BTI 5000 and 5000/ES

MANAGEMENT SUMMARY

BTI Computer Systems started out in 1968 as Basic Timesharing, Inc., a time-sharing service company serving the San Francisco peninsula. The experience gained in the next two years led to the development of a packaged proprietary time-sharing system capable of accommodating up to 16 users.

Installation of these initial systems took place in 1971. Main memory (core) was 48K bytes, and the basic on-line disk storage capacity was 2.4 megabytes, available in fixed- and removable-cartridge configurations. Up to three drives could be added for a total on-line capacity of 9.6 megabytes.

BTI's first formal product, the BTI 3000 System, an outgrowth of the company's assembled systems, was introduced in November 1972. This new system was based on a Hewlett-Packard 2100 minicomputer, chosen primarily because its user-microprogrammability enabled implementation of an efficient time-sharing facility in a system of relatively modest cost. At the time, microprogrammability was not as popular as it has since become, and manufacturers usually did not bother to mention the feature to anyone except those with the most specialized applications in mind. However, the concept of microprogrammability was far from new; microprogrammable computers had been in limited use in process control and measurement applications since the mid-1960's because of the need for faster programmable real-time systems.

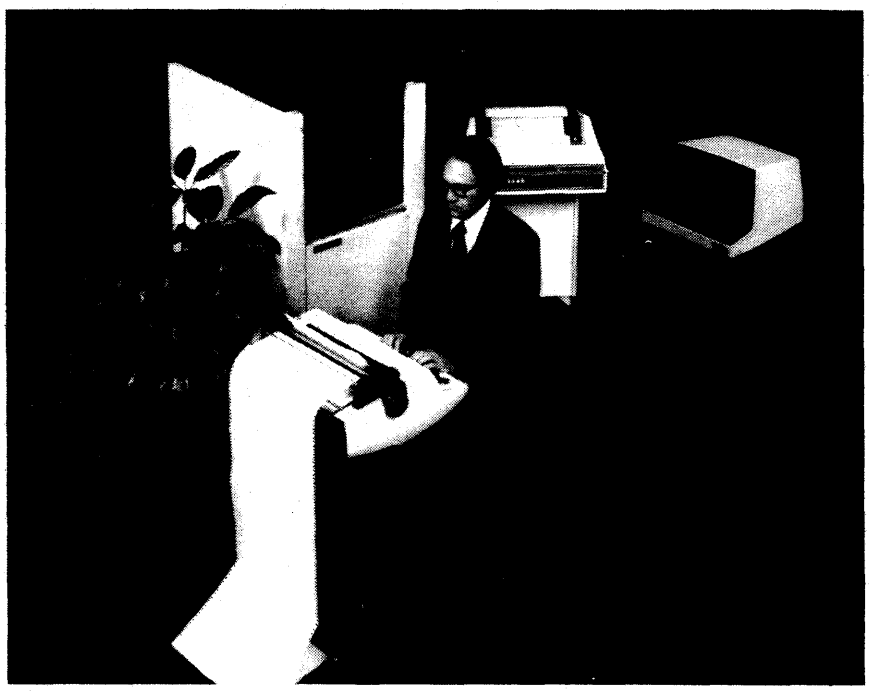
The BTI 5000 and 5000/ES are the current offerings of 16-bit minicomputers by BTI Computer Systems. The BTI 5000 provides 27 megabytes of disk storage, a 10-megabyte magnetic tape cartridge drive for software backup and recovery, and 8 user ports. The BTI 5000/ES, the entry-level system to the BTI 5000 product line, features 10 megabytes of disk storage and 4 user ports. Both systems can support up to 32 simultaneous users, but over 5000 users can access the systems through authorized IDs and passwords.

MAIN MEMORY: 64K bytes.
DISK CAPACITY: 468M bytes (5000), 262M bytes (5000/ES).
WORKSTATIONS: Up to 32.
PRINTERS: Up to 900 lpm.
OTHER I/O: Magnetic tape cartridge drive, magnetic tape reel-to-reel drive.

CHARACTERISTICS

MANUFACTURER: BTI Computer Systems, Inc West Maude Avenue, Sunnyvale, California 94086. phone (408) 733-1122.

BTI Computer Systems started in the San Francisco area in 1968 as a time-sharing service company under the name Basic Timesharing, Inc., and took its present name in 1978. From this time-sharing experience, the company developed a series of interactive systems initially based on a



The BTI 5000 is shown here with the optional Model 5620 (300 lpm) line printer to the right of the processor cabinet. Terminals utilized by the BTI 5000 include Hazeltine CRTs or Texas Instruments' Model 1800 teleprinters.

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In addition to the 48K bytes of 980-nanosecond core memory and the on-line disk storage, the basic 3000 System included 8 user ports, expandable to 16 ports, and the ability to extend the disk storage capacity beyond 9.6 megabytes by adding more disk controllers as required.

The Model 3000, at the outset, was offered to: 1) end users interested in acquiring in-house systems to save on outside time-sharing services; 2) users with dedicated applications, based on proprietary software developed by the system owners; and 3) time-sharing service bureaus. Most minicomputer manufacturers offered system hardware and time-sharing operating systems ostensibly comparable with those required by time-sharing service companies. But what no other vendor offered then, and few offer now, are the accounting and security functions supplied by the BTI system.

