Burroughs A 10

MANAGEMENT SUMMARY

On March 20, 1986 Burroughs Corporation did the unexpected and introduced the entry-level A 10 D, a new addition to the A 10 family of information systems which was first introduced on October 10, 1985, and included the single-processor A 10 F and the dual-processor A 10 H. According to Burroughs the A 10 D offers an attractive price/performance for the intermediate user by providing a lower entry point in terms of system performance and user investment. Internal testing has indicated that the processor performance of the A 10 D will range from 0.54 to 0.65 times a similarly configured A 10 F.

The A 10 is designed for batch or on-line, general-purpose data processing in either a centralized or distributed environment. The A 10 system utilizes the concepts of multiprogramming (interleaving), pipelining, and multiprocessing to obtain increased capacity and system capability. The microprocessor-based central processor uses "look-ahead" logic, multiple bus structures, and a series of functional processors to improve performance. The A 10 features 256K-bit dynamic RAM chips and Emitter Coupled Logic (ECL) circuitry, thereby reducing the footprint and the power requirements of the system.

Main memory consists of up to 96 megabytes, in 12-megabyte increments, of error-correcting integrated circuit (IC) memory. The memory controller includes 6K bytes of cache memory and can support up to 48 megabytes of main memory in the single-processor A 10 F configuration. Two memory controllers with 6K bytes of cache each are required to support 96 megabytes of main memory in a dual-processor A 10 H configuration. The memory controller in the single-processor A 10 D supports up to 24 megabytes of

The A 10 system is the fourth addition to the Burroughs A Series, a family of general-purpose, medium-scale mainframes. The object code-compatible A Series, ranging from the entry-level A 3 to the top-of-the-line A 15, operates in either a centralized or distributed processing environment. The A 10 provides current users with a smooth upwards migration path, and offers prospective users a medium-scale system for entry into the A Series.

MODELS: A 10 Models D, F, and H.
CONFIGURATION: The A 10 D and A 10 F are single processors with 12 to 48 megabytes of main memory. The A 10 H is a dual-processor with 12 to 96 megabytes of main memory. Models F and H have 6K bytes of cache memory and a multiply/divide accelerator. The A 10H has the capability to operate as a partitioned or monolithic system.
COMPETITION: Amdahl 5860, 5867; Honeywell DPS 88/81, 88/42; IBM 3081; NAS AS/9000.
PRICE: Purchase prices for basic configurations range from $410,000 to $962,000.

CHARACTERISTICS

MANUFACTURER: Burroughs Corporation, Burroughs Place, Detroit, Michigan 48232. Telephone (313) 972-7000. Canada: Burroughs Canada, 801 York Mills Road, Don Mills, Ontario M3B 1X8. Telephone (416) 445-4030.

The Burroughs A 10 H is an intermediate-range, dual-processor mainframe with up to 96 megabytes of main memory, two I/O cabinets with a maximum of 80 DLPs, and up to 288 data communication lines.

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main memory, but has no cache memory. The multiply/divide accelerator feature, which enhances the performance in applications involving repetitive operations using the multiply and divide functions, is only available on the A 10F and A 10 H and not on the A 10 D.

The A 10 system provides a middle range between the A 9 and the recently announced A 12, offering the user a smoother migration path through the A Series. Burroughs lists a relative performance of 2.6 over the A 3 D for the A 10 D, 3.8 for the A 10 F, and 7.0 for the A 10 H. The A 10 is available in the single-processor Models D and F, or the dual-processor Model H. The dual-processor A 10 H can operate as either a single monolithic system sharing peripherals, or partitioned into two single processors each with its own memory, operating system, and peripherals. The A 10 D is field-upgradable to the A 10 F, and the A 10 F is field-upgradable to the A 10 H. The A 10 FXH, an upgrade package for A 9 systems, is also available, providing the necessary components for A 9 F and A 9 FX users to upgrade their system to an A 10 H dual-processor system.

The A 10 uses Burroughs' Master Control Program (MCP), and the new Master Control Program/Advanced Systems (MCP/AS) operating system, a key product of the A Series Software Release Mark 3.6. A significant new feature of the MCP/AS is the Actual Segment Descriptor (ASD) Memory Management, which is capable of addressing up to 24 gigabytes of main memory and is available on all A Series systems. No program conversion is required, provided that application programs have been compiled under system software release 3.4 patch release 1 or later, and DMS II data bases are at release 3.5 or later. The MCP/AS runs on all A Series mainframes, but special hardware facilities are required on the A 3 and A 15. MCP/AS is not compatible with the B 5900, B 6900, and B 7900 systems; for these systems Burroughs will continue to support and enhance the MCP operating system. To further improve the memory and storage capacities of the A 10, two new software facilities were added to the MCP/AS. The Memory Disk feature enables the user to specify some portion of the system's main memory as a disk unit and no special programming is required. Programs compiled with release 3.5 will interact with Memory Disk immediately, and recompilation is not necessary. The Mirror Disk feature provides a convenient means of duplicating realtime data on disk units. Through the maintenance of multiple copies of disk packs, the availability of critical data is virtually guaranteed and the need for pack backup is decreased, freeing the system for other functions. Mirror Disk is available on all supported disk types used on DLP-based systems and recompilation is not necessary if the application program has been compiled with release 3.5 or later.

COMPETITIVE POSITION

In the general-purpose data processing arena, the Burroughs A 10 is competing with computer systems from Amdahl, Honeywell, IBM, and NAS. The comparison of the systems is based on main memory capacity and price, because MIPS ratings (millions of instructions per second) could not be obtained from the vendor.

MODELS: Burroughs A 10 D, A 10 F, A 10 H.

DATA FORMATS

BASIC UNIT: 60-bit word consisting of 48 data bits, three control bits, one parity bit, and eight error correcting bits.

FIXED-POINT OPERANDS: Each single-precision integer operand occupies one word and consists of a 6-bit octal exponent with sign and a 39-bit fraction with sign. Each double-precision operand occupies two words and consists of a 15-bit octal exponent with sign and a 78-bit fraction with sign. String operands may consist of a variable number of 4-, 6-, 7-, or 8-bit characters.

FLOATING-POINT OPERANDS: Integer and floating-point operands have the same format and may be freely combined in arithmetic operations.

INSTRUCTIONS: One to twelve eight-bit syllables in length. Syllables are packed six to a program word and executed sequentially from left to right. Three of the basic types of instruction syllables are operators, value calls, and name calls.

INTERNAL CODE: 8-bit EBCDIC is standard. Information coded in ASCII can also be processed. Characters are collated according to their binary value.

MAIN MEMORY

The memory subsystem is housed in an independently powered memory cabinet containing a card cage, two DC power supplies and up to two memory bases. Each memory base can be configured with up to two dual-port memory modules providing storage space for two or four million 60-bit words of main system memory. The interface between the memory subsystem and the central processor is provided by the Memory Control located in the processor cabinet. The Memory Control has the ability to address 48 megabytes of main memory. Two Memory Controls must be configured to address 96 megabytes of memory. The A 10 Models F and H Memory Control includes 6K bytes of high-speed purgeless cache to reduce the average access time to memory. About 85 percent of memory data access requirements are handled in cache. When the Memory Control logic detects a cache fault, cache memory is deleted from the Memory Control path and system operations continue, but with diminished memory subsystem performance. Logic contained in the Memory Control performs single-bit error corrections on-line without interrupting other processor modules, and detects multiple-bit errors. All memory errors are logged into a memory register and periodically written to the system log-on disk and stored for reference.

STORAGE TYPE: 256K-bit DRAM integrated circuit (IC) boards.

CAPACITY: 12 to 96 megabytes. See Table 1 for capacities of individual models.

CYCLE TIME: Not available from vendor.

CHECKING: A parity bit with each word is generated during writing and checked during reading. The A 10 system generates and checks an eight-bit error detection byte during each main memory reference, permitting automatic rewrite correction of single-bit errors and detection of multiple-bit errors.

RESERVED STORAGE: Not available on the A 10 system.

