

Basic Timesharing 4000 Series

MANAGEMENT SUMMARY

Basic Timesharing, Inc. began its corporate life in 1968 as a time-sharing service company serving the San Francisco Bay area. The experience acquired during two years of this activity led to the development of specialized, proprietary hardware and software for use in time-shared systems. In 1970 the company incorporated these hardware and software developments into a packaged time-sharing system for up to 16 users. Initial installations of this system took place in 1971.

BTI's first product line, the 3000 Series, an outgrowth of the company's assembled systems, was first shown at the Fall Joint Computer Conference in November 1972. This new system was based on a Hewlett-Packard 2100 minicomputer (Report M11-472-101). The HP 2100 was chosen for the system primarily because of its user-microprogrammability, a feature found on only a few systems (most notably the Microdata minicomputers). At the time of the introduction of the BTI Model 3000, microprogrammability was not as popular as it has recently become, and manufacturers often didn't bother to mention the feature to anyone but those who had the most specialized applications in mind. But the concept is far from new; microprogrammable computers have been in limited usage in process control and measurement applications since the mid-1960's because of the need for faster programmable real-time systems.

The basic BTI Model 3000 system included an HP 2100A minicomputer with 48K bytes of 980-nanosecond core ➤

The Basic Timesharing 4000 Series is the product of six years of development. These highly reliable time-sharing systems feature unique computer hardware as well as distinctive service and support features. Although these systems address a specialized segment of the market, they have been very well received.

CHARACTERISTICS

MANUFACTURER: Basic Timesharing Inc. (BTI), 870 West Maude Avenue, Sunnyvale, CA 94086. Telephone (408) 733-1122.

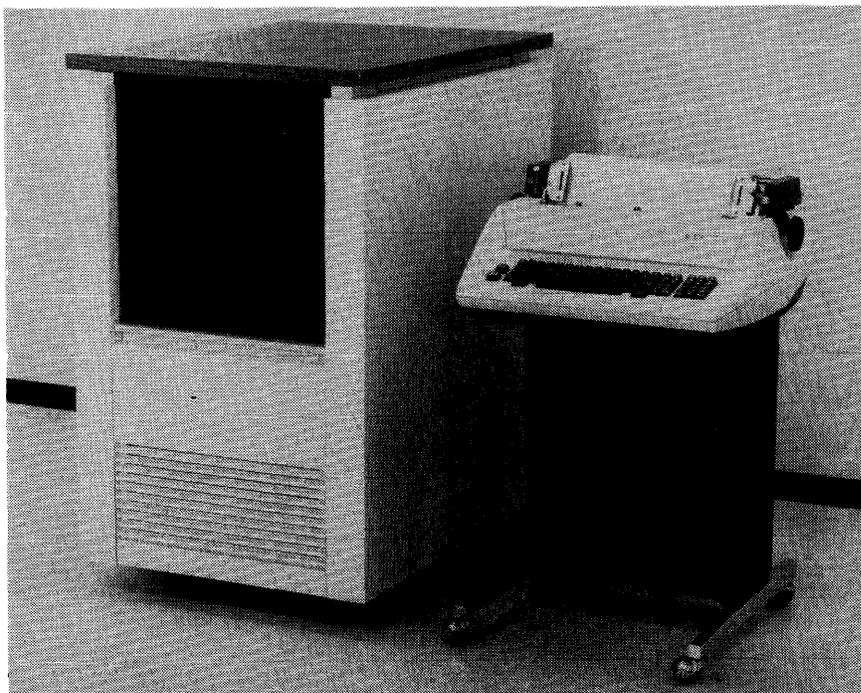
Basic Timesharing was organized in the San Francisco Bay Area in 1968 as a time-sharing service company. From this activity, a series of interactive time-sharing systems using modified Hewlett-Packard computers has been developed. The company has one manufacturing facility in Sunnyvale, California, and has sales offices in Cherry Hill, New Jersey; Atlanta, Georgia; and Minneapolis, Minnesota. Western regional sales are handled by the headquarters in Sunnyvale.

MODELS: 4000/15 and 4000/25. (Former Models 4000/10, 4000/20, and 4000/30 are no longer actively marketed.)

DATE ANNOUNCED: March 1976 (4000/15 and 4000/25).