In June 1973, BTI expanded the 3000 System into a series. The initial system, described above, was designated the Model 3000/30, and two more models were added: the 3000/20 and 3000/40. The 3000/20 low-end model was a 32K-byte system for up to 8 users. The 3000/40 high-end model had 64K bytes of memory and could support up to 32 users. In addition, the new 3000s featured enhanced file capabilities and string arithmetic functions. Subsequently, in September 1973, BTI announced the 3000/35 and 3000/45, which offered substantially more disk storage in the form of 49-megabyte 2314-type disk drives. One disk controller could operate up to 10 drives, and more than one controller could be used in a system.

During the product life of the 3000 Series, from 1972 to 1974, the 3000's application programming language, an extended version of BASIC, was successively enhanced to further the 3000's use in business applications. One feature of the 3000 which set it apart from other minicomputer-based, multiple-user systems was the high degree of security provided for system access and application software designed into the operating system. As upgraded versions of the operating system became available, they were offered to system owners for just a handling charge. This practice encouraged system owners to upgrade their systems to the latest configuration and made it easier for BTI to service its products since it minimized the number of installations using different software.

The method of maintenance which BTI adopted for the 3000 and subsequent series is noteworthy in that it is based on fault diagnosis by dial-up telephone access to the customer's system from BTI's factory service center. The ability to perform remote diagnosis was specifically designed into the 3000's operating system. Since its inception, BTI's diagnosis-by-phone support has been available 24 hours per day, 365 days per year.

BTI's service is also unusual in that it relies on "customer cooperative maintenance." Under this arrangement, the

modified Hewlett-Packard minicomputer. Today the company manufactures three product lines: two 16-bit single-processor systems capable of supporting up to 32 users and a 32-bit modular multiprocessor system which can support over 500 users. BTI's manufacturing facility is in Sunnyvale, California, and U.S. sales offices are in Piscataway and Cherry Hill, New Jersey; Braintree, Massachusetts; Dallas, Texas; Minneapolis, Minnesota; Chicago, Illinois; St. Louis, Missouri; and Sunnyvale and Anaheim, California. BTI also has a European subsidiary, BTI Computer Systems (UK), Ltd., with a sales office in Slough, England, and a service office in Birmingham, England.

MODELS: BTI 5000 and BTI 5000/ES.

DATE ANNOUNCED: September 1978 (BTI 5000); August 1979 (BTI 5000/ES).

DATE OF FIRST DELIVERY: October 1978 (BTI 5000); September 1979 (BTI 5000/ES).

NUMBER INSTALLED TO DATE: Approximately 2500.

DATA FORMATS

BASIC UNITS: 16-bit word and 8-bit byte.

FIXED-POINT OPERANDS: 16-bit operand for all instructions except extended arithmetic (integer double-word) and floating-point instructions, which are 32 bits long. String arithmetic instructions, implemented in microcode, permit variable-length operands.

FLOATING-POINT OPERANDS: Six floating-point instructions are implemented in the basic instruction set. Operands for these instructions are 32 bits, including a signed 7-bit exponent (8 bits) and a signed 23-bit fraction (24 bits). BTI has implemented additional floating-point instructions in firmware.

Within the 5000 systems, floating-point numbers range between 5.87747×10^{-39} and $1.70141 \times 10^{+38}$. Decimal numbers are limited to six digits and are internally rounded if they exceed six digits. Scientific or "E" notation is used for floating-point numbers. For example, the number 458146 is changed to 4.58146E+05, and 0.00576 becomes 5.76E-03.

INSTRUCTIONS: All user-written instructions to the BTI 5000 systems are either BASIC language statements or system control statements defined by BTI.

All machine instructions, including the optional DMS instructions, are one word long except for 10 extended arithmetic instructions, each of which is two words long.

Memory reference instructions combine an operation code and a memory address into one word. Ten bits in the instruction plus 5 bits in the P-register are used to specify an absolute address within the current 1024-word page or within the base page (page zero). Indirect or direct addressing is specified by one bit position. Register reference instructions are used to manipulate bits in the A, B, and F registers. One bit is used to specify the shift rotate group (SRG) of register reference instructions, or the alter-skip group (ASG) of instructions. Four bits are used to specify type or class of instruction, and 10 bits are used to contain one or more "micro instructions" defining register manipulation operations.

I/O instructions contain a 4-bit class identifier, a 5-bit operation code, and a 6-bit channel identifier. Extended (2-word) arithmetic memory reference instructions use 5 bits to specify the class of instruction, 7 bits to indicate an operation code, and 15 bits to specify the memory address

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PERIPHERALS/TERMINALS

DEVICE	DESCRIPTION & SPEED	MANUFACTURER
MAGNETIC TAPE UNITS		
5330	9-track, 800/1600 bpi, switch-selectable density, 45 ips, 10.5-in. reels, IBM/ANSI-compatible, 72K char./sec.	Kennedy, among others
5520	Cartridge, 4-track, 6400 bpi, 30 ips, 24K char./sec., data blocks of up to 131K char., 10M bytes total	DEI
PRINTERS		
5620	Line printer, 96-character set, 132 columns, 300 lpm	General Electric
5630	Line printer, 64- or 96-character set, 136 columns, 300 lpm	Dataproducts
5660	Line printer, 64- or 96-character set, 136 columns, 600 lpm	Dataproducts
5690	Line printer, 64- or 96-character set, 136 columns, 900 lpm	Dataproducts
TERMINALS		
1410	80 x 24 CRT screen format, 5 x 7 character matrix, 64 displayable characters, TTY-style keyboard with numeric keypad, transmission rate of 9600 bps	Hazeltine
1420	80 x 24 CRT screen format, 5 x 8 character matrix, 94 displayable characters (including lower case), dual-density, typewriter-style keyboard with numeric keypad, transmission rate of 9600 bps	Hazeltine
1500	80 x 24 CRT screen format, 7 x 10 character matrix, 94 displayable characters, dual-density and reverse video, ANSI standard keyboard with numeric keypad, serial printer output, transmission rate of 9600 bps	Hazeltine
1510	80 x 24 CRT screen format, 7 x 10 character matrix, 95 displayable characters, dual-density, reverse video, screen protect, and block transmission (254 characters per block), ANSI standard keyboard with numeric keypad, serial printer output, transmission rate of 9600 bps	Hazeltine
1800	Printing terminal; includes 9 x 7 character matrix, 132 columns, 120-cps impact printer, full ASCII 128-character keyboard, transmission rates of 110 to 1200 bps	Texas Instruments

