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Editor-in-Chief
Michael A. Goulde

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Unix and PC Interoperability

Toward the Utility Era of Computing

By Stanley H. Dolberg

IN BRIEF: Users struggling to piece diverse information islands together into coherent enterprise information systems typically hit a series of brick walls of intractable incompatibility. Users take heart. The convergence of Unix and PC LANs has begun to reach critical mass. Multiple vendors from both the Unix and PC LAN worlds offer the means to achieve cross-environment interoperability with increasingly reasonable ease of use. Careful technology, product, and vendor selection can enable users to cost-effectively integrate Unix and PC resources and take that tentative first step toward utility computing.

Report begins on page 3.

Windows NT Mania

This Too Shall Pass

IN A FEW more weeks, it will all be over. Bill Gates will have stood in front of an excited audience at Windows World in Atlanta, Georgia, and formally introduced Windows NT. This will be an anticlimactic event since Microsoft has been demonstrating Windows NT at every trade show since Fall Interop in San Francisco and has placed many thousands of beta copies in the hands of users. The primary significance of the introductory event seems to be that Microsoft will now actually sell Windows NT to customers.

As we draw closer to the big day, the industry has seemed obsessed with either accommodating or challenging Windows. Sun announced Wabi, a layer of software that allows Windows applications to run on Solaris. IBM, Apple, and Novell announced Exemplar, their distributed improvement on Microsoft's Object Linking and Embedding (OLE) specification. Novell recently acquired Software Transformations Incorporated, a company with a portable Windows API. Novell and Apple have also announced that they would develop technology to run Macintosh applications on DR DOS. And the list of tactical, anti-Windows maneuvers goes on. It would seem that Microsoft Windows and Windows applications are the only thing that matter to the future of the industry.

However, let's look at some harsh realities facing Windows NT. First, desktop applications written to the full 32-bit Windows NT API (Win32) will not be available for six months. Even then, few of those applications will be multithreaded, which means they cannot really take advantage of the new Pentium multiprocessor systems that will emerge at the end of 1993. Interest in Windows NT on the desktop will grow slowly, driven more by the extra performance gained from being able to run Windows applications on powerful RISC processors than other factors. It will do well against Unix on commercial desktops, but in small numbers. Windows will remain dominant for the foreseeable future; there will be little impetus for wholesale upgrades from Windows to Windows NT.

On the server side, once the OS/2 servers currently running Microsoft SQL Server (approximately 28,000) have been upgraded, additional shipments of Windows NT Advanced Server will probably equal the sum of current Microsoft SQL Server and LAN Manager shipments. Windows NT Advanced Server is not the panacea for client/server application development, and, as a server, it isn't measurably superior to most Unix offerings.

If Windows NT makes any additional gains, it will most likely be at the expense of NetWare application servers. After all, native NetWare 4.0 is an operating system that is unprotected, limited to Intel uniprocessor systems, and lacking support for virtual memory. However, Windows NT will not replace existing NetWare application servers; that is too costly a migration for most customers to consider.

The prospects for Windows NT are likely to improve in the long run, but mostly on the desktop, not on the server. Customers have too many viable choices on the server side for Windows NT to so easily capture large pieces of the market. And, as customers continue to develop large-scale distributed applications, Microsoft's proprietary approach will hold little interest. ONC+ or DCE will be chosen as the preferred distributed platform. As distributed object computing gains momentum, Object Management Group (OMG) standards will challenge Microsoft's proprietary technologies.

The introduction of Windows NT signals the end of Microsoft as we have known it. Once it begins challenging mainstream enterprise computing platforms, its products and technologies will be subject to much closer scrutiny than they have ever received. Its service and support will be compared to the best in the world. In fact, customers will expect Microsoft to immediately provide global response capabilities that other system vendors have been building for decades. Microsoft has given itself a substantial challenge. As the next few months unfold, the noise and the hype will fade, and, in their place, will come hard work and execution. No more fanfare or glitzy introductions. Can Microsoft clear the bar that it has, itself, raised to new heights?

OPEN INFORMATION SYSTEMS

Editor-in-Chief
Michael A. Goulde

MCI:
MGoulde
Internet:
mgoulde@mcimail.com

Publisher
PATRICIA B. SEYBOLD

Analysts and Editors
JUDITH R. DAVIS
STANLEY H. DOLBERG
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Patricia Seybold Group
148 State Street, 7th Floor,
Boston, Massachusetts 02109

Telephone: (617) 742-5200 or
(800) 826-2424
Fax: (617) 742-1028
MCI: PSOCG
Internet: psocg@mcimail.com
TELEX: 6503122583

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Unix and PC Interoperability

Toward the Utility Era of Computing

Introduction

Underneath the rhetoric of the operating systems wars of the 1990s lies the tacit assumption that operating system diversity will remain a fixture in user organizations for the foreseeable future and beyond. Novell has certainly embraced this philosophy in its breadth of operating system offerings. On the surface, however, Novell, Microsoft, Sun, Apple, IBM, and Taligent continue to pitch global replacement technologies, along with dual-personality marketing messages that alternate between themes of continuity and discontinuity. The continuity messages emphasize scalability from desktop to server, support for existing desktop applications, and interoperability with legacy mainframe applications. The discontinuity messages stress advanced features that support distributed applications, multiple data types, and object orientation. Simply put, continuity sells discontinuity, and continuity smooths the bumpy road to adoption of new technologies.

Users are tracking these new offerings closely, carefully assessing the timing and choices of operating systems for the next generation of strategic applications. But for every strategic development project out there starting with a blank slate, there might be 5 or 10 tactical projects focused on integrating existing environments. Many of those tactical projects are focused on increasing interoperability between PC LANs and Unix systems because user organizations recognize that valuable resources exist in both arenas which must be shared to maximize the productivity and return on investment.

Unix and PC Integration: A Convergence of Forces

Moving toward Utility-Style Computing—with or without Distributed Objects

Users want to be able to share information within and across workgroups without having to deal with the barriers of incompatible technologies. The ideal of generic desktop information appliances and utility-like access to information resources provides the conceptual framework for addressing this user need in the future. The distributed object-based replacement infrastructure has been conceived to eliminate the need for manual intervention in giving and gaining access to services on the network. However, the typical user environment today has just begun learning about distributed objects, and the enabling technologies continue to evolve slowly toward commercial products. The intent of Novell Corporation to offer the Hyperdesk distributed object management system and the uniting of Apple, IBM, and Novell around the Exemplar cross-platform OLE alternative are promising developments in the utility computing front, but they are years away from achieving mainstream status.

Breaking down Organizational Barriers

While the distributed object-based technologies go through the maturity cycle and standards emerge, pragmatic users will wisely leverage existing commercial standards to increase interoperability between Unix systems and PC systems. Most user organizations outside the trading floors of lower Manhattan are looking for simple, practical ways to increase user productivity—without starting over. Integrating the PC and Unix environments has become particularly important in user organizations where the two system architectures have proliferated in different functions, such as marketing and engineering. Organizations cannot

afford to have critical functions impeded from working together, particularly when time-to-market for new products might be affected.

Enabling Implement First, Plan Later

Some organizations persist in believing that enforced corporate technical architectures offer the best models for enterprise computing. In the current business climate, few organizations are choosing that path. In fact, the corporate technical architecture has generally collapsed under the weight of unchecked business and technological change. In many organizations today, the pressing business problems of corporate departments and business units are driving investment in new information systems on an "implement first, plan later" basis. In the absence of a grand plan, accepting managed chaos seems to be the first step to making sense out of information systems in the 1990s. Providing interoperability between PCs and Unix systems is one piece of the managed chaos puzzle.

Mapping PC LAN/Unix Integration Strategies

Doing Ordinary Work in Unusual Circumstances

Many reasons exist for crossing the boundaries between Unix and PC LANs, but they all boil down to wanting to perform everyday work with resources that are not local and not fundamentally compatible. The range of typical operations includes filing, printing, accessing data, sending and receiving electronic mail, and logging into host-based applications.

Unix/PC LAN Scenarios

Some scenarios help frame the possibilities: a software engineer on a Unix workstation needs to update a portion of the marketing plan that is resident on a NetWare server; a financial analyst working on a Windows PC on a LAN wants to print a presentation on a 1600 DPI PostScript printer installed on the Unix net; an independent software vendor (ISV) that markets Unix and PC-based word processors needs a central point of access and source-code control for developers on the different systems; the Xbase PC user needs to update the central customer record file stored in an NFS volume on a NetWare server; the marketing manager working on the Macintosh client needs to check the X Window-based customer comment bulletin board running on the Unix server; the LAN administrator wants to consolidate desktop hardware required to manage the NetWare LAN and Unix network to a high-resolution X Window workstation.

