Burroughs B 5900

MANAGEMENT SUMMARY

The B 5900 systems are versatile midrange computer systems that feature full hardware and software compatibility with the larger B 6900 systems. The original B 5900 model, the B 5930, was introduced in September 1980. In September 1982, Burroughs replaced the B 5930 with two new models, the B 5920 and B 5935. The B 5920 is a compact system that offers a 69 percent reduction in floor space requirements over the B 5930 and B 5935, according to Burroughs. The B 5935 looks just like the B 5930. Both the B 5920 and B 5935 provide twice the entry level memory capacity of the B 5930 and include one Network Support Processor as standard equipment.

The B 5920 is the primary B 5900 model. It offers the same memory capacity and performance as the B 5935, in a smaller cabinet at a lower cost. However, installations that require the maximum number of I/O Base Modules may find the B 5935 a better buy. A maximum B 5935 configuration requires only one I/O Expansion Cabinet, compared to the three I/O Expansion Cabinets required for a maximum B 5920 configuration.

HARDWARE

The B 5900 systems use Burroughs' multi-level Function Processor concept, in which major hardware functions are assigned to separate microprocessors, each with its own memory. The central processing unit has an open-ended design that currenty 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 medium-scale B 5900 systems can be used for both central host data processing and distributed processing applications. The B 5900 features multiple-microprocessor architecture and maintains full program compatibility with the larger B 6000 and B 7000 systems.

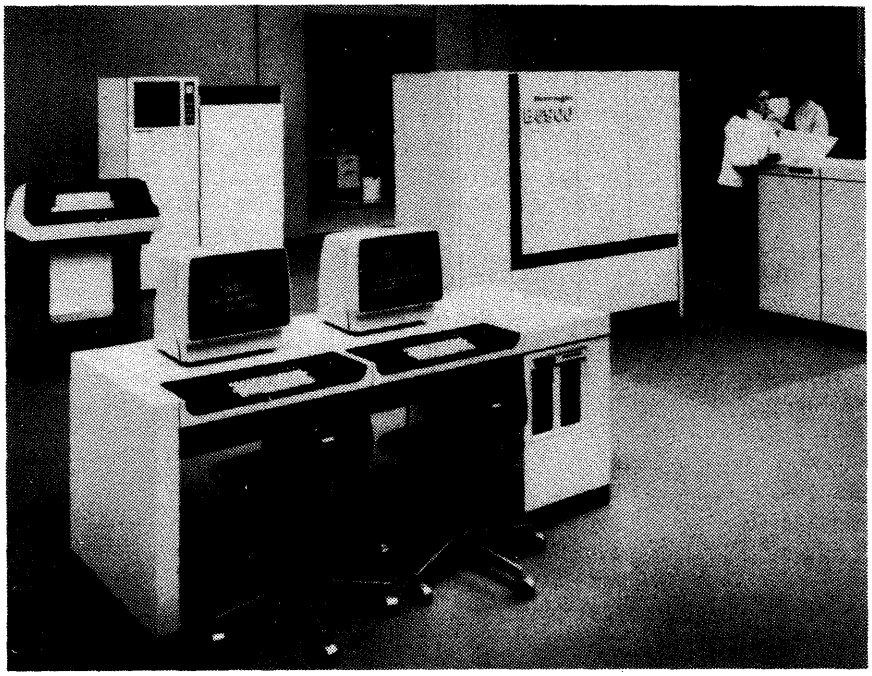
MODELS: B 5920 and B 5935.
CONFIGURATION: Single-processor system - 3.1 to 6.2 megabytes of main memory, 5 to 20 Data Link Processors, 4 to 144 communications lines, and 1 to 3 operator consoles. Multiprocessor system - up to 4 CPUs, 15.7 megabytes of main memory, 80 DLPs, 576 communications lines, and 12 operator consoles.
COMPETITION: Digital Equipment DECSYSTEM-20, Honeywell DPS 7 and DPS 8, IBM 4331 and 4341, Magnuson M80 Series, NCR 8500 Series, and Sperry Univac System 80, 90/60, 90/80, and 1100/60 C.
PRICING: The basic B 5920 sells for $180,000; the B 5935, for $205,000.

