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INSIDE



PRODUCTS • TRENDS • ISSUES • ANALYSIS

# IBM's Second Generation RISC

*With its new RISC System/6000, IBM claims center stage.*

**By Judith Hurwitz**

IN TRADITIONAL IBM STYLE, it was one of the industry's worst-kept secrets. Many of the details of the RISC System/6000 (code-named Rios), IBM's next-generation RISC platform, have been plastered all over the trade publications for almost a year. By announcement time, bookies were still taking bets on the month in which the platform would *(continued on page 3)*

• E D I T O R I A L •

# OS/2 vs. Unix, Round 2

## The New OS/2 Knocks Unix off the Desktop, but Puts Microsoft's Control up for Questioning.

**By Judith S. Hurwitz**

MY COLLEAGUE, Mike Millikin, recently spent some time with the OS/2 developers at Microsoft, who are hard at work perfecting the 32-bit version of OS/2. Their goal is to make it as portable as possible to as many hardware architectures as possible. And they seem to be doing a good technical design job. Application developers are excited about no longer having to deal with 64-bit segments of memory.

Microsoft has also made significant progress in the DOS compatibility for OS/2. The 32-bit version will support up to 16 DOS windows of more than 600K each and LIM expanded memory. Software developers are excited because there will finally be application development tools, including object-oriented enablers.

We are telling you about the wonders of OS/2 in a Unix report because apparently Unix's opportunity to win the desktop has passed. For the past four years, as Microsoft toiled in vain to make OS/2 a standard, Unix developers and vendors engaged in a holy war against AT&T. Yes, some good has resulted from their efforts, such as the formation of Open Software Foundation (OSF) and Unix International (UI). In the long run, the Unix industry will be better off. But the downside is becoming obvious. Too much energy was spent fighting, and too little went into making Unix technology easy enough and streamlined enough for application developers and users. Open Desktop, the best hope for Unix desktops, is moving forward, but at a slow clip. Developers interested in the Open Desktop environment still face hurdles, such as network management, systems management, and development tools.

The bottom line is that OS/2 is slowly but surely coming into its own as an environment for shrinkwrapped applications development. This means that Unix has a less certain role in the commercial market for desktop applications. It also means that if OS/2 is being developed to be ported to other architectures—primarily RISC—then it will be an even greater threat to Unix, not only on the desktop but also as a server. OS/2 could transcend the perceived commercial OS/2 market and encroach into the technical and scientific territory that has traditionally been owned by Unix.

Nevertheless, Unix still has a very strong chance of making it as the de facto server environment. Unix hardware vendors have done a good job of creating good price/performance at the higher range of systems. Also, the momentum behind Unix servers is enough to make this trend a reality, especially if Unix vendors continue to exploit the capabilities of distributed computing as illustrated in the De Corum proposal to OSF. True distributed computing is probably the salvation for Unix as a client option and, in the long run, as a key server technology.

Ironically, just as we are on the verge of renewing the round of debates concerning the relative merits of OS/2 and Unix, the answer may matter less than ever. In the end, users are going to ask about the applications in both environments. They will want to combine both Unix and OS/2, forcing them to become strange bedfellows.

AT&T had to concede control of what was becoming an industry standard bigger than any one company. Will the same thing happen to Microsoft? Perhaps, especially when OS/2 is ported to a number of different architectures. Ah, the power and politics of control.

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## • I B M •

(continued from page 1) appear. The premiere of the RS/6000, originally set for October, was delayed till mid-February. The reason? Speculation has ranged from operating system problems to the lack of application software. The reason was a little of both.

But there is another dimension to IBM's introduction of the RS/6000. The company's developers were determined not to repeat past mistakes. IBM had been severely humiliated by the failure of its first RISC platform, the RT/PC. Not only was the platform limited in power, but it also lacked the graphics required for the applications IBM had targeted. In addition, IBM introduced only workstations, not servers. When it became apparent that the industry wanted servers as well, IBM wasn't prepared to compete with companies like Sun Microsystems and Apollo Computer.

The company that invented RISC had failed to implement it well enough to capture any meaningful market share. IBM quickly realized that it would need a new-generation platform to compete. It started working on the RS/6000 in 1986, just after the RT was released. This time, IBM was obsessive in its development efforts. It was out to prove its workstation manhood.

*The bottom line is that IBM has gone all out. Its goal for the RS/6000 is to establish RISC leadership in terms of both price and performance.*

Despite all the pre-announcement speculation, there were surprises. The basic information was correct. But the depth and magnitude of IBM's new-generation RISC machine were underestimated. It offered more floating-point performance than anyone had expected—up to 13 MFLOPS. It exceeded expectations in areas such as graphics performance and bus performance. It also expanded the levels of support available to developers. The level of activity is similar to IBM's efforts to encourage third parties to port software to the AS/400 several years ago.

The RS/6000 is clearly a second-generation RISC platform. Its CMOS design is six times denser than the RT chip. The RISC System/6000 has as much as 30 times faster floating-point performance than the RT, and 16 times as much memory. IBM's 32-bit version of the MicroChannel is 10 times faster than the RT bus. Perhaps its most important single achievement is its ability to process up to four instructions per cycle, made possible by the implementation of what is called *superscalar*. This is a much higher performance implementation of RISC, which allows the system to process an instruction in a single cycle. In contrast, superscalar allows for multiple instructions to be handled in one cycle.

The bottom line is that IBM has gone all out. Its goal for the RS/6000 is to establish RISC leadership in terms of both price and performance. It is leading with exceptional floating-point performance and throughput, and IBM has also announced optical cabling for the new systems, which adds to its performance and throughput. The RS/6000 leapfrogs the competition in terms of performance. This fact buffers the impact of the four-month delay in the introduction. However, the delay did give key competitors such as Sun, Digital Equipment, MIPS, and Hewlett-Packard more time to prepare responses. IBM seems to understand the challenge, and it promises to double performance every 12 months. To compete, it will have to keep that promise.

# The RS/6000 Family

IBM announced the RS/6000 as a family of four workstations and five servers, and an X terminal. In the future, IBM will be providing diskless software support to lower the price of the offering. In the future, IBM will expand the product line on the low end as well as the high end. All of the family uses the Power (Power Optimization With Enhanced RISC) architecture. (*Power* refers to the internal CPU.)

All of the workstations and servers come with a minimum of 8MB of main memory. The maximum memory on the upper end of the spectrum is 256MB. When IBM begins implementing 4MB chips, all the boxes except the desktop model will support 512MB of memory. The desktop model will be able to expand to 128MB of memory. Also included are: the internal 3.5-inch diskette, 19-inch display (gray scale), color monitors in either 16, 19 or 23-inch sizes (1024x1080 megapel displays), mouse, operating system (AIX Version 3), graphical user interface (either AIXwindows based on Motif or NextStep from NeXT), and Ethernet. MIPS performance ranges from 27.5 MIPS on the entry-level workstation to 41.1 MIPS on the high-end server. A rack-mounted server configuration has a MIPS rating of 34.5. MFLOPS rating ranges from 7.4 MFLOPS on the low-end workstation to 13 MFLOPS on the high-end server (non-rack-mounted).

The following is a description of the various workstations and servers.

**XStation 120.** XStation 120 (IBM's own X-station design) can be configured with up to 8.5MB of RAM memory, and it supports a range of displays from the PS/2 8503 monochrome display to high-performance graphics displays. Price tag is $2,525 (with gray-scale display).

**The Powerstation 320.** The Powerstation 320 is the low-end workstation. It includes a 20 MHz processor with 8KB of instruction cache, a 32KB data cache, and a 64-bit memory bus. It includes only two memory slots and four I/O slots. It has a price tag of $12,995. On the low end, IBM has not touched the

magic under-$10,000 price tag that Sun Microsystems set with the SPARCstation1. IBM's pricing is therefore a little bit higher than or on par with its competitors', but the performance for the money is better. In addition, IBM is adding a one-year, on-site maintenance agreement as part of the package. While other vendors (including H-P and Digital) offer a one-year warranty as well, users must carry their machines to a service center for repair. (Sun's warranty is 90 days). Pricing also includes high-quality black-and-white or color monitors. IBM may have a bit of a problem with some VARs and OEMs; they may perceive its pricing as higher than it actually is.

**The Powerstation 520.** The only difference between the Powerstation 520 and the 320 is the availability of a larger internal disk (from 355MB up to 2.5GB), and the number-memory and I/O slots have been expanded to eight. There are 2-port optical slots built into the direct memory bus of all models except the 320. These have not been implemented yet but will be in the future. The price tag is $30,425.

*IBM wants to be a major player in the RISC marketplace for open systems in general and for workstations in particular. In this game, price/performance is king.*

**The Powerstation 530.** This is a full implementation of the Power architecture. IBM uses a 25-MHz processor in the Powerstation 530, compared to a 20-MHz version in the 320 and 520. This faster clock speed combined with the 64KB cache and 128-bit memory bandwidth (which results in a 400-Mbit per second transfer rate) translates into 34.5 MIPS and 10.9 MFLOPS. Main memory begins at 16MB; cost is $41,125.

**The Powerstation 730.** The Powerstation 730 is IBM's high-performance graphics workstation. The only difference between the 730 and the 530 is graphics capabilities. The 730 processes approximately 990K vectors per second and 120K polygons per second. This compares to graphics on the other workstations of 90K vectors per second and 10K polygons per second. Its price is $73,815.

## RS/6000 Servers

**The Powerserver 320.** The processor on the Powerserver 320 is the same as that on the Powerstation 320. The difference is that the Powerserver 320 has been configured with 16MB of memory rather than 8MB. No display or graphical user interface is included since this is a server. It is intended to support between 5 and 50 users. The price is $20,375.

**The Powerserver 520.** The Powerserver 520 is the same processor as used in the Powerstation 520. It has been configured with 16MB of main memory rather than 8MB. No display or graphical user interface is included. It is intended to support between 25 and 150 users.

**The Powerserver 530.** The Powerserver 530 is identical to the Powerstation 530, and it is priced $1,580 less than the workstation because it includes no display or user interface.

**The Powerserver 540.** This is IBM's high-end server and the only one to use a 30-MHz processor. Main memory starts at 64MB. It is the only model that will include the 4Mbit chips initially. Also, internal disk begins at 640MB. Price on this machine is $92,885.

**The Powerserver 930.** The Powerserver 930 is a rack-mounted version of the Powerserver 530. Like the 530, it operates at 25 MHz, but it supports more users because internal disk size has been increased. The rack-mounted version has two optical slots (each card has two ports). With the optical technology, users would be able to link three floor-standing systems together or link five rack mounted systems. Starting disk size is 670MB to 11.9GB. Price is $62,230.

IBM intends to provide aggressive discounts to third parties as well as to end users. For example, it will offer VARs as much as a 35-percent discount. Discounts for software developers will be up to 50 percent. A developer could easily pick up a low-end Powerstation 320 for as little as $6,500.

Does this aggressive pricing mean that IBM will lose money? Probably not. IBM is using the same manufacturing facilities and, in some instances, the same parts used on the PS/2. The rack-mounted server uses the same racks used for the 9370 systems. IBM has also leveraged some of the technology developed in its laboratories, such as the optical cabling between systems. And, because IBM was able to pick up software from the various Unix vendors and industry consortia, its costs were lower than it is accustomed to spending.

