

AT&T 3B Computer Family

MANAGEMENT SUMMARY

Nineteen eighty-four has been a watershed year for AT&T. Not only has the company endured the final breakup of the old Western Electric/Bell conglomerate; it has also made its first foray into the market for general-purpose computer systems with the Unix-based 3B Computer family, a seven-member grouping of 32-bit systems that runs the gamut from desktop supermicro to fault tolerant supermini. Drawing upon its experience in communications, the company has also introduced several networking products—both hardware and software—that permit interconnection among 3B systems and those from other manufacturers.

The 3B family is divided into three subgroups. The first consists of the 3B2/300 supermicro. The second is the 3B5 grouping of mid-range superminis: 3B5/100, 3B5/200, and 3B5/300. The third is the 3B20 series, comprising the 3B20S, 3B20A, and 3B20D—three high-end superminis. Prior to being made available on the open market, the three groups of systems had been used internally at AT&T. All systems except the 3B20D run AT&T's Unix System V operating system; the 3B20D runs Unix RTR (Real Time Reliable), which incorporates the principal features of System V with extensions for realtime, fault tolerant processing.

The 3B Computers are manufactured by AT&T's Technology Systems Division, but are sold to end users through AT&T Information Systems (ATTIS). (Under AT&T's current structure, Technology Systems sells directly only to Value Added Resellers (VARs) and OEMs, not to end users.) The 3B2/300 and 3B5/300 are directly available from ATTIS, while the others may be obtained through ATTIS on a "special assembly" (that is, special request) basis. (According to ATTIS, the 3B5/100 and 3B5/200 will be directly available early in 1985.)

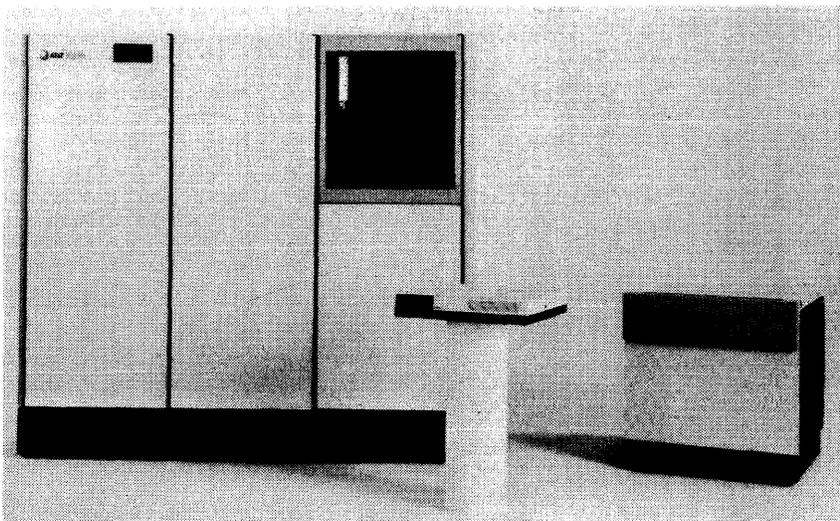
The seven members of AT&T's 3B Computer family run the gamut from desktop multiuser supermicro to fault tolerant supermini. The systems are targeted toward a range of applications, especially custom applications and distributed processing. All systems run versions of Bell Laboratories' Unix operating system. A variety of networking products provide communications among both 3B systems and Unix-based and non-Unix-based computers from other vendors.

MODELS: 3B2/300; 3B5/100, 3B5/200, and 3B5/300; 3B20S, 3B20A, and 3B20D.
MEMORY: 512KB to 16MB.
DISK CAPACITY: 10MB to 10.5GB.
WORKSTATIONS: Up to 18 on the 3B2/300; up to 40 on the 3B5/100; up to 60 on the 3B5/200 and 3B5/300; up to 256 on the 3B20S, 3B20A, and 3B20D.
PRICE: \$9,950-\$340,000 (base system prices).

CHARACTERISTICS

MANUFACTURER: The 3B Computers are manufactured by AT&T's Technology Systems Division, but are sold to end users through AT&T Information Systems, 1 Speedwell Avenue, Morristown, NJ 07690. Telephone (800) 247-7000.

CANADIAN ADDRESS: AT&T Canada, Inc., 1500 Don Mills Road, Suite 500, Don Mills, Ontario, M3B 3K4, Canada. Telephone (416) 449-4300.



AT&T's line of 32-bit, Unix-based 3B Computers ranges from desktop supermicro to fault tolerant supermini. The 3B20S (left) is a high-end supermini that supports up to 16MB of main memory and 256 workstations. The 3B2/300 (center) is a supermicro for single-user and multiuser applications; it can support up to 18 workstations. The 3B5 processor (right) is a mid-range supermini based, like the 3B2/300, on AT&T's WE 32000 series of microprocessors; the 3B5 is available in three models.

AT&T 3B Computer Family

CHART A. SYSTEM COMPARISON

MODEL	3B2/300	3B5/100	3B5/200	3B5/300
SYSTEM CHARACTERISTICS				
Date of introduction	March 1984	March 1984	March 1984	June 1984
Date of first delivery	March 1984	March 1984	March 1984	June 1984
Operating system	Unix System V	Unix System V	Unix System V	Unix System V
Upgradable from	Not applicable	Not applicable	3B5/100	Not applicable
Upgradable to	Not applicable	3B5/200	Not applicable	Not applicable
MIPS	0.5	0.6	0.8	0.8
Relative performance (based on a rating of the 3B20S at 1.0)	0.5	0.6	0.8	0.8
MEMORY				
Minimum capacity, bytes	512K	1M	2M	1M
Maximum capacity, bytes	2M	8M	8M	8M
Type	DPDRAM	DRAM	DRAM	DRAM
Cache memory	Not applicable	8KB	8KB	8KB
Cycle time, nanoseconds	560	500	500	500
Bytes fetched per cycle	4	—	—	—
INPUT/OUTPUT CONTROL				
Number of channels	4	—	25	—
High-speed buses	CPU-RAM	—	—	—
Low-speed buses	CPU-I/O	—	—	—
MINIMUM DISK STORAGE				
	10MB	40MB	40MB	134MB
MAXIMUM DISK STORAGE				
	32MB	1.1GB	2.2GB	2.2GB
NUMBER OF WORKSTATIONS				
	18	40	60	60
COMMUNICATIONS PROTOCOLS				
	Async, 3BNet, Omninet, Ethernet, TTY, ISN	Async, Sync, TTY, RJE, 3BNet, Ether- net, ISN, UUCP	Async, Sync, TTY, RJE, 3BNet, Ether- net, ISN, UUCP	Async, Sync, TTY, RJE, 3BNet, Ether- net, ISN, UUCP

Note: A dash (—) in a column indicates that the information is unavailable from the vendor.

➤ The 3B2/300 is based on AT&T's WE 32000 microprocessor and is intended for use in office, laboratory, and manufacturing plant environments. It features a single-board CPU and can support from 512KB to 2MB of plug-in memory. The system board includes two asynchronous RS-232-C serial I/O ports; four feature card slots in the 3B2/300 allow configuration of up to four I/O expansion cards, each of which adds four more RS-232-C ports and a parallel peripheral port. The 3B2/300 can be used as either a single-user or multiuser system; it can support up to six concurrently active users (although up to 18 workstations can be configured). The 3B2/300 supports either a 10MB or a 32MB Winchester disk drive.

The 3B2/300 is offered in three configurations. Each has the same core hardware and firmware, including cabinetry, cabling, system board, Unix System V core software and standard utilities, system and user documentation, and a 720KB floppy disk drive. The basic configuration comes with 512KB of main memory and a 10MB Winchester disk. The standard configuration includes 1MB of memory and a 32MB Winchester disk. The expanded standard configuration includes 1MB of main memory, a 32MB Winchester disk, and an expansion I/O feature card that provides four additional serial ports and a parallel peripheral port. Main memory, I/O, terminal, and printer options can be added to the core configurations.

The three 3B5 systems are directed toward office automation, business information processing, operations support, and communications. The 3B5/100, 3B5/200, and 3B5/300 CPUs are based on the WE 32000 microprocessor. The ➤

➤ DATA FORMATS

BASIC UNIT: 32-bit word.

FIXED POINT OPERANDS: On 3B20 systems, integers can be 8 bits, 16 bits, 32 bits, or 64 bits. All have the same format; the high-order bit is used as the sign. On 3B5 and 3B2 systems, data are read or written in word (32-bit), halfword (16-bit), or byte (8-bit) lengths. Bytes and halfwords are automatically expanded to 32-bit words for processing.

FLOATING POINT OPERANDS: The 3B20 systems accommodate both single-precision (4-byte) and double-precision (8-byte) formats; in both formats, the high-order bit is the sign. Single-precision fractions are 23 bits long and the exponent is 8 bits long; double-precision fractions are 52 bits in length, with the exponent 11 bits long.

Optional with the 3B20S and 3B20A computers is a Floating Point Accelerator that, according to AT&T, increases floating point performance by a factor of three.

INSTRUCTIONS: The 3B20 computers employ 13 instruction types: Arithmetic; Function Call; Dual Serial Channel I/O; Special I/O; Field; Serial Channel I/O; Jump; Logical; Miscellaneous; Maintenance Channel; PSI-ACHI; Special; and Floating Point.

The instructions for the 3B5 and 3B2 systems are divided into the following functional groups:

- Data Transfer instructions, which copy data to and from registers and memory. These instructions include move and swap for byte, halfword, and word values; move a block of words; extract or insert a field; and string operations. ➤

AT&T 3B Computer Family

CHART A. SYSTEM COMPARISON (Continued)

MODEL	3B20S	3B20A	3B20D
SYSTEM CHARACTERISTICS			
Date of introduction	March 1984	March 1984	March 1984
Date of first delivery	March 1984	March 1984	March 1984
Operating system	Unix System V	Unix System V	Unix RTR
Upgradable from	Not applicable	3B20S	Not applicable
Upgradable to	3B20A	Not applicable	Not applicable
MIPS	1.0	1.5-1.8	0.9
Relative performance (based on a rating of the 3B20S at 1.0)	1.0	1.5-1.8	0.9
MEMORY			
Minimum capacity, bytes	2M	2M (each CPU)	5M
Maximum capacity, bytes	16M	16M (each CPU)	16M
Type	DRAM	DRAM	DRAM
Cache memory	8KB	8KB (each CPU)	8KB (optional)
Cycle time, nanoseconds	400	400	400 (with cache)
Bytes fetched per cycle	4	4	4
INPUT/OUTPUT CONTROL			
Number of channels	—	—	2
High-speed buses	—	—	Proprietary
Low-speed buses	—	—	Proprietary
MINIMUM DISK STORAGE			
MAXIMUM DISK STORAGE			
NUMBER OF WORKSTATIONS			
COMMUNICATIONS PROTOCOLS			
	256MB	256MB	279MB
	8.8GB	8.8GB	10.5GB (unformatted)
	256	256	256
	Async, Sync, X.25, HDLC, RJE, 3BNet, Ethernet, Hyperchannel, ISN, UUCP, DDCMP	Async, Sync, X.25, HDLC, RJE, 3BNet, Ethernet, Hyperchannel, ISN, UUCP, DDCMP	Async, Sync, X.25, HDLC, RJE, ISN, Ethernet, Hyperchannel, UUCP, DDCMP

Note: A dash (—) in a column indicates that the information is unavailable from the vendor.

➤ 3B5/100 has a 7.2MHz CPU, while the higher-speed 3B5/200 and 3B5/300 have 10MHz processors. Each CPU includes an 8KB cache memory. The 3B5/100 and 3B5/300 both support from 1MB to 8MB of main memory, while the 3B5/200 supports from 2MB to 8MB. The 3B5/100 supports up to 1.1GB of disk storage; the 3B5/200 and 3B5/300 each support up to 2.2GB. The 3B5/100 can support attachment of up to 40 workstations, and the 3B5/200 and 3B5/300 can support up to 60 stations; depending upon the application, the optimal number of concurrently active users is about 24. The 3B5/100 can be upgraded to a 3B5/200 (although not to a 3B5/300 because of differences in packaging).

The 3B5/100 and 3B5/200 are available in four and three packaged configurations, respectively; each has a specific disk or tape storage option. These configurations can be expanded with additional disk storage, I/O, and communications options. The 3B5/300 is available in 12 preconfigured packages, each of which contains the following core components: a 10MHz CPU; a 1MB main memory module; a basic processor cabinet; an Intelligent Tape Controller and 9-track tape drive; a Growth Control Unit; an Integrated Disk File Controller; a Storage Module Drive Controller; cabling; and the Unix System V operating system. Each 3B5/300 package also includes a combination of fixed disk storage devices, I/O, and communications options.

Although the 3B5/300 largely shares the characteristics of the 3B2/300, it differs from that system and from the 3B5/100 in its physical packaging. The 3B5/100 and 3B5/200 employ a mixture of horizontal and vertical sys-

- • Arithmetic instructions, which perform arithmetic operations on one, two, or three operands. Operations include add, subtract, increment, decrement, multiply, divide, module (remainder of a division operation), and arithmetic shift (right or left).
- Logical instructions, which perform a logical operation on one, two, or three operands. Operations include AND, XOR (exclusive OR), OR, compare, test, clear, rotate, and logical shift (left or right).

The 3B2 and 3B5 systems also use unique instructions. Program control instructions (branch, jump, return) provide different levels of execution privilege by allowing alteration in the sequence in which instructions are executed. Priority interrupt and exception handling instructions permit the processor to establish an environment in which other processes can take control of the microprocessor. Memory management instructions provide relocation and protection capabilities.

INTERNAL CODE: ASCII for text-oriented data; binary for calculations.

MAIN STORAGE

TYPE: Dynamic Random Access Memory (DRAM) for the 3B20 and 3B5 computers; Dual Port DRAM (DPDRAM) for the 3B2/300.

CYCLE TIME: 400 nanoseconds for the 3B20 systems (cache-enabled on the 3B20D); 500 nanoseconds for the 3B5s; and 560 nanoseconds for the 3B2.

CAPACITY: Main memory capacities on the 3B Computers range from 512KB to 16MB. Refer to Chart A for the memory capacities of specific models.

The main memory unit on the 3B20S and 3B20A consists of the memory controller and from 2 to 16MB of memory per

AT&T 3B Computer Family

CHART B. MASS STORAGE

MODEL	10MB	32MB	48MB Lark II	160MB FSD
Type	Winchester	Winchester	Fixed/Removable	Fixed
Controller model	Integral (ST506)	Integral (ST506)	Local bus	Local bus
Drives per subsystem/controller	2	2	2 (SMDC) or 4 (IDFC)	2 (SMDC) or 4 (IDFC)
Formatted capacity per drive, megabytes	10	32	20F/20R	134
Number of usable surfaces	4	5	3	10
Number of sectors or tracks per surface	1,224 tracks	697 tracks	—	—
Bytes per sector or track	512/sector	512/sector	512/sector	512/sector
Average seek time	76.7 ms	45 ms	35 ms	30 ms
Average rotational/relay time	8.3 ms	8.3 ms	8.5 ms	8.3 ms
Average access time	85 ms	53.3 ms	43.5 ms	38.3 ms
Data transfer rate	5M bps	5M bps	—	1.209MB/sec.
Supported by system models	3B2/300	3B2/300	3B5/100, 3B5/200	3B5/100, 3B5/200, 3B5/300

CHART B. MASS STORAGE (Continued)

MODEL	300MB	340MB	675MB
Type	Removable	Winchester	Winchester
Controller model	DFC	DFC/local bus	DFC
Drives per subsystem/controller	8	8	8
Formatted capacity per drive, megabytes	256	279	550
Number of usable surfaces	19	24	40
Number of sectors or tracks per surface	823 tracks	711 tracks	823 tracks
Bytes per sector or track	512/sector	512/sector	512/sector
Average seek time	30 ms	20 ms	30 ms
Average rotational/relay time	8.3 ms	8.4 ms	8.3 ms
Average access time	38.3 ms	28.4 ms	38.3 ms
Data transfer rate	1.2MB/sec.	1.2MB/sec.	1.2MB/sec.
Supported by system models	3B20S/3B20A	All 3B20 and 3B5	3B20S/3B20A

Note: A dash (—) in a column indicates that the information is unavailable from the vendor.

tem, growth, and storage cabinetry. In addition to their system cabinets, the 3B5/100 and 3B5/200 can support a horizontal growth cabinet, a vertical disk drive cabinet, and a tape drive cabinet. Either storage cabinet can be placed on top of the system cabinet or the growth cabinet. The 3B5/300, designed more for office environments, consolidates the cabinetry. Its components are housed in a single cabinet 67.5 inches high, 31¼ inches wide, and 28 inches deep; a growth cabinet of the same dimensions can be added.

The 3B20 computers are designed for high-volume applications. All 3B20 processors employ the bit-slice-based 3B20S processor in various permutations. CPU functions on the 3B20S are handled through the Central Control complex. The Central Control handles logic, control, and arithmetic processes; it is microprogrammed, using both 2K of ROM and an 8K writable microstore. The Central Control also includes a data manipulation unit with an address translation mechanism that provides virtual addressing; the data manipulation unit is duplicated, and all arithmetic operations are matched. Main memory on the 3B20S computer ranges from 2MB to 16MB; it can be expanded in 1MB increments. The main memory is complemented by an 8KB cache memory. The 3B20S can support up to 8.8GB of on-line disk storage. Up to 256 terminals can be configured; the optimal number of simultaneous users is between 48 and 64.

► CPU. For the 3B20A, duplicate copies of main memory are maintained in each of the system's dual processors; the maximum amount of addressable memory is 16MB. The duplicate copies of memory increase the memory bandwidth by allowing each processor to read memory simultaneously.

CHECKING: In 3B20 systems, each 32-bit word in main storage is divided into four 8-bit bytes; each byte has an associated parity bit. The four parity bits are modified and combined with four additional Hamming bits make up a modified 8-bit form of the Hamming code. During memory read operations, the main store controller uses this code to check for and correct all single bit errors and to identify double and detectable multibit errors. During each memory refresh cycle (every 8 microseconds), the main store is checked for bad parity. If bad parity is detected, an error signal is generated to the central processor.

In 3B5 systems, Hamming codes are used for double-bit error detection and single-bit error correction.