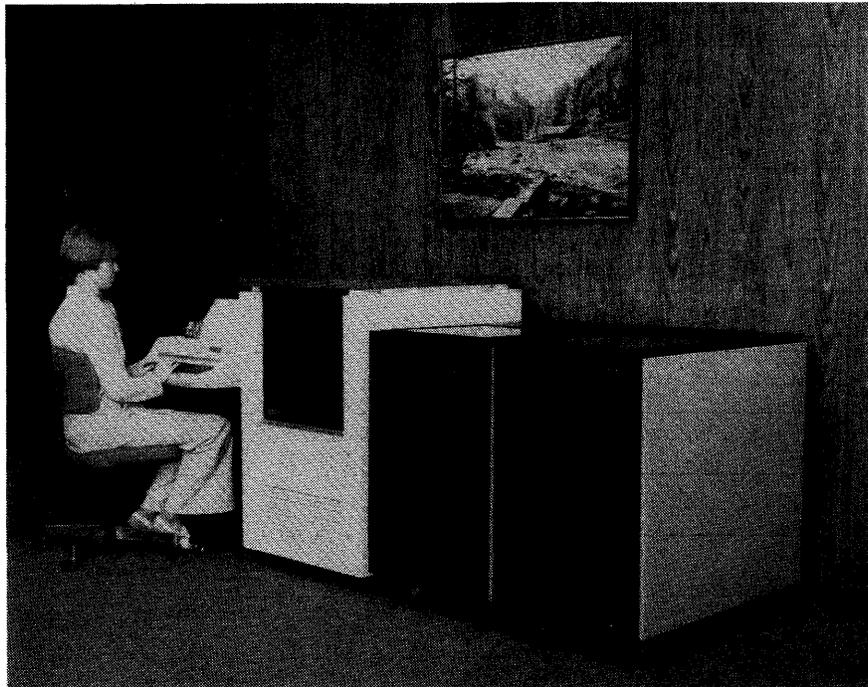
DATE OF FIRST DELIVERY: 3000 Series—April 1971; ➤
4000 Series—March 1975.

The entry-level BTI system, a Model 4000/15, is shown with one of several brands of terminals that can be successfully employed. BTI does not supply any particular terminal with its systems, but instead provides recommended specifications and a list of terminals that have been successfully used. Customers can then choose the best units for their needs. The Model 4000/15 includes a modified Hewlett-Packard 21MX CPU with 64K bytes of MOS memory, a 7.5-megabyte cartridge disk subsystem that can be expanded to 30 megabytes (3 additional drives), a magnetic tape cartridge drive and controller, and an 8-port communications controller. Purchase price for the system (not including the terminal) is \$35,950.



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BTI's largest current system, the Model 4000/25, can be expanded to support up to 32 user terminals. The system shown includes a 64K-byte CPU, two 49-megabyte disk drives, a magnetic tape pack drive (in the CPU cabinet), and a communications controller for up to eight terminals. Additional 49-megabyte drives can be added to the first controller, and additional 8-drive controllers can be incorporated. The configuration shown, without the terminal, is purchase-priced at \$74,800.



▷ memory, eight user ports, and one 2.4-megabyte cartridge disk drive. Port capacity could be increased to 16 ports. Storage could be expanded by adding up to three 2.4-megabyte drives to the disk controller in the basic system, and the storage capacity could be further extended 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, concurrently with the National Computer Conference, 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 3000's 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.

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

▶ **NUMBER INSTALLED TO DATE:** 195 total, of which 185 are 4000 Series systems.

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 of the HP 21MX. 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 4000 Series 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 4.58146 E+05, and 0.00576 becomes 5.76E-03.

INSTRUCTIONS: All user-written instructions to the BTI 4000 systems are either BASIC language statements or system control statements defined by BTI.