CHARACTERISTICS

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

MODELS: B 5920 and B 5935.

PREVIOUS MODEL: B 5930.



This basic B 5935 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 3.1 megabytes of main memory, and a disk drive and controller.

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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 5900 program-compatible with the larger systems. The other CPU Function Processors are dedicated to the following specific functions: the Program Controller accesses and 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 5900'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' Function Processor architecture enables the B 5900 to achieve a competitive price/performance level without reliance on exotic circuitry. The system uses LSI logic circuits and 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 5900 CPU can range from 3.1 to 6.2 megabytes. On the B 5920, memory is provided in 3.1-megabyte modules; on the B 5935, in 768K-byte modules. Expansion beyond 3.1 megabytes requires a Memory Expansion Adapter on the B 5935.

From two to four B 5900 central processors can be interconnected via Burroughs' Global memory and operated in any of three modes. The Global memory capacity can range from 768K bytes to 3.1 megabytes in 768K-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 5900 systems can also be intermixed with Burroughs 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 5900 system can include up to 20 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,

DATE ANNOUNCED: See Table 1.

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.

MAIN STORAGE

STORAGE TYPE: See Table 1.

CAPACITY: See Table 1 for minimum and maximum memory capacities. On the B 5935, expansion beyond 3.1 million bytes requires the addition of the Memory Expansion Adapter, which provides a second Memory Controller.

If less than the maximum 6.2 megabytes of main memory is configured, the B 5900 systems can also support a Global Memory interface. The Global Memory subsystem can be shared by up to four processors in a multiprocessor system. Each processor can address a total of 6.2 megabytes of main (local) memory and Global (shared) memory combined. Thus, a four-processor system supports up to 15.5 megabytes of memory (3.1 megabytes in each processor plus 3.1 megabytes of 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 5900 Central Processing Unit employs a fully microprogrammed architecture based on Burroughs' multi-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.

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TABLE 1. CHARACTERISTICS OF THE B 5900 SYSTEMS

	B 5920	B 5935
CENTRAL PROCESSORS		
Date of introduction	September 1982	September 1982
Number of processors per system	1 to 4	1 to 4
MAIN STORAGE		
Type	64K-bit MOS	16K-bit MOS
Minimum capacity, bytes	3,145,728	3,145,728
Maximum capacity, bytes (per processor)	6,291,456	6,291,456
Increment size, bytes	3,145,728	786,432
Maximum system capacity, bytes (main memory plus Global memory)	15,728,640	22,806,528
Bytes fetched per cycle	6	6
Error correction	Standard	Standard
Interleaving	2-way	
GLOBAL MEMORY		
Minimum capacity, bytes	786,432	786,432
Maximum capacity, bytes	3,145,728	3,145,728
Increment size, bytes	786,432	786,432
I/O AND COMMUNICATIONS		
Number of DLPs per processor	5 to 20	5 to 20
Aggregate I/O data rate, bytes per second	2,359,296	2,359,296
Number of NSPs per processor	1 to 3	1 to 3
Number of communication lines per NSP	4 to 48	4 to 48

which houses up to eight DLPs, can be connected to as many as four B 5900 central processors; any DLP can then be switched from one processor to another under MCP control.

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 moving-head drives with either removable or non-removable 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 Network Support Processors (NSPs) and Line Support Processors (LSPs). The B 5900 central system now includes one NSP as standard. The NSP relieves the CPU of higher-level communications functions, while the LSPs perform low-level network control functions. Each NSP can control up to 48 communications lines, and a B 5900 system supports up to 3 NSPs. In multiprocessor systems, the NSPs and LSPs can be switched among processors in the same manner as the Data Link Processors.

