Burroughs B 5900

MANAGEMENT SUMMARY

Introduced in September 1980, the Burroughs B 5930 is a versatile midrange computer system that features full hardware and software compatibility with the larger B 6900 systems. According to Burroughs, the processing power of the B 5930 falls between that of the IBM 4331 Model Group 2 and the 4341 Model Group 1. The B 5930 appears to be well suited for both central host data processing and distributed processing applications.

HARDWARE

The principal architectural innovation of the B 5930 is Burroughs' multi-level Function Processor concept, in which major hardware functions are assigned to separate programmable microprocessors, each with its own memory. The central processing unit has an open-ended design that currently includes the following Function Processors: Micro Master Control Processor (MMCP), Program Controller, Data Processor, Memory Controller, Message-Level Interface Port, and Maintenance Processor. The various CPU Function Processors intercommunicate by means of a 52-bit-wide Main Data bus and a 30-bit-wide Control bus.

The Micro Master Control Processor controls and coordinates the activities of all the other Function Processors and contains a microcoded implementation of the full instruction set of the large-scale Burroughs computers, thereby making the B 5930 program-compatible with the larger systems. The other CPU Function Processors are dedicated to the following specific functions: the Program Controller accesses and

The medium-scale B 5900 features an innovative multi-microprocessor architecture and maintains full program compatibility with the larger Burroughs computers. Up to four CPUs can be configured in a multiprocessor system.

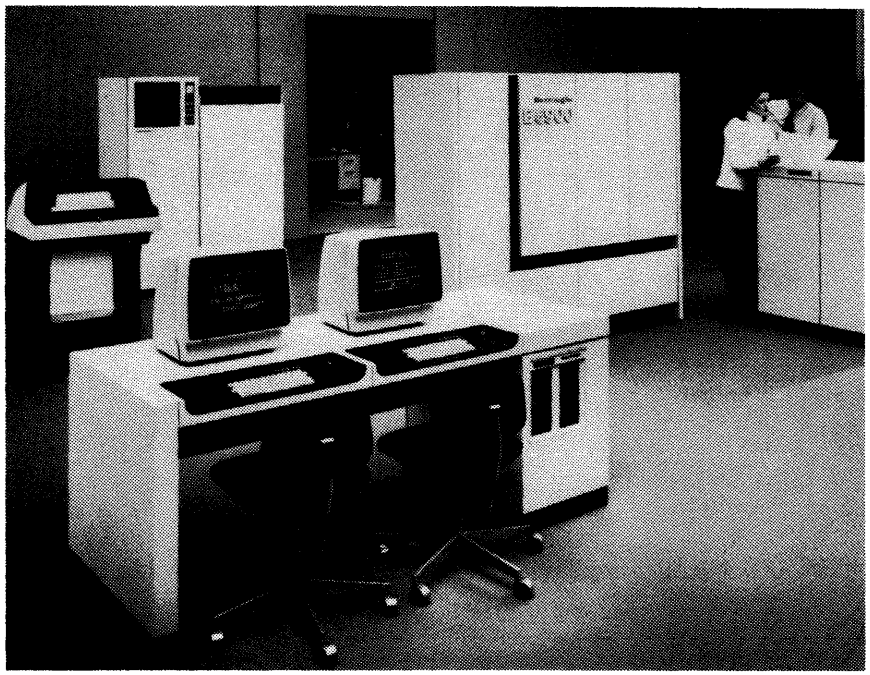
MODEL: B 5930.
CONFIGURATION: Single-processor system—1.5 to 6.2 megabytes of main memory, 5 to 32 Data Link Processors, 4 to 64 communications lines, and 1 to 3 operator consoles. Multiprocessor system—up to 4 CPUs, 21.6 megabytes of main memory, 128 DLPs, 256 communications lines, and 12 operator consoles.
COMPETITION: Digital Equipment DECSYSTEM-20; Honeywell DPS 7, DPS 8, and Levels 64 and 66; IBM 4331 and 4341; Magnuson M80 Series; NCR 8500 Series; and Sperry Univac System 80, 90/60, 90/80, and 1100/60.
PRICING: The basic B 5930 system sells for $210,000.

CHARACTERISTICS

MANUFACTURER: Burroughs Corporation, Burroughs Place, Detroit, Michigan 48232. Telephone (313) 972-7000.

MODEL: B 5930 Computer System (only model announced in B 5900 Series to date).

DATE ANNOUNCED: September 17, 1980.



This basic B 5900 system includes a dual-display operator console with two built-in mini-disk drives for maintenance functions, a 650-lpm printer, a tape drive and controller, the central processing unit with 1.5 megabytes of main memory, and a disk drive and controller.

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decodes instructions to determine the proper entry points in the microcode stored in the MMCP; the Data Processor performs all arithmetic and logical functions; the Memory Controller provides the interface to the B 5930's MOS main memory modules; the Message-Level Interface Port provides the interface to the input/output and data communications subsystems; and the Maintenance Processor monitors the system's operation and facilitates diagnostic testing by field engineers.

Burroughs' new Function Processor architecture enables the B 5930 to achieve a competitive price/performance level without reliance on exotic circuitry. The system uses LSI logic circuits and 16K error-correcting MOS RAM memory circuits, packaged on circuit boards which field engineers can simply unplug and replace when trouble occurs.

Main memory capacity of each B 5930 CPU can range from 1.5 to 6.2 megabytes, configured in the form of two to eight 786K-byte modules. Expansion beyond 3.1 megabytes requires a Memory Expansion Adapter, which contains a second Memory Controller.

From two to four B 5930 central processors can be interconnected via Burroughs' Global memory and operated in any of three modes. The Global memory capacity can range from 786K bytes to 3.1 megabytes in 786K-byte increments, and each CPU can address a total of up to 6.2 megabytes of local memory plus Global memory. In the Multiprocessor (tightly coupled) Mode, a single Master Control Program manages all of the system's resources and controls the entire workload. In the Shared Resources (loosely coupled) Mode, each processor executes its own workload under the direction of its own Master Control Program, but the processors can intercommunicate through the Global Memory to transfer data, interrogate each other's data bases, and share I/O and data communications resources. In the Independent Systems (uncoupled) mode, each processor operates independently under its own Master Control Program, and interprocessor communication is prohibited to ensure a secure environment. B 5930 systems can also be intermixed with Burroughs B 6800 and/or B 6900 systems and operated in either the Shared Resources or Independent Systems Mode.

Information is transferred to or from peripheral devices through additional Function Processors known as Data Link Processors (DLPs), which relieve the central system of input/output "housekeeping" tasks. Each DLP includes one or more microprocessors, an interface, and a buffer memory. A single-processor B 5930 system can include up to 32 DLPs, each controlling one peripheral device or a group of similar devices. The maximum aggregate I/O data rate is 2.3 million bytes per second. An I/O base module, which houses up to eight DLPs, can be connected to as many as four B 5930 central processors; any DLP can then be switched from one processor to another under MCP control.

DATE OF FIRST DELIVERY: Second quarter 1981.

DATA FORMATS

BASIC UNIT: Fixed-length memory word, consisting of 48 data bits, 3 control bits, and 1 parity bit. Eight additional bits, used for automatic error correction, are standard. Each word can hold one single-precision operand, half of a double-precision operand, one descriptor, or six 8-bit instruction syllables.

OPERANDS: Integer and floating-point operands have the same format and may be freely combined in arithmetic operations. Each single-precision operand (integer or floating-point) 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.

INSTRUCTIONS: 1 to 12 eight-bit syllables in length. Syllables are packed six to a program word and executed sequentially from left to right.

INTERNAL CODE: 8-bit EBCDIC is standard. Information coded in ASCII can also be processed. ASCII is the primary data communications code. In general, characters are collated according to their internal binary values.

MAIN STORAGE

STORAGE TYPE: Error-correcting MOS RAM (metal oxide semiconductor random-access memory), composed of 16K-bit chips.

CAPACITY: Two 786K-byte modules (1.572 million bytes total) in basic system; expandable in 786K-byte modules to a maximum of 6.2 million bytes (8 modules) per B 5930 CPU. Expansion beyond 3.1 million bytes (4 modules) requires the addition of a Memory Expansion Adapter, which provides a second Memory Controller.

If less than the maximum 6.2 million bytes of main memory is configured, the B 5930 can also support a Global memory interface. Burroughs' Global memory subsystem can be shared by up to four processors in a multiprocessor B 5930 system. The capacity of the Global (shared) memory can range from 786K bytes to 3.1 million bytes in 786K-byte increments, while the local memory capacity in each processor can range from 1.5 million bytes to 5.4 million bytes. Each processor can address a total of 6.2 million bytes of local and Global memory. Thus, the maximum usable capacity of a four-processor B 5930 system is 22.4 million bytes (5.4 million bytes in each of the four processors plus 786K bytes of shared Global memory).

CYCLE TIME: Not specified.

CHECKING: Logic in the Memory Controller provides automatic detection and correction of single-bit memory errors as well as detection of multiple-bit errors. All memory errors are logged into a memory register that is periodically written to the system log on disk to aid field engineers in locating and correcting the faults.

STORAGE PROTECTION: Provided by a combination of hardware and software. A memory protect bit prevents user programs from writing into locations which have the protect bit set. Attempts by programs to index beyond their assigned data areas are automatically detected.