Some Assembly Required

It is reasonable to expect that many of these scenarios require manual intervention and facility across operating system command sets and user interfaces. This has been true in many instances, but the situation is changing rapidly. The range of operations becoming possible within a user's preferred working environment with point-and-click and drag-and-drop operations is growing. The working assumption is that Unix users can handle any obstacle the PC world throws at them, while Windows and Macintosh users need to stay close to their accustomed system metaphor. Product introductions and enhancements in the past year have simplified the procedures required to meet the needs outlined in these scenarios. Sun and Novell have emerged as leaders in pushing for simplification in this space. Each in its way has been driving forward to win market share by blurring the lines of distinction between PC LANs and Unix systems.

PC LAN/Unix Technology Issues

The Standards Handshake

Unix has been forged in the crucible of interoperability, compelling the development of standards and interface abstractions that offer stationary targets and facilitate broad market acceptance. These standards enable systems ranging from mainframes to PC LANs to interoperate with Unix systems:

- SVR4 Streams architecture and Transport Layer Interface (TLI)

- TCP/IP protocols and related applications such as File Transfer Protocol (FTP), Telnet, and LPR
- ONC/NFS-based file-sharing
- X Window System

While PC LANs have been mastering the Unix handshake, Unix players have responded to the emergence of NetWare as a ubiquitous presence in the corporate accounts where Unix systems have entered as database servers or as engineering islands.

The Network File System: Bedrock of Heterogeneous Environments

Developed by Sun Microsystems, Network File System (NFS) is the market-dominant distributed file system for Unix systems, though not the selection for the Open Software Foundation Distributed Computing Environment (OSF DCE). NFS has since transcended the Unix operating system to be implemented in many proprietary operating systems and processor architectures, mostly for the purpose of interoperability with Unix-based systems. NFS is a layered stack of protocols that, in turn, layer on top of the TCP/IP User Datagram Protocol (UDP) and Internet Protocol for transport services. (See Illustration 1.) NFS provides a self-contained environment that encapsulates all the transactions that must occur between physically remote and architecturally dissimilar systems to enable file systems running on remote systems to appear and to function as part of a user's local file system. NFS operates on the "sender makes it right" approach to ensuring the standardization of the data format between dissimilar machine architectures.

NFS and Underlying Network Architecture

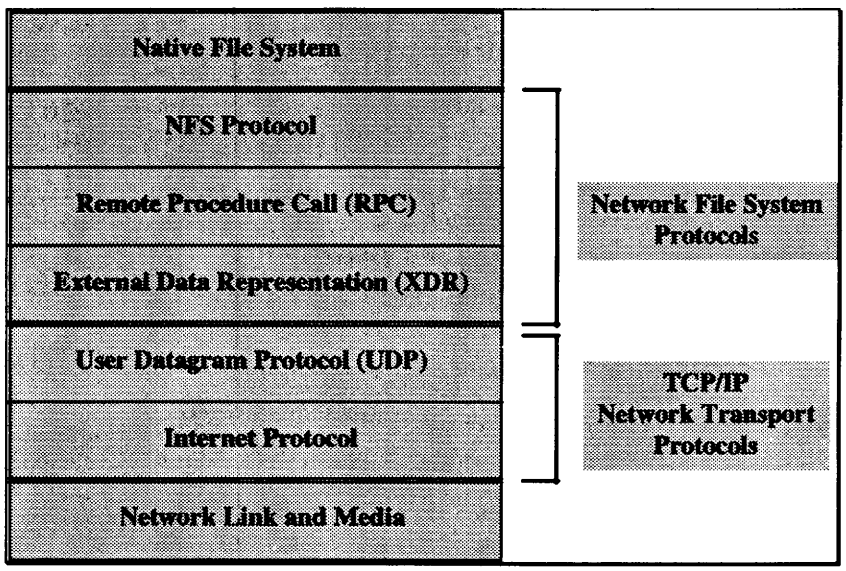

Illustration 1. Developed by Sun Microsystems, NFS is the dominant distributed file system for Unix systems. NFS has since transcended the Unix operating system to be implemented in many proprietary operating systems and processor architectures, mostly for the purpose of interoperability with Unix-based systems. NFS is a layered stack of protocols that, in turn, layer on top of the TCP/IP User Datagram Protocol (UDP) and Internet Protocol for transport services. NFS is part of Sun's ONC, which includes additional features.

RPC Transport Independence

The version of ONC and NFS most widely implemented in the marketplace is hardwired to TCP/IP for transport services as shown in Illustration 1. The transport-dependent version of

NFS has been replaced by a Transport-Independent RPC (TI-RPC) developed by Sun in collaboration with others in the industry, such as Novell, and implemented by Novell in its NetWare NFS NetWare Loadable Module (NLM). The DCE RPC, enhanced from the original Apollo NCS RPC, has also been designed for protocol independence over both connectionless and connection-oriented transports. DCE implementations from the system vendors may not fully support both connection-oriented and connectionless transports, which could result in incompatibilities between DCE implementations that would prevent cross-vendor implementation of DCE applications.

Heterogeneous File Services: The File-Naming Problem

One of the keys to getting real benefit from common access to files from diverse client types is bridging the file-naming gap. File-naming for many users is inseparable from file system organization. The enormous naming discrepancies between Unix and DOS/Windows systems illustrate this point. MS-DOS 8.3 case-insensitive file names are the height of cryptic naming, while Unix names are case-sensitive and can run up to 255 characters in length. The logical organization of directories and subdirectories derives in part from the constraints on naming imposed by the native system.

File systems store considerably more information than merely the file name. Depending on the operating system, file system name spaces also store a variety of attributes, such as access control restrictions, date of creation, date of last modification, pointers to the physical location of the file metadata, and more.

The Solution: One File, Many Attributes

Support for multiple name-spaces is spotty in the Unix/PC LAN overlap, with the particular exception of NetWare and LAN Manager for Unix (formerly LMX). NetWare supports what Novell terms "heterologous" access. Heterologous access offers a native file system view simultaneously to DOS/Windows clients (File Allocation Table, or FAT, file system), Macintosh clients (Hierarchical File System, or HFS), Unix clients, non-Unix NFS clients, and OS/2 clients (High-Performance File System, or HPFS). When a new file is created, NetWare automatically generates a native name for each environment that is active on the server, though the name-binding to the file occurs at access time. Unfortunately, the translation to DOS file-naming from other environments is imperfect and can result in nonusable DOS names. Other network operating system (NOS) servers offer partial coverage on the namespace issue, but none offers the full NetWare solution. To appreciate the dimensions of this problem, ask any Macintosh user who has to switch back and forth between naming conventions while working between a Macintosh and a Windows laptop.

Printing with PC NFS

In the Unix world, printers are associated with servers. The listing of printers available in a Unix network can be overwhelming and less than informative to the ad hoc inquirer. The printer comment field that could help identify the printer locations and attributes tends to be used inconsistently in most organizations. In order for a PC-NFS client to even browse the network printer listings with the support of an exported server-based directory and then print a document to a Unix printer, the PC-NFS daemon (PCNFSD) must be running on the server. Sun systems that do not support PostScript printing use Sun's Newsprint to translate from PostScript output to bits that printers can print on Unix servers.

The WinSock API

In June 1992, a collaborative effort between Microsoft and several TCP for Windows vendors, including FTP Software and Sun's SunSelect operation, produced a specification for a Windows Sockets API (WinSock), which offers a standard interface for developers to use in developing Microsoft Windows applications for use over TCP/IP networks. Previously, application developers were saddled with having to implement to each Windows version of TCP/IP, which constrained the market for TCP/IP-based Windows applications. One of the first applications to utilize the Windows Sockets API is a mail application, SelectMail, included in Sun's PC-NFS 5.0.

Meeting the Transparency Challenge

Moving beyond Simple Interoperability

With basic Unix/PC LAN interoperability accounted for, vendors have been shifting focus to increasing the seamlessness of the environments. The transparency challenge has been met successfully in some instances. For example, the recently announced NetWare NFS Gateway server NLM for NetWare 3.11 enables a high degree of transparency in accessing Unix from NetWare. NFS Gateway handles file-name mapping and, in combination with the NetWare NFS and TCP/IP NLMs, all of the connectivity and resource location issues under the familiar Windows/DOS interface. A DOS/Windows NetWare client can mount a Unix volume without even knowing it is a Unix volume. One interesting application of the NetWare NFS Gateway would be for DOS clients with undersized hard disks to transparently map additional DOS drives to Unix NFS volumes over the network. With this capability, users can manually balance network hardware resources and extend the useful life of installed systems.

Point and Click: The Acid Test

For users, the acid test of transparency is the ability to operate across environments with point-and-click methods. Several products meet a reasonable standard of transparency through support for drag-and-drop file copy operations between Unix and PC LAN file systems. With PC-NFS 5.0, Univel's UnixWare, and NetWare 3.11 with the appropriate NLMs, the local environments display exported file systems as if they were local, and all support at least some functions with seamless drag-and-drop file manipulation.