SOFTWARE

One of the principal attractions of the B 5900 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

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 5900'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/Output Base Module via a Message-Level Interface (MLI).

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TABLE 2. MASS STORAGE

Subsystems	B 9484-12 Disk	B 9484-51 Disk	B 9494-5 Disk	B 9494-41 Disk
Cabinets per subsystem	2 to 8	Up to 8	2 to 8	Up to 4
Disk packs/HDAs per cabinet	1 removable	2 removable	1 fixed	2 fixed
Capacity, megabytes	252	130.4	542	402
Average access time, milliseconds	28.5	25	22	28
Average rotational delay	8.3	8.3	8.3	8.17
Data transfer rate, bytes/second	600,000	605,000	600,000	650,000
Controller model	B 9387-51, B 9387-52	B 9387-4X	B 9387-51 B 9387-52	B 9387-4X
Comments	Requires B 5304-90 DLP; can be intermixed with B 9494-5 on two controllers for a maximum of 16 drives	Requires B 5304-90 DLP	Requires B5304-90 DLP; can be intermixed with B 9484-12 on two controllers for a maximum of 16 drives	Requires B 5304-90 DLP

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 statements or the console keyboard/display units.

B 5900 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, and RPG 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 5900, 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 (DMSII), 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-

The *Memory Controller* provides the interface between the memory modules and the M-bus that services all of the CPU modules. Each B 5920 Memory Controller supports up to 6.2 megabytes of memory. Each B 5935 Memory Controller supports 3.1 megabytes; expansion beyond 3.1 megabytes of memory requires the B 5935 Memory Expansion Adapter. 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 document designed to aid field engineers in isolating and diagnosing system faults.

The B 5900 MMCP contains a microcoded implementation of the complete instruction set used in the larger Burroughs B 6000 Series computers. As a result, the B 5900 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

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TABLE 3. INPUT/OUTPUT UNITS

Magnetic Tape Units	Number of Tracks	Recording Density, Bits/Inch	Encoding	Tape Speed Inches/Sec.	Transfer Rate, Bytes/Sec.
B 9495-82	9	1600	PE	75	120,000
B 9495-83	9	1600	PE	125	200,000
B 9495-32	9	1600	PE	75	120,000
	9	6250	GCR	75	470,000
B9495-33	9	1600	PE	125	200,000
	9	6250	GCR	125	780,000
Printers	**Printing Speed**	**Print Positions**	**Horizontal Spacing, Chars./Inch**	**Vertical Spacing, Lines/Inch**	**Form Size, Inches**
B 9246-6	650 lpm	132	10	6 or 8	4 to 20 in.
B 9246-12	1250 lpm	132	10	6 or 8	wide
B 9246-21	2000 lpm	132	10	6 or 8	
B 9247-14	1100 lpm	132	10	6 or 8	4 to 20 in.
B 9247-15	1500 lpm	132	10	6 or 8	wide
Punched Card Equipment	**Columns**	**Speed Cards/Min.**	**Input Hopper Capacity**	**Output Stacker Capacity**	**Options**
B 9115 Card Reader	80	300	1000	1000	51-col.read
B 9116 Card Reader	80	600	1000	1000	51-col.read
B 9117 Card Reader	80	800	1000	1000	50-col.read

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 5900, including systems oriented toward production control, inventory control, project control, text management, banking, and hospitals.

COMPATIBILITY

The B 5900 features full compatibility, at both the source and object-code levels, with the larger Burroughs computers. There is, however, no object-level program compatibility between the B 5900 and any of the smaller Burroughs systems; programs written for these computers must be recompiled to run on the B 5900.

The B 5900 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 written in ANSI Cobol, Fortran, or PL/1 for the IBM computers, however, should be transferable to the B 5900 without undue conversion difficulty.