customer is expected to assist the factory in preventive and corrective maintenance activities in exchange for maintenance charges considerably lower than the prevailing rates in the industry. The customer's preventive maintenance obligations are simple, consisting primarily of inspecting the system for cleanliness and replacing air filters as needed. Kits that contain all materials necessary to perform required maintenance are mailed to customer sites, and the required routines are performed by the customer. Such functions as air filter replacement, tape head cleaning, and other preventive functions are carried out and reported back to BTI via enclosed forms. For corrective maintenance, customer personnel contact the BTI factory by telephone. Service engineers at BTI log onto the operating system through special access passwords and then exercise the system remotely. If it is determined that a part has failed, a spare is immediately shipped by the fastest method to the customer site. If the malfunction cannot be cleared up through telephone consultation, a field service engineer is then dispatched to the site from BTI's California headquarters.

Thus, while BTI started small in terms of personnel, it was able to maximize the value of its most expert service people by having them concentrate on the important task of problem diagnosis.

The 4000 Series, introduced in January 1975, was a continuation of the total hardware and software system

of the operand. One bit is used to signify direct or indirect addressing (32K words directly addressable). Extended arithmetic register reference instructions provide long shifts and rotates on combined A and B registers. Five bits identify the class, and seven bits specify the direction and type of shift. Four bits specify the number of shifts (1 to 16 places).

INTERNAL CODE: ASCII.

MAIN STORAGE

TYPE: N-channel dynamic MOS RAM.

CYCLE TIME: 650 nanoseconds.

CAPACITY: 65,536 bytes. No user expansion is offered.

CHECKING: Single-bit error correction, two-bit detection.

STORAGE PROTECTION: The operating system provides protection to both user programs and files through an elaborate scheme. Files are automatically assumed to be "read only" to all accounts (users) except the owner, unless specifically designated as shared files. The user can share a file on a "read only" or "read-write" basis and change the designation at will. To preclude update errors, files can also be shared on a "non-interfering read-write" basis in which write requests to a file are queued while a current write access is in progress.

RESERVED STORAGE: The first 64 main memory addresses may be used for vectored interrupts. The uppermost 64 locations are used by the binary loader, which is loaded from ROM. Both areas may be overwritten by the operating system.

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established by the 3000 Series. The 4000 Series was based on the newer, more cost-effective, Hewlett-Packard 21MX minicomputer and initially consisted of three models: the 4000/10, 4000/20, and 4000/30. The new CPUs incorporated many system functions implemented in microcode. All of the 4000 Series models had 64K-byte core memories and differed in the type and amount of mass storage offered with each system. The 4000/10 used the same 2.4-megabyte disk drives as the 3000/20 and 3000/30, while the 4000/20 used the same 49-megabyte disk pack drives as the 3000/40. The 4000/30 featured 73-megabyte disk drives. All models were supplied initially with ports for up to 16 users, with the 4000/20 and 4000/30 having expansion capabilities to 32 ports.

In March 1976, the 4000 Series was upgraded and redesignated as the Models 4000/15, 4000/25, and 4000/35. The most visible difference between the new 4000s and the old was the cabinetry. Using a special modular packaging technique, the equipment mounting chassis were stacked together. Decorative skins were then added to lock the stack together and form an integrated cabinet.

Less visible differences included 650-nanosecond MOS memory instead of the 980-nanosecond core, more internal functions implemented in microcode, and 7.5-megabyte disk drives substituted for the 2.4-megabyte drives on the low-end model. Sources within Hewlett-Packard regarded the BTI product line as one in which the microprogramming capabilities of the 21MX were most extensively exploited.

Another enhancement over the 4000/10, /20, and /30 was the addition of a magnetic tape subsystem which incorporated a new tape pack. This tape subsystem was used as a backup device to dump files and programs and to regenerate a user's complete system in the event of a catastrophic failure. A tape pack copy of the operating system and BASIC compiler was supplied with each system. User files and programs could also be added to the tape pack, which served as a convenient method for storing software. In addition, the tape packs contained an internal mechanism to keep the tape under proper tension during transportation, making them well suited for shipment to other sites. A conventional 9-track, 800/1600-bpi tape transport, which operated in IBM/ANSI format, was also offered.

The basic 4000 Series system now included a CPU with 64K bytes of main memory, a disk subsystem, a magnetic tape pack subsystem, and eight user-terminal ports.