► **STORAGE PROTECTION:** The 3B20 computers use a 24-bit virtual address and support a segmented-paged memory management scheme. Each system provides 16MB of virtual address space. The memory manager, in conjunction with the operating system, automatically controls mapping, scheduling, and swapping the required processes into and out of main memory or peripheral storage devices; several processes are allowed to share the memory on a segment basis. The main store on 3B20 systems performs maintenance plus three types of memory operations: read, write, and read-and-clear. The main store of both 3B20D CPUs are normally updated simultaneously to ensure that the off-line processor can take over operations at any time.

AT&T 3B Computer Family

➤ The 3B20A is a symmetrical multiprocessor version of the 3B20S; it offers from 1.5 to 1.8 times the performance of the single-processor system. The 3B20A comprises the 3B20S and an attached processor unit; the two units process in parallel. Both the primary and the attached processors perform operating system calls. Both execute scheduling routines from a single job queue. Input/output functions are handled by the primary processor, however, and both processors execute different jobs. Like the primary 3B20S processor, the auxiliary processor features 8K of writable microstore.

The 3B20A supports from 2MB to 16MB of main memory in each processor; however, the maximum amount of addressable memory is 16MB, because duplicate copies are kept. The duplicate copies of memory increase the memory bandwidth by allowing each processor to read memory simultaneously. The 3B20A supports the same amount of disk and the same number of workstations as the single-processor system. The 3B20A is available as a separate system or as an upgrade for the 3B20S.

The 3B20S and 3B20A are available in three core systems each. The systems are differentiated by the types of disk and tape devices supported. Each core system is a functional system that includes a tape drive, a disk drive, an operator console, and an eight-port asynchronous controller. Each package includes a set of options. Tape drives, Input/Output Processors, and Disk File Controllers are specific to each core system; their locations in the cabinet differ according to the core system. Options common to all core systems include additional memory, printers, disk drives and cabling, co-location cabling, and communications interfaces.

According to AT&T, the 3B20S and 3B20A are designed for applications such as office services, software development, and manufacturing.

The 3B20D is a fault tolerant, duplex version of the 3B20S intended for banking, reservations, financial services, and other commercial transaction processing applications; according to AT&T, it can also be used in command and control applications.

In the 3B20D, a hot standby is used for each major unit, including the CPU, main memory, disk controllers, disks, and I/O processors; all disk volumes are mirrored. Circuits for all major functional units are replicated, and output from the circuits is continually monitored for disagreement.

The 3B20D features dual processors connected through an interprocessor channel; if one fails, the other continues processing while performing a diagnosis of the failed unit. The system's standard microcode can run the complete complement of system software; additional microstore is available for applications requiring emulation or special-purpose instructions.

➤ In the 3B5 computers, memory management logic divides memory into 512- or 2048-byte pages. The 3B5 systems are also equipped with read and write protection of system and user files.

Memory protection in the 3B2/300 is achieved through per-byte parity. The system's address bus provides up to 4GB of virtual address space.

RESERVED STORAGE: The minimum reserved storage in 3B5 systems is 512KB for the Unix kernel and drivers; disk buffer cache requires an additional 512KB-1MB. Minimum memory required for the Unix kernel and drivers on the 3B2/300 is about 300KB.

CACHE MEMORY: The 3B20S and 3B5 computers all feature a standard 8KB cache; each processor of the dual-processor 3B20A also contains an 8KB cache. An 8KB cache is optional on the 3B20D.

CENTRAL PROCESSOR

GENERAL: All 3B20 processors employ the bit-slice-based 3B20S processor in various permutations. The central processor (also called the central control) of the 3B20 computers comprises the following subunits:

- The microcontroller, which provides sequencing and control of the instructions executed from control storage.
- Control storage, a microprogrammed processor with 10KB of microstore, of which 2KB is read-only memory (ROM) containing a series of microinstructions that directs such systems activities as booting. An additional 8KB writable microstore is used to store microinstructions that form the machine instruction set, microsequences, special diagnostic microcode, and control unit sequences.
- Main store update unit, controlling access to the main store. This bidirectional unit receives main store access requests and controls the order in which the requesting units receive access to main storage.
- Cache store, which comprises the cache controller and cache memory and allows bypassing of the main store for frequently used memory locations.
- Data manipulation unit, which includes the arithmetic logic unit and general registers for the central control.
- Special registers used by hardware and software for special functions, such as maintenance access, self-checking, time-of-day clock, and interrupt source register.
- Store data controller, store address controller, and store address translator, which maintain control of virtual memory addressing and of all data and address transfers in and out of central control
- Maintenance channel interface, which provides the diagnostic processor with maintenance and recovery access to the central control.
- Power converters, which convert DC power from the power conditioning cabinet to the logic levels required in the central control.
- Power control and monitor, which provides for display of power and alarm states, out-of-service requests, and command of control unit power.

➤ The 3B20 central control interfaces with the main store and direct memory access unit through internal processor buses. ➤

AT&T 3B Computer Family

CHART C. WORKSTATIONS

MODEL	Dataspeed 4410/ Teletype 5410	Dataspeed 4415/ Teletype 5420	Dataspeed 4420	Teletype 5620	BCT 513
DISPLAY PARAMETERS					
Max. chars./screen	1920 or 3168	1920 or 3168	1920	800 x 1024 resolution	3168
Buffer capacity	1 page	3 pages	3 pages	256KB or 1MB	3 pages
Screen size (lines x chars.)	24 x 80 or 132	24 x 80 or 132	24 x 80	70 x 88	24 x 80 or 132
Tilt/swivel screen	Tilt standard	Tilt standard	Tilt standard	Not applicable	Tilt standard
Symbol formation	5x7/7x9 dot-matrix	5x7/7x9 dot-matrix	5x7/7x9 dot-matrix	Not applicable	5x7/7x9 dot-matrix
Character phosphor	White, green, or amber	White	White	Green	White
Total colors/no. simult. displayed	Not applicable	Not applicable	Not applicable	—	Not applicable
KEYBOARD PARAMETERS					
Style	Typewriter	Typewriter	Typewriter	Typewriter	Typewriter
Character/code set	128 ASCII	128 ASCII	128 ASCII	ANSI 3.64	128 ASCII
Detachable	Yes	Yes	Yes	Yes	Yes
Program function keys	8 standard	8 standard (16 functions)	None	8 standard	15 fixed- character sequence keys std.
TERMINAL INTERFACE	RS-232-C	RS-232-C	RS-232-C	RS-232-C	RS-232-C
COMMENTS	Integrated autodial modem avail.	Dot-mapped		Dot-mapped display (DMD) terminal	

Note: A dash (-) in a column indicates that the information is unavailable from the vendor.

➤ The 3B20D supports from 5MB to 16MB of main memory. According to AT&T, the 3B20D also supports up to 10.5GB of on-line disk storage. (The figure quoted is for unformatted storage). Up to 256 workstations can be attached; the optimal number of concurrently active users is between 48 and 64.

The 3B20D is available in a single core package whose major components are two CPUs, 5MB of main memory, an IOP, a DMA controller, a dual serial channel, two 340MB Winchester disks (unformatted capacity), a 9-track, 1600 bpi tape unit, and a color video maintenance terminal and controller. Additional disk drives, tape drives, and other options can be added.

To connect the 3B Computers to both AT&T systems and those from other vendors, AT&T offers three principal networking products: 3BNet, Information Systems Network (ISN), and PC Interface.

3BNet is a high-speed local area network that provides file-transfer facilities for 3B2/300, 3B5, and 3B20A and 3B20S systems operating within an area of over 540 yards (500 meters). The network operates at a transmission rate of 10M bits per second over coaxial cable and is intelligent, using WE 32000-microprocessor-based interfaces to deload all protocol, flow control, and maintenance overhead from attached host computers. The 3BNet is Ethernet-compatible, permitting connection of 3Bs to computers and peripherals supporting the Ethernet standard. 3BNet employs the Carrier Sense Multiple Access/Collision Detection (CSMA/CD) communications scheme.

The 3BNet network allows users to select packet sizes (up to 4096 bytes on the 3B20S, the 3B20A, and the 3B5s, and up to 1500 bytes on the 3B2/300). It also provides centralized administration with automatic backup, so users can

➤ The 3B20D is a fault tolerant, duplex version of the 3B20S. A hot standby is used for each major unit, including the CPU, main memory, disk controllers, disks, and I/O processors; all disk volumes are mirrored. Circuits for all major functional units are replicated, and output from the circuits is continually monitored for disagreement.

The 3B20D features dual processors connected through an interprocessor channel; if one fails, the other continues processing while performing a diagnosis of the failed unit. The system's standard microcode can run the complete complement of system software; additional microstore is available for applications requiring emulation or special-purpose instructions.

The 3B20S and 3B20A CPUs are powered from batteries continually charged through the AC source, permitting the systems to resist power fluctuations that would otherwise cause them to fail. During a power outage, the batteries can power the processor for 10 minutes. If power is restored during that period, disk and tape I/O queued during the outage are completed and normal system operation continues. If commercial power is not restored within 10 minutes, the remaining battery power shuts the computer down.

The 3B20D can be supplied with an optional battery backup and uninterruptible power to protect it from commercial power outages. That battery backup unit is capable of running the system's 340MB disk drives for full processing while backup is in effect.

The 3B20S and 3B20A processors feature two diagnostic modes—on-line and off-line. On-line diagnostics are executed under control of the Unix System V operating system. For off-line diagnostics, code is executed in a special-purpose diagnostic processor. The diagnostic routines for the 3B20D run under the Unix RTR operating system, and are run automatically on a routine basis. They are requested automatically on units removed from or left out of service. Any diagnostic can be requested manually through input messages. The 3B20D does not require a diagnostic processor, because one CPU diagnoses the other.

➤ The processors used in the 3B5 and 3B2/300 computers are based on the WE 32000 microprocessor. It has a 32-bit data

AT&T 3B Computer Family

CHART D. PRINTERS

MODEL	Teletype 5310	Teletype 5320	Model 455	Model 460	Model 470
Type	Dot-matrix	Dot-matrix	Daisywheel	Dot-matrix	Dot-matrix
Speed	200 cps	200 cps	55 cps	240 cps	120 cps
Bidirectional printing	Yes	Yes	Yes	Yes	Yes
Paper size	Up to 9.5 in. wide	Up to 9.5 in. wide	Up to 15 in. wide	3-16 in. wide, 3-14 in. long	4.5 to 11 in. wide
Character formation	7 x 9 dot-matrix	7 x 9 dot-matrix	Full	7 x 7 dot-matrix	9 x 9 dot-matrix
Horizontal character spacing (char./inch)	Variable	Variable	10 or 12	10-16.7	Variable
Vertical line spacing (lines/inch)	Variable	Variable	Variable	6-8	Variable
Character set	96 ASCII plus APL	96 ASCII plus APL	ASCII	ASCII or EBCDIC	ASCII or AT&T proprietary
Controller/Interface	RS-232-C, EIA CCITT	RS-232-C, EIA CCITT	RS-232-C, IBM and Centronics parallel	EIA RS-232-C, SSI	Parallel
No. of printers per controller/interface	—	—	—	—	—
Printer dimensions, in. (h x w x d)	5.5 x 16.0 x 14.4	5.5 x 21.2 x 14.4	7.13 x 24.5 x 15.5	8.4 x 26.4 x 23.9	5.35 x 15.6 x 11.22
Graphics capability	Yes	Yes	No	No	Yes

Note: A dash (—) in a column indicates that the information is unavailable from the vendor.

▷ monitor and configure the network from a single terminal. 3BNet operates in conjunction with a package of network services contained in the 3B systems' Unix operating systems, allowing users to move data among machines and set network security. The 3BNet network allows configuration of up to 100 nodes. Up to 30 nodes can be 3B20S, 3B20A, or 3B5 systems; the rest can be 3B2/300s.

Information Systems Network (ISN) is AT&T Information Systems' proprietary local area network for building complexes and campuses; it permits networking of 3B family systems and computers from other manufacturers. ISN is based on a short, centralized bus architecture incorporating attributes of star networks, distributed buses, and distributed token rings.

The components of ISN include: a packet controller that contains a high-speed, hardware-based packet switch for virtual circuit data transport, features an 8.64M bps bus transmission speed, and serves up to 1920 ports; a control console for system initialization and administration; and concentrators that statistically multiplex up to 40 EIA device ports to the packet controller through an optical fiber pair with an 8.64M bps transmission rate.

The ISN can use both fiber optic and four-twisted-pair copper wire distribution cables. The copper wires link terminals or host computers, AT&T personal computers, and similar devices directly to the packet controller or to concentrators. The optical fibers form the backbone of the system, carrying multiplexed data between packet controllers and host computers, between packet controllers and concentrators, and among multiple packet controllers. ISN supports multiplexed fiber optic interfaces to DEC VAX-11 systems running under Unix System V. It can also be interconnected to AT&T's System 75 and System 85 PBXs.

PC Interface, a software product supported by the 3B2/300, is a hardware/software link that interconnects the 3B2/300 to personal computers running the MS-DOS operating system. PC Interface allows multiple PCs to share files and peripherals on a central 3B2/300 running Unix System V. Files can be transferred back and forth from PCs to 3B2/300 systems; all necessary translations are performed ▷

▷ and address bus. The clock rate for the central control processor is 7.2MHz in the Model 100 with an option to upgrade to the 10.0MHz that is standard in the Model 200 and Model 300. The 3B2/300 CPU, located on the system board, has a clock rate of 7.2MHz.

The WE 32000-based CPUs include the following components:

- Sixteen 32-bit registers for processor and programmer use.
- An Address Arithmetic Unit (AAU) that computes addresses and extracts data from instructions.
- A 33-bit Arithmetic Logic Unit (ALU) that performs arithmetic and logic operations.
- A 32-bit barrel switch that performs shift, rotate, and mask operations.
- 170 opcodes implemented in on-chip Programmable Logic Array (PLA), a procedure linkage facility, built-in system call instructions, process switch instructions for Unix and C operations, and a macro ROM for executing operating system instructions and microsequences.
- A 12-byte instruction queue for storing prefetched bytes from the instruction stream.
- A Program Counter (PC) and internal registers that identify the instructions currently being executed and the contents of the queue.
- A Process Status Word (PSW) that provides information on the status of the processor and the current process.
- A parity tree that provides a signal for validating redundant-processor operation.

The processor in each 3B5 and 3B2/300 system performs address and data calculations independently. The 32-bit CBUS carries the results of data manipulation, while the 32-bit ABUS handles instruction stream and memory board operand accesses. Data is passed between the ABUS and the CBUS over a 32-bit bidirectional bus multiplexer. The CPU's address bus can access 4GB of virtual memory to address main memory or feature cards. In addition to the address and data buses, the processor also has an 18-bit status bus that performs status monitoring activities, reporting read or write activity, data length, execution level, and operating system status. ▷

AT&T 3B Computer Family

CHART D. PRINTERS (Continued)

MODEL	Model 475	DQP-10	LQP-40	P300
Type	Dot-matrix	Dot-matrix	Letter-quality	Dot-matrix
Speed	120 cps	160 cps	18 cps	300 lpm
Bidirectional printing	Yes	Yes	Yes	Yes
Paper size	4.5 to 11 in. wide	Up to 10 in. wide	Up to 16 in. wide	Up to 16 inches
Character formation	9 x 9 dot-matrix	Dot-matrix	Daisywheel	Variable
Horizontal character spacing (char./inch)	Variable	Variable	Variable	10-16.67
Vertical line spacing (lines/inch)	Variable	6 or 8	6 or 8	6 or 8
Character set	ASCII or AT&T proprietary	96 ASCII	96 ASCII	96
Controller/Interface	RS-232-C	RS-232-C	RS-232-C or Centronics parallel	—
No. of printers per controller/interface	—	1 per interface	1 per interface	2
Printer dimensions, in. (h x w x d)	5.35 x 15.6 x 11.22	15.7 x 4.7 x 11.2	23.8 x 14.7 x 6.7	16.5 x 30.0 x 24.25
Graphics capability	Yes	Yes	No	Yes

Note: A dash (—) in a column indicates that the information is unavailable from the vendor.

▷ by the Interface unit. The PC Interface supports three types of media to interconnect PCs and 3B2/300s: RS-232 media operating at speeds up to 9.6K bps; Omninet, at 1M bps; and Ethernet, at 10M bps.

As previously mentioned, the 3B20S, the 3B20A, the 3B5 systems, and the 3B2/300 all run AT&T's Unix System V, a general-purpose, multiuser, multitasking, interactive operating system. The two major components of Unix System V are the file system and the shell, or command language.

The Unix System V file system consists of a uniform set of directories and files arranged in a tree-like structure. The file system includes such features as: consistent naming conventions; mountable and demountable file systems and volumes; file linking across directories; automatic and transparent file space allocation and deallocation; facilities for uniform creation, accessing, moving, and processing of files, directories, or sets thereof; and uniform device input/output handling among terminals, disk files, and main memory. Each physical input/output device, from interactive terminals to main memory, is treated as a file.

The Unix System V shell is the user/system interface program that interprets command links input by the user from a terminal. The shell is not only an interactive command language, but also a full programming language. It can be used to create scripts, which establish the operating environment by defining the variables and the conditional and interactive constructs under which commands and shell programs are executed. Through the shell, users can add to and change the environment according to specific individual and group requirements, adapting the operating system to varied and unique applications without resorting to compiled programs.

Other features of Unix System V include: protection for disk file systems to prevent corruption through system crashes; access to the facilities of other host computer systems; and support for C, the high-level programming language in which the operating system and most of its subsystems are written. Unix System V also provides support for development, diagnostics support, system administration, system services, and text processing tools.

▶ The 3B2/300 system board features three programmable timers: time-of-day, periodic, and bus. A 3.6-volt lithium battery provides power to all I/O expansion board connector slots, the time-of-day clock, and the NVRAM to retain some nonvolatile storage during periods in which external power has been removed.

The WE 32000 microprocessor also contains features to support the process-oriented operating system environments afforded by Unix System V and its associated C language. The address space of every process is large enough to include space for the operating system. There are four levels of execution privilege: kernel, executive, supervisor, and user. The four levels separate users' program from elements of the operating system by limiting access to certain code. Execution control can be transferred among privilege levels. The CPU also supports explicit process switching through a scheduler; implicit switching of processes is supported through the interrupt structure. The processor also provides a layered exception handling structure, with different mechanisms for different exceptions.

CONTROL STORAGE: The 3B20 central control contains a microprogrammed control storage processor with 10KB of microstore, of which 2KB is read-only memory (ROM) containing a series of microinstructions that directs such system activities as booting. An additional 8KB writable microstore is used to store microinstructions that form the machine instruction set, microsequences, special diagnostic microcode, and control unit sequences.

