

Concurrent Computer Supermini Systems

MANAGEMENT SUMMARY

Company Background

Concurrent Computer Corporation designs, manufactures, markets, and services high-performance 32-bit supermini-computer systems primarily for time-critical applications. Time-critical applications—realtime and online transaction processing—appear in industrial, scientific, engineering, government, military, and commercial markets. Examples of realtime applications include industrial automation and process control, geophysics data acquisition and analysis, military defense systems, aircraft flight simulation, and message switching. Examples of online transaction processing applications include securities trading, insurance database management systems, inventory tracking and distribution systems, gaming/wagering systems, and hotel reservation systems.

Concurrent brings nearly 20 years of realtime, time-critical computing experience to the marketplace and is the largest company to focus solely on realtime-oriented technology. Over 30,000 concurrent systems are installed worldwide. Concurrent's systems are used by more than 30 percent of the top 50 U.S. *Fortune* 500 industrial corporations and 70 percent of the leading aerospace corporations. Concurrent systems also are frequently used in military defense applications and commercial and government weather systems.

Concurrent today is a combination of two respected realtime computer system manufacturers:

- The original Concurrent Computer Corporation—a Perkin-Elmer subsidiary, and
- The publicly owned Massachusetts Computer Corporation (Masscomp).

The company was launched when Masscomp completed its tender for the Perkin-Elmer subsidiary. During September 1988, Masscomp acquired all of Concurrent's outstanding shares. With the acquisition and merger, Masscomp:

- Changed its name to Concurrent Computer Corporation;
- Moved Masscomp's UNIX-based and Concurrent's proprietary supermini models into positions where they complement each other;
- Continued the marketing and R&D functions for both the Masscomp and Concurrent lines;
- Moved all production of its Masscomp systems to Concurrent manufacturing facilities;

Concurrent Computer Corporation, formerly two distinct companies, the "old" Concurrent Computer Corporation and Masscomp Corporation, provides two major product lines: the Series 3200 and the Masscomp MC5000/MC6000 Series. Both series target realtime processing within industrial, engineering, scientific, and other technical automation and control environments. The Series 3200 primarily handles the more demanding realtime requirements while the Masscomp series manages the lower to midrange requirements. In addition, the Series 3200 handles online transaction processing within commercial environments and government services.

MODELS: Series 3200 comprises the 3203, 3205, 3212, 3280SP, 3280MPS, and 3280E MPS.

The Masscomp MC5000/MC6000 Series contains four MC5000 Series models and eight MC6000 models. Included within the MC5000 group are the MC5450, MC5550, MC5600, and MC5700. The MC6000 family comprises the MC6300, MC6400, MC6350, MC6450, MC6600, MC6700, MC6650, and MC6750.

PARAMETERS: See the tables on Pages -102 to -105 for a listing of capabilities, capacities, and basic configuration purchase prices.

CHARACTERISTICS

MANUFACTURER: Concurrent Computer Corp., 106 Apple Street, Tinton Falls, New Jersey 07724. Telephone (201) 758-7000.

DATA FORMATS

BASIC FORMAT: 32-bit word.

INTERNAL CODE: ASCII.

MAIN STORAGE

The Series 3200 contains from 512K to 256M bytes of physical memory, and the Masscomp series holds from 4M to 128M bytes of memory. Memory on the Series 3200 and Masscomp computers is expanded in 1M-, 2M-, 4M-, 8M-, 16M-, and 32M-byte increments. See Table 1 for specifics on memory capacities and expansion options for individual members of the Series 3200 and Masscomp families.

Concurrent Computer Supermini Systems

TABLE 1. SERIES 3200 SYSTEMS

MODEL	3203	3205	3212
SYSTEM CHARACTERISTICS			
Date of introduction	February 1985	May 1983	September 1986
Model type/packaging	Microsystem	Microsystem	Microsystem or full-sized cabinet
Technology/architecture	Proprietary	Proprietary	Proprietary
Operating system	OS/32, Xelos	OS/32, Xelos	OS/32, Xelos
Integer performance	Not specified	Not specified	Not specified
Floating-point performance	Not specified	Not specified	Not specified
Field upgradable to	Not applicable	Not applicable	Not applicable
CENTRAL PROCESSOR ARCHITECTURE			
Number of CPUs	1	1	1
Fl.-pt. hardware/co-processor	Integral	Integral	Integral
Cache (bytes)	None	None	1K
MEMORY SIZE			
Minimum capacity (bytes)	512K	2M	4M
Maximum capacity (bytes)	4M	8M	16M
Increment size (bytes)	1M, 2M, 4M	Not specified	1M, 2M, 4M, 8M
INPUT/OUTPUT CONTROL			
System bus	Not applicable	Not applicable	Not applicable
High-speed I/O channels/buses	1	1	1 to 8
Slow-speed I/O channels/buses	1	1	1
No. of peripheral controllers	1 master w/one disk and one tape controller	Not specified	Not specified
No. of communications controllers	1 or 2	1 to 3	1 to 8
Intelligent I/O control	Yes	Yes	Yes
DISK STORAGE			
Minimum capacity (bytes)	143M (formatted)	143M (formatted)	298M (formatted)
Maximum capacity (bytes)	542M (formatted)	1.2G (formatted)	44G (formatted)
WORKSTATION CAPACITY			
Max. physical connectivity	16	24	64
Max. working concurrently	Not specified	Not specified	Not specified
COMMUNICATIONS CAPABILITY			
Max. no. of serial lines	16	24	64
No. of LAN interfaces	1	1	1
Protocols	PENnet Plus, IEEE 802.3 Ethernet, CCITT X.25, CCITT X.29, Async, 2780/3780, HASP, BSC/3270, SNA/RJE, SNA/3270, SNA/HCF, SNA/DSX	PENnet Plus, IEEE 802.3 Ethernet, CCITT X.25, CCITT X.29, Async, 2780/3780, HASP, BSC/3270, SNA/RJE, SNA/3270, SNA/HCF, SNA/DSX	PENnet Plus, IEEE 802.3 Ethernet, CCITT X.25, CCITT X.29, Async, 2780/3780, HASP, BSC/3270, SNA/RJE, SNA/3270, SNA/HCF, SNA/DSX
PURCHASE PRICE			
Basic system platform	\$19,920	\$20,070	\$42,000
COMMENTS			

- • Moved most of the management and administrative functions to Concurrent's old corporate headquarters in Tinton Falls, New Jersey; and
- Named James Sims, Concurrent's president and CEO, to the offices of chairman, president, and CEO.

Masscomp acquired and merged with P-E's Concurrent to increase its size, market penetration, manufacturing economies, R&D, and ability to compete. For the former P-E subsidiary, the merger gives it a clear path for growth; brings more distribution channels; adds more customers to the installed base; broadens the product line; and provides more R&D resources. The new corporation kept the Concurrent Computer Corporation name to preserve brand name recognition.

The original Concurrent contributes significant resources and strengths to the new company. It offers nearly two decades worth of realtime, time-critical computing experience, and it has installed approximately 27,000 systems in ➤

➤ CENTRAL PROCESSOR

The Concurrent Series 3200 superminicomputers contain one or more CPUs. Each CPU is a microprogrammed, board-level CPU implemented in very large scale integration technology and comprises one or more boards.

The CPU on the Concurrent 3203 has:

- A microinstruction cycle time of 200 ns.
- Eight sets of sixteen 32-bit, general-purpose registers.
- Eight 32-bit, single-precision floating-point registers and eight double-precision floating-point registers, each 64 bits wide.
- Direct, program relative, single and double indexing address modes.
- Direct addressing up to 4M bytes.
- An interface to the dedicated bus that handles CPU and memory communications. ➤

Concurrent Computer Supermini Systems

TABLE 1. SERIES 3200 SYSTEMS (Continued)

MODEL	Micro3200 Series MicroThree CS	Micro3200 Series MicroThree ES	Micro3200 Series MicroFive CS	Micro3200 Series MicroFive ES
SYSTEM CHARACTERISTICS				
Date of introduction	April 1989	April 1989	April 1989	April 1989
Model type/packaging	Microsystem	Full-scale cabinet	Microsystem	Full-scale cabinet
Technology/architecture	Proprietary	Proprietary	Proprietary	Proprietary
Operating system	OS/32	OS/32	OS/32	OS/32
Integer performance	3 MIPS	3 MIPS	5 MIPS	5 MIPS
Floating-point performance	Not specified	Not specified	Not specified	Not specified
Field upgradable to	MicroFive CS	MicroFive ES	Not applicable	Not applicable
CENTRAL PROCESSOR ARCHITECTURE				
Number of CPUs	1	1	1	1
Fl.-pt. hardware/co-processor	Integral	Integral	Integral	Integral
Cache (bytes)	32K	32K	32K	32K
MEMORY SIZE				
Minimum capacity (bytes)	8M	8M	8M	8M
Maximum capacity (bytes)	64M	128M	64M	128M
Increment size (bytes)	8M, 16M, 32M	8M, 16M, 32M	8M, 16M, 32M	8M, 16M, 32M
INPUT/OUTPUT CONTROL				
System bus	Not applicable	Not applicable	Not applicable	Not applicable
High-speed I/O channels/buses	1 or 2	Up to 16	1 or 2	Up to 16
Slow-speed I/O channels/buses	1	1	1	1
No. of peripheral controllers	1 or 2	Not specified	1 or 2	Not specified
No. of communications controllers	1 to 4	Not specified	1 to 4	Not specified
Intelligent I/O control	Yes	Yes	Yes	Yes
DISK STORAGE				
Minimum capacity (bytes)	143M (formatted)	298M (formatted)	143M (formatted)	298M (formatted)
Maximum capacity (bytes)	1.1G (formatted)	88G (formatted)	1.1G (formatted)	88G (formatted)
WORKSTATION CAPACITY				
Max. physical connectivity	32	256	32	256
Max. working concurrently	Not specified	Not specified	Not specified	Not specified
COMMUNICATIONS CAPABILITY				
Max. no. of serial lines	32	Not specified	32	Not specified
No. of LAN interfaces	1	1	1	1
Protocols	PenNet Plus, IEEE 802.3 Ethernet, CCITT X.25, CCITT X.29, Async, 2780/3780, HASP, BSC/3270, SNA/RJE, SNA/3270, SNA/HCF, SNA/DSX	PenNet Plus, IEEE 802.3 Ethernet, CCITT X.25, CCITT X.29, Async, 2780/3780, HASP, BSC/3270, SNA/RJE, SNA/3270, SNA/HCF, SNA/DSX	PenNet Plus, IEEE 802.3 Ethernet, CCITT X.25, CCITT X.29, Async, 2780/3780, HASP, BSC/3270, SNA/RJE, SNA/3270, SNA/HCF, SNA/DSX	PenNet Plus, IEEE 802.3 Ethernet, CCITT X.25, CCITT X.29, Async, 2780/3780, HASP, BSC/3270, SNA/RJE, SNA/3270, SNA/HCF, SNA/DSX
PURCHASE PRICE				
Basic system platform	\$55,000	\$100,000	\$80,000	\$160,000
COMMENTS				

technical and commercial environments. Over the last few years, annual revenues have ranged between \$200 million and \$250 million. The former P-E subsidiary also contributes an extensive worldwide distribution channel and significant R&D resources to the new corporation.