To assist users of competitive systems in converting to the B 5900, Burroughs offers a number of program products called Conversion Aids. These include Cobol, RPG, and BAL translator 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.

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.

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 5900 provides about 50 percent of the processing

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USER REACTION

Preliminary returns from Datapro's 1983 survey of general-purpose computer users yielded seven responses from B 5900 users. These users had a total of one B 5920 system and six B 5930 systems installed. The oldest system had been in use since January 1981; the newest, since November 1982.

Five of the survey respondents had acquired the B 5900 as an upgrade from a Burroughs B 1800, B 1900, or B 3800 system. In the two remaining installations, the B 5900 had replaced a Honeywell system and a Sperry Univac 90/30 system.

All seven respondents named Cobol as their primary programming language, and five of them developed applications programs in-house. Only two users were getting most of their applications packages from Burroughs.

The users' ratings of the B 5900 systems were as follows:

	Excellent	Good	Fair	Poor	WA*
Ease of operation	2	4	1	0	3.14
Reliability of mainframe	3	3	1	0	3.28
Reliability of peripherals	2	2	1	1	2.83
Maintenance service:					
Responsiveness	1	4	2	0	2.86
Effectiveness	2	2	2	1	2.71
Technical support:					
Trouble-shooting	0	5	2	0	2.71
Education	0	1	6	0	2.14
Documentation	0	1	5	1	2.00
Manufacturers software:					
Operating system	3	4	0	0	3.43
Compilers & assemblers	3	3	1	0	3.28
Applications programs	0	4	2	0	2.67
Ease of programming	2	4	1	0	3.14
Ease of conversion	1	4	1	1	2.71
Overall satisfaction	2	4	1	0	3.14

Weighted Average on a scale of 4.0 for Excellent.

The above ratings indicate that the B 5900 users were reasonably well satisfied with their systems, except in the area of Technical Support.

In February 1983, we spoke with three of the survey respondents in order to gain additional insight into their experience with the B 5900. These three users represented a manufacturer, a municipal government, and a transportation company.

The first user interviewed had purchased a B 5930 as an upgrade from a B 1860 in December 1981. He reported that he had experienced "very few problems" during the conversion, and that someone in his organization had written a translator that "worked like a charm." He also commented that, in his opinion, the B 1800 software was "more compatible with Burroughs' large systems than with their medium systems." His company had considered an IBM 4300 Series system, but chose the B 5900 because it offered "more bang for the buck."

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 5920 central system, including the central processor, main memory, and two I/O Subsystem Base Modules, is housed in a single cabinet measuring 45 inches wide and 29 inches deep. The B 5935 central system, including the central processor, main memory, and three I/O Subsystem Base Modules, is housed in a cabinet that measures 68 inches high, 80 inches wide, and 24 inches deep.

CONFIGURATION RULES

The entry-level B 5920 central system consists of one CPU, one 3.1-megabyte Memory Module, one Maintenance Processor, two Mini-Disk Drives, one Operator Display Terminal, two I/O Subsystem Base Modules, one dual-processor I/O Base Module Exchange, one Network Support Processor, 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 subsystems).

The basic B 5935 central system consists of one CPU, four 768K-byte Memory Modules, one Maintenance Processor, one Operator Console with dual displays and dual Mini-Disk Drives, three I/O Subsystem Base Modules, and the same communications equipment and Data Link Processors as listed above for the B 5920.

The systems 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 5900 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 768K bytes to 3.1 million bytes, and each processor can also have 3.1 million bytes of local memory. The total amount of local plus Global memory that can be addressed by each processor, 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. This mode of operation is supported by the Burroughs Network Architecture Local Network Services with the Global Memory Station Group.