The 3B2/300 incorporates 32KB of ROM for self-test sanity checks, auto configuration, and system initialization. It also provides 1024 bytes by 4 bits of nonvolatile CMOS RAM (NVRAM) for storage both of system configuration parameters, such as terminal settings and security passwords, and of error information.

REGISTERS: The 3B20 computers employ 12 general-purpose registers. The WE 32000 microprocessor that forms the basis of the 3B5 CPU has 14 general-purpose registers. (A register is "general-purpose" in that it can be referenced in all possible addressing modes.) Three of the 3B5 registers are privileged, that is, any attempt to write them when the processor is not in the kernel execution level will result in privileged register exception. The privileged registers are: register 14, the Interrupt Stack Pointer (ISP); register 13, the Process Control Block Pointer (PCBP); and register 11, the Process Status Word (PSW). Three registers can be used in any addressing mode by any program, privileged or nonprivileged; those are: register 12, the Stack Pointer (SP); register 10, the Argument Pointer (AP); and register 9, the Frame Pointer (FP). The Frame Pointer and

AT&T 3B Computer Family

CHART D. PRINTERS (Continued)

MODEL	P600	C600	C900	C1200
Type	Dot matrix	Band	Band	Band
Speed	600 lpm	600 lpm	900 lpm	1200 lpm
Bidirectional printing	Yes	Not applicable	Not applicable	Not applicable
Paper size	Up to 16 inches	4 to 16.75 in.	4 to 16.75 in.	4 to 16.75 in.
Character formation	Variable	Full	Full	Full
Horizontal character spacing (char./inch)	10-15	10 or 15	10	10
Vertical line spacing (lines/inch)	6 or 8	6 or 8	6 or 8	6 or 8
Character set	96	96	96	96
Controller/Interface	—	—	—	—
No. of printers per controller/interface	2	2	2	2
Printer dimensions, in. (h x w x d)	16.5 x 30.0 x 24.25	49 x 34 x 27	49 x 34 x 27	49 x 34 x 27
Graphics capability	Yes	No	No	No

Note: A dash (—) in a column indicates that the information is unavailable from the vendor.

➤ Unix RTR (RealTime Reliable), the operating system for the 3B20D, incorporates all basic features of Unix System V, with extensions for realtime, fault-tolerant processing. Unix RTR supports both realtime and time-sharing environments simultaneously, permitting response to critical events, such as interrupts from disks. Support for realtime response is implemented through a layered architecture based on a process hierarchy supported by 16 hardware execution levels. The kernel and the special and kernel processes operate in realtime so that they have first call on the computer's available real time. Realtime allocation is based on execution levels, round-robin scheduling, and preemption by interrupts.

For fault tolerance, Unix RTR monitors, logs, and tabulates transient hardware errors both internally on the system and externally on the operator's console. If a hardware unit exceeds its critical error threshold, Unix RTR judges the unit to be faulty, removes it from service, and begins hardware diagnosis immediately. The faulty unit is automatically replaced by the standby unit. Switchovers are transparent to application software. In addition, all software processes are isolated and protected from one another.

Unix RTR works in conjunction with a database tool kit called Low-Level Access. Designed for performance-critical applications, Low-Level Access supports hierarchical, network, and relational data models.

Languages available for the 3B Computer Family include the C language, Basic, Fortran 77, and RM/Cobol (Ryan-McFarland Corporation's implementation of ANSI 74 standard Cobol); the 3B20 computers also support Pascal and LPI/Cobol. To date, AT&T has developed little proprietary application and database management software for the systems. Most of the software the company currently offers has been developed by third-party vendors, although it is available through AT&T's auspices. AT&T has an ongoing agreement with Digital Research, Inc., of Pacific Grove, California, to develop a library of application software for Unix System V.

➤ the Argument Pointer are only affected by the procedure "call", "save", "restore", and "return" instructions. In "C", the Frame Pointer indicates the location in the stack that is the start of local variables for a function. The Argument Pointer indicates the beginning of the set of arguments for that function that have been "pushed" onto the stack. The remaining registers, 0 through 8, have no special attributes.

The microprocessor on the 3B2/300 includes sixteen 32-bit registers for processor and programmer use. A 16-bit Command and Status Register (CSR) provides low-level access to system board circuitry. All bits in the CSR are software-readable through either a byte or a half-word read. Some bits are only set or cleared by software. Some bits, such as those that identify interrupting devices, are not latched in the CSR; instead, they simply reflect the state of signals produced by other system board peripheral devices.

ADDRESSING: The 3B20 computers use eight address modes: six memory modes, immediate mode, and register mode. Memory mode operands give the memory location of data for the instruction. The value used to execute the command is read from the address given. The six memory address modes are: displacement mode; displacement deferred mode; external addressed mode; external address deferred mode; absolute address mode; and absolute address deferred mode. Immediate mode operands provide the value used to execute an instruction. Register mode operands specify the register in which the desired value is located. Either memory mode operands may specify destinations for finished calculations as well as for sources of data.

The 3B5 and 3B2/300 processors recognize commonly used address modes: absolute, displacement (or offset) from a register's contents, immediate, and register. Some modes involve a pointer (the address of a word location in memory that contains the address of the operand) and are called deferred modes. In assembly language, the syntax of the operand defines the operand and its address mode. In absolute address mode, an absolute address is embedded in the operand; it may be the address of the operand or of a pointer. In displacement modes, a displacement contained in the operand added to a register forms the address of the operand or a pointer to the operand; sign extension expands the displacement to 32 bits before the addition occurs. In immediate modes, the instruction stream contains the operand data; the type of mnemonic used does not affect the width of an operand that uses an immediate mode. Register modes use the contents of a module register as the operand or as a pointer to the operand. Normally, the mnemonic (or opcode) controls the type of all operands for the instruction. Expanded-operand modes change the type of an operand and of those that follow it in an instruction.

AT&T 3B Computer Family

CHART E. MAGNETIC TAPE EQUIPMENT

MODEL	—	1600	6250HD	6250IN/1	6250IN/2
TYPE	Reel-to-reel	Reel-to-reel	Reel-to-reel	Streaming	Streaming
FORMAT					
Number of tracks	9	9	9	9	9
Recording density, bits per inch	1600	1600	1600/6250	1600/6250	1600/6250
Recording mode	—	PE	PE/GCR	PE/GCR	PE/GCR
CHARACTERISTICS					
Controller model	Local bus adapter	UN52 C.P.	UN138, UN139 C.P.	UN137 C.P.	UN138, UN139 C.P.
Drives per controller	4	4	2	2	2
Storage capacity, bytes	40M	38M-40M	140M	100M	100M
Tape speed, inches per second	25	125	100	25	25/75
Data transfer rate, units per second	—	200K	625K	244K	40KB
Streaming technology	Yes	No	No	Yes	Yes
Start/stop mode; speed	Not applicable	Not applicable	Not applicable	Yes	Yes
Switch selectable	No	—	—	—	—

Note: A dash (—) in a column indicates that the information is unavailable from the vendor.

▷ COMPETITIVE POSITION

The variety of applications toward which AT&T has targeted the 3B Computer systems is quite broad, and competition could be said to be diffused, with the 3B systems competing against specific vendors in each application market, rather than across the board against a few major competitors. Nonetheless, AT&T is focusing in general on the custom applications market, attempting to provide users with complete systems for addressing specific application requirements. The company aims to deliver complete systems that offer a simple migration path to protect the customer's software investment, while offering strong communications capabilities. Because the amount of software currently available for the 3B Computer systems is limited, AT&T will have to target the systems toward Fortune 1000 corporations and companies large enough to develop their own applications; in so targeting larger user organizations, AT&T will necessarily be competing with IBM and DEC, the two most prominent and firmly entrenched suppliers of superminis for the special applications marketplace.

The 3B2/300 competes against DEC's MicroVAX I and VAX-11/725. The AT&T system supports less memory (2MB) than the MicroVAX I (2.5MB) and the VAX-11/725 (3MB); it can handle more disk storage (32MB) than the MicroVAX I (28.8MB), but less than the VAX-11/725 (52MB). The 3B2/300, however, supports attachment of more workstations (18) than either of the DEC systems (8 stations each). IBM's major competitor for the 3B2/300 is the PC AT, which supports both more memory (3MB) and more disk (40MB) than the AT&T computer, but allows attachment of far fewer workstations, supporting only 3. Although the PC AT is only a 16-bit system, while the 3B2/300 is a 32-bit machine, the PC AT incorporates networking features rivaling those available for the 3B2/300. Where the 3B2/300 supports PC Interface to act as a file server for MS-DOS-based PCs, the PC AT supports the IBM PC Network, a broadband LAN connecting up to 72 PCs within an area of 1000 feet.

The 3B5/100 vies with DEC's VAX-11/730, providing greater processor power (0.6 MIPS versus the 11/730's 0.36), memory (8MB against 5MB for the DEC system), ▷

▶ **INTERRUPTS:** 3B20 computers recognize 32 interrupt levels. The 3B5 computers have 16 hardware input/output interrupt levels; one of these is designated to the central controller. There are 20 software interrupt levels. The 3B2/300 supports eight hardware interrupt levels; three of the levels are routed over the input/output bus to the I/O expansion board.

OPERATING ENVIRONMENT: A 3B20S configuration with three cabinets, one disk drive, console printer, and operator terminal occupies a minimum of 31 square feet of floor space. It requires 208 VAC single-phase, 208 VAC three-phase, and 120 VAC, single-phase. Operating temperatures range from 32 degrees Fahrenheit to 122 degrees Fahrenheit at 20 percent to 80 percent relative humidity. Heat dissipation is 14K BTU per hour. The 3B20A has the same power requirements and range of operating temperatures. However, the 3B20A (four cabinets, one disk drive, console printer, and operator terminal) takes up a minimum of 36 square feet of floor space and has a heat dissipation rate of 18.5K BTU per hour. The 3B20D with four cabinets, console printer, and operator terminal occupies at least 30 square feet of floor space and operates at temperatures from 32 degrees Fahrenheit to 122 degrees Fahrenheit at 20 percent to 80 percent relative humidity. Heat dissipation is 25.3K BTU per hour. No water cooling is required, and an uninterruptible power system (UPS) is optionally available.

The 3B5/100 and 3B5/200 are modular and have several cabinets. The basic system cabinet for each is 31¼ inches high, 30 inches wide, and 31¼ inches deep and weighs 400 pounds; a horizontal expansion cabinet is also available with the same dimensions, but weighs 250 pounds. The basic system cabinet takes up 12.6 square feet of floor space; the system and horizontal cabinets combined occupy 21.6 square feet of space. A vertical expansion cabinet for disk drives, which can be placed on top of the system or horizontal cabinet, is 19 inches high, 30 inches wide, and 31¼ inches deep; it weighs 225 pounds. A tape drive cabinet can also be positioned on top of a system or horizontal cabinet; it is 38 inches high, 30 inches wide, and 31¼ inches deep and weighs 225 pounds.

The 3B5/300 is housed in a cabinet 67.5 inches high, 31¼ inches wide, and 28 inches deep, weighing 850 pounds. A growth cabinet of the same dimensions can be added.

Power requirements for the 3B5 computers are 104-128 VAC, 15 amp (multiple feeder), 59-60.5 Hz. The 3B5 systems operate at temperatures ranging from 40 degrees Fahrenheit to 100 degrees Fahrenheit at 20 percent to 80 percent relative humidity, noncondensing. Heat dissipation for a typical 3B5 configuration is 13K BTU per hour. ▶

AT&T 3B Computer Family

▷ and a larger number of attachable workstations (40 versus 24). The AT&T system supports less disk storage than the DEC machine: 1.1GB, as opposed to the 11/730's 2GB. The principal competitors offered by IBM are the System 38 Models 4XX and 6XX, and the 4361 Model Group 3. The 3B5/100 provides greater processor power than the two System 38 models (which operate at 0.2 and 0.3 MIPS, respectively), and supports more memory (the IBM systems support 2MB and 4MB, respectively). The System 38 machines, however, support more workstations (128) and greater disk storage (3.3GB). The 4361 Model Group 3 falls short of the 3B5/100 in main memory, supporting only 4MB; however, it supports more disk—5.8GB.

The 3B5/200 and 3B5/300 compete primarily against DEC's VAX-11/750, and against IBM's System/38 Models 8XX and 20. The two high-end 3B5s support the same amount of memory as the DEC system (8MB), and better it in pure processor performance (0.8 MIPS versus the 11/750's 0.72). However, the 11/750 supports more users than the AT&T computer (128 versus 60) and provides more disk storage (19GB, against 2.2GB for the 3B5s). The 3B5/200 and 3B5/300 match the two System 38 models in main memory capacity, and exceed them in processor power (Models 8XX and 20 operate at 0.5 and about 0.65 MIPS, respectively); however, the System 38 has the edge in workstations (128) and disk storage (6.2MB on Model 8XX and 5.8GB on Model 20).

The chief competitors of the 3B20S are DEC's VAX-11/780 and 11/785 and IBM's System 38 Model 40 and 4361 Model Groups 4 and 5. The VAX-11 systems have the edge against the AT&T system across the board, providing greater processor power (1.06 and 1.5 MIPS, respectively, versus 1.0 MIPS for the 3B20S), main memory (36MB versus the 3B20S' 16MB), workstations (384 against 256), and disk storage (30GB, as opposed to 8.8GB). Although the System 38 Model 40 and the 3B20S are evenly matched in memory capacity (16MB), the 3B20S has the advantage over the Model 40 in processor performance, workstations, and disk storage. (The Model 40 does only 0.85 MIPS, and supports 128 stations and 5.8GB of disk.) The 4361 Model Group 4 provides less processor power (0.79 MIPS) and less memory (12MB) than the 3B20S, although it supports a greater amount of disk storage (80.6GB). The 4361 Model Group 5 also supports less main memory than its AT&T rival, but provides greater processor power (1.14 MIPS) and far higher disk capacity (121GB).

The 3B20A competes against DEC's VAX-11/782 and IBM's 4381 Model Groups 1 and 2. The 3B20, which operates at between 1.5 and 1.8 MIPS, can match the processor power (1.8 MIPS) of its DEC rival and can support a greater amount of main memory (16MB versus 8MB for the 11/782). The 11/782, however, supports 384 workstations, while the 3B20A supports only 256; the DEC system also has the edge in disk storage capacity (30GB versus the 3B20A's 8.8GB). The IBM 4381 models provide the same main memory capacity as the 3B20A, but support much higher disk storage (403.2GB). In addition, each of

▶ The 3B2/300 is housed in a cabinet 3.6 inches high, 22 inches wide, and 17 inches deep; a basic configuration weighs about 30 pounds. The 3B2/300 computer can be positioned either horizontally or vertically; when horizontally positioned, it can support an external load up to 60 pounds. The 3B2/300 requires standard power of 120 VAC, 15 amp, 60 Hz. Operating temperatures range from 40 degrees Fahrenheit to 100 degrees Fahrenheit at 8 percent to 80 percent relative humidity, noncondensing. Heat dissipation is less than 700 BTU per hour.

INPUT/OUTPUT CONTROL

The 3B20 systems employ parallel processing, using micro-processor-controlled Input/Output Processors and Disk File Controllers to transfer data through the Direct Memory Access Controller (DMAC) to or from main storage, bypassing the CPU. Each I/O Processor (IOP) and Disk File Controller (DFC) acts as a front-end processor. Up to four fully equipped IOPs can be accommodated on a 3B20 computer; each IOP can handle up to 16 peripheral controllers. An IOP consists of a basic input/output processor (BIOP) and a growth input/output processor (GIOP). An IOP can be located in the processor input/output cabinet, the tape and growth cabinet, or a system expansion cabinet. In the 3B20A, an IOP can also be located in the second processor I/O cabinet. The 3B20D can handle up to 16 IOPs with expansion cabinets. Up to four DFCs can be accommodated on each 3B20 computer; each DFC can handle eight disk drives. (For further discussion of the DFC, refer to the CONFIGURATION RULES section of this report.)

The 3B20S and 3B20A (where I/O is handled by the primary 3B20S processor) each have up to two DMACs, featuring two DMA channels per controller and eight I/O devices per DMA channel. The 3B20D has two I/O Processors in standard cabinets.

I/O Processors for the 3B20D are mirrored for fault tolerance. They are duplicated and cross-connected to both processors, so that, in the event of a CPU or IOP failure, the system can maintain a path between the healthy IOP and processing unit.

The 3B20S and 3B20A incorporate a distributed architecture that enhances I/O control by permitting partial failures. For example, if a peripheral device such as a DFC or IOP fails on a system with multiple devices, the system can continue to operate, provided that the failed unit is not the primary (bootstrap) unit; the computer diagnoses the failed unit still running the Unix operating system. Because Unix permits devices to be brought in and out of service, the failed device can also be repaired without affecting system operation.

The 3B20S and 3B20A also permit disks to be dual-ported. Moving-head disks can be connected to two DFCs connected in turn to Dual Serial Channels (DSCHs) on one or two 3B20S/A computer systems. Dual-ported disks can be accessed by only one DFC at a time; the system administrator determines which DFC has access. In addition, two 3B20S or 3B20A systems can be co-located within 90 feet to access each other's peripherals and disks. If one system fails, access to designated DFCs or IOPs can be transferred to the functioning system while the failed system is restored to service. Co-located devices can be accessed by only one of the processors in the configuration at a time; access is determined by the system administrator.

The fault tolerant 3B20D has no single point of failure. Because all critical devices are duplicated, they can be taken off-line automatically or manually for diagnostics, repair, or system reconfiguration. All disks can be mirrored to guard against disk controller and disk drive failures.

AT&T 3B Computer Family

▷ the 4381s exceeds the MIPS rate of the 3B20A; the 4381 Model Group 1 performs at 2.1 MIPS, and the 4381 Model Group 2 operates at 2.7 MIPS.

The 3B20D faces different competitors than the other machines because it competes in a more specialized market. The system's principal competitors in the transaction processing marketplace are the Stratus/32 Continuous Processing Systems and Tandem's NonStop TXP. The 3B20D has greater processor power than the low-end Stratus FT 200, operating at 0.9 MIPS versus the Stratus system's 0.75 MIPS; however, Stratus' upper-end systems, the XA400 and XA600, provide 2.0 and 3.0 MIPS, respectively. In other respects, the Stratus machines dwarf the 3B20D. Stratus provides main memory, workstation, and disk support figures for each processing module of a system; up to 32 modules can be configured. Thus, while the 3B20 supports system totals of 16MB of memory, 256 workstations, and 10.5GB of disk storage (unformatted capacity), the Stratus systems provide the following for each processor module in a system: 8MB (FT200 and XA400) or 16MB (XA600) of duplexed memory; support for 64, 128, or 256 workstations (FT200, XA400, and XA600, respectively); and 21GB (FT200 and XA400) or 44GB (XA600) of disk storage. Similarly, Tandem's NonStop TXP allows configuration of up to 16 processors; each can operate at up to 2 MIPS, support 16MB of main memory, and handle 4.3GB of disk per controller.