CENTRAL PROCESSOR

The B 5930 Central Processing Unit employs a fully microprogrammed architecture based on Burroughs' multi-

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Burroughs offers an appropriate complement of peripheral equipment for the B 5900 Series systems, with principal emphasis on mass storage units, magnetic tape drives, and data communications terminals. In general, these devices are well-engineered and reliable, but far more conventional in design than the mainframes. Mass storage buyers can choose either head-per-track disk files or moving-head disk pack drives. Burroughs has been gradually shifting its emphasis from the head-per-track disk files to the more economical moving-head disk pack drives, and the company now offers moving-head drives with both removable and nonremovable packs. Magnetic tape drives with data transfer rates of up to 780,000 bytes per second are available, as are line printers with speeds ranging from 650 to 2000 lines per minute.

Data communications control functions are handled by specialized, microprocessor-based Function Processors called Line Support Processors (LSPs) and Network Support Processors (NSPs). Every communications-oriented B 5930 system includes one or more Line Support Processors to perform the low-level network control functions, plus an appropriate Line Adapter to provide the required electrical interface for each line. In larger networks, one or more Network Support Processors are added to relieve the CPU of higher-level communications control functions. Each LSP can control up to 16 communications lines, each NSP can accommodate up to 4 LSPs and 64 lines, and each B 5930 CPU can support up to 2 NSPs (but no more than 64 lines). When the NSP is not used, up to 2 LSPs can be connected directly to a B 5930 CPU for a maximum capacity of 32 lines. In multiprocessor systems, the NSPs and/or LSPs can be switched among the processors in the same manner as Data Link Processors.

The basic B 5930 central system, priced at exactly $210,000, consists of a central processor, 1.5 million bytes of main memory, a dual-display operator console, 5 Data Link Processors, and a 4-line data communications subsystem. This basic system can be leased for $7,219 per month on a one-year lease, $6,563 on a three-year lease, or $6,237 on a five-year lease, including full maintenance coverage.

SOFTWARE

One of the principal attractions of the B 5930 is its ability to use all of the mature, highly regarded software that is available for the larger Burroughs computers. This software support centers on the Master Control Program (MCP), the integrated operating system that oversees and controls all operations. Many of the MCP functions that were unique when Burroughs introduced them in the early sixties are now provided by competitive large-scale operating systems as well—but the MCP continues to draw users' praise for being easier to understand and use than most of its competitors. The MCP receives its orders through straightforward messages entered via control cards or the console keyboard/display units.

level Function Processor concept, in which specific hardware functions are assigned to separate programmable microprocessors, each with its own memory. The CPU has an open-ended design that currently includes six major Function Processors, as described in the following paragraphs. These modules are interconnected by means of two major buses, the Main Data bus (M-bus) and the Control bus (C-bus). The M-bus is 52 bits wide, consisting of 48 bits for data, 3 for tag information, and 1 for parity. The C-bus is 30 bits wide, with 26 control bits, a 3-bit processor module address, and 1 parity bit.

The *Micro Master Control Processor (MMCP)* controls the overall operation of the system and issues execution command signals to the other processing modules. It controls the Data Processor on a clock-by-clock basis, issuing the proper commands to execute each instruction. The MMCP includes 800K bits of high-speed microcode memory, enabling it to support the complete B 6000 Series instruction set. The MMCP is the only processing module that is permitted to place information on the C-bus, while all the other modules are permitted to read the control information that is placed on the bus and addressed to them.

The *Program Controller* obtains information via the Memory Controller, decodes instructions to determine the proper entry points into the microcode in the MMCP, and provides information to the Data Processor via the M-bus. It functions as an independent processor, works closely with the Memory Controller to transfer information efficiently, and can operate as many as three instructions ahead of the MMCP.

The *Data Processor* performs all arithmetic and logical functions. It consists of an Arithmetic Logic Unit (ALU), 16 general-purpose registers, and a series of PROMs (programmable read-only memories) that perform high-speed address decoding. The Data Processor is controlled by the MMCP via the C-bus. It can operate independently of the other processing modules and of the data transfer operations occurring on the M-bus. An internal data path within the ALU permits its operations to continue without inputs from the C-bus or M-bus if the necessary information is already present in the registers.

The *Message-Level Interface Port (MLIP)* provides the interface between main memory and the B 5930's Function Processor-based input/output and data communications subsystems, which are described in later sections of this report. The MLIP provides up to four ports, each capable of servicing one Input/Ouput Base Module via a Message-Level Interface (MLI).

The *Memory Controller* provides the interface between the memory modules and the M-bus that services all of the CPU modules. Each Memory Controller supports up to 3.1 million bytes (four 786K-byte modules) of memory. A B 5930 equipped with the Memory Expansion Adapter includes a second Memory Controller and supports a total of up to 6.2 million bytes of memory. The Memory Controller contains logic that provides automatic correction of single-bit memory errors as well as detection of multiple-bit errors.

The *Maintenance Processor* simplifies the maintenance of the B 5930 system to provide increased reliability and system availability. Its components include a Maintenance Display Microprocessor (MDM), which uses Burroughs Modular Terminal Series (MTS) terminal devices to display a variety of status messages; a Maintenance Interface Processor (MIP), which operates in conjunction with the MDM to access and display the status of every register in the system; and a dual mini-disk subsystem, which provides storage for system diagnostic test cases. Any failures are reported on the maintenance displays and indexed into a supporting

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B 5930 users have an unusually wide choice of programming languages. Compilers are available for Algol, APL, Basic, Cobol 68 and 74, Fortran IV and 77, PL/1, RPG, and REPORTER II. The compilers divide all object programs into logical, relocatable segments, and all coding generated by the compilers is re-entrant. Subprograms coded in different languages can readily be intermixed.

Burroughs offers an impressive complement of data communications software for the B 5930, including the Network Definition Language II (NDL II) for network control, the Generalized Message Control System (GEMCOS) for transaction processing, the Command and Edit Language (CANDE) for time-sharing and on-line program development, and Remote Job Entry (RJE) and Burroughs Network Architecture (BNA) for distributed data processing.

Another featured software product is the Data Management System II (DMS II), Burroughs' comprehensive data base management system. DMS II is integrated with the MCP operating system and uses MCP facilities to access records in the data base for increased run-time efficiency. Several extensions are available to increase the power and ease of use of DMS II. These include DMS II Inquiry, which enables non-EDP personnel to access the data base via remote terminals; the Transaction Processing System (TPS), which facilitates the implementation of transaction-oriented data base systems; and the Data Dictionary, which maintains comprehensive documentation describing the DMS II data base environment.

Burroughs also offers a number of applications programs for the B 5930, including systems oriented toward production control, inventory control, project control, text management, banking, and hospitals.

B 5930 software and support are fully unbundled. The Basic System Software Facility, consisting of the MCP, NDL II, GEMCOS, and one compiler, is available for either a monthly license fee of $1,335 or a one-time payment of $40,000 plus an annual fee of $7,600. All of the other B 5930 software components are individually priced.

COMPATIBILITY

The B 5930 features full compatibility, at both the source and object-code levels, with the larger Burroughs B 6800 and B 6900 Series computers. There is, however, no object-level program compatibility between the B 5930 and any of the smaller Burroughs systems; programs written for these computers must be recompiled to run on the B 5930.

The B 5930 uses the same byte-oriented data structure, EBCDIC internal code, and magnetic tape formats as the IBM System/370, 303X, and 4300 Series computers, but there is no direct program compatibility at the machine-language or assembly-language level. Most programs

document designed to aid field engineers in isolating and diagnosing system faults.

The B 5930 MMCP contains a microcoded implementation of the complete instruction set used in the larger Burroughs B 6000 Series computers. As a result, the B 5930 is fully program-compatible with the larger systems. Two key concepts, stacks and descriptors, underlie the distinctive CPU architecture of these systems.

STACKS: A stack is an area of memory, assigned to each program, that provides temporary storage for program and data references, stores a dynamic history of the program's operating status, and contains other descriptors pertaining to the legitimate addressing environment for each procedure. Functionally, the stack acts as a push-down list that operates on the "last-in, first-out" principle.

DESCRIPTORS: A descriptor is a word used to describe a data or program area in storage. There are three types: data, string, and segment descriptors. A data descriptor defines a data area by specifying its starting address in either main or disk storage, its size, and certain other descriptive information. String and segment descriptors provide similar information about data areas organized as character strings and about program segments, respectively.

INSTRUCTION REPERTOIRE: There are three basic types of instruction syllables: operators, value calls, and name calls.

A value call is 2 syllables (16 bits) long. It causes the specified operand to be brought into the top location of the stack.

A name call is also 2 syllables (16 bits) long. It causes the specified address to be placed in the top location of the stack.

Operators range from 1 to 12 syllables in length, though most are only 1 or 2 syllables long. Each operator causes the specified operation to be performed. There are approximately 200 operators in the basic instruction repertoire.

The arithmetic operators cause the two operands at the top of the stack to be combined according to the specified binary arithmetic process, with the result placed at the top of the stack. Floating-point and integer operands of single and double precision may be freely combined. Other word-mode operators perform logical operations, comparisons, branches, field or bit manipulation, stack management functions, subroutine entry and exit, etc.

A flexible group of string operators is used to transfer, compare, scan, translate, pack, unpack and edit strings of data.

The Vector Mode operators are a group of 40 additional operators designed to speed up the processing of vectors (or strings of numbers) and matrices (or arrays of numbers) by using high-speed processor registers to store and increment data addresses.

INSTRUCTION TIMES: Burroughs declines to release timing figures for individual instructions, claiming that its unconventional architecture makes straightforward instruction comparisons impossible. Burroughs states, however, that the B 5930 provides about 50 percent of the processing power of the larger B 6900 system, and that its performance falls between that of the IBM 4331 Model Group 2 and the IBM 4341 Model Group 1.