**RISC WARS: PLAYING BY THE RULES.** But, when a company is as big and as complex as IBM, nothing is simple. When a vendor has both its traditional systems offerings and Unix boxes, strategies are bound to conflict. IBM wants to be a major player in the RISC marketplace for open systems in general and for workstations in particular. In this game, price/performance is king. But any hardware leader is only king for a day. Things tend to change so fast that it doesn't take long for a competitor to finesse the leader into a second-place finish. This is a market that IBM is not used to playing in. In fact, it is much more analogous to the semiconductor marketplace of the late 1970s and early 1980s. In those days, the joke was that semiconductor makers would compete by slashing their wrists and waiting to see who would bleed to death first. This story could well be told about RISC hardware vendors today.

IBM may take some time to learn the rules of the game.

But it is eager to begin. In the traditional minicomputer and mainframe world, IBM could always be a little more expensive and get away with it. Users often looked for the IBM seal of approval and were willing to pay extra to get it. The same cannot be said of the aggressively paced workstation market, which has a very low tolerance for games that vendors might want to play to keep their existing systems looking good. Having two different and competing product lines has been an agonizing struggle for IBM, but, of course, the company is not alone here. Digital Equipment, for example, has trouble making peace between its VAX and MIPS-based product lines.

The price of having two competing product lines is steep. Digital has come to understand this well. The difference in price/performance between its RISC and VAX product lines is enormous and has impacted VAX sales. To make matters worse, Digital's sales force still does not understand how to sell Ultrix, its Unix product line, and feels more comfortable pushing what it knows—the VAX. Traditionally, the VAX and the VMS have been the platforms for innovation in areas such as office, compound document architecture and decision support. Digital's new transaction processing software will be introduced on VMS, not Ultrix.

IBM will face the same challenge as it is forced to position the AS/400 against the RISC servers. In the short run, IBM will legitimately claim that there is an incredible amount of software on the AS/400 for the turnkey, small business market. Much of this software has migrated from earlier IBM systems, including the Systems/34, /36, and /38. In the long run, however, this may no longer be true. We expect that traditional Unix turnkey software vendors will provide solutions that will operate on the RS/6000. These vendors are motivated by price and are likely to find the RS/6000 to be an attractive server.

On the workstation side, IBM will find the RS/6000 competing against the high end of the Intel-based PS/2 line. This, too, will generate problems: The power and pricing of these two lines will intersect. The PS/2 system configured with the i860 processor Wizard board as a graphics coprocessor creates an impressive high-performance offering. However, IBM is being careful to position this PS/2 configuration at the OS/2 applications market.

How well will the RS/6000 withstand the internal pressures to keep other IBM proprietary platforms vibrant? When different IBM platforms were positioned for different markets, there was internal jockeying. However, top management within IBM has made it clear that the RS/6000 must be free from internal politics. In fact, we understand that the project team

# RS/6000 vs. the Competition

IBM WILL NOT have much time to rest on its laurels. The competition is hot in pursuit. Here's how it looks for IBM's top competitors:

**HEWLETT-PACKARD.** In terms of breadth of offering and outright performance, IBM's most direct competitor will be Hewlett-Packard. HP has plans to merge its own RISC architecture, called Precision Architecture, with Apollo's PRISM architecture. The company is promising that its second generation, which will appear by the end of the year, will have a starting point of 30 MIPS. By the end of 1991, HP is planning for a workstation with more than 100 MIPS.

**SUN MICROSYSTEMS.** At the low end of the market, IBM will have to face off with Sun Microsystems in terms of applications strategy. Sun has clearly grabbed hold of the low end of the workstation market with its under-$10,000 diskless SPARCstation. Sun is also promising to match IBM performance in the near term. Sun has a head start in attracting third parties to write for its platform by providing a lot of tools that make porting easier than some other platforms. Its catalogue includes 3,000 applications.

**DIGITAL EQUIPMENT.** Digital Equipment is aiming for the same spot as IBM in terms of number and types of third-party applications. But it has some catching up to do. For example, Digital's entry-level price for its DECstation 3100 is about $12,000 (diskless). We expect that Digital will have to announce workstations and servers to update its stock.

**DATA GENERAL.** Data General gained a lot of mileage from its Aviion family, based on the Motorola 88000 workstations. It has captured the spot of the lowest cost per MIPS. IBM's announcements challenge its position. DG will have to move fast in the applications arena to be able to compete.

**MIPS.** MIPS, which supplies systems to Digital, is an aggressive company that will work hard to beat IBM at the price/performance game. However, we expect that MIPS will aim at the high end of the spectrum.

**INTEL.** Intel has decided to sell systems of its own, rather than being only an OEM supplier. It could well use its i860 platform to try to make itself a competitor.

**MOTOROLA.** Like Intel, Motorola is seeking a bigger piece of the pie by integrating systems of its own. It has uses its 88000 product line to get into the race.

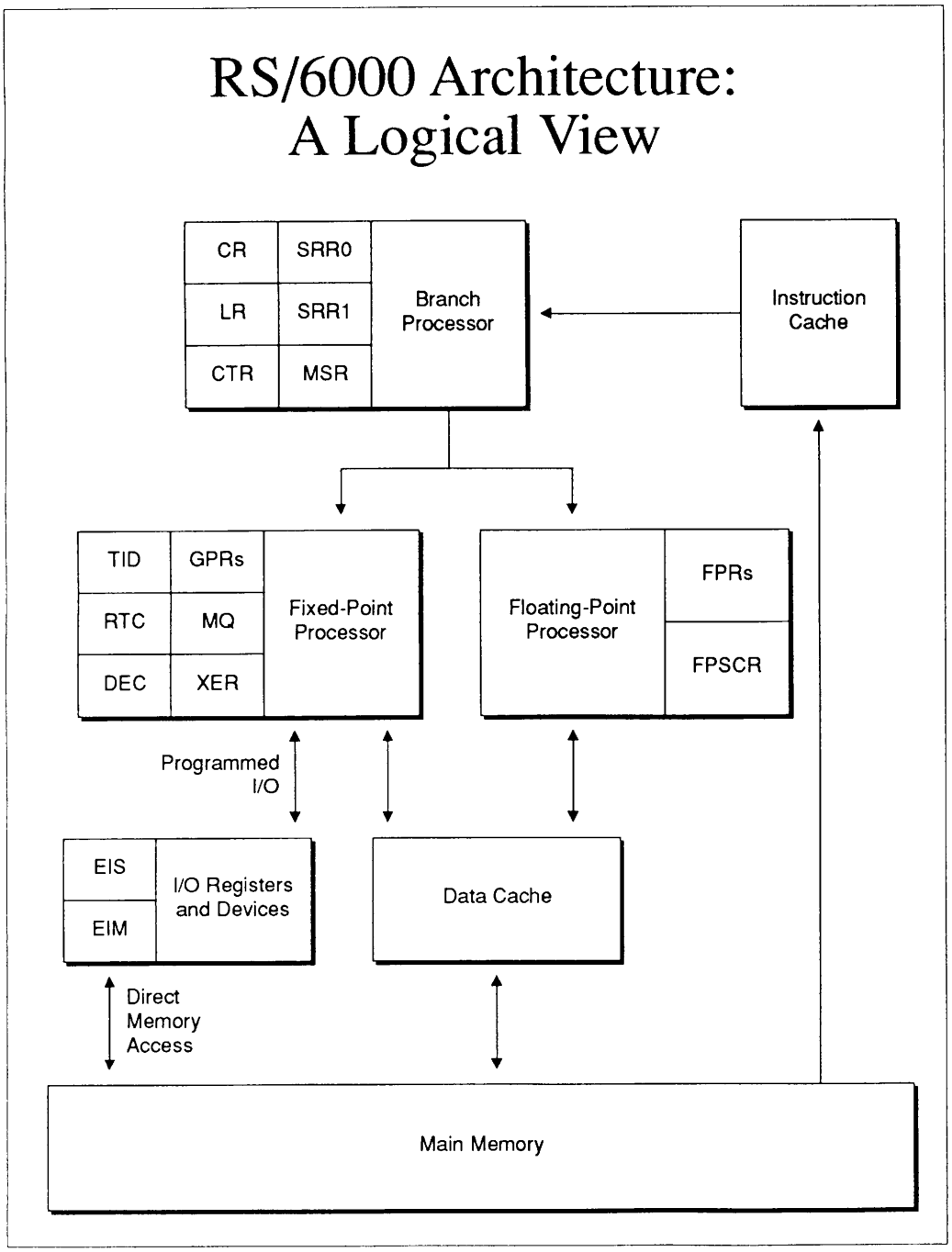


*Illustration 1. IBM's goal with the RS/6000 is to achieve price/performance leadership in workstations and servers. The RS/6000 architecture combines wide buses with high-memory bandwidth and microcoded graphics capabilities.*

had a direct line of communications into IBM CEO, John Akers. Akers asked to be informed if these upstarts found their path being obstructed from within. Obviously, the top echelons within IBM wanted to make sure that the new RISC family would not fail because of any internal forces. This does not mean that there will be no internal conflicts among the groups. This will be one of the most critical areas for IBM to manage. Internal fighting for market share will hurt the AS/400 and PS/2 as well as the RS/6000 platforms.

**TECHNICAL VERSUS COMMERCIAL.** To reduce market conflicts with the AS/400, IBM is positioning the RS/6000 at the technical, numeric-intensive marketplace. While this makes sense given the power, speed, and graphics of the new RS/6000 platforms, it is also clearly a defensive move. First, it gives AS/400 marketers some breathing room; second, it allows IBM time to build up the perception that the platform is "best of breed."

In fairness, IBM is leaving a window open for the commercial market in the future because management is smart enough to realize that commercial Unix is becoming a reality. From our perspective, IBM's strongest appeal will be in the commercial arena. While IBM will have to fight hard to win a coveted place in the numeric-intensive workstation market, it is in the best position to understand the needs and requirements of commercial data processing organizations. As Unix slowly moves into corporations because of the freedom it offers, IBM will be well positioned. The company still has an excellent reputation and relationship with traditional MIS organizations. If these managers are forced or decide on their own to pursue Unix, they are more likely to trust IBM than an unknown Unix hot-box maker.

## The Hardware Architecture

IBM's objective in developing the RS/6000 was to achieve its goal of leadership in terms of price/performance in the work-

station and server arena. As part of this goal, IBM intends to provide competitive products in terms of high-performance processing and graphics. It also intends to achieve network computing leadership. High on this list is communication, not only between members of its own family, but also with other Unix platforms and between AIX and SAA. IBM's most ambitious goal is to propel the RS/6000 into becoming the development platform of choice. IBM will have to lure the best-of-breed developers. Its first chore will be to encourage them to add an AIX port. Its second challenge will be to foster enough confidence so they'll write to the RS/6000 first.

*IBM has done a good job developing a high-performance graphics environment. IBM's goal is to make the RS/6000 into an integrated multimedia system.*

Considering the magnitude of its goals and the place where it is starting (with only about 2 percent of the workstation market), IBM will not achieve its plan overnight. It will be a journey that will take years to achieve. How does the score card look? IBM gets its best grades for developing excellent price/performance and design. IBM seems to understand the long-term commitment required and therefore plans to "double the price/performance every 12 to 24 months."

**BUS ARCHITECTURE AND I/O.** One problem that can sink the most powerful processor is inadequate bus bandwidth. The RISC architecture combines wide buses with high memory bandwidth. IBM has two separate high performance buses. One is the memory bus (either 64 or 128 bits, depending on the model) that transfers data between memory, cache, and the processor. The second bus is a new generation of the MicroChannel architecture. This I/O bus allows 40 Mbits per second burst mode transfers. This is double the data transfer rate on the first-generation PS/2 MicroChannel. Future versions of this technology will produce transfer rates of up to 80 MB and, at some point, to 160 MB per second. When such a powerful version of the MicroChannel will be available is anyone's guess.