Although DEC and IBM are AT&T's principal competitors, along with Stratus and Tandem in the more rarified transaction processing market, systems from other major vendors also provide competition for the 3B20 line. Those systems include Data General's Eclipse MV/Family, the 32-bit members of the Wang VS Family, and the Prime 50 Series.

Technologically, the 3B Computers exhibit both competitive strengths and weaknesses. The low-end systems, particularly the 3B2/300, are well positioned from a technological standpoint; the WE 32000 microprocessor on which they are based is a true 32-bit microprocessor (that is, it employs both a 32-bit data path and a 32-bit address bus); true 32-bit MPUs are not generally employed in other vendors' supermicros. The higher-end systems implement architectural technologies that are not especially advanced. The bit-slice architecture of the 3B20 processors is not novel; thus, these machines compete against higher-end IBM and DEC VAX systems, as well as with comparable systems from other entrenched competitors, without offering distinctive or more powerful technological features.

In addition, the hot-standby concept employed in the 3B20D is hardly state-of-the-art for fault tolerance; this system could have trouble competing against the more architecturally sophisticated Stratus/32 and Tandem Non-Stop TXP. Also, according to AT&T, the 3B20D's system software in highly specialized and requires a great deal of training and expertise; that complexity could be an impediment to competition in the commercial market. In fact, due ▷

▷ On 3B5 systems, the local bus provides the interconnection for the various subsystems. During local bus transactions, one device acts as the bus "master" and another device as the "slave." The central control provides centralized arbitration so that multiple "masters" may exist. Possible masters include the Central Control, the memory controller, a disk or tape controller, an IOA, or the 3BNet Network Interface CPU (NICPU). Once a master is granted permission by the arbiter, it may address any board on the bus as a slave. The master may then write or read data to or from the internal locations on the slave. The local bus supports byte, half-word, and word data transactions; parity is carried over all local bus addresses and data.

Input/output activities are accelerated through Input/Output Accelerators (IOAs). The IOA is a WE 32000-microprocessor-based intelligent peripheral controller designed to control a number of peripheral interfaces, including the Asynchronous Data Link Interface (ADLI), Synchronous Data Link Interface (SDLI), and Teletype Terminal Interface (TTI).

On the 3B2/300, peripheral interfaces are controlled by the asynchronous, multiplexed I/O bus. The I/O bus has a 16-bit data path, a 24-bit address, and can support direct addressability up to 16MB. The I/O bus supports both 8-bit and 16-bit peripherals, as well as single- and multiple-data transfers per cycle.

The I/O bus supports both programmed and intelligent peripherals. Programmed peripherals communicate with the CPU on the system board through interrupts and on-board registers. The microprocessor- or integrated-circuit-based operate autonomously, receiving interrupts through a read or write of specific memory mapped I/O addresses within the address spectrum of the CPU; they communicate with the CPU through request and completion queues in main memory.

Along with normal peripheral read of main memory, peripheral write to main memory, and CPU read/write of a peripheral, the I/O bus supports the following two special transfer cycles:

- Peripheral interlock with main memory—an uninterruptible sequence, within a single bus cycle, of a read of main memory by a peripheral, a modification of the data read, and a write back to the same location in main memory.
- Multiple bus accesses—through which more than one data transfer by the same peripheral can be accomplished in a single bus cycle. These accesses occur without bus arbitration overhead; a maximum of 64 transfers per arbitration is permitted.

The arbitration circuit on the system board controls I/O bus mastership. Any peripheral can become the bus master. When a peripheral publicly sends a peripheral bus request signal (shared by all peripherals), the arbiter grants the bus to the peripheral by asserting a peripheral bus acknowledge signal daisy chained through all peripherals. At the end of the cycle, the arbiter is free to grant the next bus mastership.

Access by the I/O bus and CPU to main memory is controlled by the DPDRAM controller, which supports four basic modes:

- Refresh—the request generator asserts a fresh request approximately every 16 microseconds. The request is passed to the arbiter, where it receives the highest priority.
- I/O access of main memory—a feature card or the integral DMA controller makes a memory request by asserting a bus request signal. The request signal is passed to the arbiter, where it is assigned the second highest priority. ▶

AT&T 3B Computer Family

▶ to the complexity of the 3B20D, AT&T is marketing it more toward OEMs and VARs; it is, however, available to end users.

From a marketing standpoint, AT&T's ability to compete immediately with entrenched commercial systems vendors can be questioned. AT&T claims that the company gained expertise in the sale of complex systems by vending and supporting switching systems like System 75 and System 85. Much of that experience was obtained in a regulated environment, however; whether whatever expertise the marketing force has gained can translate into sales in the competitive marketplace remains to be seen. The company's ability to provide support for installed systems is less open to question; the company has traditionally been strong in customer service, and has implemented a strong support program for the 3B Computer line.

ADVANTAGES AND RESTRICTIONS

The systems in the 3B Computer family have both advantages and disadvantages. The 3B Computers must stand or fall with AT&T's Unix, the only operating system offered for the family. AT&T has announced that it hopes to see its Unix System V become the standard for all Unix operating systems; in that regard, users can be assured that AT&T will labor diligently to support and enhance its Unix implementation. Although application software for the system is in short supply, AT&T is actively developing application products both internally and in conjunction with third-party suppliers; some are already available through AT&T Information Systems. However, because Unix in general is only offered as a secondary operating system by other major vendors, and because Unix System V in particular is hardly the standard AT&T would like to see it become, applications for 3B systems are likely to be somewhat scarce for the immediate future.

Because all 3B Computers use Unix-based operating systems, all offer software compatibility at the source code level; software is only object-code-compatible between the 3B2/300 and 3B5 systems. However, the systems provide only a limited hardware migration path. Only two computers can be upgraded: the 3B5/100 to a 3B5/200 and the 3B20S to a 3B20A.

The 3B Computers do exhibit significant strengths for networking and distributed processing, implemented in a variety of ways. The UUCP (Unix to Unix Communications Protocol) facility in each computer's Unix operating system permits communications with both AT&T Unix and non-AT&T Unix systems (for example, those running a version of Unix based on the University of California at Berkeley implementation). With PC Interface, the 3B2/300 can be networked with MS-DOS-based personal computers. The Information Systems Network links 3B computer systems to non-AT&T systems (DEC VAX-11 systems, for example) running Unix System V; it also supports protocol converters for SNA/SDLC communications. The 3BNet LAN provides local interconnection for a group of 3B systems. In local networking, in fact, AT&T has an advan-

- ▶ • CPU access of main memory—to increase system performance, read cycles are treated differently from write cycles. Read requests are passed directly to the arbiter, while a write request is blocked until the CPU is completely ready for the access sequence. CPU accesses of main memory are assigned third priority by the arbiter.
- CPU access of I/O—the CPU can reach across the main memory to communicate directly with feature cards or with the system-board-resident DMA controller. The direct access is made possible by the Dual Port Memory Address Bypass Circuit and the Byte Rotation Unit (BRU); the BRU formats data, formats data from the 8- and 16-bit so that the cards can access the 32-bit main memory. I/O requests from the CPU receive fourth (lowest) priority from the arbiter.

The DMA controller features four independent DMA channels and provides service for the hard disk controller, the floppy disk controller, and the transmit ports of the dual asynchronous serial RS-232-C ports, which all attach to the I/O bus and follow the same bus protocol as feature cards. To support the integral controllers and ports, the DMA controller accepts DMA requests, acquires the bus, and generates both a DPDRAM address and appropriate peripheral bus signals to accomplish the transfer. All data transfers between the DMA controller and main memory or the CPU are 8 bits wide.

CONFIGURATION RULES

GENERAL: The 3B20A and 3B20S are available in three core systems each. The systems are differentiated by the types of disk and tape devices supported. Each core system is a functional system that includes a tape drive, a disk drive, an operator console, and an eight-port asynchronous controller. Each package includes a set of options. Tape drives, Input/Output Processors, and Disk File Controllers are specific to each core system; their locations in the cabinet differ according to the core system. For example, a second IOP or 1600 bpi tape drive does not necessarily require the same hardware when added to different cores. Options common to all core systems include additional memory, printers, disk drives and cabling, co-location cabling, and communications interfaces. The 3B20S supports from 2MB to 16MB of main memory; the 3B20A can support 2MB to 16MB of memory in each CPU.

The 3B20D is available in a single core package whose major components are two CPUs, 5MB of main memory, an IOP, a DMA controller, a dual serial channel, two 340MB Winchester disks, a 9-track, 1600 bpi tape unit, a color video maintenance terminal and controller. Additional disk drives, tape drives, and other options can be added. The 3B20D can support up to 16MB of main memory.

The 3B5/100 and 3B5/200 are available in four and three packaged configurations, respectively (Models 100A, 100B, 100C, 100D, 200E, 200F, and 200G). Configurations using either disk and tape as load and backup devices are available. An 8KB cache memory is a standard feature of each system. Each 3B5/100 and 3B5/200 system has eight asynchronous RS-232-C ports. On the 3B5/100, the ports are controlled directly by the Central Control; on the 3B5/200, they are controlled by the IOA.

Model 100A is the minimum working 3B5 computer system. Intended for use in small operations, it has five user-definable input/output card slots. The Model 100A has 1MB of main memory as standard and supports a maximum main memory of 4MB. Model 100A is a Lark II disk-drive-based system, depending on a Lark II drive for loading and changing the Unix operating system and for backup of data. ▶

AT&T 3B Computer Family

► tage over IBM, which, although it has developed a net for the PC AT, has yet to deliver its long-awaited general-purpose LAN.

USER REACTION

Because the 3B Computer family has only been generally available since the end of March 1984, only a small number of systems has been delivered to end users. According to AT&T Information Systems, the current user base is not large enough to provide a meaningful cross section of user reactions; ATTIS was thus unable to provide us with a list of users from whom we could obtain assessments of the 3B systems. □

► Model 100B is a medium-capacity 3B5 computer system, offering 15 customer-definable input/output card slots, providing space for special input/output functions like the AT&T 3BNET computer interface. The system offers 2MB of main memory as standard and 8MB as a system maximum. Like the Model 100A, the Model 100B depends on the Lark II disk drive for loading and changing the operating system and for data backup.

Model 100C, like Model 100A, is a minimum-configuration 3B5 computer system. However, it has a 9-track tape unit included as standard equipment, allowing the user to omit the standard Lark II disk drive as the system disk and operate with a larger 160MB Fixed Storage Device (FSD) drive. The 100C offers four user-definable input/output slots and 1MB of main memory as standard. Maximum main memory is 8MB.

Model 100D, like Model 100B, is a medium-capacity 3B5 system with a 9-track tape unit included as standard equipment. Model 100D provides 14 user-definable input/output slots and 2MB of main memory; memory can be expanded to a maximum of 8MB.

The 3B5/200 is similar to the 3B5/100, using the same circuit board racks, input/output circuit boards, and peripherals. However, the 3B5/200 provides some capabilities not available on the 3B5/100. The standard central control in the 3B5/200 runs at 10MHz, while the standard central control of the 3B5/100 runs at 7.2MHz. In addition, 2MB of main memory is standard on the 3B5/200. Moreover, the 3B5/200 incorporates both the growth control unit and the Extended Local Bus (ELB) units as standard equipment, providing up to 27 user-definable input/output slots, almost twice the number offered by the 3B5/100. (In controlled situations, the 3B5/300 can support more than four disk drives.)

Model 200E is a large-capacity, Lark II disk-drive-based 3B5 computer system, offering 27 user-definable input/output slots and standard main memory of 2MB. Maximum main memory is 8MB.

Model 200F is also a large-capacity system, with 26 user-definable input/output slots. It incorporates a 9-track tape unit as standard equipment. Standard main memory is 2MB, and maximum main memory is 8MB.

Model 200G is a large-capacity 3B5 computer system with two 9-track tape units. Model 200G provides 26 user-definable input/output slots. Standard main memory is 2MB, and maximum memory is 8MB.

The 3B5/300 has the same general characteristics as the 3B5/200, supporting up to 8MB of main memory. The 3B5/300 is available in 12 preconfigured packages, each of

which contains the following core components: a 10MHz CPU; a 1MB main memory module; a basic processor cabinet; an intelligent tape controller and 9-track tape drive; a growth control unit; an integrated disk file controller; a storage module file controller; cabling; and the Unix System V operating system. Each package also includes a combination of 160MB fixed disk storage devices, I/O, and communications options.

The 3B5/300 differs from the other 3B5 systems in that it does not employ a mixture of horizontal and vertical growth cabinetry. One vertical growth cabinet can be added to the single vertical cabinet that houses the basic system.

AT&T Information Systems offers three configurations of the 3B2/300. Each has the same core hardware and firmware, including: system board, cabinet, power supply, fan, internal and external cables, connectors, Unix System V core software and six user-installable Unix System V utilities packages, a backup copy of core Unix software, system and user documentation, a 720KB floppy disk drive, and two RS-232-C cables. The basic configuration comes with 512KB of main memory and a 10MB hard disk. The standard configuration includes 1MB of memory and a 32MB hard disk. The expanded standard configuration includes 1MB of main memory, a 32MB hard disk, and an expanded I/O feature card that provides four additional serial ports and a parallel peripheral port; the system can support up to 18 I/O ports. The 3B2/300 can support up to 2MB of main memory. Various main memory, I/O, terminal, and printer options can be added to the core configurations.

On the 3B2/300, four I/O expansion slots are available to support feature cards; up to four I/O expansion cards can be added, for a maximum of 18 serial RS-232-C ports and four parallel ports.

In configuring the 3B2/300, the following rules must be observed:

- A maximum of two 256KB or two 1MB memory cards can be used; 256KB and 1MB cards cannot be mixed.
- Double-width feature cards can be used; they occupy two feature card slots.
- The sum of RS-232-C baud rates cannot exceed 38.4K baud per I/O expansion feature card; no individual baud rate can exceed 19.2K.
- Only one computer network feature card need be configured per 3B2/300. (This card uses one feature card slot on the backplane.)
- A terminal must be connected to the integral RS-232-C console port.
- Parallel printers should not be located further than 10 feet from the computer.
- To operate at a maximum of 19.2K baud, all asynchronous serial EIA peripherals must be located within 50 feet of the computer; greater distance will reduce operating speed.

AT&T recommends that when multiple terminals are to be attached or a Teletype Dot-Mapped Display (DMD) terminal is to be used, the system configuration should include a 32MB disk and at least 1MB of memory.

WORKSTATIONS: The 3B20 computers can support up to 256 workstations; the optimal number of concurrent users is between 48 and 64. The 3B5/100 can support up to 40 workstations and the 3B5/200 and 3B5/300 up to 60; however, the optimal number of simultaneously active users is 24. The 3B2/300 can support up to 18 workstations; the optimum number of simultaneously active users is 6. ►

AT&T 3B Computer Family

► **DISK STORAGE:** The 3B20S and 3B20A support up to 8.8GB of on-line disk storage; the 3B20D can support up to 10.5GB of disk. (The 10.5GB figure, quoted by AT&T, is unformatted capacity). The Disk File Controller (DFC) in the 3B20S and 3B20A provides an interface for up to eight 300MB, 340MB, or 675MB disk drives through dual serial channels in the DMA unit; the DFC for the 3B20D provides an interface for eight 340MB drives. The DFC can be located in the processor and input/output cabinet, the tape and growth cabinet, or a system expansion cabinet. (*Note: The drives designated as 300MB, 340MB, and 675MB have formatted capacities of 256MB, 279MB, and 550MB, respectively.*)

The 3B5/100 and 3B5/200 support both 48MB Lark II fixed/removable disk drives and 160MB FSD (Fixed Storage Device) drives. (*Note: the drives have formatted capacities of 40MB and 134MB, respectively.*) Up to two Lark II drives can be placed in the basic system cabinet. All 160MB drives must be placed in vertical or horizontal growth cabinets. The 3B5/300 supports only 160MB FSD drives. The maximum formatted storage capacity the 3B5/100 is 1.1GB; it is 2.2GB for the 3B5/200 and 3B5/300.

The 3B2/300 supports 10MB and 32MB Winchester disk drives.

MAGNETIC TAPE: The 3B20 computers support the UN52, a high-speed tape controller for use with 1600 bpi magnetic tape drives. Up to four drives can be controlled through two tape formatters. Also supported is the UN137, a single-board controller for 6250 bpi tape devices. The 3B20S and 3B20A also support the UN138 and UN139 controller and Tape Input/Output Processor (TIOP). Two 6250 bpi tape transports can be supported by the 3B20S and 3B20A; the 3B20D can support up to four 6250 bpi tape drives.

The 3B5 computers can support up to two 9-track, 1600 bpi magnetic tape units capable of accepting 6.25-, 7-, 8.5-, and 10.5-inch reels meeting American National Standards Institute (ANSI) requirements. To add a tape unit to a 3B5 system not already configured with one, a user must configure an Intelligent Tape Controller (ITC) circuit board to interface the tape unit to the computer. This circuit board must be plugged into an available general-purpose slot.

PRINTERS: The 3B20S and 3B20A support up to two line printers through each TN85 line printer controller; the controller permits maximum circuit pack throughput of 2000 lpm (with 132-character lines). The 3B2/300 permits connection of dot-matrix and letter-quality printers through serial RS-232-C ports or Centronics parallel interfaces.

MASS STORAGE

For information on available mass storage devices, refer to Chart B.

INPUT/OUTPUT UNITS

See Chart C for workstations, Chart D for printers, and Chart E for magnetic tape equipment.

COMMUNICATIONS CONTROL

GENERAL: Communications control on the 3B20 systems is provided by the following devices:

The *TN74 Two-Channel Asynchronous Data Link Controller* permits communications between the computer and a variety of asynchronous serial communications channels through the EIA RS-232-C interface. The asynchronous channels can be connected to asynchronous terminals or computers locally or remotely through modems. Speeds up

to 9600 bps can be achieved for local operation with terminals or computers. The TN74 features program-controlled options; the user can specify the data rate, data format, parity generation and detection, and character input and output processing options. The option processing tasks are performed by the peripheral controller to relieve the processor.