All HP 21MX 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 ▶

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PERIPHERALS/TERMINALS

DEVICE	DESCRIPTION & SPEED	MANUFACTURER
MAGNETIC TAPE EQUIPMENT		
4300	Tape Transport; industry-compatible, 9-track, 800/1600 bpi, switch-selectable density, 45 ips, 10.5-inch reels, one drive per controller; 36/72 KBS	Data Disc/Bright
4500	Tape Pack Drive; uses proprietary 1/2-inch tape cartridge with max. unformatted capacity of 17 million bytes, dual-capstan drive, 9-track, 800 bpi, 25 ips; 20 KBS	Emerson
LINE PRINTERS		
4630	Line Printer; 136 positions, drum-type, 64 ASCII characters, 12-channel VFU; 300 lpm	Dataproducts
4660	Line Printer; 136 positions, drum-type, 64 ASCII characters, 12-channel VFU; 600 lpm	Dataproducts
4690	Line Printer; 136 positions, drum-type, 64 ASCII characters, 12-channel VFU; 900 lpm	Dataproducts

➤ established by the 3000 Series. The 4000 Series was based on the newer, more cost-effective, Hewlett-Packard 21MX minicomputer (Report M11-472-201) and initially consisted of three models: the 4000/10, 4000/20, and 4000/30. The new CPU's 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.

The 4000 Series also featured a new concept in system maintenance, based on customer participation and telephone consulting. When a system problem occurs, 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, with the customer supplying indicator readings and performing minor functions such as button-pushing or cable connecting and disconnecting. If it is determined that a part has failed, a spare is immediately shipped by air to the customer site. If the malfunction cannot be cleared through telephone consultation, a field service engineer is then dispatched to the site from the manufacturer's California headquarters. This method of maintenance is said to be unique in the industry and available 24 hours a day, 7 days a week.

To aid in system maintenance and operation, a new 10-button front panel was substituted for the standard HP front panel. The standard panel functions were not discarded, but compressed and re-created *inside* the new panel, to be available for maintenance purposes. The new panel contains a START button, a STOP button, and eight special-function buttons designated A through H. These buttons initiate microcoded system functions such as system start-up, operating system conversions, core

➤ 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 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: All 4000 Series models have 65,536 bytes of main memory. No user expansion is offered.

CHECKING: One parity bit per 16-bit word is standard.

PROTECTION: Although hardware memory protection is available for the 21MX, BTI does not use it. Instead, 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,

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▷ dumps, disk-to-disk copying, and disk-to-tape copying. Except for system start-up, these functions are reserved for service usage.

In keeping with its customer-participation corrective maintenance scheme, BTI also extends this concept to preventive maintenance. 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 accomplished and reported back to BTI via enclosed forms. This unique service policy enables BTI to offer both corrective and maintenance support to users at costs ranging from one-half to one-third those charged by other vendors for a comparable equipment complement.

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

Less visible differences include 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. It should be noted at this point that sources within Hewlett-Packard regard the BTI product line as one in which the microprogramming capabilities of the 21MX have been most extensively exploited.

Another enhancement over the 4000/10, /20, and /30 is the addition of a magnetic tape subsystem that incorporates the new Emerson tape pack. This tape subsystem is 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 is supplied with each system. User files and programs can also be added to the tape pack, which serves as a convenient method for storing software. In addition, tape packs contain an internal mechanism that keeps the tape properly tensioned during transportation, making them well suited for shipment to other sites. A conventional 9-track, 800/1600-bpi tape transport, which operates in IBM/ANSI format, is also offered.

The basic 4000 Series system now includes the 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 is the disk subsystems. The 4000/15 is supplied with 7.5-megabyte nonremovable disk drives, and the 4000/25 has 49-megabyte 2316-type disk pack drives. The 4000/15 system can be upgraded, and the two disk ▷

▶ which is loaded from ROM. Both areas may be overwritten by the operating system.

CENTRAL PROCESSOR

The BTI 4020 processor is a modified Hewlett-Packard 21MX CPU, greatly enhanced through BTI-generated microcode implemented in the CPU's writable control storage. BTI purchases the basic CPU, chassis, and power supply from HP and adds 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.

Only the characteristics of the BTI 4020 that differ from those outlined in the Hewlett-Packard 21MX report (M11-472-201) are presented in this report.

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 21MX 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 21MX cannot be accessed by the BTI user. Please consult Report M11-472-201 for details.

INSTRUCTION REPERTOIRE: The BTI 4020 CPU uses the standard Hewlett-Packard 21MX 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 4450 disk drive, and magnetic tape pack drive are mounted in a modular cabinet 26 inches wide, 36 inches deep, and 43 inches high. The addition of a third and fourth Model 4450 disk drive increases the height by 11 inches per drive.