This 40MB per second transfer rate is attainable when long blocks of data are transferred. The burst (or streaming data mode, as IBM calls it) is important for large quantities of data. It allows multiple data cycles to be transferred all at once within one bus envelope. Therefore, rather than requiring the user to send an address with every data transfer, the streaming data works so that only the starting address has to be sent; then multiple consecutive data packets can be transferred without multiple addresses being sent. This doubles the performance for large groups of data being transferred together and also serves to improve error recovery because of the precise I/O load and store interrupts.

**Graphics.** For the RS/6000 to become a primary developer's platform of choice, high-performance graphics are a given. In fact, the lack of advanced graphics was one of the key problems with the RT. IBM has done a good job developing a high-performance graphics environment. IBM's goal is to make the RS/6000 into an integrated multimedia system. Over time, the same capabilities will be available on all platforms—across SAA and AIX. Even the entry-level, monochromatic workstation includes 16 gray shades. The color displays provide 256 of 16 million colors. IBM will support 2-D as well as 3-D graphics. Its high-end workstation, the 730, provides microcoded graPHIGS (PHIGS is the IEEE-sanctioned distributed protocol for X-Window) and over 100 MFLOPS of dedicated throughput. And it also has the performance of a million vectors per second. To improve performance, IBM has added hardware assists for graphics. This workstation is specifically geared to graphic-intensive 3-D applications such as molecular modeling and will compete with the Apollo/HP DN 10000 and high-end machines from Sequent and Stardent. In addition, IBM is providing the Silicon Graphics' GL library.

**Memory.** In the RS/6000, IBM has gone for a larger amount of real memory than that on the RT. The RS/6000 can support from 8 to 512MB (with 4Mbit chips). In addition, IBM has improved virtual memory management so that programs or databases can span multiple physical disks. (See Illustration 1.)

## System Balance

Since the success of the original PC, vendors have traditionally integrated technology from different sources into a single system. But, as the workstation market grows more competitive, this is no longer enough. Leadership in this market requires attention to detail and attention to performance. IBM wants so badly to succeed in the hot workstation arena that it had to do better. Again, IBM is not alone here. MIPS has been aggressive in eking out the most performance possible from its 6000 line. However, because the 6000 is based on ECL technology, it is a high-end processor with a price tag of more than $100,000.

**THE POWER DESIGN.** The foundation of IBM's Power family is both RISC and CMOS technology. RISC will ensure speed, and CMOS allows for low power consumption. Unlike the many RISC implementations that are based on the single CPU chip design, IBM has chosen to use multiple chips with more transistors than are usually implemented in a single CPU. This allowed the company to construct a balanced system at the chip level. As CMOS technology gets denser, we expect the Power architecture to move to a single-chip implementation.

IBM achieves its performance in several specific ways. It has hard-wired instructions rather than implementing them in microcode. To be able to achieve multiple instructions per

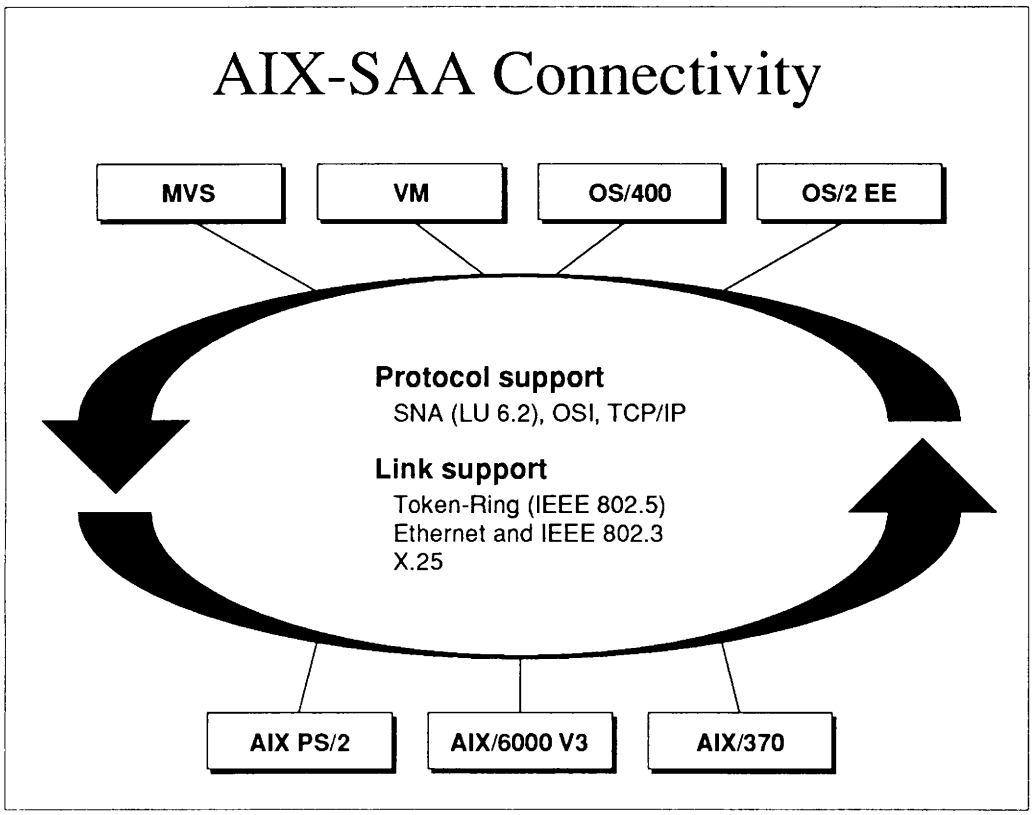


*Illustration 2. This is how IBM explains connectivity among its various operating environments.*

cycle, IBM uses a pipelined implementation of RISC that allows for several different kinds of instructions to be processed simultaneously. IBM calls its POWER architecture for the RS/6000 a Reduced Instruction Set Cycle architecture, based on concurrent execution of fixed, floating point, and branch operations. Therefore, a user could process—in parallel—four instructions and five operations in one cycle. IBM has also embedded as much technology in the hardware as possible in areas such as database assist and compiler-optimized performance.

Yes, there are definitely some advantages to owning the hardware environment and not worrying about selling silicon to other vendors. Here, IBM has a unique advantage. There are very few companies that can develop a platform intended for the open systems arena and develop and market their own processor without fear of offending users. Users will not be afraid to be boxed into an IBM-only hardware platform. The same cannot be said of smaller players in this market. In the future, IBM may decide to license some or all of its hardware technology.

**Functional Units.** The Power architecture is based on three independent functional units, each comprising its own chip: a branch processor, a fixed-point processor, and a floating-point processor. Also included in the architecture are instruction and data cache units (DCU) as well as main memory and I/O registers and devices. The key to the Power design is the fact that the units were designed for maximum concurrence. The 184 RS/6000 instructions are divided among the functional units to minimize interaction and synchronization.

**Floating Point.** Floating-point performance is an integral part of IBM's strategy. In order to capture the attention of numeric-intensive application developers, floating-point performance has to be good. IBM has tightly coupled the floating-point coprocessor to the rest of the CPU. Therefore, the floating-point unit and the fixed-point unit have equal priorities and independent functional units. The floating-point unit has a double-precision, wide data path, and it executes floating-point arithmetic operations.

**Multiprocessing Support.** IBM supports concurrent parallel execution within a single processor. But there is no multiprocessor support at introduction. However, because IBM is using optical cabling, coupled processors should provide good throughput and speed. In the future, IBM has stated, it will be building N-way multiprocessing systems. IBM's use of optical cabling will help increase speed even on clustered processors as well as future multiprocessor designs.

## The Software Environment

IBM has done a credible job developing a superb hardware platform for the '90s. But the real test will be how well it will be able to apply its sophistication in hardware to software. The name of the game is volume of applications—at least initially. Competitors in the market will have a field day over the next few months because there will be so few software packages available at announcement.

By first customership, some 200 products will be completed or near completion. Several hundred other vendors will be at some stage of negotiation or completion of development. IBM has targeted about 1,500 "leading" applications by the end of the year, but it will have to have many thousands of applications in the pipeline. Luckily for IBM, it won't have to do all of the work. The company's job will be to lure developers to port their software to the RS/6000.

This is also IBM's most vulnerable area. Vendors like Sun, which has 3,000 applications, and Digital, which is quickly

building a base of applications, will be quick to point out that IBM doesn't have the same applications or tools. IBM, aware of its weaknesses here, is being extremely aggressive in luring developers. Those we've talked to have been pleased with the performance and the support IBM has provided. IBM has 22 porting centers and intends to build more. For those developers IBM considers the most critical, the company has paid for ports and provided technical coding support. It has invited software developers to bring their applications to the Austin Labs where the development team is based. Already, some 300 loaner systems are in the hands of developers. Also, IBM is providing technical hot-line telephone support and electronic support. Discounts for developers will be up to 50 percent. Therefore, a developer could buy an entry-level system for as little as $6,500. At the same time, IBM is training its own technical and marketing staff. During 1989, IBM's AIX training accounted for 40,000 student days; during 1990, it will provide 50,000 student days. In addition, IBM sent members of its technical staff for three-week internships with software developers.

IBM expects 1,500 RT applications and 2,000 PS/2-based AIX applications to be ported to the RS/6000. If IBM accomplishes this goal, it would definitely help in the applications race.

## Target Markets

Initially, IBM has staked out

(continued on page 12)

# Expanded AIX Family Definition

| | **Initial Relationships** (Announced March 1988) | **Industry Compatibility Emphasis** (To Be Announced 1st Q, 1990) |
|---|---|---|
| **Kernel** | | |
| | **Compliance**<br>Posix<br><br>**Equivalent function to**<br>Sys V.2<br>BSD 4.3 | **Compliance**<br>Posix<br>X-Open<br>Sys V.2<br>BSD 4.3<br>Security |
| **Languages** | | |
| | C - ANS Standard<br>FORTRAN - ANS Standard | C - ANS & SAA Extensions<br>FORTRAN - ANS & SAA Extensions<br>COBOL - ANS & SAA Extensions |
| **Display Support** | | |
| | Standard Unix ASCII<br>X-Window 11.2 | Standard Unix ASCII<br>X-Window 11.3<br>OSF/Motif |
| **Graphics (Workstations)** | | |
| | GSL | XGSL<br>GKS<br>PHIGS |
| **Data Management** | | |
| | | SQL - ANS & IBM Dist |
| **Communications** | | |
| | TCP/IP | TCP/IP (BSD 4.3)<br>OSI<br>SNA LU6.2 |
| **Distributed Services** | | |
| | NFS 3.2<br>DS/IP | NFS 3.2 & 4.0<br>OSF/DCE (SOD)<br>BSD 4.3 Remote |