The *TN4 Eight-Channel Asynchronous Data Link Controller* provides data communications between 3B20S and 3B20A computers and asynchronous serial communication channels through the RS-232-C interface. Its capabilities are the same as those of the TN74.

The *UN56 Eight-Port Automatic Call Unit Interface* is a circuit-pack peripheral controller. Each port provides an optically isolated EIA RS-366 standard interface for controlling 801CR-type Data Auxiliary Sets (DASs). The UN56 provides dialout capability for eight data sets where one ACU is dedicated to controlling one data set. Up to 96 data sets can be obtained with one eight-port ACU using expansion hardware. Dialout activities may proceed in any order, but not simultaneously.

The *TN82 X.25 Level 2 Data Link Interface* can provide one RS-232-C interface running at 9600 baud or one CCITT V.35 interface running at 56K baud. The X.25 Level 2 is implemented by the peripheral controller to free CPU time.

The *TN75 Synchronous Link* is an X.25 Level 2 synchronous link controller arranged for full duplex, private line, or dial backup operation. It provides two independent X.25 Level 2 channels. It can operate at 9600 bps full duplex; in a typical configuration, one channel would operate at 9600 bps or two would operate at 4800 bps. The X.25 Level 2 is implemented by the peripheral controller to free CPU time.

The *UN49 High-Speed Network Interface* allows 3B20S and 3B20A computers to communicate with other computer systems through a Network Systems Corporation Hyperchannel adapter network. A Hyperchannel network consists of adapters that interface computers and peripheral control units from various manufacturers to coaxial cable data trunks.

In addition, the 3B20S and 3B20A support RJE protocols. The 3B20D can also interface to DDCMP message-switching networks for wide area communications.

In 3B5 systems, communications control for peripheral interfaces is provided by the *Input/Output Accelerator (IOA)*, the WE 32000-microprocessor-based intelligent peripheral controller. The IOA supports a Virtual Protocol Machine/Common Synchronous Interface (VPM/CSI) implementation. In this environment, scripts using VPM primitives are downloaded and run on the IOA to provide protocol processing while Unix/VPM drivers supply the user interface. Drivers and scripts supporting the following hardware and protocols are available under Unix System V, Release 1: Unix character processing through both the Teletype Terminal Interface (TTI) and the Asynchronous Data Link Interface (ADLI), and RJE processing through the Synchronous Data Link Interface (SDLI). IOA firmware also provides support for an AT&T Teletype Model 5620 Dot Mapped Display (DMD) terminal through the ADLI or the IOA's on-board serial data port. As an alternative to the DMD, the IOA's on-board serial port can accommodate a high-speed asynchronous printer.

The *Teletype Terminal Interface (TTI)* provides 16 ports supporting the 56K bps Standard Serial Interface (SSI) for AT&T Teletype terminals and printers. This interface is supported by the IOA/VPM environment; a driver and script are provided for Unix character processing. ►

AT&T 3B Computer Family

► The *Asynchronous Data Link Interface (ADLI)* provides eight RS-232-C serial ports, which operate at speeds from 300 to 9600 baud; two ports may be configured for 801 Automatic Call Units (ACUs). Unix character processing support is provided for the unaccelerated (CPU-controlled) ADLI using the standard Unix TTY driver, as well as for the IOA-controlled accelerated ADLI under the VPM environment.

The *Synchronous Data Link Interface (SDLI)* provides an eight-port interface for full duplex synchronous data communications at up to 9600 baud using RS-232-C or RS-449 signal levels. This board is used in the IOA/VPM environment with drivers and scripts provided to support the RJE synchronous protocol.

On the 3B2/300, the system board provides two standard serial RS-232-C asynchronous I/O ports, operating full duplex at rates up to 9.6K baud. Each channel provides transmit and receive data, as well as one data set control signal in each direction. The two serial channels feature: full duplex asynchronous communications; quad buffered receiver data registers; programmable data format; programmable baud rates from 50 to 19.2K baud; false start bit detection; and programmable channel mode. When receiving, the ports can be operated under either interrupt-driven or polled programmed I/O. When transmitting, they can be operated under programmed I/O, whether interrupt-driven or not; they can also be DMA-driven.

The 3B2/300 also allows configuration of up to four I/O expansion cards that each add four serial RS-232-C asynchronous ports (along with a Centronics parallel printer interface). An *Autodial Modem* feature, along with a basic networking utility, allows the 3B2/300 to be connected to other Unix systems over a standard telephone network. The Autodial Modem unit is externally attached to the computer through a standard RS-232-C port. (No expansion port feature card is required.) Automatic dial/answer facilities are provided at data rates from 300 to 1200 baud.

The 3B2/300, the 3B5 computers, and the 3B20A and 3B20S can also be connected to *3BNet*, a high-speed local area network that provides a file-transfer network for systems operating within an area of over 540 yards (500 meters). The network operates at a transmission rate of 10M bits per second over coaxial cable. The network is intelligent, using WE 32000-microprocessor-based interfaces to deload all protocol, flow control, and maintenance overhead from attached host computers. The 3BNet is Ethernet-compatible, permitting connection of 3Bs to computers and peripherals supporting the Ethernet standard. The network allows users to select packet sizes (up to 4096 bytes on the 3B20S, the 3B20A, and the 3B5s, and up to 1500 bytes on the 3B2/300). It also provides centralized administration with automatic backup, so users can monitor and configure the network from a single terminal. The 3BNet operates in conjunction with a package of network services contained in the 3Bs' Unix operating systems, allowing users to move data among machines and set network security.

The 3BNet protocol is a higher-level Ethernet protocol that automatically constructs and processes packet header information. 3BNet hardware comprises the interconnect medium (IM), network interface (NI), transceiver, and transceiver power supply. Each host computer or peripheral device connects to the network through a network interface. The network interface is an intelligent link between the interconnect medium and the associated peripheral/computer device. The interconnect medium is a coaxial cable interconnecting all network interfaces through transceivers. A transceiver is placed in the coaxial cable at each point of connection to a network interface. Transceiver power is supplied through the host computer/peripheral device from

a transceiver power supply on the 3B20S, 3B20A, and 3B5 series computers, and from a feature card on the 3B2/300.

A maximum of 100 transceivers can be handled on the network, allowing up to 100 nodes for interconnection of Unix-based host computers or Ethernet-compatible peripheral devices. Up to 30 nodes can be 3B20S, 3B20A, or 3B5 systems; the rest can be 3B2/300s.

The 3BNet is a structured network in which one 3B20S, 3B20A, or 3B5 host computer node is defined as the master node, that is, the hub that handles administrative and security processes for the network. A 3B20S, 3B20A, or 3B5 network backup node must be defined as a substitute master in case the master node crashes or is removed from service. All other nodes on the network are slave nodes. (A 3B2/300 cannot function as a master node.)

Communication over the common interconnection medium is controlled through the Carrier Sense Multiple Access/Collision Detection (CSMA/CD) scheme.

The 3BNet LAN also includes a software component that provides a user-level interface to the network, maintenance capabilities, network administration, and security features.

Information Systems Network (ISN) is AT&T Information Systems' proprietary local area network for building complexes and campuses; it permits networking of 3B family systems and computers from other manufacturers. ISN is based on a short, centralized bus architecture incorporating attributes of star networks, distributed buses, and distributed token rings.

The components of ISN include: a packet controller that contains a high-speed, hardware-based packet switch for virtual circuit data transport, features an 8.64M bps bus transmission speed, and serves up to 1920 ports; a control console for system initialization and administration; and concentrators that statistically multiplex up to 40 EIA device ports to the packet controller through an optical fiber pair with an 8.64M bps transmission rate.

The ISN can use both fiber optic and four-twisted-pair copper wire distribution cables. The copper wires link terminals or host computers, AT&T personal computers, and similar devices directly to the packet controller or to concentrators. The optical fibers form the backbone of the system, carrying multiplexed data between packet controllers and host computers, between packet controllers and concentrators, and among multiple packet controllers. ISN supports multiplexed fiber optic interfaces to DEC VAX-11 systems running under Unix System V. It can also be interconnected to AT&T's System 75 and System 85 PBXs.

SOFTWARE

AT&T offers a range of software products, both proprietary and developed by third parties. Products developed by other vendors and discussed in the following section are all available directly from AT&T.

OPERATING SYSTEM: *Unix System V*, the operating system for the 3B20S, 3B20A, 3B5 series, and 3B2/300 computers, is a general-purpose, multiuser, multitasking, interactive operating system. The two major components of Unix System V are the file system and the shell, or command language.

The file system consists of a uniform set of directories and files arranged in a tree-like structure. Some features of the file structure are:

AT&T 3B Computer Family

- ▶ • Consistent naming conventions; file names can be fully qualified or relative to any directory in the file system hierarchy.
- Mountable and demountable file systems and volumes.
- File linking across directories.
- Automatic file space allocation and deallocation transparent to users.
- A set of flexible directory and file protection modes that allows all combinations of read, write, and execute access. Protection modes can be set independently for the owner of each file or directory, for a specified group of users (all members of a project, for example), and for all other users. File protection modes can be set dynamically.
- Facilities for creating, accessing, moving, and processing files, directories, or sets thereof in a uniform way.
- Uniform device input/output handling among terminals, disk files, and main memory. Each physical input/output device, from interactive terminals to main memory, is treated like a file.

Unix System V supports file systems with 512- or 2048-byte blocks and 512- or 2048-byte buffers for enhanced file system throughput in operations requiring a large number of reads and writes.

The shell is the user/system interface program that interprets command links input by the user from a terminal. The Unix system shell is not only an interactive command language, but also a full programming language. It can be used to create scripts, which establish the operating environment by defining the variables and the conditional and interactive constructs under which commands and shell programs are executed. Through the shell, users can add to and change the environment according to specific individual and group requirements, adapting the operating system to varied and unique applications without resorting to compiled programs. The Unix Operating System typically runs unattended.

Other features of Unix System V include:

- Support for C, the high-level programming language in which the operating system and most of its subsystems are written. According to AT&T, the C language endows Unix System V with portability not only across the line of 3B computers running under the system, but also among systems from microcomputers to mainframes developed by other manufacturers.
- Protection for disk file systems to prevent corruption through system crashes.
- Access to the facilities of other (host) computer systems.

Unix System V also provides support for the following types of tools:

- Development, including compilers, debuggers, optimizers, and program version administration.
- Diagnostics support, including automatic error logging, off-line diagnostics, and self-configuring hardware and software.
- System administration, including monitoring facilities, maintenance utilities, recovery tools, user accounting, and security controls.

- System services, including event-driven scheduling, scheduling/priority control, page/process memory lock, and interprocess communications.
- Text processing, including editors and formatters.

Unix System V for the 3B2/300 consists of a core package that incorporates the system kernel, standard device drivers, and basic commands for shell programming, directory and file management, system administration, user environment, status request, and special-purpose functions (comparing, searching, sorting, and counting data). Separately available are packages of utilities normally bundled with Unix System V: system administration, shell programming, directory and file management, user environment, editing, and calculation.

Unix RTR (Real Time Reliable), the operating system for the 3B20D, incorporates all the basic features of Unix System V, with extensions for realtime, fault tolerant processing. Unix RTR supports both realtime and time-sharing environments simultaneously, permitting response to critical events, such as interrupts from disks. Support for realtime response is implemented through a layered architecture based on a process hierarchy supported by 16 hardware execution levels. The kernel and the special and kernel processes operate in realtime so that they have first call on the computer's available real time. Realtime allocation is based on execution levels, round-robin scheduling, and preemption by interrupts.

For fault tolerance, Unix RTR monitors, logs, and tabulates transient hardware errors both internally on the system and externally on the operator's console. If a hardware unit exceeds its critical error threshold, Unix RTR judges the unit to be faulty, removes it from service, and begins hardware diagnosis immediately. The faulty unit is automatically replaced by the standby unit. Switchovers are transparent to application software. In addition, all software processes are isolated and protected from one another.

Unix RTR works in conjunction with a database tool kit called Low-Level Access. Designed for performance-critical applications, Low-Level Access supports hierarchical, network, and relational data models.

Software tools supported by Unix RTR on the 3B20D include: the C language and Fortran 77; preprocessors; a linker and system generator; symbolic debuggers; source management tools; and software analysis. Unix RTR also provides support for interfaces to the 3BNet.

DATABASE MANAGEMENT SYSTEM: Several DBMS products are available from AT&T for 3B5 and 3B2/300 computers. (The products described in the following paragraphs are applicable to both sets of systems, unless otherwise noted.)

dBase II, developed by Ashton-Tate, Inc., is a relational data management tool for constructing and manipulating numeric and character information files. It features an English-style program building language and capabilities for sorting, editing, and displaying the data base directly from the keyboard. It can also be used to write menus and programs to support specific applications.

AT&T Ingres (a version of the Ingres DBMS originally developed by Relational Technology, Inc.) is an integrated relational database management system for end-users and application developers. For use on 3B5 computers, this system models data as simple tables that can be altered through an English-like database language. AT&T Ingres stores all information about data definitions, protections, storage structures, and the applications of user tools in an integrated data dictionary that is automatically updated. It provides full-screen forms for query retrieval, database up-

AT&T 3B Computer Family

► dates, and report generation. It also permits applications to be written in English-like script for direct execution or for inclusion in C language programs. (AT&T also states that Ingres will be made available for 3B20 systems.) A fully compatible subset of the Ingres package, *AT&T Ingres/CS*, is available for the 3B2/300.

Informix, a multiuser relational DBMS from Relational Database Systems, Inc., combines screen generation, report writing, and query language modules. It also features menu creation facilities and a C language interface.

File-it! is an Informix-compatible file manager for personal record keeping; databases created by one system can be accessed by the other. The system also features interactive database construction and screen design and update capabilities.

LANGUAGES: Languages available for the 3B Computer Family include the C language, Basic, Fortran 77, and RM/Cobol. (According to AT&T, the 3B20 computers can also support Pascal and LPI/Cobol.)

The C language is a general-purpose programming language featuring control flow and data structures and an extensive set of operators. The C compiler includes the standard C library, Unix System V math, object file access, and plotter libraries. The compiler permits source-code compatibility among the 3B20, 3B5, and 3B2/300 computers, and object-code compatibility between the 3B5 and 3B2/300 systems.

Fortran 77 is compatible with the American National Standards Institute (ANSI) standard. The compiler is portable and generates code compatible with calling sequences produced by compilers for the C language.

Basic is an interpreter-based language specifically designed to run under the Unix operating system. The interpreter is ANSI-standard compatible. Features of Unix system Basic include debugging, editing capabilities, and Unix system environment extensions.

RM/Cobol, from Ryan-McFarland Corporation, is based on ANSI 74 standard Cobol. It includes commonly used Cobol features for application development, including: level 2 sequential, relative, and indexed file access methods, including alternate and duplicate key handling; interactive debugging at the source statement level; and a single-pass compiler that generates ready-to-execute pseudocode. *RM/Cobol* is available with or without a run-time component that allows the execution on 3B systems of *RM/Cobol* programs compiled on other machines.

COMMUNICATIONS: All 3B Computers support the *Unix-to-Unix Communications Protocol (UUCP)*, a software-to-software protocol that provides the capability to copy and send files from a resident 3B20 or 3B5 system to a remote Unix system.

The 3B2/300 supports *PC Interface*, a hardware/software link that interconnects the 3B2/300 to personal computers running the MS-DOS operating system. The PC Interface allows multiple PCs to share files and peripherals on a central 3B2/300 running Unix System V. Files can also be transferred back and forth from PCs to 3B2/300 systems; all necessary translations are performed by the Interface unit. The PC Interface supports three types of media to interconnect PCs and 3B2/300s: RS-232 media operating at speeds up to 9.6K bps; Omninet, at 1M bps; and Ethernet, at 10M bps.

PC Interface software provides: transparent sharing of files resident on the 3B2/300 by personal computers running MS-DOS version 2.0; transparent printer spooling, through which a PC user can obtain output from a printer on the 3B2/300; and, in conjunction with Unix System V, control over user access privileges.

UTILITIES: Unix System V provides the following types of standard utilities:

- System administration. These include a set of commands for file system maintenance, measurement, and scheduling.
- Shell programming. These utilities aid the user in creating shell programs using Unix system commands, especially programs that run in multiple Unix machine environments (for example, a shell program that allows the user to perform specific functions based on the type of processor in the system).
- Directory and file management. These utilities comprise commands that provide enhanced file and directory manipulation capabilities. These commands reduce multistep file and directory manipulation operations to single steps.
- User environment. These utilities consist of commands that enhance the user interface to the Unix system environment. They also give the user access to commands for controlling command priority and changing environmental variables, among others.
- Editing. These are text editors based on a consistent set of commands designed for use by both inexperienced and expert users. The editors include both screen and text editing capabilities.
- Calculator. These utilities allow the user to employ the mathematical capabilities of the Unix operating system. The principal feature is an interactive processor for a language that resembles the C language but provides precision arithmetic.

The Unix System V utilities are bundled with the core system in all versions of Unix System V except that which runs on the 3B2/300; utilities for that system are available separately.

Also available for the 3B5 and 3B2/300 computers is the *Software Generation System (SGS)*, a package of tools used to create and test programs for WE 32000 series micro-processors. The SGS includes 11 utilities that can examine and manipulate object files, performing the following functions:

- Check the contents of an object file.
- Convert WE 32000 processor object files from one host machine format to another.
- Compress object files by removing duplicate structure and union descriptors.
- Disassemble object files to allow assembly-level debugging.
- Dump selected parts of the named object files.
- Produce a C language source list with line numbers specifying where breakpoints can be inserted.
- Generate an ordered listing of object files suitable for link editing in one pass.
- Print the symbol table for an object file.
- Report the number of bytes of text, uninitialized data, and initialized data (and their sum) included in an object module.
- Reduce file storage overhead by removing symbolic testing information from an object file.
- Perform symbolic debugging on C language code. ►

AT&T 3B Computer Family

► Because the SGS operates under Unix System V, it can use features of the Unix system shell.

OFFICE AUTOMATION: *Handle*, developed by Handle Corporation and available from AT&T for both 3B5 and 3B2/300 computers, is an office automation package integrating tools for text, data, graphics, and spreadsheets. It comprises two principal modules: *Writer/Spell/List*, for word processing and file management, and *Calc/Graph*, for spreadsheets and charts. The modules are available separately or in a single package.

APPLICATIONS: The *Communications Management Control System* is an on-line package that runs on 3B5 computers and provides financial and facilities tracking support for large PBX systems built around AT&T's Dimension (FP8) and System 85 PBXs. Call record data is stored on-line for rating, billing, and tracking. The package comprises six subsystems: Toll, Inventory, Accounts Receivable, Traffic, Billing, and Sales Administration.