Sun and Novell: Archetypes in Competition

Many Vendors Work the Interoperability Angle, but...

Virtually every vendor in the industry is working to some degree on PC LAN/Unix interoperability, but Sun and Novell stand out for the level of emphasis each is putting on this area and the impact of each on the industry and the user. Each has institutionalized a set of core protocols in the marketplace and has put high priority on becoming the center of the interoperability universe as a means to becoming a dominant enterprise player in the post-mainframe era. Of course, Sun is making a hardware/software play, and Novell is making a software-only play.

Sun Plays the Client and Server Card

With ONC on the server delivering near-universal file and print services and with PC-NFS on the DOS and Windows client systems, Sun has taken its core technology well toward ubiquity. On the server, Sun offers an implementation of NetWare for Unix ported to Solaris. And, on the workstation, Sun offers PC emulation software, with and without add-in hardware assist, that enables the Unix workstation to become a LAN client to NetWare, LAN Manager, or Windows for Workgroups.

PC-NFS and the PC TCP/IP Market

PC-NFS is Sun's implementation of ONC/NFS for non-Unix client systems, originally DOS clients. It has been in the market for several years and has widely become the basis for DOS/Windows client access to Unix systems over the TCP/IP network transport protocol. Client systems running PC-NFS can operate as file, print, and E-mail clients with any ONC/NFS server. In addition to supporting ad hoc access to basic Unix services, PC-NFS implements the client side of the native ONC development environment for client/server distributed applications. The recently introduced PC-NFS 5.0 includes Windows versions of TCP/IP applications such as Telnet and FTP, putting it more on par with such offerings as Novell's LAN Workplace. Some organizations have built entire application environments around Windows desktops, PC-NFS, and Unix servers, including full-blown custom screens and menus.

Novell: Racing down Parallel Tracks

For several years, Novell has been moving incrementally toward an enterprise model that integrates NetWare office environments with Unix engineering and relational database systems. Beginning in 1989 with the acquisition of Excelan and the LAN Workplace product,

Novell has been moving steadily toward a multiprotocol, multiclient, multioperating system strategy with the NetWare print and file engine running NetWare Core Protocol (NCP) over the IPX/SPX transport at the heart of the proposition. NetWare has become truly ubiquitous as system vendors offer ports of NetWare for Unix and are porting NetWare to run native to RISC platforms. NetWare for Unix offers NetWare server file, print, and messaging services hosted under a variety of system vendor Unix versions. NetWare for Unix maps NetWare functions and system calls to the functions of the underlying Unix system platform, representing functions to NetWare clients unchanged from native NetWare. However, certain NetWare functions that do not map to Unix are not supported, such as deleted file recovery.

NetWare NFS

NetWare NFS is Novell's version of Sun's ONC, implemented as a set of NetWare 3.11 NLMs. NetWare NFS delivers a set of network filing and print services over the TCP/IP protocol suite, which is also implemented as a NetWare 3.11 NLM. (See Illustration 2). All features of NetWare, such as fault tolerance, disk-mirroring, and security, operate with the NetWare NFS NLMs. The NetWare NFS NLMs sit on top of the NetWare real-time operating system, making NetWare calls for services.

NetWare NFS Architecture

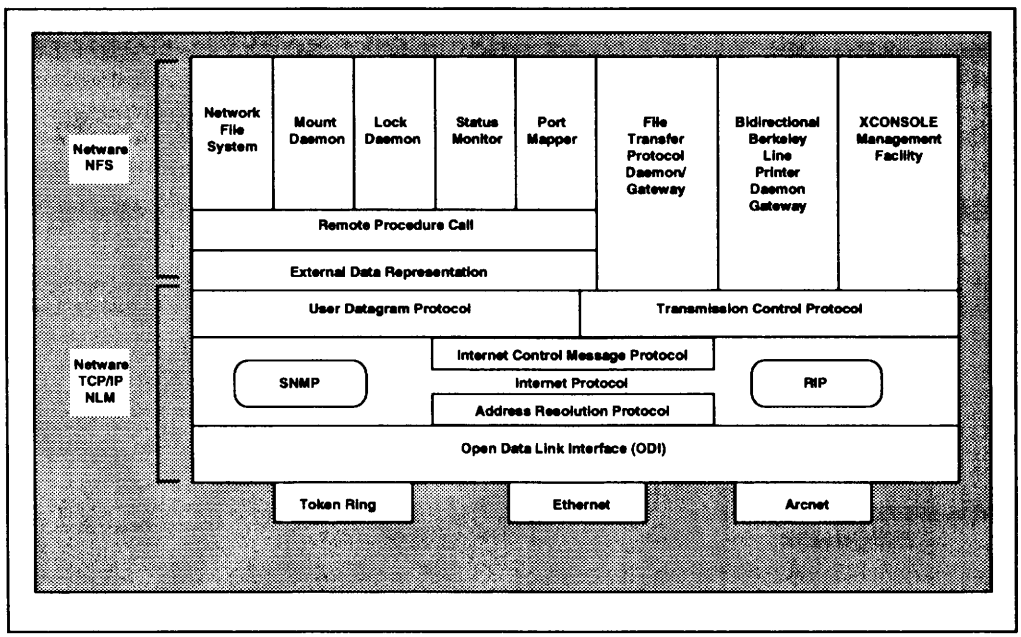

Illustration 2. The NetWare NFS NLM operates over the TCP/IP NLM, which is part of the standard protocol offering in NetWare 3.11. The Line Printer Daemon enables Unix and PC users to use printers located in the "foreign" environment, while the File Transfer Protocol enables manual file transfer across environments. Novell has also included the XCONSOLE, which allows an X Window-based user to manage a Novell NetWare environment from within X Window. The ODI allows multiple protocols to run simultaneously over LAN adapter hardware.

NetWare Started with a Client-Enabled Approach

The Novell strategy is currently both client and server oriented but is clearly moving to focus functionality and related overhead on the NetWare server. Novell's first cut at this problem, LAN Workplace, took a PC-NFS style approach of equipping the PC client with a set of TCP/IP-based network utilities such as Telnet and File Transfer Protocol (FTP) to enable the individual user to access and retrieve files and work as a terminal to a Unix host system. The latest version of LAN Workplace offers these applications under Windows. For example, the FTP file copy application has evolved to Rapid Filer, with which the user can copy with drag-and-drop action between any two systems that support FTP.

Shifting the Center of Gravity to the NetWare NLMs

The Novell move to emphasize server-based NLMs for TCP/IP, NFS, and other Unix functionality leverages the Open Data-Link Interface (ODI) support for multiple protocols on the same LAN adapter cards, as shown in Illustration 2. The Novell LAN Workgroup provides similar functions and features to those of LAN Workplace, based instead on server-based and -managed TCP/IP and applications. The newest addition to the NetWare/Unix interoperability portfolio, NFS Gateway, extends the transparency of file access by presenting a set of NFS services, including remote volume mount, within the native Windows/NetWare interfaces.

Server Centrism vs. PC Centrism

The debate on whether to focus interoperability on the server or the client pivots on the issue of server versus PC client memory consumption due to multiple network protocols, and on the network management issue of having to manage networking software on one server per *n* nodes versus *n* peers. With DOS and Windows 3.1, the client protocols must run within the 640K system memory, which can get pretty tight for a NetWare PC client. We expect to see the server-based alternatives offered for NetWare and LAN Manager become preferred alternatives over time, except where the PC clients implement PC-NFS and TCP/IP as a virtual Network Operating System (NOS) for a bounded business application and do not require ad hoc cross-environment access to the IPX/SPX and other protocol stacks.

Cross-Environment Emulation and Beyond

Terminal Emulation to Unix Hosts

Unix servers often play a role in the corporate environment as database or business application servers. If, for example, the Unix system hosts a customer comment bulletin board, the product manager on the LAN needs to check periodically for customer feedback on new products. Simple character-based terminal emulation from a PC or Macintosh can be accomplished through a TCP Telnet application, running either locally or on the LAN server. With Telnet, a Windows PC can emulate a VT100/102 terminal and operate a character-based application, or it can interact at the Unix command line to send and receive electronic mail and cut and paste screen text in either direction between active Unix and local Windows, DOS applications, and OS/2 applications. A broad range of ISV products support these functions over the market-leading LANs.

PC-Based X Servers and DDE Hot Links

For PC users who need to access an X Window-based application, X server programs are required which run locally and utilize PC-NFS or equivalent TCP/IP transports to talk to Unix systems. For example, XVision from VisionWare Limited supports the display of OSF/Motif or OpenLook X Window client applications in the Microsoft Windows environment. XVision offers the PC user two options for window management. The user can choose to display all X clients under host system control inside one Microsoft Windows window or choose the XVision display manager, which puts both X clients and local applications under the control of the local Microsoft window manager. Under XVision, data can be cut and pasted bidirectionally between the local Microsoft Windows applications and X-based applications. With VisionWare's PC Connect, DDE-enabled DOS/Windows and character-based or X-based Unix applications can be hot-linked through the DDE protocol, for example, linking a Unix database field to PC spreadsheet cells. PC Connect manages the implementation of DDE on the Unix side.