*Illustration 3. How IBM has become more standards compliant to compete.*

# RISC System/6000 Servers

| | Powerserver 320 | Powerserver 520 | Powerserver 530 | Powerserver 540 | Powerserver 930 |
|---|---|---|---|---|---|
| **PACKAGING** | DESKSIDE | DESKSIDE | DESKSIDE | DESKSIDE | 1.5M RACK |
| **INTEGER PERFORMANCE**<br>**FLOATING-POINT**<br>**SPECmark** | 27.5 MIPS<br>7.4 MFLOPS<br>22 | 27.5 MIPS<br>7.4 MFLOPS<br>22 | 34.5 MIPS<br>10.9 MFLOPS<br>29 | 41.1 MIPS<br>13.0 MFLOPS<br>34 | 34.5 MIPS<br>10.9 MFLOPS<br>29 |
| **TYPICAL WORKGROUP** | 5-50 | 25-150 | 25-150 | 25-150 | 50-250 |
| **PROCESSOR**<br>**CLOCK SPEED** | POWER<br>20 MHz | POWER<br>20 MHz | POWER<br>25 MHz | POWER<br>30 MHz | POWER<br>25 MHz |
| **MAIN MEMORY**<br>**MEMORY TYPE** | 8-32MB<br>1 MBIT ECC | 8-128MB<br>1 MBIT ECC | 16-128MB<br>1 MBIT ECC | 64-256MB<br>4 MBIT ECC | 16-128MB<br>1 MBIT ECC |
| **DATA/INST CACHE**<br>**BUS WIDTH** | 32KB/8KB<br>64 BIT | 32KB/8KB<br>64 BIT | 64KB/8KB<br>128 BIT | 64KB/8KB<br>128 BIT | 64KB/8KB<br>128 BIT |
| **INTERNAL DISK**<br>**INTERFACE** | 120-640MB<br>DBA/SCSI | 355MB-2.5GB<br>SCSI | 355MB-2.5GB<br>SCSI | 640MB-2.5GB<br>SCSI | 670MB-11.9GB<br>SCSI |
| **INTERNAL DISKETTE** | 3.5" | 3.5" | 3.5" | 3.5" | 3.5" |
| **TAPE BACKUP** | 2.3GB 8MM<br>150MB 1/4"<br>1/2" 9-TR | 2.3GB 8MM<br>150MB 1/4"<br>1/2" 9-TR | 2.3GB 8MM<br>150MB 1/4"<br>1/2" 9-TR | 2.3GB 8MM<br>150MB 1/4"<br>1/2" 9-TR | 2.3GB 8MM<br>150MB 1/4"<br>1/2" 9-TR |
| **MEMORY SLOTS**<br>**I/O SLOTS** | 2<br>4 | 8<br>8 | 8<br>8 | 8<br>8 | 8<br>8 |
| **WARRANTY** | 1 YEAR | 1 YEAR | 1 YEAR | 1 YEAR | 1 YEAR |
| **BASE PRICE CONFIGURATION** | 16MB, 320MB<br>E'NET, SCSI<br>DISKETTE<br>1/4" TAPE<br>AIX BASE | 16MB, 355MB<br>E'NET, SCSI<br>DISKETTE<br>1/4" TAPE<br>AIX BASE | 16MB, 355MB<br>E'NET, SCSI<br>DISKETTE<br>1/4" TAPE<br>AIX BASE | 64MB, 640MB<br>E'NET, SCSI<br>DISKETTE<br>1/4" TAPE<br>AIX BASE | 16MB, 670MB<br>E'NET, SCSI<br>DISKETTE<br>8MM, CD-ROM<br>AIX BASE |
| **BASE PRICE** | 20,375 | $30,425 | $41,125 | $92,885 | $62,230 |

- INTEGER (MIPS): COMPUTED USING DHRYSTONE 1.1 RESULTS COMPARED TO VAX 11/780. VAX IS A TRADEMARK OF DIGITAL EQUIPMENT CORPORATION.
- FLOATING-POINT(MFLOPS):DOUBLE PRECISION, 64-BIT, ALL FORTRAN UNPACK, N=100.
- SPECmark: GEOMETRIC MEAN OF THE 10 BENCHMARK TESTS. CONFIGURATIONS AND INDIVIDUAL TEST RESULTS ARE AVAILABLE FROM IBM. SPEC IS A TRADEMARK OF THE STANDARD PERFORMANCE EVALUATION CORPORATION.

*VALUES SHOWN ARE RESULTS OF TEST LEVEL SYSTEMS. WHILE THESE VALUES SHOULD BE INDICATIVE OF GENERALLY AVAILABLE SYSTEMS, NO WARRANTIES ARE STATED OR IMPLIED BY IBM.*

# RISC System/6000 Workstations

| | Powerstation 320 | Powerstation 520 | Powerstation 530 | Powerstation 730 |
|---|---|---|---|---|
| **PACKAGING** | DESKTOP | DESKSIDE | DESKSIDE | DESKSIDE |
| **INTEGER PERFORMANCE**<br>**FLOATING POINT**<br>**SPECmarks** | 27.5 MIPS 7.4<br>MFLOPS<br>22 | 27.5 MIPS<br>7.4 MFLOPS<br>22 | 34.5 MIPS<br>10.9 MFLOPS<br>29 | 34.5 MIPS<br>10.9 MFLOPS<br>29 |
| **PROCESSOR**<br>**CLOCK SPEED** | POWER<br>20 MHz | POWER<br>20 MHz | POWER<br>25 MHz | POWER<br>25 MHz |
| **MAIN MEMORY**<br>**MEMORY TYPE** | 8-32MB<br>1 MBIT ECC | 8-128MB<br>1MBIT ECC | 16-128MB<br>1 MBIT ECC | 16-128MB<br>1 MBIT ECC |
| **DATA/INST CACHE**<br>**BUS WIDTH** | 32 KB/8KB<br>64 BIT | 32 KB/8KB<br>64 BIT | 64KB/8KB<br>128 BIT | 64KB/8KB<br>128 BIT |
| **2D COLOR/GRAYSCALE**<br>**3D COLOR/GRAPHICS**<br>**VECTORS/SECOND**<br>**POLYGONS/SECOND** | 125K/72K<br><br>90k<br>10k | 125K/72K<br><br>90K<br>10K | 131K/76K<br><br>90K<br>10K | <br><br>990K (EST)<br>120K |
| **INTERNAL DISK**<br>**INTERFACE** | 120-640MB<br>DBA/SCSI | 355MB-2.5GB<br>SCSI | 355MB-2.5GB<br>SCSI | 355MB-2.5GB<br>SCSI |
| **INTERNAL DISKETTE** | 3.5" | 3.5" | 3.5" | 3.5 |
| **TAPE BACKUP** | 2.3GB 8MM<br>150MB 1/4"<br>1/2" 9-TR | 2.3GB 8MM<br>150MB 1/4"<br>1/2" 9-TR | 2.3GB 8MM<br>150MB 1/4"<br>1/2" 9-TR | 2.3GB 8MM<br>150MB 1/4"<br>1/2" 9-TR |
| **MEMORY SLOTS**<br>**I/O SLOTS** | 2<br>4 | 8<br>8 | 8<br>8 | 8<br>8 |
| **WARRANTY** | 1 YEAR | 1 YEAR | 1 YEAR | 1 YEAR |
| **BASE PRICE CONFIGURATION** | 8MB, 120 MB<br>19" DISPLAY<br>GRAYSCALE (16)<br>DISKETTE<br>KB, MOUSE<br>AIX, GUI, E'NET | 8MB, 355MB<br>19" DISPLAY<br>GRAYSCALE (16)<br>DISKETTE<br>KB, MOUSE<br>AIX, GUI, E'NET | 16MB, 355MB<br>19" DISPLAY<br>GRAYSCALE (16)<br>DISKETTE<br>KB, MOUSE<br>AIX, GUI, E'NET | 16MB, 355MB<br>19" COLOR<br>SUPERGRAPHICS<br>DISKETTE<br>KB, MOUSE<br>AIX, GUI, E'NET |
| **BASE PRICE** | $12,995 | $27,245 | $42,705 | $73,815 |

- INTEGER (MIPS): COMPUTED USING DHRYSTONE 1.1 RESULTS COMPARED TO VAX 11/780. VAX IS A TRADEMARK OF DIGITAL EQUIPMENT CORP.
- FLOATING-POINT (MFLOPS): DOUBLE PRECISION, 64-BIT, ALL FORTRAN UNPACK.
- SPECmark: GEOMETRIC MEAN OF THE 10 BENCHMARK TESTS. CONFIGURATIONS AND INDIVIDUAL TEST RESULTS ARE AVAILABLE FROM IBM. SPEC IS A TRADEMARK OF THE STANDARD PERFORMANCE EVALUATION CORPORATION.
- 2D LINES/SECOND: (COLOR GRAPHICS & GRAYSCALE) CONNECTED RANDOMLY ORIENTED, 10 PIXEL LINES IN SCREEN INTEGER COORDINATES.
- 3D VECTORS/SECOND: RANDOMLY ORIENTED, 10 PIXEL POLYLINES IN FLOATING-POINT COORDINATES, TRANSFORMED, SCALED AND CLIP TESTED.
- 3D POLYGONS/SECOND: 50 PIXEL GOURAUD SHADED TRIANGLE MESH IN FLOATING-POINT COORDINATES.

*PERFORMANCE VALUES SHOWN ARE RESULTS OF TEST LEVEL SYSTEMS. WHILE THESE VALUES SHOULD BE INDICATIVE OF GENERALLY AVAILABLE SYSTEMS, NO WARRANTIES ARE STATED OR IMPLIED BY IBM.*

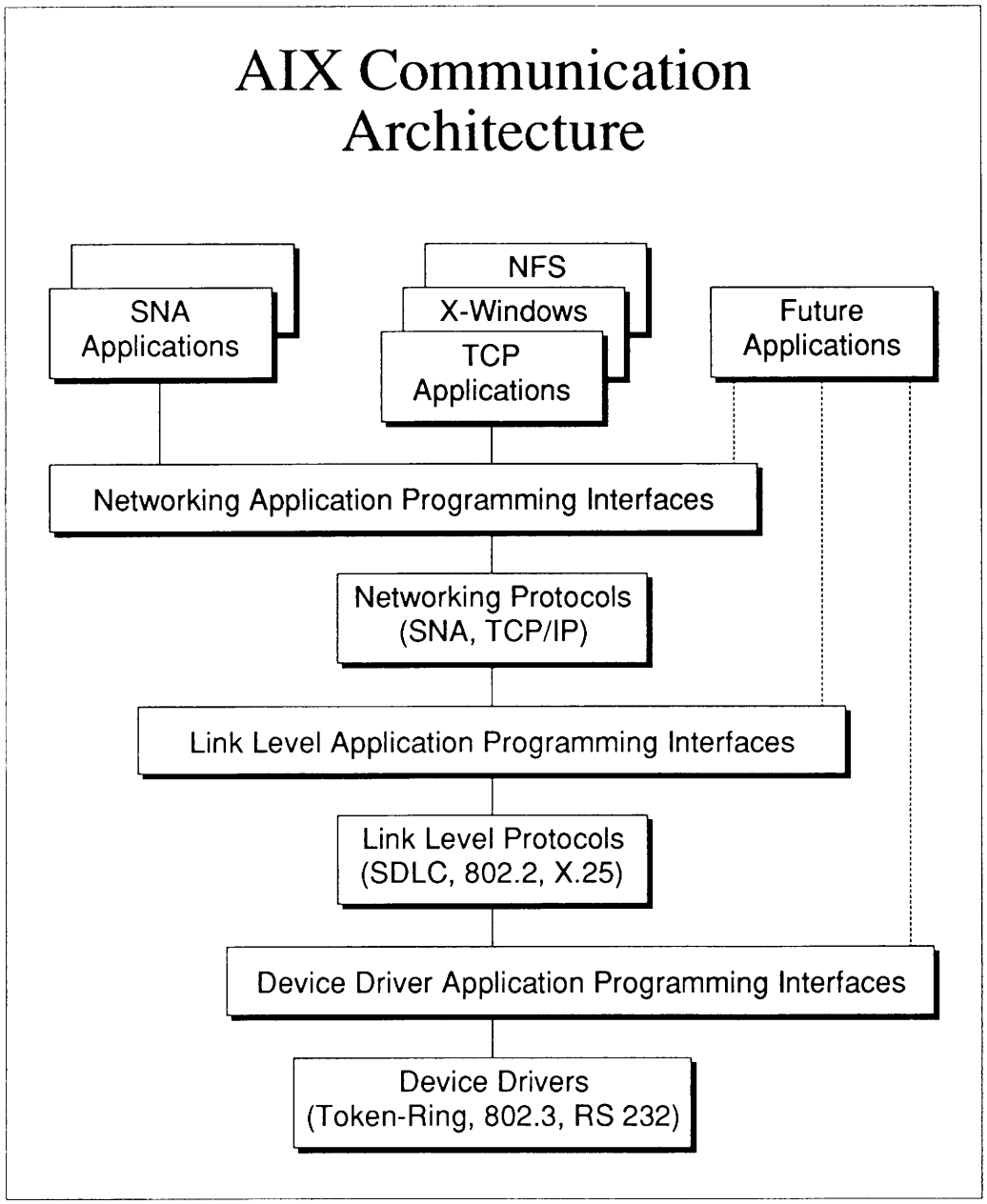


*Illustration 4. IBM's AIX communications architecture is designed to deliver a robust distributed computing environment.*

*(continued from page 9)* the most power-hungry applications to show off the power and throughput of the RS/6000. These include CAD/CAM/CAE, CASE, research, technical publishing, securities and trading systems, financial and economic analysis, statistical analysis, mapping, 3-D visualization, and animation. To begin the cautious move into the commercial market, IBM has also targeted the personal productivity requirement of technical professionals. This gives the company a foot in the door to the general commercial market. IBM is also including "multiuser" as a target market.