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TABLE 1. SYSTEM COMPARISON

MODEL	A 10 D	A 10 F	A 10 H
SYSTEM CHARACTERISTICS			
Date announced	February 1986	October 1985	October 1985
Date first delivered	Second quarter 1986	October 1985	October 1985
Field upgradable to	A 10 F	A 10 H	—
Relative performance	2.6*	3.8*	7.0*
Number of processors	1	1	2
Cycle time, nanoseconds	—	—	—
Word size, bits	48	48	48
Operating systems	MCP MCP/AS	MCP MCP/AS	MCP MCP/AS
MAIN MEMORY			
Type	256K-bit DRAM	256K-bit DRAM	256K-bit DRAM
Minimum capacity, bytes	12MB	12MB	24MB
Maximum capacity, bytes	24MB	48MB	96MB
Increment size, increment	12M	12M	12M
Cycle time, nanoseconds	—	—	—
BUFFER STORAGE			
Minimum capacity	—	6KB	12KB
Maximum capacity	—	6KB	12KB
Increment size	—	—	—
INPUT/OUTPUT CONTROL			
Number of channels:			
Byte multiplexer	Not applicable	Not applicable	Not applicable
Block multiplexer	Not applicable	Not applicable	Not applicable
Word	Not applicable	Not applicable	Not applicable
Other	Up to 40 DLPs	Up to 40 DLPs	Up to 80 DLPs

**Relative performance rating based on the A 3 D as 1.0.*

The A 10 with one processor, 12 megabytes of memory, two IODC base modules, and a price tag of $580,000 competes with the Amdahl single-processor Model 5860 with 16 megabytes of memory and 16 I/O channels, and with the NAS single-processor Model AS/9050 with 8 megabytes of memory and 8 I/O channels. The Amdahl 5860 is priced at $2,150,000, and the NAS AS/9050 is priced at $1,909,000.

The dual-processor A 10 with 24 megabytes of memory, four IODC base modules, and a purchase price of $962,000 competes with the IBM two-processor Model 3081 GX with 16 megabytes of memory and 16 integrated channels, and with the Honeywell dual-processor Model DPS 88/42 with 16 megabytes of memory and 64 I/O channels. The price for the IBM 3081 is $2,190,000, and the Honeywell DPS 88/42 is priced at $2,920,000. While the dual-processor A 10 system can operate as either a single monolithic system or partitioned into single processors, the IBM 3081 cannot be split into two uniprocessors executing simultaneously.

ADVANTAGES & RESTRICTIONS

The A 10 system's greatest advantage is not the performance and reliability of its hardware, but the new operating system MCP/AS included in the software release 3.6. MCP/AS supports extended 32-bit memory addressing. Up to 24 gigabytes of main memory can now be addressed, enabling the user to take advantage of the large main storage available with A Series systems, without confronting disruptive application conversions such as those confronting IBM users migrating to MVS/XA. Building on the good reputation of its system software, Burroughs has further enhanced the Interpro software modules. New utili-

CENTRAL PROCESSORS

The Central Processing Unit (CPU) consists of the following elements: the Multiple Logical Processor (MLP), the Message Level Interface Processor (MLIP), the Memory Controller (MC), the Host Console Port (HCP), and, on the Model H only, the Dual-Processor Link (DPL).

The microprocessor-based central processor uses an enhanced implementation of stack architecture, accessing up to 16 pairs of top-of-stack registers for instruction execution. Two pairs of these stacks are reserved to control the multiple processing modules; the rest are used for storage of operators awaiting execution. The CPU consists of three controllers which are responsible for executing instructions, servicing interrupts, and initiating input/output operations. The Program Controller accesses program code from memory via the Memory Controller. The Program Controller has extensive look-ahead capabilities and generates multiple hardware operators to be executed. The task controller works asynchronously with the program controller and schedules the hardware operators. The Stored Logic Controller, Address and State Unit, and Data Path are organized as a three-stage pipeline and contain the algorithm microcode, current-state attributes, data, and memory addresses needed to schedule and process A 10 algorithms. This three-stage processing of tasks is referred to as Multiple Logical Processor (MLP) organization.

The Message Level Interface Processor (MLIP) functions independently to control the operation of peripheral devices connected to the system. The Message Level Interface Processor logic contains four or eight Message Level Interface (MLI) ports. Each MLI connects the Message Level Interface Processor to one Input/Output IODC base module.

The Host Console Port (HCP) interfaces the central processor with the Maintenance Subsystem, and also performs error detection, logging, and control functions in the A 10. The Maintenance Subsystem operates in conjunction with the Maintenance Interface Processor (MIP) to access and display the state of the system. In addition to its connection

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ties, compilers, programming tools, and extended workstation integration facilities are supported. But with all these enhancements comes a higher price tag. License fees and annual product service agreement prices for system software and the MCP/AS have been increased substantially.

Burroughs reduced the purchase price, monthly lease fee, and monthly maintenance charge on the A 10 system hardware, perhaps to compensate for the higher software prices, or as a move to phase out the A 9 system and replace it with the A 10. Based on a scale of relative performance the A 9 and A 10 systems are equal, with the A 10 having the edge on price/performance. The extended memory, the Memory Disk and Mirror Disk features, and the enhanced NDL II software makes the A 10 system very attractive to new users or to A 9 users looking to expand their distributed processing networks.

USER REACTION

The first customer shipments of the A 10 H did not take place until the third quarter of 1985, therefore no user ratings are available. Prospective buyers of the A 10 system may consult the Report "User Ratings of Mainframes" on Page 70C-000EB-101 for user experiences with earlier Burroughs mainframes. Burroughs computers have consistently earned high marks for their operating system, hardware reliability, and conversion ease. □

to the CPU, the maintenance processor provides a special test link to the I/O and Data Communications subsystems. The Maintenance Subsystem is configured with a dual built-in fixed disk drive which provides storage for system diagnostic cases, and one mini-disk drive for firmware loading. The diagnostic software is system-driven and runs on-line; normal preventive maintenance routines are run concurrently with application programs.

When the dual-processor system operates in monolithic mode, the Dual-Processor Link (DPL) feature is needed to provide a message-passing mechanism for communications between two A 10 processors, and to maintain cache consistency.

SPECIAL FEATURES: The A 10 H dual-processor system can be split into two independent partitions to perform system applications such as workload management or subsystem maintenance. Partitioning can be accomplished statically using maintenance subsystem System Control Processor (SCP) command inputs, or dynamically using Operator Display Terminal (ODT) configuration commands. When in partitioning mode, the A 10 processor in one partition cannot access memory or communicate with processors in the other partition. Each processor has its own memory, operating system, and peripherals.

PHYSICAL SPECIFICATIONS: The A 10 system Models D and F including processor, memory, and input/output cabinets are 105 inches long, 44 inches high, 30 inches deep, and weigh approximately 1,650 pounds. The same configuration Model H is 181 inches long, 44 inches high, 30 inches deep and weighs approximately 2,075 pounds. Models D and F will typically require 6.4 kVAs and have a heat dissipation of 20,340 Btus per hour. Model H requires 12.0 kVAs and has a heat output to air of 38,730 Btus per hour.

CONFIGURATION RULES

The basic A 10 Model D consists of one A 10-DCP processor cabinet, one independent memory cabinet with one memory base and 12 megabytes of main memory, one dependent input/output cabinet with two I/O bases, two operator display terminals, one operator console DLP-3, and one modem. Main memory can be expanded up to 24 megabytes. Up to 40 data link processors providing 160 lines can be added to the system. The Model D can be field upgraded to a Model F by exchanging processor cabinets.

The basic A 10 Model F consists of one A 10-FCP processor cabinet with cache, one independent memory cabinet with one memory base and 12 megabytes of main memory, one dependent input/output cabinet with two I/O bases, two operator display terminals, one operator console DLP-3, and one modem. Main memory can be expanded up to 48 megabytes in 12-megabyte increments. Up to 40 data link processors and a network support processor can be added to the system to provide more data communication capabilities. The Model F is field upgradable to the Model H.

The basic A 10 Model H consists of two A 10-HCP processor cabinets with cache, one independent memory cabinet with one memory base and 12 megabytes of main memory, one additional memory base and 12-megabyte dual-port memory module, two dependent input/output cabinets with two I/O bases, two operator display terminals, two operator console DLP-3, one A 10 dual-processor link, four IODC base exchanges for the two-processor system, and one modem. Two memory controls are required to expand the main memory to the 96-megabyte maximum.

Independently powered memory and I/O cabinets have a power source located inside the cabinets and do not depend on the central processor as a power source as the dependent cabinets do. Independently powered memory cabinets can provide the same degree of redundancy provided by two independent systems. Independently powered I/O cabinets can be configured to ensure that all key elements of the I/O subsystem and data communications network can be duplicated on a separate power source.