PHYSICAL SPECIFICATIONS: The B 5930 central system, including up to 6.2 million bytes of main memory and 3 I/O Subsystem Base Modules, is housed in a single cabinet that is 68 inches (173 cm) high, 80 inches (203 cm) wide, and 24 inches (61 cm) deep.

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written in ANSI Cobol, Fortran, or PL/1 for the IBM computers, however, should be transferable to the B 5930 without undue conversion difficulty.

To assist users of competitive systems in converting to the B 5930, Burroughs offers a number of program products called Conversion Aids. These include Cobol, RPG, and BAL translators for IBM DOS and OS-based systems; Cobol, RPG, and Easycoder translators for Honeywell Series 200, 2000, 600, and 6000 systems; and Cobol, RPG, and BAL translators for Univac Series 70 and 9000 systems. Data File Conversion utilities for sequential data files are also available.

USER REACTION

In February 1982, we interviewed four B 5900 users, whose names were provided by Burroughs. All four installations were single-processor configurations. The oldest of these systems was installed in June 1981; the newest, in November 1981.

These four users represented a service bureau, two manufacturers, and an agricultural cooperative. Three of them were already experienced with Burroughs equipment. The fourth had switched to the B 5900 from a Sperry Univac system.

The users' ratings of the B 5900 are summarized in the table below.

	Excellent	Good	Fair	Poor	WA*
Ease of operation	3	1	0	0	3.75
Reliability of mainframe	4	0	0	0	4.00
Reliability of peripherals	0	4	0	0	3.00
Maintenance service:					
Responsiveness	2	2	0	0	3.50
Effectiveness	2	2	0	0	3.50
Technical support:					
Trouble-shooting	1	2	1	0	3.00
Education	0	3	1	0	2.75
Documentation	0	2	2	0	2.50
Manufacturer's software:					
Operating system	4	0	0	0	4.00
Compilers & assemblers	3	1	0	0	3.75
Ease of programming	2	2	0	0	3.50
Ease of conversion	2	2	0	0	3.50
Overall satisfaction	3	1	0	0	3.75

*Weighted Average on a scale of 4.0 for Excellent.

One of the users had acquired the B 5900 as an upgrade from a Sperry Univac 90/30 system. He said he had experienced no unusual problems during the conversion and described the B 5900 as "more powerful and easier to use than the 90/30." This user's only complaint was in the area of software support, which he said was a problem because he was not near a large city. However, he stated that software support was "getting better."

Another user had added a B 5900 to a system that included three B 7800s. He said the B 5900 was "brought up quickly" and was compatible with the larger systems. The only problem he encountered were "some bugs in the software," which he said were quickly solved. This user

CONFIGURATION RULES

The entry-level B 5930 central system consists of one CPU, two 786K-byte memory modules, one Maintenance Processor, one Operator Display Console with dual CRT displays and keyboards, two I/O Base Modules, one Line Support Processor, one Quad Line Adapter, and five Data Link Processors (for the console, a line printer, a magnetic tape subsystem, and two disk pack subsystems).

The system's memory, input/output, and data communications capabilities can be expanded as described under the "Main Storage," "Input/Output Control," and "Communications Control" headings, respectively.

A multiprocessor B 5930 system can consist of up to four central processors interconnected via a Global memory subsystem. The capacity of the Global (shared) memory can range from 786K bytes to 3.1 million bytes, and each processor can also have from 1.5 million to 5.4 million bytes of local memory. The total amount of local plus Global memory that can be addressed by each processor, however, is limited to 6.2 million bytes. A multiprocessor configuration can operate in any of three different modes: Multiprocessor Mode (tightly coupled), Shared Resources Mode (loosely coupled), or Independent Systems Mode (uncoupled).

In the Multiprocessor Mode, a single Master Control Program (MCP) manages all of the system's resources and schedules and controls the entire workload. Because the MCP and other systems software must reside in Global memory, a minimum of 1.5 million bytes of Global memory is required for operation in this mode.

In the Shared Resources Mode, each processor is logically partitioned with its own resources and supported by its own MCP. Each processor executes its own independent workload, but the processors can intercommunicate through the Global memory to share information in their respective data bases.

In the Independent Systems Mode, each processor operates independently under its own MCP, as in the Shared Resources Mode, but communication between the processors is prohibited in order to ensure a secure environment. In this mode, the Global memory is allocated among the processors and used exclusively as an extension of each processor's local memory.

B 5930 systems can be intermixed with Burroughs B 6800 and/or B 6900 systems in either the Shared Resources or Independent Systems Mode, but not in the Multiprocessor Mode.

INPUT/OUTPUT CONTROL

I/O CHANNELS: In place of conventional I/O channels, the B 5930 input/output subsystem uses an extension of Burroughs' Function Processor architecture. Specialized microprocessors called Data Link Processors (DLPs) control the transfer of data between peripheral subsystems and main memory, thereby relieving the CPU of that responsibility.

Each type of peripheral subsystem has its own specialized DLP. Some DLPs (such as those for disk drives) can service multiple peripheral devices of the same type. In operation, a DLP receives a request for an I/O data transfer from the CPU via the Message-Level Interface. Some DLPs (such as those for disk drives) can accept multiple I/O requests and queue them for processing. The DLP then initiates the peripheral-dependent functions required to perform the I/O data transfer. Data is transferred through a Message-Level Interface to or from main memory. Each DLP includes local memory that is used to buffer the data transfer operations.

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also commented that the B 5900 is very cost effective and is "one of the best Burroughs has turned out."

In two of the installations, the B 5900 had replaced B 1800 systems. Both of these users reported that they were well satisfied with the B 5900 and that they had experienced no problems with it.

Clearly, in the opinion of these users, the B 5900 is off to a good start. As might be expected from the ratings and comments, all four users said they would recommend the system to others.□

Up to eight Data Link Processors of any type can be housed in each I/O Subsystem Base Module. The entry-level B 5930 system includes two I/O Subsystem Base Modules, and an optional third module can be housed in the basic central system cabinet. An I/O Subsystem Expansion Cabinet can be added to hold a fourth I/O Subsystem Base Module. Each I/O Subsystem Base Module contains a Message-Level Interface and accommodates up to 8 DLPs, providing for a maximum of 4 Message-Level Interfaces and 32 DLPs in a single-processor B 5930 system.

Each of the I/O Subsystem Base Modules can be connected to up to four B 5930 central systems by means of I/O Base Module Exchanges. Each DLP in the I/O Subsystem Base Module is logically assigned to only one central system at a time, but it can be transferred to another system when desired through the use of MCP operator console commands. A B 5930 I/O Subsystem Base Module and its attached complement of DLPs and peripheral subsystems can also be shared with a B 6900 computer system.

I/O DATA RATES: Data is transferred between the DLPs and the central system in the form of blocks or messages at the rate of 2.3 million bytes per second. The maximum aggregate I/O data rate for each B 5930 central system is also 2.3 million bytes per second. All of the DLPs in an I/O Subsystem Base Module share the same Message-Level Interface; contention for the interface is resolved by priority logic in the I/O Subsystem Base Module. The buffer memories in the individual DLPs permit simultaneous peripheral operations.

MASS STORAGE

B 9494 FIXED DISK DRIVES: These units, which store data on nonremovable 4-platter disk packs, are expected to be the mass storage devices most commonly used with the B 5930 system. The basic B 9494-41 contains two spindles and has a total capacity of 402 megabytes. The B 9494-42, B 9494-43, and B 9494-44 consist of two, three, and four B 9494-41 units and store 804, 1206, and 1608 megabytes of data, respectively.

Each spindle has an independent actuator and four nonremovable platters with eight recording surfaces. All recording surfaces are used for data storage. Servo information, used to locate data storage tracks, is interspersed between the data tracks. Average head positioning time is 28 milliseconds, and average rotational delay is 8.17 milliseconds. The data transfer rate is 650,000 bytes per second.

The B 9494 disk subsystem is controlled by a B 9387-4X Controller, which is available in 5 models (1x8, 2x8, 2x16, 4x16, and 6x16) and is capable of accommodating up to 6 simultaneous access paths and 16 disk spindles. Also required is a B 5304-90 Disk Pack DLP for each B 5930 access path.

B 9484-51 DISK PACK DRIVE SUBSYSTEM: This medium-capacity disk pack drive has a capacity of 65.2 million bytes per spindle, 130.4 million bytes per drive, and a total storage capacity of 1.04 billion bytes in a subsystem with the maximum of 16 spindles. The average access time is 25 milliseconds, average rotational delay is 8.3 milliseconds, and data transfer rate is 605,000 bytes per second. As many as eight spindles (four dual drives) can be attached to a B 9387-43 or B 9387-44 Controller. The B 9484-51 can also be configured with the 2x16 B 9387-45 Controller, the 4x16 B 9387-47 Controller, or the 6x16 B 9387-48 Controller to permit up to 16 spindles (8 dual drives) with up to 8 simultaneous access paths to the disk pack subsystem. The B 9387-4X controllers include a disk exchange. The B 9484-51 subsystem is interfaced to the B 5900 system through a B 5304-90 Disk Pack DLP.

SEQUENTIAL HOST TRANSFER CONTROL: Doubles the data transfer rate between the central processor and B 9484-51 or B 9494 disk drives. With this feature, the data transfer rate is increased from 605,000 to 1,210,000 bytes per second on the B 9484-51 drives and from 650,000 bytes to 1,300,000 bytes per second on the B 9494 drives.

B 9470 HEAD-PER-TRACK FILES: These fixed-head disk files provide very fast access to relatively small volumes of data. The disk units use noninterchangeable disks and have a fixed read/write head serving each data track. The B 9470-2 Primary Storage Module and B 9470-12 Add-On Module record data in 180-byte sectors and have a capacity of 5.9 million bytes per module. The disk revolution time is 10 milliseconds, the average access time is 5 milliseconds, and the data transfer rate is 650,000 bytes per second.