Concurrent appeared on the time-critical computing scene in 1985. The company was created from Perkin-Elmer's Data Systems Group, which was formed in 1974 after P-E acquired Interdata Incorporated, founded in 1966. P-E established Concurrent as a 99 percent owned subsidiary to provide it with a clearer growth path within the computer industry and to gain greater visibility as a computer technology company. After the subsidiary provided several years of haphazard performance, however, P-E decided to withdraw from its role as a realtime computer system supplier and sold its interest in the computer systems manufacturer to Masscomp.

- An interrupt system with 1,023 vectors and one interrupt level.
- An auto driver channel.

The CPU of the Concurrent 3205 features:

- A microinstruction cycle time of 200 ns.
- Eight sets of sixteen 32-bit, general-purpose registers.
- Eight 32-bit, single-precision floating-point registers and eight 64-bit, double-precision floating-point registers.
- Direct, program relative, single and double indexing address modes.
- Direct addressing up to 8M bytes.
- An interface to the dedicated bus for CPU and memory communications.
- An interrupt system with 1,023 vectors and one interrupt level.

Concurrent Computer Supermini Systems

TABLE 1. SERIES 3200 SYSTEMS (Continued)

MODEL	3280SP	3280MPS	3280E MPS
SYSTEM CHARACTERISTICS			
Date of introduction	January 1987	September 1985	November 1988
Model type/packaging	Full-scale system	Large full-scale system	Large full-scale system
Technology/architecture	Proprietary	Proprietary	Proprietary
Operating system	OS/32, Xelos	OS/32	OS/32
Integer performance	6.4 MIPS	6.4 to 33+ MIPS	12 to 75+ MIPS
Floating-point performance	Not specified	Not specified	1.2 to 12 MFLOPS
Field upgradable to	Not applicable	3280E MPS	Not applicable
CENTRAL PROCESSOR ARCHITECTURE			
Number of CPUs	1	1 to 6	2 to 12
Fl.-pt. hardware/co-processor	Integral on each CPU	Integral on each CPU	Integral on each CPU
Cache (bytes)	16K	16K on each CPU	16K on each CPU
MEMORY SIZE			
Minimum capacity (bytes)	4M	8M	16M
Maximum capacity (bytes)	32M	128M	256M
Increment size (bytes)	Not specified	Not specified	16M, 32M, 64M
INPUT/OUTPUT CONTROL			
System bus	Not applicable	Not applicable	Not applicable
High-speed I/O channels/buses	Up to 16	Up to 32	Up to 96
Slow-speed I/O channels/buses	1	1	1
No. of peripheral controllers	Not specified	Not specified	Not specified
No. of communications controllers	Not specified	Not specified	Not specified
Intelligent I/O control	Yes	Yes	Yes
DISK STORAGE			
Minimum capacity (bytes)	298M (formatted)	Not specified	Not specified
Maximum capacity (bytes)	60G (formatted)	176G (formatted)	176G (formatted)
WORKSTATION CAPACITY			
Max. for physical connectivity	72	512	512
Max. working concurrently	Not specified	Not specified	Not specified
COMMUNICATIONS CAPABILITY			
Max. no. of serial lines	Not specified	Not specified	Not specified
No. of LAN interfaces	1	1	1
Protocols	PenNet Plus, IEEE 802.3 Ethernet, CCITT X.25, CCITT X.29, Async, 2780/3780, HASP, BSC/3270, SNA/RJE, SNA/3270, SNA/HCF, SNA/DSX	PenNet Plus, IEEE 802.3 Ethernet, CCITT X.25, CCITT X.29, Async, 2780/3780, HASP, BSC/3270, SNA/RJE, SNA/3270, SNA/HCF, SNA/DSX	PenNet Plus, IEEE 802.3 Ethernet, CCITT X.25, CCITT X.29, Async, 2780/3780, HASP, BSC/3270, SNA/RJE, SNA/3270, SNA/HCF, SNA/DSX
PURCHASE PRICE			
Basic system platform	\$199,500	\$265,000	\$360,000
COMMENTS			
	Supports options for inter-system coupling and Resilient System configuration.	Supports options for inter-system coupling and Resilient System configuration.	Supports options for inter-system coupling and Resilient System configuration.

➤ The Masscomp organization first appeared on the realtime computing scene in August 1981 and released its first product in November 1982. It brings an installed base of 4,000 computer systems, some international business, and \$60 to \$75 million in annual revenues to the new corporation.

Company and Product Strategy

Market Approaches

Concurrent uses both a direct sales force and indirect sales organizations to market its products. Direct marketing is conducted out of 36 U.S. sales offices. Major subsidiaries are responsible for marketing in Canada, Europe, the Far East, and the Pacific Basin. Indirect marketing channels in the U.S. include value-added resellers (VARs), original equipment manufacturers (OEMs), and systems integrators. In countries where the sales volume does not warrant the establishment of a direct sales force, sales are generally made through distributors.

➤ • An auto driver channel.

The CPU for the Concurrent 3212 contains:

- A writable control store implemented in 60-ns. static RAM.
- Eight sets of sixteen 32-bit, general-purpose registers.
- Eight 32-bit, single-precision floating-point registers and eight 64-bit, double-precision floating-point registers.
- Direct, program relative, single and double indexing address modes.
- Direct addressing up to 16M bytes.
- An interface to the dedicated bus that handles CPU and main memory communications.
- 1K-byte direct-mapped cache.
- An interrupt system with 1,023 vectors and four interrupt levels.
- • An auto driver channel.

Concurrent Computer Supermini Systems

TABLE 2. MASSCOMP SERIES SYSTEMS

MODEL	MC5450, MC5550	MC5600, MC5700	MC6300, MC6400	MC6350, MC6450	MC6600, MC6700	MC6650, MC6750
SYSTEM CHARACTERISTICS						
Date of introduction	Not specified	Not specified	Not specified	Not specified	Not specified	Not specified
Model type/packaging	MC5450: micro-system; MC5550: micro-system or full-sized cabinet	Microsystem or full-sized cabinet	Microsystem	Microsystem	Microsystem	MC6650: micro-system or full-sized cabinet; MC6750: full-sized cabinet
Technology/architecture	Standards-based w/propr. enhancements	Standards-based w/propr. enhancements	Standards-based w/propr. enhancements	Standards-based w/propr. enhancements	Standards-based w/propr. enhancements	Standards-based w/propr. enhancements
Operating system	RTU (UNIX System V and Berkeley 4BSD compatible)	RTU (UNIX System V and Berkeley 4BSD compatible)	RTU (UNIX System V and Berkeley 4BSD compatible)	RTU (UNIX System V and Berkeley 4BSD compatible)	RTU (UNIX System V and Berkeley 4BSD compatible)	RTU (UNIX System V and Berkeley 4BSD compatible)
Integer performance	Not specified	Not specified	Not specified	10 MIPS	Not specified	33 MIPS on MC6750
Floating-point performance	1.5K to 4.4K Whets	1.2K to 4K Whets	2.2K to 7K Whets	3.2M to 14M Whets	2.2K to 7K Whets	Up to 35M Whets
Field upgradable to	Not specified	Not specified	Not specified	Not specified	Not specified	Not specified
CENTRAL PROCESSOR ARCHITECTURE						
Number of CPUs	One 25MHz MC68020	MC5600: one to three 16.67MHz MC68020; MC5700: one to eight 16.67MHz MC68020	One or two 25MHz MC68030	One or two 33MHz MC68030	MC6600: One to three 25MHz MC68030; MC6700: two to five 25MHz MC68030	MC6650: One to three 33MHz MC68030; MC6750: two to five 33MHz MC68030
Fl.-pt. hardware/co-processor	Integral MC68881 and opt. fl.-pt. accelerator 8K	Integral MC68881 and opt. fl.-pt. accelerator 8K with each CPU	Integral MC68882 and opt. fl.-pt. accelerator 64K with each CPU	Integral MC68882 and opt. fl.-pt. accelerator 64K	Integral MC68882 and opt. fl.-pt. accelerator 64K with each CPU	Integral MC68882 and opt. fl.-pt. accelerator 64K with each CPU
Cache (bytes)	8K	8K with each CPU	64K with each CPU	64K	64K with each CPU	64K with each CPU
MEMORY SIZE						
Minimum capacity (bytes)	4M	4M	8M	8M	8M	8M
Maximum capacity (bytes)	10M	64M	120M	120M	128M	120M
Increment size (bytes)	4M, 6M	8M, 16M, 32M	8M, 16M, 32M	8M, 16M, 32M	8M, 16M, 32M	8M, 16M, 32M
INPUT/OUTPUT CONTROL						
System bus	One 4M-6MB/sec Multibus	MC5600: One or two 4M-6MB/sec Multibus; MC5700: One to four Multibus	40MB/sec VMEbus	40MB/sec VMEbus	MC6600: One or two 4M-6MB/sec Multibus; MC6700: One to four Multibus	MC6650: Two 4M-6MB/sec Multibus; MC6750: Four 4M-6MB/sec Multibus
High-speed I/O channels/buses	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Slow-speed I/O channels/buses	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
No. of peripheral controllers	Not specified	Not specified	Not specified	Not specified	Not specified	Not specified
No. of communications controllers	1	Not specified	1 or 2	1 or 2	1 to 8	1 to 8
Intelligent I/O control	Yes	Yes	Yes	Yes	Yes	Yes
DISK STORAGE						
Minimum capacity (bytes)	Not specified	Not specified	Not specified	Not specified	Not specified	Not specified
Maximum capacity (bytes)	Not specified	Not specified	Not specified	Not specified	Not specified	Not specified
WORKSTATION CAPACITY						
Max. for physical connectivity	Not specified	Not specified	Not specified	Not specified	64	64
Max. working concurrently	4	4	12	12	30	30
COMMUNICATIONS CAPABILITY						
Max. no. of serial lines	12	12	20	20	64	64
No. of LAN interfaces	1	1	1	1	1	1
Protocols	TCP/IP IEEE 802.3 Ethernet, uucp program set, Berkeley protocols, NFS, DECnet, X.25	TCP/IP IEEE 802.3 Ethernet, uucp program set, Berkeley protocols, NFS, DECnet, X.25	TCP/IP IEEE 802.3 Ethernet, uucp program set, Berkeley protocols, NFS, DECnet, X.25	TCP/IP IEEE 802.3 Ethernet, uucp program set, Berkeley protocols, NFS, DECnet, X.25	TCP/IP IEEE 802.3 Ethernet, uucp program set, Berkeley protocols, NFS, DECnet, X.25	TCP/IP IEEE 802.3 Ethernet, uucp program set, Berkeley protocols, NFS, DECnet, X.25
PURCHASE PRICE						
Basic system platform	Not specified	Not specified	Not specified	Not specified	Not specified	Not specified
COMMENTS						
	Has integral and independent graphics processors. Supports a data acquisition and control processor. Has a VMEbus option.	Has integral and independent graphics processors. Supports a data acquisition and control processor. Has a VMEbus option.	Has integral and independent graphics processors. Supports a data acquisition and control processor. Has a Multibus option.	Has integral and independent graphics processors. Supports a data acquisition and control processor. Has a Multibus option.	Has integral and independent graphics processors. Supports a data acquisition and control processor. Has a VMEbus option.	Has integral and independent graphics processors. Supports a data acquisition and control processor. Has a VMEbus option.