Power requirements for both the 4000/15 and /25 are 120 VAC \pm 20 percent, 47 to 66 Hertz. Disk pack drives require 208 to 230 VAC, 3-phase power. Heat dissipation for the basic system, including Model 4450 disk drives, is between 2400 and 3200 BTU's per hour, depending on the number of drives. The Model 4250 disk pack drive dissipates 3100 BTU's per hour.

Operating environment for the 4000 Series systems is 60 to 90 degrees F. with a relative humidity of 20 to 80 percent, noncondensing.

CONFIGURATION RULES

All BTI 4000 Series systems include a CPU with 64K bytes of main memory, a magnetic tape pack subsystem, eight user-terminal ports, and one disk subsystem. Systems with two or more 49-megabyte disk drives can support disk-to-disk backup in place of the standard magnetic tape ▷

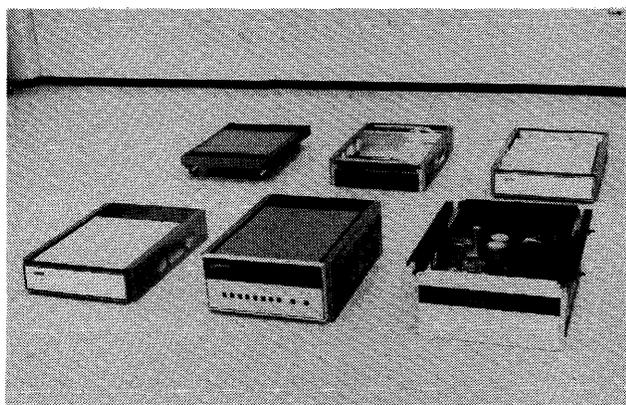
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▷ subsystems can be intermixed. The 7.5-megabyte disk controller can accommodate up to four drives, and the 49-megabyte controller can have up to eight drives connected to it. No additional hardware is required to add disk drives to either subsystem.

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

The new 4000/15 and 4000/25 represent substantial cost reductions in addition to the performance increases they offer over the original 4000 Series systems. The smallest member of the original 4000 Series, the 4000/10, was priced at \$49,500 but required a second disk drive, raising the true system price to \$55,500. The same situation occurred with the 4000/20 and 4000/30. The true cost of a 4000/30 was \$91,400 when the extra disk pack drive was added to the basic system. The new 4000's, the 4000/15 and 4000/25, do not require any equipment other than that included in the basic configurations. The new low-end price for a BTI 4000 system is \$35,950, and this includes 7.5 megabytes of disk storage, compared with 4.8 megabytes in the older system, plus a magnetic tape pack subsystem. One small difference is that the older 4000 Series systems included 16 user ports, while the newer systems start at 8. Both, however, are expandable, in increments of 8 ports, up to 32 ports.

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



Here are two exploded views of a BTI 4000 Series system showing the company's unique stack-mounting technique. The individual chassis (at left) form the cabinet, and the skins (side panels) simply lock onto the stacked chassis, binding the stack into a rigid structure. Index pins on the upper side of each chassis mate with holes on the lower side of the next one, providing a flexible mounting system. Individual units can be removed from the special shells for service.

▷ backup. The Model 4000/15 includes 7.5-megabyte nonremovable disk drives and the Model 4000/25 uses 49-megabyte disk pack drives. The CPU contains four additional I/O expansion slots that can be used for any type of controller. No additional memory expansion is possible.

The Model 4410 cartridge disk controller used in the 4000/15 system can support up to four 7.5-megabyte drives, while the Model 4210 disk pack controller used in the 4000/25 system can accommodate up to eight 49-megabyte drives. The 7.5-megabyte disk drives mount in the equipment cabinet, while the disk pack drives are free-standing. Additional disk controllers can be added to each system and require one I/O slot each.