The basic B 9470 subsystem includes one B 9470-2 Primary Storage Module, which contains a power supply and air system and one disk drive with 5.9 million bytes of storage. The B 9470-2 can accommodate one B 9470-12 Add-On Module with a storage capacity of 5.9 million bytes. Additional expansion of the subsystem can be achieved by adding additional B 9470-2 Primary Storage Modules and associated B 9470-12 Add-On Modules. One B 9471-6 Disk Electronics Unit is required for every four disk storage units; the DEU has the capability to detect the loss of up to 11 bits in a transfer of one 180-byte sector. The B 9470 subsystem is connected to the B 5930 central system via the B 5373-90 5N Disk DLP.

INPUT/OUTPUT UNITS

B 9495 PE MAGNETIC TAPE UNITS: These high-performance 9-track tape drives record data on 1/2-inch tape in IBM-compatible phase-encoded (PE) mode at 1600 bpi. The B 9495-82 has a tape speed of 75 ips and a data transfer rate of 120,000 bytes per second, while the B 9495-83 has a tape speed of 125 ips and a data transfer rate of 200,000 bytes per second. Both drives accept 10.5-inch reels holding 2400 feet of tape and can rewind a 2400-foot reel in a maximum of 92 seconds. The drives feature a single vacuum-driven capstan, a sealed tape-path chamber, a power access window, a positive reel latch, automatic tape threading and loading, and "on-the-fly" detection and correction of most errors. A unique "coaxial" hub mounts the feed reel directly in front of the take-up reel, reducing the overall width of the unit to just 24 inches. An optional PE/NRZ feature equips the drives to operate in either phase-encoded or NRZ mode.

The B 9495-82 and -83 tape units can be configured with the B 5930 in a subsystem consisting of up to 16 tape units, up to four B 5395-91 or B 5395-90 Magnetic Tape Data Link Processors, and an appropriate B 9499 Master Electronics Exchange (1x4, 1x8, 2x8, 2x16, 3x16, or 4x16).

B 9495 GCR/PE MAGNETIC TAPE UNITS: These drives employ 1/2-inch tape certified at 1600 bpi. Data is recorded

either in IBM-compatible group coded recording (GCR) mode at 6250 bpi or in phase-encoded (PE) mode at 1600 bpi. The B 9495-32 has a tape speed of 75 ips and a data transfer rate of 470,000 bytes per second in GCR mode or 120,000 bytes per second in PE mode. The B 9495-33 has a tape speed of 125 ips and a data transfer rate of 780,000 bytes per second in GCR mode or 200,000 bytes per second in PE mode. Rewind time is a maximum of 55 seconds.

A tape subsystem consisting of B9495-32 or -33 Tape Units can be configured with up to 4 simultaneous access paths to up to 16 tape drives employing the B 9499-2X controllers. Capabilities of these controllers are as follows: the B 9499-21, 1x8; the B 9499-22, 2x8; the B 9499-23, 3x8; and the B 9499-24, 4x8. The 9499-4X Electronics Exchange increases the capabilities of the B 9499-22, B 9499-23, and B 9499-24 to 2x16, 3x16 and 4x16, respectively. In addition to the B 9499-2X controller, the subsystem must include one B 5395-92 GCR/PE Magnetic Tape Data Link Processor for each B 5930 access path.

B 911X CARD READERS: These units read standard 80-column cards serially by column. There are three models, with the following rated speeds:

B 9115—300 cpm
B 9116—600 cpm
B 9117—800 cpm

Either EBCDIC or binary-coded cards can be read. The cards are read photoelectrically, with a double strobe comparison for each column to help ensure reading accuracy. A single input hopper and output stacker hold up to 1000 cards each. An optional feature permits the reading of 51-column cards. A B 5110-90 Card Reader DLP connects the reader to a B 5930 system.

LINE PRINTERS: Burroughs offers B 5930 users a choice of five printers that span a range of speeds from 650 to 2000 lines per minute. Their model numbers, rated speeds, printing techniques, and required B 5930 Data Link Processors are as follows:

B 9246-6: 650 lpm, band; B 5246-91 DLP
B 9247-14: 1100 lpm, train; B 5247-93 DLP
B 9246-12: 1250 lpm, band; B 5246-91 DLP
B 9247-15: 1500 lpm, train; B 5247-94 DLP
B 9246-20: 2000 lpm, train; B 5246-92 DLP

All of the printers have 132 print positions. The B 9247 Train Printers achieve their rated speeds with the standard 48-character train module; other interchangeable modules containing 16, 64, or 96 printable characters are also available, and the 96-character set contains both upper and lower case ASCII or EDCDIC alphabetics. The train printers handle vertical format control through either the Burroughs Forms-Self Align System, which uses codes preprinted on the forms, or a 12-channel VFU. The B 9247 Train Printers can employ 4- to 20-inch-wide paper and have a skipping speed of 20 ips. The B 9246-20 Train Printer has a skipping rate of 90 ips.

READER-SORTERS: The B 5390 Reader-Sorter Processor (RSP) subsystem includes a specialized Data Link Processor and a Reader-Sorter Processor that provides the system interface for connecting a B 9137-4 MICR Reader-Sorter or B 9190-2 MICR/OCR Reader-Sorter to a B 5900 system. The RSP contains 256K bytes of local memory and takes over all of the real-time processing functions involved in controlling the reader-sorter. The RSP is programmed with the same Sorter Control Language currently used for B 6000 Series reader-sorter subsystems. Functions performed by the RSP include scanning of document images to identify key fields; determination of document routing through table scans; control of document selection, endorsing, and microfilming; maintenance of pocket totals; etc. The central system receives a stream of processed check images from the RSP, and these are further processed by the Item Processing System (IPS) software. The RSP subsystem requires 8 DLP address positions (i.e., one full I/O Subsystem Base Module) in the B 5930 central system.

The B 9137-4 MICR Reader-Sorter has a rated speed of 1000 documents per minute. The basic unit includes E13B character recognition, four pockets, off-line sorting in two fields, a resettable item counter, and a host control interface.

The B 9190-2 is a MICR/OCR reader-sorter with a rated speed of 1625 documents per minute. The B 9190-2 is a four-pocket unit to which must be added at least one character recognition module and one internal interface module. Optional features include three types of endorsers, a microfilm camera module, an off-line sort package, special equipment for processing 51-column cards, and additional 4-pocket modules that can be combined for a maximum configuration of 32 pockets.

COMMUNICATIONS CONTROL

The B 5930 data communications control hardware consists of the Network Support Processor (NSP), the Line Support Processor (LSP), and Line Adapters. Every network includes one or more Line Support Processors to perform the low-level network control functions and a Line Adapter to provide the electrical interface for each line. For large networks, one or more Network Support Processors are added to provide a hierarchy of network control functions and relieve the central processor of communications housekeeping functions. Each B 5930 central processor can support a maximum of 64 communications lines if the NSP is used or 32 lines if not.

NETWORK SUPPORT PROCESSOR: The NSP is a programmable front-end processor that serves as the central element of large B 5930 communications subsystems. It contains 160K bytes of integrated-circuit memory, which is expandable to 256K bytes in 32K-byte increments. 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.

Each Network Support Processor can control up to 4 Line Support Processors and up to 64 communications lines. A single B 5930 CPU can be equipped with a maximum of 2 NSPs, but the maximum number of communications lines per CPU is 64. (A second NSP would nonetheless be useful for increased reliability and performance.) The basic 160K-byte NSP requires 5 DLP address positions in a B 5930 I/O Subsystem Base Module, and each additional 32K-byte NSP memory module requires 1.5 additional DLP positions. Each NSP can support up to four Message-Level Interface paths, and each path can physically connect the NSP to a different CPU. Only one of these physical paths can be logically active at a time, but a different path can be activated under MCP control whenever network reconfiguration is required.

LINE SUPPORT PROCESSOR: The LSP is a microprocessor-based unit that performs the low-level network control functions in a B 5930 communications subsystem. The Network Support Processor (when present) off-loads most of the detailed data link control functions onto the LSP by down-line loading the appropriate line discipline and parameters into the LSP memory. In networks that do not include an NSP, the central system takes on the function of

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loading and directing the LSP. The LSP then controls individual line protocol functions (such as input, output, and auto-polling), switched-line functions (such as auto-dialing, answering, and disconnecting), and code translation. Information is transferred between the LSP and the NSP (or central system) at the message level. Message lengths are dependent upon the types of terminals being serviced. Each Line Support Processor is capable of supporting up to 16 half-duplex or full-duplex communications lines connected via up to 4 Quad Line Adapters. Each line can be configured with either single-drop or multi-drop support. The maximum aggregate data rate for all lines attached to a single LSP is 50,000 bits per second.

For installations that require broadband transmission speeds, Burroughs offers a special Broadband LSP. This unit services only one line, connected via a broadband Line Adapter, and handles transmission rates ranging from 56,000 to 1,344,000 bits per second.

Up to 4 LSPs can be connected to each NSP, providing a capacity of up to 64 lines per NSP. In a B 5930 system that does not include an NSP, up to 2 LSPs can be connected directly to the central system for a total capacity of up to 32 lines. Each LSP can support up to four Message-Level Interface paths, and each path can physically connect the LSP to a different NSP or central system. Only one of these physical paths can be logically active at a time, but a different path can be activated under MCP control whenever network reconfiguration is required.