**BASE APPLICATION DEVELOPMENT TOOLS.** To encourage CASE developers to jump on board, IBM has included a toolkit for CASE programmers. Many of these are existing tools for X-Window development. Others are conventional Unix commands and libraries that IBM has packaged for developers. IBM has also lined up some key CASE tools developers, such as Cadre (Teamwork product for analysis and design); Oasys (C, Glockenspiel C++ preprocessor, cross-compilers); Sabre (Sabre-C for development and testing); Verdix (Ada development system called VADS); Rational (Ada language development environment); and Atherton Technology (Software Backplane).

**NATIONAL LANGUAGE SUPPORT.** To support multiple language characters, IBM is supporting full eight-bit multibyte, multilingual message facilities. IBM is supporting 14 national languages including Japanese (with full Kanji), French, German and Italian.

**PROGRAMMING ENVIRONMENT.** The availability of languages and tools will be key to IBM success in the technical Unix workstation market. To start, IBM will be offering C, Fortran, Pascal, Cobol, C++, Lisp, Basic, and Ada, and it will need the support of many of the ISVs specializing in tools. It will be especially important for IBM to gain access to tools and compilers that run in a distributed environment.

**USER INTERFACE AND USABILITY.** AIXwindows, IBM's implementation of Motif, is the key user interface for Rios. In fact, Motif was a gift to IBM, since IBM's Presentation Manager look was adopted for consistency with what OSF (Open

Software Foundation) expected would be the commercial norm. Therefore, IBM has a good story to tell about having a common look and feel for user interface on AIX and SAA.

IBM has added its own enhancements to Motif. For example, it has added Display PostScript as an extension to X-Window. It has also tightly integrated the X Server into the hardware, which is transparent to the X application. It writes to the hardware to gain speed for window-clipping and color tables.

As a desktop manager, IBM has adopted IXI's X.desktop. X.desktop provides PM-like icons that hide Unix commands by graphically representing files and programs. From within X.desktop, users can run programs and carry out file management tasks such as copying, deleting, creating new fields and directories, printing, and archiving. Administrators can configure menus and rules from within X.desktop.

IBM is also providing traditional Unix interface shells such as the Korn (the default shell for AIX), Bourne, and C shells. In order to be able to run NextStep in the Unix environment, IBM is offering virtual terminal support so that users can hot-key between environments. To satisfy the requirements of university researchers and other BSD aficionados, IBM is providing support for BSD job control.

One of the more interesting IBM-developed software is a new hypertext Help, a documentation and navigation tool called InfoExplorer that comes as part of the operating system. The Help system allows users to navigate to specific Help screens by selecting highlighted words within a Help screen. The Help system is intended to be used in conjunction with CD ROM technology, but it can also be used with conventional storage media. In the future, IBM will make InfoExplorer available to software developers so that users can use the same help for the system and the application.

In addition to Motif, IBM has made NeXT's NextStep available as an alternative user interface and development environment. While NextStep provides IBM with the opportunity to give its third-party developers a set of advanced tools, it also causes some problems. First, users may be confused by having a choice of two user interfaces. This problem is fairly easy to solve if IBM positions NextStep as a development environment. However, a more difficult problem is the fact that NextStep does not run under X-Window. Therefore, developers working with the NextStep tools cannot port their applications outside of that closed environment. The stumbling block is Steven Jobs's reluctance to port NextStep to X-Window. Some developers at MIT have found a way to display an X-Window inside NextStep, but they have not figured out how to have the NextStep tools run directly under X. But, because IBM is trying to position itself on the leading edge of technology—both hardware and software—it makes sense for the company to be able to offer a set of tools like NextStep. IBM's managers would like to offer lots of tools like NextStep for developers. It is part of the overall strategy to provide developers with best-of-breed tools and technology.

**AIX AND DOS.** IBM has enhanced its PC Simulator software. The emulation is handled in the software rather than in hardware. It also supports extended memory. PC Simulator will now enable binary shrinkwrapped 20 MHz, 386 DOS applications to run unaltered. This makes AIX a more attractive environment for users who want to maintain their DOS environment.

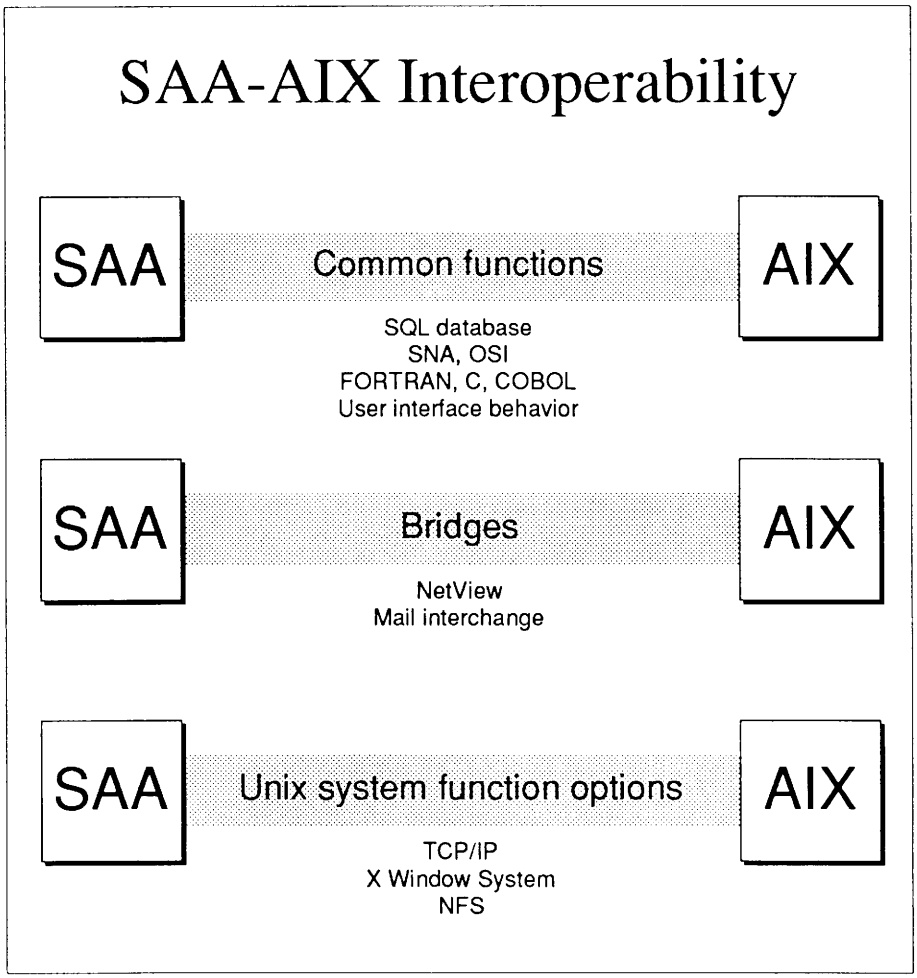


*Illustration 5. Interoperability between AIX and SAA is becoming increasingly important to IBM because of pressure from its customer base.*

## Communications

IBM has two goals for its communications environment. The first is to provide a robust distributed computing environment for AIX (see Illustration 3). In the long term, IBM would like to be able to proclaim DE Corum the RFT submission to the Open Software Foundation from itself, HP/Apollo, Locus, Digital, and Microsoft. However, IBM is intent on proving that it is conforming to industry standards (see Illustration 4). Therefore, it wants to wait and make sure DE Corum is accepted by OSF. IBM would be in an awkward situation if it gave all-out support to DE Corum and then had to backtrack if OSF adopted another solution or even parts of other solutions.

We expect that, once OSF makes its decision this spring, IBM will aggressively begin to implement DE Corum for the RS/6000. In addition, IBM has indicated that it will also port this distributed computing technology to its proprietary SAA environment. The implications are intriguing.

The part of DE Corum that IBM has not hesitated about supporting is Apollo's Network Computing System (NCS). Interestingly, NCS will also be adopted as part of OS/2. The NCS Remote Procedure Call mechanism is now well-acknowledged and is accepted as sophisticated technology. In addition, IBM plans to adopt the HP/Apollo Location Broker, a directory system for NCS. In deference to industry de facto standards, IBM has adopted Sun's Network File System (NFS) Version 4.0 with locking and Yellow Pages, and has killed off its own Distributed Services (DS).

It is no surprise that TCP/IP is a key part of IBM's strategy for handling communications between systems. TCP/IP also supports interoperability between AIX and SAA. TCP/IP has been ported to OS/2, the AS/400, and will be available on MVS and VM.

Other protocols supported include:

- Basic Networking Utilities (BNC/UUCP), available for either asynchronous communication or for any networks supported by TCP/IP via the IP protocol
- X.25 application support, including messaging and file transfer, and a link control and line monitoring program
- Ethernet and Token-Ring support

**MAIL.** IBM is supporting two mail facilities: the Tahoe 4.3 BSD mail-based application or the Mail Handling (MH) application. MH, originally developed by the Rand Corporation, includes message annotation, mail folder-handling, message-sequencing, message-packaging, and date-sorting. In the future, IBM plans to provide an X.400 mail gateway between OfficeVision and Unix mail. SNA connectivity is part of AIX, including support for LU0, 1, 2, 3 and LU6.2. Long term, IBM will provide native OSI protocols across both AIX and SAA. (See Illustration 5.)

Network Management has traditionally been a weakness in IBM Unix strategy since it relies on a 370 to manage systems via NetView. IBM will provide NetView alerts from RS/6000 systems networks into a NetView mainframe environment. However, for a user who chose not to implement a member of the 370 family, this network management software would not be available. To remedy this situation, IBM is offering network management through the TCP/IP Simple Network Management Protocol (SNMP). Long term, IBM intends to provide CMIS (Common Management Information Services) and its associated protocol CMIP (Common Management Information Protocol).