Concurrent Computer Supermini Systems

TABLE 3. MASS STORAGE

MODEL	SCSI-182D	SCSI-300D	HPD368F	HPMD851F	HPD1300F
Type	5¼-inch Winchester	5¼-inch Winchester	8-inch Winchester	8-inch Winchester	Winchester
Controller model	IPC with SCSI Disk Controller	IPC with SCSI Disk Controller	HPDI	HPDI	HPDI
Formatted capacity per drive (bytes)	142.6M	271.4M	298.4M	698.5M	1102M
Average seek time	16.5 ms	16.5 ms	18 ms	16 ms	Not specified
Average latency	8.3 ms	8.3 ms	8.3 ms	8.3 ms	Not specified
Data transfer rate	1.25M bytes/sec	1.25M bytes/sec	1.8M bytes/sec	2.5M bytes/sec	3M bytes/sec
Supported by system models	All 3200 models	All 3200 models	3212 and above	3212 and above	3212 and above
Purchase Price (basic model)	\$9,200	\$10,200	\$11,200	\$17,000	\$29,500

TABLE 3. MASS STORAGE (Continued)

MODEL	RWD-300	RSD-80	MSM-300
Type	5¼-inch removable Winchester subsystem	9-inch removable	Removable
Controller model	Not specified	Not specified	Not specified
Formatted capacity per drive (bytes)	542M on two drives (271M per drive)	67.2M	256.2M
Average seek time	16.5 ms	27 ms	30 ms
Average latency	8.3 ms	Not specified	8.3 ms
Data transfer rate	12M bps	Not specified	1.2MB/sec
Supported by system models	3200 models	3200 models	3200 models
Purchase Price (basic model)	Not specified	Not specified	Not specified

TABLE 3. MASS STORAGE (Continued)

MODEL	D-5N142	D-5N318	D-5N278	D-8N568	D-9N5678
Type	5¼-inch Winchester	5¼-inch Winchester	8-inch Winchester	8-inch Winchester	9-inch removable
Controller model	DC-432 or DC-SCSI-E	DC-432 or DC-SCSI-E	DC-451	DC-451	DC-451
Formatted capacity per drive (in bytes)	142.1M	318.8M	277.7M	568.4M	67.4M
Average seek time	23 ms	18 ms	20 ms	16 ms	30 ms
Average latency	8.3 ms				
Data transfer rate	1.25M bytes/sec	1.25M bytes/sec	2.5M bytes/sec	2.5M bytes/sec	1.2M bytes/sec
Supported by system models	Any MC5000 or MC6000				
Purchase price (basic model)	Not specified				

➤ Concurrent uses its direct sales force to target technically sophisticated end users at large corporations, government organizations, and private institutions that are prepared to develop and support their own applications. Concurrent's system engineers provide system installation support, and Concurrent helps end users design custom systems and applications under consulting contracts.

Resellers provide Concurrent with the readily available marketing, sales, and technical expertise needed to generate sales and support customers in various vertical markets and niche application sectors. The VARs integrate Concurrent systems with industry- or niche-specific applications software to provide turnkey solutions to end users. OEMs add additional equipment and software to Concurrent models or embed Concurrent models in specialized systems, and market, sell, and support these systems under private labels. Systems integrators combine Concurrent models with diverse equipment and customized software and communications to address their customers' specific needs.

Most of Concurrent's sales are generated by indirect sales agents: 60 to 70 percent of Concurrent systems distributed to end users are sold through resellers. Customers that buy through the indirect marketing channel include small businesses, large corporations, government agencies, and corporate and intraagency departments that 1) do not have the

➤ The 3280SP supports a CPU that features:

- An 8K-word writable control store.
- An instruction execution unit that employs a 64-bit parallel multiplier array.
- An integral 64-bit floating-point processor.
- Eight sets of sixteen 32-bit, general-purpose registers.
- Eight 32-bit, single-precision and eight 64-bit, double-precision floating-point registers.
- One set of sixteen 32-bit scratch pad registers.
- A four-stage instruction pipeline.
- An interface to a 64M byte-per-second memory bus.
- A 16K-byte cache.
- An interrupt system with 1,023 vectors and four interrupt levels.
- An auto driver channel.

The 3280MPS and 3280E MPS are tightly coupled asymmetrical multiprocessor models. Processing is modular and distributed among 1 or 2 master CPUs and as many as 10 auxiliary CPUs (APUs). Each processor performs a unique primary function. The master CPU performs system control; schedules APUs; handles physical I/O requests; and typically serves as a database, terminal, or communications server. In addition, master CPU can be programmed for user

Concurrent Computer Supermini Systems

TABLE 4. WORKSTATIONS

MODEL	6312	GA1000 IGP Display	GA800 IGP Display	Integral Monochrome Display	Integral Color Display
WORKSTATION TYPE	Alphanumeric display	Graphics workstation	Graphics workstation	Graphics workstation	Graphics workstation
DISPLAY PARAMETERS					
Screen size	Not defined	19 inches	19 inches	19 inches	12 inches
Screen format	24 lines x 80 rows	1,152 x 910 pixels	1,024 x 800 pixels	1,152 x 910 pixels	640 x 480 pixels
Character phosphor	Monochrome	Color	Monochrome	Monochrome	Color
KEYBOARD PARAMETERS					
Style	Detachable typewriter-style	Detachable typewriter-style with tablet and mouse options	Detachable typewriter-style with tablet and mouse options	Detachable typewriter-style with mouse option	Detachable typewriter-style with mouse option
Character/code set	ASCII	ASCII	ASCII	ASCII	ASCII
TERMINAL INTERFACE	Supported on Series 3200	Supported by Mass-comp systems	Supported on Mass-comp systems	Supported by Mass-comp systems	Supported on Mass-comp systems
PURCHASE PRICE (basic model)	\$795	Not specified	Not specified	Not specified	Not specified
COMMENTS					

application development expertise; 2) cannot afford to spend the time and effort on application development; or 3) need assistance in building specialized application systems.

Concurrent's direct sales force and resellers focus solely on selling realtime technical systems, realtime automation and control, and online transaction processing systems. Primary target industries include aerospace, automotive, electronics/electrical, telecommunications, military, government scientific, government service, petroleum and mining, chemical, financial services, gaming/wagering, insurance, and health care. The realtime systems in these markets support technical and scientific applications that require an instantaneous response to an external event, or which acquire, store, manipulate, and display enormous amounts of data in realtime. Automotive test simulation, process control, laboratory test data acquisition, medical diagnostics, and geographic information systems are examples of targeted applications.

The online transaction processing systems serve business and commercial applications requiring rapid information management and communications capability. They enable a user to interact with a central database to update or retrieve information almost immediately. Examples of targeted online transaction processing systems are automated bank teller machine network transaction processing, securities trading, inventory tracking, insurance database systems, and patient information systems.

Products

Concurrent offers systems satisfying a broad range of performance requirements for time-critical applications. The MC5000 and MC6000 serve the low-to-midrange market. These systems feature an architecture that couples standards and commodity components (e.g., MC68020 and MC68030 microprocessors and UNIX) with proprietary innovations. Distinguishing characteristics that contribute to relatively high-performance include multiple MC68020 and MC68030 microprocessor-based CPUs configured into tightly coupled arrangements; a triple bus architecture that features a proprietary bus and enhanced standards-based buses; and a UNIX operating system that combines UNIX System V and Berkeley 4BSD with proprietary realtime facilities and utilities. The series ranges from a 1-MIPS sys-

tasks. The auxiliary APUs run computational tasks and, in some cases, database, terminal, and communications management. Work configurations are accomplished through system commands and microprogramming at initialization. An APU executes program code simultaneously with the CPU and other APUs. The processing operations of all units are synchronized and coordinated through interprocessor communications. The tightly coupled design gives each processor equal access to all memory so that data and programs can be shared.

The 3280MPS contains one CPU and up to five APUs. Each APU is equivalent to a CPU in hardware and microcode design. In fact, an APU can be initialized as a CPU in the event of a CPU failure. Both the CPU and APU contain:

- An 8K-word writable control store.
- An instruction execution unit that employs a 64-bit parallel multiplier array.
- An integral 64-bit floating-point processor.
- A four-stage instruction pipeline.
- An interface to a 64M byte-per-second memory bus.
- A 16K-byte cache.
- Interprocessor communications.
- An interrupt system with 1,023 vectors and four interrupt levels.
- An auto driver channel.

The 3280E MPS comes with 2 CPUs and supports up to 10 APUs. Each processor contains:

- A 16K-word writable control store.
- A 100-ns. microinstruction cycle.
- An instruction execution unit that employs a 64-bit parallel multiplier array.
- An integral floating-point processor.
- Eight sets of sixteen 32-bit, general-purpose registers.
- Eight 32-bit, single-precision and eight 64-bit, double-precision floating-point registers.
- One set of sixteen 32-bit scratch pad registers.
- A four-stage instruction pipeline.

Concurrent Computer Supermini Systems

TABLE 5. PRINTERS

MODEL	LP300	LP600	LP1200	PM-180	PR-650
Type	Band line	Band line	Band line	Desktop dot matrix	Floorstanding line matrix
Speed	255 to 317 lpm	600 to 655 lpm	950 to 1,250 lpm	180 cps	300 lpm
Character set	64 or 96 ASCII	64 or 96 ASCII	64 or 96 ASCII	96 ASCII, 160 JIS	300 lpm
Graphics capability	Does not apply	Does not apply	Does not apply	Bit image	Bit image
Purchase price (basic model)	\$9,000	\$15,000	\$29,000	Not specified	Not specified

tem to a 33-MIPS model. Various performance enhancing options such as floating-point accelerators, vector accelerators, data acquisition and control processors, graphics subsystems, and high-speed networking equipment are provided to address specific application requirements.

