Minicomputers: An Overview

In this report:

Synopsis

Editor's Note
The report defines the minicomputer and shows where and how it fits in today's midrange marketplace, which continues to change as technological advances increase hardware price performance. Midrange hardware now involves supermicros and workstations as well as minicomputers and superminis, and competition is intensifying among vendors competing for a place in this ever-changing arena.

Market Highlights
The minicomputer market has gone through a period of rapid change. Vendors have made major extensions to their product lines to exploit the benefits associated with open systems and reduced instruction set computing (RISC) and are embracing open standards as the future of minicomputing. This report discusses the changing midrange market and highlights the current strategies of selected vendors.

Analysis

The Classic Minicomputer

Minicomputers continue to play an important, albeit diminished, role in the midrange market, which includes commercial, service, industrial, and government sectors running business, office, and technical applications. The classic or traditional minicomputer is defined as a multiuser, multiprogramming, multitasking computer based on an 8- or 16-bit architecture, although some models had 12-, 18-, and 24-bit architectures.

While the majority of currently available midrange systems are 32-bit machines, there are still some 16-bit models on the market. Continuing demand coupled with performance, functionality, and price adjustments offered by the vendors has allowed the traditional minicomputer to persevere despite unrelenting pressures from both microprocessor-based systems and proprietary 32-bit machines. For customers with an investment of experience and software in minicomputers, changing architectures can be unacceptably expensive. Although 8- or 16-bit architecture applications can be moved to 32-bit systems, the migration requires software modification on top of the cost of the 32-bit computer itself and the required investment in retraining. And, while present minicomputer customers create incentive for computer manufacturers to continue selling and supporting traditional minicomputer product lines, 16-bit minicomputers are also being kept alive by VARs who have no reason to move their applications to faster, and usually more costly, 32-bit architecture.

Another reason for the tenacity of the minicomputer is the growth of the market for PC-based departmental processing systems. Groups of PCs and workstations are clustered around a single server—the minicomputer—which offers shared-resource system communications, file management, and applications to the attached workstations. The communications, networking, database management, and transaction processing capabilities of minis make them well suited for this type of application. Acting as the connection between individual microcomputers and either local or remote mainframes, these departmental servers prove highly functional at a low cost.

A Current Definition

The midrange marketplace includes a broad range of products. Commercially used workstations at the low end are built around faster processors and offer more memory than "classic" minicomputers. At the high end, microprocessor-based products that claim mainframe power are becoming a reality. Within that range, the computing category between microcomputers and mainframes is characterized by:

- Multiuser and multitasking capabilities
- A 16- or 32-bit word length
- Support for between 100 and 600 users
- A performance of between 3 and 60 MIPS
- Virtual and cache memories
- Up to 512M bytes of main storage
- Up to 32G bytes of fixed disk storage

Processor Type

The typical minicomputer has a central processing unit (CPU) with proprietary technology for instruction execution, system control, and I/O support. It uses one or more boards to hold the arithmetic logic unit (ALU), related data manipulation circuitry, registers, instruction set, and associated control logic of the CPU. In this respect, minicomputers are like superminicomputers and mainframes, which use the same configuration. This organization in direct contrast with microcomputers or supermicros, which use a semiconductor chip to house the CPU.

Depending upon the model, the minicomputer's CPU runs at a speed of 100 to 500 nanoseconds (ns.). This cycle time is much slower than that of a supermini, which typically has a CPU running at speeds under 100 ns. The processor cycle time represents the total time required for the CPU to complete one instruction and be ready for the next task.

Main Memory

Traditionally, minicomputers used 128 kilobytes to 16 megabytes of main memory to hold active

program code, routines, and data. In many instances, minicomputers were sold with 1M byte of memory and supported expansion options to accommodate up to an additional 4M bytes of memory.

Those minicomputers with a relatively substantial amount of memory can better support multiple applications and tasks, since the larger memory capacity keeps memory from becoming overburdened as applications and tasks compete for available memory space. More space is available to hold all of the data and instructions required to execute the program code and routines, decreasing the need to access disk storage for instructions or data that can't be held in memory. Eliminating disk access reduces time-consuming I/O operations, thus increasing overall performance.