One missing piece from the interoperability story is the lack of a defined Applications Programming Interface (API) between AIX and SAA. While

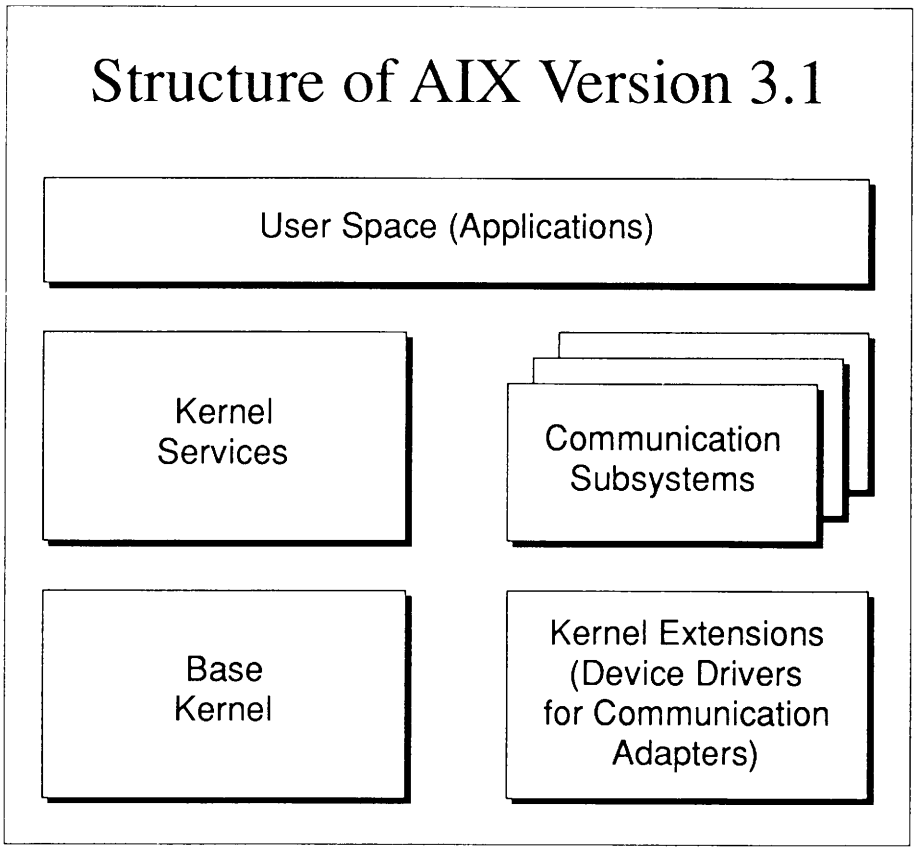


*Illustration 6. For the RS/6000, IBM did a major rewrite of AIX that complies with the Posix standard interfaces, X/Open's XPG 3 guidelines, and with AT&T's System V Release 3 and BSD 4.3.*

IBM has established CPI-C (Communications Programming Interface-C) as the API for SAA, it is not yet available under Unix. In the long term, this could be solved because IBM provided CPI-C to X/Open. If CPI-C can evolve outside of the SAA environment, it will help IBM tremendously. In the meantime, IBM does not have a good story to tell in terms of interoperability at the applications level. However, even if CPI-C becomes a generalized interface adopted by X/Open, additional work is required before developers will be able to make good use of the technology. CPI-C is a low-level protocol that is extremely difficult for developers to write to. IBM needs to develop higher level APIs.

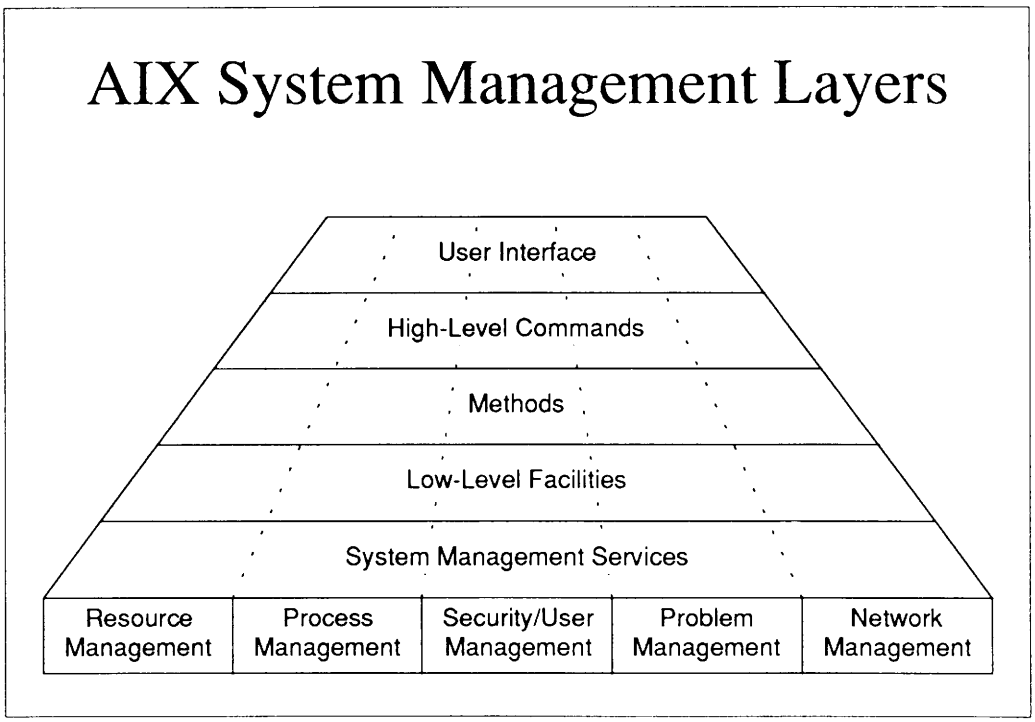


*Illustration 7. IBM's System Management Interface Tool for the RS/6000 includes 1,000 menus to speed administration tasks like configuration and administration.*

**Database.** IBM, in its initial release of the RS/6000, will be relying on the dominant Unix database management systems. Therefore, it will have ports of the major offerings, including Ingres (the first to be available), Informix, Oracle, Sybase, Unify, Data Access, and Progress. Long term, however, IBM has greater ambitions in the database arena. First, it plans to have its own SQL Distributed Database for AIX that will be based on DB2 and will be much like the database manager on OS/2. IBM also has plans to provide an object-oriented data repository for AIX (similar to the SAA repository), which will be aimed at the CASE market.

**Office.** The same issue facing IBM in the Unix database arena faces IBM in the office. Initially, the best IBM will be able to do is to provide ports of the usual suspects (Quadratron, Uniplex, R Systems, and Applix). In addition, IBM has picked up two lesser known vendors—BBN's Slate product (see Vol. 3, No. 8), which includes a compound document editor, mail system, and calendar; and Decathlon's Medallion, an integrated office package that has been bid to the government. IBM's first announced spreadsheet will be Informix's innovative Wingz product. We wouldn't be surprised to see Lotus 1-2-3 in the near future.

IBM has stated publicly that it will port OfficeVision for AIX. However, no time frame is indicated for such a port. We question whether IBM could or should move this code base. OfficeVision has not been widely accepted in corporations so far, and it is less rich than some of the stable of existing Unix office products. IBM might be better off providing a more open office environment by providing enablers and communications underpinning and allowing users to add in their productivity applications of choice.

## The Operating System (AIX 3.1)

AIX has been big news since OSF decided to adopt it as the foundation for its operating system. It was even bigger news when OSF decided to replace the AIX kernel with the Mach kernel from Carnegie Mellon. However, as IBM is eager to point out, OSF still will use its commands and libraries as part of OSF/1. Although IBM has licensed OSF/1, it is still studying the ramifications of replacing its own kernel with the OSF operating system. It has not yet made the decision.

IBM has done a major rewrite of its operating system, a task made difficult by the scope and ambition of the plan. While IBM wanted to add a lot of value, it also had to remain within the acceptable standards. AIX is an industry-standard operating system, inasmuch as any Unix vendor's operating system is. It is fully compliant with Posix 1003.1, and all compilers for the operating system are ANSI compliant. However, to compete, each vendor in the market tends to make changes (some more extensive than others) to provide value-added.

IBM has not, however, moved to AT&T System V.3. IBM is missing Streams, the Transport Library Interface (TLI), and the file system switch (fss). IBM does support the NFS Vnode switch. Because it does not support fss, IBM will have to develop its own optical disk file system. IBM's version of Unix

complies with AT&T's System V.2 (based on a System V.3 license) and BSD 4.3. (Version 3.2 will fully comply with XPG 3 guidelines.) The previous version of AIX provided many System V.2 functions but was deviant in many areas. This is an improvement. IBM is leaving out Streams and TLI from System V.3. IBM even now talks about its relationship with Unix International in addition to its well-documented relationship with OSF. This is definitely a change in attitude.

To keep the research and university community happy, IBM added to AIX 3.1 all of the Berkeley operating system (BSD 4.3). Commands that conflict or are contradictory to a System V command are taken out and included in a separate library. These folks want nothing to do with System V. As far as they are concerned, only BSD counts.

IBM has gone to great lengths to completely merge (including the interfaces) these two operating systems, which has not been easy. AT&T did not go this far when it developed System V.4. The coupling of System V and BSD is less well integrated in System V.4. However, if System V.4 should become an industry standard, IBM will have to make more changes to AIX Version 3 to be compliant.

IBM has also gotten rid of one of its biggest impediments—the Virtual Resource Manager (VRM), which was closely tied to the 370 architecture. The VRM had enabled IBM to quickly get up and running with a version of Unix, but detracted from its ability to move to other architectures. VRM has been merged into the kernel. Much of this work was initiated so that AIX could become a portable operating system for OSF. (See Illustration 6.)

*To encourage RT customers to migrate, IBM is offering them an 80 percent trade-in option (for all systems installed until the end of 1990).*

- IBM's extensions to the standards are impressive. Some of the most interesting changes include:

- Extension of the kernel so that users can install code when the system is running. Therefore, for example, a user who has installed an SNA subsystem and seen a mistake can reinstall the system without taking it down.

- Full support for shared libraries.

- A paged kernel that runs in 52-bit virtual memory.

- Support for real-time and priority scheduling and dynamic linking as well as support for preemption, which is useful in tightly coupled multiprocessing.

- Journaled file system, an extension to the Unix file system. It does database journaling and allows all files to be swapped in and out of virtual memory with one I/O mechanism. The biggest benefit of this is that a user does not have to rebuild a file system if there is a crash or if not enough space has been allocated for files.

- A buffered cache mechanism, allowing the file system to keep track of the status of files. If something happens, a user can rerun the log and not allow any partial records to be brought forward. This is important for online transaction processing applications.

**System Management.** The System Management Interface Tool (SMIT) includes 1,000 menus for system administration to help guide administrators through such thorny processes as system configuration and administration (see Illustration 7). It will prompt the administrator in installing different systems such as NFS, device drivers, and logical and mini disks. Having easily installable device drivers will be a major benefit to users who have struggled with the intricacies of installing drivers on traditional Unix systems. Also included with SMIT are some base application and graphics development tools.

**Diagnostics.** The diagnostics run on top of Version 3 and are used for electronic customer support. They include tracing and error-logging, and will indicate how much file system space is available and allocated.

**The Logical Volume Manager (LVM).** The Logical Volume Manager (LVM) will allow applications and files to span physical disks. It also includes the ability to automatically maintain several copies of files at the logical volume level. Thus, AIX provides disk-mirroring capability, which is important for transaction processing applications. The LVM will be implemented as part of OSF/1.

**Security.** Initially, AIX Version 3 will support C2 security. However, B1 is IBM's goal for this year. This is a key requirement for government and international bids.