In the Independent Systems Mode, each processor operates independently under its own MCP, as in the Shared Re-

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The second user interviewed had switched from a B 3800 to a B 5930 in October 1982. This user reported that he had experienced more problems than he had anticipated and commented that it "might have been easier to change vendors." He agreed with the previous user that it was "easier to convert from a small to a large Burroughs system than from a small to a medium Burroughs system or from a medium to a large Burroughs system." This user also said that he had experienced "a lot of downtime in the first three or four months," but that the situation had "improved tremendously."

The third user interviewed had upgraded from a B 1885 system to a B 5930. This user said that there were "no real problems" during the conversion and that he was well satisfied with the B 5930. His only complaint was that the system originally proposed by Burroughs had insufficient memory capacity.

Of the seven survey respondents, four said they would recommend the B 5900 to others and three were undecided.□

sources 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 5900 systems can be intermixed with Burroughs 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 5900 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.

The Data Link Processors are housed in the I/O Subsystem Base Module, which contains 24 card positions and a power supply sufficient to handle 8 DLPs. Although the maximum number of DLPs per base is always eight, the exact number that can be housed in one base module is determined by the number of cards required by the individual DLPs, as signified by each DLP's numeric suffix. A total of 19 cards per base are available for the DLPs.

The basic B 5920 system includes two I/O Subsystem Base Modules. One of these can contain up to eight DLPs, while the other contains a Network Support Processor, Line Support Processor, and up to three Quad Line Adapters. Up to three I/O Expansion Cabinets, each with two additional I/O Subsystem Base Modules, can be added to the system. Each B 5920 processor supports a maximum of 20 DLPs.

The basic B 5935 system includes three I/O Subsystem Base Modules. An I/O Subsystem Expansion Cabinet can be added to hold four additional I/O Subsystem Base Modules. Up to 20 DLPs are supported on a single-processor B 5935 system.

Each of the I/O Subsystem Base Modules can be connected to up to four B 5900 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 5900 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 burst rate of 2.3 million bytes per second. (The maximum aggregate I/O data rate for each B 5900 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

See Table 2 for disk storage subsystems supported on the B 5900 systems.

INPUT/OUTPUT UNITS

For magnetic tape drives, card readers, and printers available for the B 5900 systems, please refer to Table 3.

COMMUNICATIONS CONTROL

The B 5900 data communications hardware consists of the Network Support Processor (NSP), the Line Support Processor (LSP), and Line Adapters. The NSP provides a hierarchy of network control functions and relieves the central processor of communications housekeeping functions. The LSP performs low-level network control functions, while the Line Adapters provide the electrical interface for each line. One NSP, one LSP, and one Quad Line Adapter are included in each B 5900 central system and are housed in the central processor cabinet.

NETWORK SUPPORT PROCESSOR: The NSP is a programmable front-end processor that serves as the central element of B 5900 communications subsystems. It contains 256K bytes of integrated-circuit memory. The NSP handles subsystem control, data link control, and line discipline control functions. Interaction between the NSP and the central system is performed at the message level, eliminating the need to interrupt the central system each time a character or word of data is to be transferred. The NSP is programmed by means of Burroughs' Network Definition Language II (NDL II), a descriptive, parameter-driven language.

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Each NSP can support up to 4 Line Support Processors and up to 48 communications lines. A single B 5900 processor can be equipped with a maximum of 3 NSPs, for a total of 144 communications lines. A four-processor B 5900 system supports a maximum of 12 NSPs and 576 communications lines. 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 paths can be active at a time, but a different path can be activated under MCP control whenever network reconfiguration is desired.

LINE SUPPORT PROCESSOR: The LSP is a microprocessor-based unit that performs the low-level network control functions in a B 5900 communications subsystem. The Network Support Processor 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. 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 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 4800 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 of 56,000 bits per second.

Up to four LSPs can be connected to each NSP. Each LSP supports up to four Message-Level Interface paths, and each path can physically connect the LSP to a different NSP. Only one of these physical paths can be active at a time, but a different path can be activated under MCP control whenever network reconfiguration is required. An NSP can control LSPs located in different I/O Subsystem Base Modules via the Line Expansion Module.