System Buses

Most minicomputers employ proprietary system buses to move data and instructions between the CPU and main memory. Buses also provide the connecting path between the CPU, main memory, and the I/O processors. The I/O processors control the peripheral and communications devices connected to the computer. Some proprietary buses can be configured with a large variety of third-party expansion boards.

Operating System

A minicomputer operating system is multiuser, multiprogramming, and multitasking. It permits multiple users to gain simultaneous access to system resources (integral security features grant access only to those users who have been authorized to use a particular application or function), provides the ability to run more than one application concurrently, and allows multiple users to execute multiple tasks.

All minicomputer operating systems support interactive applications; some support realtime processing. Most minis also perform batch processing.

Traditional minicomputers feature proprietary operating systems, but as users began looking for standardization, several manufacturers introduced industry-standard operating systems in addition to their proprietary systems.

The Changing Marketplace

The availability of industry-standard operating systems answered customer demands for an "open computing" solution. Industry-standard operating systems standardize computing across the organization and provide the user with a degree of compatibility between systems in a multivendor or multiple-architecture computing environment. They also reduce system migration and application porting costs when moving to or from another platform with similar facilities and increase application accessibility to off-the-shelf software.

The move to open systems has also made defining a minicomputer increasingly difficult. Traditionally, computers were categorized into three groups: mainframes, minicomputers, and microcomputers. Technology advances have blurred the lines between computer categories. What was once a mainframe might now be considered a top-end mini, and a computer that once represented the leading edge of minicomputer technology might now compare unfavorably with the latest generation of high-end workstations.

With system diversification has come the addition of new classifications. Product categories falling between mainframes and micros now include "open" minicomputers, "proprietary" minicomputers, superminicomputers, supermicros, workstations, and servers—and distinctions are sometimes difficult to find. To classify a system, Datapro looks at the target market, usage, product history, competitors, and architecture.

Whether a proprietary or open systems design, the current offering of midrange systems features a 16-bit (some) or 32-bit (most) word length. In contrast to their predecessors, which offered maximum memory capacities of 16M bytes, current midrange offerings feature from 1M byte to 256M bytes (and sometimes 512M bytes) of main memory. Depending on the model, the main memory expansion increments can be available in 1M byte, 2M bytes, 4M bytes, 8M bytes, 16M bytes, and/or 32M bytes.

Client/Server Computing

Client/server computing challenges the tradition of placing all of the workload on the application server as in a terminal/host configuration. Instead, it takes the emphasis away from the host processor and shares the workload more evenly between the client—a whole or partial application running on

either a user's workstation or on a server—and its associated server. The client, often a user's workstation, is responsible for local operations, such as the user interface and preprocessing commands and data, as well as its share of the application workload with the server. The server—usually a smaller dedicated system than the large, centralized, general-purpose host in a terminal/host configuration—can delegate work to the client; in intelligent client/server networks, the server can pass work on to any connected client that has less workload to maintain an even distribution of work. The division of labor is transparent to the users.

Open Systems

Because they use industry-wide standards across all areas, such as applications, communications, and operating systems, "open systems" provide users with the flexibility to work in a multivendor environment and allow them to be selective when purchasing software or peripherals. The vendor who has secured the system sale is no longer guaranteed the peripheral sales. Users are turning to third-party sources for software, peripherals, and upgrades, and large vendors are competing with smaller manufacturers in the open systems market. As dominant players in the traditional proprietary market, mini and mainframe vendors, such as IBM, Digital Equipment, Data General, Hewlett-Packard, and Unisys, have introduced high-profile "open" systems products.

The move toward open systems has also reduced the shelf life of products. Because products from different vendors are now much more closely related, vendors wishing to retain their competitive position are forced to respond more quickly to changes in the marketplace. Technological advances or innovations have *immediate*, industry-wide repercussions.