The only difference between the 4000/15 and the 4000/25 was the disk subsystems they used. The 4000/15 was supplied with 7.5-megabyte nonremovable disk drives, and the 4000/25 had 49-megabyte 2316-type disk pack drives. The 4000/15 system could be upgraded, and the two disk subsystems could be intermixed. The 7.5-mega-

CENTRAL PROCESSOR

The BTI 6030 processor is greatly enhanced through a BTI-generated microcode implemented in the CPU's writable control storage. The processor includes its own memory, peripheral controllers, and programming panel. The programming panel is a specially designed unit with the normal displays and data switches mounted on the inside, accessible only for maintenance purposes. On the outside, the panel contains a 2-digit display and 10 pushbuttons. Eight of these pushbuttons initiate ROM-stored system functions, including system startup, program syntax changes to accommodate system software updates, an upgrade installation routine, core dump, a disk-to-disk copying routine, and a disk-to-magnetic-tape copying routine.

CONTROL STORAGE: Consists of 325-nanosecond PROM fixed user control storage (UCS) or RAM writable control storage (WCS). Combinations of both types can be implemented up to a maximum of 4096 24-bit words. User control storage is organized into 256-word pages. The basic instruction set occupies 1024 words, and there are provisions for another 1024 words to be added. Writable control storage is on 256-word modules that mount with the I/O controllers.

REGISTERS: The internal data structure of the CPU cannot be accessed by the BTI user.

INSTRUCTION REPERTOIRE: The BTI 6030 CPU uses a standard instruction set plus several additional functions implemented in both user control storage and writable control storage. These additional functions include string arithmetic, matrix operations, and binary operators.

PHYSICAL SPECIFICATIONS: The CPU, communications interfaces, Model 5430 disk drive, and magnetic tape pack drive are mounted in a cabinet 26 inches wide, 34 inches deep, and 54 inches high. The addition of a third and fourth disk drive requires a second cabinet.

Power requirements for the 5000 and 5000/ES are either 120 VAC ± 10%, 60 Hertz ± 1%, single phase or 240 VAC ± 10%, 50 Hertz ± 1%, single phase. Heat dissipation for the basic systems, including Model 5430/5460 disk drives, is between 5300 and 7400 BTUs per hour, depending on the number of drives. The Model 5260 disk pack drive dissipates 2500 BTUs per hour.

Operating environment for the 5000 Series systems is 60 to 80 degrees F., with a relative humidity of 20 to 80 percent, noncondensing.

CONFIGURATION RULES

Maximum configuration parameters for the BTI 5000 systems are as follows:

- **Up to 64K bytes of main memory,**
- **Up to 468 megabytes of on-line disk storage for the BTI 5000 (up to 262 megabytes of disk storage for the BTI 5000/ES),**
- **Up to 32 terminals,**
- **Up to four magnetic tape cartridge drives (40 megabytes),**
- **A 300-, 600-, or 900-lpm printer,**
- **A 9-track, 800/1600-bpi reel-to-reel tape drive.**

WORKSTATIONS: The 5000 and 5000/ES are capable of supporting up to 32 interactive terminals. The basic system

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The basic BTI 5000 system includes a magnetic tape cartridge drive for software backup and recovery. With four drives installed, up to 40 megabytes can be transferred without physical handling of the tape cartridges.

byte disk controller could accommodate up to four drives, and the 49-megabyte controller could handle up to eight drives. No additional hardware was required to add disk drives to either subsystem.

Although three of the new 4000 Series systems were originally announced, BTI subsequently withdrew the largest, the 4000/35, from the market, citing problems encountered with the 73-megabyte disk drives.

Besides the user terminal ports, the new 4000 Series systems offered optional ports for intersystem communications via any asynchronous protocol. These ports were compatible with Bell System 202C-type modems and allowed system-to-system communications with another BTI 4000 system or with another mainframe. Communications protocol was established by the user with a BASIC program. Up to four such communications ports could be included in a system.

One essential component of all time-sharing systems, user terminals, was *not* supplied by BTI for the 4000 Series. The company recognized that many terminals are available directly to users and passed on to its customers the potential savings of direct procurement. Any terminal with a data rate between 100 and 2500 bits per second and a standard RS-232-C interface could be used on any 4000 Series system. Similarly, any modem with the RS-232-C interface could be used for remote terminals.

BTI chose not to develop application software, but reached end users requiring such software through an informal alignment of its computer systems with application software furnished by independent vendors. BTI was able to offer a unique advantage to the application software supplier: protection for his software compar-

includes one 5810 communications controller with eight ports (four ports with the 5000/ES), which can be expanded to 32 ports in eight-port increments. (The basic configuration of the 5000/ES can be equipped with an optional 8-port controller.)

DISK STORAGE: The base configuration of the BTI 5000 includes a 27-megabyte disk drive and a controller. For additional storage, the controller accepts up to four 27-megabyte or 54-megabyte drives in any mix. The 5000 supports a second controller which accommodates up to four 63-megabyte disk drives. The total possible capacity for on-line disk storage for the BTI 5000 is 468 megabytes.

The base system configuration of the 5000/ES is equipped with a controller and a 10-megabyte disk drive. The controller is capable of supporting a second 10-megabyte drive. In lieu of this second drive, the system supports a second controller for up to four 27- or 54-megabyte drives or a controller for up to four 63-megabyte disk drives. On-line disk storage capacities for the BTI 5000/ES, therefore, are 226 megabytes or 262 megabytes, depending on the disk drive configuration.

MAGNETIC TAPE UNITS: An optional 9-track, 800/1600-bpi, 45-ips magnetic tape subsystem can also be added to the 5000 and 5000/ES systems for loading and dumping data files and programs.

