support effort (and therefore cost). Macintosh was by far the easiest, but the real question is whether the additional effort and learning to support a cluster of NeXT's is justified by the additional functionality one receives. Finally, while an MS-Windows user is unable to provide, let alone control the use of local resources by others (again, leaving Windows for Workgroups aside), Macintosh users do this with ease (perhaps too much ease for security's sake) and NeXT users do this easily, but often with system manager intervention.

			MS-Windows PC	Apple Macintosh	NeXT
Costs	Hardware	Total	$3,970	$4,483	$4,547
	Software	Total	$334	$310	$564
	Total		**$4,304**	**$4,793**	**$5,111**

Figure 6: Cost Comparison

The differences in cost for these systems was not as substantial as one might have

guessed. The MS-Windows system priced here consists of a PC-clone based on a 50MHz Intel 80486DX processor, 16MB RAM, 170MB disk, and 21" high resolution monochrome monitor. The Macintosh is a IIvx with a 32MHz Motorola 68030 processor, 16MB RAM, 230MB disk, 21" high resolution monochrome monitor. The NeXTstation Turbo is based on a 33MHz Motorola 68040 processor, 16MB RAM, 250MB disk, 17" MegaPixel monochrome monitor. The intent here is to select a reasonable configuration for each environment. Some might argue that Macintosh Quadra is a better comparison for the other two systems; this would significantly raise the price for the Macintosh configuration. The software cost is for a typical set of applications as described in the requirements and comparisons above.

Platform Selection

After careful analysis, the NeXT was chosen for installation in the Dean's Office. Its strengths in multimedia mail and spreadsheet applications, as well as networking and application integration, made it the best choice for an office that values ease of use above all else. Cost was certainly a factor, but it was felt that performance and functionality differences still made the NeXT a better buy over the Macintosh, the other leading contender.

Implementation

The introduction of a multimedia electronic mail system provided the client with the basic needs plus much more. All of the staff have taken extremely well to electronic mail as a primary method of communication within the office. Telephone messages can be recorded through a mail message instead of on pink slips allowing each person access to all their communications though a single interface either in the office or away. Internal office meetings have been reduced by more than half and the timely dissemination of information has increased significantly. This use of technology has changed the way the office communicates.

Through the use of an office file server, documents are now stored online and are easily accessible by members of the office. In the spring a shared fax gateway will be installed which will allow all users to send a fax directly from word processing without having to make a printed copy. This convenience will save time and reduce costs. Software is also provided on the server, making it very easy to update to new versions with only a single physical installation required.

Through streamlining the incoming mail process, and utilizing database and imaging technologies, we anticipate reducing the number of individuals involved in the handling of incoming mail by half and reducing the time to perform this task by two thirds. To date, the database technology has been implemented to automate the log in process and to provide easy tracking. Imaging technology will be implemented in the spring to allow mailing of copies to interested parties and reduce the time and cost of copying and paper distribution.

Through online work group calendars several people have access to calendar simultaneously, including the deans. Appointments can be made and changed in one location. The application also provides an easy method of printing schedules, if necessary.

With the introduction of the change in technology the single most difficult factor that needed to be addressed was the resistance many people had to changing the manner in which they perform their work. It was clear, however, that in order to take full advantage of the new

technology it was essential to make this change. Using the NeXT, we have customized the desktop of the office members to make it easier, more efficient and more appealing for them to work.

Because of the GUI environment and the common structure of applications, we were able to complete initial training within a short period of time. Three ninety minute hands-on training sessions were held over the first week. These included basic computing, electronic mail, word processing, database management, and network basics. Within two days of the conversion to NeXT's and only the basic applications being utilized, work was flowing in and out of the Dean's Office well and the office was adapting to the new way of business.

Conclusion

This has been a true success story because people are using the new technology to improve the way they do their work. The changes in the technology have allowed for the opportunity to review the work flow, to make significant improvements, and thereby increase the quality of the work of the Dean's Office. Over the next few months several new applications will be introduced to the office including imaging technology. These changes will allow us to make better use of our staff and their time and improve our ongoing commitment to better service.

Reference

James Martin & Co. *Business Re-engineering Overview: Student Guide* (July, 1992).