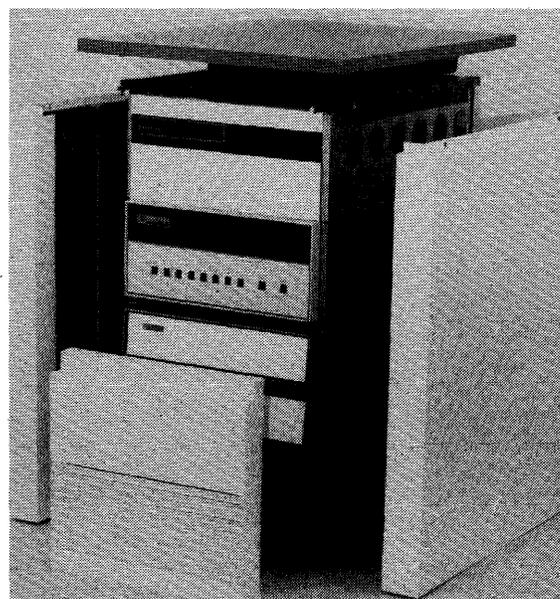
All systems include 8 user-terminal ports, which can be expanded to 16 by the addition of one Model 4820 communications extender. For systems requiring more than 16 user-terminal ports, an 8-port Model 4811 communications controller, requiring two I/O slots, must be added. Eight additional ports, for the maximum of 32, can be added to the Model 4811 controller through another Model 4820 extender. The 4820 extender does not require an I/O slot.

Any terminal, CRT or hard-copy, with a standard RS-232C interface can be used with the system. Likewise, any modem with facilities for the RS-232C interface can be used for remote applications. In addition, a special Bell 202C-compatible controller provides two 1200-bps ports for intersystem communications. Two such controllers can be included for a total of four ports. The total number of both user and 202C-compatible ports, however, cannot exceed 32.

An optional 9-track, 800/1600-bpi, 45-ips magnetic tape subsystem can also be added to the system for loading and dumping data files.

MASS STORAGE

▷ **7.5-MEGABYTE DISK SUBSYSTEM:** Includes one 7.5-megabyte 4450 disk drive and one 4410 controller capable of supporting up to three additional drives. The drive has one nonremovable disk. Data is recorded at 256 bytes per sector, 36 sectors per track, and 400 tracks on each surface. Average head-positioning time is 70 milliseconds, and average rotational delay is 20 milliseconds. Data transfer



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▷ One essential component of all time-sharing systems, user terminals, is *not* supplied by BTI. The company recognizes that a wide variety of terminals is available directly to users, and passes the potential savings of direct procurement on to its customers. Any terminal with a data rate between 100 and 2500 bits per second and a standard RS-232C interface will work on any 4000 Series system. BTI makes no specific endorsement or recommendations in favor of any particular vendor's terminal, but instead supplies a list of terminals known to have been used successfully with its equipment. Some of the terminals on the list include:

- Anderson Jacobson 830
- Data Terminals DTC-300 and DT-300/5
- Digital Equipment LA36 DECwriter II
- GE TermiNet 30, 300, and 1200
- Teletype ASR 33, 35, 37, and 38
- Texas Instruments 725, 733 KSR, 733 ASR
- ADDS Consul 880 and 840
- Beehive Mini Bee and Super Bee
- Digital Equipment VT50 DECscope
- Hazeltine 1000 and 2000
- Infoton Vistar and Vistar/GT
- Lear-Siegler ADM-1, ADM-2, and ADM-3
- TEC 430, 435, and 436.

Similarly, any modem with the RS-232C interface can be used for remote terminals.

USER REACTION

In July 1976, Datapro interviewed eight BTI 4000 Series users, who collectively represented over 50 percent of the total 4000 Series installed base. This high percentage was primarily due to one large user, a combined time-sharing service and system builder that employs BTI 4000 systems to serve its time-sharing customers and also sells BTI 4000 systems with proprietary applications software. The other users included an industrial equipment manufacturer, a small college, two CPA firms, and three turnkey systems houses. Each user had several systems, and nearly all of these systems were 4000's, though a substantial percentage were originally 3000's that had been upgraded. This fact underlines the ease with which BTI users can upgrade and improve their systems.

The installed life of the average system was slightly longer than one year, with some systems installed for about two years. The only variations noted in these systems were in the size and number of disk drives and the type of terminals used. The majority of the systems were evenly divided between 7.5-megabyte and 49-megabyte disk drives. Few incorporated magnetic tape equipment, although that situation will change shortly due to the inclusion of the Emerson tape pack drives in each of the new BTI models.