MASS STORAGE

10-MEGABYTE DISK SUBSYSTEM: Includes one 10-megabyte disk drive and one 5412 controller. The controller is capable of supporting a second 10-megabyte disk drive. This 10-megabyte disk subsystem is used exclusively by the BTI 5000/ES.

27-MEGABYTE DISK SUBSYSTEM: Includes one 27-megabyte 5440 disk drive and one 5416 controller capable of supporting up to three additional drives. Data is recorded at 256 bytes per sector, 36 sectors per track, and 400 tracks on each surface. Average head-positioning time is 40 milliseconds. Data transfer rate is 1 million bytes per second. Maximum formatted subsystem capacity is 116 million bytes.

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able to that of BTI's proprietary operating system. With his software protected by an exclusive "proprietary" screen initially set up by BTI, the vendor was able to install his software on BTI systems of his choice where he could support his software over the telephone, much as BTI supported its own software. This exclusive proprietary software protection facility is also available with BTI's current products. The 4000's special protection for added-value software made it easier for the company to establish joint selling arrangements with independent software suppliers, including OEM purchasers. This feature was also an advantage in selling to service bureaus because it enabled the service bureau to become an OEM supplier to clients whose billings had grown to the point of justifying the acquisition of an in-house system.

In September 1978, BTI introduced the BTI 5000 to replace the 4000. The 5000 is BTI's current offering in this class of system. It uses BTI's own upgraded version of the operating system proven on the 4000. The principal design change in the 5000's CPU enables BTI to perform *automatic* remote fault diagnosis. With BTI's long experience in manually implemented diagnosis, many advantages could be seen in having this work performed by a computer. The 5000 was therefore designed to allow it to be called and tested by a computer at BTI's service center without on-site assistance by the customer. Diagnostic tests can be performed even if the customer's system has halted. The diagnosing computer can perform its tests faster and more precisely than a human operator, and its use can be initiated by a service engineer in the field.

BTI's diagnostic computers are also used to monitor a customer's system after a repair has been made and to carry out periodic "health checks," looking, for example, at the incidence of soft (disk-read) errors which could later lead to a hard failure. Another advantage of computer-to-computer communication is the ease with which patches can be inserted into an operating system. If a bug is discovered, possibly on just one system, a patch can be made automatically and quickly by BTI's service computers (usually overnight) on *all* Model 5000 installations.

New disk drives, available in 27- and 54-megabyte capacities (nonremovable), are offered for the 5000. BTI recently introduced a new storage-module-type drive with a formatted capacity of 63 megabytes. For terminal communications, a new communications controller/interface is used in the 5000. It can be expanded from 8 to 32 ports in 8-port increments and supports terminal data rates up to 9600 bits per second, up from the 4000's limit of 2400 bps.

A magnetic tape cartridge drive is furnished for software backup and recovery. One cartridge stores 10 megabytes. A single-drive module is included in the basic system configuration, and up to three additional drive units can be installed in the drive module. Software backups and recoveries can be performed under command or pro-

54-MEGABYTE DISK PACK SUBSYSTEM: Includes one 54-megabyte 5470 disk pack drive and one 5416 controller capable of supporting up to three additional drives. Data is recorded at 256 bytes per sector, 24 sectors per track, and 400 tracks on each surface. Average head-positioning time is 38 milliseconds, and average rotational delay is 10 milliseconds. Data transfer rate is 996K bytes per second. Maximum formatted subsystem capacity is 468 million bytes.

63-MEGABYTE DISK PACK SUBSYSTEM: Includes one 63-megabyte 5260 disk drive and one 5220 controller capable of supporting up to three additional drives. Data transfer rate is 1,200,000 bytes per second, and average seek time is 36 milliseconds. Maximum formatted subsystem capacity is 250 million bytes. The 5260 disk pack drives are manufactured by Ampex.

INPUT/OUTPUT UNITS

See the PERIPHERALS/TERMINALS table on M11-089-103.

COMMUNICATIONS CONTROL

The BTI 5000 systems can support up to 32 local or remote user terminals.

5810 ASYNCHRONOUS CONTROLLER/MULTIPLEXER: Can interface up to eight RS-232-C terminal or modem interfaces, and up to 32 interfaces if communications controllers are added. Data rates can be set individually, to any speed between 110 and 9600 bps. The data rate for a port is normally established by the system manager, but can be temporarily overridden by the user. The original data rate again becomes effective whenever the user relinquishes the line. Character lengths, also program-selectable, can be either 10 or 11 bits long.

SOFTWARE

OPERATING SYSTEM: The BTI 5000 and 5000/ES operating system provides a time-shared environment for the BASIC-X compiler and also performs all control and accounting functions necessary to determine usage and maintain security and privacy between users. The time-sharing control portion of the operating system includes a dynamic time-slicing and allocation task. About 20K bytes of the 64K-byte main memory are allocated as the user area. Only one user program is resident in main memory at a given time. As each program's time expires, a complete roll-out/roll-in cycle occurs and the next highest priority program is brought in from disk. Users in interactive mode are given the highest priority for system resource allocation.

The operating system is designed primarily for commercial time-sharing applications. As such, it maintains all user programs and files within separate *accounts*. The software system is organized into three levels: control, master, and user. At the control account level, the system manager has responsibility for the overall system operation. Through three specially defined accounts, the system manager can:

- **Establish new master accounts.**
- **Remove both user and master accounts from the system.**
- **Change passwords and disk authorizations for master accounts.**
- **List disk authorizations on command.**
- **List locations of accounts and files by logical disk.**
- **Protect programs and files.**

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grammatically. With four drives installed, up to 40 megabytes can be transferred without physical handling of tape cartridges. Optional peripherals are a 9-track, open-reel magnetic tape drive which is IBM/ANSI-compatible and four line printers with print speeds from 300 to 900 lines per minute.