LINE ADAPTERS: A Line Adapter provides the electrical interface between the Line Support Processor and each communications 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 and station parameters, polling sequences, and the code required to control the communications 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. (Character-oriented transmission is used in most of the current communications protocol, while bit-oriented transmission is employed in newer protocols such as Burroughs Network Architecture.) 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. Autocall is available for any Line Adapter as a no-charge feature. Each LSP accommodates up to 4 Quad Line Adapters and up to 16 lines.

The special Broadband LSP supports a single Line Adapter with a CCITT V.24/Bell 306 or Bell 303 electrical interface and a maximum transmission rate of 1,344,000 bits per second.

The B 5930 data communications hardware, in conjunction with the NDL II programming language, supports a wide range of transmission characteristics such as the following:

- Character-oriented Line Adapters can operate in either asynchronous or synchronous mode.
- Bit-oriented Line Adapters can support BDLC and other bit-oriented protocols.
- Transmission rates in asynchronous mode can range from 45.5 to 19,200 bits per second.
- Character sizes can be 5, 6, 7, or 8 bits.
- Vertical parity checking can be even, odd, or omitted.
- Horizontal parity checking can be BCC (even/odd), CRC16, CCITT (even/odd), or a user-specified error polynomial.
- Code translation can be EBCDIC, ASCII, binary, or a translation table.

INTER-SYSTEM CONTROL (ISC): This facility is designed to establish a local network of large-scale Burroughs B 5900, B 6800, B 6900, B 7700, or B 7800 systems connected through an I/O channel link. ISC operates under the control of Burroughs Network Architecture (BNA). The BNA Host Service and Network Services provide for resource sharing among the I/O-coupled processors in the network. Files can be created and accessed on any system in the network, and jobs and files can be transferred from one system to another. And, if desired, application programs can be developed and tested on one system in the network and then distributed to the system that will execute them.

ISC hardware components consist of Host Controls and HUBs. The Host Control 2 (HC2) is a Data Link Processor that resides in a DLP slot in the host's I/O subsystem. Each HC2 provides bidirectional data flow; therefore, only one HC2 is required to read and write to a single host. The HUB, which is housed in a free-standing cabinet, provides interaction between the Host Controls and must be used when connecting two or more host processors. HUB4 permits the interconnection of up to 4 Host Controls, while HUB16 permits interconnection of up to 16 Host Controls. However, to add more than two Host Controls, a HUB Expansion Adapter is required for each additional Host Control.

SOFTWARE

The System Software Facility, required on every B 5900 system, consists of the Master Control Program (MCP) operating system, utilities, Network Definition Language II (NDL II), Generalized Message Control System (GEMCOS), and one compiler.

MASTER CONTROL PROGRAM: The MCP is an integrated operating system that oversees and controls all operations of the B 5900 Series systems. It 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 routines. The second-level routines handle the MCP's major task: 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 also allows processing to continue while faulty hardware is being diagnosed or new system software is tested and debugged.

Jobs are submitted to the MCP through the console keyboard and/or the systems input unit, 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

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program scheduling priority ordinarily is specified by the programmer, although a default option automatically assigns a priority of one-half the maximum allowable priority.

The MCP maintains a queue of jobs available for initiation. A scheduling routine evaluates the equipment 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 MCP 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 assigned to 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 re-entrant 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. A Data Descriptor is used to fetch data to the stack or to store data in a storage area outside the stack. Both the absolute address and the length of the data array are specified in the Data Descriptor, along with a Presence Bit which indicates whether the referenced data is located in main memory or in disk storage. 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. Segment Descriptors contain the address of the segment in main memory or secondary disk storage, the length of the program segment, and a Presence Bit to indicate whether the program segment is located in main memory or disk storage.

True dynamic memory allocation is a feature of the MCP. The compilers automatically divide all object programs into logical, relocatable segments. Moreover, all object programs use re-entrant coding, so that coding is never modified during execution and 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 MCP automatically overlays these new segments over other program or data segments that have not been accessed recently. If the old segment contains modifiable data, it is written on a disk file prior to being overlaid; if it is a program segment or a read-only segment, this "roll-out" operation is unnecessary. The MCP attempts to concentrate program segments in one area of memory and data segments in another to avoid excessive "checkerboarding" of memory.

Main memory is allocated to programs in working sets, which represent the amount of memory each program most often requires during execution to process efficiently. The optimum working set size is calculated first by the compiler, and afterward it is recalculated by the MCP each time the program is executed. Time-sharing operations are assigned a contiguous block of memory, with allocation of memory to time-sharing programs controlled by a Swapper. Memory within the time-sharing area is divided into fixed-size partitions that can be shared among time-sharing users. The Swapper can be invoked from the operator console.

Communication between the system operator and the MCP is accomplished through a combination of CRT display units, keyboards, control cards, 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 cards 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: compile and execute, compile for the library, or compile for the syntax. Optional control cards for all jobs contain an execute statement, process time statement, priority statement, core requirement statement, I/O time statement, and I/O statements which associate file labels with specific input/output devices.

Work Flow Management is an MCP facility that provides enhanced facilities for control of task initiation and resource allocation. The Work Flow Language (WFL), an extension of the previous MCP job control statements, 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 cards, 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.

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 MCP.

The MCP provides comprehensive input/output and file control facilities. It automatically assigns peripheral devices to symbolic files whenever possible to minimize operator intervention. Three tables are maintained by the operating system containing label equations 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,

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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.

The MCP also controls user access to the system. Each user provides a "usercode" and, optionally, a password. Each job deck may have a usercode associated with it, and its enforceability may be optional. The user must also supply the password whenever there is one. Passwords may be changed at any time to prevent unauthorized access. File security controls can be applied to both data files and program files. The owner of a file can designate the file to be read-only, write-only, read/write-allowed, or secured. The owner can also make the file private, accessible by all users, or accessible by specified users only. The owner of a file can alter its security classification at any time.

Up to four B 5900 Series processors can be interconnected via a Global memory subsystem. Under MCP control, a multiprocessor B 5900 system can operate in any of three different modes: Multiprocessor Mode (tightly coupled), Shared Resources Mode (loosely coupled), or Independent Systems Mode (uncoupled). These three operational modes are described under the "Configuration Rules" heading.

COBOL: The B 5900 Cobol 74 compiler is based on the ANSI 74 language and includes all the facilities of full American National Standard Cobol, including the Sort, Report Writer, and Segmentation modules. Source-language program debugging facilities, data communications constructs, and a number of other useful extensions are also included. The EBCDIC, BCL, and ASCII character sets are now supported. The compiler accepts a Cobol source program and generates a machine-code object program which is placed in disk storage, ready for execution; it can also be written on magnetic tape if desired. The compiler automatically divides all object programs into logical, relocatable segments, and all coding generated by the compiler is re-entrant.

Also available for the B 5900 Series computers is a Cobol 68 compiler, which is compatible with the older American National Standard Cobol 68 language.

FORTRAN: The B 5900 Fortran IV language is generally compatible with IBM's Fortran IV, Level H and includes American National Standard Fortran as a fully compatible subset. Programs written in most other versions of the Fortran language are acceptable to the B 5900 compiler with certain exceptions. The compiler generates re-entrant object code and automatically divides all object programs into logical, relocatable segments. Subprograms coded in Fortran can be intermixed (or "bound") with other subprograms coded in Algol or Cobol. Extensive compile-time diagnostic and debugging facilities are provided.

ALGOL: The B 5900 Algol language is based upon the "Revised Report on the Algorithmic Language Algol 60" (*Communications of the ACM,* January 1963), with extensions to handle I/O operations, character manipulation, partial-word operands, and diagnostic facilities. DC Algol is a specialized version of Algol oriented toward the writing of message control systems for communications networks; it features additional constructs for handling queues.

APL: Burroughs APL/700 is a compatible superset of the IBM System/370 APL language and includes additional primitive functions, extended editing, and a report formatter. Automatic recovery from system and communications line malfunctions is provided by swapping user information to disk on every input/output transaction and at 200-millisecond intervals during processing. APL/700 includes a filing system that permits files to be shared among multiple APL programs. All output to APL terminals is automatically formatted, although the capability also is provided for specifying special formats. APL/700 utilizes the vector mode hardware in B 5900 systems for efficient processing of large data arrays, and can run concurrently with other modes of processing on B 5900 systems.

BASIC: B 5900 Basic is a non-interactive, industry-standard implementation of the Basic language that is generally compatible with the offerings of the GE Mark II time-sharing service.

PL/1: The B 5900 PL/1 language is an implementation of the American National Standard PL/1 language. There are some differences from IBM's PL/1 in various machine-dependent constructs, but Burroughs claims that little difficulty has been encountered in field conversions from IBM to B 5900 PL/1. ISAM files are supported in PL/1.

RPG: B 5900 RPG is a full implementation of the RPG II language, with extensions for data communications and DMS II data base management. The RPG compiler can be used on all B 6000 and B 7000 Series computers as well as on the B 5900, and provides source-code compatibility with the IBM RPG II language and with B 1700/1800/1900 Series RPG.

REPORTER II: This is a report writer designed to simplify the retrieval, analysis, and reporting of information maintained in computer files. REPORTER II 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 (RP2) version, REPORTER II is available in an Advanced version, an Audit version, and an On-Line version. REPORTER II (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 II 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.

COMMUNICATIONS SOFTWARE: Burroughs offers a variety of communications control software facilities for the B 5900 Series computers, including NDL II for network control, GEMCOS for transaction processing, CANDE for time-sharing and on-line program development, and RJE and Burroughs Network Architecture for distributed data processing. These facilities are individually described in the following paragraphs.