The *AT&T Business Accounting System*, applicable on 3B5 and 3B2/300 systems, is a family of multiuser accounting systems written in RM/Cobol; it can be used by companies with up to one billion dollars in sales. The package comprises five modules: Accounts Receivable, Payroll, Accounts Payable, Order and Inventory Management, and General Ledger.

The *AT&T Gift Registry System* is an on-line, interactive data base providing a centralized registry system through which retail stores can track gift selections. The system runs on the 3B5 and 3B2/300 systems, and can produce management information reports to track sales results and slow-moving items while projecting future merchandise requirements.

C-Isam is a library of C language functions to create and manipulate indexed file systems; it employs an indexed sequential data access method. When the C-Isam library has been linked to a user program, it can perform all tasks necessary for the maintenance and manipulation of a user-defined file system. Developed by Relational Database Systems, Inc., C-Isam runs on 3B5 and 3B2/300 systems.

Microsoft Word, developed by Microsoft Corporation, is applicable to both 3B5 and 3B2/300 systems. It provides editing and formatting capabilities for document preparation and phototypesetting. The system employs a menu-based user interface and permits simultaneous display of up to eight screen windows.

Multiplan, for the 3B2/300 and 3B5 computers, is an electronic spreadsheet package that supports entry and manipulation of numerical data. Providing methods of copying, moving, saving, and manipulating data within a spreadsheet, Multiplan can be used for financial processing, modeling, or what-if analysis in both personal and business environments. Multiplan was developed by Microsoft Corporation.

PRICING

POLICY: The 3B Computers are available for purchase or lease. Volume discounts for all systems are available. List prices for all systems are quoted in the EQUIPMENT PRICES information following. The purchase price for software includes a one-time use license fee. Maintenance fees are provided on a monthly basis. Separate price schedules for spares and growth, software licensing, and fee schedules are also available.

SUPPORT: AT&T offers tailored maintenance agreements for 3B Computer systems. The agreements include combinations of toll-free hotline assistance for hardware and software and on-site service by field service technicians.

Hotline service can include remote diagnostics services, in some cases. Calls will be accepted from any of a customer's employees; for those problems that cannot be resolved by telephone, a systems technician will be dispatched to the user's site.

On-site service options include:

- Business day service, AT&T's standard maintenance agreement, which provides coverage from 8 a.m. to 5 p.m. Monday through Friday.
- Around-the-clock service, which extends coverage to 24 hours a day, seven days a week, including holidays.
- Dedicated service, which allows customers to have technicians on-site for one, two, or three shifts a day for five, six, or seven days a week.
- Per-occurrence service on a time-and-materials basis.

AT&T also offers software-only services. Options include:

- Hotline assistance, 8 a.m. to 5 p.m. Monday through Friday in all time zones.
- Hotline assistance plus on-site visits by technicians, 8 a.m. to 5 p.m. Monday through Friday.
- Hotline assistance plus on-site visits by technicians 24 hours a day, seven days a week, including holidays.
- Hotline assistance plus on-site technicians' visits charged on a noncontract, per-occurrence, time-and-materials basis.

The 3B systems have 90-day warranties; during that period, customers receive Business day service and hotline assistance.

TRAINING: AT&T provides hardware and software training at national and regional centers. The company also provides on-premises training in complex software packages.

TYPICAL CONFIGURATIONS: The following tables show typical 3B Computer configurations.

The following is a typical 3B2/300 configuration.

3B2/300 expanded standard configuration; includes:	\$15,510
WE 32000 CPU	
1MB main memory	
Two RS-232-C ports, cables, and connectors	
Cabinet	
720KB floppy disk	
32MB Winchester disk drive	
I/O expansion card with four RS-232-C ports and a Centronics parallel printer port	
Unix System V core and standard utilities	
Four Dataspeed 4410 terminals	4,580
Model 470 120 cps printer with Centronics interface	695
Total Price	\$20,785

AT&T 3B Computer Family

► The following is a typical 3B5/300 configuration:

3B3/300, Model C; includes:	\$122,600
10MHz CPU, 8KB cache memory Basic processor cabinet (BPC) with cooling, power, and Basic Cabinet Unit Four 1MB main memory modules Intelligent tape controller and 9-track tape drive in BPC Growth Control Unit Integrated Disk File Controller Storage Module Drive Controller Cabling Three Asynchronous Data Link Interfaces Unix System V operating system Two 160MB FSD fixed disk drives	
24 Dataspeed 4410 Terminals	27,480
Three Model 475 120 cps dot-matrix printers	2,235
Total Price	\$152,315

The following is a typical 3B20S configuration:

3B20S, Package A; includes:	\$230,000
CPU with 8KB cache memory 2MB main memory Input/Output Processor Disk File Controller 8-channel asynchronous communications controller 300MB removable disk drive 1600 bpi tape drive and controller Operator CRT and console printer Unix System V operating system Two 1MB add-on memory circuit packs	
Two 300MB add-on removable disk drives (single-port)	9,800
Six 8-channel asynchronous communications controllers	48,000
1200 lpm band printer	24,000
40 Dataspeed 4410 terminals	23,500
Total Price	\$381,100

EQUIPMENT PRICES

	Purchase Price (\$)	Monthly Maint.* (\$)
3B20 SYSTEM PACKAGES		
Package A		
J3B200SA2-1	230,000	1,833.00
Consists of 3B20S computer, 2M bytes memory, 300M bytes disk storage equipped with 10-ft. cables, disk file controller, tape unit (125 ips, 1600 bpi), 8-line asynchronous controller, operator CRT and console printer, and Unix operating system.**		
Package B		
J3B200SB2-1	235,000	1,922.00
Consists of 3B20S computer, 2M bytes memory, 675M bytes disk storage equipped with 10-ft. cables, disk file controller, tape unit (125 ips, 1600 bpi), 8-line asynchronous controller, operator CRT and console printer, and Unix operating system.**		
Package C		
J3B200SC2-1	255,000	2,230.00
Consists of 3B20S computer, 2M bytes memory, 675M bytes disk storage equipped with 10-ft. cables, disk file controller, tape unit (1600/6250 bpi), tape I/O processor, 8 line asynchronous controller, operator CRT and console printer, and Unix operating system.**		
Package E		
J3B200SE2-1	330,000	1,920.00
Consists of 3B20A computer, 2M bytes memory/CPU, 300M bytes disk storage equipped with 10-ft. cables, disk file controller, tape unit (125 ips, 1600 bpi), 8-line asynchronous controller, operator CRT and console printer, and Unix operating system.**		
Package F		
J3B200SF2-1	335,000	2,010.00
Consists of 3B20A computer, 2M bytes memory/CPU, 675M bytes disk storage equipped with 10-ft. cables, disk file controller, tape unit (125 ips, 1600 bpi) 8-line asynchronous controller, operator CRT and console printer, and Unix operating system.**		

NA—Not applicable.

* National average; price will vary depending on geographic location.

** The Unix operating system carries a monthly maintenance charge of \$350.

*** Indicates that the order number or price was not supplied by AT&T.

**** The maintenance charge is an annual one, at 12 percent of the list price.

***** The maintenance charge is an annual one, at 15 percent of the list price.

† An X in the eighth character position in a 3B20S or 3B20A order code represents the model number of any of the available packages (A, B, C for 3B20S and E, F, G for 3B20A).

†† An X in the seventh character position in a 3B5/100 or 3B5/200 order code represents the model number of any of the available packages (A, B, C, D for the 100 and E, F, G for the 200).

AT&T 3B Computer Family

		<u>Purchase Price (\$)</u>	<u>Monthly Maint.* (\$)</u>
Package G			
J3B200SG2-1	Consists of 3B20A computer, 2M bytes memory/CPU, 675M bytes disk storage equipped with 10-ft. cables, disk file controller, tape unit (1600/6250 bpi), tape I/O processor, 8-line asynchronous controller, operator CRT and console printer, and Unix operating system.**	355,000	2,324.00
3B20D CORE PACKAGE			
J3B203SA1-1	Consists of 3B20D computer, 2 CPUs, IOP0 arranged for 2 I/O communities, two 340MB Winchester disks, color video maintenance terminal & controller (w/100-ft. cable), scan/signal distributor, dual serial channel, DMA 0, maintenance channel, 4K of writable microstore, 4K of microcode, 9-track tape unit (25 ips, 1600 bpi) and controller, 5M bytes of main store memory, main store update, port switch, power conditioning cabinet (converts 208 V 3-phase AC power to 48 V DC), fuse unit and cooling fans.	340,000	***
3B5 SYSTEM PACKAGES			
Model 100A			
J3B500A1-List 1	Includes: basic system cabinet and hardware (power-conditioning, basic card cage and backplane, fan and filter units, and terminal connections); 7.2MHz central control; main store controller card; 1MB memory card; cache memory Integrated Disk File Controller; Storage Module Drive Controller (provides interface for up to 2 disk drives); 5 user-selectable I/O slots, includes Basic Cabinet Unit (BCU); 48MB Lark II disk drive (unformatted capacity); 300-baud asynchronous maintenance port; Asynchronous Data Line Interface (ADLI board) providing 8 RS-232-C EIA standard asynchronous, full duplex communications ports; cache memory; Unix System V operating system (binary).	57,000	269.00
Model 100B			
J3B500B1-List 1	Basic system cabinet and hardware (power conditioning, basic card cage and backplane, fan and filter units, and external power and terminal connections); growth control unit, providing 4 additional slots for main memory and 13 additional I/O board slots; 7.2MHz central control; main store controller card; two 1MB memory cards; cache memory; Integrated Disk File Controller; Storage Module Drive Controller (provides interface for up to two disk drives); 15 user-selectable I/O slots (includes BCU); 48MB Lark II disk drive (unformatted capacity); 300-baud asynchronous maintenance port; Asynchronous Data Link Interface (ADLI board), providing 8 RS-232-C EIA standard asynchronous, full duplex communications ports; Unix System V operating system (binary).	61,000	288.00
Model 100C			
J3B500C1-List 1	Basic system cabinet and hardware (contains power conditioning, basic card cage and backplane, fan and filter units, and external power and terminal connections); 7.2MHz central control; main store controller card; 1MB memory card; cache memory; Integrated Disk File Controller; Storage Module Drive Controller (provides interface for up to 2 disk drives); 4 user-selectable I/O slots (BCU only); 48MB Lark II disk drive (unformatted capacity); 9-track 1600 bpi tape unit and ITC; 300 baud asynchronous maintenance port; Asynchronous Data Link Interface (ADLI board) providing 8 RS-232-C EIA standard asynchronous, full duplex communications ports; Unix System V operating system (binary).	66,000	311.00
Model 100D			
J3B500D1-List 1	Basic system cabinet and hardware (contains power conditioning, basic card cage and backplane, fan and filter units, and external power and terminal connections); growth control unit (provides 4 additional slots for main memory and 13 additional I/O board slots); 7.2MHz central control; main store controller card; Two 1MB memory cards; cache memory; Integrated Disk File Controller; Storage Module Drive Controller (provides interface for up to two disk drives); 14 user-selectable I/O slots including BCU and Growth Control Unit (GCU); 48MB Lark II disk drive (unformatted capacity); 9-track 1600 bpi tape unit and ITC; 300-baud asynchronous maintenance port; Asynchronous Data Link Interface (ADLI board), providing eight RS-232-C EIA standard asynchronous, full duplex communications ports; Unix System V operating system (binary).	70,000	313.00

NA—Not applicable.

* National average; price will vary depending on geographic location.

** The Unix operating system carries a monthly maintenance charge of \$350.

*** Indicates that the order number or price was not supplied by AT&T.

**** The maintenance charge is an annual one, at 12 percent of the list price.

***** The maintenance charge is an annual one, at 15 percent of the list price.

† An X in the eighth character position in a 3B20S or 3B20A order code represents the model number of any of the available packages (A, B, C for 3B20S and E, F, G for 3B20A).

†† An X in the seventh character position in a 3B5/100 or 3B5/200 order code represents the model number of any of the available packages (A, B, C, D for the 100 and E, F, G for the 200).

AT&T 3B Computer Family

		<u>Purchase Price (\$)</u>	<u>Monthly Maint.* (\$)</u>
► Model 200E			
J3B500E2-List 1	Basic system cabinet and hardware (two 31 by 31 by 30 inch cubes containing power conditioning. The basic card cage, backplane, and GCU are in the first cabinet, the ELB in the second cabinet). Package includes all necessary fan and filter units and external power and terminal connections; also includes: 10MHz central control; main store controller card; Two 1MB memory cards; cache memory; Integrated Disk File Controller; Storage Module Drive Controller (provides interface for up to two disk drives); 27 user-selectable I/O slots including BCU, GCU, and Extended Local Bus (ELB); 48MB Lark II disk drive (unformatted capacity); 300-baud asynchronous maintenance port; Asynchronous Data Link Interface (ADLI board) providing eight RS-232-C EIA standard asynchronous, full-duplex communications ports; Input/Output Accelerator (IOA); Unix System V operating system (binary).	73,000	324.00
Model 200F			
J3B500F2-List 1	Basic system cabinet and hardware (two 31 by 31 by 30 inch cubes containing power conditioning). The basic card cage and backplane and the GCU are in the first cabinet; the ELB is in the second cabinet). Package includes all necessary fan and filter units, and external power and terminal connections. Also includes: 10MHz central control; main store controller card; Two 1MB memory cards; cache memory; Integrated Disk File Controller; Storage Module Drive Controller (provides interface for up to two disk drives); 26 user-selectable I/O slots (includes BCU, GCU, and ELB); 48MB Lark II disk drive (unformatted capacity); 300-baud asynchronous maintenance port; Asynchronous Data Link Interface (ADLI board) providing eight RS-232-C EIA standard asynchronous, full duplex communications ports; 9-track 1600 BPI tape unit and ITC; IOA; Unix System V operating system (binary).	82,000	162.00
Model 200G			
J3B500G2-List 1	Basic system cabinet and hardware (two 31 by 31 by 30 inch cubes containing power conditioning, the basic card cage and backplane and the GCU in the first cabinet; the ELB is in the second cabinet. Package includes all necessary fan and filter units, and external power and terminal connections. Also includes: 10MHz central control; main store controller card; Two 1MB memory cards; cache memory; Integrated Disk File Controller; Storage Module Drive Controller (provides interface for up to two disk drives); 26 user-selectable I/O slots (includes BCU, GCU, and ELB); 48MB Lark II disk drive (unformatted capacity); 300-baud asynchronous maintenance port; Asynchronous Data Link Interface (ADLI board) providing eight RS-232-C EIA standard asynchronous, full duplex communications ports; two 9-track 1600 bpi tape units and one ITC; IOA; Unix System V operating system (binary).	91,000	391.00
<p>The following packages, for the 3B5/300, contain the following core components: 10MHz CPU; basic processor cabinet (BPC) with cooling, power, and BCU; 1MB memory module; intelligent tape controller and 9-track tape drive in BPC; growth control unit; Integrated Disk File Controller; Storage Module Drive Controller; cabling for L200 and L201; and Unix System V operating system (binary).</p>			
Model 300A			
7350-390	Includes core components, plus 160MB fixed disk (unformatted capacity); two 1MB add-on memory modules; I/O Accelerator; direct IOA async port; two Asynchronous Data Link Interfaces (ADLI); ACU interface; two connectors for L300 and L310; and door for BPC.	101,500	****
Model 300B			
7350-391	Same as 7350-390, but with three 1MB add-on memory modules, three ADLIs, and three connectors for L300 and L310.	108,600	****
Model 300C			
7350-392	Same as 7350-391, but with a second 160MB fixed disk.	122,600	***** ►

NA—Not applicable.

* National average; price will vary depending on geographic location.

** The Unix operating system carries a monthly maintenance charge of \$350.

*** Indicates that the order number or price was not supplied by AT&T.

**** The maintenance charge is an annual one, at 12 percent of the list price.

***** The maintenance charge is an annual one, at 15 percent of the list price.

† An X in the eighth character position in a 3B20S or 3B20A order code represents the model number of any of the available packages (A, B, C for 3B20S and E, F, G for 3B20A).

†† An X in the seventh character position in a 3B5/100 or 3B5/200 order code represents the model number of any of the available packages (A, B, C, D for the 100 and E, F, G for the 200).

AT&T 3B Computer Family

		Purchase Price (\$)	Monthly Maint.* (\$)
▶	Model 300D		
	7350-393 Same as 7350-392, but with four 1MB add-on memory modules, two I/O Accelerators, and a Synchronous Data Link Interface.	141,000	****
	Model 300E		
	7350-394 Same as 7350-393, but with four ADLs, four connectors for L300 and L310, a third 160MB fixed disk with SMD controller, a growth cabinet, and a full door for the growth cabinet.	156,200	****
	Model 300F		
	7350-395 Same as 7350-392, but with two I/O accelerators, four ADLs, and four connectors for L300 and L310.	131,800	****
	Model 300G		
	7350-396 Same as 7350-395, but with four 1MB add-on memory modules, five ADLs, and five connectors for L300 and L310.	138,900	****
	Model 300H		
	7350-397 Same as 7350-396, but with five 1MB add-on memory modules, six ADLs, six connectors for L300 and L310, a third 160MB fixed disk and SMD controller, a growth cabinet, and a full door for the growth cabinet.	159,000	****
	Model 300I		
	7350-398 Same as 7350-397, but with three I/O Accelerators, a Synchronous Data Link Interface, a fourth 160MB fixed disk, and an Extended Local Bus.	196,300	****
	Model 300J		
	7350-382 Same as 7350-392, but with 3BNet interface card, 10-meter (32.8-ft.) cable, and software.	133,600	****
	Model 300K		
	7350-385 Same as 7350-394, but without Synchronous Data Link Interface and including 3BNet interface card, 10-meter (32.8-ft.) cable, and software.	160,700	****
	Model 300L		
	7350-387 Same as 7350-397, but with fourth 160MB fixed disk and 3BNet interface card, 10-meter (32.8-ft.) cable, and software.	183,000	****
	3B2/300 SYSTEM PACKAGES		
	Basic Configuration		
	7320-300 3B2/300 Computer system, including: WE32000 microprocessor; 512KB main memory; two integral RS-232-C ports; two RS-232-C cables and connectors; low-profile cabinet; 720KB minifloppy; 10MB Winchester disk; Unix System V operating system and standard utilities; three-volume set of user documentation; also includes 90-day hardware warranty and software information and update service.	9,950	*****
	Standard Configuration		
	7320-301 3B2/300 Computer system, including: WE32000 microprocessor; 1MB main memory; two integral RS-232-C ports; two RS-232-C cables and connectors; low-profile cabinet; 720KB minifloppy; 32MB Winchester disk; Unix System V operating system and standard utilities; three-volume set of user documentation; also includes 90-day hardware warranty and software information and update service.	15,125	*****

NA—Not applicable.

