AT&T 3B Computer Family

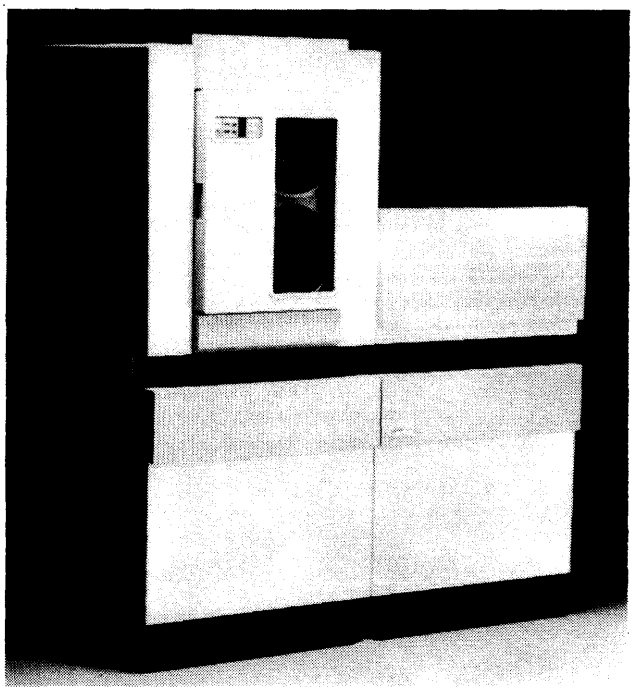
MANAGEMENT SUMMARY

UPDATE: *Since this report was last updated, AT&T has both altered and added to the 3B line. The company has introduced the mid-range 3B15, which runs a new version of Unix System V, and has consolidated and enhanced the low-end 3B5 subgroup. To the roster of products available for the 3B5 and 3B15, AT&T has also added communications products for IBM interconnection, C language compilers, and a plotter.*

The 3B15 Computer is based on AT&T's proprietary WE 32100 microprocessor. The WE 32100, which features a full 32-bit address path and data bus, is the more powerful successor to the older WE 32000 MPU. The 3B15 CPU employs a 14MHz WE 32100, and includes a Math Acceletion Unit (MAU) based on AT&T's WE 32106 chip. The MAU reportedly provides a 137-fold performance increase for math-intensive applications.

Three models of the 3B15 are available: 101, 201, and 301. Each model can reportedly deliver up to 40 percent greater performance than a comparable 3B5 model, with processor power up to 1.4 MIPS.

The 3B15 runs a new release of Unix System V, Release 2.1, providing support for demand paged memory management (as opposed to the swapping method supported in Release 2.0, which runs on the 3B5 computers), mandatory record/file locking, simplified system administration, and en-



The 3B15, comprising Models 101, 201, and 301, is the new mid-range system in AT&T's 3B Computer family. The 3B15 supports up to 60 simultaneously active users. It runs under Release 2.1 of Unix System V, which provides demand paged memory management and record/file locking.

AT&T's 3B Computer family of superminicomputers comprises nine models distributed among the low-end 3B5, mid-range 3B15, and high-end 3B20 groupings. The systems all run versions of AT&T's Unix operating system. A range of communications products provides access to other Unix-based computers and to systems employing IBM's Systems Network Architecture (SNA).

MODELS: 3B5/101, 201, and 301; 3B15/101, 201, and 301; 3B20S, 3B20A, and 3B20D.
MEMORY: 2MB to 16MB.
DISK CAPACITY: 40MB to 8.8GB.
WORKSTATIONS: Up to 128 on the 3B5 and 3B15; up to 256 on the 3B20.
PRICE: $34,500 to $340,000 (core system prices).

CHARACTERISTICS

MANUFACTURER: AT&T Information Systems, 1 Speedwell Avenue, Morristown, NJ 07690. Telephone (201) 898-2000.

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

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 3B15 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.

The 3B5/201, 3B5/301, and all 3B15 models include the WE 32106 Math Accelerator Unit (MAU), which provides floating-point capabilities; the unit is optional on the 3B5/101. The WE 32106 MAU is compatible with the proposed IEEE Standard for Binary Floating Point Arithmetic, Draft 10.0. The MAU provides single (32-bit), double (64-bit), and double-extended (80-bit) precision. It provides the following functions: add, subtract, multiply, divide, remainder, negate, absolute value, square root, compare, move, and rounding to integral value.

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CHART A. SYSTEM COMPARISON

MODEL	3B5/101	3B5/201	3B5/301	3B15/101	3B15/201
SYSTEM CHARACTERISTICS					
Date of introduction	June 1985	June 1985	June 1985	June 1985	June 1985
Date of first delivery	October 1985	October 1985	October 1985	December 1985	December 1985
Operating system	Unix System V, Release 2.0	Unix System V, Release 2.0	Unix System V, Release 2.0	Unix System V, Release 2.1	Unix System V, Release 2.1
Upgradable from	Not applicable	Not applicable	Not applicable	3B5/101	3B5/201
Upgradable to	3B15/101	3B15/201	3B15/301	Not applicable	Not applicable
MIPS	0.8-1.0	1.0	1.0	1.4	1.4
Relative performance (based on a rating of the 3B20S at 1.0)	0.65	0.65	0.65	0.91	0.91
MEMORY					
Minimum capacity, bytes	2M	2M	2M	2M	2M
Maximum capacity, bytes	8M	16M	16M	8M	16M
Type	DRAM	DRAM	DRAM	DRAM	DRAM
Cache memory	8KB	8KB	8KB	16KB	16KB
Cycle time, nanoseconds	125	125	125	125	125
Bytes fetched per cycle	—	—	—	—	—
INPUT/OUTPUT CONTROL					
Number of channels	16	16	16	16	16
High-speed buses	3	3	3	3	3
Low-speed buses	None	None	None	None	None
MINIMUM DISK STORAGE	40MB	40MB	134MB	40MB	40MB
MAXIMUM DISK STORAGE	1.1GB	2.2GB	2.2GB	1.1GB	2.2GB
NUMBER OF WORKSTATIONS	128 (32 concurrently active)	128 (48 concurrently active)	128 (48 concurrently active)	128 (48 concurrently active)	128 (60 concurrently active)
COMMUNICATIONS PROTOCOLS	Async, sync, BSC/3270, SNA/3270, TTY, RJE, 3BNet, Ethernet, ISN	Async, sync, BSC/3270, SNA/3270, TTY, RJE, 3BNet, Ethernet, ISN	Async, sync, BSC/3270, SNA/3270, TTY, RJE, 3BNet, Ethernet, ISN	Async, sync, BSC/3270, SNA/3270, TTY, RJE, 3BNet, Ethernet, ISN	Async, sync, BSC/3270, SNA/3270, TTY, RJE, 3BNet, Ethernet, ISN

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

hanced file hardening with dynamic bad block handling. (The version of Unix System V running on the 3B20S and 3B20A incorporates the features of Release 2.1, except for simplified administration.)

The 3B15/101 supports up to 8MB of ECC dynamic random access memory (DRAM), while Models 201 and 301 accommodate up to 16MB. Each core system provides 2MB of main memory, which can be expanded in 2MB increments. All models have a 16KB cache memory.

3B15 Models 101 and 201 support 40MB fixed/removable and 134MB and 279MB fixed disk drives; Model 301 supports only the fixed drives. Up to four drives can be configured on Model 101, for 1.1GB of storage; up to eight drives can be attached to Models 201 and 301, for maximum storage of 2.2GB.

Up to 128 workstations can be connected to 3B15 Computers; up to 48 can be simultaneously active on Model 101, and up to 60 on Models 201 and 301. Each 3B15 model permits attachment of up to four tape drives, either single-density 1600-bpi or dual-density 1600-/6250-bpi.

A basic 3B15/101 provides five I/O, two general-purpose, and four memory card slots, along with mounting space for two 40MB fixed/removable disk drives. The 3B15/201 and 3B15/301 provide 15 I/O, four general-purpose, and eight memory card slots, with mounting space for two disk drives in any combination permissible on the specific model. A card cage providing space for 14 more feature cards can be added to all three models.

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 3B15 systems are divided into the following functional groups:

- **Data Transfer instructions, which copy data to and from registers and memory.**
- **Arithmetic instructions, which perform arithmetic operations on one, two, or three operands.**
- **Logical instructions, which perform a logical operation on one, two, or three rotate, and logical shift (left or right).**

The 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).

CYCLE TIME: Refer to Chart A for the cycle times on the various 3B models.

CAPACITY: Main memory capacities on the 3B Computers range from 2MB to 16MB. Refer to Chart A for the memory capacities of specific models.