The upper limits of midrange performance and the very high-performance requirements of time-critical applications are addressed by the Series 3200 systems. The Series 3200 features a hardware platform that includes multiple board-level, supermini-based CPUs implemented in proprietary designs and a software platform based on the proprietary OS/32 operating system. The product line is capable of processing up to more than 75 MIPS and respond to external interrupts in about 10 milliseconds. When the application mandates continuous uptime, options are available to implement a fully redundant system with hot standby services.

Concurrent's consistent architecture and full upward compatibility within both the MC5000/MC6000 and Series 3200 product lines allow applications to be moved to more powerful machines. Binary compatibility permits applications to be moved upward and run without modification, thereby saving development resources and protecting the customer's investment. Further, with an incremental, modular, multiple-processor architecture, application expansion is relatively inexpensive. Much of the MC5000/MC6000 line and the upper portion of the Series 3200 line allow additional CPUs to be added without affecting existing applications. Thus, processing power is increased without the need to migrate to another model.

A complete set of application programming languages and development tools is available for technical and commercial processing. Through broad networking capabilities, Concurrent's systems can be interconnected with IBM mainframes, the DECnet network, UNIX-based superminis and technical workstations, diverse systems with the TCP/IP protocol or the standard-based NFS networking application, standard-based PC workstations, and public data networks with the CCITT-recommended X.25 protocol. Furthermore, system usability is extended by a full range of standard and application-specific peripherals. Additionally, Concurrent offers a variety of service and support programs to meet the customer's maintenance requirements for hardware, software, and communications. The company also offers contract service for third-party equipment and a set of technical and business consulting services and customer training and education.

- ▶ • An interface to a 256M byte-per-second memory bus.
- A 16K-byte cache.
- Interprocessor communications.
- An interrupt system with 1,023 vectors and four interrupt levels.
- An auto driver channel.

The Masscomp series of supermicrosystem-based models has central processors that combine proprietary designs with microprocessor and advanced VLSI technologies from independent, standards-oriented computer component suppliers. Each central processor contains one or more CPUs tightly coupled to a main storage. Multiple CPUs are arranged into a tightly coupled configuration where they share memory, I/O, and a single queue of runnable processes. The operating system dynamically controls the work flow to each central processor. Also, users can dedicate processes to CPUs to accommodate parallel processing.

Both the MC5450 and the MC5550 are single-CPU computers. The central processor is based on one 25MHz Motorola MC68020 chip complemented with:

- A Motorola MC68881 floating-point co-processor that runs at 20MHz.
- An optional floating-point accelerator with its own MC68881 chip.
- A memory management unit (MMU) that supports virtual addressing up to 128M bytes and provides a 16M-byte physical address space.
- An 8K-byte cache.
- An interface to the 12M byte-per-second system memory bus that supports main storage and an integral graphics processor.
- An MC68020-based AMD 7990 Ethernet chip that off-loads TCP/IP IEEE 802.3 Ethernet communications from the main MC68020.
- A Hitachi ACTRC graphics controller.
- A SCSI-based mass storage controller.
- A serial communications interface with four ports.
- An I/O bus adapter.

Both the MC5600 and MC5700 accommodate multiple CPUs. The MC5600 comes with one CPU and has options for two additional CPUs. The MC5700 supports up to eight CPUs. Each CPU on the MC5600 and MC5700 contains:

- ▶ • One 16.67MHz Motorola MC68020.
- A 16.67MHz Motorola MC68881 floating-point co-processor.

Concurrent Computer Supermini Systems

TABLE 6. MAGNETIC TAPE EQUIPMENT

MODEL	SCSI-T Streaming Tape	CT-1600	MTS-6250	HPTD-125	Tri-Density 75-ips Tape Drive	Tri-Density 50-ips Tape Drive
TYPE	¼-inch streaming cartridge	½-inch open reel	½-inch reel-to-reel streamer	½-inch reel-to-reel start/stop	½-inch reel-to-reel start/stop	½-inch reel-to-reel start/stop
CHARACTERISTICS						
Recording mode	QIC-24	1600 bpi PE	1600 bpi PE, 6250 bpi GCR	800 bpi NRZI, 1600 bpi PE, 6250 bpi GCR	800 bpi NRZI, 1600 bpi PE, 6250 bpi GCR	800 bpi NRZI, 1600 bpi PE, 6250 bpi GCR
Storage capacity per reel (bytes)	60M	43M	40M or 150M	Not specified	Not specified	Not specified
Tape speed	90 ips	100 ips in streaming mode	75 ips in streaming mode and 25 ips in start/stop mode	125 ips	75 ips	50 ips
PURCHASE PRICE (basic model)	\$2,100	\$9,900	\$18,500	\$49,500 (for first drive within subsystem)	Not specified	Not specified

TABLE 6. MAGNETIC TAPE EQUIPMENT (Continued)

MODEL	150MB ¼-inch Cartridge Tape Drive	6250/1600 ½-inch Reel-to-Reel Magnetic Tape Drive	1600 ½-inch Incremental/Streaming Tape Drive
TYPE	¼-inch streaming cartridge	½-inch dual-density reel-to-reel	½-inch streaming reel-to-reel
CHARACTERISTICS			
Recording mode	10000 bpi	1600 bpi PE, 6250 bpi GCR	1600 bpi PE
Storage capacity per reel (bytes)	125M to 150M	146M or 180M	40M to 46M
Tape speed	90 ips	25 or 75 ips in streaming mode and 25 ips in start/stop mode	100 ips in streaming mode and 25 ips in start/stop mode
Purchase Price (basic model)	Not specified	Not specified	Not specified

► Competitive Position

The MC5000/MC6000 and Series 3200 systems remain competitive in overall systems performance, quality and reliability, price, operating systems functionality and interface compatibility, and service and support. Concurrent's primary competitors include Digital Equipment, Hewlett-Packard, Harris Corporation, Gould, MODCOMP, IBM, Stratus Computer, and Tandem Computer.

Although the Concurrent models are competitive, these proprietary and UNIX-based systems do not have the visibility of well-established and popular systems such as the Digital VAX, the Hewlett-Packard HP 1000 or HP 9000, Stratus Continuous Processing systems, or Tandem Non-stop computers. Gaining market share, therefore, will not be easy. Digital Equipment Corporation earns nearly \$1 billion per year in revenues for realtime solutions and Tandem earns over \$1 billion annually from its online transaction processing systems. In contrast, Concurrent is only a \$300 to \$350 million company.

Despite the intense competition, Concurrent will continue to succeed at selling into its existing installed base.

Concurrent would like installations with the aged and obsolete Masscomp and Series 3200 models—e.g., the Masscomp MC5300 and the Concurrent 3260MPS—to move to the more strategic models—e.g., the MC6000 line and the Concurrent 3280. When users upgrade, the upward compatibility within each family allows them to preserve software, peripheral, and communications investments. Additionally, Concurrent encourages large environments to add one or more systems to the existing computer infra-

- • An optional floating-point accelerator with its own MC68881.
- A virtual memory-based MMU.
- An 8K-byte cache.
- An interface to the high-speed system memory bus.
- An on-board serial communications interface.
- An I/O bus interface.

The MC6300, MC6400, MC6350, and MC6450 each support a central processor with one or two CPUs. Versions with dual CPUs house both CPUs on a single processor card. The CPU on the MC6300 and MC6400 is a 25MHz Motorola MC68030 chip tightly coupled with:

- A Motorola MC68882 floating-point co-processor.
- An optional two-chip set floating-point accelerator.
- A virtual memory-oriented MMU that performs 4G-byte virtual addressing and provides a 256M-byte physical address space.
- An interface to a 64K-byte cache.
- An interface to a 26M byte-per-second system memory bus that supports main storage, vector processor options, and I/O bus adapters.
- An on-board serial communications interface.

The CPU on the MC6350 and MC6450 is a 30MHz Motorola MC68030 chip tightly coupled with:

- A Motorola MC68882 floating-point co-processor.
- An optional two-chip set floating-point accelerator.

Concurrent Computer Supermini Systems

➤ structure. The intersystem coupling scheme on the Series 3200 allows customers to upgrade an installation without discarding previously installed systems. The networking schemes used on both the Masscomp series and the Series 3200 systems enables Concurrent to sell its systems as part of a distributed processing solution.

Concurrent also would like to increase the sales of its Masscomp series by selling the models as front-end systems to the larger Series 3200 systems. As front ends, the models would 1) off-load realtime processing from the host, 2) act as an information display and end-user decision support processor or professional workstation into the host, or 3) perform a combination of both functions. Presently, the Masscomp and Series 3200 systems exchange data rudimentarily with one another through the TCP/IP protocol. A complete set of communication utilities and network applications for transparent interfacing between the Masscomp series and Series 3200 has not yet been developed. Once the more sophisticated and more functional communications/networking applications are available, the Masscomp series' role as a front end to a Series 3200 will increase significantly.

Furthermore, Concurrent will benefit from the growing demand for realtime technical, realtime automation and control, and realtime transaction processing systems. Currently, the demand for general-purpose technical and commercial systems is growing at only 5 to 7 percent annually. In contrast, demand for specialized systems dedicated to realtime technical and online transaction processing is growing at approximately 10 percent annually. The trend toward "realtime" computing is developing because users in time-critical applications environments want a reliable, accurate response instantaneously from the computer. General-purpose systems typically are not as efficient as realtime-oriented computers when very rapid response to external events and transactions must take place.

Moreover, Concurrent's success at selling realtime technical, realtime automation and control, and online transaction processing systems will improve as Concurrent moves to:

- Raise market awareness.
- Set realtime standards.
- Leverage technological advantages.
- Integrate the diverse product lines—Masscomp and Series 3200 systems—into a more compatible framework for smoother intersystem networking and application migration.
- Focus on niche applications.
- Expand the solutions orientation by:

- • A virtual memory-oriented MMU that performs 4G-byte virtual addressing and provides a 256M-byte physical address space.
- An interface to a 64K-byte cache.
- An interface to a 26M byte-per-second system memory bus.
- An on-board serial communications interface.

Also included on the central processor of the MC6300, MC6400, MC6350, and MC6450 is one 64K-byte cache tightly coupled with the CPU and main storage. On a central processor with two CPUs, the 64K-byte cache, like main storage, is shared between the two CPUs. Additionally, the central processor contains an Ethernet controller and an electronically erasable programmable ROM (EEPROM) with system initialization software.

The MC6600, MC6700, MC6650, and MC6750 each have a central processor that accommodates multiple CPUs. Both the MC6700 and MC6650 come with one CPU and each has options to support two additional CPUs. The MC6700 and MC6750 both come with two CPUs and each has options to support up to five CPUs.