* National average; price will vary depending on geographic location.

** The Unix operating system carries a monthly maintenance charge of \$350.

*** Indicates that the order number or price was not supplied by AT&T.

**** The maintenance charge is an annual one, at 12 percent of the list price.

***** The maintenance charge is an annual one, at 15 percent of the list price.

† An X in the eighth character position in a 3B20S or 3B20A order code represents the model number of any of the available packages (A, B, C for 3B20S and E, F, G for 3B20A).

†† An X in the seventh character position in a 3B5/100 or 3B5/200 order code represents the model number of any of the available packages (A, B, C, D for the 100 and E, F, G for the 200).

AT&T 3B Computer Family

Purchase Price (\$)	Monthly Maint.* (\$)
---------------------------	----------------------------

► **Expanded Standard Configuration**

7320-302	3B2/300 Computer system, including: WE32000 microprocessor; 1MB main memory; two integral RS-232-C ports; two RS-232-C cables and connectors; low-profile cabinet; 720KB minifloppy; 32MB Winchester disk; I/O expansion card (includes four RS-232-C ports and a Centronics parallel printer port); Unix System V operating system and standard utilities; three-volume set of user documentation; also includes 90-day hardware warranty and software information and update service.	15,510	*****
----------	---	--------	-------

CPU OPTIONS

3B20S/3B20A†

J3B200SX2-2	Additional 4K microcode	4,500	5.00
J3B200SX2-3	Floating point unit	NA	NA
J3B200SX2-4	Additional DMA Controller	5,500	8.00
J3B200SX2-5	Additional dual serial channel pack	2,900	10.00

3B20D

J3B203SA 1-3	Additional DMA Controller for DMA1	11,000	***
J3B203SA 1-4	Cache memory (8KB)	20,000	***
J3B203SA 1-5	4K of additional writable microcode	9,000	***
J3B203SA 1-6	Additional dual serial channel	5,800	***
J3B203SA 1-7	Additional 5V power (for any of the above options)	1,500	***
J3B203SA 1-8	Utility test circuit	6,500	***
J3B203SA 1-9	Scan Signal distributor peripheral controller (not duplicated)	8,500	***

3B5/100

J3B500A1-List 4	10MHz central control	10,000	15.00
-----------------	-----------------------	--------	-------

MEMORY OPTIONS

3B20S/3B20A†

J3B200SX2-6	1MB circuit pack	4,900	5.00
J3B200SX2-7	Power mod (required when memory totals more than 8MB or when additional DMA Controller is provided)	1,000	NA

3B20D

J3B203SA1-14	Additional 1MB main memory	9,800	***
J3B203SA1-15	Main store growth unit (required for memory beyond 8MB)	10,200	***
J3B203SA1-16	Additional power for memory or dual serial channel packs in growth unit	1,925	***
J3B203SA1-17	Bus terminating assembly and memory growth control cables (required if memory is in growth unit)	1,100	***

3B5/100

J3B500A1-List 2	1MB main memory	4,900	8.00
-----------------	-----------------	-------	------

3B5/200

J3B500E1-List 2	1MB main memory	4,900	8.00
-----------------	-----------------	-------	------

3B2/300

73201	1MB expansion memory	2,200	***** ►
-------	----------------------	-------	---------

NA—Not applicable.

* National average; price will vary depending on geographic location.

** The Unix operating system carries a monthly maintenance charge of \$350.

*** Indicates that the order number or price was not supplied by AT&T.

**** The maintenance charge is an annual one, at 12 percent of the list price.

***** The maintenance charge is an annual one, at 15 percent of the list price.

† An X in the eighth character position in a 3B20S or 3B20A order code represents the model number of any of the available packages (A, B, C for 3B20S and E, F, G for 3B20A).

†† An X in the seventh character position in a 3B5/100 or 3B5/200 order code represents the model number of any of the available packages (A, B, C, D for the 100 and E, F, G for the 200).

AT&T 3B Computer Family

Purchase Price (\$)	Monthly Maint.* (\$)
---------------------------	----------------------------

▶ INPUT/OUTPUT OPTIONS

The 3B20S, 3B20A, and 3B20D have optional Input/Output processors (IOPs) that provide common interfaces for peripheral and disk file controllers. The IOP comprises a basic section (BIOP) and a growth section (GIOP). The growth section supports an additional Disk File Controller (DFC). Options vary from package to package. The 3B5 systems have optional I/O Accelerators (IOAs), and the 3B2/300 has optional I/O expansion cards.

3B20S, Package A

J3B200SA2-100	Second BIOP (TAG) with fan and power units, DSCH cable.	24,500	203.00
J3B200SA2-101	Third BIOP (SEC)	18,000	203.00
J3B200SA2-102	Fan and power units, DSCH cable. (if there is a second 1600 bpi tape)	6,100	Incl.
J3B200SA2-103	Expansion cabinet, fan and power units, DSCH cable (if there is no second 1600 bpi tape).	10,100	Incl.
J3B200SA2-104	Fourth BIOP (SEC)	18,000	203.00
J3B200SA2-105	Fan and power units, DSCH cable (if there are second and third 1600 bpi tapes)	6,100	Incl.
J3B200SA2-106	Expansion cabinet fan and power units, DSCH cable (if there is a second 1600 bpi tape and no third 1600 bpi tape)	10,100	Incl.
J3B200SA2-107	DSCH cable (if there is no second and no third 1600 bpi tape)	125	Incl.
J3B200SA2-108	Second GIOP (TAG)	7,500	34.00
J3B200SA2-109	Third GIOP (SEC)	7,500	34.00
J3B200SA2-110	Fourth GIOP (SEC)	7,500	34.00
J3B200SA2-111	Second DFC (TAG), with DSCH cable.	14,500	139.00
J3B200SA2-112	Third DFC (SEC)	14,500	139.00
J3B200SA2-113	DSCH cable (if there is a second 1600 bpi tape)	125	Incl.
J3B200SA2-114	DSCH cable (if there is no second 1600 bpi tape)	125	Incl.
J3B200SA2-115	Fourth DFC (SEC)	14,500	139.00
J3B200SA2-116	DSCH cable (if there are second and third 1600 bpi tapes)	125	Incl.
J3B200SA2-117	DSCH cable (if there is a second 1600 bpi tape and no third 1600 bpi tape)	125	Incl.
J3B200SA2-118	DSCH cable (if there is no second and no third 1600 bpi tape)	125	Incl.

3B20S, Package B

J3B200SB2-100	Second BIOP (SEC)	18,000	203.00
J3B200SB2-101	Fan and power units, DSCH cable (if there is a second 1600 bpi tape)	6,100	Incl.
J3B200SB2-102	Expansion cabinet, fan and power units, DSCH cable (if there is no second 1600 bpi tape)	10,100	Incl.
J3B200SB2-103	Third BIOP (SEC)	18,000	203.00
J3B200SB2-104	Fan and power units, DSCH cable (if there are second and third 1600 bpi tapes)	6,100	Incl.
J3B200SB2-105	Expansion cabinet, fan and power units, DSCH cable (if there is a second 1600 bpi tape and no third 1600 bpi tape)	10,100	Incl.
J3B200SB2-106	DSCH cable. (if there is no second and no third 1600 bpi tape)	125	Incl.
J3B200SB2-107	Second GIOP (SEC)	7,500	34.00
J3B200SB2-108	Third GIOP (SEC)	7,500	34.00
J3B200SB2-109	Second DFC (SEC)	14,500	139.00
J3B200SB2-110	DSCH cable (if there is a second 1600 bpi tape)	125	Incl.
J3B200SB2-111	DSCH cable (if there is no second 1600 bpi tape)	125	Incl.
J3B200SB2-112	Third DFC (SEC)	14,500	139.00
J3B200SB2-113	DSCH cable (if there are second and third 1600 bpi tapes)	125	Incl.
J3B200SB2-114	DSCH cable (if there is a second 1600 bpi tape and no third 1600 bpi tape)	125	Incl.
J3B200SB2-115	DSCH cable (if there is no second and no third 1600 bpi tape)	125	Incl.

3B20S, Package C

J3B200SC2-100	Second BIOP (TAG) with DSCH cable	18,000	192.00
J3B200SC2-101	Third BIOP (SEC)	18,000	203.00
J3B200SC2-102	Fan and power units, DSCH cable (if there is a first 1600 bpi tape)	6,100	Incl.
J3B200SC2-103	Expansion cabinet, fan and power units, DSCH cable (if there is no 1600 bpi tape)	10,100	Incl.
J3B200SC2-104	Second GIOP (TAG)	7,500	34.00
J3B200SC2-105	Third GIOP (SEC)	7,500	34.00
J3B200SC2-106	Second DFC (TAG), with DSCH cable	14,500	139.00
J3B200SC2-107	Third DFC (SEC)	14,500	139.00
J3B200SC2-108	DSCH cable (if there is a first 1600 bpi tape)	125	Incl.
J3B200SC2-109	DSCH cable (if there is no 1600 bpi tape)	125	Incl.

NA—Not applicable.

* National average; price will vary depending on geographic location.

** The Unix operating system carries a monthly maintenance charge of \$350.

*** Indicates that the order number or price was not supplied by AT&T.

**** The maintenance charge is an annual one, at 12 percent of the list price.

***** The maintenance charge is an annual one, at 15 percent of the list price.

† An X in the eighth character position in a 3B20S or 3B20A order code represents the model number of any of the available packages (A, B, C for 3B20S and E, F, G for 3B20A).

†† An X in the seventh character position in a 3B5/100 or 3B5/200 order code represents the model number of any of the available packages (A, B, C, D for the 100 and E, F, G for the 200).

AT&T 3B Computer Family

		Purchase Price (\$)	Monthly Maint.* (\$)
3B20A, Package E			
J3B200SE2-100	Second BIOP (PIOC-1) with DSCH cable	18,000	194.00
J3B200SE2-101	Third BIOP (TAG), with fan and power units, DSCH cable	24,500	203.00
J3B200SE2-102	Fourth BIOP (SEC)	18,000	203.00
J3B200SE2-103	Fan and power units, DSCH cable (if there is a second 1600 bpi tape)	6,100	Incl.
J3B200SE2-104	Expansion cabinet, fan and power units, DSCH cable (if there is no second 1600 bpi tape)	10,100	Incl.
J3B200SE2-105	Second GIOP (PIOC-1)	7,500	34.00
J3B200SE2-106	Third GIOP (TAG)	7,500	34.00
J3B200SE2-107	Fourth GIOP (SEC)	7,500	34.00
J3B200SE2-108	Second DFC (PIOC-1) with DSCH	14,500	139.00
J3B200SE2-109	Third DFC (TAG) with DSCH	14,500	139.00
J3B200SE2-110	Fourth DFC (SEC)	14,500	139.00
J3B200SE2-111	DSCH cable (if there is a second 1600 bpi tape)	125	Incl.
J3B200SE2-112	DSCH cable (if there is no second 1600 bpi tape)	125	Incl.
3B20A, Package F			
J3B200SF2-100	Second BIOP PIOC-1 with DSCH cable	18,000	194.00
J3B200SF2-101	Third BIOP (SEC)	18,000	203.00
J3B200SF2-102	Fan and power units, DSCH cable (if there is a second 1600 bpi tape)	6,100	Incl.
J3B200SF2-103	Expansion cabinet fan and power unit, DSCH cable (if there is no second 1600 bpi tape)	10,100	Incl.
J3B200SF2-104	Second GIOP (PIOC-1)	7,500	34.00
J3B200SF2-105	Third GIOP (SEC)	7,500	34.00
J3B200SF2-106	Second DFC (PIOC-1) with DSCH cable	14,500	139.00
J3B200SF2-107	Third DFC (SEC)	14,500	139.00
J3B200SF2-108	DSCH cable (if there is a second 1600 bpi tape)	125	Incl.
J3B200SF2-109	DSCH cable (if there is no second 1600 bpi tape)	125	Incl.
3B20A, Package G			
J3B200SG2-100	Second BIOP (PIOC-1) with DSCH cable	18,000	194.00
J3B200SG2-101	Third BIOP (TAG) with DSCH cable	18,000	192.00
J3B200SG2-102	Second GIOP (PIOC-1)	7,500	34.00
J3B200SG2-103	Third GIOP (TAG)	7,500	34.00
J3B200SG2-104	Second DFC (PIOC-1) with DSCH cable	14,500	139.00
J3B200SG2-105	Third DFC (TAG) with DSCH cable	14,500	139.00
3B20D Core Package			
J3B203SA 1-18	Tape controller for second tape unit (not duplicated)	2,500	***
J3B203SA 1-19	Asynchronous peripheral controller (not duplicated) with two duplex and two half-duplex	3,700	***
J3B203SA 1-20	Two-channel 9600 bps synchronous peripheral controller (not duplicated)	4,100	***
J3B203SA 1-21	BX.25 56K-bit Datalink (not duplicated)	5,000	***
J3B203SA 1-22	Growth unit (if total individual peripheral control packs exceed 16)	10,200	***
J3B203SA 1-23	Additional 5V power (if dual serial channel is in growth unit)	1,925	***
J3B203SA 1-24	IOP Community 2 power & cables	2,900	***
J3B203SA 1-25	IOP Community 3 power & cables	2,900	***
J3B203SA 1-26	Second IOP basic unit (incl. exterior cabinet with fan & power units)	24,500	***
J3B203SA 1-27	Second IOP growth unit	3,800	***
J3B203SA 1-28	Third IOP basic unit	18,000	***
J3B203SA 1-29	Third IOP growth unit	3,800	***
J3B203SA 1-30	IOP exterior cabinet hardware (required with J3B203SA 1-26)	1,700	***
J3B203SA 1-31	IOP exterior cabinet doors & hardware (required with J3B203SA 1-26)	500	***
3B5/100††			
J3B500X1-List I01	Input/output Accelerators (IOA)	7,000	NA
J3B500A1-List	IOA direct asynchronous port	110	NA
3B5/200††			
J3B500X2-List I01	Input/output accelerators (IOA)	7,000	***
J3B500E1-List I01A	IOA direct asynchronous port	110	***
3B2/300			
73202	I/O expansion card	660	***

NA—Not applicable.

* National average; price will vary depending on geographic location.

** The Unix operating system carries a monthly maintenance charge of \$350.

*** Indicates that the order number or price was not supplied by AT&T.

**** The maintenance charge is an annual one, at 12 percent of the list price.

***** The maintenance charge is an annual one, at 15 percent of the list price.

† An X in the eighth character position in a 3B20S or 3B20A order code represents the model number of any of the available packages (A, B, C for 3B20S and E, F, G for 3B20A).

†† An X in the seventh character position in a 3B5/100 or 3B5/200 order code represents the model number of any of the available packages (A, B, C, D for the 100 and E, F, G for the 200).

AT&T 3B Computer Family

► MASS STORAGE

Purchase Price (\$)	Monthly Maint.* (\$)
---------------------	----------------------

3B20S/3B20A†

J3B200SX2-15	300MB drive, single port	24,000	305.00
J3B200SX2-16	300MB drive, dual port	26,000	305.00
J3B200SX2-17	675MB drive, single port	38,000	394.00
J3B200SX2-18	675MB drive, dual port	40,000	394.00
J3B200SX2-19	Interlock kit for 300MB drive	950	NA
J3B200SX2-20	Disk skirt for 300MB drive	195	NA
J3B200SX2-24	Disk pack for 300MB drive	1,200	NA

3B20D

J3B203SAI-L56-L77	Additional 340MB disk drive (includes cables, power unit, and power switch)	22,000	***
-------------------	---	--------	-----

3B5/100 and 3B5/200 Systems

The number of Lark II units cited includes the base unit.

3B5/100 Only:

J3B500A1-List 200	Integrated Disk File Controller (IDFC)	4,950	***
J3B500A1-List 201	Storage Module Driver Controller (SMDC)	2,850	***

3B5/200 Only:

J3B500E1-List 200	Integrated Disk File Access Controller (IDFC)	4,950	***
J3B500E1-List 201	Storage Module Drive Controller (SMDC)	2,850	***

All 3B5/100 and 3B5/200 Models:

J3B500X1-List 1A	Group A; two 48MB Lark II disk drives	12,000	162.00
J3B500X1-List 1C	Group C; four 48MB Lark II disk drives	34,000	492.00
J3B500X1-List 1E	Group E; one 48MB Lark II and one 160MB disk drive	15,000	53.00
J3B500X-List 1F	Group F; two 48MB Lark IIs and one 160MB disk drive	26,000	221.00

Model 100A:

J3B500A1-List 1B	Group B; three 48MB Lark II disk drives	23,000	330.00
J3B500A1-List 1G	Group G; three 48MB Lark IIs and one 160MB disk drive	38,000	383.00
J3B500A1-List 1I	Group I; one 48MB Lark II and two 160MB disk drives	29,000	112.00
J3B500A1-List 1J	Group J; two 48MB Lark IIs and two 160MB disk drives	41,000	274.00
J3B500A1-List 1L	Group L; one 48MB Lark II and three 160MB disk drives	42,000	165.00

Model 100B:

J3B500B1-List 1B	Group B; three 48MB Lark II disk drives	23,000	248.00
J3B500B1-List 1G	Group G; three 48MB Lark IIs and one 160MB disk drive	38,000	383.00
J3B500B1-List 1I	Group I; one 48MB Lark II and two 160MB disk drives	29,000	112.00
J3B500B1-List 1J	Group J; two 48MB Lark IIs and two 160MB disk drives	41,000	274.00
J3B500B1-List 1L	Group L; one 48MB Lark II and three 160MB disk drives	42,000	165.00

Model 100C:

J3B500C1-List 1B	Group B; three 48MB Lark II disk drives	23,000	330.00
J3B500C1-List 1D	Group D; one 160MB disk drive	7,000	***
J3B500C1-List 1G	Group G; three 48MB Lark IIs and one 160MB disk drive	38,000	383.00
J3B500C1-List 1H	Group H; two 160MB disk drives	21,000	***
J3B500C1-List 1I	Group I; one 48MB Lark II and two 160MB disk drives	29,000	112.00
J3B500C1-List 1J	Group J; two 48MB Lark IIs and two 160MB disk drives	41,000	274.00
J3B500C1-List 1K	Group K; three 160MB disk drives	34,000	***
J3B500C1-List 1L	Group L; one 48MB Lark II and three 160MB disk drives	42,000	165.00
J3B500C1-List 1M	Group M; four 160MB disk drives	47,000	***

NA—Not applicable.