Terminals showed more diversity. Among the most popular hard-copy terminals were the GE TermiNet 30's, 120's, 300's, and 1200's. CRT terminals interfaced to the various systems included Hazeltine 2000's, Lear-Siegler ▷

▶ rate is 293K bytes per second. Maximum formatted subsystem capacity is 30 million bytes. The 4450 disk drives are manufactured by Diablo.

49-MEGABYTE DISK PACK SUBSYSTEM: Includes one 49-megabyte 4250 disk pack drive and one 4210 controller capable of supporting up to seven additional drives. The drive employs IBM 2316-type disk packs. Data is recorded at 256 bytes per sector, 24 sectors per track, and 400 tracks on each of 20 surfaces. Average head-positioning time is 32 milliseconds, and average rotational delay is 12.5 milliseconds. Data transfer rate is 312K bytes per second. Maximum formatted subsystem capacity is 393 million bytes. The 4250 disk pack drives are manufactured by Ampex.

COMMUNICATIONS CONTROL

The BTI 4000 Series systems can support up to 32 local or remote user terminals and up to 4 ports for intersystem communication; however, the maximum total number of ports, of either or both types, is 32.

4810/4811 ASYNCHRONOUS CONTROLLER/MULTIPLEXER: Can interface up to eight RS-232C terminal or modem interfaces, and up to 16 interfaces if one 4820 communications extender is added. Up to two controller/extender combinations can be incorporated in a system for a maximum of 32 ports. Data rates can be set individually, to any speed between 100 and 2500 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.

4830 ASYNCHRONOUS 202C INTERFACE: Provides two 1200-bps ports for use with Bell 202C or equivalent data sets. The communications protocol is user-programmed in BASIC. Two Model 4830 interfaces can be installed to provide the allowable maximum of four intersystem communications ports.

SOFTWARE

OPERATING SYSTEM: The BTI 4000 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. ▶

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▷ ADM-3's, and Western Union Video 100's. All of these terminals were highly rated by their users. The majority of the systems had between 6 and 25 terminals connected.

The tabulated responses to Datapro's questions about the BTI systems are presented below.

	Excellent	Good	Fair	Poor	WA*
Ease of operation	8	0	0	0	4.0
Reliability of mainframe	8	0	0	0	4.0
Reliability of peripherals	6	2	0	0	3.8
Responsiveness of maintenance service	7	1	0	0	3.9
Effectiveness of maintenance service	7	1	0	0	3.9
Technical support	3	3	2	0	3.1
Operating system	6	2	0	0	3.8
Compilers and assemblers	8	0	0	0	4.0
Ease of programming	7	1	0	0	3.9
Overall satisfaction	8	0	0	0	4.0

*Weighted Average based on 4.0 for Excellent.

Out of the 10 categories, four were rated perfect (i.e., 4.0), and five others nearly perfect. Typical comments received were "No downtime in one and a half years," "Two head crashes in two years," and "Installed six months and no failures of any kind."

The few critical remarks we received were directed at the scientific orientation of the system (although the critical user still rated the system excellent in 8 of the 10 categories), and at the system documentation; specifically, more details were desired concerning the functions performed by BTI's proprietary operating system. One user expressed a desire for improved filing techniques, while another said he would like to see data base management added to the system. Still another user felt that the company could offer more applications packages and that the BTI staff could provide more support in developing applications programs.

The BTI BASIC compiler drew exceptionally favorable comments, although one user said he would like to see more detailed documentation regarding the use of more complex statements.

Datapro made specific inquiries about the users' experience with BTI's innovative maintenance procedures, i.e., the telephone consulting with customer participation and the customer-installed preventive maintenance kits. All of the users we surveyed had required service at least once, but none reported excessive maintenance calls. In general, all of the users were quite happy with the arrangement and reported the method to be successful. In each case, BTI personnel had trained several people at the user site, and the procedures were deemed uncomplicated and easily accomplished. One user had compared his maintenance charges with those of similar configurations from other vendors using conventional servicing techniques, and cited savings of over 50 percent with the BTI approach. □

- ▶ ● List locations of accounts and files by logical disk.
- Protect programs and files.
- Make programs and files permanent at the system level.
- Produce lists of shared files.
- Product 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 numbers.

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 4000 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 ▶

Basic Timesharing 4000 Series

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.

Other protection mechanisms available include making programs run-only or read-only, making files and programs non-deletable or non-closable, or making programs non-abortable. The latter form of protection ensures that a particular program will run to completion.