Processor Types

Microprocessors are classified as either CISC (complex instruction set computing) or RISC (reduced instruction set computing). CISC processors provide a large instruction set (the low-level machine instructions that may be executed by the CPU), which contains commands that perform complex functions. RISC processors provide a limited instruction set containing commands that perform only simple operations. Until a few years ago, the trend was toward elaborate instruction sets and processor complexity. RISC challenges this notion and is now a popular alternative for workstation and minicomputer vendors and users.

The two major producers of microprocessors are Motorola and Intel. Other significant CPU manufacturers include Hewlett-Packard, with its Precision Architecture; IBM, offering the POWER architecture processor; Intergraph, with the Clipper; Mips, whose range of RISC processors (R2000 and R3000) are gaining popularity; and Sun Microsystems, who licenses its Scalable Processor Architecture (SPARC) to semiconductor and system manufacturers.

Motorola produces two main central processor families: the 68000 and 88000 series. The 68000, 68020, 68030, and 68040 are CISC processors and share essentially the same instruction set, ensuring backwards compatibility—each chip in the series can run programs written for lower-end processors in the family. The 68000 (which developed from Motorola's original 8-bit 6800 processor), has a 32-bit word length, a 16-bit data bus, and a 24-bit address bus. The high-end 68040, launched in January 1990, has a 32-bit word length, data bus, and address bus and offers a performance of 20 MIPS when running at 25MHz.

Motorola's RISC processor—the 88100—is a recent addition to its product line. A 32-bit chip, the 88100 contains an integrated floating point unit (FPU). The 88000 family also includes the 88200 cache/memory management unit (CMMU) which provides a 16K-byte cache and virtual memory addressing up to 4G bytes.

Intel's family of CISC chips comprises the 8088, 8086, 80186, 80286, 80386SX, 80386DX, and i486. The 8088 and 8086, popularized by their use in the original IBM PC and PC-compatible computers, have established a huge user base worldwide. They are identical processors, each having a 16-bit word length and 20-bit address bus, but whereas the 8088 has an 8-bit data bus, the 8086 uses a 16-bit bus. The other chips in Intel's line were developed from the 8088/8086. They range from the 80186, which proved unpopular as a CPU and is now most commonly used for such tasks as peripheral control, to the 32-bit i486, the most recent and powerful addition to the family. In between, the 16-bit 80286 is currently the most widely used Intel chip and is found in micros, supermicros, and low-end minis. The 80386SX and

80386DX, identical except for the width of their data and address buses, provide the 32-bit architecture on which Intel will base all its future processors to ensure compatibility and the protection of users' software investments . At the top of the range, the i486 incorporates an 80386DX processor, 80387 co-processor, 8K bytes of cache memory, and a cache controller on a single chip

Intel has entered the RISC market with its i860 processor. The i860 is a 64-bit RISC chip featuring separate instruction and data caches, floating point addition and multiplication units, and a 3-D graphics unit all integrated onto the chip.

UNIX

The advance of open systems has given UNIX—the predominant operating system for open computing—unprecedented popularity: from its scientific and academic background, it has experienced a renaissance and has been adopted by the commercial sector—UNIX is the operating system most commonly used for multiplatform, midrange applications. The advantages of UNIX are many, not least of which is its high level of portability. Proprietary operating systems, on the other hand, although traditionally less compatible with products from different vendors, retain the advantage of being optimized for their intended applications.

From its inception at Bell Laboratories in the late 1960s, UNIX has evolved through the interaction between AT&T and academic institutions, such as the University of California at Berkeley and computer manufacturers, such as IBM and Digital Equipment. Due to its eclectic development, many versions of UNIX have emerged, with varying degrees of compatibility. The drive towards open systems has made compatibility a primary issue, and a number of organizations are now addressing trying to standardize the variety of UNIX dialects that currently exists.

UI (Unix International) and OSF (Open Software Foundation) both have their own versions of UNIX: UI is backing AT&T's UNIX System V.4, while OSF has its own OSF/1, released at the end of October 1990. In addition, many vendors supply their own, proprietary versions of UNIX, examples are Hewlett-Packard's HP-UX, Digital's ULTRIX, and Data General's DG/UX. While this diversity limits the extent to which applications and hardware can be interchanged, it nurtures a climate of innovation and evolution, which is essential for the industry to progress.