AT&T 3B Computer Family

CHART A. SYSTEM COMPARISON (Continued)

MODEL	3B15/301	3B20S	3B20A	3B20D
SYSTEM CHARACTERISTICS				
Date of introduction	June 1985	March 1984	March 1984	March 1984
Date of first delivery	December 1985	March 1984	March 1984	March 1984
Operating system	Unix System V, Release 2.1	Unix System V, Release 2.1	Unix System V, Release 2.1	Unix RTR, Release 1
Upgradable from	3B5/301	Not applicable	3B20S	Not applicable
Upgradable to	Not applicable	3B20A	Not applicable	Not applicable
MIPS	1.4	1.0	1.5-1.8	0.9
Relative performance (based on a rating of the 3B20S at 1.0)	0.91	1.0	1.5-1.8	0.9
MEMORY				
Minimum capacity, bytes	2M	2M	2M (each CPU)	5M
Maximum capacity, bytes	16M	16M	16M (each CPU)	16M
Type	DRAM	DRAM	DRAM	DRAM
Cache memory	16KB	16KB	16KB (each CPU)	16KB (optional)
Cycle time, nanoseconds	125	400	400	400 (with cache)
Bytes fetched per cycle	—	4	4	4
INPUT/OUTPUT CONTROL				
Number of channels	16	—	—	2
High-speed buses	3	—	—	Proprietary
Low-speed buses	None	—	—	Proprietary
MINIMUM DISK STORAGE	134MB	256MB	256MB	279MB
MAXIMUM DISK STORAGE	2.2GB	8.8GB	8.8GB	8.8GB
NUMBER OF WORKSTATIONS	128 (60 concurrently active)	256 (100-150 concurrently active)	256 (100-150 concurrently active)	256 (100-150 concurrently active)
COMMUNICATIONS PROTOCOLS	Async, sync BSC/3270, SNA/3270, TTY, RJE, 3BNet, Ethernet, ISN	Async, sync, X.25, HDLC, RJE, 3BNet, Hyperchannel, Ethernet, ISN, DDCMP	Async, sync, X.25, HDLC, RJE, 3BNet, Hyperchannel, Ethernet, ISN, DDCMP	Async, sync, X.25, HDLC, RJE, ISN, Ethernet, Hyperchannel, DDCMP

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

According to AT&T, the 3B15 needs no special power equipment; it plugs into a standard office electrical outlet and requires 117 VAC, 20 amp of current, typically consuming 1.36 kilowatts.

The basic cabinet of the 3B15/101 and 201 measures 31¼ inches high, 30 inches wide, and 31¼ inches deep; vertical and horizontal growth cabinets can be added. The 3B15/301 comes in a single cabinet 67½ inches high, 31¾ inches wide, and 28 inches deep. A growth cabinet of the same dimensions can be added.

AT&T has streamlined the low-end 3B5 supermini grouping by bringing out Models 101, 201, and 301, which are available in single core packages; these three models replace Models 100, 200, and 300, which had been available in almost a score of base configurations.

The three new 3B5 models employ 10MHz WE 32100 CPUs; each CPU has a WE 32106 MAU. (The original three models of the 3B5 were based on the WE 32000; the 3B5/101 is available with a 7.2MHz WE 32000 CPU, as well as with the 10MHz WE 32100.) AT&T quotes MIPS rates of 0.8 to 1.0 MIPS (depending upon the processor) for Model 101 and 1.0 for Models 201 and 301. All models feature an 8KB cache memory. The 3B5 systems run under AT&T's Unix System V, Release 2.0.

AT&T claims that the new 3B5 models better the performance of the previous 3B5 systems. According to the

The main memory unit on the 3B20S and 3B20A consists of the memory controller and from 2 to 16MB of memory per 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 and 3B15 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. The main stores of both 3B20D CPUs are normally updated simultaneously to ensure that the off-line processor can take over operations at any time.

In the 3B5 computers, which use a swapping scheme, 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.

The 3B15 provides demand paged memory management through the WE 32101 Memory Management Unit (MMU), a 32-bit bus-structured device providing logical-to-

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CHART B. MASS STORAGE

MODEL	48MB	160MB	300MB	340MB	675MB
Type	Fixed/removable	Fixed	Removable	Fixed	Fixed
Controller model	IDFC/SMDC	IDFC/SMDC	DFC	IDFC/SMDC (3B5 & 3B15); DFC (3B20)	DFC
Drives per subsystem/controller	2 per SMDC, 4 per IDFC	2 per SMDC, 4 per IDFC	8	2 per SMDC, 4 per IDFC; 8 per DFC	8
Formatted capacity per drive, megabytes	20/20	134	256	279	550
Number of usable surfaces	4	10	19	12	20
Number of sectors or tracks per surface	—	—	823 tracks	711 tracks	823 tracks
Bytes per sector or track	512/sector	512/sector	512/sector	512/sector	512/sector
Average seek time	35 ms	30 ms	30 ms	20 ms	25 ms
Average rotational/relay time	8.5 ms	8.3 ms	8.3 ms	8.3 ms	8.3 ms
Average access time	43.5 ms	38.3 ms	38.3 ms	28.3 ms	33.3 ms
Data transfer rate	1.2MB/sec.	1.2MB/sec.	1.2MB/sec.	1.2MB/sec.	1.2MB/sec.
Supported by system models	3B5/101, 3B5/201, 3B15/101, 3B15/201	All 3B5 and 3B15	3B20S/3B20A	All	3B20S/3B20A

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vendor, Model 101 now supports up to 32 simultaneous users, while the 201 and 301 support up to 48; the previous recommended maximum for 3B5 systems was 24. The maximum number of terminals that can be physically connected to any of the models is 128. In addition, a high-speed memory controller reportedly boosts 3B5 system performance by 30 percent over previously attainable levels; an improved disk file controller subsystem reportedly increases disk I/O by a factor of five.

The 3B5/101 supports up to 8MB of main memory; the 3B5/201 and 301 provide up to 16MB. Each core system comes with 2MB of main memory, expandable in 1MB or 2MB increments.

All three 3B5 models support 134MB and 279MB fixed disk drives; Models 101 and 201 also support a 40MB fixed/removable drive. Model 101 permits attachment of up to four disk drives in any combination, for a maximum of 1.1GB of auxiliary storage. Models 201 and 301 support up to eight drives, to a maximum of 2.2GB. Each model supports up to four single-density or dual-density tape drives.

Like the 3B15, the 3B5 plugs into a standard office electrical outlet. The cabinets are the same dimensions as those for the 3B15.

Each 3B5 model can be converted to its counterpart 3B15 model with a hardware/software migration kit consisting of two replacement circuit packs for the central controller and cache and Unix System V, Release 2.1.

Conversion from a 3B5 to a 3B15 reportedly requires little or no change in application programs. AT&T states, however, that large and complex multitasking applications may experience some correctable timing differences, due to the faster run time of the 3B15. AT&T states that the 3B5 and 3B15 are object-code compatible with the company's 3B2 supermicrocomputers (covered in a separate report in this volume of DATAPRO REPORTS ON MINICOMPUTERS) and source-code compatible with the 3B20 supermini systems.

physical address translation, memory organization, control, and access protection. The MMU maps virtual memory addresses to physical memory addresses through, allowing up to 4GB each of virtual and physical address space. The MMU also accommodates demand segmented virtual memory systems. The MMU offers four types of access protection—execute only, read/execute, read/write/execute, and no access—at each of four execution levels (kernel, executive, supervisor, and user).

RESERVED STORAGE: The minimum reserved storage in 3B5 and 3B15 systems is 512KB for the Unix kernel and drivers; disk buffer cache requires an additional 512KB-1MB.

CACHE MEMORY: The 3B5 computers all feature a standard 8KB cache; a 16KB cache is standard on the 3B15. The 3B20S has a 16KB cache memory; the 3B20A provides 16KB of cache in each processor. A 16KB cache is optional on the 3B20D. The 16KB cache on the 3B20 computers is divided into two 8KB units: one for standard memory cache and the other for a subroutine return stack. (Unix applications typically consist of many subroutine calls, so the 3B20 cache is optimized for the Unix environment.)

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.**
- **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.**

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In communications, the Host Connectivity products, for AT&T/IBM networking on 3B5 and 3B15 computers, include the Communication Processor—a hardware product—and three software packages: SNA/3270 Emulator+, BSC/3270 Emulator+, and 3270 Application Program Interface.

The Communication Processor provides support for multiple 3B Computers. It is a node on an AT&T 3BNet network, and links the 3Bs on the network to IBM hosts for 3270 emulation services. The intelligent Communication Processor manages protocol conversions between the asynchronous 3B Computer environment and the IBM SNA/SDLC continuum; it is available in both local and remote versions.

AT&T SNA/3270 Emulator+ allows an ASCII terminal user to access an SNA network and use the resources available to a 3278 display station user. AT&T BSC/3270 Emulator+ is functionally the same as the SNA/3270 emulator, except it emulates bisynchronous protocol. Both emulators use the interface between the IOA (Input/Output Accelerator) and SDLI (Synchronous Data Link Interface) on 3B5 and 3B15 computers.