The operating system provides extensive accounting information to both the system manager and the master account supervisor. Information in the report includes the user account storage limits, current storage usage, and peak storage used. Connect time and user time limits are also included, as well as the amount of time each terminal was in use as a private dedicated port. The system also enforces the limits specified for each user. Requests to save files that would exceed the stated storage limit are refused, with an appropriate notation. Users exceeding their allocated time intervals are not thrown off the system, but subsequent attempts to log on are denied.

Library activity is also monitored by the system. For each library level (system, master, group, or private) the system records the length, date saved, date of last access, and cumulative number of times accessed. Protected and permanent programs and files are noted on the status reports, together with the level (system, master, user) at which the protection or permanence was established. Non-abortable programs are also noted.

Port activity and status are monitored, showing the number of user ports in use at the moment and also the identity of the account using each port. Other activities monitored and noted by the operating system include all user log-ons and log-offs; all user-specified terminal data rate changes; all operator-commanded system halts; all system startups, date changes, and software loadings; and snapshot copies of the disks.

LANGUAGES: BTI offers only the BASIC-X program development language for the 4000 Series.

BASIC-X is an enhanced version of Dartmouth BASIC that features extensions such as matrix operations, character string manipulations, extended numerical precision, extensive file handling, facilities and program chaining.

BASIC-X matrix operations include addition, subtraction, multiplication, transposition, and inversion. In addition, one- and two-dimensional arrays are treated as single-value variables. Multiple arrays can be dimensioned and defined by the MAT READ or MAT INPUT statements. In the same manner, the MAT PRINT statement will print one or more arrays in packed or unpacked format.

Character strings from 1 to 254 ASCII characters in length can be manipulated and stored through single commands. Substrings can also be extracted and operated upon. String operations include input printing, copying from other strings, and string comparisons. String variables can also be mixed with numeric variables in the READ, INPUT, DATA, and PRINT statements. The string manipulating capabilities of the 4000 system have also been extended to arithmetic operations, providing string addition, subtraction, and multiplication. Decimal number strings of up to 252 digits can be operated on by the system.

All system users can create and maintain data files in private libraries. Data or programs from these files can also

be transferred into the group, master, or system public library. Files transferred into higher libraries from user private libraries are available to other users on a read-only basis, unless otherwise specified. Users can specify other levels of access, such as read-write access, through the SHARE command.

The BTI 4000 provides random and sequential file access, and a utility for indexed sequential access. Data files can contain up to 9502 records, each record 256 bytes long. Thus, a maximum-length file contains 2.4 million bytes, is called a logical disk, and is equivalent to the storage capacity of one disk surface. File sharing capabilities permit a data base to occupy as many disks as required. User programs can have up to 63 files open simultaneously, and file links can be changed during program execution to permit access to greater numbers of files. Programs can also create scratch files for internal usage. File buffers are variable in length and can contain up to 32 records.

The user area in main memory is limited to 20,224 bytes; however, the CHAIN command causes a new program segment to overlay the previous segment. Chained programs can be specified either by name or as the current value of all or a portion of a string variable. During program chaining, the COMMON statement can be used to preserve selected variables and allow them to be passed intact between program blocks. In the same manner files can be declared common to avoid the need of relinking.

APPLICATION SOFTWARE: Basic Timesharing does not generate applications software, but assists in the marketing of selected user-generated packages. A unique feature of the BTI operating system permits applications software to be installed on a system where it may be used in read-only mode by the system owner. It can, however, be accessed for updates and maintenance by the software vendor through a special "proprietary software account." Under this feature, the system owner and users are permitted access to the program and to all system management privileges *except* the proprietary source code. The vendor, however, can gain unlimited telephone access to his proprietary software, and thereby update and correct the package without the need of sending copies or interrupting users.

Currently, two user-developed packages are available: Management's Interactive Data Accounting System (MIDAS), and the Student On-Line Administration Registration System (SOARS).

MIDAS, developed by DLM Enterprises of Chicago, contains all the necessary accounting functions for typical manufacturing companies. Included in *MIDAS* are modules for general ledger, inventory control, bill of materials, material requirements planning, order entry, invoicing, accounts receivable, sales analysis, sales commissions, accounts payable, purchase orders, and payroll. All system module transactions are integrated; i.e., a transaction in one module updates all related modules.