PC Emulation Continues to Improve

When Unix workstations first began a play for the commercial desktop, the price of admission included PC emulation with products such as SoftPC from Insignia Solutions. Performance problems, imperfect emulation, and inherent lags in consistency with the evolving Windows API have mitigated the excitement that users feel about this product segment. However, despite the problems, the products in this space have remained highly interesting and strategic to the Unix workstation vendors. As more applications migrate to the Windows API and vendors such as Sun offer hardware-assisted emulation, another barrier to use of Unix workstations in the commercial market will fall.

Cross-Environment Emulation and Beyond

Sun Plans an End Run with Wabi

In early May, SunSelect introduced Wabi, which will run Microsoft Windows application binaries on Solaris. Wabi is essentially a translation mechanism between the Windows API and the Unix functionality stack. A Windows 3.1 application written to the Windows API generates systems calls to the Graphics Device Interface (GDI), Windows kernel, DOS, BIOS, and even the hardware for CPU, file, and I/O functions, and all of those map to the Wabi. The Wabi, in turn, translates the calls to Xlib and Unix. On Solaris for Intel, the CPU instructions are directly accessible, while, on a SPARC system, an Intel CPU emulator is required. Wabi has generated considerable interest, including a competitive response from Microsoft and a potential legal response, although Sun asserts that WABI is "Windows code-free." (See following article on page 16, "Windows on Unix and the Public Windows Interface.")

UnixWare: A Unique Offering

The UnixWare Alternative

Novell has raised the profile and hopes for SVR4 Unix with the introduction of UnixWare. The hybrid Unix and NetWare version of SVR4.2 liberally intertwines the basic functions of the file systems, network transports, and kernel functions of the two environments to achieve a high degree of seamlessness between UnixWare and NetWare. (See Illustration 3.)

UnixWare Client Architecture

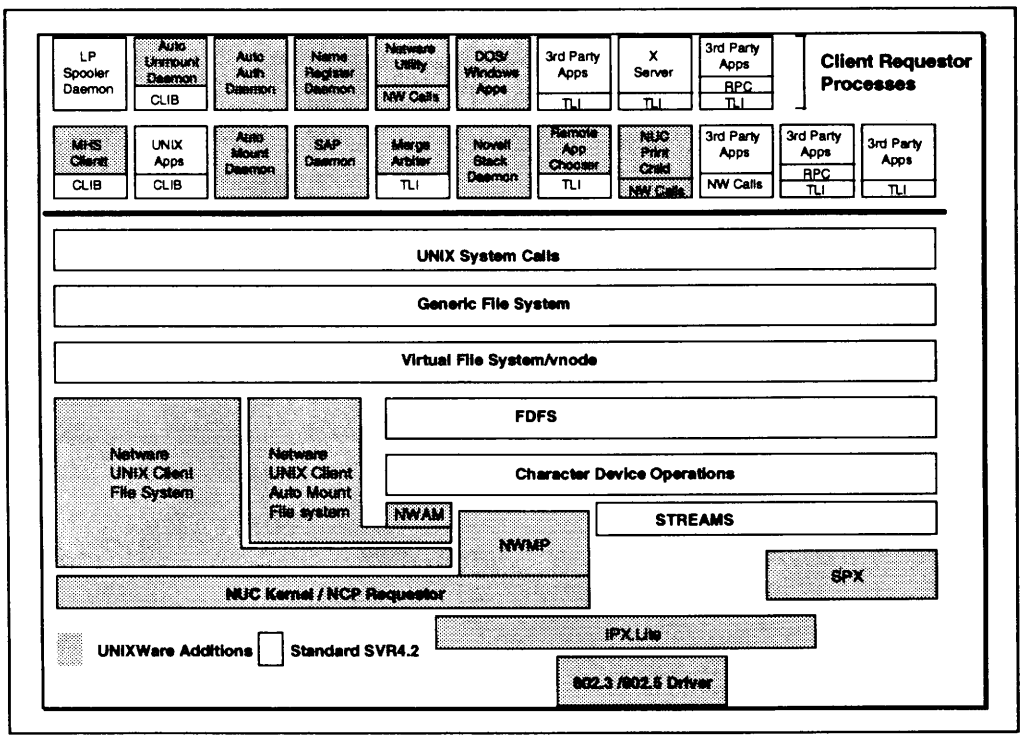

Illustration 3. The UnixWare client architecture illustrates the high level of integration Novell has achieved between the core SVR4.2 and NetWare. Features such as the NetWare Unix Client Auto Mount file system offer the user the experience of seamlessness between Unix and NetWare files.

UnixWare not only offers interoperability between Unix applications and NetWare, but also the UnixWare architecture utilizes NetWare as its primary file and print engine. In support of this strategy on the UnixWare client, Univel offers a convincing demonstration of NetWare DOS Requestor network file retrieval, where a remote file is actually retrieved faster than a local file. UnixWare has not yet achieved comparable performance with the UnixWare client

but will be working to approach such performance through increased caching in the NetWare protocols. Even assuming that "mileage will vary" on file retrieval time, the integration of the NetWare engine into UnixWare is impressive.

Transparent File Access with UnixWare

Illustration 3 shows the NetWare underpinnings in the UnixWare architecture. Novell has nominated NetWare as the solution to the problem of delivering a common set of services to heterogeneous operating systems. Inspired by the Macintosh finder functionality, with the NetWare Unix Client File System (NUCFS) implemented under the Unix Virtual File System (VFS) interface and the NetWare Unix Client Auto Mount (NUCAM) file system, UnixWare supports browsing NetWare networks and automatic mounting of NetWare volumes across the network, based on the "no user interface" paradigm. As Illustration 3 shows, the transparency available with the first release of UnixWare has been achieved through the liberal use of daemons. This "brute force" approach to delivering simplicity to the user, based on cooperating daemon agents, will likely evolve to greater engineering elegance in subsequent deliveries.

UnixWare Mail Interoperability in the NetWare World

The NetWare MHS store-and-forward mail protocol has been integrated into UnixWare as a mail gateway in the first UnixWare release. MHS operates differently from the end-point-oriented X.400 approach in that it is server oriented, essentially using the server file system to migrate messages to the client addressee on query by the client. MHS in NetWare 3.x and 4.x offers global messaging that supports mail interoperability among UnixWare systems, NetWare systems, Unix simple mail transport protocol (SMTP), and Apple QuickMail. Fully configured UnixWare can interoperate in native mode with the NetWare world or with the Unix SMTP world. The UnixWare client does not include TCP/IP and SMTP in its standard base version; the server does.

Why UnixWare Matters

Clearly, from the Novell point of view, UnixWare represents the first move toward a "good" Unix. As such, UnixWare offers insight into the future of Unix System V Release 4. With UnixWare, Novell has moved Unix away from the role of a general purpose operating system toward a value-added positioning on top of the NetWare print and file engine. Stay tuned to how Novell handles the USL acquisition. Unlike the previous owners of Unix, Novell will be relatively reluctant to be driven by a filtered industry view and will prefer to migrate Unix firmly into a complementary position with respect to NetWare-based Novell corporate beliefs about the needs of the marketplace and Novell's strategic plan for building a multifaceted corporate network environment.

LAN Manager/LAN Manager for Unix

Microsoft: Still Committed after All These Years

Microsoft remains committed to LAN Manager, despite having handed over development and marketing responsibility for LAN Manager for Unix (LMX) to NCR. Microsoft's plan to bundle LAN Manager features into the NT operating system will yield greater opportunity for PC/Unix interoperability with LAN Manager for Unix, which might increase market interest in LAN Manager for Unix.

Supporting Heterogeneous Clients and Servers

Like Banyan's VINES, LAN Manager for Unix is a network operating system for heterogeneous clients that NCR builds on Unix System V Release 4 and is licensed by Microsoft to other OEMs, such as SCO and Olivetti, to port to their own operating systems. LAN Manager for Unix supports DOS, Windows, OS/2, and Macintosh clients, and supports a broad range of network protocols, including NetBEUI, TCP/IP, OSI, IPX/SPX, and AppleTalk. It delivers access to print resources over the LAN, even for printers that are connected to a DOS or Macintosh client over AppleTalk. The NCR implementation of LAN Manager for Unix offers a multiple name-space file system that supports all native file attributes.

LAN Manager/LAN Manager for Unix

LAN Manager for Unix servers supports bidirectional integration with Unix resources for file services and print services. It can mount and share Unix NFS as a LAN Manager for Unix resources, and Unix users can access LAN Manager for Unix volumes through the NFS support. LAN Manager for Unix PC clients can seamlessly copy and move files between LAN Manager for Unix and NFS volumes.