INPUT/OUTPUT CONTROL

The Input/Output Subsystem interfaces to the central processor via the Message Level Interface (MLI). Up to eight I/O bases can be directly interfaced to each processor. Each I/O base accommodates up to eight microprocessor-based Data Link Processors (DLPs) which are responsible for information transfer to and from the peripheral and data communication subsystem. The DLPs also perform the data transfers to and from main memory via the Message Level Interface. There is a special DLP for each type of peripheral subsystem. Some DLPs can service multiple peripherals of the same type through standard peripheral exchanges. Each DLP includes a microprocessor, a peripheral interface, and a quantity of local memory.

MASS STORAGE

For disk storage devices qualified on the A 10 system see Table 2.

INPUT/OUTPUT UNITS

Tape drives and printers are covered in Table 3.

TERMINALS

For information on terminals available for the A 10 see Table 4.

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COMMUNICATIONS

The A 10 data communications subsystem allows a modular approach to the design of small, medium, and large data communications networks. The subsystem off-loads communications responsibilities from the central processor and distributes them to one or more *Network Support Processors* (NSPs). The NSP's internal architecture divides the communications workload between the NSP and a series of microprocessor-based *Line Support Processors* (LSPs). The NSP and LSPs are incorporated into the I/O Bases of the A 10 input/output data communications subsystem, providing a common data communications and input/output architecture. The third hardware component required for larger networks and increased protocol flexibility is the *Quad Line Adapter* (QLA) which provides the electrical interface for each communication line. The *Data Communications DLP II* (DCDLP II) with four communication lines allows for the configuration of small to medium networks.

The N*etwork Support Processor* is a programmable front-end processor that serves as the central element of the A 10 communications subsystem. It contains 512K bytes of integrated circuit memory. The NSP handles subsystem control, data link control, and line discipline control functions. Interaction between the NSP and the central system is performed at the message level, eliminating the need to interrupt the central system each time a character or word of data is to be transferred. The NSP is programmed by means of Burroughs' *Network Definition Language II* (NDL II), a descriptive, parameter-driven language.

Line Support Processors are a series of specialized microprocessors that provide the connection between the Quad Line Adapters and the NSP. Information is transferred between the LSP and the NSP at the message level, reducing NSP interruptions and allowing more information to be transferred at a time. A single Line Support Processor can support up to 16 half- or full-duplex communication lines with subbroadband speeds of up to 19.2 bits per second.

A *Line Adapter* provides the electrical interface between the LSP and each communication line. The Line Adapter maintains physical control of the line, accumulates characters, and transfers them to or from the LSP. Each Line Adapter includes 4K bytes of local memory for storage of translation tables, message buffers, line parameters, polling sequences, and the code required to control the communication line and line discipline.

The Line Adapters are packaged in sets of four. Each set, called a *Quad Line Adapter*, accommodates the electrical interfaces for four lines and may be specified as either character-oriented or bit-oriented. For each line position within a Quad Line Adapter, one of three types of electrical interfaces must be specified: RS-232 for U.S. modem connection; CCITT V.24 for international modem connection; or TDI/20, for direct connection. Different electrical interfaces can be intermixed within the same Quad Line Adapter, and character- and bit-oriented Quad Line Adapters can be intermixed on the same LSP. Each Line Support Processor accommodates up to 4 Quad Line Adapters and up to 16 lines.

Data Communication DLP II: The microcoded protocols used with the DCDLP II provide an interface to IBM 2780-compatible devices, access into a BNA-1 network environment and enhanced connectivity without the need for an NSP/LSP implementation.

SOFTWARE

OPERATING SYSTEM: The *Master Control Program (MCP)* and the Software Release 3.6 *Master Control Program/Advanced System (MCP/AS)* designed to support the advanced architecture of the A Series family of computers, are the two operating systems used by the A 10. The operating system software consists of a group of routines organized in three-level hierarchical fashion. The first level is a kernel routine that fields all interrupt signals and transfers control to the appropriate MCP or MCP/AS routines. The second-level routines handle the dynamic resource allocation of main memory, disk storage, I/O devices, processors, and time among the concurrently operating programs. The third-level routines handle utility functions such as job scheduling, control card interpretation, file control, library maintenance, etc. The multilevel MCP or MCP/AS in the A 10 H allows processing to continue while faulty hardware is being diagnosed or new system software is tested and debugged.

Jobs are submitted to the operating system through the Operator Display Terminal (ODT) and/or the system input units, which can be a card unit or a disk or tape file performing as a "pseudo card unit." As the control statements for each task are analyzed, a partial stack is created on a schedule queue containing the estimated main memory requirements, the priority, the maximum amount of processing time and I/O time, the size and location of the file parameter block, the working storage stack size and the size and location of code segments. The program scheduling priority ordinarily is specified by the programmer, although a default option automatically assigns a priority job one half the maximum allowable priority.

The operating system maintains a queue of jobs available for initiation. A scheduling routine evaluates resource and priority requirements of the programs in the queue and schedules their execution so as to utilize the system's resources efficiently in a multiprogramming mode, using either single or multiple processors. The job sequence is dynamically rescheduled whenever a high-priority job is introduced into the schedule. When the required resources are available (for example, when a job completes processing or suspends itself to await completion of an input/output operation) an available job with the highest priority is added to the processing mix. Jobs submitted from remote terminals are interpreted and entered into the schedule queue and are added to the multiprogramming mix in much the same way as batch jobs.

The operating system maintains control of tasks through the use of stacks, descriptors, and tables that summarize the history and current status of each task in process. A stack is created for each job in the system to provide storage for basic program and data references. When a task is activated, four high-speed registers are linked to the task's stack memory area. In addition, an area of high-speed local memory is available to contain additional portions of the active stack, for fast access. The contents of the top-of-stack registers are maintained automatically by the central processor hardware according to the requirements of the executing program. Central processors can handle multiple active stacks organized into a tree structure. The tree-structured organization allows program code and program data and variables to be described at different stack levels, thus permitting program code to be reentrant and shared. The tree-structured stack also enables a single task to split itself into two independent tasks by establishing a new link on the stack to make full use of a multiprocessor configuration or to multiprogram independent processes.

Both data and program segments are referenced through descriptors. Segment Descriptors, maintained in a portion of the stack base known as the Segment Dictionary, are the basis for the Burroughs implementation of virtual memory. In contrast to the fixed-page concept utilized in many storage allocation schemes, Burroughs programs can be divided into variable-length segments, which are brought into main memory only as they are needed. In MCP/AS Segment Descriptors contain a length field, ASD (Actual Segment Descriptor) number field, and a touched bit. The length field

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TABLE 2. MASS STORAGE

MODEL	B 9484-5	B 9484-13	B 9494-5	B 9494-10	B 9494-12	Multi-Disk4
Cabinets per subsystem	Up to 8	2 to 16	2 to 16	2 to 8	1 to 8	2
Disk packs/HDAs per cabinet	2 removable	1 removable	1 fixed	2 fixed	1 fixed	2 to 4 Winchester
Capacity	130MB formatted	252MB formatted	542MB formatted	1084MB formatted	868MB formatted	245.6MB formatted
Tracks/segments per drive unit	—	—	—	—	—	—
Average seek time, msec.	24.7	27.7	21.7	21.7	16	30
Average access time, msec.	33	36	30	30	24.3	38.3
Average rotational delay, msec.	8.3	8.3	8.3	8.3	8.3	8.3
Data transfer rate	605,000	1,200,000	1,200,000	1,200,000	3,000,000	1,200,000
Controller model	B 9387-51 B 9387-52	B 9387-51 B 9387-52	B 9387-51 B 9387-52	B 9387-51 B 9387-52	B 9389 B 9399	SMD interface
Comments	—	—	—	—	—	—

specifies the length of the code segment in words. The touched bit indicates the status of the ASD number field. If the touched bit is on, the ASD number field points to an ASD table entry, and the ASD table entry points to the code segment in memory or on disk. If the touched bit is off, the code segment is on disk and has never been referenced.

A Data Descriptor is used to fetch data to the stack or to store data in a storage area outside the stack. The Data Descriptors contain a length or index field, ASD number field, touched bit, copy bit, indexed bit, and size field. The size field indicates the size of the data items in the data segment. The index bit indicates the status of the length or index field. If the index bit is on, the length or index field is an index. The touched bit indicates the status of the ASD number field. If the touched bit is on, the ASD number field points to an ASD table entry. The ASD table entry points to the data segment in memory or on disk. If the touched bit is off, the data segment has never been referenced by the program. If the copy bit is off, it specifies that the data descriptor is the original descriptor for a data segment.