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 transmission rate of 56,000 bits per second.

The B 5900 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 7800, or B 7900 systems connected through an I/O channel link. ISC operates under the control of Burroughs Network Architecture (BNA), which provides 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 System Management Facility II (SMF II) Site Management, one additional compiler.

MASTER CONTROL PROGRAM: The MCP is an integrated operating system that oversees and controls all B 5900 operations. MCP 3.3.1 is the current release of the operating system for the B 5900 systems. Release 3.3.1 offers the following enhancements over previous releases: improved logging of file open operations, improved use of formatted I/O in Algol and Fortran, improved creation of records in RPG and Cobol 74, optimized microcode to

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improve CPU performance, reduction in the overhead required to initiate I/O operations, improved memory management in the NSP, and dynamic path selection for I/O units.

The MCP consists of groups 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 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 jobs 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 reference 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 are re-entrant because code 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 statements, and a comprehensive system log. The status of the system and of the jobs in progress is presented on the CRT displays. Messages and requests can be keyed by the operator, and the system responses are displayed on the CRT. Jobs are usually submitted to the system in the form of a set of control statements accompanied by a source-language deck, or alternatively through control statements entered through the console keyboard if the programs have previously been compiled and stored on disk. Jobs to be compiled must be accompanied by a compile statement identifying the compiler to be used and specifying one of three types of compilations: compile and execute, compile for the library, or compile for the syntax. Optional control statements 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 statements, improved

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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, 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 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 code generated by the compiler is reentrant.

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: Burroughs offers two Fortran compilers for the B 5900. 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.

Also available for the B 5900 systems is a Fortran 77 compiler that conforms to the ANSI 77 specifications. Several enhancements and extensions are provided, including an expanded array size of one million words. The Fortran 77 compiler can also be used on Burroughs' B 6000 and B 7000 systems.

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 ouput 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 timesharing 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, providing control specifications, file description specifications, extension specifications, input specifications, calculation specifications, output specifications, data communications specifications, header/trailer specifications, and compile control options, 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.

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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 Line Support Processors. NDL II is a descriptive, parameter-driven language that carries forward and enhances the 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.

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.

NDL II ANALYZER: The NDL II Analyzer is an optional data communications utility for NSP-based systems. It accesses the Network Information File and an NSP dump file to provide information on the status of NDL II source programs running on an NSP.

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.

EDITOR: A programmer productivity aid that runs as a task under CANDE. The Editor is a general line- and page-oriented text editor that creates and maintains program text and simple documents.

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.

SUPPORT LIBRARIES: The Securitysupport Library provides additional security control facilities for installations with RJE or CANDE. Each time an RJE or CANDE user logs on, the Securitysupport Library is called to verify the user code, charge code, access code, and station identification.

The Billingsupport Library enables users to implement a customized method for processing billing information. It provides the capability of converting resource usage information into charge information.

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

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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.

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.

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 is dependent upon 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.

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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.

DMINTERPRETER: A DMS II facility that provides non-DMS II languages, such as Fortran 77 and APL, with an interpretive interface to a DMS II data base. DMINTERPRETER decouples the application from the data base, so that, in most cases, changes to the data base do not require the recompilation of applications programs.

DBCERTIFICATION: This DMS II utility enhances data base integrity by certifying the structures of a DMS II data base as they reside on secondary storage. DBCERTIFICATION ensures that a file is accessible, that data within a structure is consistent and valid, and that relationships between structures are correct.

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

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

APT III (numerical control)

BASIS (Burroughs Advanced Statistical Inquiry System)

BHIS (Burroughs Hospital Information System)

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

BIS (Banking Information System)

BPS (Business Planning System)

DIS (Distribution Information System)

GBMS (General Business Management System)

Government/Education Systems

HMS (Hospital Management System)

Infostats (forecasting and statistical analysis)

The Manufacturing System (TMS)

TMS (Text Management and Electronic Mail System)

PRICING

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 I" (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.