SCO: Bridging Unix and LAN Manager

SCO has taken the position of using LAN Manager for Unix to link PC and Unix environments. By providing support for popular PC protocols, such as SMB and NetBEUI, as well as Unix protocols, such as NFS and TCP/IP, SCO is able to provide customers with an effective bridge between the two environments. For example, an SCO server can mount a file system on another Unix system across the network using NFS and then share that file system with LAN Manager clients without the clients having to run NFS, or, for that matter, TCP/IP. In addition, since SCO Unix is running on familiar, Intel-based PC hardware, it provides its customers with a familiar hardware environment, simplifying purchase decisions as well as service and support.

At the same time that it is functioning as a file and print server for PCs, SCO Unix can be providing application services as well. Through its support for multiprocessing, it can run on MP systems from a number of vendors, providing database services as well as other services to connected PC users. We expect SCO to continue positioning its offering as a PC and Unix integration platform, in addition to being a Unix application platform, using the Unix part of that equation to fend off challenges from Windows NT.

Other Vendors' Strategies for PC LAN/Unix Integration

Apple: The Contrarian Looks Forward

In the past, third parties have addressed Macintosh/Unix interoperability more vigorously than Apple. For example, Apple still does not support printing from a Macintosh running MacOS over a Unix network, while products such as PC-NFS 5.0 and Wollongong Pathworks do. But the close relationship with IBM around the PowerPC architecture will probably change this orientation, and DCE will play a key role in the change

Apple is pushing the integration of PCs and Unix systems into the future with DCE client services integrated with Macintosh OS, based on the theme of the mobile client in the client/server model. The goals for cross-environment work will include database, file and print services, text retrieval, imaging, and multimedia, based on future developments expected from Kaleida (Mountain View, California) and Taligent (Cupertino, California). Client types in this strategy are planned to include Macintosh systems, PCs through Novell with AppleTalk, or NLMs with a Unix client.

Banyan: Unix Comes out of the Closet

Banyan VINES NOS users have unwittingly used a highly integrated Unix/PC environment, but it is one in which the Unix-based services were firewalled behind the StreetTalk directory and other user-friendly constructs. Banyan has taken its Unix roots out of the closet in the past year by porting VINES to the SCO Unix environment. PC/NFS on the DOS/Windows clients supports interoperability between VINES NOS clients and VINES on Unix systems.

Banyan has jumped into the multiple namespace fray with its new Universal Client File Services (UCFS) filesystem. The UCFS stores files in a neutral format, and it has been designed to identify the requestor's file type requirements. UCFS can service Unix, PC, and Macintosh client file requests by automatically running the filters appropriate for the requestor environment.

IBM: Looking to DCE and Workplace Shell to Integrate PCs and Unix

IBM offers a reasonably complete range of interoperability mechanisms, including PC emulation, NetWare for Unix on AIX, and NFS and TCP/IP-based PC access. But IBM, like Apple, is looking to the future for improved enabling technologies such as a consistent user interface across environments and DCE-based application-level heterogeneous

interoperability. Object orientation and microkernel-based operating systems are also key to IBM's strategy to enable interoperability and to deliver services such as system management and network management.

Distributed Computing Alternatives

ONC vs. DCE/PC-DCE

While ONC dominates heterogeneous file and print management in the commercial market, DCE continues to hold significant promise as a scalable and robust basis for the development of distributed applications for heterogeneous environments. While DCE has been evolving toward commercial products, its PC client strategy has undergone radical transformation by replacing LAN Manager for Unix and PC-NFS with the breakthrough PC-DCE work done by Gradient Technologies (Hudson, Massachusetts).

PC-DCE: The DCE Client Strategy

PC-DCE runs under Windows as a runtime Dynamic Link Library (DLL) that implements the DCE APIs and the core DCE services such as threads, time, naming, RPC, and security. Gradient recently shifted its architecture from a set of DLLs to a single DLL in order to reduce the overhead that was resulting from "inter-library "communication. (see Illustration 4.) Combining the DLLs into one does not affect the application because DLLs operate similarly to shared libraries under Unix, and Windows loads only those library segments that contain the procedures needed to implement the system calls made by the application.

PC-DCE has been designed for transport independence by supporting both connection-oriented and connectionless transport mechanisms, including the WinSock API. Gradient has been moving slowly, along with the rest of the market, to implement the Distributed File System. Unlike the Microsoft approach of targeting DCE client support with 32-bit Windows NT with a DCE-compatible RPC only, PC-DCE offers full DCE trusted-client support under 16-bit Windows 3.1 and subsequent versions of Windows by building to the Win32 specification.

Cross-Environment Application Development

In the past year, cross-environment application development environments have entered the marketplace which support the development of applications on PCs, Macintoshes, or Unix systems for deployment on any or all of the above. Products such as Galaxy from Visix Software (Reston, Virginia) (see *Open Information Systems*, Vol 7, No. 10, October 1992) actually obsolete platform-specific application development and runtime APIs with what is essentially a virtual operating environment consisting of a set of object-oriented libraries and tools that simplify single-, multi-, or cross-platform deployment. These products enable new application development to proceed without platform dependencies at the application source level, allowing corporate developers to plan and execute development without constraints based on which platforms are installed at the server or desktop level.

Gradient Data Access across the Divide

Ad Hoc Access across Environments

The basic enablers for ad hoc file and print interoperability between PC LANs and Unix systems also support ad hoc data access. Databases implemented on Unix systems interoperate with the same applications implemented on PC LANs, for example, an Xbase database running on Unix and on PCs on the LAN. User applications, such as research databases, built on multiuser Xbase with files in an NFS volume on the Unix server would support ad hoc queries from PCs running Xbase on a LAN, leveraging commonly available LAN- or PC-based TCP/IP and NFS implementations. The database handles security and record-locking responsibilities.

Gradient Data Access across the Divide

Gradient Technologies' PC DCE Architecture

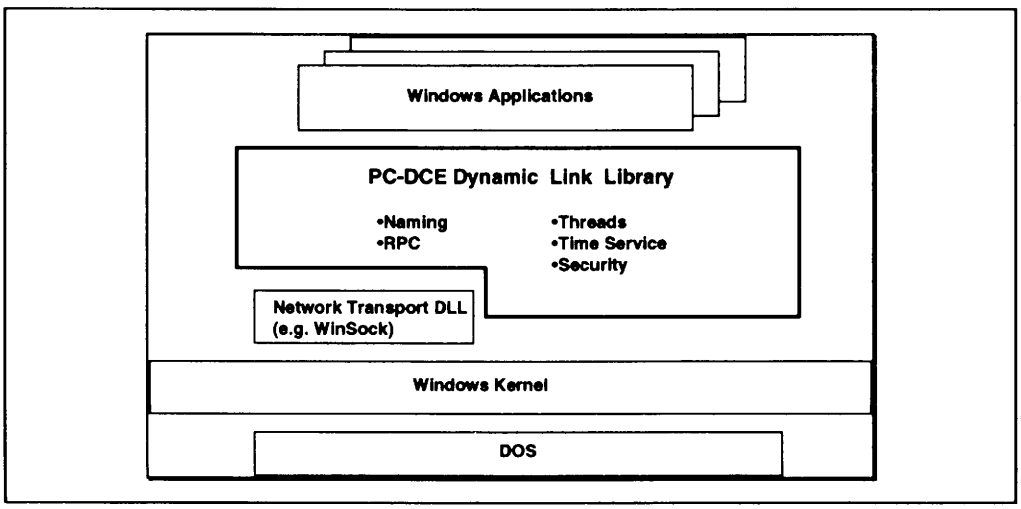

Illustration 4. PC-DCE from Gradient Technologies is a DLL that implements DCE Core Services to offer a "trusted" PC client for DCE-based distributed applications.

Client/Server Application Data Access

Client/server applications built on a Windows or OS/2 client with, for example, PowerSoft's PowerBuilder or Gupta's SQLWindows depend on runtime library support from the application development environment to establish and maintain the necessary network connections to the database and to launch the SQL commands. In the case of SQLWindows, the client systems must be configured with the appropriate SQLNetwork drivers to negotiate the network protocols and connect to the database. Sybase and Oracle offer clean client/server APIs that incorporate network protocol libraries that manage the connections and the raw data transfer over the network, and ODBC and IDAPI both approach the problem with the same basic idea of standardizing the API to the developer while offering API runtimes enriched with a variety of network protocols and SQL dialects. The Sybase Open Server API allows applications to be developed and replaced without obsoleting the data model and without concern for the underlying network transports.