AT&T 3270 Application Program Interface (API) provides virtual terminal facilities, allowing the user of an ASCII terminal to access 3270 applications on a mainframe through a C-language-callable interface. The API can be used with both the SNA/3270 and BSC/3270 Emulator+ products.

The new C compilers are C Programming Language Utilities, Issue 3 and CFP+ Programming Language Utilities, Issue 1. The C Programming Language Utilities product comprises a C compiler and associated programming tools for producing and debugging code. It provides IEEE P754 draft 10 floating point support, automatically making use of the WE 32106 MAU. The CFP+ package, also comprising a C compiler and tools, works with the MAU to increase floating point performance to a reported maximum of 225K Whetstones per second.

The AT&T 435 Plotter, designed for color graphics, uses the HPGL graphics protocol. The 435 has a six-pen carousel that can plot on 8½-by-11 inch or 11-by-17 inch paper or on 8½-by-11 inch glossy presentation paper and transparency film. The 435 Plotter is compatible with software from Graphics Software Systems.

The high end of the 3B family is the 3B20 series, comprising the 3B20S, 3B20A, and 3B20D. These systems are designed for high-volume applications, and are compatible at the source-code level with the 3B5 and 3B15 computers. All 3B20s 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, and provides virtual addressing. Main memory on the 3B20S computer ranges from 2MB to 16MB; it can be expanded in 2MB increments. Main memory is complemented by a 16KB cache memory. The 3B20S can support

- **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.

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. AT&T claims that the 3B20D provides response time of less than 200 milliseconds for high-priority jobs.

The 3B20S and 3B20A CPUs are powered from batteries continually charged through the AC source. During a power outage, the batteries can power the CPU, DMA controllers, I/O and peripheral controllers, Disk File Controllers, memory subsystem, and DC disk drives; only tape drives and AC disk drives will go 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 processors used in the 3B5 and 3B15 computers are based on AT&T's WE 32100 microprocessor, which features 32-bit data and address buses. The clock rate for the central control processor is 10MHz in the 3B5 and 14MHz in the 3B15. (The 3B5/101 is available with either the 10MHz WE 32100 or a 7.2MHz version of the older WE 32000.)

The WE 32100-based CPUs include: sixteen 32-bit registers; an Address Arithmetic Unit (AAU); a 33-bit Arithmetic Logic Unit (ALU); a 32-bit barrel switch; 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; a Program Counter (PC) and internal registers; a Process Status Word (PSW); and a parity tree. The WE 32106 MAU is standard on all WE 32100-based CPUs. The 3B15 CPU also includes the WE 32101 MMU.

The processor in each 3B5 and 3B15 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.

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CHART C. WORKSTATIONS

MODEL	4410	4418	4425	5620	BCT 513
DISPLAY PARAMETERS					
Max. chars./screen	1920 or 3168	1920 or 3168	1920 or 3168	800 x 1024 resolution	1920
Buffer capacity	1 page	1 page	9600 characters	256KB or 1MB	1 page
Screen size (lines x chars.)	24 x 80 or 132	24 x 80 or 132	24 x 80 or 132	70 x 88	24 x 80
Tilt/swivel screen	Tilt standard	Tilt standard	Tilt standard	Not applicable	Tilt standard
Symbol formation	7 x 9 or 5 x 7 dot-matrix	7 x 9 or 5 x 7 dot-matrix	7 x 9 or 5 x 7 dot-matrix	Not applicable	7 x 11 dot matrix
Character phosphor	White, green, or amber	Amber or green	White or amber	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 or 96 line-drawing/graphics	128 ASCII, line-drawing graphics, others	128 ASCII, special character sets	ANSI 3.64	128 ASCII, special character sets
Detachable	Yes	Yes	Yes	Yes	Yes
Program function keys	8	8	38	8 standard	8
TERMINAL INTERFACE	RS-232-C	RS-232-C	RS-232-C	RS-232-C	RS-232-C
Comments	Integrated autodial modem available	Integrated autodial modem available; 3278-like keyboard	Integrated autodial modem available; allows up to 4 windows	Dot-mapped display (DMD) terminal	

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

up to 8.8GB of on-line disk storage. Up to 256 terminals can be configured; from 100 to 150 can be simultaneously active, depending upon the application.

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. The 3B20A supports from 2MB to 16MB of main memory in each processor. 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. 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.

Each 3B5 model can be upgraded to its 3B15 counterpart through a hardware/software migration kit consisting of two replacement circuit packs for the central controller and cache, and Unix System V, Release 2.1, which runs on the 3B15.

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. On the 3B20D, an additional 8KB writable microstore is used to store microinstructions that form the machine instruction set, microsequences, special diagnostic microcode, and control unit sequences.

REGISTERS: The 3B20 computers employ 12 general-purpose registers. The WE 32100 microprocessor in the 3B5 and 3B15 CPUs has sixteen 32-bit registers: nine general-purpose and seven special-purpose. (A register is "general-purpose" in that it can be referenced in all possible addressing modes.) Three registers are privileged.

ADDRESSING: The 3B20 computers use eight address modes: six memory modes, immediate mode, and register mode. The 3B5 and 3B15 processors recognize commonly used address modes—absolute, displacement (or offset) from a register's contents, immediate, and register—as well as a special (expanded operand type) mode.

INTERRUPTS: 3B20 computers recognize 32 interrupt levels. The 3B5 and 3B15 computers have 15 hardware interrupt levels.

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

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CHART D. PRINTERS

MODEL	5310	5320	470	475
Type	Dot-matrix	Dot-matrix	Dot-matrix	Dot-matrix
Speed	200 cps	200 cps	120 cps	120 cps
Bidirectional printing	Yes	Yes	Yes	Yes
Paper size	Up to 9.5 in. wide	Up to 17 in. wide	Up to 10 in. wide	Up to 10 in. wide
Character formation	7 x 9 dot-matrix	7 x 9 dot-matrix	9 x 9 dot-matrix	9 x 9 dot-matrix
Horizontal character spacing (char./inch)	Variable	Variable	Variable	Variable
Vertical line spacing (char./inch)	Variable	Variable	Variable	Variable
Character set	96 ASCII plus APL	96 ASCII plus APL	ASCII plus AT&T proprietary	ASCII or AT&T proprietary
Controller/Interface	RS-232-C, EIA CCITT	RS-232-C, EIA CCITT	Centronics parallel	RS-232-C
No. of printers per controller/interface	—	—	—	—
Printer dimensions, in. (h x w x d)	5.5 x 16 x 14.4	5.5 x 21.2 x 14.4	5.4 x 15.7 x 11.3	5.4 x 15.7 x 11.3
Graphics capability	Yes	Yes	Yes	Yes
Comments	Various submodels available	Various submodels available		

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

CHART D. PRINTERS (Continued)

MODEL	476	447	447X
Type	Dot-matrix	Band	Band
Speed	120 cps	600 lpm	1000 lpm
Bidirectional printing	Yes	Not applicable	Not applicable
Paper size	—	Up to 16 in.	Up to 16 in.
Character formation	9 x 9 dot-matrix	Full	Full
Horizontal character spacing (char./inch)	Variable	Variable	Variable
Vertical line spacing (char./inch)	Variable	Variable	Variable
Character set	ASCII or AT&T proprietary	Full ASCII	Full ASCII
Controller/Interface	RS-232-C	Dataproducts L.C. or RS-232-C	Dataproducts L.C. or RS-232-C
No. of printers per controller/interface	—	—	—
Printer dimensions, in. (h x w x d)	—	15 x 30.3 x 25.2	15 x 30.3 x 25.2
Graphics capability	Yes	No	No

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

In addition to the Host Connectivity facilities, AT&T offers two other products designed to connect the 3B Computers to both AT&T systems and those from other vendors—3BNet and Information Systems Network (ISN).

3BNet is a high-speed local area network that provides file-transfer facilities for 3B5, 3B15, and 3B20A/S 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. 3BNet is Ethernet-compatible, permitting connection of 3B systems to computers and peripherals supporting the Ethernet standard. 3BNet employs the Carrier Sense Multiple Access/Collision Detection (CSMA/CD) communications scheme. It operates in conjunction with a package of network services contained in the Unix operating systems, allowing users to move data among machines and set network security. The 3BNet network allows configuration of up to 100 nodes.

Information Systems Network (ISN) is AT&T Information Systems' proprietary local area network for building complexes and campuses; it permits networking of 3B systems

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. According to AT&T, the 3B20 systems do not require special air conditioning or raised floors.

Models 101 and 201 of the 3B5 and 3B15 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 of the same height and depth, but with a width of 31 inches, is also available; it 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, 31 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.

Model 301 of the 3B5 and 3B15 is housed in a cabinet 67.5 inches high, 31¾ inches wide, and 28 inches deep, weighing 750 pounds. A 550-pound growth cabinet of the same dimensions can be added.