The BTI 5000/ES, introduced in August 1979, is the entry-level system of the BTI 5000 product line. Its base configuration includes a 64K-byte CPU, 10 megabytes of on-line disk storage, a magnetic tape cartridge subsystem for application software backup, and a four-port communications controller/interface. For port expansion, an eight-port communications controller/interface can be substituted for the four-port module in the base configuration. Ports can further be expanded in 8-port increments to a maximum total of 32 ports.

Disk storage can also be expanded with the addition of a second controller. One optional controller accommodates up to four 27- or 54-megabyte disk drives for a maximum total storage of 226 megabytes. A second optional controller supports up to four 63-megabyte drives for a total of 262 megabytes of on-line disk storage.

The 5000/ES is capable of supporting up to four cartridge magnetic tape drives, each with a storage capacity of 10 megabytes. A 9-track, 800/1600-bpi IBM/ANSI-compatible magnetic tape drive and several line printer options are also available for the entry-level system.

Along with the 32-bit BTI 8000 (M11-089-201), the 5000 and the 5000/ES provide time-sharing computer users with a wide range of processing power. Together, BTI Computer Systems has formed a popular product line of computing systems, as witnessed by approximately 2500 user installations.

USER REACTION

Seven users of BTI systems responded to Datapro's 1980 survey on minicomputer and small business computer systems, representing a total of 15 installed systems. Included in this total were nine BTI 5000 systems installed by three users.

The average installation period for the BTI 5000 systems is approximately 22 months. Main memory for each system is 64K bytes, with disk storage capacities ranging from 58 megabytes to 128 megabytes. The maximum number of workstations reported by the three users is 24.

The principal applications accommodated by the BTI 5000 systems include accounting, construction, payroll/personnel, service bureau, and transportation. The sources for these applications programs, according to the users, were in-house personnel, "ready-made" programs from BTI, contracted programmers, and proprietary software packages.

- Make programs and files permanent at the system level.
- Produce lists of shared files.
- Produce status reports on user storage utilization and time usage.
- Produce current activity reports.
- Copy accounts from one disk to another.
- Resequence program and file serial number.

The three accounts used by the system manager are the system management account, the system operations account, and the system resources account. The latter account controls non-time-sharable system resources such as magnetic tape. The system manager also controls the system public library.

The system manager can subdivide the system into as many as 26 independent segments, each supervised by a master account manager. This group of master accounts makes up the master level within the system. Master accounts are identified by a single-letter prefix. Each master account has a separate master library accessible only to users in that master account. For accounts in his letter group at the master level, the master account manager can:

- Open and close user accounts.
- Establish passwords, time limits, and storage for user accounts.
- Protect and unprotect programs and files.
- Make programs permanent or temporary.
- Produce status activity reports.
- Designate the "Hello" program—the program entered automatically by each user immediately after logging on the system.

Each master account can be subdivided into 10 user groups, each with its own group library. User groups can be made up of as many as 100 individual user accounts, each with a separate private library of programs and data files.

Although the *theoretical* maximum number of user account numbers is 26,000 (26 x 10 x 100), the BTI 5000 Series operating system restricts the number to 5800.

Programs and files in private libraries belonging to specific user accounts can be accessed by the corresponding master account or, ultimately, through the system manager account, without the need for a password. Users, however, cannot access other users' private libraries without the passwords. In the same fashion, both group and master libraries can be accessed by members of their own groups or master accounts, but not by members of the other groups of master accounts. Programs and files, however, can be declared universally or selectively "sharable" by the individual users.

Selective sharing permits each user to designate those accounts that are to be granted access to specified programs and files. Users can also share programs or files with the public library or any other master or group library. All shared files are automatically assumed to be read-only unless read-write access is granted. File sharing is done on a non-interfering read-write basis. Requests to write into shared files are automatically queued if the desired file is in the process of being updated. This assures that the file is updated in the proper sequence.

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The following table summarizes the ratings of the BTI 5000 systems issued by the three users:

	Excellent	Good	Fair	Poor	WA*
Ease of operation	2	1	0	0	3.7
Reliability of mainframe	3	0	0	0	4.0
Reliability of peripherals	1	1	1	0	3.0
Maintenance service:					
Responsiveness	3	0	0	0	4.0
Effectiveness	3	0	0	0	4.0
Technical support:					
Trouble-shooting	2	1	0	0	3.7
Education	2	0	1	0	3.3
Documentation	2	1	0	0	3.7
Manufacturer's software:					
Operating system	1	1	1	0	3.0
Compilers & assemblers	0	1	1	0	2.5
Applications programs	1	2	0	0	3.3
Ease of programming	3	0	0	0	4.0
Ease of conversion	2	1	0	0	3.7
Overall satisfaction	3	0	0	0	4.0

*Weighted Average on a scale of 4.0 for Excellent.

As shown by the ratings, the users were quite satisfied with their systems. Significant advantages of the BTI 5000 sighted by the users included excellent response time, ease of expansion and reconfiguration, and compatibility of terminals/peripherals carried over from other systems. Other advantages reported by the users included excellent productivity aids, an effective and efficient data base language, and that the delivery and installation of the equipment was ahead of schedule. One user commented that there was "almost no downtime" with the BTI 5000.