Each CPU on the MC6600, MC6700, MC6650, and MC6750 is based on a MC68030 chip. The MC68030 on the MC6660 and MC6700 runs at a clock speed of 25MHz. The MC68030 on the MC6650 and MC6750 performs at 30MHz. Combined with each MC68030 is:

- A Motorola MC68882 floating-point co-processor.
- An optional two-chip set floating-point accelerator.
- A virtual memory-oriented MMU that performs 4G-byte virtual addressing and provides a 256M-byte physical address space.
- A 64K-byte cache.
- An interface to a 26.6M byte-per-second system memory bus that supports main storage, vector processor options, and I/O bus adapters.

INPUT/OUTPUT CONTROL

Each Concurrent 3200 employs selector channels and multiplexer channels for I/O control and communications functions.

A selector channel transfers disk and tape data between main memory and the magnetic storage subsystem. Up to 1.5M bytes of data can be actively transferred between a controller or a device and memory at any one time. A 10M byte-per-second direct memory interface (DMI) gives the 16-bit selector channel a direct, high-speed 32-bit access channel into main memory. From one to eight selector channels can be attached to the DMI. One DMI is employed on the low-end 3200 models and up to twelve on the high-end models.

The multiplexer channel handles traffic for terminals, workstations, printers, and data communications and networking devices. It can support up to 1,023 devices, divided among four priority levels. Data transfers occur in either the byte or block multiplexer mode. An auto driver channel, driven by the fixed control store, is used by the multiplexer channel to transfer blocks of data to and from memory. Throughput on the multiplexer bus is between 334K bytes and 400K bytes per second.

Concurrent Computer Supermini Systems

- Seeking out additional resellers that sell packaged, customized, or turnkey solutions and improving business relationships with existing resellers.

Building application expertise in direct marketing.

Seeking strategic alliances.

Decision Points

Several points should be considered when analyzing and evaluating Concurrent systems for purchase.

Orientation. Unlike the general-purpose computer systems which support add-on features for realtime performance, Concurrent's systems are designed specifically for realtime technical and realtime transaction processing. All the hardware and software on the Concurrent systems have been designed to provide instantaneous, accurate, reliable responses to external events and transactions. Featured are multiprocessing with asymmetric and symmetric configurations, high bandwidth buses, priority scheduling and realtime interrupt response, sub-10-millisecond response time, fast disk I/O, full redundancy, and automatic online recovery.

Architecture. Concurrent offers a dual product line approach to realtime-oriented technical and online transaction processing.

The Masscomp series, with its UNIX-based RTU operating system, provides a standards-based approach, which allows Concurrent to leverage relatively low-cost commodity technologies into attractive price/performance. Furthermore, using off-the-shelf components and de facto, industry-standard facilities allows Concurrent to minimize the risk of technological obsolescence; Concurrent can easily incorporate new technologies into its computers as they become available. Moreover, by building the Masscomp systems around widely employed hardware (such as the Motorola MC68020 and MC68030 chips), a UNIX System V- and Berkeley 4BSD-compatible operating system, and industry-standard applications such as IEEE 802.3 TCP/IP Ethernet networking, Concurrent reduces the customer's cost of migrating from or to another vendor's system that employs such common facilities. In addition, these commonly available facilities enable the Masscomp series to provide users with access to a broad range of low-cost peripherals and an increasingly large application base.

A proprietary solution is provided by the Series 3200 and its OS/32 operating environment. This approach enables Concurrent to deliver more realtime and online transaction processing performance than would be possible with a standards-based approach. With the strictly proprietary Series 3200, users receive up to 75 MIPS, responsiveness within the 1-to-10 millisecond range, 120M bytes per second of I/O throughput, support for over 1,000 terminals, large-capacity database systems, and continuous processing capability.

- Magnetic storage connection is performed by the:

- **Intelligent Peripheral Controller (IPC)**—A microprocessor-driven controller that uses its own operating system, drivers, and utilities to provide autonomous peripheral operation. It generates a Small Computer Systems Interface (SCSI) bus to communicate with supported SCSI-based Winchester disk drives and magnetic tape. The IPC services three SCSI devices: one or two 5.25-inch disk drives and one or two streaming cartridge tape drives. A SCSI disk controller and a SCSI tape controller execute the commands received from the IPC.
- **High Performance Disk Interface (HPDI)**—A microprocessor-driven controller that handles up to four disk drives of various types and speeds. It communicates with the disk drives via the HPDI bus.
- **High Performance Tape Interface (HPTI)**—A microprocessor-driven controller that controls I/O operations for one to four magnetic tape drives.

Data communications and networking device control and connectivity on the Series 3200 are performed by integral board-level multiplexers and intelligent interfaces as well as front-end processors. Descriptions of these devices are in the COMMUNICATIONS CONTROL section of this report.

Standard I/O controllers provided directly within the central processor of the Masscomp MC5450 and MC5550 include a SCSI interface for attaching the SCSI-based disk drives and magnetic tape equipment; a serial line interface which comprises up to four programmable serial I/O channels for local terminals, modems, data communications lines, or other I/O devices; and an Ethernet interface which transfers data directly into memory with direct virtual memory access (DVMA).

Add-on expansion I/O controllers used within the MC5450 and MC5500 include:

- **Multibus-resident disk controllers.** Available disk controllers for ESDI-compatible Winchester disk drives support two disk drive options. Available disk controllers for HSMD interface- and SMD interface-based Winchester and removable disk drives support up to four disk drive units.
- **Multibus-resident tape controllers.** Available disk controllers support one or two cartridge or 0.5 inch magnetic reel tape drives.
- **High-speed serial multiplexer.** This microprocessor-driven multiplexer runs device drivers for terminal support and protocols for systems-to-systems communications. See the COMMUNICATIONS CONTROL section of this report for further details.
- **Ethernet controller.** This LAN interface is explained in the COMMUNICATIONS CONTROL section of this report.

The add-on I/O expansion options communicate with the central processor and memory through an enhanced, industry-standard 32-bit Multibus I/O bus. The Masscomp-enhanced Multibus runs at 4M to 6M bytes per second and can support a wide range of commercially available Multibus devices. Up to 7 or 15 peripheral I/O control cards can be configured on the bus.

The Masscomp MC6350 and Masscomp MC6450 use an enhanced industry-standard 32-bit VMEbus to interconnect the peripheral controllers to the central processor and memory. Devices supported on this bus include:

Concurrent Computer Supermini Systems

▷ For users with UNIX requirements on the upper midrange and very high-performance systems, Concurrent provides the Series 3200 with Xelos, a UNIX System V operating system with Berkeley extensions, Concurrent enhancements, and System V Interface Definition (SVID) compatibility. Xelos is best suited for environments where portability and standardization are the major requirements. Realtime and online transaction processing requirements on the Series 3200 are best met with OS/32.

Applications Availability. A very small base of readily available end-user production-oriented applications exists for the Series 3200. Although third parties have developed packaged solutions for the OS/32 environment, very few off-the-shelf applications exist. The software base has remained relatively small because the Series 3200 has a low profile and because of the specialization of realtime technical, realtime automation and control, and online transaction processing systems. The applications software base for the Series 3200 is expanded somewhat by the system's capability to run Xelos, a SVID-compatible UNIX. Off-the-shelf, SVID-compliant UNIX applications, however, are only source-code compatible under the Series 3200 architecture and have to undergo modifications to execute on the proprietary platform. Furthermore, there is only a limited amount of realtime and online transaction processing applications for the UNIX environment. Realtime-oriented technical and commercial application development under UNIX has been slow because most versions of UNIX System V and Berkeley 4BSD are not ideally structured to give "true" realtime responsiveness or online transaction processing performance.

The packaged applications base for the Masscomp series, the strictly UNIX-based product line, is much larger than that of the Series 3200. The Masscomp series has access to over 250 applications developed specifically for the Masscomp series architecture. Furthermore, it can access independent software vendor (ISV) applications that are SVID compliant or strictly Berkeley based. Like all System V-compatible and Berkeley platforms, however, the Masscomp series is only source-code compatible with these applications and cannot run the applications until they undergo modification. Furthermore, the third-party applications base mostly contains realtime technical, technical graphics, and online technical information systems. Very few applications have any commercial orientation.

Modularity. The modularity and expandability of the Masscomp and Series 3200 models provide for relatively inexpensive application expansion. With much of the Masscomp line and the upper portion of the Series 3200 line, processing power on a particular model can increase through horizontal expansion. Additional power is obtained by simply adding CPU boards and other associated processing hardware. Through this approach, processing power is increased without the need to migrate to another model.

High Growth. Concurrent also allows customers to grow their Series 3200 complex through system clustering. The

- ▶ • Disk controllers that support Masscomp's high-speed, high-capacity, HSMD-based Winchester disk drives and Masscomp's removable disk drive options.
- Tape controllers that support one or two cartridge or 0.5-inch magnetic reel tape drives.
- A high-speed serial multiplexer.
- An ethernet controller.
- A Multibus adapter. This device generates a Multibus for the connectivity of Multibus options.

A SCSI bus is also provided on the MC6350 and MC6450. This bus supports Masscomp's 5.25-inch Winchester disk drives and 0.25-inch cartridge tape drives.

The Masscomp MC6650 and Masscomp MC6670 integrate the central processor and memory with the peripheral and data communications subsystems via an enhanced Multibus that runs at 4M to 6M bytes per second. Supported devices include:

- Disk controllers for ESDI-, HSMD-, and SMD-compatible Winchester disk drives and removable disk drive options.
- Tape controllers that support one or two cartridge or 0.5-inch magnetic reel tape drives.
- A high-performance serial multiplexer.
- An Ethernet controller.

Also provided on the MC6650 and MC6670 is an option to support a VMEbus. The VMEbus I/O subsystem consists of a 6- or 10-slot chassis that supports disk, tape, LAN, and data communications options.

All the Masscomp MC5000 and MC6000 models support graphics processors. These graphics processors off-load 2-D, 3-D, and visualization graphics work from the main central processor and handle graphics display and data input. They consist of a microprocessor, a graphics controller, system memory, display memory, a display monitor, a keyboard, and graphics data input devices such as a mouse and tablet. Two versions of these graphics controllers are available: the Integral Graphics Subsystem and the Independent Graphics Subsystem. The Integral Graphics Subsystem does not come with a microprocessor and resides on the memory bus with the CPUs. The Independent Graphics Subsystem contains the microprocessor, offers more sophisticated graphics and graphics speed, and resides on the Multibus I/O bus with the other I/O options.

All of the Masscomp MC5000 and MC6000 computers can be configured with data acquisition and control processors. These specialized I/O controllers collect data from analog and digital devices that operate in realtime application environments such as scientific laboratories and factory floors. An STD+ Bus interface bus carries communications between the data acquisition and control processor and the interfaces that enable the devices to communicate across the STD+ Bus. The data acquisition processor resides on the Multibus or VMEbus I/O bus.

CONFIGURATION RULES

The Concurrent 3200 Series addresses small, medium, and large environments. Table 1 depicts the performance ratings, system capacities, configuration rules, and operational capabilities of each model.