NETWORK DEFINITION LANGUAGE II (NDL II): Introduced along with the B 5900 Series computers, NDL II is a high-level language designed to simplify the programming of network control functions for networks based on Burroughs' Network Support Processors and/or Line Support Processors. NDL II is a descriptive, parameter-driven language that carries forward and enhances the

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concepts of the earlier NDL language. Programs written in NDL II are compiled and loaded into the Network Support Processor (NSP) to perform communications subsystem control, data link control, and line discipline control functions. Line Support Processors in LSP-only environments (i.e., those that do not include an NSP) are programmed by means of a specialized version of NDL II.

An NDL II source program is made up of two modules: a Protocol Module, which contains Editors and Algorithms, and a Configuration Module, which specifies the attributes and interrelationships of the lines, stations, and terminals in the network. Editors are user-written NDL II routines that use string manipulation capabilities to edit the text portions of input and output messages, while Algorithms are user-written NDL II routines that implement line protocols, control message handling, detect and recover from communications errors, and interface with the host system. The Algorithms have two distinct components: Line Control, which runs in the NSP and handles high-level line protocol and error recovery functions; and Adapter Control, which runs in the LSP and performs transmitting and receiving functions such as code translation and parity generation/checking.

GENERALIZED MESSAGE CONTROL SYSTEM (GEMCOS): This software system 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 applications programs. All transaction terminals in the network are controlled by the GEMCOS-created MCS and interfaced to the applications programs and the data base. Thus, GEMCOS enables users to develop transaction processing application 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, recovery, etc.

The Format Generator (MCF) is an optional extension that provides GEMCOS users with an on-line message format generator. The user enters a "picture" of a formatted message on the display screen, and this is automatically converted into a Transaction Control Language format description for the GEMCOS MCS.

COMMAND AND EDIT LANGUAGE (CANDE): This time-sharing Message Control System 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 applications programs. It also provides effective control of the access, security, and charging functions in a computer time-sharing network.

REMOTE JOB ENTRY (RJE): This Message Control System 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): A set of software 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 is designed to work 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 processors 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 currently available software such as NDL II and GEMCOS.

BNA also supports the Inter-System Control (ISC) subsystem, which is used to physically establish a local processor-to-processor network of large-scale Burroughs computer systems. ISC permits users on one system in a local network to access and share the resources of other systems through the BNA Host Services and Network Services.

DATA MANAGEMENT SYSTEM II (DMS II): This comprehensive data base management system, introduced in 1974, is integrated with the MCP operating system and uses MCP facilities for accessing records in the data base to achieve greater run-time efficiency. Through the MCP 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 is 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. A random access method is planned for future release.

Data can be structured in links, hierarchical structures, network structures, or ring structures. Two members in a set can be related to each other using one of five link relationships: the unprotected link, verified link, self-correcting link, symbolic link, or counted link. The unprotected link maintains a relative disk address as the pointer to the related member. The verified link also contains symbolic information to permit the relationship between two member records to be verified at each access, while the self-correcting link will also attempt to correct volatile relationships. The symbolic link, used for very volatile information, utilizes a symbolic key to point to an index of the related information. The counted link relationship ensures that no member record will be deleted until no other member records contain pointers to it.

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.

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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.

A more detailed description of DMS II can be found in Report 70E-112-01.

The power, flexibility, and ease of use of DMS II can be enhanced by means of several optional extensions, as described in the following paragraphs.

DMS INQUIRY: This optional extension of DMS II 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 existing information in the data base and, with Release 3.2 of DMS II, 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.

TRANSACTION PROCESSING SYSTEM (TPS): This optional extension of DMS II facilitates the implementation of remote data base systems by providing the capability to move transactions throughout the network efficiently. TPS consolidates all data base access/update code into a centralized update library consisting of user-written Transaction Processing Routines (TPRs). Each TPR is a relatively small unit of processing that contains at most a single data base transaction. All input to a TPR is encoded in a single transaction record, as is all output from a TPR, and no transaction may directly use the results of a previous transaction. User application programs that use the TPRs are completely independent of the TPRs. Thus, either the application programs or the TPRs can be altered at any time with no effect on the other programs. All data base updates must be handled by the Transaction Processing System; no other updates are allowed, although DMS Inquiry programs may run in parallel with TPS. The use of TPS provides a high degree of control and security over data base accessing and updating, simplifies the process of data base recovery, eliminates the need for application programmers to have detailed knowledge of the DMS II data base and access commands, and permits use of the Shared Resources (loosely coupled) mode of multiprocessor system operation.

DATA DICTIONARY: This DMS II extension simplifies the design and maintenance of the data base and the TPS transaction base by maintaining comprehensive, up-to-date documentation of the data base environment. The Data Dictionary maintains its own DMS II data base containing information that describes the data base structure, the application programs accessing the data base, and the usage of TPS transaction bases. The data structure is defined in terms of physical and logical data bases, data sets, subsets, remaps, and data items. A utility permits the entry of descriptive text information to aid in describing the data base environment. A set of report programs extracts information from the dictionary and produces formatted reports on a printer or display screen. Whenever there is a need to revise a DMS II data base or TPS transaction base, the Data Dictionary can provide the user with a list of all the application programs that will be affected by the change.

DBANALYZER: This DMS II extension provides 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. This information can aid the user in determining the efficiency of the current implementation, changing the structure for increased efficiency, and deciding when reorganization is needed.

DBMONITOR: This DMS II extension provides real-time monitoring and control of the status of a DMS II data base. DBMONITOR provides dynamic monitoring of current data base performance statistics such as memory usage, audit trail attributes, syncpoint/controlpoint 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. Dynamic revisions can be made in parameters such as the amount of allowed memory, the number of buffers for a structure, or syncpoint/controlpoint frequencies. In addition, reblocking can be enabled or disabled, data base statistics can be listed or cleared, and the audit trail can be switched to an alternate audit trail and medium. No special coding is required to use DBMONITOR.

SYSTEM MANAGEMENT FACILITY II (SMF II): Announced in April 1981, SMF II provides information on system resource usage, hardware performance, and system availability. Two modules are available: SMF II System Resource Management and SMF II Site Management. The SMF II System Resource Management module extracts pertinent data from the system logs, combines this data with sampling data obtained from the MCP, and measures the usage of system resources. The SMF II Site Management module logs the incidence and nature of system-detected faults in processors and peripheral devices during normal system operation. The SMF II Query Program provides customized reports in either batch or interactive mode. The SMF II System Resource Management module and Site Management module can be used independently in a standalone environment, or they can be integrated to provide a comprehensive performance management system.

UTILITY ROUTINES: The Master Control Program includes a variety of utility routines that perform functions such as data transcription, library maintenance, and system log analysis. The MCP Load Control Facility permits data and control cards to be "spooled" to disk for subsequent access by system pseudo card readers. Printer and punch output can be routed to disk or tape files under MCP, program, or operator direction for output upon command by the operator or automatically when a suitable device is available. Library Maintenance routines include Copy and Move statements that permit files to be transferred between library tapes and disk storage.

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. Each error is identified by the date and time it occurred, the associated hardware device, the location of the record, the I/O control word, etc.

Conversion Aids which are available to facilitate conversions from competitive systems to the B 5900 Series computers include translators for the following languages: IBM DOS or OS BAL, Cobol, or RPG to Burroughs Cobol; Honeywell 200/600/2000/6000 Easycoder, Cobol, or RPG to Burroughs Cobol; and Univac Series 70 and 9000 BAL, Cobol, or RPG to Burroughs Cobol. Data File Conversion utilities for sequential data files are also available for the

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above computers and languages. Another Conversion Aid program translates Burroughs Cobol 68 to Burroughs Cobol 74.

The Test Data Generator (TDG) is a utility program that generates customized test data generating programs which, in turn, produce files of data for program testing. The test data files are built in accordance with specifications written in Test Data Definition Language (TDDL) syntax. Physical file attributes are described in syntax similar to that of the Work Flow Language (WFL), while file-layout attributes (record descriptions) are coded in standard compiler syntax and can be "included" directly from compiler-produced symbolic files. Records may be fixed and/or variable in length, and a wide variety of techniques is available for assigning values to data fields. TDG operation consists of four steps: TDDL interpretation, generation of a symbolic program, compilation of the program, and execution of the program to produce the required test data. The test data can be listed as it is generated.

APPLICATION PROGRAMS: Among the programs currently available from Burroughs are:

APT III (numerical control)

BASIS (Burroughs Advanced Statistical Inquiry System)

BGIS (Burroughs Government Information Systems)

BHIS (Burroughs Hospital Information System)

BIPASS (Burroughs Inventory Planning, Analysis, and Simulation System)

BIS (Banking Information System)

BPS (Business Planning System)

CAI (Computer-Aided Instruction)

DIS (Distribution Information System)

GBMS (General Business Management System)

HMS (Hospital Management System)

Infostats (forecasting and statistical analysis)

The Manufacturing System (TMS)

TMS (Text Management and Electronic Mail System)

PRICING

EQUIPMENT: The following configurations illustrate a small B 5930 system, a larger single-processor system, and a dual-processor system configured to run in the Multiprocessor (tightly coupled) mode with disk and tape subsystems accessible by both processors. The quoted prices include all necessary hardware components, but no software.

SMALL B 5930 SYSTEM: Includes one B 5930 Basic System (i.e., Central Processor, Power Subsystem, Maintenance Processor, two I/O Base Modules, two 786KB Memory Modules, Operator Console, five Data Link Processors, one Line Support Processor, and one Quad Line Adapter) plus one 804-megabyte B 9494-42 Disk Subsystem with 2x8 controller, two 780KBS B 9495-33 Magnetic Tape Units with 1x8 controller, one 800-cpm B 9117 Card Reader with DLP, and one 1500-lpm B 9247-15 Line Printer. Monthly rental is $16,040 on a 1-year lease, including 24-hour, 7-day maintenance service. Purchase price is $464,847.