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BTI 5000 and 5000/ES

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BTI provides an extensive text-processing package, a mailing list management system, and a keyed-sequential access program, in addition to a comprehensive set of utilities and a substantial program library.

PRICING

POLICY: BTI provides the 5000 and the 5000/ES on a purchase-only basis. In some areas, distributorships have been established by system builders serving particular market segments. The system price includes the operating system and the BASIC-X language. BTI warrants all hardware for 90 days and software for one year.

SUPPORT: BTI features a unique customer-participation service and support system that combines human resources and hardware features of the 5000 systems. The BTI 6030 CPU contains integrated maintenance aids for automatic fault diagnosis by a remote computer located at BTI's factory service center. BTI customer engineers can gain access to the operating system through a user port and exercise various system components. Customer cooperation, in the form of a person standing by the system to perform specified actions, may be required to aid the BTI engineer in testing and evaluating a failed system. The customer's responsibility to provide such assistance is noted in BTI's corrective maintenance contract.

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System purchase prices include on-site training by BTI personnel. Training includes both operation and maintenance procedures.

The BTI operating system is typically updated about three times a year. Customers can update their systems for a nominal handling fee. Each update extends the software warranty for one year.■

EQUIPMENT PRICES

		Purchase Price
SYSTEMS		
5000	Time-sharing system; includes central processor, 64K bytes of MOS memory, battery backup for two hours, one 29-megabyte disk drive and controller, one magnetic tape cartridge drive and controller, eight terminal ports, power supply, and cabinet	$38,950
5000/ES	Time-sharing system; includes central processor, 64K bytes of MOS memory, one 10-megabyte disk drive and controller, one magnetic tape cartridge drive and controller, four terminal ports, power supply, and cabinet	29,950
MASS STORAGE		
5220	Disk controller for one to four 5260 disk drives	8,650
5260	63-megabyte disk drive (removable)	13,500
5412	Disk controller for one or two 5414 disk drives	7,500
5414	10-megabyte disk drive (nonremovable)	4,450
5416	Disk controller for one to four 5440 or 5470 disk drives; (when used in 5000/ES System, supports one or two 5440 or 5470 disk drives)	8,500
5440	27-megabyte disk drive (nonremovable)	9,250
5470	54-megabyte disk drive (nonremovable)	11,500
MAGNETIC TAPE EQUIPMENT		
5502	Optional cartridge tape subsystem, including one 5510 tape controller and one 5520 tape cartridge drive	5,000
5530	Additional tape cartridge drive; installs in 5520 module (total of four drives can be accommodated)	2,550
5302	Optional magnetic tape subsystem, including one 5320 controller, one 5330 tape drive, and cabinet	14,000

BTI 5000 and 5000/ES

EQUIPMENT PRICES

		Purchase Price
PRINTERS		
5602	Includes 5610 line printer controller and 5620 line printer; 300 lpm	8,950
5604	Includes 5612 line printer controller and 5630 line printer; 300 lpm	15,000
5606	Includes 5612 line printer controller and 5660 line printer; 600 lpm	18,000
5608	Includes 5612 line printer controller, 5690 line printer, and quietized cabinet; 900 lpm	23,700
—	Quietized cabinet for 5604 or 5606	800
—	96-character set for 5604, 5606, or 5608	1,500
TERMINALS		
1410	80 x 24 CRT screen format, 5 x 7 character matrix, 64 displayable characters, TTY-style keyboard with numeric keypad, transmission rate of 9600 bps	900
1420	80 x 24 CRT screen format, 5 x 8 character matrix, 94 displayable characters (including lower case), dual-density, typewriter-style keyboard with numeric keypad, transmission rate of 9600 bps	995
1500	80 x 24 CRT screen format, 7 x 10 character matrix, 94 displayable characters, dual-density and reverse video, ANSI standard keyboard with numeric keypad, serial printer output, transmission rate of 9600 bps	1,225
1510	80 x 24 CRT screen format, 7 x 10 character matrix, 95 displayable characters, dual-density, reverse video, screen protect, and block transmission (254 characters per block), ANSI standard keyboard with numeric keypad, serial printer output, transmission rate of 9600 bps	1,395
1800	Printing terminal; includes 9 x 7 character matrix, 132 columns, 120-cps impact printer, full ASCII 128-character keyboard, transmission rates of 110 to 1200 bps	2,395
COMMUNICATIONS INTERFACE		
5810	Communications controller and interface, 8 ports, EIA RS-232-C compatible, standard transmission rate of 9600 bps	3,100
—	8-port controller substitute in basic configuration of the 5000/ES System	2,350
SYSTEM CABINET		
5910	For expanded disk drive configurations; includes blank front panels, forced air ventilation, and power distribution assembly	1,750

BTI 5000 and 5000/ES

grammatically. With four drives installed, up to 40 megabytes can be transferred without physical handling of tape cartridges. Optional peripherals are a 9-track, open-reel magnetic tape drive which is IBM/ANSI-compatible and four line printers with print speeds from 300 to 900 lines per minute.

The BTI 5000/ES, introduced in August 1979, is the entry-level system of the BTI 5000 product line. Its base configuration includes a 64K-byte CPU, 10 megabytes of on-line disk storage, a magnetic tape cartridge subsystem for application software backup, and a four-port communications controller/interface. For port expansion, an eight-port communications controller/interface can be substituted for the four-port module in the base configuration. Ports can further be expanded in 8-port increments to a maximum total of 32 ports.