Concurrent Computer Supermini Systems

➤ Distributed Bus Link (DBL) interconnects multiple Series 3200 models into a tightly coupled complex that provides the processing, storage, and I/O needed to handle large applications that have grown beyond the limitations set by a single complex. Through the DBL, customers satisfy growth needs while protecting the initial system investment—customers can add new computers without discarding existing systems.

High Availability. One advantage Concurrent has given its Series 3200 systems is a measure of fault tolerance through built-in protection (i.e., automatic online database recovery, sophisticated diagnostics, and central processors and I/O with designated backup) and with the Resilient System. The benefits of a highly reliable system are obvious—the system is always available for use, the integrity of the data stored is assured, and the costs associated with downtime and repairs are greatly decreased.

Communications and Networking. Concurrent provides a number of data communications languages for heterogeneous distributed processing and networking. Included are Ethernet TCP/IP networking, DDN protocols, X.25, and communication with IBM and compatible host systems. Furthermore, Concurrent offers the Network File System (NFS) client/server model, compatibility with Digital's DECnet, and PC connectivity. Concurrent's supermini systems, however, do not support a uniform communications and networking structure. Not all of the tools can be employed throughout Concurrent's product line. Each series differs in communications and networking capabilities. The Masscomp series only supports TCP/IP, NFS, DECnet, X.25, uucp, and the Berkeley program set across Ethernet or X.25 lines. Series 3200 only accommodates Ethernet TCP/IP, X.25, SNA, BSC, and PC communications.

Compatibility. Masscomp models maintain upward compatibility with other Masscomp family members with respect to systems software, architecture, peripherals, networks, communications, and applications. Likewise, the Series 3200 is upwardly binary compatible with other Series 3200 members. Applications developed on one model within a series can be moved to a higher performance system without recompilations or modification. Software moved downward to a lower performance model, however, maintains source-code compatibility. The software will run on the lower performance model but must undergo recompilation and modification.

Product Line Integration. The UNIX-based Masscomp product set and proprietary Series 3200 systems each are distinct products that remain incompatible with one another. Applications moved from the UNIX-based, realtime-oriented RTU to the proprietary OS/32 environment must be reconstructed. Also, any application off-loaded from an OS/32 host and placed on an RTU-based system must be reworked so it can execute. The differences in languages, program development tools, and operating environments require drastic modification and significant rewriting of the applications. Furthermore, Concurrent has not yet supplied a common application set that would allow

➤ The Masscomp 5000/6000 Series serves low-to-midrange performance requirements. Table 2 defines the parameters of each Masscomp 5000/6000 model.

MASS STORAGE

Table 3 describes the disk drives Concurrent offers for the Series 3200 and the Masscomp product line.

INPUT/OUTPUT UNITS

The Series 3200 and Masscomp computers support a range of ASCII-based alphanumeric terminals, graphics workstations, Centronics-compatible printers, and plotters with standard interfaces. The terminal I/O devices Concurrent directly manufactures or OEMs are listed in Table 4 and Table 5. Table 4 describes the terminals and workstations while Table 5 specifies Concurrent's printers.

The Series 3200 also can support industry-standard PCs. Concurrent does not directly make or typically supply PCs; however, it does provide the appropriate PC support needed to interface the PCs with the Series 3200 host. PCs communicate with the host through terminal emulation, file transfer, and application-to-application facilities. They physically attach to the Series 3200 via an asynchronous connection or through Ethernet local area networking.

Concurrent supplies a range of magnetic tape equipment devices for disk backup, archival storage, software distribution, and data collection on the Series 3200 and Masscomp series. The profiles of these devices appear in Table 6.

OTHER PERIPHERALS

Third-party vendors that supply the Series 3200 and Masscomp series computers support various types of special-purpose and vertical market equipment. Available devices include plotters, graphics equipment, data acquisition controllers, laboratory automation equipment, and factory automation equipment.

COMMUNICATIONS CONTROL

The Series 3200 performs asynchronous and synchronous communications with the:

- *Multi-Peripheral Controller (MPC)*—A microprocessor-based, single-card controller that runs asynchronous, synchronous, and bisynchronous protocols across eight RS-232-C full-duplex communications lines. MPC also provides a parallel line printer port capable of supporting line printers with parallel interfaces. Furthermore, the MPC also supports a Loader Storage Unit (LSU) that automatically loads the OS/32 operating system from a secondary storage device.
- *Two-Line Communications Multiplexor Two-Line Comm Mux*—An interface that provides two RS-232-C-based communications lines for asynchronous communications.
- *Eight-Line Communications Multiplexor Eight-Line Comm Mux*—An interface that provides eight asynchronous RS-232-C communications lines.
- *Single Line Synchronous Adapter (SSA)*—An interface that controls synchronous communications across one line that operates in half- or full-duplex mode. ➤

Concurrent Computer Supermini Systems

► easy full-scale networking and communication between the Masscomp models and Series 3200 systems. Presently, the diverse sets of computers can only exchange data through the TCP/IP protocol, but do not yet have full, readily available virtual terminal, resource-sharing, or program-to-program communications capabilities.

Vendor Commitment. Concurrent is greatly concerned about product line integration. The company is working on developing an operating system that would support both the RTU and OS/32 environments and make them compatible. Furthermore, Concurrent is developing a set of language systems, program development tools, and system applications that will be employed across the entire range of Concurrent systems to provide commonality for application porting. Additionally, the networking and communications tools that will transparently interconnect Masscomp and Series 3200 models are also under development. Concurrent expects to complete the product line integration within the next two years.

Besides developing a Concurrent computer series that combines features from the Masscomp series and Series 3200 technologies, Concurrent plans to maintain the development effort for its present product sets. Concurrent intends to give Masscomp customers who wish to remain with the Masscomp line new, fully compatible Masscomp-architecture models that upgrade present Masscomp series capabilities and provide new, price/performance-competitive entry points. Likewise, Concurrent plans to introduce new Series 3200 models that maintain full compatibility with today's Series 3200 so it can accommodate the growth and applications needs of Series 3200 customers who do not wish to switch to the new, upcoming architecture. □

- • *Quad Synchronous Adapter (QSA)*—An interface that controls synchronous communications across one to four lines. Each line can operate individually in either half- or full-duplex mode.
- *Direct Memory Access I/O Subsystem (DIOS)*—A high-performance, intelligent communications controller that provides DMA facilities between main memory and multiple I/O devices, allowing data transfers to take place with no processor intervention. The DIOS supports up to 63 two-wire or 31 four-wire communications devices. For asynchronous devices, the DIOS supports both the two-line and eight-line communications multiplexers. For synchronous or bit synchronous devices, the DIOS supports the SSA and QSA data communications interfaces.
- *Programmable Communication Controller (PROCOM)*—An intelligent downline-loadable controller optimized for data communications with the X.25 protocol. It comes in two versions: a two-port PROCOM that supports two 64K bit-per-second X.25 connections and an eight-port PROCOM that accommodates eight 9.6K bit-per-second connections.

Concurrent 3200s handle Ethernet communications through the *Ethernet Data Link Controller*. The Ethernet Data Link Controller provides the link to the IEEE 802.3-compatible 10M bps Ethernet network and runs the protocols for transmitting data across, and gathering data from, Ethernet. The *Ethernet Terminal Server* connects asynchronous RS-232-

C-compatible devices to the Ethernet local area network. In addition to terminals, the Terminal Server can also interface to minicomputer ports, modems, serial printers, microcomputers, and other devices that are RS-232-C compatible. The Terminal Server contains eight EIA RS-232-C asynchronous ports.

The Masscomp MC5000 and MC6000 computers perform asynchronous and synchronous communications through on-board serial interfaces directly linked with the microprocessor-based CPU and through the I/O bus-resident High Performance Serial Multiplexer (HSPM). The HSPM provides an MC68010 microprocessor with its own on-board device drivers to run asynchronous and synchronous communications across eight independently programmable, full-duplex RS-232-C lines at output rates of 9.6K or 19.2K bits per second (bps).

The Masscomp series computers generate Ethernet communications through an on-board controller or a full-board processor dedicated to Ethernet communications. The microprocessor-based Ethernet controller provides the basic platform for communications through the industry-standard IEEE 802.3-compatible 10M bps Ethernet network and runs the TCP/IP protocols for transmitting and gathering data.

SOFTWARE

The Concurrent Series 3200 primarily runs under the proprietary-based OS/32 operating environment. If there are UNIX requirements, the Series 3200 runs Xelos.

The Masscomp 5000/6000 Series is a UNIX-based system. It runs under Concurrent's RTU operating environment.

OS/32 OPERATING ENVIRONMENT

OPERATING SYSTEM: OS/32 provides a realtime, multitasking, multiprogramming monitor and serves as a real-time base upon which higher level software environments are built. OS/32 supports such software environments as the Multi-Terminal Monitor (MTM) for multiuser, timesharing support; Reliance Plus for transaction processing and relational database management; and PENnet Plus, BSC, or SNA tools for data communications and networking.

OS/32 consists of the OS/32 Executive, OS/32 File Manager, OS/32 Human Interface, and OS/32 Utility Programs. The OS/32 Executive manages the system and coordinates I/O requests for local devices and telecommunications facilities, allocation of memory, and interrupt and fault conditions. The OS/32 File Manager coordinates the use of disk space and controls access to files. The OS/32 Human Interface provides foreground system control over application tasks concurrently with sequential control of a batch processing background. The OS/32 Utility Programs provide a comprehensive set of capabilities for system management and program development.

Up to 255 user tasks can execute concurrently in memory. Task scheduling priorities are user defined. Tasks exist as foreground, user/executive, and background. Tasks at the same priority level are serviced using either round-robin or time-slice scheduling. Configurations can be defined where tasks are rolled to disk or executed virtually.

OS/32 provides dynamic memory allocation—users do not have to allocate partitions for tasks. Memory is allocated to task segments dynamically on a first-come, first-served basis and always selected from the first free area large enough. Once user task space is exhausted, the roll mechanism may be activated. The roll mechanism removes tasks from mem-

Concurrent Computer Supermini Systems

► ory and places them on disk to make space for more urgent tasks. The roll eligibility of a task is a user-defined option when a task is established.

OS/32 contains a virtual task manager. Through this user-transparent capability, multiple user tasks consisting of up to 16M bytes of code and data can execute in a minimum of 128K bytes of user task memory. The virtual memory feature does not require any special user programming: Each user task has access to 16M bytes of logical address space that are automatically paged between disk and the user's working set.