**MIGRATION FROM THE RT.** With the RS/6000, the RT has been replaced. To encourage RT customers to migrate, IBM is offering them an 80 percent trade-in option (for all systems installed until the end of 1990). The operating system is designed so that applications are source-code compatible with the RT. In many cases, code will have to be recompiled only to migrate. The exception is where developers have written code to the hardware interface level, such as graphics, to develop applications.

## Service and Support

IBM will try to leverage its solid reputation in service and support as a way to gain market share in the Unix arena. For example, IBM is bundling a one-year, on-site service warranty with its workstation and server. It will also offer remote electronic problem-determination. If IBM has done a good job training its support team, this could be a valuable asset, especially when the company starts trying to sell into the commercial market. In this same vein, IBM has initiated a program called SystemXtra to provide "a total service solution after system installation." It will support both IBM's own systems and third-party hardware and software. This is the first time IBM is undertaking such a multivendor support program. Included is an 800 number for both hardware and software support.

## The Bottom Line

IBM has paid its dues and has done a credible job of completely revamping its Unix platform. It is now clearly in the running and can play in the big leagues. The company will be under incredible pressure to get as many enablers and products out on the platform before the end of the year. Because of the frantic and competitive pace of this market, IBM will not have any grace period for enjoying its initial success. Its competitors are breathing down its neck and are poised to respond. HP is incredibly aggressive in terms of price/performance on the combined Apollo/HP RISC platforms coming by the end of '90. MIPS is also hot, and it can claim the same level of price/performance. Sun Microsystems and its partners clearly will not stand still. Digital Equipment has lots of equipment in the pipelines. And there will certainly be other start-ups that will be able to move fast to leapfrog them all.

The one benefit IBM has over these guys is the fact that it is IBM. It will gain respectability that will go a long way in encouraging third parties to move to its platform. The fact that IBM fell flat on its face with the RT has motivated its developers to go all-out for the Rios platform. They have learned a lot of lessons about what it takes to fail: that they need to differentiate between workstations and servers, that applications and graphics and high levels of performance are critical, and just how important it is for a company to pledge allegiance to standards. IBM's developers are going to make sure this time that they succeed.

The coming year will be a critical period for IBM. It will have to continue to work with developers and end users, begin to position the RS/6000 in the commercial as well as the numeric-intensive market, exploit the distributed computing technology it has begun to make use of, and continue to ramp up the production of more powerful boxes. The RS/6000 is a good first step on a tough road.

# NEWS ANALYSIS

PRODUCTS • TRENDS • ISSUES • ANALYSIS

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## A New and Improved X

MIT has issued a new version of X-Window—11.4. Although it's not a major release (in the past, this meant rewriting the X protocol, which nobody—except perhaps a handful of overenthusiastic systems programmers—would be anxious to see happen at this point), MIT has been working on V.11.4 for well over a year, and the enhancements in security, standardization, and server performance are significant.

**SECURITY.** Until this release, X didn't address security at all. X merely maintained a host authorization list. And a host could contain thousands of users—any of whom could spy on and tamper with your work. Developers were forced to rely on tricky manipulation of host lists for security.

V.11.4, however, implements a user-level authorization library for X terminals as well as workstations. So now you can pick and choose the people who can spy on or tamper with your work. X, incidentally, has no notion of access rights. Since it deals only with the display services, responsibility for levels of access are left, appropriately, to the client application.

**STANDARDIZATION.** At the heart of V.11.4 is the completion of MIT's Inter-Client Communication Conventions Manual (ICCCM). ICCCM is MIT's standard for client communication—the way X clients talk to the window manager, for example, or the way windows talk to each other. ICCCM guarantees continuity and compatibility among separate X implementations—which V.11.3 implementations lack.

**PERFORMANCE.** An oft-heard complaint about X Window is its speed—or lack of it. With that in mind, MIT has done a major overhaul on the X server. The internals have been restructured and optimized to improve speed. In addition, Hewlett-Packard has offered to the X Consortium a rewritten X server—completely independent of MIT's—that also improves performance and works with the HP300 and HP800 series. Apollo appears to have made substantial enhancements in reliability to its implementation of the X server as well.

MIT has also extended server support for the following:

- Mac II (color and multiple screens)
- Sun's SPARCstation 1 (Conceptually, the X server should support Sun 3/80 and 386i too, but MIT hasn't tested these systems yet.)
- PS/2s (IBM 8514 and VGA devices)
- DECstation 3100 (color and mono)
- Tektronix Tek 4319

In addition, MIT has implemented a number of new fonts (including DECwindows and OpenLook fonts and new two-character byte set fonts) and server extensions, including:

- Utilities for writing extensions
- Extensions for nonrectangular and 3-D windows
- Shared-memory pixmap extensions
- Multibuffering extensions (for adding things like video and stereo)

**But Wait; There's More.** MIT has also made several miscellaneous enhancements, among them:

- An upgrade of the Athena widget set to include the fairly basic menu, toggle switch, and chart (or bar graph) widgets (among others)
- Improved error-handling
- Support for shared libraries
- Support for 64-bit architectures

- Improved out-of-memory errors (i.e., the system won't crash without warning when you run out of memory)
- On-the-fly font-changing
- A reconstructed mail handler

**CONCLUSION.** All in all, the X Consortium has put together a solid upgrade of X Window. The main problem with X is actually not a problem with the system itself, but rather one with the computer industry and its conflicting toolkits and APIs. And while commercial Unix application developers are finally getting their X-based (Motif or OpenLook) products out, they might not have an audience until the expense of X comes down. Not X itself; that's free. But the hardware it demands is pricey. Not everyone who wants to use X has the right equipment to do so.

*—L. Brown*

•NCD•

# eXciting X terminals

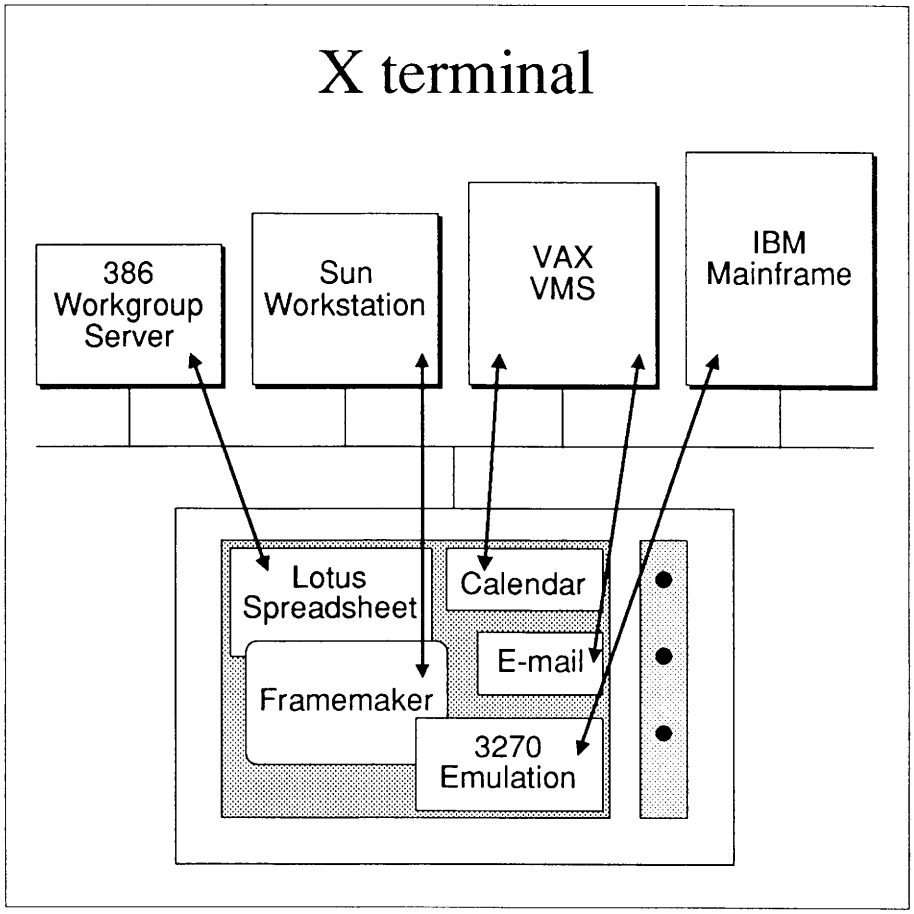
X terminals are becoming more than simply a neat idea. They are beginning to find market share in commercial and development environments. As X Window applications flourish, so will these hybrids between technical workstations and dumb terminals.

**NCD LEADS THE WAY.** In the year since X terminals were introduced, Network Computing Devices (Mountain View, California) has taken the lead among independent X terminal vendors. The company has been a major influence both in championing the technology and delivering high-performance products, and has achieved profitability in its second year. NCD sells to end-user and VAR accounts and has OEM agreements with many major computer vendors, such as Pyramid, MIPS, Bull, Tectronics, and Data General—this last agreement has yet to be announced, but seems to be common knowledge in the industry. NCD's chief competition is likely to come from Digital and Hewlett-Packard, both of which produce their own X terminals, though there are other independent X terminal manufacturers, such as Visual Technology (Westboro, Massachusetts), that would like to grab part of this market.

**New NCD Products.** Last year, NCD released the first two versions of its X terminal: one aimed at the entry level and the other aimed at higher level, graphics-intensive applications. The NCD16, with prices beginning around $2,500, sports a 16-inch diagonal monochrome monitor with a 1024-by-1024 pixel and 105 dpi resolution, and uses a 12.5 MHz 68000 CPU and a graphics coprocessor. The NCD19 offers a 1280-by-1924 pixel 19-inch monitor and a 32-bit, 15 MHz 68020.

At the recent UniForum show in Washington, D.C., NCD wowed showgoers with its introduction of the NCD17c, a color X terminal that displays up to 256 colors simultaneously on a 17-inch, flat-color CRT (1024 by 768 pixels). With prices starting at $5,000, the NCD17c cuts in half entry into the multiwindowed, high-resolution, color environment.

In addition, NCD has begun to address the needs of remote users in an X environment with its XRemote software, which allows the connection of X terminal to host over RS-232 wiring or serial modem. The software, which runs on both the terminal (in PROM) and host, provides compression/decompression algorithms specifically designed to meet the heavy bandwidth demands of bit-mapped displays and




*A user sitting at a workstation or X terminal can access applications throughout the network regardless of the make, model, or operating system of the host.*

windowing systems. According to NCD, the algorithm is approximately 10 times faster than SLIP, which is currently the most popular protocol used for X serial connectivity. NCD recommends a 9600-baud modem or faster for most applications.

**Network Management.** NCD's products currently support the following network management features:

- Diagnostic windows
- PING utility
- Ethernet statistics
- Protocol statistics
- Packet-received LED on keyboard

NCD plans to add SNMP support by the second quarter of this year.

**X TERMINALS VS. PCS.** The obvious questions arise: If a DOS PC can run as an X display server, why do I need X terminals? In fact, isn't being an X server the perfect role for my old PC?

PCs, at least 286 and 386 PCs, can indeed be used as X servers in a networked environment. However, according to NCD vice president Judy Estrin, they are limited when compared with workstations and X terminals, specifically in the area of high-resolution graphics and multiwindow support. VGA is not sufficient for high-resolution (over 1MB) display, and the performance of PCs, even 386s, seriously decays when multiple windows are opened. Estrin also points to the ergonomic issues—small footprint, tilt and swivel monitors, no fan—which set NCD X terminals apart from the PC.

In a mixed environment, Estrin recommends the PC-based X server for the occasional user of X-based network applications who mainly exists in a DOS environment. For the heavy user of network-based applications and for the user who has to occasionally access a DOS application, she recommends an X terminal with a window open on a 386-based DOS applications server. Estrin predicts that we will eventually see OS/2 as an X client, accessible by X terminals.