Disk storage can also be expanded with the addition of a second controller. One optional controller accommodates up to four 27- or 54-megabyte disk drives for a maximum total storage of 226 megabytes. A second optional controller supports up to four 63-megabyte drives for a total of 262 megabytes of on-line disk storage.

The 5000/ES is capable of supporting up to four cartridge magnetic tape drives, each with a storage capacity of 10 megabytes. A 9-track, 800/1600-bpi IBM/ANSI-compatible magnetic tape drive and several line printer options are also available for the entry-level system.

Along with the 32-bit BTI 8000 (M11-089-201), the 5000 and the 5000/ES provide time-sharing computer users with a wide range of processing power. Together, BTI Computer Systems has formed a popular product line of computing systems, as witnessed by approximately 2500 user installations.

USER REACTION

Seven users of BTI systems responded to Datapro's 1980 survey on minicomputer and small business computer systems, representing a total of 15 installed systems. Included in this total were nine BTI 5000 systems installed by three users.

The average installation period for the BTI 5000 systems is approximately 22 months. Main memory for each system is 64K bytes, with disk storage capacities ranging from 58 megabytes to 128 megabytes. The maximum number of workstations reported by the three users is 24.

The principal applications accommodated by the BTI 5000 systems include accounting, construction, payroll/personnel, service bureau, and transportation. The sources for these applications programs, according to the users, were in-house personnel, "ready-made" programs from BTI, contracted programmers, and proprietary software packages.

- Make programs and files permanent at the system level.
- Produce lists of shared files.
- Produce status reports on user storage utilization and time usage.
- Produce current activity reports.
- Copy accounts from one disk to another.
- Resequence program and file serial number.

The three accounts used by the system manager are the system management account, the system operations account, and the system resources account. The latter account controls non-time-sharable system resources such as magnetic tape. The system manager also controls the system public library.

The system manager can subdivide the system into as many as 26 independent segments, each supervised by a master account manager. This group of master accounts makes up the master level within the system. Master accounts are identified by a single-letter prefix. Each master account has a separate master library accessible only to users in that master account. For accounts in his letter group at the master level, the master account manager can:

- Open and close user accounts.
- Establish passwords, time limits, and storage for user accounts.
- Protect and unprotect programs and files.
- Make programs permanent or temporary.
- Produce status activity reports.
- Designate the "Hello" program—the program entered automatically by each user immediately after logging on the system.

Each master account can be subdivided into 10 user groups, each with its own group library. User groups can be made up of as many as 100 individual user accounts, each with a separate private library of programs and data files.

Although the *theoretical* maximum number of user account numbers is 26,000 (26 x 10 x 100), the BTI 5000 Series operating system restricts the number to 5800.

Programs and files in private libraries belonging to specific user accounts can be accessed by the corresponding master account or, ultimately, through the system manager account, without the need for a password. Users, however, cannot access other users' private libraries without the passwords. In the same fashion, both group and master libraries can be accessed by members of their own groups or master accounts, but not by members of the other groups of master accounts. Programs and files, however, can be declared universally or selectively "sharable" by the individual users.

Selective sharing permits each user to designate those accounts that are to be granted access to specified programs and files. Users can also share programs or files with the public library or any other master or group library. All shared files are automatically assumed to be read-only unless read-write access is granted. File sharing is done on a non-interfering read-write basis. Requests to write into shared files are automatically queued if the desired file is in the process of being updated. This assures that the file is updated in the proper sequence.

BTI 5000 and 5000/ES

The following table summarizes the ratings of the BTI 5000 systems issued by the three users:

	Excellent	Good	Fair	Poor	WA*
Ease of operation	2	1	0	0	3.7
Reliability of mainframe	3	0	0	0	4.0
Reliability of peripherals	1	1	1	0	3.0
Maintenance service:					
Responsiveness	3	0	0	0	4.0
Effectiveness	3	0	0	0	4.0
Technical support:					
Trouble-shooting	2	1	0	0	3.7
Education	2	0	1	0	3.3
Documentation	2	1	0	0	3.7
Manufacturer's software:					
Operating system	1	1	1	0	3.0
Compilers & assemblers	0	1	1	0	2.5
Applications programs	1	2	0	0	3.3
Ease of programming	3	0	0	0	4.0
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Overall satisfaction	3	0	0	0	4.0

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As shown by the ratings, the users were quite satisfied with their systems. Significant advantages of the BTI 5000 sighted by the users included excellent response time, ease of expansion and reconfiguration, and compatibility of terminals/peripherals carried over from other systems. Other advantages reported by the users included excellent productivity aids, an effective and efficient data base language, and that the delivery and installation of the equipment was ahead of schedule. One user commented that there was "almost no down-time" with the BTI 5000.

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5440	27-megabyte disk drive (nonremovable)	9,250
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5502	Optional cartridge tape subsystem, including one 5510 tape controller and one 5520 tape cartridge drive	5,000
5530	Additional tape cartridge drive; installs in 5520 module (total of four drives can be accommodated)	2,550
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BTI 5000 and 5000/ES

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—	Quietized cabinet for 5604 or 5606	800
—	96-character set for 5604, 5606, or 5608	1,500
TERMINALS		
1410	80 x 24 CRT screen format, 5 x 7 character matrix, 64 displayable characters, TTY-style keyboard with numeric keypad, transmission rate of 9600 bps	900
1420	80 x 24 CRT screen format, 5 x 8 character matrix, 94 displayable characters (including lower case), dual-density, typewriter-style keyboard with numeric keypad, transmission rate of 9600 bps	995
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