Selection of virtual memory is optional. Virtual memory occurs when a program is passed through the operating system's linkage editor. At virtual memory initialization, the user can select how much real memory is allocated for the execution of the virtual task. Also, the virtual memory capability allows users to employ several memory management methods. The roll-in/roll-out method permits realtime system builders to keep noncritical tasks on secondary storage when those tasks are not needed. The tree-structured, transparent overlay scheme enables highly structured applications to control the swapping of program segments between disk and memory. In addition, virtual demand paging allows the general user to fit a large program into a smaller physical space without regard for program structure.

OS/32 contains flexible control features for the multiprocessor model. For dedicated, realtime applications, the user has complete control over the assignment of tasks to the master CPU and the auxiliary CPUs. OS/32 distributes the processing file management services according to the master CPU and auxiliary CPU assignment of the requesting task. Tasks and processors are individually mappable to task execution queues for optimum performance tailoring. For time-sharing environments, tasks are automatically allocated to any CPU, resulting in transparent load leveling of all tasks within the system. If required, multiprocessor configurations can be set up via operator commands.

The file manager within OS/32 allows user programs to access disk files in a device-independent fashion. Both random and sequential access methods are provided for file types. Files can be protected against unauthorized access through assignment of access privileges and read-write protection keys.

An optional mirrored disk capability is provided by the file manager. This feature permits creation of complete dual images for all user files and critical transactions; the two sets of images are stored on separate disk units. If one disk fails, the system will detect the failure, alert the system operator, and automatically switch to the remaining unit. When the failed unit has been restored, the operator can use system-provided utilities to guide the rate at which the restored drive will reach full synchronization.

OS/32 is controlled by a system operator through a local, interactive system console. Via OS/32MTM, the user can establish a multiterminal environment for concurrent time-sliced program development for up to 64 terminal users.

OPERATING SYSTEM APPLICATIONS: System-level applications are provided for timesharing control and high availability/fault tolerance.

OS/32 Multi-Terminal Monitor (OS/32MTM) is a time-sharing monitor that supports up to 65,535 user accounts and 128 concurrent terminals. The full program development facilities of the OS/32 operating system are available to each interactive terminal user, including the OS/32 command set, the command substitution system, the language processors, and the service utility programs. The virtual memory capability of OS/32 is also available. System ca-

capacity and throughput are maximized by the provision of background batch processing and an I/O spooler.

OS/32MTM allows individual users to operate autonomously, with complete privacy from all other users of the system. In particular, each user can create disk files inaccessible to any other user. MTM also allows cooperating users to define group files accessible to any group member. Passwords, user-access privileges, and audit sign-ons secure the application environment. In addition, the sign-on time or CPU time for individual accounts can be limited to preassigned maximums.

In Concurrent's fault-tolerant Resilient System package, OS/32 combines with a *Reconfiguration Monitor* to ensure resiliency. The Reconfiguration Monitor runs as a continuous task under OS/32. The Resilient System requires Series 3200 computers and redundant hardware; the Reconfiguration Monitor runs in all computers, allowing each to monitor the others for correct responses. Each system can run independently, with separate applications. When a failure occurs, the unaffected system takes control of those programs, environments, and peripheral devices required for total operation. The Reconfiguration Monitor accepts operator commands to reconfigure the system for maintenance with minimal impact on the production environment.

The *Mirror Disk* option, available with the OS/32 file manager, can be employed within a Resilient System configuration.

DATABASE MANAGEMENT SYSTEM: Database management system requirements under OS/32 are met by *Reliance Plus*, a transaction-oriented database management system. Reliance Plus contains all the facilities needed to build and execute a variety of online transaction processing applications, such as those found in the banking, manufacturing, and distribution industries. The integrated components of Reliance Plus include:

- A data dictionary.
- A relational database management system with concurrency control, integrity control, transaction unit handling, access security, automatic database recovery, and data entry validation.
- A transaction processing monitor that handles terminal communications, data presentation, and data flow to and from the database.
- Interfaces to communications and networking gateways.
- A relational query language.
- A nonprocedural language for database updating.
- A database report writer.
- Application design, development, and testing tools.
- A security system for both database and application security.

LANGUAGES: Concurrent provides the following high-level programming languages for the OS/32-based Concurrent Series 3200: Fortran VII, Cobol, Pascal, C, Basic II, Coral 66, Sibol, and RPG II. Assembly-language programming is performed with Concurrent Assembler Language (CAL) and CAL Macro.

COMMUNICATIONS AND NETWORKING: OS/32 supports several data communications languages. Capabilities offered within the OS/32 distributed processing environment include homogeneous networking between Series

Concurrent Computer Supermini Systems

- 3200 models with OS/32 or Xelos; SNA and BSC operations; wide area networking with CCITT- and OSI-compliant X.25 and X.29 facilities; and support for IBM PC-compatible workstations.

PENnet Plus allows 3200 superminis to communicate with other OS/32- or Xelos-based Concurrent systems in local area networks or geographically dispersed network configurations. It supports virtual terminal, file transfer, remote batch, and remote printing. In addition, direct program-to-program communications is supported. IEEE 802.3 Ethernet supports *PENnet Plus* local area networking, and the wide area networking occurs over private or public X.25 packet-switching networks.

PENnet Plus also allows 3200 superminis to interface with diverse systems from other vendors. Via the *Transport Service Programming Interface (TSPI)* and the *X.25 Programming Interface* within *PENnet Plus*, users can implement the data communications and networking application programs which interact with the vendors' packet switch data interface products.

PENnet Plus also allows Series 3200 systems to host distributed MS-DOS-based PCs or a PC network. PC-to-host capabilities include virtual terminal, file transfer, remote batch, remote printing, and direct program-to-program communications. These communications occur over IEEE 802.3 Ethernet or either local or remote asynchronous connections.

IBM mainframe databases and application systems are accessed for interactive and batch jobs through SNA and BSC protocols and applications.

SNA communications capabilities are provided by:

- SNA/3270 Emulator—gives Logical Unit Type 1, 2, and 3 support and enables interactive terminals, printers, or application programs on a 3200 to emulate the capabilities of IBM 3270 terminals.
- SNA/RJE Emulator—makes a Concurrent 3200 appear as a Logical Unit Type 1 3776 RJE (remote job entry/remote batch processing) workstation. Both program interface and device emulation are provided.
- SNA/HCF.
- SNA/DSX.

The BSC/3270 Emulator, BSC/Hasp Emulator, and the BSC 2780/3780 Emulator supply bisynchronous communications. The BSC/3270 Emulator provides facilities identical to those offered by SNA/3270, but over bisynchronous (BSC) lines. The BSC/Hasp Emulator permits a 3200 to emulate the IBM multileaving Hasp RJE workstation. The BSC 2780/3780 Emulator allows 3200s to appear and act as IBM 2780 or 3780 remote job entry terminals.

UTILITIES: The OS/32 Software Package includes all the functional programs necessary to install and run the full facilities of the OS/32 operating system. In addition, the package includes tools for file manipulation, job accounting, performance monitoring, diagnostics, file backup and restore, archive management, library maintenance, and program development.

OFFICE AUTOMATION: *Network Electronic Mail (NEM/32)* permits Reliance database management system users on *PENnet Plus* distributed networks to send mail to other users on the network. *NEM/32* allows mail receipt confirmation, private tray storage, multiple-addressed mail, and broadcast facilities.

PRODUCTION-ORIENTED APPLICATIONS/LINE APPLICATIONS: Series 3200 targets realtime technical, realtime automation and control, and realtime transaction processing environments. Primary target industries include aerospace, automotive, electronics/electrical, telecommunications, military, government scientific, government service, petroleum and mining, chemical, financial services, gaming/wagering, insurance, and health care. Automotive test simulation, robotics, process control, laboratory test data acquisition, medical diagnostics, and geographic information systems are examples of targeted applications. Examples of targeted online transaction processing systems are automated bank teller machine networks, securities trading, inventory tracking, an insurance database system, and a patient information system.

A limited amount of readily available (off-the-shelf) application packages exist for the OS/32 environment. The primary source is third parties, such as original equipment manufacturers (OEMs), system integrators, value-added resellers (VARs), and independent software houses.

XELOS OPERATING ENVIRONMENT

OPERATING SYSTEM: *Xelos* is based on the UNIX System V Release 2 operating system. It contains all the standard System V.2 functions and utilities in addition to Berkeley 4BSD extensions. Proprietary features contained within *Xelos* address the Series 3200 architecture and provide unique programming tools and application environment controls. Despite proprietary extensions, *Xelos* complies with the System V Interface Definition (SVID) standard to give it source-code compatibility with other versions of UNIX that follow the SVID standard.

DATABASE MANAGEMENT SYSTEM: *Xelos* supports the Unify relational database management system, a commodity DBMS from Unify Corporation.

LANGUAGES: *Xelos* supports C, Fortran 77, Cobol, and Unibol.

COMMUNICATIONS AND NETWORKING: Communications and networking under *Xelos* are performed with the UNIX-based *uucp* program set and with a version of Concurrent's *PENnet Plus* communications and networking package.

UTILITIES: Several proprietary system administration tools are provided with *Xelos*. Included are a menu development system, menu-driven system administration tools, and a system accounting application.

LINE APPLICATIONS: Third parties have not written off-the-shelf, production-oriented applications for *Xelos*. *Xelos*, however, is source-code compatible with other versions of UNIX that follow the SVID standard.

RTU OPERATING ENVIRONMENT

OPERATING SYSTEM: *RTU* (Realtime UNIX Operating System), only available for the Masscomp series, provides all the capabilities of industry-standard UNIX combined with Masscomp-developed realtime computing features and proprietary functions. *RTU* remains compatible with UNIX System V and provides system call and library compatibility with Berkeley 4.2BSD. The user can alternate at will between AT&T UNIX System V and Berkeley environments. Once a program is compiled in either universe, it will execute in both without further modification. ►

Concurrent Computer Supermini Systems

► Realtime enhancements include:

- Guaranteed realtime response of 3 ms.
- Fixed priority scheduling
- Provisions for special realtime program priorities
- Memory locking
- Faster interprocess communications
- Faster disk I/O
- Support for high-speed data acquisition

RTU also performs multiprogramming and multitasking within a multiprocessing environment. A single copy of the operating system controls all the CPUs in the architecture. The CPUs are tightly coupled into a configuration where they share memory, I/O, and a single queue of runnable processes. The operating system dynamically controls the work flow to each central processor, or users can dedicate processes to CPUs to accommodate parallel processing. All multiprocessor support is transparent to the programmer and end user.

Other significant UNIX enhancements included within RTU are:

- Floating-point processor and vector processor support.
- Kernel debugger.
- Virtual memory capability of 128M or 3G bytes per process.
- Shared memory regions.
- Contiguous disk files.
- Direct record locking.

LANGUAGES: RTU accommodates C, ANSI-validated Fortran 77, Pascal-2, Common LISP, and Ada.

GRAPHICS SOFTWARE: RTU supports industry-standard and proprietary graphics application development and control software for 2-D graphics, 3-D graphics, and visualization. Included within the graphics software product set are X Window System, Graphical Kernel System (GKS), Graphics Compatibility Library (GCL), MC Graphics, and MC Presentation.