The Actual Segment Descriptor (ASD) Memory management provides monolithic memory management of memory sizes up to 24 gigabytes. The ASD table is an area in memory which can contain up to one million entries. Each entry in this table is a multiple-word structure. The operating system will initially allocate an ASD table of a size that is proportional to the amount of main memory. The ASD Operator Display Terminal command allows the operator to display the size of the table and the maximum number of entries used, as well as to change the size of the table. The ability to change the size of the ASD table ensures the user the table is large enough for the workload, but not so large as to waste memory. The ASD table contains an entry for each code or data segment which has been touched. A touch will occur on the first reference to the code or data segment. At that time the MCP/AS operating system will allocate an entry in the ASD table. An entry in the ASD table contains an address field and a presence bit. The presence bit indicates the status of the address field. If the presence bit is on, the data or code segment is in memory and the address field contains a 32-bit physical memory address. If the presence bit is off, the data or code segment is on disk and the address field contains the record number of the item in the overlay or code file. With ASD Memory Management, when an area of physical memory is overlayed all data and segment descriptors point to a common descriptor, the ASD; a bit maintained in the ASD entry specifies whether or not the segment has been altered. The segment will only be written to disk if it has been altered.

True dynamic memory allocation is a feature of the operating system. The compilers automatically divide all object programs into logical, relocatable segments. Moreover, all object programs are reentrant. Because code is never modified during execution, two or more jobs can concurrently make use of a single program segment residing in main memory. Program and data segments are automatically transferred from disk storage to main memory when needed. When necessary, the operating system automatically overlays these new segments over other program or data segments that have not been accessed recently.

Memory protection is provided by a combination of hardware and software features. Two registers associated with the stack mechanism, the Base of Stack register and the Stack Limit register, define the upper and lower limits of the stack. An interrupt is generated if an attempt is made to exceed these limits. When an element in a data array is referenced, an automatic comparison of the index value of the data element and the length of the data area as specified in the Data Descriptor identifies any attempt by a program to reference beyond its designated data area. In addition, control bits in each word prevent a user program from altering program segments, data descriptors, segment descriptors, and memory links, control words, and tables maintained by the operating system.

The MCP and MCP/AS provide comprehensive input/output and file control facilities. They automatically assign peripheral devices to symbolic files whenever possible to minimize operator intervention. Three tables are maintained by the operating system containing label equation and file attribute information such as the access type, peripheral type, physical unit being used, etc. This allows modification of file specifications at program execution time. Blocking, buffering, label checking, and other standard I/O control functions are performed in accordance with the programmer's specifications. Magnetic tape drives or disk files can be freely used as backup or "pseudo" devices for card readers, punches, and printers. This makes it unnecessary to delay the processing of a job because of the nonavailability of a particular I/O unit.

Communication between the system operator and the operating system is accomplished through a combination of CRT display units, keyboards, control statements, and a comprehensive system log. The status of the system and of the jobs in progress is presented on the CRT displays. Messages and requests can be keyed by the operator, and the system responses are displayed on the CRT. Jobs are usually submitted to the system in the form of a set of control statements accompanied by a source language deck, or alternatively through control statements entered through the console keyboard if the programs have previously been compiled and stored on disk. Jobs to be compiled must be accompanied by a compile statement identifying the compiler to be used and specifying one of three types of compilations: a compile and execute, compile for the library, or compile for the syntax. Optional control statements for all jobs contain an execution statement, process time statement, priority statement, and I/O statements which associate file labels with specific input/output devices.

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TABLE 3. INPUT/OUTPUT UNITS

Magnetic Tape Units	Number of Tracks	Recording Density, Bits/Inch	Encoding	Tape Speed, Inches/Sec.	Transfer Rate, Bytes/Sec.
B 9495-82	9	1600	PE	75	120,000
B 9495-83	9	1600	PE	125	200,000
B 9495-32	9 9	1600 6250	PE GCR	75 75	120,000 470,000
B 9495-33	9 9	1600 6250	PE GCR	125 125	200,000 780,000
B 9495-24	9 9	1600 6250	PE GCR	200 200	320,000 1,250,000
Printers	**Printing Speed**	**Print Positions**	**Horizontal Spacing, Chars./Inch**	**Vertical Spacing, Lines/Inch**	**Form Size, Inches**
B 9246-12	1200 lpm	132	10	6 or 8	4 to 20 in.
B 9246-21	2000 lpm	132	10	6 or 8	4 to 20 in.
B 9246-6	650 lpm	132	10	6 or 8	4 to 20 in.
B 9290-30	30 ppm	—	3.5 to 20	2.5 to 13.3	8½ by 11 in.

Memory Disk is a major new feature of the MCP/AS operating system. With Memory Disk some portion of the system's main memory may be used as a disk unit. Up to two units of Memory Disk can be specified as a family or as individual units. Each unit is declared in terms of pages, 768K bytes per page. Up to 80 pages are possible per unit, or a total of 120 megabytes for two units. Each unit must be identified as a unique peripheral unit and will be treated as a disk. From 3 megabytes up to 120 megabytes of memory may be specified as disk, and files from any disk unit may be copied to the Memory Disk units.

The *Menu Assisted Resource Control (MARC)* module has been enhanced under MCP/AS to provide a more flexible system. The MARC module offers menu assistance for all system operations. Complete on-line help and teach information is available. A direct interface allows a user to define, create, and name commands to be executed by MARC. Products and features such as PrintS and ReprintS are supported by MARC.

Work Flow Management is an MCP/AS facility that provides enhanced facilities for the control of task initiation and resource allocation. The *Work Flow Language (WFL)* enables users to describe each job as a network of interrelated tasks. The WFL compiler accepts these control statements as input and generates machine code to control the tasks within each job as the user prescribes. Facilities provided by the Work Flow Management System include sequencing and synchronizing of related tasks via input from control statements, improved consistency in task restarts after system failures, job summary printouts, multiple job scheduling queues for different levels of service, interfaces for installation-tailored system control programs, and accounting records grouped by job. WFL has been enhanced with the Print statement providing a batch interface to the PrintS and ReprintS system.

PrintS is integrated with the MCP/AS and provides routing and scheduling of files for printing and controls when and where to print. Printer backup file control descriptors maintain the number of copies to be printed by destination and handle the file after printing. Several descriptors control the presentation of printed files in terms of forms, banners, and transformation of data. *ReprintS* extends these PrintS facilities to remote printers.

Mirror Disk is the parallel functioning of two to four disks where all the units are exact copies of each other. This feature is an extension of the MCP/AS operating system. Critical operations, key object program packs, and data base systems should be mirrored. Each pack may be copied up to three times, with each pack family and each of its copies constituting a mirrored set. On-line creation of mirrors is allowed while still providing access to the master pack. An audit trail is maintained to identify which areas have already been copied, are to be copied, and are in the process of being copied. At the completion of the mirror creation, a recopy of updated areas will take place to ensure the mirrored copy is brought up to the level of the master. Members of a mirrored set residing off-line are audited and updated to match the master and then placed on-line.

PROGRAMMING LANGUAGES: A wide range of high-level and interpreter languages including APL, Algol, Basic, Cobol 68 and 74, Fortran 66 and 77, Pascal, PL/1, and RPG II are supported.

DATA BASE MANAGEMENT: *DMS II* is a comprehensive Data Base Management System which uses MCP or MCP/AS facilities for accessing records in the data base to achieve greater run-time efficiency. Through the operating system facilities, the DMS II data base can be accessed by applications programs operating in multiple processing environments, such as batch, remote job entry, time-sharing, and transaction processing. DMS II incorporates a Data and Structure Definition Language (DASDL) that provides for the logical description of data in sets or subsets and for mapping the logical data into physical structures. A variety of retrieval methods are supported, including indexed sequential, indexed random, and bit vectors. The latter method creates indices that require small amounts of disk storage and permit very fast searches.

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DMS II permits multiple indices to be established for accessing a file, and each file can be accessed by any of the available access methods to provide retrieval of information by different applications programs. User-language interfaces to the data management system are provided for the Cobol, Algol, RPG, and PL/1 languages. When multiple programs are accessing the data base, DMS II provides lockout protection at the record level to prevent simultaneous updating of a record. DMS II recovery capabilities include the ability to audit transactions as they are referenced or added to the data base and a checkpoint/restart capability. A recovery utility is automatically initiated by the operating system in the event of system failure to effect recovery of the data base and restart of applications programs. In addition, DMS II permits the data base to be dumped concurrently with updates to the files, so that dumps correspond to the current audit trail.