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SOFTWARE: All of the B 5900 Series software is unbundled. The Basic System Software Facility, consisting of the MCP, NDL II, GEMCOS, SMF II Site Management, and one compiler of the user's choice, is available on either a Limited-Term Plan, for a monthly license fee of $1,467, or an Unlimited-Time Plan, for a one-time payment of $40,000 plus an annual fee of $8,360. 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 1 to 10 days in length, cost $180 to $1,950 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.

EQUIPMENT: The following configurations illustrate a small B 5920 system, a medium B 5920 system, a dual-processor B 5920 system, and a large B 5935 system. The quoted prices include all necessary hardware components, but no software. Rental prices include 24-hour, 7-day maintenance service.

SMALL B 5920 SYSTEM: Consists of one B 5920 Basic System (CPU, 3.1 megabytes of main memory, Maintenance Processor, Mini-Disk Drives, two I/O Base Modules, 2 x 1 I/O Base Module Exchange, Operator Display Terminal, five Data Link Processors (DLPs), Network Support Processor (NSP), Line Support Processor (LSP), and Quad Line Adapter) plus one 1608-megabyte B 9494-44 Disk Subsystem with 1 x 8 Controller, two 200KBS B 9495-83 Magnetic Tape Units with 1 x 4 Master Electronics Exchange, and one 1500-lpm B 9247-15 Printer. The purchase price is $397,744, monthly maintenance is $2,054.90, and monthly rental on a one-year contract is $16,895.

MEDIUM B 5920 SYSTEM: Consists of one B 5920 Basic System (as above) plus the following additional components: one 3.1-megabyte Memory Module (for a total of 6.2 megabytes), two B 9494-44 Disk Subsystems (3.2 billion bytes) with 2 x 8 Controller, four 780KBS B 9495-33 Magnetic Tape Units with 1 x 8 Controller, two 1250-lpm B 9246-12 Printers and one printer DLP, one LSP, and two Quad Line Adapters (for a total of 12 communications lines). The purchase price is $690,485, monthly maintenance is $3,561.17, and monthly rental on a one-year contract is $27,654.

DUAL-PROCESSOR B 5920 SYSTEM: Consists of two B 5920 Basic Systems (as above) plus the following additional components: three 768K-byte Global Memory Modules with control (for a total of 2.3 megabytes), two 3 x 1 I/O Base Module Exchanges, four B 9494-44 Disk Subsystems (6.4 billion bytes) with 4 x 16 Controller, eight 780KBS B 9495-33 Magnetic Tape Units with 2 x 8 Controller, four 1250-lpm B 9246-12 Printers and two Printer DLPs, two LSPs, and two Quad Line Adapters (for a total of 16 communications lines). The purchase price is $1,507,933, monthly maintenance is $6,981, and monthly rental on a one-year contract is $58,908.

LARGE B 5935 SYSTEM: Consists of one B 5935 Basic System (CPU, 3.1 megabytes of main memory, Power Subsystem, Maintenance Processor, three I/O Base Modules, Operator Console, five DLPs, Network Support Processor, Line Support Processor, and Quad Line Adapter) plus the following additional components: four 768K-byte Memory Modules (for a total system capacity of 6.2 megabytes), one Memory Expansion Adapter, four B 9494-44 Disk Subsystem (6.4 billion bytes) with 4 x 16 Controller, sixteen 200KBS B9495-83 Magnetic Tape Units with 4 x 16 Master Electronics Exchange and one Magnetic Tape DLP, two 2000-lpm B 9246-21 Printers and one Printer DLP, two LSPs, and 11 Quad Line Adapters (for a total of 48 communications lines). The purchase price is $1,447,938, monthly maintenance is $7,317, and monthly rental on a one-year contract is $57,868.