Running Common Applications Ensures that Applications Will Work Together

The safest way to make sure that a document or file can be shared across the PC and Unix environments is to run the same application on both ends, for example, WordPerfect, FrameMaker, or Lotus 1-2-3. Of course, if a Unix workstation is running the same PC application under PC emulation as the originating application running on, for example, LAN Manager, there should be no problem sharing the document. But if the Unix workstation user wants to open a document created in Word on a PC with FrameMaker, then a filter must be run, and all bets are off on formatting and graphics retention. Even moving between the latest revisions of the same applications from the same maker on PCs and Macintoshes predictably loses some graphics and table formatting going in one direction or another. Some Unix applications take full responsibility for making these kinds of exchanges work. Aster*x from Applix, for example, runs conversion filters automatically when a user tries to open a non-Unix document from a Unix workstation.

Conclusion

Vendors Encroach on Entrenched Positions

The battle for the desktop and the battle for the server have heated up simultaneously. Server and desktop environments have begun to overlap and blur. Unix software, hardware, and system vendors are targeting growth potential at the low end, with a value proposition based on improved ease-of-use, enhanced security, superior system and network management, data integrity features, and inherently strong heterogeneous networking capability. While Unix vendors have targeted down-market growth, Microsoft, Novell, Apple, and others have

Conclusion

targeted growth at the enterprise level with enhanced and new desktop systems, enterprise directories, heterogeneous networking, and industrial-strength server software.

Interoperability as a Trojan Horse

There is an immediate revenue incentive for selling interoperability add-ons, but the strategic goal in this space is to render the competition moot through encapsulation—removing the reason to continue investing in the "other" environments. Vendor strategies acknowledge that the price of admission to the market for replacement operating environments includes servicing the competition's installed base. This is not strictly a software play. For example, if the NetWare NFS and TCP/IP NLMs perform well enough, perhaps an upgrade for the Sun server could be delayed or avoided in favor of upgrading the NetWare server. Then again, all that software could run on a RISC box, either native or under one of the many NetWare for Unix instantiations.

Winning Big by Being There

On this basis, vendors have begun to compete in earnest to provide new and improved ways to increase the interoperability between the PC environment and the Unix environment. This battle could enable users to simplify operating environments without obsoleting investments in user training and applications. Whichever environment provides the best functionality for new applications and adequately services existing systems could win big when users concede that existing applications and infrastructures have run out of moxie.

Implications for Users

User organizations faced with a sea of PC desktops and installed or anticipated Unix systems should take heart. As long as users stay in tune with products based on the ubiquitous standards such as NFS, X Window, transport-independent operating system and RPC interfaces, TCP/IP and related applications, IPX/SPX, and other commercial standards, they should feel confident proceeding to integrate PC LANs and Unix systems. Users can certainly expect levels of interoperability that are already acceptable to continue to improve. For development of new applications, users should look carefully at cross-application development products. Galaxy from Visix Software, suited for large-scale applications, or the Universal Component System from Software Transformations Incorporated (Cupertino, California) for smaller-scale applications offer approaches to leveraging the diverse platforms installed in the enterprise.

Is This Utility Computing?

The computer industry is built on the principle of establishing concepts far in advance of products that fulfill the promise. Utility computing and distributed objects have been closely allied as a concept bundle, and the beauty of concepts is that they can always rise above prickly reality. The comprehensiveness of the interoperability and the increasing seamlessness between the PC and Unix worlds is based on entrenched commercial standards, and this might just be as close as we get to utility-style computing for a while. It's not quite as simple as picking up the telephone and dialing, but, then again, since deregulation, the simplicity of using the telephone doesn't always measure up to the ideal either.

Next month's *Open Information Systems* will address
Electronic Mail Interoperability.

For reprint information on articles appearing in this issue,
please contact Donald Baillargeon at (617) 742-5200, extension 117.

Open Systems: Analysis, Issues, & Opinions

FOCUS: PORTABILITY

Windows on Unix and the Public Windows Interface

Emulation technologies have long been a mainstay of the computer industry. They have been critical in helping users make difficult transitions from an older generation of products to a newer, but incompatible, one. Even in the PC arena, emulation has been around for some time. Remember the AT&T Unix PC and its DOS coprocessor? That was one approach. Software emulation on PCs has also been around for some time, typified by Insignia Solutions' (Mountain View, California) SoftPC. This product, emulating a complete PC environment including everything from the CPU and hardware registers to disk drives, initially appeared for the Macintosh and soon found a niche on RISC/Unix. Insignia has extended SoftPC to also run Microsoft Windows.

A new generation of emulation is upon us. In fact, it is questionable as to whether these technologies should even be called emulation or whether other terms are more applicable. More important than such distinctions, however, is the fact that these technologies are starting to serve strategic purposes as opposed to tactical ones, both for their suppliers and for customers.

Instead of emulating a PC or even emulating DOS, the target now is to take applications written for one operating environment, like Windows or the Macintosh, and run them on another, specifically Unix. The outcome of this trend may be to de-couple the decision of which environment to write an application for from the decision about on which operating system to run the application.

SunSelect Introduces Wabi

SunSelect, the Sun Microsystems group responsible for PC technologies, has announced technology it calls Wabi. Wabi is based on technology the company acquired when it purchased Praxsys Technologies last year, and it is software that provides a Windows application run-time environment that allows users to run off-the-shelf Microsoft Windows applications on Unix without having to run either DOS or Microsoft Windows. Applications run unchanged—the user installs them on the workstation or on a server from the shrink-wrapped Windows distribution disks just as he or she would install the application on his or her PC.

Wabi translates calls that Windows applications make to the Win16 API (the Windows 3.1 API which is the predecessor to Window NT's Win32 API) into calls to its own Wabi library, which sits on top of the X Window System Xlib. The Unix system then executes the Xlib functions and displays the application in an X Window. Since this approach is X Window-based and since Wabi is an X client, the user could run the application from an X terminal as well as from a workstation. (This approach raises issues about software licensing, but honest users will work with ISVs to make certain the proper licensing is in place.) In addition, each application gets its own X Window in which to run, and it runs at native X performance. And since the Windows application is actually an X Window display managed by the X Window manager, users can cut and paste text or bitmaps back and forth across Unix and Windows/Wabi applications. Wabi isn't able to support the wide variety of clipboard formats supported by Windows, however, because X Window doesn't yet support them.

How Does It Work? Windows applications make a majority of their calls to the Windows API and the balance to the CPU. Estimates are that Windows applications spend between 60 percent and 80 percent of their time in the Windows libraries. Wabi is an implementation of those Windows libraries, and it grabs the calls made by a Windows application, translates them, and services them. The calls that a Windows application makes to the Windows DLLs are 16-bit calls which are mapped to 32-bit Xlib calls. In spite of the overhead of "thunking" from 16-bit to 32-bit word length and addressing, performance gained from processing in a linear 32-bit environment instead of a segmented 16-bit one can make execution noticeably faster.

This speed-up effect can be found whether the application is running on an Intel machine or on a RISC machine. SunSelect has demonstrated a performance advantage for graphics-intensive Windows applications

running on Wabi versus real Windows using the same hardware configuration. Identically configured Intel PCs were used, one running Solaris and Wabi and one running DOS and Windows. The Wabi/Solaris system was faster than DOS/Windows using Texas Instruments' WinTach benchmark. Although WinTach is somewhat biased toward video subsystem performance, it does reflect many common characteristics of Windows application behavior. There are other aspects to performance, of course, and Wabi may not be faster than Windows in every area.

When running in a Unix environment on an Intel machine, the x86 instruction set calls that the Windows applications make are handled by the Intel CPU. On non-Intel Unix systems, there is a small CPU simulator running—as opposed to a DOS emulator—that handles calls to the x86 instruction set. If the user wants to execute DOS commands, such as Format, then a DOS emulator like SoftPC or VP/ix would be required. But those services could be supplied by any emulator on the platform, and none is required to only run Windows applications.

Not A Better Windows. Wabi handles memory management for applications, running everything in a single address space. This helps prevent ill-behaved Windows applications from affecting Unix applications. If a Windows application hangs, it does not lock the system. Wabi also manages all message ordering and interrupt handling. Wabi may prove to be a more stable run-time environment because it handles memory allocation more cleanly than Windows.

However, Wabi is not meant to be a "better Windows than Windows" as the IBM OS/2 line goes. Nor is it a Windows clone. Although it does supply its own Application Manager, which performs the function of the Windows Program Manager, and a Control Panel equivalent called the Configuration Manager, it is not meant to serve as a substitute for all the various applications that are included in Windows. Many of those are already available in the native Unix environment. One could, however, buy a copy of Windows and run the bundled applications like the games, Notepad, Calculator, etc. under Wabi. Even though Wabi is not running Microsoft Windows, it does support OLE and DDE links between applications, including drag and drop between applications. TrueType font rasterizer technology has been licensed from Bitstream, Incorporated (Cambridge, Massachusetts) providing access to the native Windows TrueType font formats. A large number (600) of TrueType fonts for Wabi can be purchased from Bitstream.