DMS Inquiry is an optional extension of DMS II and provides an easy-to-use language that enables non-EDP personnel to access the data base via remote terminals. Users can "browse" through information stored in the data base and retrieve it either serially or randomly, without the delays normally associated with programming and debugging an inquiry program. Users with appropriate security clearances can also update information in the data base and add new records or delete existing records. The DMS II audit trail captures a record of all data base maintenance functions to facilitate automatic recovery.

DMS II DB Analyzer gives detailed statistical and descriptive attributes of both the physical and logical data base implementation. The information is presented by means of a series of predefined report programs, aiding the user in determining the efficiency of the current implementation, changing the structure for increased efficiency, and deciding when reorganization is needed.

DMS II DB Monitor provides realtime monitoring and control of the status of a DMS II data base. DB Monitor provides dynamic monitoring of current data base performance statistics such as memory usage, audit trail attributes, sync point/control point frequency, buffers allocated for each structure, and user counts of the number of programs accessing the data base and one or more structures within it.

DM Interpreter is a DMS II facility which expands the capabilities and control characteristics of DMS II. It provides an interpretive interface to a DMS II data base, permitting non-DMS II languages access to DMS II-managed information. This allows for extended flexibility in a DMS II environment. It decouples the application from the data base and allows data base changes without a corresponding recompilation of the application program in most cases.

The *Advanced Data Dictionary System (ADDS)* is a DMS extension providing for the centralized definition, storage and retrieval of data descriptions. Information about DMS II data base definitions, Cobol 74 file structures, and SDF screen formats are all stored in the ADDS data base. Line and page scrolling allow easy browsing of data base structures and their entities. A security mechanism restricts access to the dictionary contents by assigning an authorized usercode when ADDS is first brought on-line. Tracking of Cobol 74 programs is optionally enforced by the Dictionary Administrator. If enforced, all Cobol 74 programs must have a valid ADDS program name identified in the dictionary. A set of report programs provide on-line support and store the specifications of printed reports for future viewing and modification.

Extended Retrieval with Graphic Output (ERGO): This enhanced inquiry and reporting system is used to access DMS II data bases and conventional files defined in the Advanced Data Dictionary System. ERGO offers a graphic representation of information and defines the relationships between data sets and powerful selection expressions to filter the data used in reports. ERGO features a prompt mode and Help commands to guide the user. Multiple presentation formats allow the user to select the most appropriate graphic output representation.

Data-Aid is a new interactive menu-driven system complemented by on-line help and teach. If a new data base is to be described, Data-Aid transfers the user to ADDS. Data-Aid monitors the generation of the data base software modules and the data base initialization, then transfers the user to ERGO to load the data base through the ERGO update capabilities, and report against it. On request Data-Aid will initiate and track the Dump, Copy, and Recovery functions of the data base.

DATA MANAGEMENT: Included in DMS II described above.

DATA COMMUNICATIONS: The special-purpose programming tool *Network Definition Language II (NDL II)* enables users to define and generate customized NSP control programs for data communications applications. These programs equip the NSP to handle line disciplines, buffer management, message queuing, auditing, and supervision of the flow of messages between user-coded programs and remote terminals. This enables the user's application programs to deal with remote terminals in the same manner as with conventional on-site peripheral devices. IBM data communications algorithms allow Burroughs networks to interface to non-Burroughs terminals utilizing 3270 and 2780/3780 protocols. IBM 3270 protocol supports both terminals and printers compatible with the IBM 3270 bisynchronous protocol for DLP-based systems. A point-to-point bisynchronous algorithm enables A Series DLP-based systems to support communications to IBM 2780/3780 RJE terminal devices.

The *Interactive Datacomm Configurator (IDC)* is an extensive tool to aid in the on-line development, implementation, and maintenance of data communications. It provides a menu-driven interface to configure the data communications subsystem from a workstation or the operator display terminal. The terminal network configuration can be changed dynamically without interruption to the network. A new enhancement enables the IDC to convert NDL to NDL II.

The *Generalized Message Control System (Gemcos)* generates an installation-defined Message Control System (MCS) that manages a transaction-oriented communications network, provides security, handles transaction routing, controls message formatting, and provides a transaction processing interface for application programs. All transaction terminals in the network are controlled by the Gemcos-created MCS and interfaced to the applications programs and the data base. Gemcos enables users to develop transaction processing applications programs independently of the network environment. The input to Gemcos is coded in the Transaction Control Language, a descriptive, free-form language that uses key words to describe both the network environment and the requirements for message routing, message formats, access control, and recovery.

The *Communication Management System (Coms)* is an advanced communication monitor facility. Coms provides most of the features offered by Gemcos and enables users to develop transaction programs independently of the network environment. Coms supports direct windows providing multiple views of the system and allows Cobol 74 programs to communicate with it. Verification of messages received by a terminal are confirmed back to the direct window. Programs communicate dynamically over a modem with a station. This

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TABLE 4. TERMINALS

MODEL	ET 1100	ET 2150	B 25
DISPLAY PARAMETERS			
Max. chars./screen	2080	2080	2240
Screen size (lines x chars.)	24 x 80	24 x 80	29 x 80
Symbol formation	7 x 9 dot matrix	7 x 9 dot matrix	9 x 12 dot matrix
Character phosphor	P39 green	P39 green	P31 green
Total colors/no. simult. displayed	—	—	—
KEYBOARD PARAMETERS			
Style	Typewriter	Typewriter	Typewriter
Character/code set	128 ASCII	128 ASCII	128 ASCII
Detachable	Standard	Standard	Standard
Program function keys	10	10	10
OTHER FEATURES			
Buffer capacity	512K	512K	256K
Tilt/swivel	Standard	Standard	Standard
Graphics capability	No	Yes	No
TERMINAL INTERFACE	RS-232-C, TDI	RS-232-C, TDI	RS-232-C, RS-422 Centronics, parallel

dial-out capability is flexible and easy to use within an application program.

The *Command and Edit (Cande)* program enables multiple users at remote terminals to create programs or data files, compile and execute programs, edit and alter programs or files, search files, send messages to other terminals, and perform a variety of other functions. Files created through Cande can be saved and used later by the same user or by other users to whom access is granted. Cande provides the capability for interactive program development and testing concurrently with the execution of application programs. It also provides effective control of the access, security, and charging functions in a computer time-sharing network.

Remote Job Entry (RJE) enables users at remote batch terminals to enter jobs into the computer system in the same manner as if they were on-site in the computer room. RJE allows files to be transferred between remote systems, and enables terminals attached to remote systems to be controlled by the host system.

Burroughs Network Architecture (BNA) software is designed to enhance the interaction of terminals with host CPUs in a network environment. BNA is also designed to facilitate a move into distributed data processing. Through the BNA Architecture, Burroughs processors and terminals can be granted access to data bases throughout a network. Job tasks and information files can be transferred from one point to another, and data processing resources available in a network can be shared among participants regardless of location. BNA works with existing Burroughs terminal networks and with the Global Memory multiprocessing facility available on Burroughs large-scale processors. BNA depends on logical links rather than physical links, relying on network tables maintained in the host processor for routing. All routing is through host mainframes. Services provided by BNA include those designated host, and those designated network. Host services include coordination of communication between tasks being executed at various hosts; control of the creation, updating, and transfer of data from host to host; and handling of communication with logical points within the network. Network services perform message routing, linking hosts using the Burroughs Data Link Control (BDLC) bit-oriented protocol. Network services also permit connection of Burroughs processors to packet-switching services using X.25 procedures. Links can also be established to non-Burroughs machines using software such as NDL II.

PROGRAM DEVELOPMENT: The *Logic and Information Network Compiler II (Linc II)* is a fourth-generation programming language which generates complete on-line, realtime systems, including programs, data base descriptions, screen formats, transaction management, and network management. Where possible, the Linc II Interactive System utilizes menu and checklist formats to provide user guidance in the development process. The central menu is referred to as the Activities Menu and provides access to all areas within the Interactive System. All documentation for Linc II will be available on-line in the Linc II Interactive System.

The Linc II Data Dictionary facility provides for the user a new level of project control when developing Linc II applications, and allows the user to specify common data items and their characteristics to ensure consistency whenever those data items are used in Linc II developed applications. There are two levels within the Data Dictionary facility. The Global level is for data items to be used across multiple Linc II applications, and the Local level is for single Linc II applications.