Power requirements for the 3B5 and 3B15 computers are 117 VAC, 20 amp (multiple feeder), 60 Hz; typical system

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CHART E. MAGNETIC TAPE EQUIPMENT

MODEL	—	1600	6250IN/1	6250IN/2
TYPE	Reel-to-Reel	Reel-to-Reel	Streaming	Streaming
FORMAT				
Number of tracks	9	9	9	9
Recording density, bits per inch	1600	1600	1600/6250	1600/6250
Recording mode	—	PE	PE/GCR	PE/GCR
CHARACTERISTICS				
Controller model	Local bus adapter	UN52 C.P.	UN145 C.P.	UN138, UN139 C.P.
Drives per controller	4	4	2	2
Storage capacity, bytes	40M	38M-40M	100M	100M
Tape speed, inches per second	25	125	25	25/75
Data transfer rate, units per second	—	200K	244K	40KB
Streaming technology	Yes	No	Yes	Yes
Start/stop mode; speed	Not applicable	Not applicable	Yes	Yes
Switch selectable	No	—	—	—

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

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.

As previously mentioned, the 3B5, 3B15, and 3B20S and 3B20A 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 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.

Unix System V includes support for C, the high-level programming language in which the operating system and most of its subsystems are written. Also provided are facilities for development, diagnostics, system administration, and system services, along with text processing tools.

Unix RTR (Real Time Reliable), Release 1, the operating system for the 3B20D, incorporates Unix features at the kernel level and employs extensions for realtime, fault tolerant processing. Unix RTR supports both realtime and timesharing 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.

Languages available for the 3B Computer Family include the C language, Basic, and Pascal. The 3B20 systems support Cobol, while the 3B5 and 3B15 also support RM/Cobol. Among applications offered directly by AT&T are those for academic instruction, courseware development, communications management control, service operation management, time clock data collection and reporting, and

power consumption is 1.36 kilowatts. The 3B5 and 3B15 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 typical 3B5 and 3B15 configurations is 4.65K Btu per hour.

INPUT/OUTPUT CONTROL

The 3B20 systems employ parallel processing, using microprocessor-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. According to AT&T, the distributed I/O architecture of the 3B20 systems permits incremental growth in bandwidth from 1MB per second to 4MB per second.

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 3B20S and 3B20A also permit disks to be dual-ported.

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.

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retail management. A variety of commercial applications from third-party vendors are offered through AT&T's Independent Software Vendor program. Details on available software products are provided in the *AT&T Computer Software Guide,* published twice a year.

COMPETITIVE POSITION

Since its entry into the minicomputer market in early 1984, AT&T has claimed that its goal is to deliver computer systems that both offer a migration path to protect the customer's software investment and provide strong communications capabilities. The company's initial efforts caused many analysts to react skeptically to that claim. First, the 3B product line lacked a bridge between the 3B5 systems and the high-end 3B20s. Secondly, omitted from the roster of available communications products were packages for communication with SNA and other IBM environments. Because the 3B computers are intended primarily for installation as departmental systems (as most superminis are), the need to communicate with SNA-based IBM mainframes, which comprise the majority of organizational systems, is a prerequisite not only for success, but also for simple survival, particularly when such products are readily available from AT&T's major supermini competitors.

Thirdly, the 3B systems did not seem to provide much of a software investment to protect. The line lacked a sufficiently extensive suite of readily available vertical applications software for Unix System V. Although some software packages emerged, both directly from AT&T and from third-party vendors sponsored by AT&T, prospective 3B customers were faced with the prospect of largely developing their own applications—a costly process, even when assisted by the comprehensive development tools intrinsic to Unix System V.

AT&T's recent announcements, however, show that the company is making progress in implementing its stated strategy. Although all the pieces are not yet in place, it has become more obvious that AT&T has at least taken definite steps to realize its acknowledged goal for the 3B family.

The introduction of the 3B15, for example, provides 3B5 users with a direct hardware migration path. They can convert to a more powerful system, and, taking advantage of the object-code compatibility provided under the common Unix operating environment, transfer their existing applications with little or no conversion. There is, admittedly, no direct hardware upgrade path from the 3B15 to the more configurable 3B20s; however, source-code compatibility between the 3B15 and 3B20 groups affords users a measure of protection for their applications investments.

While on the subject of added power, it must also be pointed out that AT&T's enhancement of the 3B5 with the more powerful WE 32100 processor raises that system's maximum power to 1.0 MIPS and allows it to compete more effectively with rival computers that previously held an edge in processor power. Needless to say, the addition of the more powerful and configurable 3B15 also positions the

On 3B5 and 3B15 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 Input/Output Accelerator (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, halfword, and word data transactions; parity is carried over all local bus addresses and data.

Input/output activities are accelerated through IOAs. The IOA is a WE 32000-microprocessor-based intelligent peripheral controller that features 256KB of RAM and 96KB of CPROM. It is designed to control a number of peripheral interfaces, including the Asynchronous Data Link Interface (ADLI), Synchronous Data Link Interface (SDLI), Synchronous/ Asynchronous Data Link Interface (SADL), and Teletype Terminal Interface (TTI).

CONFIGURATION RULES

GENERAL: The 3B20S and 3B20A are each available in single core systems. The core configuration for each includes one (3B20S) or two (3B20A) CPUs, 2MB of main memory, one I/O processor and channel, a disk controller, and an operator console, and read-only console printer. To the core system must be added options for additional memory, tape drives, disk drives and cabling, printers, co-location cabling, networking features, and communications interfaces.

The 3B20D is available in a single core package whose major components are two CPUs, 2MB of main memory, an IOP, a DMA controller, a dual serial channel, two 279MB formatted 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 3B5/101 is available with either a 7.2MHz WE 32000 or a 10MHz WE 32100 processor with WE 32106 MAU. In either case, the core system includes a CPU, system cabinet, dual maintenance port function, 8KB cache memory, two RS-232-C ports for console and maintenance, main memory controller, one 2MB main memory board, Integrated Disk File Controller (IDFC), Storage Module Drive Controller (SMDC), basic control unit, and Unix System V. The basic control unit can accommodate three additional memory boards, five additional I/O boards, and an additional SMDC. Two 40MB fixed/removable disk drives can be configured in the processor cabinet. The aforementioned components are included in the core package of the 3B15/101, whose central control includes a 10MHz WE 32100 CPU with WE 32106 MAU. (Cache memory on the 3B15/101 is 16KB.)

The 3B5/201 core system centers around a 10MHz WE 32100 CPU with MAU, while the 3B15/201 incorporates a 14MHz CPU, also with MAU. Components of both core systems include a basic processor cabinet, a vertical growth cabinet, dual maintenance port function, 8KB (3B5) or 16KB (3B15) cache, two RS-232-C control ports, main memory controller, two 1MB memory boards or one 2MB memory board, IDFC, SMDC, basic control unit, growth control unit, and Unix System V. The 3B5/201 core includes Unix System V, Release 2.0, while the core for the 3B15/201 includes Unix System V, Release 2.1. The basic control unit and growth control unit combined provide 15 physical I/O slots and room for six additional memory boards, additional SMDCs, and a 3BNet interface. The vertical growth cabinet can accommodate two 40MB fixed/removable disk drives, two 134MB and 279MB fixed disk drives in any combina-

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3B line against systems that the 3B5 could not take on alone.

The new Math Acceleration Unit (MAU) for the 3B5 and 3B15, along with the release of Unix System V supporting demand paging and record/file locking, enhances the competitive position of the 3B Computer line. The MAU opens doors into computation-intensive applications areas. Support for demand paging on the 3B15 provides greater system efficiency for high-throughput applications, and record/file locking offers greater security for multiuser applications. The Unix enhancements also endow System V with features previously found only in the Berkeley 4.2 version of Unix, and, thus, move Unix System V beyond commercial computing, giving it entree into the technical and research areas, where Berkeley 4.2 has been dominant.

In the matter of communications, AT&T's Host Connectivity products provide the requisite SNA communications capabilities for the 3B5 and 3B15 systems, and make them more credible competitors in the market for department-level processors. AT&T has asserted its intention to conform to such industry standards as SNA, as it must in order to survive in the supermini market. In fact, AT&T must begin to deliver even more complex communications products, such as those for LU6.2 peer-to-peer communications and DIA/DCA (Document Interchange Architecture/Document Content Architecture) file exchanges. Products of that ilk are offered by such AT&T rivals as Digital Equipment Corporation, Data General, and Wang. AT&T must also deliver them to build effectively upon the foundation it has laid with the Host Connectivity packages.

As for the software issue, AT&T now twice a year publishes the *AT&T Computer Software Catalog,* which currently lists over 150 packages certified or reviewed by the company for the 3B5, 3B15, and 3B20. Although not all of the packages are vertical applications (some are for database management, software development, communications, and other functions), the catalog is an earnest of AT&T's attempts to provide 3B users with reliable applications and development tools in a systematic fashion. With a formal software promotion program underway, more software is sure to come.