Wabi does not yet have support for NetBIOS or for printers other than PostScript. Epson and HP PCL printer support will be available before the end of the year. Support for the Windows Sockets API, NetWare, MultiMedia APIs, and Win32s has been committed to by SunSelect for a future version of Wabi.

Key Capabilities. Since Wabi is translating Windows applications in real-time to the native Unix desktop, it can support multiple simultaneous applications. It provides video, mouse, and keyboard performance at native speeds; provides access to Unix network resources, including files and printers, from within the Windows applications; and provides access to Unix serial ports. Devices are seen as Windows devices to the application and are managed using the facilities contained within the Windows application (e.g., File/Print Setup in Word for Windows to select and configure a printer).

Application Support. Not every Microsoft API is supported in this release of Wabi. In addition to the ones mentioned above, MAPI, ODBC, and Multimedia API support will be provided over time. Applications which require those APIs are not supported yet. Ensuring that applications are compatible with Wabi boils down to a simple test: Either an application runs, or it doesn't.

Programmers are known to do all sorts of strange things to optimize functionality or performance. Also, it is believed that there are many undocumented calls in the Windows API programmers use that Wabi will have to support. Therefore, SunSelect has put into place a certification program so that applications may be certified as Wabi compatible. To get the ball rolling, it has certified about a dozen—which is not to say that these are the only ones that will run. SunSelect will handle certification of major applications, like Microsoft Excel and Word, Lotus 1-2-3 and AmiPro, WordPerfect, and PageMaker. For others, SunSelect will make available to ISVs in June 1993 a Certification Program which will include a preview copy of Wabi, a self-certification program, and support.

Distribution and Availability. Sun's business model calls for SunSelect to have responsibility for distributing Wabi to any and all parties. This includes SunSelect's own sibling, SunSoft, for inclusion in Solaris and other Unix OEMs as well. Release 1.0 will be available to licensees this summer, each of which will make independent announcements on pricing and availability. SunSoft will make Wabi available on Solaris 2.x almost immediately.

Keeping Pace with the Windows API

SunSelect's challenge will be to evolve Wabi to keep pace with Microsoft's evolution of the Windows API. For example, Win32s, the 32-bit subset of Win32, the Windows NT API, will not be supported until 1994. Additional Microsoft APIs which extend the functionality of Windows will have to be supported as well, at least to the extent that Windows applications actually make use of them. Some, like ODBC and Windows Sockets, which are derived from standards outside of Microsoft's control, will be straightforward. Others, ranging from MultiMedia to Telephony, may be harder. On the other hand, it is conceivable that SunSelect, with its development partners, could have support in place for future versions of Microsoft's APIs in approximately the same time frame as applications developers support those APIs in their products. After all, both parties are working from the same set of specifications in the same time frame.

Strategic Partners

USL is going to be working with SunSelect on Wabi, assisting in the development of the Wabi Application Manager, the Wabi Configuration Manager, the Viewer component of the Help subsystem, and dynamic link libraries (DLLs) that support DDE across Windows applications, common dialogue, and ISO Latin internationalization. USL plans to integrate Wabi into the Unix SVR4.2 desktop, giving users the ability to launch either Windows applications or Unix applications in a consistent manner.

The Santa Cruz Organization (SCO) has also indicated that it is investigating Wabi supports in a future release of its Unix operating environment.

A number of other companies endorsed Wabi, including SPARC clone-maker Toshiba (Tokyo, Japan); Windows software companies like Corel (Ottawa, Ontario, Canada), Lotus, and Borland; and NCD (Mountain View, California), the X terminal company.

Strategic Value to Sun

Sun admits that Windows is a de facto standard for personal productivity applications and that the availability of a wealth of applications has made Windows both a successful product and a successful specification. While it will continue to support COSE (See *Open Information Systems*, Vol. 8, No. 4, April 1993) to attract native Motif applications to Unix, Wabi hopes to neutralize the applications advantage that Windows has had over Motif. This will allow systems to be sold on a basis other than applications availability. It will also allow Sun and other Unix vendors to draw side-by-side comparisons between their approach to distributed computing and Microsoft's. And it will allow Sun to contrast its approach to open systems and standards to Microsoft's.

This announcement doesn't mean that Sun is backing off from its position of recommending that users develop mission-critical applications for Solaris. Wabi is focused on personal productivity applications. Sun's support of COSE is meant to provide a robust, standards-based environment for distributed applications running on networks of Unix servers and workstations.

Microsoft Not to be Left Out

However, Microsoft has quickly countered Wabi with its own cross-platform Windows announcement. Although the timing seemed to be driven by the well-publicized SunSelect announcement, Microsoft had been exploring portable Windows technology for some time. It has been looking at ways of running Windows applications on Unix, and as far back as October 1992, Bill Gates told an audience at an analyst briefing that Microsoft was considering putting the Windows API on Unix as one way of ensuring that Unix workstation users and Windows users could share workgroup applications.

Windows Libraries for Unix. In conjunction with Insignia Solutions, Microsoft announced that a variety of products will be made available over time that would allow users to run Windows applications on Unix and allow ISVs to recompile their Windows applications to run on Unix and on Macintoshes with System 7. Microsoft will license Windows source code to Insignia so that Insignia can build an environment for running Windows and MS DOS applications on Unix platforms. The Insignia product will, in effect, be a licensed version of Windows for Unix that includes Insignia emulation technology as well as Windows libraries built from Microsoft source code. Microsoft has licensed source code, the Windows interface, the Windows APIs, and the Windows trademark and logo to Insignia. Insignia had already entered into an agreement with Bristol Technology (Ridgefield, Connecticut) for technology to help accelerate Windows performance on Unix. (For more information about Bristol Technology, see *Open Information Systems,* Vol. 7, No. 11, November 1992.)

Insignia will introduce its Microsoft-licensed technology gradually in a series of releases of its existing SoftPC products for HP, IBM, Sun, SGI (Mountain View, California), and NeXT. SoftPC for the Macintosh will also include this capability. Users will gradually receive benefits of faster performance and more accurate emulation. Through its licensing agreement, Insignia will

be able to track the evolution of the Windows API more easily as it evolves through Win32s, Win32, and beyond. In no case should there be any difficulty mapping Windows functionality to Unix, not even mapping NT functionality in the future.

Over time, other implementations of Windows on Unix will be forthcoming from Microsoft and others. While Microsoft isn't licensing Windows to all comers, it is seeding the market with strategic partners. Another example of this strategy is its licensing of Windows NT code to Citrix for that company to develop a multi-user subsystem.

Windows on the Mac. To run Windows applications on the Macintosh, Microsoft will use internally developed technology to deliver a library for the Macintosh that will allow developers to recompile their C and C++ Windows applications for System 7. Those applications will have the native Macintosh look and feel. Conceptually, this approach is like the Bristol approach to recompiling Windows applications for Unix, yielding a Motif look and feel. The difference between what Microsoft is doing on the Macintosh and what Insignia is doing on Unix is that Insignia runs Windows binaries, and Microsoft will support recompiling to native Macintosh code.

Making Windows a Public Interface

SunSelect also proposed the creation of a specification called the Public Windows Interface (PWI). PWI's objective would be to bring the specification for the Microsoft Windows API into the public domain and include undocumented or unsupported APIs that developers are using as well. Once a specification exists, multiple implementations are possible. In fact, counting Windows, Wabi, and OS/2, there are already three implementations of the Windows specification.

SunSelect enlisted a number of industry players to support this proposal, ranging from IBM to USL to SCO. With a standard Windows API, many vendors could provide Wabi-like support on their platforms for applications. If PWI came about, changes to the API would be made through an open, consensus-oriented process.

Judging by its reaction to this proposal, Microsoft didn't seem to get the point. The notion of taking something which it owns, specifically the Windows API, and turning it over to (Heaven forbid!) a committee is so alien to the thinking and business practices at Microsoft that it is not clear that the company even understands the proposal. From Microsoft's perspective, what would be the point of putting the Windows API in the public domain? Microsoft doesn't seem to understand the difference between specification and implementation. For example, it doesn't seem to realize that Wabi is an implementation of the Windows specification and that there is no separate Wabi specification.

As Microsoft develops future technologies, such as OLE 2.0, which will, in turn, evolve into its object-oriented environment, CAIRO, it reveals those technologies as interfaces or specifications. It isn't willing to allow others to develop competing technologies that implement the same specification. In effect, while the rest of the industry is moving toward competing on implementation, Microsoft is still competing on specifications.

Microsoft also doesn't see the role that X/Open could play. If it includes a Windows specification as a part of the XPG4 Desktop profile as an option along with the COSE specification, customers would be assured that products that receive Desktop profile branding meet a neutral party's requirements and that they still have a choice of desktop environments.