COMMUNICATIONS AND NETWORKING: The Masscomp computers are fluent in several different data communications languages. Protocols and applications included under RTU include:

- IEEE 802.3 Ethernet.
- UNIX uucp program set (e.g., uucp, uux, and cu).
- Berkeley rcp, rsh, and rlogin.
- Network File System.
- TCP/IP.
- DECnet.
- X.25.

UTILITIES: RTU contains AT&T Unix System V, Berkeley 4BSD, and Masscomp-developed utilities for programming, professional support, and system administration.

LINE APPLICATIONS: The Masscomp series targets real-time technical computing, technical graphics, and technical online information systems. VARs, OEMs, system integrators, and independent software houses are the primary sources for applications. Over 250 applications have been developed specifically for Masscomp platforms. The Masscomp systems also have access to application systems that were developed for the open system market. The Masscomp computers accommodate applications written to run on computer systems with AT&T UNIX System V-based operating systems that conform to SVID or with a Berkeley 4BSD-based UNIX. The open system applications, however, will have to undergo some modification to effectively execute on the system.

PRICING AND AVAILABILITY

DISTRIBUTION CHANNELS: The Concurrent systems are marketed and distributed worldwide through Concurrent's direct sales force and indirect sales organizations.

PURCHASE POLICY: Concurrent's general policy is to sell its products. In limited situations, arrangements for leasing can be made. Leasing is provided on three-, four-, and five-year terms. Concurrent does not offer any rental plans.

Discounting is available for direct customers, VARs, and OEMs. The discounts are based on the number of systems purchased. Educational institutions receive discounts in line with the GSA schedule.

Products are warranted for 90 days following installation and acceptance. Purchase warranties for resellers, e.g., VARs and OEMs, begin from the day of shipment.

All software is unbundled and carries a onetime license fee. Terms include installation, a 90-day warranty, and one year of maintenance beginning on the date shipped.

SERVICE AND SUPPORT

HARDWARE MAINTENANCE: Concurrent offers several service options for its equipment. Contracts which provide scheduled preventive maintenance and unscheduled repair during normal business hours can be drawn. Another option allows an organization to contract for a resident customer engineer. Concurrent will also contract service under a limited service addendum which provides minimal preventive and remedial calls within relaxed response times. Also, an organization may contract for the comprehensive service addendum which calls for 95 to 98 percent uptime system availability. Other options include a per-call service and a depot repair service for self-maintenance customers.

SOFTWARE SUPPORT: Besides the standard software maintenance program, Concurrent provides an extended software maintenance service. This service provides telephone support and remote diagnostics.

TRAINING: Training at every level of expertise is provided. Education is priced on a per-student, per-topic basis. Customers receive some educational credits based on the type of system and total purchase price of that system, but will be charged for education desired beyond those credits. ►

Concurrent Computer Supermini Systems



EQUIPMENT PRICES

	<u>Purchase Price (\$)</u>
SERIES 3200 SYSTEMS	
Basic Processor Complex	
3203	
3203 processor with one CPU, 512K bytes of main memory, eight serial ports, one 143M-byte Winchester disk drive, and one streaming cartridge tape drive	19,920
3205	
3205 processor with one CPU, 2M bytes of main memory, eight serial ports, and an alphanumeric display terminal	20,070
3212	
3212 processor with one CPU, 4M bytes of main memory, eight serial ports, and an alphanumeric display terminal	42,000
Micro3200 MicroThree CS	
MicroThree CS processor with one CPU, 8M bytes of main memory, eight serial ports, one 298M-byte Winchester disk drive, and one cartridge tape drive	55,000
Micro3200 MicroFive CS	
MicroFive CS processor with one CPU, 8M bytes of main memory, eight serial ports, one 298M-byte Winchester disk drive, and one cartridge tape drive	80,000
Micro3200 MicroThree ES	
MicroThree ES processor with one CPU, 8M bytes of main memory, eight serial ports, and one alphanumeric display terminal	100,000
Micro3200 MicroFive ES	
MicroFive ES processor with one CPU, 8M bytes of main memory, eight serial ports, and one alphanumeric display terminal	160,000
3280SP	
3280SP processor complex with one CPU, 8M bytes of main memory, 298M-byte Winchester disk drive, one magnetic tape device, and an alphanumeric display terminal	199,500
3280MPS	
3280MPS processor complex with one CPU, 8M bytes of main memory, and an alphanumeric display terminal	265,000
3280E MPS	
3280E MPS processor complex with two CPUs, 8M bytes of main memory, and an alphanumeric display terminal	360,000
MASSCOMP SERIES	
Basic Processor Complex	
MC5450	
MC5450 processor with one CPU, 4M bytes of memory, I/O channel bus, and tabletop packaging	Not specified
MC5450 processor with one CPU, 4M bytes of memory, I/O channel bus, and pedestal packaging	Not specified
MC5550	
MC5550 processor with one CPU, 4M bytes of memory, I/O channel bus, and tabletop packaging	Not specified
MC5550 processor with one CPU, 4M bytes of memory, I/O channel bus, and pedestal packaging	Not specified
MC5550 processor with one CPU, 4M bytes of memory, I/O channel bus, and cabinet packaging	Not specified



Concurrent Computer Supermini Systems

	Purchase Price (\$)
MC5600	
MC5600 processor with one CPU, 4M bytes of memory, I/O channel bus, and tabletop packaging	Not specified
MC5600 processor with one CPU, 4M bytes of memory, I/O channel bus, and pedestal packaging	Not specified
MC5600 processor with one CPU, 4M bytes of memory, I/O channel bus, and cabinet packaging	Not specified
MC5700	
MC5700 processor with one CPU, 4M bytes of memory, I/O channel bus, and cabinet packaging	Not specified
MC6300	
MC6300 processor with one CPU, 8M bytes of memory, I/O channel bus, and pedestal packaging	Not specified
MC6400	
MC6400 processor with one CPU, 8M bytes of memory, I/O channel bus, and tabletop packaging	Not specified
MC6400 processor with one CPU, 8M bytes of memory, I/O channel bus, and cabinet packaging	Not specified
MC6350	
MC6350 processor with one CPU, 8M bytes of memory, I/O channel bus, and pedestal packaging	Not specified
MC6450	
MC6450 processor with one CPU, 8M bytes of memory, I/O channel bus, and tabletop packaging	Not specified
MC6450 processor with one CPU, 8M bytes of memory, I/O channel bus, and cabinet packaging	Not specified
MC6600	
MC6600 processor with one CPU, 8M bytes of memory, I/O channel bus, and tabletop packaging	Not specified
MC6600 processor with one CPU, 8M bytes of memory, I/O channel bus, and pedestal packaging	Not specified
MC6600 processor with one CPU, 8M bytes of memory, I/O channel bus, and cabinet packaging	Not specified
MC6700	
MC6700 processor with two CPUs, 8M bytes of memory, I/O channel bus, and cabinet packaging	Not specified
MC6650	
MC6650 processor with one CPU, 8M bytes of memory, I/O channel bus, and tabletop packaging	Not specified
MC6650 processor with one CPU, 8M bytes of memory, I/O channel bus, and pedestal packaging	Not specified
MC6650 processor with one CPU, 8M bytes of memory, I/O channel bus, and cabinet packaging	Not specified
MC6750	
MC6750 processor with two CPUs, 8M bytes of memory, I/O channel bus, and cabinet packaging	Not specified

MASS STORAGE OPTIONS

Devices for Series 3200

143M-byte Winchester drive	9,200
271M-byte Winchester disk drive	10,200
298M-byte disk drive	11,100
699M-byte Winchester disk drive	17,000
1G-byte Winchester disk drive	29,500

Devices for Masscomp Series

142M-byte Winchester disk drive	Not specified
319M-byte Winchester disk drive	Not specified
278M-byte Winchester disk drive	Not specified
568M-byte Winchester disk drive	Not specified

MAGNETIC TAPE

Devices for Series 3200

0.25-inch streaming cartridge tape drive	2,100
0.5-inch 1600 bpi PE, 100-ips streaming magnetic tape drive	9,900
0.5-inch 1600 bpi PE/6250 bpi GCR 75-ips streaming magnetic tape drive	18,500
First drive within the tri-density, 125-ips magnetic tape subsystem; includes controller and formatter	49,500

Concurrent Computer Supermini Systems



	<u>Purchase Price (\$)</u>
Devices for Masscomp Series	
0.25-inch, 90-ips streaming cartridge tape drive	Not specified
0.5-inch 1600 bpi PE/6250 bpi GCR 75-ips streaming magnetic tape drive	Not specified
0.5-inch 1600 bpi PE 100-ips streaming magnetic tape drive	

TERMINALS

6312 alphanumeric display terminal	795
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PRINTERS

300-lpm band line printer	9,000
600-lpm band line printer	15,000
1,200-lpm band line printer	29,900
180 cps desktop dot matrix printer	
300-lpm floorstanding line matrix printer	

COMMUNICATIONS EQUIPMENT

Devices for Series 3200

Ethernet Data Link Controller	4,070
Ethernet terminal server host end package	6,050
Ethernet terminal server package	6,050
Ethernet terminal server host end package	5,280
Ethernet terminal server terminal expansion package	5,280
DMA I/O subsystem (DIOS)	7,750
1-line synchronous adapter	1,820
4-line synchronous adapter	2,541
2-line communications multiplexer	1,090
8-line communications multiplexer	2,640
2-port communications processor	4,000
8-port communications processor	6,000

Devices for Masscomp Series

Ethernet data link controller	Not specified
8-port serial communications multiplexer	Not specified

SOFTWARE PRICES

	Tier 1 License Fee (\$)	Tier 2 License Fee (\$)	Tier 3 License Fee (\$)	Tier 4 License Fee (\$)
OS/32 Environment				
OS/32	1,900	4,900	9,800	12,100
OS/32 MTM	400	2,100	4,600	5,600
Mirror Disk	4,000	4,000	4,000	4,000
Resilient System	—	—	—	15,000
Fortran-language system	4,850	9,700	15,000	16,500
Fortran VII compiler	1,100	2,200	3,400	3,740
Reliance Plus	6,900	18,900	34,580	38,870
Reliance DBMS	4,600	12,600	23,010	25,870
Reliance Monitor	200	200	200	200
Reliance Builder	7,900	18,900	23,900	27,900
Reliance Access	2,300	6,300	8,800	9,970
Cobol	1,700	4,275	5,600	—
PENnet Plus	3,350	6,250	9,600	13,200
BSC/3270 Emulation	1,800	3,400	5,200	7,150
SNA/RJE Emulation	1,800	3,400	5,200	7,150
SNA/3270 Emulation	1,800	3,400	5,200	7,150