Most analysts view IBM as AT&T's major competitor, not only because their comparable organizational sizes make them natural rivals, but also because of the ability of each to provide integrated computer and communications systems. (Predictions of impending conflict on the integrated systems front have been particularly marked since IBM's acquisition of PBX manufacturer Rolm.) While that view is justifiable in the strategic sense, AT&T also faces stiff competition from other vendors in more limited but equally crucial areas. In the departmental systems area, for instance, IBM's System/38 and 4300 Series provide competition for the 3B family. Equally competitive, however, is Digital Equipment Corporation's VAX family, which has been a touchstone product line in that market for years. In fact, many installed VAXes run under native Unix—unlike

tion, or one 40MB drive and either a 134MB or a 279MB drive.

The 3B5/301 and 3B15/301 core systems pack the same components as the respective 201 cores into a single 67½ by 31¼ by 28 inch basic processor cabinet with cooling fans. The basic cabinet can hold two fixed disk drives and a 9-track tape drive.

The 3B5 and 3B15 permit attachment of a chassis, in an expansion cabinet, providing 14 additional I/O slots; each feature card requires one slot.

WORKSTATIONS: The 3B20 computers can support up to 256 workstations; 100 to 150 can be concurrently active, depending upon the application. Up to 128 workstations can be attached to any of the 3B5 and 3B15 systems, although the number of concurrently active users varies. The 3B5/101 supports up to 32 simultaneous users, while the 3B5/201, 3B5/301, and 3B15/101 support up to 48 each. Up to 60 users can be concurrently active on both the 3B15/201 and 3B15/301.

DISK STORAGE: The 3B20 computers all support up to 8.8GB of on-line disk storage. The Disk File Controller (DFC) in the 3B20S and 3B20A provides an interface for up to eight 256MB, 279MB, or 550MB disk drives through dual serial channels in the DMA unit; the DFC for the 3B20D provides an interface for eight 279MB drives. The DFC can be located in the processor and input/output cabinet, the tape and growth cabinet, or system expansion cabinets.

All 3B5 and 3B15 models support 134MB and 279MB fixed disk drives; Models 101 and 201 in both groups also support a 40MB fixed/removable drive. The 3B5/101 and 3B15/101 permit attachment of up to four disk drives in any combination, for a maximum of 1.1GB of auxiliary storage. The 3B5 and 3B15 Models 201 and 301 support up to eight drives, to a maximum of 2.2GB. A Storage Module Drive Controller is required for each additional two disk drives; an additional Integrated Disk File Controller (IDFC) is required for a system with more than four drives. (Each IDFC supports two SMDCs.)

(Note: The unformatted capacities of the aforementioned 40MB, 134MB, 256MB, 279MB, and 550MB disk drives are 48MB, 160MB, 300MB, 340MB, and 675MB, respectively.)

MAGNETIC TAPE: The 3B20S and 3B20A 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. The 3B20D supports 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.

Each 3B5 and 3B15 model can accommodate up to four tape 9-track drives. Two types of drives are available: single-density 1600 bpi or dual-density 1600/6250 bpi. Both tape drives can be controlled by either of two Intelligent Tape Controller (ITC) cards; one ITC supports 25 ips, while an optional one supports 75 ips.

PRINTERS: The 3B20S and 3B20A support up to two line printers through each TN85 data long lines printer interface, which permits maximum circuit pack throughput of 2000 lpm (with 132-character lines). RS-232-C interfacing is available through the TN4 asynchronous controller.

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the IBM systems, which at best can run it as a guest—so DEC can compete against the 3B systems on their own ground.

The 3B5/101 vies with DEC's VAX-11/730, providing greater processor power (0.8 to 1.0 MIPS, depending on the CPU, versus the 11/730's 0.36), memory (8MB against 5MB for the DEC system), and a larger number of attachable workstations (128, with 32 concurrently active, versus DEC's 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, while supporting the same number of workstations as their DEC competitor (128), provide 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 far more disk—80,6GB.

The 3B5/101 and 3B5/201 compete primarily against DEC's VAX-11/750 and IBM's System/38 Model 18. The two 1.0-MIPS AT&T models edge the rival systems in processor power; the 11/750 operates at 0.72 MIPS, while the IBM system delivers about 0.57 MIPS. The AT&T systems have the edge in memory, supporting up to 16MB compared to the 8MB supported on each of the competitors. The 3B5/201 and 301 each support up to 128 workstations—as many as the 11/750, but only half the number that can be attached to the comparable System/38 model. Both the IBM and DEC systems provide more disk capacity (5.8GB and 19GB, respectively) than the AT&T models, which can handle up to 2.2GB.

Principal competition for the 3B15/101 comes from IBM's System/38 Model 20, which, like the AT&T computer, provides 8MB of main memory and support for 128 workstations. The System/38 Model 20, however, supports almost six times as much disk (6.2GB) as the 3B15/101 (1.1GB).

The 3B15/201 and 301 vie chiefly with the System/38 Model 40 and the 4361 Model Groups 4 and 5. At 3.0 MIPS, the Model 40 delivers more raw power than the 1.4-MIPS 3B15s; the AT&T systems, however, edge the 4361 systems, which provide 0.79 and 1.14 MIPS, respectively. The 3B15s and their System/38 counterpart support up to 16MB of main memory—4MB more than that provided by the 4361-4 and 5. As for disk support, the 3B15s' 2.2GB is bettered by the System/38 Model 40's 6.2GB and dwarfed by the 4361-4's 161.2GB and the 4361-5's 241GB. While both the 3B15 and the comparable System/38 model support 128 workstations, the 4361s support up to 1024 through 3270 connections.

The 3B20S's primary rival is the VAX-11/780, longtime mainstay of the VAX family (until it was recently superseded by the vastly more powerful VAX 8600). The two are

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.

The 3B5 and 3B15 computers support the AT&T 435 Plotter, designed for color graphics. Using the HPGL graphics protocol, the 435 has a six-pen carousel that can plot on 8½-by-11-inch or 11-by-17-inch paper or on 8½-by-11-inch glossy presentation paper and transparency film. The plotter employs an RS-232-C interface and is compatible with software from Graphics Software Systems.

Also supported by the 3B5 and 3B15 are two daisywheel printers: the 55-cps Model 455 and the 46-cps Model 458/457.

COMMUNICATIONS CONTROL

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

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. It provides the capabilities of the TN74, but at a lower cost.

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 *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 Synchronous Data Link Interface,* a one-channel device, 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 X.25 Level 2 Synchronous Data Link Interface,* a two-channel device, is 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 *UN141 X.25 Level 2 Syncrhonous Data Link Interface* is an eight-channel device providing essentially the same capabilities as the TN75. In the UN141, however, the hardware Level 2 interface is implemented in silicon. All

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roughly equal in processor power, with the 3B20S delivering 1.0 MIPS and the 11/780 providing 1.06 MIPS. In all configurability categories, however, the AT&T offering is outdistanced by the 11/780; the 3B0S provides less memory (16MB versus 64MB), disk (8.8GB versus 30GB), and workstation support (256 versus 384) than its DEC rival. AT&T claims, however, that the disparities in configurability are compensated for, particularly in I/O-intensive applications, by the 3B20S's distributed I/O architecture; that architecture is shared by all 3B20 computers, and uses mini front-end processors to offload the CPU.

The attached-processor 3B20A comes up against DEC's dual-processor VAX-11/782, as well as against the uniprocessor VAX-11/785 and IBM 4381 Model Group 1. The 3B20A provides up to 1.8-MIPS power, against the approximately 1.9 MIPS delivered by the 11/782. The 3B20A supports up to 16MB of main memory per CPU, compared to the 8MB of shared memory configurable on the 11/782. The dual-processor DEC system gets the edge in disk, supporting 30GB to the 3B20A's 8.8GB, and in workstation attachability, supporting up to 384, compared to 256 for the AT&T system. The 11/785 supports the same amount of disk and the same number of workstations as the 11/782; the 11/785, however, provides up to 1.7 MIPS of processor power, and supports up to 64MB of main memory. The 4381-1 overshadows the 3B20A in MIPS (2.1), maximum disk storage (806GB), and workstation support (1024); it supports 16MB of main memory in its single processor.

The 3B20D faces different competitors than the other 3B 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 Sytems and Tandem's NonStop systems. The 3B20D has the same processor power as the low-end Stratus FT 200 and FT 250, operating at 0.9 MIPS; however, Stratus' upper end systems, the XA 400 and XA 600, provide up to 3.0 and 5.0 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 3B20D supports system totals of 16MB of memory, 256 workstations, and 8.8GB of disk storage, the Stratus systems provide the following for each processor module in a system: 8MB (FT 200, FT 250, and XA 400) or 16MB (XA 600) of duplexed memory; support for 64, 128, or 256 workstations (FT 200/250, XA 400, and XA 600, respectively); and 21GB (FT 200/250 and XA 400) or 44GB (XA 600) of disk storage. Similarly, Tandem's NonStop TXP allows configuration of up to 16 processors; each can operate at up to 2.0 MIPS, support 16MB of main memory, and handle 4GB of disk per controller. Again, however, AT&T claims that the 3B20D's distributed I/O architecture suits the computer to compete with the aforementioned systems in high-volume applications.