The Role of Standards

Standardization is the underlying principle of open systems: only by conforming to a universal set of industry standards can a system be described as "open." The major organizations and pressure groups are involved in either defining and implementing standards or promoting a particular standard.

Uniforum (previously known as usr/group)

The U.S.-based usr/group was one of the first standards setting committees. Its charter was to provide a network within the UNIX community for the exchange of information and ideas. A result of usr/group's (now Uniforum's) activities was the usr/group Standard—a software development specification, enabling applications to be transported between otherwise incompatible UNIX systems. Launched in 1984, the usr/group Standard has had considerable influence: the Institute of Electrical and Electronic Engineer's (IEEE's) POSIX, AT&T's System V Definition Suite (SVID), and X/Open's Portability Guide (XPG) were all originally based on it.

X/Open

X/Open was formed in 1984 by five European vendors—Bull, ICL, Nixdorf, Olivetti, and Siemens. Its aim is the standardization and portability of applications software. To this end it has developed an open systems blueprint—the Common Application Environment (CAE)— which lays out a set of standards for application development to ensure that compliant software can be ported to any hardware platform that also complies with the CAE specifications. In 1988, X/Open introduced a branding program, which enables users to identify hardware and software that conforms to X/Open's standards. X/Open's overall blueprint, including the CAE, is its Portability Guide (XPG); the third and current version, XPG3, was released in 1989. The Guide discusses the concepts of the CAE and central issues, including internationalization and relational database languages. X/Open now has 20

corporate members; most major system manufacturers, as well as OSF and UI, are members.

Open Software Foundation (OSF)

OSF was formed in May 1988 by seven computer manufacturers—Apollo, Bull, Digital Equipment, Hewlett-Packard, IBM, Nixdorf, and Siemens—primarily to develop and market its own open systems software. The stated principles of OSF's products are portability—the ability of applications to run on systems from different vendors; interoperability—the ability of systems from different vendors to work together; and scalability—the ability of applications to run on systems of different sizes.

Its first product—the graphical user interface (GUI) OSF/Motif—was announced in January 1989. Motif is a multiplatform user environment, combining X Windows-based contributions from Digital, and joint contributions from Hewlett-Packard and Microsoft. It can be used on a wide range of systems from personal computers to mainframes and runs under a variety of operating systems including UNIX System V and OSF/1. Motif is the first phase of OSF's plan to provide a universal open-software user environment.

OSF's only other product to date is its OSF/1 version of UNIX, released in October 1990. OSF/1 is based on Carnegie Mellon University's Mach operating system and complies with POSIX 1003.1, XPG3, and AT&T's SVID issue 2 standards.

Unix International (UI)

Unix International was formed by AT&T, ICL, NCR, Prime, Sun Microsystems, Olivetti, and Unisys in December 1988 to direct the evolution of AT&T's UNIX System V. Its members contribute to the operating system's development by producing requirements and specifications for future versions; these are accepted by AT&T's software development division—the UNIX Software Operation (USO)—which incorporates them into the design process. UI works closely with other standards bodies, in particular X/Open, of which it is a member and whose CAE provides the portability structure of System V.4.

SPARC International

Sun Microsystems helped form SPARC International in February 1990 to promote and develop SPARC/RISC architecture. Scalable Processor Architecture (SPARC), developed by Sun in the mid-1980s, is openly licensed. Membership in SPARC International is offered to any hardware or software vendor or to any user interested in promoting SPARC as an open RISC standard.

88open Consortium

88open is a consortium of system and software vendors formed in April 1988 to promote Motorola's 88000 RISC architecture in the open systems market. It has created a set of POSIX- and SVID-compliant standards, against which systems and applications are tested for *88open Certification of Compatibility*. Certified software and hardware is guaranteed to be compatible with any other certified system from any vendor. The standards are defined by the 88open Software Initiative and are based on the consortium's Binary Compatibility Standard (BCS), Object Compatibility Standard (OCS), and binary definitions of Networking and Graphical User Interface standards. ■