Using Linc II, all screen and report formats are built through an interactive painting process. This process permits a screen or report format to be developed and displayed without requiring a generation, but a generation is still required to put the form into production. The Linc II enhanced generation process, using the interactive syntax checking and screen and report painting features, will significantly reduce the previous Linc generation times as well as the number of generations necessary to create the production version. The Linc II Logic Editor is used to enter the specifications for global logic, global setup data items, keywords, profiles, teach/help text for a screen format, and all types of on-line and report logic. Linc II command syntax convention is still required by the Linc II Editor. As a page of logic is entered and the screen is transmitted, the Editor will verify all information for syntax errors and return the page with any errors highlighted. Temporary memory areas may be defined within the Editor to allow the user to store commonly used logic. Up to nine temporary memory areas can be used with each area allowing 23 lines of stored logic.

The *Query Mode* facility allows a user to perform generalized interrogations about a Linc II application specification. Essentially, Query provides a higher level "where used" capability which aids the user in remembering particular naming conventions devised for a Linc II application.

The *Test and Debug System (TADS)* is an interactive, source level debugging tool supporting Cobol 74, Fortran 77, and Algol. The debugging code is generated at compilation time and is evoked when the application program is executed with the TADS option set. Program execution will terminate at

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the initiation of a conditional or unconditional breakpoint specified by the programmer via TADS. Data is then displayed and modified as appropriate, and the execution of program can continue.

UTILITIES: The Master Control Program includes a variety of utility routines that perform functions such as system resource management, data transcription, library maintenance, and system log analysis. Also included is a multilingual system, and an intelligent printer support facility. The System Log program accumulates statistics relating to the execution of programs, the number of file openings and closings, and data on system operation such as halt/load information, time/date changes, the amount of system overhead, and operator input messages. Errors detected during system operation are stored in a Maintenance Log that includes descriptor errors, invalid memory address errors, I/O errors, violations of memory protection, parity errors, and write lockout errors.

OTHER SOFTWARE: The *Intelligent Distributed Editor (IDE)* supports the Fortran 77, Cobol 74 and Algol languages and offers source file editing and text editing extensions. IDE is available in two versions. In the first version, functions are performed on the host system and interaction is achieved via a standard display terminal. The second version runs under Infoview II on an intelligent workstation off-loading much of the mainframe overhead associated with editing into the workstation, thus balancing resource utilization between these processing units.

Reporter III is a report writer designed to simplify the retrieval, analysis, and reporting of information maintained in computer files. Reporter III accepts report specifications coded in a free-form report description language and generates a Cobol program tailored to produce the required report. The system can retrieve input data from multiple files and/or DMS II data bases, select data based on a wide range of criteria, perform arithmetic and statistical functions, sort data in ascending or descending order according to multiple keys, control access through a password system, produce automatically formatted reports, and create one or more files of extracted data for subsequent processing or reporting.

In addition to the basic version, *Reporter III* is available in an Advanced version, an Audit version, and an On-Line version. Reporter III (Advanced) adds the capabilities for generation of multiple reports in one pass through the input data, creation of summary-only (matrix) reports, and controlled formatting for special reports or preprinted forms. Audit-Reporter extends the Reporter III system by providing auditors with effective software tools for testing and evaluating the records produced by an EDP system. The On-Line Reporter is an optional module that can be added to any of the three preceding systems to provide an on-line mode of operation that enables users at remote terminals to enter, generate, compile, and execute report programs.

The *Screen Design Facility (SDF)* features both screen painting facilities and data entry functions such as field verification, status checking, required field, and many more. An extended inquiry capability displays all form libraries defined in the SDF indexed file or the ADDS dictionary.

The *Transaction Processing System (TPS)* provides the framework and methodology for implementing an application system for high-volume, on-line transaction processing. TPS has the ability to synchronize data base and input message recovery and to centralize, formalize, and simplify message interfaces and user programming. It also provides an interface to access remote data bases using the BNA network.

Infoview II manages the interconnection of intelligent workstations including the B 25 and ET 2000 with the A Series host mainframe. Up to five windows may be assigned using Burroughs MT terminal emulation. One of these windows may be used to run an application program under the workstation native mode. Native mode for Infoview II will function under MS-DOS on an ET 2000 or BTOS on a B 25. Infoview II supports manipulation of the window environment with the keyboard arrow keys or a mouse device. To further control the local workstation environment the commands View, Edit, Repeat, and Write, as well as a scrolling capability, have been added. Copy and paste functions support the transfer of text between windows, allowing for more effective editing when working with multiple source files.

PRICING AND SUPPORT

POLICY: The A 10 system is available for purchase or lease under a 1-year, 3-year, or 5-year lease agreement. The standard lease agreement entitles the customer to unlimited use of the equipment and includes full-time equipment maintenance coverage (24 hours a day, 7 days a week). The standard maintenance agreement for purchased systems covers maintenance of the equipment for eight consecutive hours per day on Monday through Friday only; extended maintenance is available at higher rates.

All maintenance charges listed in this report are for monthly maintenance Metro 1 (city) plan A.

All lease plans may include purchase options that allow 50 percent of the rental paid during the first 36 months to be applied toward the purchase price at any time during the lease period.

SUPPORT: Users can purchase Burroughs' Program Product Service Agreement which provides various Support Service packages. The availability of a particular service package (PSA) is product dependent. Generally, PSAs provide for ongoing program product service and/or field service. Program product service deals with corrections by the program product design facility. Field service provides program product problem identification assistance via telephone and/or on-site. Five service packages (PSAs) are defined: Software Product Support (PSA 1) for computers and customers who will not require on-site program product problem assistance; Extended Software Product Support (PSA 2) for computers and customers who will require on-site program product problem assistance; Centralized Software Product Support (PSA 3) for selected program products where only telephone service is needed; Software Product Assistance (PSA 4) for micro and PC products only; and Basic Software Product Support (PSA 5) for certain products for which telephone and on-call services are not generally available.

Mainframe computer systems will be supported from a hardware and operating system (MCP) standpoint for at least seven years from date of last manufacture. Reworked, refurbished, and remarketed models are guaranteed support from a hardware and operating system (MCP) standpoint for a period of five years from date of delivery. Notification of termination of either hardware or MCP support, or both, will be provided at least 24 months in advance of such termination. Burroughs will support the current and immediately preceding version of each major release of the MCP and utilities.

All software is unbundled. Program products for the A 10 system are offered under a plan which provides for the use of the products on a designated system on a month-to-month or extended basis.

EDUCATION: Users can obtain the necessary training by paying for individual courses. The currently available courses range from 1 to 10 days in length, and fall into the following broad categories: Systems Management and Operations, Control Systems, Network Systems, Data Base Systems, Programming Systems, and Applications.

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TYPICAL CONFIGURATION: The following configurations illustrate three typical A 10 systems. The quoted prices include all necessary hardware, but no software.

A 10 Model D:

One central processor with 12MB memory and 1 memory base, 1 I/O cabinet with 2 DLP bases, 2 operator terminals, 1 console DLP, 1 modem	$410,000
4 A378-10 data communication DLP II 16 data communication lines	32,000
2 B9495-33/B9499-21 GCR tape units and controller	80,634
1 B9246-12 line printer (1200 lpm)	42,500
3 MD4-4 disk drives (491MB each)	82,500
6 ET2150 workstations	20,970
Disk, tape, printer DLPs	29,500
TOTAL PURCHASE PRICE:	$698,104

A 10 Model F:

One central processor with 12MB memory and cache, 1 memory base, 1 I/O cabinet with 2 DLP bases, 2 operator display terminals, 1 console DLP, 1 modem	$580,000
12MB dual-port memory increment	80,000
1 A378-5 Network Support Processor 24 data communication lines	64,000
4 B9494-12 disk drives (868MB each)	128,880
1 B9389 storage controller	53,600
1 B9399 string Controller	26,100
3 B9495-24/B9499-21 GCR tape units and controller	107,134
1 B9246-21 line printer (2000 lpm)	69,300
12 ET2150 workstations	41,940
Disk, tape, printer DLPs	26,100
TOTAL PURCHASE PRICE:	$1,178,054

A 10 Model H:

Two central processors with 24MB memory and cache, 2 memory bases, 2 I/O cabinet with 4 DLP bases, 2 operator display terminals, 2 console DLPs, 4 I/O base exchanges, 1 modem	$962,000
2 12MB dual-port memory increments,	160,000
2 A378-5 Network Support Processors 48 data communication lines	130,000
6 B9494-12 disk drives (868MB each)	193,320
1 B9389 storage controller	53,600
1 B9399 string controller	26,100
4 B9495-24/B9499-21 GCR tape units and controller	171,288
1 B9246-21 line printer (2000 lpm)	69,300
1 B9246-12 line printer (1200 lpm)	42,500
24 ET2150 workstations	83,880
Disk, tape, printer DLPs	37,800
TOTAL PURCHASE PRICE:	$1,929,788