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

channels can be set for 19.2K bps full duplex; a burst of throughput, however, can cause the aggregate data rate per channel to become 9600 bps.

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 *Terminal Interface (TI)* provides 16 full-duplex asynchronous channels supporting the 56K bps Standard Serial Interface (SSI) for AT&T terminals and printers. This interface is supported by the IOA/VPM environment; a driver and script are provided for Unix character processing.

The *Synchronous/Asynchronous Data Link (SADL) Interface* provides eight serial, asynchronous or synchronous full-duplex channels with programmable data rates from 300 to 192K baud in async mode and 300 to 64K baud in sync mode. Synchronous communications require appropriate software to support the protocols. An IOA is required.

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.

The 3B5, 3B15, 3B20A, and 3B20S can 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 stan-

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vendors also provide competition for the 3B line. Those systems include Data General's Eclipse MV/Family, the 32-bit members of the Wang VS Family, Pyramid Technology Corporation's 90X series, and Perkin-Elmer's Xelos Family of superminis, which runs an operating system based on Unix System V.

ADVANTAGES AND RESTRICTIONS

The greatest strength of the 3B Computer family lies in its operating system. Unix System V provides object-code compatibility among the 3B5 and 3B15 supermini systems and the 3B2 supermicro grouping, permitting users to port applications with little conversion as they move upward in system power. There is also source-code compatibility among the 3B5/15 and 3B20 systems; while conversion is rendered more complex than if the systems were object-code compatible, users at least need not rewrite applications completely when moving from the bottom to the top of the line.

Unix System V also seems to be evolving as the standard among Unix systems, at least insofar as it incorporates features that the majority of Unix users want. Now that it supports demand paging and record/file locking, it should become even more popular. While the amount of vertical-market applications software remains limited, AT&T's commitment to improving the system and promoting its use should lead to an increase in the size of the Unix System V applications library.

AT&T's recent product announcements have also improved the upgradability of the 3B line. Each 3B5 can now be field-upgraded to its corresponding 3B15 model. Still, the microprocessor-based 3B5 and 3B15 cannot be upgraded to the bit-slice-based 3B20 systems, so there is no direct migration path from the bottom of the line through the top. However, the software compatibility afforded by Unix System V does ameliorate that situation to some extent.

AT&T could help the expandability of the 3B5 and 3B15 systems by introducing disk drives with formatted capacities larger than the current high of 279MB. The company is focusing its marketing efforts on those systems, and higher disk capacities would make them more formidable competitors against rival systems that support larger disk drives.

The 3B Computers exhibit significant strengths for networking and distributed processing, implemented in a variety of ways. The UUCP (Unix to Unix Copy) 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). The Information Sytems Network links 3B computer systems to non-AT&T systems (DEC VAX 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.

dard. The network allows users to select packet sizes (up to 4096 bytes on the 3B20S, the 3B20A, and the 3B5s). 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.

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 AT&T's 3B2/300 supermicros. 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.

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 1,920 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 systems running under Unix System V. It can also be interconnected to AT&T's System 75 and System 85 PBXs.

A member of AT&T's Host Connectivity product family for AT&T/IBM networking, the *Communication Processor* provides support for multiple 3B Computers. It is a node on

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USER REACTION

We received no responses for 3B Computer systems in our 1985 Datapro Computer Users Survey. As a matter of policy, AT&T Information Systems does not divulge data about its customers. Thus, AT&T-IS declined to provide us with a list of users from whom we could obtain assessments of the 3B systems. □

an AT&T 3BNet network, and links the 3Bs on the network to IBM hosts for 3270 emulation services. Employing its own processor, disk drive, memory, special feature cards, and operating system, the Communication Processor manages protocol conversions between the asynchronous 3B Computer environment and the IBM SNA/SDLC continuum. Two models of the Communication Processor are available. Model 1 emulates a channel or local connection to the IBM host; Model 2, designed for remote applications, emulates a 3270-type cluster controller.

Also available for AT&T/IBM networking environments is the *E4540 Information Display System*. The E4540 product group includes terminals compatible with IBM's 3278-2, 3278-5, 3178, and 3279-S2A (color) displays. The displays connect to remote controllers compatible with IBM 3276 and 3274 C-type controllers, supporting SNA/SDLC and BSC protocols and allowing attachment of up to 32 devices. (A Local Channel Controller for direct connection to IBM systems is also available.)

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, and 3B15 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:

- 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.
- Flexible directory and file protection modes that allow all combinations of read, write, and execute access.
- Facilities for uniformly creating, accessing, moving, and processing files, directories, or sets thereof.
- 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 the C language; protection for disk file systems; access to the facilities of other (host) computer systems; development, diagnostics, system administration, system services, and text processing tools.

The 3B5 computers run Unix System V, Release 2.0, which supports swapping as a memory access method; an entire program must be loaded into memory before it can run. Unix System V, Release 2.1 runs on the 3B15; it supports demand paged memory management, in which portions of a program can be loaded into memory and executed. Release 2.1 also features mandatory record/file locking, enhanced file hardening with dynamic bad block handling, and simplified system administration. The version of Unix System V running on the 3B20S and 3B20A incorporates all features of Release 2.1, except for simplified administration.

Unix RTR (Real Time Reliable), Release 1, the operating system for the 3B20D, incorporates Unix features at the kernel level and contains 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 standard relational DBMS products are available for the 3B5 and 3B15 systems through AT&T. Those include: Ashton-Tate's *dBase II*; *AT&T Ingres*, a version of the Ingres

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DBMS originally developed by Relational Technology, Inc. (also available for the 3B20s); *Informix,* from Relational Database Systems, Inc.; *File-it!,* an Informix-compatible file manager for personal record keeping; and *Unify,* a relational data base management system from Unify Corporation.

LANGUAGES: Languages available for the 3B Computer Family include the C language, Basic, and Pascal. The 3B20 systems support Cobol, while the 3B5 and 3B15 also support RM/Cobol.

COMMUNICATIONS: For the 3B5 and 3B15, AT&T offers *Host Connectivity* software products for AT&T/IBM networking. The three members of the family are SNA/3270 Emulator+, BSC/3270 Emulator+, and 3270 Application Program Interface.

AT&T SNA/3270 Emulator+ allows an ASCII terminal user to access an SNA network and use the resources available to a 3278 display station user. The package emulates a remote 3274 cluster controller Model 51C, 3278 information display stations Model 2, and 3287 printers. *AT&T BSC/3270 Emulator+* is functionally the same as the SNA/3270 emulator, except it emulates bisynchronous protocol for the same devices in the 3270 family. Both emulators use the interface between the IOA (Input/Output Accelerator) and SDLI (Synchronous Data Link Interface) on 3B5 and 3B15 computers.

AT&T 3270 Application Program Interface (API) provides virtual terminal facilities, allowing the user of an ASCII terminal to access 3270 applications on a mainframe through a C-language-callable interface. The API appears to the mainframe as a 3278 display station. The 3270 API does not interface at the protocol level, so there is no SNA or BSC protocol-specific code; thus, the API can be used with both the SNA/3270 and BSC/3270 Emulator+ products.

UTILITIES: Unix System V utilities are bundled with the core system. The following types of standard utilities are provided:

- System administration—for file system maintenance, measurement, and scheduling.
- Shell programming—to aid users 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—to provide single-step file and directory manipulation capabilities.
- User environment—to enhance the user interface to the Unix system environment and provide access to commands for controlling command priority and changing environmental variables, among others.
- Editing—providing both screen and text editors based on a consistent set of commands designed for use by both inexperienced and expert users.
- Calculator—to let the user 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.

Also available for the 3B5 and 3B15 computers is the *Software Generation System (SGS),* a package of tools used to create and test programs for WE 32100 series microprocessors. The SGS includes 11 utilities that can perform the following functions, among others: check the contents of an object file; convert WE 32100 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; generate an ordered listing of object files suitable for link editing in one pass; and perform symbolic debugging on C language code. Because the SGS operates under Unix System V, it can use features of the Unix system shell.

Available for the 3B20 systems is *S Software.* Integrated with Unix System V, S Software provides a language and system for analytical computing, data analysis, graphics, and data management.

All 3B Computers support the *Unix-to-Unix Copy (UUCP)* utility of Unix System V. UUCP is a software-to-software facility that provides the capability to copy and send files from a resident 3B20 or 3B5 system to a remote Unix system.