Even while Microsoft retains all rights to the API, an organization like X/Open could ensure that other implementations conform to the PWI specification, that the specification is available to anyone, and that all parties are treated fairly. Microsoft would continue to evolve and extend the API, but so could others. An X/Open process would allow input to future PWI specifications from more sources than are currently involved when Microsoft seeks input. Unfortunately, although users and ISVs would benefit from a PWI, it is extremely unlikely that Microsoft will embrace such a specification. This is one prediction, however, that we would like to see proven wrong.

Impact on the Market

Wabi will not, overnight, change the fortunes of Windows, Windows NT, or Microsoft. Nor will either Microsoft's or SunSelect's approaches to Windows on Unix dramatically impact the fortunes of Unix on the desktop in the near term.

Wabi will initially be available to customers only on Solaris, and it will be lacking certain key capabilities, like NetBIOS support. Other vendors and platforms will follow slowly. By mid-1994, Windows NT will have been available for nearly a year, and Microsoft will have sold between a half-million and a million copies. Any major problems with it as a desktop will have been patched, and it will provide support not only for 16-bit Windows applications, but for emerging 32-bit

applications as well. Wabi will not stem the initial tide for Windows NT.

Wabi makes it clear that in the longer term, application interfaces and operating systems can be treated independently. The Windows API will be supported on Unix, DOS, NT, and Macintosh System 7. The Motif API will be supported on many of those same operating systems, as will the Macintosh Finder and Toolkit. Software developers will not be selecting operating systems as target platforms, but user interfaces. Cross-platform tools will become less important. Users will be able to select their preferred applications, preferred interfaces, and preferred platforms.

The real battle will not be fought over desktops but over providing scalable environments for distributed applications. If users can run Windows applications on Unix desktops and still have access to the rich functionality in ONC+ and DCE for building the next generation of distributed applications, then both Wabi and Windows for Unix are wins for the customer. Being able to deploy in a consistent environment without having to worry about how compatible the Microsoft RPC is with the OSF DCE RPC or whether third-party DCE implementations for Windows NT are well-integrated with the platform will be a comfort to customers. Running Windows applications is an added benefit that users will welcome.

Nor can we lose sight of the possibility that even if Microsoft allows the Windows API to become an industry standard, the market might not embrace that standard either immediately or completely. The folks at Apple and Taligent, just to name two organizations, might have other thoughts about what an industry-standard desktop API should be. *— M. Goulde*

FOCUS: EUROPEAN OPEN SYSTEMS VENDORS

Looking for Open Systems at CeBIT

Finding the latest in open systems at Germany's annual CeBIT mega-conference is like finding the proverbial needle in the haystack. Yet, behind the scenes in Hannover, open systems were very much in evidence, with German companies like Siemens-Nixdorf Informationssysteme (SNI) AG and SAP AG as well as American companies like Apple Computer Incorporated and the ASK Group making announcements at the March show.

In part, open systems remain behind the scenes at CeBIT because these technologies are already so pervasive in the European market. Indeed, there is an interesting dynamic in Europe today: Conferences that target the general themes of Unix and open systems, like the Open Forum conference in Utrecht last fall and the Convention Unix conference in Paris last March, have been rather spectacular failures. The reason is that it's hard to get Europeans excited any more about technology for technology's sake. They are already sold on the basic rationales for open systems and don't feel the need to show up at general purpose technology conferences just to be born yet again.

CeBIT may be a general purpose conference, but it's raison d'etre is hardly to be a pure technology, much less pan-European, show. More accurately, CeBIT is a celebration of the enormous depth and breadth of the German information technology market. At CeBIT—which, this year, attracted 660,000 attendees to view the wares of over 5,600 exhibitors—the majority of the action on the show floor is in the German language, and the focus is clearly on the German market. For good reason. Despite a withering recession, Germany remains the largest single market in Europe and one with a relatively high growth potential. Estimates from the European Commission are that Germany will consume more than $25 billion in IT spending in 1993, over a quarter of the 12-member European Community's total. Germany is also making heavy investments in its new eastern states, and many are looking at the east as a new frontier with huge possibilities once infrastructure and business practices are brought up to par.

Against this backdrop of German market potential comes no small amount of open systems activity at CeBIT, however hidden among the general purpose computing exhibits. Siemens-Nixdorf, as always, seized the high ground with a first-day announcement of the completion of the massive reorganization started last October. (See *Open Information Systems*, Vol. 8, No. 4, April 1993) The new organization will structure SNI into a total of nine independent business units with marketing and sales responsibility for specific product lines. Besides the High Performance Printers, PC, and Systems Integration units announced last fall, the new units include Networking Systems, Office Automation, Point-of-Sale Systems, Engineering, Training and Services, and IT Service. In addition, SNI now has four Systems Units as well—for the BS2000 proprietary line, Midrange Systems, Self-Service Systems, and Application Software—that will oversee planning, development and production for these horizontal products. Riding herd over this new organization is the System Architecture Group, a 50-person technology board that will have a major part in ensuring that research, development, and products have a consistent role within the company's Open Systems Direction distributed architecture. This is

an important task for SNI. The former monolithic business structure made it easy for the company to dictate technology changes across the different product groups. But, with a much more structurally diverse organization, the System Architecture Group will have to work hard to provide a consistent message throughout its new business and systems units.

There was one major surprise in SNI's announcements. Although its senior executives had said last February that the company was downgrading its systems integration business unit, Sietec Consulting, to the role of "pre-sales consulting," the reality is that that Sietec has already begun to offer full-service integration, from consulting and business design to implementation and outsourcing. This is good news and bad news for the German market leader. As we noted before, major hardware vendors must offer these types of services in order to both stay competitive in the market and leverage new sources of revenues. Based on the situation as of last February, it looked as if SNI was going to leave a lot of potential revenue on the table by foregoing a full-service offering. Hence, the turnaround in integration policy is welcome news. The bad news is that, as SNI's new organization comes together, the confusion between what senior executives said in February regarding Sietec and the present reality of its role is evidence that SNI has a long way to go before it fully understands and comes to grips with its new organization.

The presence of Europe's other major vendors—France's Groupe Bull, Italy's C. Ing. Olivetti & Company SpA, and the United Kingdom's ICL Limited—at CeBIT was much more muted, testimony to both the German focus of CeBIT and these companies' relatively small presence in Germany. All three stuck mainly to the show floor and made no major announcements. Bull, which announced its Distributed Computing Model at CeBIT two years ago, rolled out some new manufacturing solutions for DCM and a new group to target the telecommunications market. That, however, was the extent of the strategic message from the rest of Europe's major vendors.

Also talking reorganization at CeBIT was the ASK Group, whose president, Pier Carlo Falotti, was formerly president of DEC Europe. Falotti took the opportunity to explain his company's recent reorganization to the CeBIT crowd. Like SNI, ASK is reorganizing into strategic business units to better leverage its manufacturing software, ManMan; its database software, Ingres; and their associated tools. The goal is more close cooperation between the two sides of the business, each of which, until now, has been operating as though the other didn't exist. There is a particularly European message in this effort for ASK, and it's no accident that Falotti plans to have his new structure fully functioning in Europe by this summer, several months ahead of the United States. Ingres has done a poor job capturing mind- and marketshare in the United States, but it is a highly competitive, well-established product in Europe, and has rival Sybase Incorporated desperately trying to catch up. On the other hand, the original ManMan and ManMan/X are virtually unknown in Europe. ASK has only recently begun to localize ManMan/X.

For these products, there is a serious threat to be considered, in the United States and Europe, from a very large and well-entrenched rival: SAP AG of Germany. Falotti is well aware that he must fight SAP on both sides of the Atlantic in order to stay in the game. That may prove to be harder than Falotti has bargained for. SAP, which repeated its traditionally massive presence at CeBIT, has been quietly improving its new R/3 open, integrated manufacturing package with a series of software tools and added functionality. New features demonstrated at CeBIT include support for imaging, business modeling, and the integration of third-party PC productivity software in R/3 systems. The company is also working hard to offer a range of databases that will work with R/3, expanding on the Oracle Version 6 DBMS that SAP's over 100 R/3 users are now using. SAP plans to add support for Informix and Software AG's SQL database later this year and is also considering support for IBM's forthcoming DB2/6000 AIX database.

The surprise showing at CeBIT came from Apple, which chose to make a worldwide announcement of its new Unix-based Macintosh servers. The fact that Apple succeeded in announcing a strong client/server message at a European show says a lot for the worldwide focus of its server-marketing efforts. Apple has been looking to deliver its message outside the United States, and CeBIT proved to be just that opportunity.

In the end, the fact that one has to look hard to find the open systems messages at a show like CeBIT is a healthy sign for the European market and part of a growing trend. The more open systems are treated like a fact of life and not a novelty, the more vendors and users can concentrate on the very real need for solutions and not just new technology. *— J. Greenbaum*

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