EQUIPMENT PRICES

		Purchase Price ($)	Monthly Maint.* ($)	1-Year Lease** ($)	5-Year Lease** ($)
PROCESSORS AND MAIN MEMORY					
A 10 D	Basic System; includes one central processor, one memory cabinet with one memory base and 12 megabytes of main memory, one I/O cabinet with two DLP bases, two operator display terminals, one operator console DLP, and one modem	410,000	650.00	21,462	16,337
A 10 F	Basic system; includes one central processor, 6K-byte cache, one memory cabinet with one memory base and 12 megabytes of main memory, one I/O cabinet with two DLP bases, two operator display terminals, one operator console DLP, and one modem	580,000	922.00	30,365	23,115
A 10 H	Basic system; includes two central processors, 12K-byte cache, one memory cabinet with one memory base, one additional dual port memory, and 24 megabytes of main memory, two I/O cabinets with two DLP bases each, two operator display terminals, two operator console DLPs, one dual processor link, four I/O base exchanges for a two-processor system, and one modem	962,000	1,595.00	50,461	38,436
A 10-DTF	D to F upgrade; includes one A 10D to A 10 F upgrade kit	187,000	—	9,753	7,415
A 10-FTH	F to H upgrade; includes one central processor, one dual port memory module with 12 megabytes of memory, one I/O cabinet with two DLP bases, and four base exchanges for a two processor system	420,200	—	22,006	16,754
A 10-MB	Additional memory with backplane and 12-megabyte dual port memory modules	90,000	160.00	4,737	3,612
A 10-DMK	Memory cabinet; includes backplane and 12-megabyte dual port memory modules	120,000	250.00	6,370	4,870
A 10-DPM	Dual port memory; 12 megabytes	80,000	150.00	4,222	3,222
A 10-DPI	Dual port increment; 12 megabytes	80,000	150.00	4,222	3,222

**For 5-day, 8-hour service.*
***Includes 7-day, 24-hour maintenance coverage.*
NC—No charge.

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		Purchase Price ($)	Monthly Maint.* ($)	1-Year Lease** ($)	5-Year Lease** ($)
SYSTEM OPTIONS					
A 10-IIO	Independently powered I/O cabinet with one message level interface extension	45,000	138.00	2,454	1,892
A 10-MLX	Message level interface	1,000	N/C	50	37
A 930-2	Input/Output base exchange for two-processor system	4,500	15.00	202	157
A 995-93	Line expansion module (LEM 1x4)	3,676	19.00	137	111
ET 1100-ODT	Freestanding operator display terminal	1,945	21.00	105	79
A 341-93	ODT adapter for additional operator display terminal (ET 1100)	3,368	15.00	195	152
CB50-ODT	ODT extension cable; (50 ft.)	550	—	—	—
DATA LINK PROCESSORS					
A 110-90	Card reader DLP (B 9115/16/17)	3,700	30.00	193	156
A 112-90	Card punch DLP (B 9112/13)	3,700	30.00	193	156
A 395-91	PE Magnetic tape DLP, 120/200KB (B 9495-82/-83)	7,200	46.00	357	285
A 395-92	GCR Magnetic tape DLP (B 9495-22/-23/-32/-33/-32M/-33M)	7,200	46.00	357	285
A 393-90	NRZ magnetic tape DLP 60/100KB	7,200	46.00	357	285
A 304-90	Disk pack DLP (interlaced)	7,200	46.00	357	285
A 304-91	Disk pack DLP (sequential interlaced)	7,200	46.00	357	285
A 246-91	Line printer DLP (B 9246-6/12)	4,500	28.00	222	177
A 246-92	Line printer DLP (B 9246-21)	4,500	28.00	222	177
A 293-30	Non-impact printer DLP (9290-30)	4,500	28.00	222	177
A 30-95	SMD disk DLP (DLP II)	8,900	39.00	503	392
A 304-99	SMD disk DLP expander	1,800	19.00	109	84
A 378-10	Data communications DLP II	8,000	39.00	458	358
MASS STORAGE					
B 9484-5	Removable disk pack drive; 130 megabytes	21,000	169.00	877	726
B 9484-13	Removable disk pack drive; 252 megabytes, single spindle	30,000	126.00	1,440	1,080
B 9494-5	Fixed disk drive; 542 megabytes, single spindle, interlaced	26,500	110.00	1,624	1,219
B 9494-10	Fixed disk drive; 1084 megabytes, dual spindle, interlaced	48,000	210.00	2,927	2,197
B 9494-12	Fixed disk drive; 868 megabytes, single spindle, thin film head	32,220	120.00	1,535	1,401
MD4-2	Fixed disk; 245.6 megabytes, (2-122.8MB drives)	21,000	110.00	1,235	926
MD4-4	Fixed disk; 491.2 megabytes, (4-122.8MB drives)	32,000	220.00	1,952	1,485
B 9387-51	Controller; 1x8 spindle	15,000	66.80	694	524
B 9387-52	Controller; 2x8 spindle	20,000	100.00	1,922	1,692
B 9987	Dual host switch for B 9387-51/-52	5,000	15.00	230	170
B 9987-2	Dual port feature for B 9484-12	2,000	21.80	89	69
B 9987-2x	Disk exchange	20,000	62.40	904	679
B 9389	Dual storage controller	53,600	176.00	—	2,292
B 9389-DH	Dual host option	5,450	19.00	—	285
B 9399	Dual string controller	26,100	85.00	—	1,115
B 9387-30	Expander (2x); exchange expansion rack, exchange module, required when more than four B 9387-51 or two B 9387-52 controllers are configured	10,700	15.60	481	361
MAGNETIC TAPE UNITS					
B 9495-82	Magnetic tape unit; 120KB, 75 ips, PE/NZR	18,100	152.00	734	576
B 9495-83	Magnetic tape unit; 200KB, 125 ips, 1600 bpi, PE/NZR	22,447	173.00	926	724
B 9499-14H	Controller; 125 ips, includes 1x4 master electronic exchange, PE control module, cabinet for B 9495-82/83	19,100	132.00	745	573
B 9499-18M	Controller; 75 ips, includes 1x8 master electronic exchange, PE control module, cabinet for B 9495-82/83	21,060	132.00	786	605
B 9499-28M	Controller; 75 ips, includes 2x8 master electronic exchange, two PE control modules, cabinet for B 9495-82/83	51,240	288.00	2,138	1,260
B 9499-2XH	Controller; 125 ips, includes 2x16 master electronic exchange, two PE control modules, cabinet for B 9495-82/83	53,940	288.00	2,247	1,450
B 9499-3XM	Controller; 75 ips, includes 3x16 master electronic exchange, three PE control modules, cabinet for B 9495-82/83	83,310	425.00	3,330	2,280
B 9499-4XH	Controller; 125 ips, includes 4x16 master electronic exchange, four PE control modules, cabinet for B 9495-82/83	110,200	563.00	4,362	3,005
B 9495-32	Magnetic tape unit; 470/120KB, 75 ips, GCR/PE	21,736	182.00	920	661
B 9495-33	Magnetic tape unit; 780/200KB, 125 ips, GCR/PE	24,917	192.00	1,044	748
B 9495-24	Magnetic tape unit; 1250/320KB, 200 ips, GCR/PE	36,225	272.00	1,315	1,061
B 9499-21	GCR/PE controller; 1x8	42,634	249.00	1,473	1,183
B 9499-22	GCR/PE controller; 2x8	85,288	495.00	2,954	2,356
B 9499-23	GCR/PE controller; 3x8	127,899	746.00	4,416	3,538
B 9499-24	GCR/PE controller; 4x8	170,553	994.00	5,878	4,716
B 9499-42	GCR/PE exchange for B 9499-21 through 24; 2x16	7,571	27.50	284	222
B 9499-43	GCR/PE exchange for B 9499-21 through 24; 3x16	9,680	36.60	369	306
B 9499-44	GCR/PE exchange for B 9499-21 through 24; 4x16	11,356	36.60	431	344
B 9999-3	Dual host switch	5,624	21.50	184	151