Also available for the 3B5 and 3B15 computers are two special development packages. *C Programming Language Utilities, Issue 3* comprises a C compiler and associated programming tools for producing and debugging code. It provides IEEE P754 Draft 10 floating point support, automatically making use of the WE 32106 MAU. *CFP+ Programming Language Utilities, Issue 1,* also comprising a C compiler and tools, works with the MAU to increase floating point performance to a reported maximum of 225K Whetstones per second.

OFFICE AUTOMATION: Third-party office products like Handle, Q-Office, and Prevail are available for AT&T's 3B Computer family through the company's Independent Software Vendor program.

APPLICATIONS: Among applications offered directly by AT&T are those for academic instruction, courseware development, communications management control, service operation management, time clock data collection and reporting, and retail management. A variety of commercial applications from third-party vendors are offered through AT&T's Independent Software Vendor program. Details on available software products are provided in the *AT&T Computer Software Guide,* published twice a year.

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.

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- 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 3B5/301 configuration:

3B5/301 Core System; includes: 10MHz WE 32100 CPU with WE 32106 Math Acceleration Unit, 8KB cache memory Dual maintenance ports Two RS-232-C ports for maintenance and console Main memory controller 2MB main memory board Integrated Disk File Controller Storage Module Drive Controller Unix System V operating system Cabinet Basic Control Unit Growth Control Unit	$44,500
160MB fixed disk drive	14,000
High-speed 1600-bpi tape drive and controller	14,000
Model 475 120-cps dot-matrix printer	593
Input/Output Accelerator	5,000
8-channel asynchronous interface	2,250
Eight Dataspeed 4410 terminals	7,560
Total Price	$87,903

The following is a typical 3B15/201 configuration:

3B15/201 Core System; includes: 14MHz WE 32100 CPU with WE 32106 Math Acceleration Unit, 16KB cache memory Dual maintenance ports Two RS-232-C ports for maintenance and console Main memory controller 2MB main memory board Integrated Disk File Controller Storage Module Drive Controller Unix System V operating system Basic processor cabinet Basic Control Unit Vertical growth cabinet Growth Control Unit	$ 64,500
2MB add-on main memory board	7,500
Two 340MB fixed disk drives	36,500
High-speed 1600-bpi tape drive and controller	14,000
Three Model 475 120-cps dot-matrix printers	1,779
Input/Output Accelerator	5,000
Three 8-channel asynchronous interfaces	6,750
24 Dataspeed 4410 terminals	22,680
Total Price	$158,709

The following is a typical 3B20S configuration:

3B20S Core System; includes: CPU with 8KB cache memory 2MB main memory Input/Output Processor and channel Disk File Controller Operator console and read-only console printer Unix System V operating system	$139,000
Two 2MB add-on memory boards	15,000
1600-bpi tape drive and formatter	23,250
Tape controller	5,000
Two 675MB single-port fixed disk drives	64,000
1000-lpm band printer	14,995
Five 8-channel asynchronous communications controllers	20,000
48 Dataspeed 4410 terminals	45,360
Total Price	$326,605

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EQUIPMENT PRICES

		Purchase Price ($)	Monthly Maint.* ($)
CORE SYSTEMS			
3B5			
7350-101	3B5/101 core system; includes 7.2MHz WE 32000 CPU, 8KB cache, system cabinet, dual maintenance port function, two RS-232-C ports for console and maintenance, main memory controller, 2MB main memory board, Integrated Disk File Controller, Storage Module Drive Controller, basic control unit, and Unix System V	34,500	**
73609	10MHz WE 32100 CPU with Math Accelerator Unit (for 3B5/101)	5,000	**
7350-201	3B5/201 core system; includes CPU with Math Acceleration Unit, 8KB cache, dual maintenance port function, two RS-232-C ports for console and maintenance, main memory controller, one 2MB or two 1MB main memory boards, Integrated Disk File Controller, Storage Module Drive Controller, basic processor cabinet, vertical growth cabinet, basic control unit, growth control unit, and Unix System V	44,500	**
7350-301	3B5/301 core system; includes CPU with Math Acceleration Unit, 8KB cache, dual maintenance port function, two RS-232-C ports for console and maintenance, main memory controller, one 2MB or two 1MB main memory boards, Integrated Disk File Controller, Storage Module Drive Controller, basic processor cabinet, basic control unit, growth control unit, cooling fans, and Unix System V	44,500	**
3B15			
7355-101	3B15/101 core system; includes CPU with Math Acceleration Unit, 16KB cache, system cabinet, dual maintenance port function, two RS-232-C ports for console and maintenance, main memory controller, 2MB main memory board, Integrated Disk File Controller, Storage Module Drive Controller, basic control unit, and Unix System V	54,500	208.00
7355-201	3B15/201 core system; includes CPU with Math Acceleration Unit, 16KB cache, dual maintenance port function, two RS-232-C ports for console and maintenance, main memory controller, one 2MB or two 1MB main memory boards, Integrated Disk File Controller, Storage Module Drive Controller, basic processor cabinet, vertical growth cabinet, basic control unit, growth control unit, and Unix System V	64,500	208.00
7355-301	3B15/301 core system; includes CPU with Math Acceleration Unit, 16KB cache, dual maintenance port function, two RS-232-C ports for console and maintenance, main memory controller, one 2MB or two 1MB main memory boards, Integrated Disk File Controller, Storage Module Drive Controller, basic processor cabinet, basic control unit, growth control unit, cooling fans, and Unix System V	64,500	208.00
3B20			
7420-240	3B20S Computer core system; includes two CPUs, 2MB main memory, I/O processor and channel, disk controller, operator console and read-only console printer, and Unix System V	139,000	**
7420-260	3B20S Computer preattached processor core system; same as 7420-240, but includes only one processor and expansion cabinet for second processor	159,000	**
7420-280	3B20A Computer core system; includes CPU, 2MB main memory, I/O processor and channel, disk controller, operator console and read-only console printer, and Unix System V	194,000	**
J3B203SA1-1	3B20D Computer core system; includes two CPUs, IOPO arranged for two I/O communities, two 340MB Winchester disks, color video maintenance terminal and 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, 5MB of main memory, main store update, port switch, power conditioning cabinet (converts 208 V 3-phase AC power to 48 VDC), fuse unit and cooling fans	340,000	**
MIGRATION KITS			
73650	3B5 to 3B15 migration kit	20,000	4.00
CPU OPTIONS			
3B5 and 3B15			
73686	Cache pack	4,800	**

NA—Not applicable.
NC—No charge.
**3B20D maintenance prices given are national averages; prices will vary depending on geographic location.*
***Indicates that the order number or price was not supplied by AT&T.*

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		Purchase Price ($)	Monthly Maint.* ($)
3B20S/A			
74203	Floating-point unit (UN140)	9,500	**
74204	DMA-1 controller (UN46)	5,500	**
74205	Dual serial channel pack (UN9)	2,900	**
74206	Power module (495FA)	1,000	**
74210	Attached processor upgrade with cabinet	95,000	**
74211	Attached processor upgrade, CPU only	80,000	**
3B20D			
J3B203SA1-3	Additional DMA Controller for DMA1	11,000	**
J3B203SA1-4	Cache memory (8KB)	20,000	**
J3B203SA1-5	4K of additional writable microcode	9,000	**
J3B203SA1-6	Additional dual serial channel	5,800	**
J3B203SA1-7	Additional 5 V power (for any of the above options)	1,500	**
J3B203SA1-8	Utility test circuit	6,500	**
J3B203SA1-9	Scan Signal distributor peripheral controller (not duplicated)	8,500	**
MEMORY OPTIONS			
3B5 and 3B15			
73602	1MB memory option (3B5/101)	NC	NC
73603	2MB memory option (3B5/201 and 301)	NC	NC
73604	1MB add-on memory pack	4,900	**
73605	2MB add-on memory pack	7,500	31.00
73684	Main store control for 2MB memory board (growth units)	2,385	
73685	First 2MB memory board (growth units)	7,500	**
3B20S/A			
74202	1MB memory board (TN28)	4,900	**
73605	2MB memory board (TN56)	7,500	**
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	**

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 and 3B15 systems have optional I/O Accelerators (IOA).