**X TERMINALS VS. [DISKLESS] WORKSTATIONS.** Similar comparisons can be made with low-cost workstations, some being delivered at under $5,000. Estrin notes that the resolution issues are similar to those of the PC because the $5,000 price does not include high-resolution monitors. In addition, these workstations have limited memory and no disk, so that, when the operating system runs out of memory (as it loads multiple applications), it uses virtual memory (swap to disk), which is not available locally. Virtual memory must be paged across the network, slowing down both the workstation and the network. Finally, the ergonomic issues may be even greater, with many workstations taking up a whole lot of desk and floor space. —*D. Marshak*

•SUN CLONES•

# Solbourne Breaks the 64-bit Barrier

Solbourne Computer is becoming the Compaq of the SPARC-based workstation business. Last month, the Longmont, Colorado, manufacturer of workstations based on Sun Microsystems' SPARC RISC design, announced a 40 MIPS, 64-bit SPARC chip. The chip will be introduced to Solbourne's line of processors—quite literally—later this year.

Matsushita Electric Industrial Company (the same folks who bring us Panasonic consumer products) owns a stake in Solbourne, and also manufactures the chips in Solbourne's Series4 and Series5 processor lines. The new 64-bit SPARC chip was designed by Solbourne and Matsushita.

**YOWZA NUMBERS.** The chip is interesting for its performance metrics—up to 40 MIPS and 20 MFLOPS at 40 MHz—and its design. It is a CMOS implementation containing one million transistors with an integral floating-point unit that operates in parallel with an integer unit. Data pathways of 64 bits and a clock frequency of 40 MHz are worth a significant performance gain. But a third important factor was reducing the clock's per load/store instructions by translating in parallel data and instruction addresses. Load/store instructions comprise 15 to 25 percent of many programs, the designers report.

Solbourne's Series4 and Series5 products are well set for the new chip. Products in those lines are sold with 64-bit internal buses today. Indeed, Solbourne can use the new chip in its existing chassis. Solbourne has told customers they'll be able to upgrade to the new chips with board swaps in the field. Solbourne plans to use the chip in a 20-25 MIPS workstation priced at about $10,000.

**HIGH-END HEROICS.** Development of the new chip establishes Solbourne at the high end of the market for Sun clones based on the SPARC design. While other clone-makers have pinned their hopes largely on inexpensive workstations, Solbourne has been building a line that ranges from single-processor machines in the range of 20 MIPS or so to quad-processor models rated at 60 to 70 MIPS.

Solbourne has also taken the lead on software to support high-end multiprocessor configurations. Its SunOS-compatible operating system now employs a rudimentary form of multiprocessing called asymmetric multiprocessing, but it will be upgraded to embrace the more sophisticated and cycle-saving symmetric technique.

On both of these scores, Solbourne has outstripped Sun as the leading implementer of SPARC technology. Sun hasn't announced a multiprocessor version of SunOS yet, and its SPARCstations are comparable in performance to equivalent Solbourne models.

**THE RISC RACE.** It's interesting that SPARC was the first of the many RISC designs in the market to be pushed to 64 bits. Each of the major RISC designs—MIPS Computer's R series (adopted by Digital Equipment),

Motorola's 88000 (adopted by Data General and others), Intel's i860, IBM's RIOS, and Hewlett-Packard's HP-Precision Architecture—are currently implemented at 32 bits and lower clock rates than the new Solbourne chip. But they'll all get to 64 bits at some point.

The way SPARC broke the 64-bit barrier is even more interesting, however. The originator of the chip—Sun—has found a third-party champion for its design. In the eyes of many, this fact legitimizes SPARC as a "standard" design, helping to broaden the market overall for SPARC machines.

*—J. Rymer*

•WANG•

# Way behind, but Playing Catch-Up

Wang recently announced a strategy designed to bring new life to the ailing company: Innovation on Standards. It is based on Wang's Open/Architecture, and is basically a commitment to Unix. The three-pronged strategy includes:

- Availability of Wang's applications in standards-based Unix environments. This is basically a commitment to provide imaging and office automation on Unix systems.

- A range of Unix system platforms, the Open/Server family, which coexist with VS and Wang's PC products. Wang is producing Unix systems built on the 386 and 486 running SCO (Santa Cruz Operations) Unix V/386. The systems will be both multiuser hosts and LAN servers.

- Development and marketing partnerships. Right now, this means Intel and SCO, including Open Desktop. In the future, we will see products integrated with Banyan VINES and Novell Portable NetWare.

The Open/Architecture is a modular design, and all components are IEEE industry-standard compliant. Absolutely no proprietary platforms or operating systems are included. Thus, you can mix and match Wang components (servers, software, whatever) with those from other vendors. Wang plans to offer multiprocessor versions of 386s and 486s as implemented by Corollary, a company that OEMs multiprocessing software and systems.

**TOO LITTLE?** Wang's commitment is all well and good, but where are the applications? Two have been introduced so far: Unix ClearView, a Motif object-oriented desktop manager (Motif is becoming the de facto Unix graphical windowing environment) that will be bundled with Wang's Open Desktop offering, and WP/x, a character-based word processing package based on the Tigera product, a Wang WP look-alike.

No strategy has yet been announced for migrating current Wang users from their proprietary platforms to the Open/Architecture.

**Wang Understands the Problems.** This isn't to say that Wang hasn't been thinking about the software directions and migration strategy. The company has been working hard to establish a coherent strategy with innovative software offerings. To that end, Dr. Steven Levine, who was the driving force in the development of FreeStyle—Wang's innovative multimedia annotation system—has been given the job of heading development for all Open/Architecture applications. This could be very exciting. Levine is a bright man with dynamic ideas. But he has only been on the job a short time, and he has the difficult task of migrating his team from the old development model to a new model. Wang understands that it has to provide a rich portfolio of applications, but it can't afford to make any mistakes. The release of buggy software could be the final downfall. Development has to proceed very carefully.

So the good news is that Wang—finally—understands its problems, has committed to an open strategy, and has put visionary leadership in place to make applications happen.

The bad news is that all this will take a while.

**TOO LATE?** While we can congratulate Wang for seeing the light—or finally recognizing the death of proprietary systems—we wonder whether the change in philosophy has come in time. The other minicomputer vendors—Prime, Data General, et al.—have all adopted an open strategy. But they did it about two years ago! The competition is ahead in platforms, application development, and migration strategy.

We can't count Wang totally out just yet, but the company will have to run fast to catch up. And not only to catch up with the leaders, but just to get into the race. *—R. Marshak*

•USENIX•

# Blazing Unix's Future Trails

There's more of a difference between Usenix and UniForum than the pinstripe-to-ponytail ratio. The agenda for developers is not only (overwhelmingly) more technical, but also more innovative. The issues and discussions at Usenix tend to foreshadow those of users and vendors. (As one Usenix attendee put it, "It takes a few years before most of the things we talk about make it to the exhibition floor." A pompous claim, perhaps, but valid nonetheless.) So, as the two conferences descended upon Washington, D.C., in January, UniForum addressed itself to current trends and products; meanwhile, across town, Usenix seemed to comment more on the direction of Unix—especially in terms of distributed computing and multiprocessing.

**MULTIPROCESSING SOLUTIONS.** In many an R&D lab, multiprocessing under Unix is a given, not an aspiration,

and researchers are devoting themselves to leveraging the power of their systems. They have their jobs cut out for them. Multiprocessing with Unix has a few wrinkles:

- Inappropriate operating system design and standardization. Unix was designed to be uniprocessor; it was never intended to handle heavy-duty, distributed commercial applications. Although, in some instances, Unix has been tinkered with to support multiprocessing, the hacking has exacted a performance toll. Multithreaded, modular operating systems like Mach, on the other hand, have been specifically designed for multiprocessing.

- The lack of tools for multiprocessing. Even with a solid multiprocessing operating system and environment in place, you still need tools for distributing new and existing applications, for debugging, for synchronization, for security, and for scheduling.

- The dearth of computer languages developed specifically for distributed, multiprocessing environments.

At Usenix, several developers shared their insights on ways to solve (or at least get around) some of these shortcomings. One presentation described the implementation of a Mach debugger for multithreaded applications. Another described a Mach-based file system. Most, however, proposed multiprocessing solutions within traditional (usually BSD) Unix environments. We heard, for example, details of an event-based scheduler for distributed environments; parallel streams, which facilitate multiprocessing by giving the kernel a more modular structure; and an NFS file server with a multiprocessing architecture.

(For more in-depth analysis on the issues surrounding multiprocessing, see Vol. 5, No. 2.)

**Network Management Solutions.** Part of the rationale behind multiprocessing is distributed computing, and network management solutions were of great interest at Usenix. The conference featured discussions of several tools, including a portable network debugger, a neural network simulation tool, a way to integrate heterogeneous distributed services, and tools to monitor the status of local hosts and routers on heavy networks (i.e., close to 200 gigabytes of data transferred monthly).

**USER INTERFACE ISSUES.** Graphical interfaces don't carry the same weight at Usenix as they have in the past. Unix developers use X. That's it; case closed. However, they acknowledge that the user interface case isn't closed and that some work needs to be done with interface design tools, or UIMSs (User Interface Management Systems).

Since the industry is still somewhat hazy about what belongs in a UIMS and what doesn't, a few general sessions and a couple of Birds of a Feather meetings struggled to come up with a solid definition. While everyone agrees that a UIMS should deal strictly with user interface issues, the distinction between a user interface function and an application function is not always clear. There was also some discussion about whether or not to include style guides in UIMSs and how to dynamically link new objects (a.k.a. widgets) to the UIMS libraries.

**WHAT'S IN IT FOR THE USER?** With all the talk at Usenix about symbolic debugging, pseudo network drivers, packet trains, and tickerplants, it's hard to extract some meaning from the conference for Unix users. Furthermore, most of the projects discussed at Usenix are just that—projects, not products.

The point, however, is that developers are putting their efforts into finding solutions for leveraging the powerful parallel multiprocessors coming out from Pyramid, Sequent, and Solbourne (and the like). And sophisticated, robust network management tools are underway. Although it remains to be seen to what extent the technology discussed at Usenix will translate into viable commercial products, the conference offers a glimpse of what might turn up at next winter's UniForum. —*L. Brown*

# Industry Conferences

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**Can Unix Set the Innovation Agenda?**

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**Overview:**

The theme of this year's Executive UniForum Symposium is the Unix software and applications development environment. If Unix is to become a commercially viable operating system, it must be able to support, attract, and nurture the next generation of applications and development tools. Is Unix up to the task?

This conference will present the views of industry leaders, including hardware, software, and networking vendors, as well as the views of commercial users. It will also provide a forum to spotlight the next generation of Unix applications.

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- **Application Developers** who need to understand the latest developments and who need to network with other software and hardware developers.
- **Software and Hardware Manufacturers** who need to understand the position of the end-user and development communities and want to have the opportunity to share many points of view.

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- What are key Unix vendors doing to ensure their success in commercial Unix?
- What will the new applications under Unix look like?
- How can Unix applications interoperate with proprietary applications?
- What are real user experiences in implementing Unix, in regard to implementation time, cost, training?
- What are potential end-user requirements and priorities in regard to transaction processing, real-time, and multiprocessing Unix system features?
- How can users move to the next generation operating systems and applications in an evolutionary way?
- What will be the role of Unix-based distributed network computing in defining the next generation of commercial data processing?
- Will OS/2 play a role in defining the importance of Unix?
- What vertical market areas and applications appear to be the leading sectors in implementing Unix?
- How are Unix markets evolving outside the United States?

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