**For 5-day, 8-hour service.*
***Includes 7-day, 24-hour maintenance coverage.*
NC—No charge.

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		Purchase Price ($)	Monthly Maint.* ($)	1-Year Lease** ($)	5-Year Lease** ($)
TERMINALS					
ET 1100	Terminal workstation with keyboard; RS-232-C, TDI	1,580	20.33	105	79
ET 2150	Terminal workstation with keyboard; character graphics, 512KB RAM	3,495	27.00	222	179
B 25	Microcomputer workstation with keyboard; 256KB RAM, 80186 processor	69,300	721.00	3,229	2,629
CARD EQUIPMENT					
B 9116	Card reader; 600 cpm, 80 columns	11,372	112.00	478	375
B 9213	Card punch; 300 cpm, 80 columns	31,085	539.00	1,249	1,014
B 9915	51-column read feature for B 9116	844	NC	26	20
PRINTERS					
B 9246-6	Band printer; 650 lpm	14,700	195.00	575	499
B 9290-30	Nonimpact printing system; 30 ppm (laser)	65,000	698.00	4,013	3,201
B 9246-12	Train Printer; 1250 lpm, 132 positions	42,500	407.00	1,615	1,340
B 9246-21	Train Printer; 2000 lpm, 132 positions	69,300	721.00	3,229	2,629
COMMUNICATIONS EQUIPMENT					
A 378-5	Network support processor (NSP IV), 256KB	30,000	75.00	1,347	1,018
A 378-1	Line support processor (LSP III)	4,000	16.00	153	131
A 378-7	Line support processor (LSP II) 56K-bit	9,800	40.00	421	351
A 378-2	Add-on memory; network support processor (NSP IV), 256K-bit	5,000	15.00	231	176
A 378-3	Quad line adapter (character)	3,000	26.00	—	120
A 378-4	Quad line adapter (bit)	3,000	26.00	—	120
A 369-10	RS-232 electrical interface (character, bit)	NC	—	—	—
A 369-11	CCITT V.24 electrical interface (character, bit)	NC	—	—	—
A 369-12	TDI/20 electrical interface (character, bit)	NC	—	—	—
A 369-40	Autocall feature (character, bit)	NC	—	—	—
1-2-3-4-QD	Foreplane jumper cable for 1, 2, 3, and 4 quads	NC	—	—	—
Inter-System Control					
A 320-IHC	Independent hub cabinet	21,210	140.00	810	657
A 320-5	Hub 16; (includes 2-port capability)	8,610	58.00	338	277
A 320-6	Hub expansion (additional 1-port capability)	735	6.00	37	30
A 3201-2	Inter-system control host DLP-3	11,866	63.00	410	337
Peripheral Reconfiguration					
A 890-PRC	Reconfiguration cabinet	5,2500	38.00	225	187
A 890-3	Disk kit (B9387-4x, B9387-5x, B9389)	1,681	15.00	68	58
A 890-34	Disk kit (B9387-4x with B9387-3x exchange)	1,681	15.00	68	58
A 890-4	PE magnetic tape kit	3,6766	23.00	153	120
A 890-8	GCR magnetic tape kit	1,996	15.00	85	68
Peripheral Power Control					
A 304-PRC	Peripheral power control (power for B9387-41/42, B9387-51/52 and B9389 controllers, one PPC per subsystem)	1,100	15.00	77	63
B 9387-RPC	B 9387 remote power control	225	5.00	19	16
CB 865	Cable; 50-ft., host to B9387 remote power control	210	NC	11	8
B 9389-RPC	B9389 remote power control	810	10.00	55	45
CB 866	Cable; 100-ft., host to B9389 remote power control	590	NC	30	22
CB 867	Cable; 200-ft., host to B9389 remote power control	970	NC	49	36

**For 5-day, 8-hour service.*
***Includes 7-day, 24-hour maintenance coverage.*
NC—No charge.

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SOFTWARE PRICES

		Limited Time-Plan	Annual Prod. Serv. Agreements	
		Monthly License Fee ($)	PSA 2 ($)	PSA 1 ($)
A 10 SS	System Software Facility; includes Master Control Program (MCP), Utility Programs, Algol Compiler, DC Algol Compiler, Program Binder, Microcode, Menu Assisted Resource Control (MARC), SMF II Site Management, Workflow Language, and Cross Reference Symbolic	1,875	10,688	6,188
A 10 AS	System Software Facility; includes Master Control Program/Advanced System MCP/AS, Algol Compiler, DC Algol Compiler, Program Binder, AS Microcode, Menu Assisted Resource Control (MARC), SMF II Site Management, Workflow Language, Utility Programs, and Cross Reference Symbolic	2,025	11,543	6,683
Compilers				
A 10 ATD	Algol Test and Debug System	145	827	479
A 10 BSC	Basic Compiler	140	798	462
A 10 APL	APL/700	140	798	462
A 10 COB	Cobol Compiler (ANSI 68)	140	798	462
A 10 C74	Cobol Compiler (ANSI 74)	140	798	462
A 10 CTD	Cobol 74 Test and Debug	145	827	479
A 10 PL1	PL/1 Compiler	140	798	462
A 10 FOR	Fortran Compiler (Level H)	140	798	462
A 10 F77	Fortran Compiler (ANSI 77)	160	912	528
A 10 FTD	Fortran 77 Test and Debug	145	827	479
A 10 RPG	RPG II Compiler	140	798	462
A 10 PAS	Pascal Compiler	305	1,739	1,007
A 10 SRT	Sort Utility	170	969	561
A 10 APB	APL B	340	1,938	1,122
A 10 LN2	Logic and Information Network Compiler (LINC II)	2,650	18,000	8,820
Support Utilities				
A 10 BAR	Activity Reporting	100	570	330
A 10 SMR	SMF II System Resource Management	390	2,223	1,287
A 10 LOG	Logger	65	371	215
A 10 BSL	Billing Support Library	45	257	149
A 10 SSL	Security Support Library	45	257	149
A 10 IPF	Intelligent Printer Support Facility	160	912	528
A 10 MLS	Multi Lingual System	120	684	396
Data Communications				
A 10 DCS	Data Communications Software package including Interactive Datacomm Configurator, Network Definition Language II, NSP/LSP Firmware	150	855	495
A 10 RJE	Remote Job Entry	95	542	314
A 10 COE	Communications Management System (Entry)	375	2,138	1,238
A 10 COT	Communications Management System	660	3,762	2,178
A 10 X25	X.25 MCS	310	1,767	1,023
A 10 NDA	Network Definition Language II Analyzer	65	371	215
A 10 RMP	Reprints	225	1,283	743
A 10 DIA	Diagnostic MCS	75	428	248
A 10 MCB	GEMCOS (Basic)	525	2,993	1,733
A 10 MCA	GEMCOS (Advanced)	840	4,788	2,772
A 10 MCT	GEMCOS (Total)	1,050	5,985	3,465
A 10 MCF	GEMCOS Format Generator (requires MCA or MCT)	200	1,140	660
A 10 CDE	Command and Edit (Cande)	140	798	462
A 10 SDF	Screen Design Facility	180	1,026	594
A 10 EDI	The Editor	150	855	495
A 10 BNS	BNA Network Services	840	4,788	2,772

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		Limited Time-Plan	Annual Prod. Serv. Agreements	
		Monthly License Fee ($)	PSA 2 ($)	PSA 1 ($)
Reporting				
A 10 RP3	Reporter III	570	3,249	1,881
A 10 OR3	On-Line Reporter III	55	314	182
Data Management				
A 10 DM2	Data Management System II	945	5,387	3,119
A 10 DI2	DMs II Inquiry	190	1,083	627
A 10 DBA	DMS II Data Base Analyzer	180	1,026	594
A 10 DDM	DMS II Data Base Monitor	180	1,026	594
A 10 IDD	Advanced Data Dictionary System	640	3,648	2,112
A 10 DMT	DMS II DM Interpreter	150	955	495
A 10 DMC	DMS II Data Base Certification	130	741	429
A 10 DIC	Data Dictionary System	235	1,340	235
A 10 ERG	Extended Retrieval with Graphic Output (requires DM Interpreter)	475	2,708	1,568
A 10 DME	Data Aid	130	741	429
A 10 TPS	DMS II Transaction Processing System	155	884	512
Workstation Integration				
A 10 DES	Data Entry System	380	2,166	1,254
DC 10 HLS	Host-Link Server	460	2,622	1,518
A 10 IDE	Intelligent Distributed Editor	155	884	512
A 10 DTS	Data Transfer System	155	884	512
A 10 DE2	ODESY	300	1,535	890
A 10 RGF	Remote Graphics Facility	—	950	550 ■