3B5 and 3B15			
73610	I/O Accelerator	5,000	14.00
73611	Asynchronous port for I/O Accelerator	310	NA
73624	Extended Local Bus unit for growth	9,000	**
3B20S/A			
74260	Basic IOP (TAG, SEC) and DSCH cable	18,000	**
74261	Basic IOP (PIOC-1)	18,000	**
74262	Growth IOP (TAG, SEC)	3,500	**
74263	Growth IOP (PIOC-1)	3,500	**
74264	Growth IOP controller and power unit	4,000	**

NA—Not applicable.
NC—No charge.
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AT&T 3B Computer Family

		Purchase Price ($)	Monthly Maint.* ($)
► **3B20D**			
J3B203SA1-18	Tape controller for second tape unit (not duplicated)	2,500	**
J3B203SA1-19	Asynchronous peripheral controller (not duplicated) with two duplex and two half-duplex	3,700	**
J3B203SA1-20	Two-channel 9600 bps synchronous peripheral controller (not duplicated)	4,100	**
J3B203SA1-21	BX.25 56K-bit Datalink (not duplicated)	5,000	**
J3B203SA1-22	Growth unit (if total individual peripheral control packs exceed 16)	10,200	**
J3B203SA1-23	Additional 5V power (if dual serial channel is in growth unit)	1,925	**
J3B203SA1-24	IOP Community 2 power & cables	2,900	**
J3B203SA1-25	IOP Community 3 power & cables	2,900	**
J3B203SA1-26	Second IOP basic unit (incl. exterior cabinet with fan & power units)	24,500	**
J3B203SA1-27	Second IOP growth unit	3,800	**
J3B203SA1-28	Third IOP basic unit	18,000	**
J3B203SA1-29	Third IOP growth unit	3,800	**
J3B203SA1-30	IOP exterior cabinet hardware (required with J3B203SA1-26)	1,700	**
J3B203SA1-31	IOP exterior cabinet doors & hardware (required with J3B203SA1-26)	500	**
MASS STORAGE			
3B5 and 3B15			
73633	Disk File Controller and two Storage Module Drive Controllers	7,000	40.00
73632	Disk File Controller and one Storage Module Drive Controller	5,000	27.50
73631	Storage Module Drive Controller	2,000	12.50
73635	340MB disk drive (279MB formatted)	18,250	113.00
73634	160MB disk drive (134MB formatted)	14,000	93.00
73638	48MB disk drive (40MB formatted)	9,000	213.00
73639	Cable and fan for 48MB disk drive	710	NA
73642	Cartridge for 48MB disk drive	485	**
3B20S/A			
74265	Enhanced Disk File Controller and DSCH cable	13,000	**
74266	Disk File Controller (TN68-based) and DSCH cable	14,500	**
74267	Enhanced Disk File Controller upgrade kit	8,200	**
74280	300MB disk drive, single-port	24,000	**
74281	300MB disk drive, dual-port	26,000	**
74282	300MB dual-port upgrade kit	2,500	**
74283	Interlock kit for 300MB drive	295	**
74285	Disk pack for 300MB drive	1,200	**
74286	675MB disk drive, single-port	32,000	**
74287	675MB disk drive, dual-port	34,000	**
74288	675MB dual-port upgrade kit	2,500	**
74300/74302	340MB AC/DC disk drive, single-port	18,250	**
74301/74303	340MB AC/DC disk drive, dual-port	18,250	**
74304	340MB dual-port upgrade kit	2,500	**
74305	Rack mounting for AC drives	1,950	**
74306	Rack mounting for DC drives	1,650	**
74316/74318	Disk package, four 340MB AC drives	69,000	**
74317	Disk package, four 340MB DC drives	69,000	**
3B20D			
J3B203SAI-L56-L77	Additional 340MB disk drive (includes cables, power unit, and power switch)	22,000	**
MAGNETIC TAPE EQUIPMENT			
3B5 and 3B15			
73651	High-performance Integrated Tape Controller	6,500	21.00
73661	1600-bpi tape drive and standard controller	12,000	125.00
73662	Additional 1600-bpi tape drive	8,500	104.00
73663	1600-bpi tape drive with high-speed controller 3B	14,000	138.00

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AT&T 3B Computer Family

		Purchase Price ($)	Monthly Maint.* ($)
73664	First 6250-bpi tape drive, standard speed	21,000	179.00
73665	First high-speed 6250-bpi tape drive	23,000	196.00
73666	Additional 6250-bpi tape drive	17,500	158.00
3B20S/A			
74220	1600-bpi primary tape system	23,250	**
74221	1600-bpi add-on tape drive with formatter	19,000	**
74222	1600-bpi add-on tape drive without formatter	14,000	**
74223	1600-/6250-bpi primary tape system (3B20S)	35,750	**
74224	1600-/6250-bpi primary tape system (3B20A)	35,750	**
74227	1600-/6250-bpi add-on tape drive	18,500	**
74229	1600-bpi tape controller	5,000	**
3B20D			
J3B203SA1 L34	Second 1600-bpi, 25-ips tape unit with cables	21,000	**
PRINTERS			
**	Model 447 600-lpm band printer	10,995	**
**	Model 447X 1000-lpm band printer	14,995	**
**	Model 470 120-cps dot-matrix printer	545	**
**	Model 475 120-cps dot-matrix printer	593	**
**	Model 476 120-cps dot-matrix printer	845	**
**	Model 5310 200-cps dot-matrix printer	1,285	**
**	Model 5320 200-cps dot-matrix printer	1,580	**
GRAPHICS PLOTTER			
**	Model 435 plotter	1,898	**
WORKSTATIONS			
**	4410 terminal	945	**
**	4418 terminal	1,065	**
**	4425 terminal	1,295	**
**	5620 terminal; hardware and software, including 256KB of memory	5,000	**
**	5620 terminal; hardware and software, including 1MB of memory	6,000	**
J3B203SA1 L42	Additional color video terminal (3B20D only)	4,500	**
COMMUNICATIONS/NETWORKING OPTIONS			
3B5 and 3B15			
73612	8-channel asynchronous interface	2,250	7.00
73613	2-channel autocall interface	260	NA
73614	4-channel synchronous interface	6,200	20.75
73615	Additional 4-channel synchronous interface	335	NA
73616	4-channel Teletype Terminal Interface	5,400	27.00
73617	Additional 4-channel Teletype Terminal Interface	240	NA
73622	4-port synchronous/asynchronous interface	6,500	**
73623	Additional 4-port synchronous/asynchronous interface	310	NA
73625	8-port Teletype Terminal Interface pack	5,640	33.00
73626	Additional 8 ports for Teletype Terminal Interface pack	480	NA
73618	3BNet interface	6,500	35.50
73619	3BNet transceiver and 10-m cable	500	2.25
73620	3BNet transceiver and 30-m cable	655	2.25
73621	3BNet transceiver and 50-m cable	840	2.25

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AT&T 3B Computer Family

		Purchase Price ($)	Monthly Maint.* ($)
3B20S/A			
74241	8-channel asynchronous controller (TN4)	4,000	**
74242	2-channel asynchronous controller (TN74)	3,700	**
74243	8-channel automatic call unit (UN56)	2,750	**
74244	2-channel synchronous controller, RS-232-C (TN75)	4,100	**
74245	2-channel synchronous controller, RS-449 (TN75)	4,100	**
74246	1-channel X.25 controller, RS-232-C (TN82)	5,000	**
74247	1-channel X.25 controller, RS-422 (TN82)	5,000	**
74248	8-channel X.25 controller (UN141)	6,500	**
74249	4-channel bisynchronous controller (TN82/UN53)	7,500	**
74215	Interface to NSC Hyperchannel Network	4,300	**
74216	3BNet Interface	6,500	**
73619	3BNet transceiver and 10-m cable	500	**
73620	3BNet transceiver and 30-m cable	655	**
73621	3BNet transceiver and 50-m cable	840	**
74217	Datakit interface	9,500	**

HARDWARE OPTIONS

3B5 and 3B15

73606	Expansion rack for extended local bus	8,000	29.00
73672	Vertical growth cabinet for two 48MB disk drives (Models 101 and 201)	2,500	NA
73673	Vertical growth cabinet for one 48MB disk drive and one fixed disk drive (Models 101 and 201)	2,500	NA
73674	Vertical growth cabinet for two fixed disk drives (Models 101 and 201)	2,500	NA
73675	Horizontal growth cabinet	3,000	NA
73601	Growth cabinet for Model 301	3,000	NA
73607	Model 301 growth cabinet tape door	1,245	**
73608	Model 301 growth cabinet with door	4,245	**
73695	Growth control unit	7,000	**

3B20S/A

74239	Half-door	1,000	**
74270	Expansion cabinet for I/O Processor or Disk File Controller	3,135	**
74271	Fan and fuse unit (SEC-0)	7,500	**
74272	Fan and fuse unit (TAG-3)	7,500	**
74273	Fan and fuse unit (TAG-3/SEC-4)	7,500	**
74274	Fan and fuse unit (SEC-5)	7,500	**
74310	Expansion cabinet for 340MB disk drives	3,135	**
74390	Earthquake bracing, 3-cabinet system	500	**
74391	Earthquake bracing, additional cabinet	150	**

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	**

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AT&T 3B Computer Family

SOFTWARE PRICES

		List Price ($)

The list price for software includes a onetime 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 3B15 systems; the Unix RTR system for the 3B20D is priced separately.

3B5 and 3B15

1051-005	Unix System V Release 1 to Release 2 upgrade	1,500

3B20D

—	Unix RTR	40,000

COMMUNICATIONS

1050-001	3BNet (3B5 and 3B15)	8,000

UTILITIES

1051-A01	C Programming Language Utilities, Issue 3	340 ■