LARGER B 5930 SYSTEM: Includes one B 5930 Basic System (as above) plus the following additional components: four 786KB Memory Modules (for total system capacity of 4.6 megabytes), one Memory Expansion Adapter, one Base Module Expansion Kit, two I/O Subsystem Base Modules, one I/O Subsystem Expansion Cabinet, five Data Link Processors, one 1600-megabyte B 9494-44 Disk Subsystem with 4x16 controller, six 780KBS B 9495-33 Magnetic Tape Units with 2x8 controller, one 800-cpm B 9117 Card Reader, one 2000-lpm B 9246-20 Line Printer, one 650-lpm B 9246-6 Band Printer, two Network Support Processors, one Line Support Processor, and three Quad Line Adapters (for total capacity of 16 communications lines). Monthly rental is $33,922 on a 1-year lease, including 24-hour, 7-day maintenance service. Purchase price is $1,017,340.

DUAL-PROCESSOR B 5930 SYSTEM: Includes two B 5930 Basic Systems (as above) plus the following additional components: four 786KB Memory Modules (for total system capacity of 6.2 megabytes—3.1 megabytes in each processor), three 786KB Global Memory Modules (for total capacity of 2.3 megabytes) with control, one 1600-megabyte B 9494-44 Disk Subsystem with 4x16 controller, four 780KBS B 9495-33 Magnetic Tape Units with 2x8 controller, two 2000-lpm B 9246-20 Line Printers, two Network Support Processors, and three Quad Line Adapters (for total capacity of 20 communications lines). Monthly rental is $44,363 on a 1-year lease, including 24-hour, 7-day maintenance service. Purchase price is $1,326,925.

CONTRACT TERMS: The B 5900 Series systems are available for purchase or for 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/day, 7 days/week). The standard maintenance agreement for purchased systems covers maintenance of the equipment for nine consecutive hours per day on Monday through Friday only; extended maintenance coverage is available at higher rates. The central system (CPU, memory, channels, etc.) is warranted for one year; the peripheral equipment, for 90 days.

All maintenance charges listed in this report are for "metro 1" (city) districts. Super city rates (e.g., New York or Chicago) are four percent higher. Rates outside a metro area (10 miles from city) are 20 percent higher.

All lease plans may include purchase options which 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.

SOFTWARE: All of the B 5900 Series software is unbundled. The Basic System Software Facility, consisting of the MCP, NDL II, GEMCOS, and one compiler of the user's choice, is available on either a Limited-Term Plan, for a monthly license fee of $1,335, or an Unlimited-Time Plan, for a one-time payment of $40,000 plus an annual fee of $7,600. All of the other B 5900 Series system software components and application programs are individually priced and available under the same two plans.

TECHNICAL SUPPORT: Users can purchase Burroughs technical support in several ways: under a Systems Analyst Assistance Agreement, on a per-diem basis, or on an hourly charge basis.

EDUCATION: Users can obtain the necessary training by paying for individual courses. The currently available courses range from 2 to 10 days in length, cost $330 to $1,940 per day for each attendee, 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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EQUIPMENT PRICES

		Purchase Price	Monthly Maint.*	1-Year Lease**	3-Year Lease**	5-Year Lease**
PROCESSOR AND MAIN MEMORY						
B 5930	Basic System; includes one Central Processor, one Power Subsystem, one Maintenance Processor, two I/O Base Modules, two 786KB Memory Modules (1.5 megabytes total), one Operator Console with dual displays and dual Mini-Mini-Disks, one Operator Console DLP, one Line Printer DLP, one Magnetic Tape DLP, two Disk Pack DLPs, one Sub-Broadband Line Support Processor, one Quad Line Adapter, and four Electrical Interfaces	$210,000	$600.00	$7,219	$6,563	$6,237
B 5007	786KB IC Memory Module	21,000	55.00	657	599	567
B 5007-1	Memory Expansion Adapter	10,500	27.50	331	300	284
B 5009-14	Global Memory Control with 786KB	131,251	165.00	4,122	3,749	3,560
B 5009-15	786KB IC Global Memory Module	31,501	55.00	993	903	861
B 5905-90	I/O Subsystem Base Module	6,563	27.50	211	190	179
B 5095-90	I/O Subsystem Expansion Cabinet	28,351	27.50	890	809	767
B 5005-90	Base Module Expansion Kit	3,151	11.00	100	90	84
B 9361-23	Additional Operator Console Display	3,098	26.40	126	121	116
B 5930-2	I/O Base Module Exchange; 2 processors; includes one path selection module and one distribution module	3,676	5.50	116	105	100
B 5930-3	I/O Base Module Exchange; 3 processors; includes one path selection module and two distribution modules	4,725	11.00	153	137	132
B 5930-4	I/O Base Module Exchange; 4 processors; includes one path selection module and three distribution modules	5,775	16.50	184	169	158
B 5095-92	Distribution Module	1,576	5.50	53	48	43
DATA LINK PROCESSORS						
B 5341-90	Operator Console DLP (supports two ODTs)	6,117	44.00	190	174	163
B 5110-90	Card Reader DLP (B 9115/16/17)	3,739	16.50	118	108	102
B 5395-91	PE Magnetic Tape DLP (B 9495-82/-83)	7,350	33.00	232	211	200
B 5395-90	NRZ Magnetic Tape DLP (NRZ/PE switchable)	7,350	33.00	232	211	200
B 5395-92	GCR/PE Magnetic Tape DLP (B 9495-32/-33)	7,350	33.00	232	211	200
B 5373-90	5N Disk DLP (B 9470)	11,309	49.50	358	326	305
B 5304-90	Disk Pack DLP (B 9484/9494)	7,560	27.50	239	217	206
B 5247-93	Line Printer DLP (B 9247-14)	4,620	22.00	146	133	126
B 5247-94	Line Printer DLP (B9247-15)	4,620	22.00	146	133	126
B 5246-92	Line Printer DLP (B 9246-20)	4,620	22.00	146	133	126
B 5246-91	Line Printer DLP (B 9246-6/-12)	4,620	22.00	146	133	126
B 5390	Reader Sorter Processor Subsystem; includes DLP (B 9137-4/B 9190-2)	27,301	100.00	816	783	735
MASS STORAGE						
B 9470-2	Primary Drive; 5.9 megabytes	42,840	112.00	1,390	1,245	1,125
B 9470-12	Add-On Drive; 5.9 megabytes; requires one B 9470-2 Module	36.540	109.00	1,181	1,060	960
B 9471-6	Disk File Electronics Unit (DFEU) for B 9470-2 drive (one required for every four drives)	12,601	67.90	389	348	316
B 9484-51	Dual Disk Pack Drive; 130.4 megabytes	21,000	122.00	776	711	632
B 9494-41	Dual Fixed-Disk Drive; 402 megabytes	25,200	94.50	770	710	583
B 9494-42	Dual Fixed-Disk Data Bank; includes two dual-spindle B 9494-41 drives; 804 megabytes	42,000	187.00	1,443	1,323	1,075
B 9494-43	Dual Fixed-Disk Data Bank; includes three dual-spindle B 9494-41 drives; 1206 megabytes	59,850	259.00	2,031	1,839	1,679
B 9494-44	Dual Fixed-Disk Data Bank; includes four dual-spindle B 9494-41 drives; 1608 megabytes	78,750	334.00	2,514	2,250	2,050
B 9987-1	Dual Port Feature for B 9494-41 drive	5,880	21.50	179	166	147
B 9387-43	Controller for B 9484-51 or B 9494 drives; 1 x 8; includes disk exchange	42,000	72.90	1,236	1,163	1,046
B 9387-44	Controller; 2 x 8; includes disk exchange	57,488	221.00	1,712	1,600	1,459
B 9387-45	Controller; 2 x 16; includes disk exchange	68,408	228.00	2,108	1,873	1,766
B 9387-47	Controller; 4 x 16; includes disk exchange	138,916	424.00	4,481	4,073	3,532
B 9387-48	Controller; 6 x 16; includes disk exchange	220,973	636.00	7,010	6,340	5,760
INPUT/OUTPUT UNITS						
Magnetic Tape Units:						
B 9495-32	GCR/PE Tape Unit; 75 ips; 470/120 KBS	21,736	146.00	788	689	621
B 9495-33	GCR/PE Tape Unit; 125 ips; 780/200 KBS	24,917	154.00	882	784	704
B 9495-82	PE Tape Unit; 75 ips; 120 KBS	17,557	125.00	641	546	497
B 9495-83	PE Tape Unit; 125 ips; 200 KBS	21,447	143.00	814	699	630
B 9999-4	PE/NRZ Feature (for B 9495-82 or -83)	788	6.10	27	23	22

* For 5-day/9-hour service.
**Includes 7-day/24-hour maintenance coverage.
NC: No charge.