* National average; price will vary depending on geographic location.

** The Unix operating system carries a monthly maintenance charge of \$350.

*** Indicates that the order number or price was not supplied by AT&T.

**** The maintenance charge is an annual one, at 12 percent of the list price.

***** The maintenance charge is an annual one, at 15 percent of the list price.

† An X in the eighth character position in a 3B20S or 3B20A order code represents the model number of any of the available packages (A, B, C for 3B20S and E, F, G for 3B20A).

†† An X in the seventh character position in a 3B5/100 or 3B5/200 order code represents the model number of any of the available packages (A, B, C, D for the 100 and E, F, G for the 200).

AT&T 3B Computer Family

		Purchase Price (\$)	Monthly Maint.* (\$)
Model 100D:			
J3B500D1-List 1B	Group B; three 48MB Lark II disk drives	23,000	330.00
J3B500D1-List 1D	Group D; one 160MB disk drive	7,000	***
J3B500D1-List 1G	Group G; three 48MB Lark IIs and one 160MB disk drive	38,000	112.00
J3B500D1-List 1H	Group H; two 160MB disk drives	21,000	162.00
J3B500D1-List 1I	Group I; one 48MB Lark II and two 160MB disk drives	29,000	274.00
J3B500D1-List 1J	Group J; two 48MB Lark IIs and two 160MB disk drives	41,000	274.00
J3B500D1-List 1K	Group K; three 160MB disk drives	34,000	***
J3B500D1-List 1L	Group L; one 48MB Lark II and three 160MB disk drives	42,000	165.00
J3B500D1-List 1M	Group M; four 160MB disk drives	47,000	56.00
Model 200E:			
J3B500E2-List 1B	Group B; three 48MB Lark II disk drives	23,000	330.00
J3B500E2-List 1G	Group G; three 48MB Lark IIs and one 160MB disk drive	38,000	383.00
J3B500E2-List 1I	Group I; one 48MB Lark II and two 160MB disk drives	29,000	112.00
J3B500E2-List 1J	Group J; two 48MB Lark IIs and two 160MB disk drives	41,000	221.00
J3B500E2-List 1L	Group L; one 48MB Lark II and three 160MB disk drives	42,000	***
Model 200F:			
J3B500F2 List-1B	Group B; three 48MB Lark II disk drives	23,000	249.00
J3B500F2 List-1D	Group D; one 160MB disk drive	7,000	***
J3B500F2 List-1G	Group G; three 48MB Lark IIs and one 160MB disk drive	38,000	86.00
J3B500F2 List-1H	Group H; two 160MB disk drives	21,000	***
J3B500F2 List-1I	Group I; one 48MB Lark II and two 160MB disk drives	29,000	112.00
J3B500F2 List-1J	Group J; two 48MB Lark IIs and two 160MB disk drives	41,000	274.00
J3B500F2 List-1K	Group K; three 160MB disk drives	34,000	84.00
J3B500F2 List-1L	Group L; one 48MB Lark II and three 160MB disk drives	42,000	165.00
J3B500F2 List-1M	Group M; four 160MB disk drives	47,000	56.00
Model 200G:			
J3B500G2 List-1B	Group B; three 48MB Lark II disk drives	23,000	249.00
J3B500G2 List-1D	Group D; one 160MB disk drive	7,000	***
J3B500G2 List-1G	Group G; three 48MB Lark IIs and one 160MB disk drive	38,000	302.00
J3B500G2 List-1H	Group H; two 160MB disk drives	21,000	***
J3B500G2 List-1I	Group I; one 48MB Lark II and two 160MB disk drives	29,000	112.00
J3B500G2 List-1J	Group J; two 48MB Lark IIs and two 160MB disk drives	41,000	274.00
J3B500G2 List-1K	Group K; three 160MB disk drives	34,000	3.00
J3B500G2 List-1L	Group L; one 48MB Lark II and three 160MB disk drives	42,000	165.00
J3B500G2 List-1M	Group M; four 160MB disk drives	47,000	56.00

MAGNETIC TAPE EQUIPMENT

3B20S, Package A

J3B200SA2-119	Second 1600 bpi tape transport; without formatter, expansion cabinet, and cabling	16,000	118.00
J3B200SA2-120	Third 1600 bpi tape transport; equipped with formatter, expansion cabinet, and cabling	21,000	118.00
J3B200SA2-121	Fourth 1600 bpi tape transport; without formatter, expansion cabinet, and cabling	16,000	118.00

3B20S, Package B

J3B200SB2-116	Second 1600 bpi tape transport; without formatter, expansion cabinet, and cabling	16,000	118.00
J3B200SB2-117	Third 1600 bpi tape transport; equipped with formatter, expansion cabinet, and cabling	21,000	118.00
J3B200SB2-118	Fourth 1600 bpi tape transport; without formatter, expansion cabinet, and cabling	16,000	118.00

NA—Not applicable.

* National average; price will vary depending on geographic location.

** The Unix operating system carries a monthly maintenance charge of \$350.

*** Indicates that the order number or price was not supplied by AT&T.

**** The maintenance charge is an annual one, at 12 percent of the list price.

***** The maintenance charge is an annual one, at 15 percent of the list price.

† An X in the eighth character position in a 3B20S or 3B20A order code represents the model number of any of the available packages (A, B, C for 3B20S and E, F, G for 3B20A).

†† An X in the seventh character position in a 3B5/100 or 3B5/200 order code represents the model number of any of the available packages (A, B, C, D for the 100 and E, F, G for the 200).

AT&T 3B Computer Family

		<u>Purchase Price (\$)</u>	<u>Monthly Maint.* (\$)</u>
▶ 3B20S, Package C			
J3B200SC2-110	First 1600 bpi tape transport; equipped with formatter, controller, expansion cabinet, and cabling	21,000	126.00
J3B200SC2-111	Second 1600 bpi tape transport; without formatter, expansion cabinet, and cabling	16,000	118.00
J3B200SC2-112	Third 1600 bpi tape transport; equipped with formatter, expansion cabinet, and cabling	21,000	118.00
J3B200SC2-113	Fourth 1600 bpi tape transport; without formatter, expansion cabinet, and cabling	16,000	118.00
3B20A, Package E			
J3B200SE2-113	Second 1600 bpi tape transport; without formatter, expansion cabinet, and cabling	16,000	118.00
J3B200SE2-114	Third 1600 bpi tape transport; equipped with formatter, expansion cabinet, and cabling	21,000	118.00
J3B200SE2-115	Fourth 1600 bpi tape transport; without formatter, expansion cabinet, and cabling	16,000	118.00
3B20A, Package F			
J3B200SF2-110	Second 1600 bpi tape transport; without formatter, expansion cabinet, and cabling	16,000	118.00
J3B200SF2-111	Third 1600 bpi tape transport; equipped with formatter, expansion cabinet, and cabling	21,000	118.00
J3B200SF2-112	Fourth 1600 bpi tape transport; without formatter, expansion cabinet, and cabling	16,000	118.00
3B20A, Package G			
J3B200SG2-106	First 1600 bpi tape transport; equipped with formatter, controller, expansion cabinet, and cabling	21,000	126.00
J3B200SG2-107	Second 1600 bpi tape transport; without formatter, expansion cabinet, and cabling	16,000	118.00
J3B200SG2-108	Third 1600 bpi tape transport; equipped with formatter, expansion cabinet, and cabling	21,000	118.00
J3B200SG2-109	Fourth 1600 bpi tape transport; without formatter, expansion cabinet, and cabling	16,000	118.00
3B20D			
J3B203SA1 L34	Second 1600 bpi, 25 ips tape unit with cables	21,000	***
PRINTERS			
3B20S/3B20A†			
J3B200SX2-39A/B	300 lpm dot-matrix printer with 25-ft. (A) or 50-ft. (B) cable	11,250	347.00
J3B200SX2-40A/B	600 lpm dot-matrix printer with 25-ft. (A) or 50-ft. (B) cable	14,500	347.00
J3B200SX2-41A/B	600 lpm band printer with 25-ft. (A) or 50-ft. (B) cable	13,000	347.00
J3B200SX2-42A/B	900 lpm band printer with 25-ft. (A) or 50-ft. (B) cable	21,500	347.00
J3B200SX2-43A/B	1200 lpm band printer with 25-ft. (A) or 50-ft. (B) cable	23,500	347.00
J3B200SX2-44	Line printer controller; can support two of the above listed printers up to 2000 lpm total	3,500	5.00
3B20D			
J3B203SA1 L43	Read only printer (220 lpm)	8,000	***
3B5 and 3B2/300			
***	Model 455	1,870	23.00
***	Model 470	695	8.00
***	Model 475	745	8.00
103924 122	Model DQP-10 160 cps dot-matrix printer	1,200	*****
103924 130	Model LQP-40 18 cps letter-quality printer	2,100	***** ▶

NA—Not applicable.

* National average; price will vary depending on geographic location.

** The Unix operating system carries a monthly maintenance charge of \$350.

*** Indicates that the order number or price was not supplied by AT&T.

**** The maintenance charge is an annual one, at 12 percent of the list price.

***** The maintenance charge is an annual one, at 15 percent of the list price.

† An X in the eighth character position in a 3B20S or 3B20A order code represents the model number of any of the available packages (A, B, C for 3B20S and E, F, G for 3B20A).

†† An X in the seventh character position in a 3B5/100 or 3B5/200 order code represents the model number of any of the available packages (A, B, C, D for the 100 and E, F, G for the 200).

AT&T 3B Computer Family

Purchase Price (\$)	Monthly Maint.* (\$)
---------------------------	----------------------------

► WORKSTATIONS

500041371	Teletype 5410 terminal	902	***
403579667	Teletype 5420 terminal	1,439	***
500052154	Teletype 5620 terminal	6,129	***
***	Dataspeed 4410 terminal	1,145	15.25
***	Dataspeed 4415 terminal	1,895	21.00
***	BCT 513 terminal	2,760	29.00
***	BCT 89-key keyboard	220	3.00
***	BCT 103-key keyboard	235	3.00
J3B203SA1 L42	Additional color video terminal (3B20D only)	4,500	***

COMMUNICATIONS/NETWORKING OPTIONS

3B20S/3B20A†

J3B200SX2-8	8-channel asynchronous controller	4,000	7.00
J3B200SX2-9	2-channel asynchronous controller	3,700	6.00
J3B200SX2-10	8-channel automatic call unit controller	2,750	7.00
J3B200SX2-11	2-channel synchronous controller	4,100	7.00
J3B200SX2-12A	1-channel X.25 level 2 data link controller with 25-ft. cable	5,000	6.00
J3B200SX2-12B	1-channel X.25 level 2 data link controller with 50-ft. cable	5,000	6.00
J3B200SX2-13A	High-speed byte synchronous controller with 25-ft. cable	7,500	6.00
J3B200SX2-13B	High-speed byte synchronous controller with 50-ft. cable	7,500	6.00
J3B200SX2-14	8-channel asynchronous data link arranged for 20 mA current loop	14,000	7.00
J3B200SX2-45	Interface to NSC Hyperchannel Network	4,300	15.00
J3B200SX2-46	3BNet Interface	6,500	73.00
J3B200SX2-74	3BNet transceiver	900	NA
J3B200SX2-75	10-meter drop cable	135	NA
J3B200SX2-76	30-meter drop cable	290	NA
J3B200SX2-77	50-meter drop cable	475	NA
J3B200SX2-83	3BNET package including interface packs, transceiver, and 10-meter drop cable	7,000	NA

3B5/100

J3B500A1-List I02	Asynchronous packs (ADLI)	2,200	NA
J3B500A1-List I02A	Automatic Calling Unit interface (ACU)	410	NA
J3B500A1-I03	Synchronous packs (SDLI); first four ports of eight	6,500	NA
J3B500A1-List I03A	Synchronous packs (SDLI); second four ports of eight	310	NA
J3B500A1-List I04	Standard serial interface (TTI); first four of 16	5,700	NA
J3B500A1-List I04A	Standard serial interface (TTI); four of 16	240	NA

3B5/200

J3B500E1-List I02	Asynchronous packs (ADLI)	2,200	***
J3B500E1-List I02A	Automatic Calling Unit interface (ACU)	205	***
J3B500E1-List I03	Synchronous packs (SDLI); first four ports of eight	6,500	***
J3B500E1-List I03A	Synchronous packs (SDLI); second four ports of eight	310	***
J3B500E1-List I04	Standard serial interface (TTI); first four of 16	5,700	***
J3B500E1-List I04A	Standard serial interface (TTI); four of 16	240	***

3B5 Systemst†

73618	3BNet Network Interface feature; includes Network Interface CPU (NICPU); Interconnect Medium Interface (IMI); data buffer; interpack cables; transceiver power supply; power supply wiring	6,500	****
73619	Same as 73618; plus 10-meter drop cable and transceiver	7,000	****
73620	Same as 73619, but with 30-meter cable	7,155	****
73621	Same as 73619, but with 50-meter cable	7,340	****
J3B500X1 List I05	3B network interface (3-board set)	6,500	***
J3B500X1 List I05	Datakit virtual switch interface	7,000	***

NA—Not applicable.

* National average; price will vary depending on geographic location.

** The Unix operating system carries a monthly maintenance charge of \$350.

*** Indicates that the order number or price was not supplied by AT&T.

**** The maintenance charge is an annual one, at 12 percent of the list price.

***** The maintenance charge is an annual one, at 15 percent of the list price.

† An X in the eighth character position in a 3B20S or 3B20A order code represents the model number of any of the available packages (A, B, C for 3B20S and E, F, G for 3B20A).

†† An X in the seventh character position in a 3B5/100 or 3B5/200 order code represents the model number of any of the available packages (A, B, C, D for the 100 and E, F, G for the 200).

AT&T 3B Computer Family

		<u>Purchase Price (\$)</u>	<u>Monthly Maint.* (\$)</u>
➤	3B2/300		
	73203	1,500	*****
	73204	2,000	*****
	73205	2,155	*****
	73206	2,340	*****
	73210	695	*****

HARDWARE OPTIONS

3B20D

J3B203SA1 L32	First tape disk growth cabinet	2,000	***
J3B203SA1 L33	Second tape disk growth cabinet	2,000	***
J3B203SA1 L35	Power distribution (if no tape unit is in cabinet)	1,700	***
J3B203SA1 L36	Power distribution (if tape unit is in cabinet)	2,475	***
J3B203SA1 L37	Cabinet hardware for cabinet with tape unit	3,000	***
J3B203SA1 L38	Cabinet hardware for cabinet with no tape unit	2,700	***

3B5, Model 100A

J3B500A1 List 5	Horizontal option (applies only to second vertical growth cabinet)	2,000	NA
-----------------	--	-------	----

3B5, Model 100B

J3B500B1 List 5X	Horizontal option (applies only to second vertical growth cabinet)	2,000	NA
------------------	--	-------	----

NA—Not applicable.

* National average; price will vary depending on geographic location.

** The Unix operating system carries a monthly maintenance charge of \$350.

*** Indicates that the order number or price was not supplied by AT&T.

**** The maintenance charge is an annual one, at 12 percent of the list price.

***** The maintenance charge is an annual one, at 15 percent of the list price.

† An X in the eighth character position in a 3B20S or 3B20A order code represents the model number of any of the available packages (A, B, C for 3B20S and E, F, G for 3B20A).

†† An X in the seventh character position in a 3B5/100 or 3B5/200 order code represents the model number of any of the available packages (A, B, C, D for the 100 and E, F, G for the 200).

SOFTWARE PRICES

The list price for software includes a one-time license fee. A dash (—) in the order number column indicates that the order number has not been supplied by the vendor.

OPERATING SYSTEMS

The Unix System V operating system is bundled with 3B20S, 3B20A, 3B5, and 3B2/300 systems; the Unix RTR (Real-Time Reliable) system for the 3B20D is priced separately.

	<u>List Price (\$)</u>
3B20D	
— Unix RTR	40,000

DATABASE MANAGEMENT SYSTEMS

— dBase II (3B5 and 3B2/300)	1,200
— AT&T Ingres (3B5)	17,000
— AT&T Ingres/CS (3B2/300)	2,000

AT&T 3B Computer Family

	<u>List Price (\$)</u>
► Informix	
— 3B5	3,000
— 3B2/300	1,600
File-it!	
— 3B5	895
— 3B2/300	495
LANGUAGES	
103924304 C programming language (3B2/300)	340
103924312 Fortran compiler (3B2/300)	275
103924320 Basic interpreter ISS 2 (3B2/300)	300
RM/Cobol	
— Basic package, 3B5	3,000
— Run-time component, 3B5	600
— Basic package, 3B2/300	1,500
— Run-time component, 3B2/300	300
COMMUNICATIONS	
— 3BNet (3B20A, 3B20S, 3B5/100, 3B5/200)	*8,000
1050-001 3BNet, 3B5/300 (object code)	4,000
1040-001 3BNet, 3B2/300 (object code)	400
— PC Interface	100
OFFICE AUTOMATION	
Handle, total package	
— 3B5	4,500
— 3B2/300	2,500
Handle Writer/Spell/List	
— 3B5	2,800
— 3B2/300	1,500
Handle Graph/Calc	
— 3B5	1,900
— 3B2/300	1,100
APPLICATIONS	
— AT&T Gift Registry System (3B5, 3B2/300)	3,000
AT&T Business Accounting System (BAC), total package	
— 3B5	10,000
— 3B2/300	5,000
AT&T BAC, A/R module	
— 3B5	2,000
— 3B2/300	1,000
AT&T BAC, A/P module	
— 3B5	2,000
— 3B2/300	1,000
AT&T BAC, Payroll module	
— 3B5	2,600
— 3B2/300	1,300
AT&T BAC, Order and Inventory module	
— 3B5	2,600
— 3B2/300	1,300

* Source code; binary sublicense available for \$4,000.

AT&T 3B Computer Family

		<u>List Price (\$)</u>
▶ AT&T BAC, G/L module		
—	3B5	2,900
—	3B2/300	1,000
C-Isam		
—	3B5	900
—	3B2/300	450
Microsoft Word		
—	3B5	1,300
—	3B2/300	650
Multiplan		
—	3B5	1,000
—	3B2/300	500 ■

* Source code; binary sublicense available for \$4,000.