SOARS, supplied by the Chama Corp. of El Cajon, California, performs all the necessary functions for student administration and school accounting. The *SOARS* administration package includes admission, registration, and student information data base; student housing lists; class lists; grade reports and transcripts; class scheduling; classroom assignments; student billing/accounts receivable; and mailing list management. The business accounting portions of *SOARS* includes accounts payable, general ledger, payroll, inventory control, and income management.

PRICING

POLICY: Basic Timesharing provides the 4000 Series systems on a purchase-only basis. In some areas,

Basic Timesharing 4000 Series

► distributorships have been established by system builders serving particular market segments. 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 4000 systems. The BTI 4020 CPU contains integrated maintenance aids in the form of pushbutton-initiated diagnostic routines. 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 provide indicator readings and perform specified actions, is 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.

Under the contract terms, BTI furnishes both parts and labor to correct all failures and to provide 7-day, 24-hour telephone service. Replacement parts are shipped from the factory by air freight, scheduled airline, or package express service to users, who replace them and return the failed parts. A BTI systems engineer is dispatched from Sunnyvale

to any site where telephone consulting and testing cannot correct the malfunction.

BTI Corrective Maintenance Plan charges are based on a basic charge, related to the hardware configuration, plus a six-zone mileage adjustment calculated from the average cost of transportation plus time and expenses. Typical charges covering both preventive and corrective maintenance for a \$75,000 system are \$400 monthly.

BTI also features a customer-participation Preventive Maintenance Plan that includes the periodic sending of kits to customer sites. These kits include necessary air filters, cleaning agents, supplies, and reporting forms. Customer personnel perform the stipulated activities and return the completed forms to BTI.

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

The Basic Timesharing 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. ■

SYSTEMS		EQUIPMENT PRICES	Purchase Price
4000/15	Time-sharing system; includes 4020 CPU, 64K bytes of MOS memory, battery backup for two hours, one 7.5-megabyte disk drive and controller, one magnetic tape pack drive and controller, eight terminal ports, and cabinet; expandable to four 7.5-megabyte disk drives		\$35,950
4000/25	Time-sharing system; includes 4020 CPU, 64K bytes of MOS memory, battery backup for two hours, one 49-megabyte disk pack drive and controller, one magnetic tape pack drive and controller, eight terminal ports, and cabinet; expandable to eight 49-megabyte disk drives		56,300
MASS STORAGE			
4210	Disk controller for 4250 disk pack drive; maximum of eight 4250 drives		8,650
4250	49-megabyte disk pack drive; maximum of eight drives per 4210 controller		18,500
4251	Disk pack for 4250 drive		500
4410	Disk controller for 4450 disk drive; maximum of four 4450 drives		2,500
4450	7.5-megabyte disk drive; maximum of four per 4410 controller		4,500
MAGNETIC TAPE			
4300	Optional magnetic tape subsystem; includes 4310 controller, one industry-compatible 4350 9-track, 800/1600-bpi, 45-ips transport; and a separate cabinet, maximum of 1 drive per controller		14,000
4500	Magnetic tape pack subsystem; includes 4510 controller and one 4550 magnetic tape pack transport with a tape pack; maximum of 1 drive per controller		7,500
4551	Magnetic tape pack for 4550 transport		100
INTERFACES			
4811	Communications controller; used to expand 16-port system to 24 terminal ports; includes eight ports, can accept one 4820 extender		5,000
4820	Communications extender; used to expand basic 8-port system to 16 ports, or may be used with 4811 controller to expand 24-port system to 32-ports		2,000
4830	Asynchronous modem interface; provides two 1200-bps ports for Bell 202C or equivalent modems		3,500
CABINETS			
4910	Modular cabinet		1,650
4920	Relay-rack type cabinet		2,650

SOFTWARE PRICES

		Perpetual License	5½-Year Lease	3-Year Lease	1-Year Lease
MIDAS	Management's Interactive Data Accounting System	\$15,000	\$310	\$500	\$550
SOARS	Student On-Line Administration Registration System (entire system)	12,500	260	415	—
SOARS	Administration Portion Only	9,000	190	105	—
SOARS	Business Accounting Portion Only	5,000	300	165	—