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EQUIPMENT PRICES

		Purchase Price	Monthly Maint.*	1-Year Lease**	3-Year Lease**	5-Year Lease**
INPUT/OUTPUT UNITS (Continued)						
GCR/PE Controllers for B9495-32 & -33 Tape Units):						
B 9499-21	1 x 8 GCR/PE Controller	42,634	215.00	1,313	1,160	1,049
B 9499-22	2 x 8 GCR/PE Controller	85,288	428.00	2,636	2,317	2,093
B 9499-23	3 x 8 GCR/PE Controller	127,899	644.00	3,941	3,475	3,143
B 9499-24	4 x 8 GCR/PE Controller	170,553	859.00	5,247	4,633	4,191
B 9499-42	2 x 16 Electronics Exchange for B 9499-22	7,571	21.50	250	222	194
B 9499-43	3 x 16 Electronics Exchange for B 9499-23	9,680	28.70	325	300	267
B 9499-44	4 x 16 Electronics Exchange for B 9499-24	11,356	28.70	381	333	302
Master Electronics Exchanges (for B 9495-82 & -83 Tape Units):						
B 9499-10	1 x 4 Exchange	18,192	46.20	663	561	506
B 9499-11	1 x 8 Exchange	20,066	46.20	700	594	535
B 9499-12	2 x 8 Exchange	48,802	97.30	1,899	1,497	1,101
B 9499-13	2 x 16 Exchange	51,371	97.30	1,998	1,600	1,274
B 9499-14	4 x 16 Exchange	104,948	145.00	3,879	3,246	2,645
B 9499-19	3 x 16 Exchange	79,349	140.00	3,027	2,480	2,009
B 9998	Optional Power Supply for B 9499-12/13/14/19	3,191	17.40	76	65	59
80-Column Card Readers & Punches:						
B 9115	300-cpm Card Reader	8,608	61.60	316	284	242
B 9116	600-cpm Card Reader	11,372	86.40	421	379	322
B 9117	800-cpm Card Reader	12,952	106.00	475	428	364
B 9915	51-Column Read Feature for B 9115/16/17	844	—	24	22	19
Line Printers:						
B 9246-6	650-lpm Band Printer	14,700	182.00	551	475	423
B 9247-14	1100-lpm Train Printer	34,650	454.00	1,470	1,334	1,171
B 9246-12	1250-lpm Band Printer	42,500	420.00	1,635	1,470	1,360
B 9247-15	1500-lpm Train Printer	46,200	520.00	1,996	1,826	1,605
B 9246-20	2000-lpm Train Printer	69,300	600.00	2,636	2,374	2,027
B 9942-10	Additional Train Module for B 9247-14 or -15	3,408	40.00	131	119	107
Reader-Sorters:						
B 9137-4	MICR Reader-Sorter; 1000 dpm, 4 pockets; includes Multirack E13B, basic off-line sort, resettable item counter, and control interface	53,336	628.00	1,747	1,630	1,480
B 9937-11	Four-Pocket Module; pockets 5 to 16	12,590	54.60	442	435	394
B 9937-50	Impact Endorser	8,781	112.00	258	233	209
B 9937-70	Basic Two-Field Off-Line Sort	1,298	10.70	36	36	32
B 9937-71	Eight-Pocket Basic Off-Line Sort; two fields only	1,558	10.70	44	43	38
B 9937-72	Expanded Off-Line Field Sort; provides one additional; maximum of eight fields	260	2.40	8	8	8
B 9937-73	Extended Sort Control	2,596	31.10	71	70	64
B 9937-74	Valid Character Check	260	2.20	8	8	8
B 9937-76	Zero Kill; three maximum	519	2.20	15	14	11
B 9937-77	No Field, No Digit; three maximum	519	2.20	15	15	13
B 9937-78	Digit Override; three maximum	519	2.20	15	15	13
B 9937-79	Digit Edit; three maximum	519	2.20	15	15	13
B 9937-80	Field Override; three maximum	519	2.20	15	15	13
B 9937-81	Field Edit; three maximum	519	2.20	15	15	13
B 9937-82	Stacker Overflow	519	2.20	15	15	13
B 9937-83	Batch Ticket Detector	519	2.20	15	15	13
B 9937-84	Resettable Item Counter	260	2.20	8	8	8
B 9937-85	Non-Resettable Item Counter	260	2.20	8	8	8
B 9937-86	Running Time Meter	260	2.20	8	8	8
B 9937-87	Mobile Carrier	163	—	—	—	—
B 9937-88	One-Tray Document Rack	66	—	—	—	—
B 9937-90	Control Interface; 3A Host Control	1,733	2.60	53	49	44
B 9937-91	Control Interface; 4A Host Control	1,733	2.60	53	49	44
B 9190-2	MICR/OCR Reader-Sorter; 1625 dpm, 4 pockets	42,525	619.00	2,299	2,113	1,951
B 9990-90	Control Interface; 4A Host Control	1,733	3,90	53	48	43
B 9990-91	Control Interface; 3A Host Control	1,733	3.70	53	48	43
B 9990-21	MICR E13B Character Recognition Module; single track	15,430	56.80	505	463	431
B 9990-22	MICR E13B Character Recognition Module; double read	40,478	113.00	1,345	1,234	1,145
B 9990-32	OCR 7B (Credit Card)	52,815	152.00	1,723	1,586	1,460
B 9990-33	OCR A/1428	52,815	152.00	1,723	1,586	1,460
B 9990-34	OCR B/1403/407	52,815	152.00	1,723	1,586	1,460
B 9990-10	Four-Pocket Module; pockets 17-20	23,521	91.40	746	688	636
B 9990-11	Four-Pocket Module; pockets 5-16	15,175	57.20	485	447	411

* For 5-day/9-hour service.
**Includes 7-day/24-hour maintenance coverage.
NC: No charge.

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EQUIPMENT PRICES

		Purchase Price	Monthly Maint.*	1-Year Lease**	3-Year Lease**	5-Year Lease**
INPUT/OUTPUT UNITS (Continued)						
B 9990-12	Four-Pocket Module; pockets 21-32	15,175	57.20	485	447	411
B 9990-50	Impact Endorser; with digital advance	15,730	75.70	541	499	463
B 9990-53	Non-Impact Endorser, Ink Jet	34,545	205.00	1,108	1,019	940
B 9990-55	Impact Endorser; without digital advance	15,121	71.90	520	484	442
B 9990-60	Microfilm Camera	85,470	568.00	3,214	2,956	2,731
B 9990-70	Off-Line Sort Package	5,198	37.80	142	132	121
B 9990-25	Short Document Feature (51-col. cards)	1,208	1.20	32	27	27
B 9990-26	Short Document Pocket Feature (one required per pocket module)	525	1.20	16	11	11
DATA COMMUNICATIONS						
B 5369	Network Support Processor with 160KB	35,700	110.00	1,124	1,019	966
B 5369-1	32KB Memory Module	4,358	27.50	132	121	116
B 5369-2	Sub-Broadband Line Support Processor	7,875	27.50	247	226	216
B 5369-3	Quad Line Adapter (Character)	5,350	27.50	170	154	146
B 5369-4	Quad Line Adapter (Bit)	5,350	27.50	170	154	146
B 5369-5	Broadband Bit Line Support Processor	15,751	55.00	499	452	431
B 5359-10	RS-232 Electrical Interface (character)	NC	—	—	—	—
B 5359-20	RS-232 Electrical Interface (Bit)	NC	—	—	—	—
B 5359-11	CCITT V.24 Electrical Interface (Character)	NC	—	—	—	—
B 5359-21	CCITT V.24 Electrical Interface (Bit)	NC	—	—	—	—
B 5359-12	TDI/20 Electrical Interface (Character)	NC	—	—	—	—
B 5359-22	TDI/20 Electrical Interface (Bit)	NC	—	—	—	—
B 5359-40	Autocall Feature (Character)	NC	—	—	—	—
B 5359-41	Autocall Feature (Bit)	NC	—	—	—	—
B 5359-30	Bell 303 Electrical Interface (Character)	NC	—	—	—	—
B 5359-31	Bell 303 Electrical Interface (Bit)	NC	—	—	—	—
B 5095-93	Logic Expansion Module (required on any NSP that supports exchanged LSPs)	3,676	18.20	137	121	111
Inter-System Control Subsystem:						
B 5320-2	Host Control 2 (HC2)	11,866	62.90	410	373	337
B 9320-4	HUB4; can connect up to 4 HC2s	8,085	42.40	279	253	226
B 9320-5	HUB16; can connect up to 16 HC2s	8,610	46.00	305	274	247
B 9320-6	HUB Expansion; one each required for third and subsequent HC2s	735	4.80	32	27	25
B 9320-9	Independently Powered Auxiliary Cabinet; used to house HUB4 or HUB16	21,210	109.00	730	662	594

* For 5-day/9-hour service.
**Includes 7-day/24-hour maintenance coverage.
NC: No charge.

SOFTWARE PRICES

		Unlimited-Time Plan One-Time License Fee	Unlimited-Time Plan Annual Maint. Fee	Limited-Term Monthly License Fee
SSF	Basic System Software Facility; includes B 5000 Master Control Program (MCP) and utilities, Network Definition Language (NDL II), Generalized Message Control System (GEMCOS), and one compiler	$40,000	$7,600	$1,335
COB	Cobol 68 Compiler	3,300	627	110
C74	Cobol 74 Compiler	3,300	627	110
BSC	Basic Language Compiler	3,300	627	110
PL1	PL/1 Compiler	3,300	627	110
FOR	Fortran Compiler	3,300	627	110
APL	APL/700 Compiler	3,300	627	110
RPG	RPG Compiler	3,300	627	110
DM2	DMS II	25,575	4,860	855
D12	DMS II Inquiry	4,950	941	165
DIC	DMS II Data Dictionary	5,940	1,133	198
RJE	Remote Job Entry	1,980	380	65
CDE	Command and Edit Language (CANDE)	3,300	627	110
BAR	BARS (Burroughs Activity Reporting System)	2,475	473	83
LOG	System/Logger	1,650	314	55
DIA	Diagnostics MCS	1,650	314	55
MCT	GEMCOS (Total)	24,824	4,717	887
MCA	GEMCOS (Advanced)	20,689	3,931	739
DBA	DMS II DBANALYZER	4,400	836	145
DBM	DMS II DBMONITOR	4,400	836	145 ■