EQUIPMENT PRICES

			Monthly Charges**		
		Purchase	Monthly Maint.*	1-Year Lease	5-Year Lease
PROCESSORS AND MEMORY					
B 5920	Basic System; includes one Central Processor, one Maintenance Processor, dual Mini-Disk Drives, two I/O Base Modules, one 3.1-megabyte Memory Module, one Operator Display Terminal, one Operator Display DLP, one Line Printer DLP, one Magnetic Tape DLP, two Disk DLPs, one dual-processor I/O Base Module Exchange, one Network Support Processor, one Sub-Broadband Line Support Processor, one Quad Line Adapter, and four Electrical Interfaces	$180,000	$650.00	$7,532	$6,100
B 5935	Basic System; includes one Central Processor, one Power Subsystem; one Maintenance Processor, three I/O Base Modules, four 768K-byte Memory Modules (3.1 megabytes total), one Operator Console with dual displays and dual Mini-Disk Drives, one Operator Console DLP, one Line Printer DLP, one Magnetic Tape DLP, two Disk DLPs, one Network Support Processor, one Sub-Broadband Line Support Processor, one Quad Line Adapter, and four Electrical Interfaces	205,000	710.00	8,295	6,719

EQUIPMENT PRICES

		Purchase	Monthly Maint.*	Monthly Charges** 1-Year Lease	5-Year Lease
PROCESSORS AND MEMORY					
B 5007	768K-byte Memory Module for B 5935	21,000	55.00	690	596
B 5007-3	3.1-Megabyte Memory Module for B 5920	45,000	181.67	1,977	1,604
B 5007-1	Memory Expansion Adapter for B 5935; required when memory exceeds 3.1 megabytes	10,500	27.50	348	299
B 5009-14	Global Memory Control with 768K bytes of memory	131,251	165.00	4,329	3,738
B 5009-15	768K-Byte Global Memory Module	31,501	55.00	1,043	904
B 5905-90	I/O Subsystem Base Module	6,563	27.50	222	188
B 5095-90	I/O Expansion Cabinet for B 5935	28,351	27.50	935	806
B 5095-95	I/O Expansion Cabinet for B 5920	20,000	25.00	721	584
B 9361-23	Additional Operator Display	3,098	26.40	133	122
B 5930-2	I/O Base Module Exchange; 2 processors; includes one path selection module and one distribution module	3,676	5.50	122	105
B 5930-3	I/O Base Module Exchange; 3 processors; includes one path selection module and two distribution modules	4,725	11.00	161	139
B 5930-4	I/O Base Module Exchange; 4 processors; includes one path selection module and three distribution modules	5,775	16.50	194	166
B 5095-92	Distribution Module	1,576	5.50	56	46
B 5095-93	Logic Expansion Module; 1 x 4	3,676	19.70	144	117
DATA LINK PROCESSORS					
B 5110-90	B 9115/B 9116/B 9117 Card Reader DLP-2 (2 cards)	3,739	16.50	124	108
B 5395-91	B 9495-82/-83 PE Magnetic Tape DLP-2 (2 cards)	7,350	33.00	244	210
B 5395-90	B 9495-82/-83 PE/NRZ Magnetic Tape DLP-2 (2 cards)	7,350	33.00	244	210
B 5395-92	B 9495-32/-33 GCR/PE Magnetic Tape DLP-3 (3 cards)	7,350	33.00	244	210
B 5304-90	B 9484/B 9494 Disk Pack DLP-2 (2 cards)	7,560	27.50	251	217
B 5247-93	B 9247-14 Printer DLP-2 (2 cards)	4,620	22.00	154	133
B 5247-94	B 9347-15 Printer DLP-2 (2 cards)	4,620	22.00	154	133
B 5246-92	B 9246-12/-21 Printer DLP-2 (2 cards)	4,620	22.00	154	133
B 5246-91	B 9246-6 Printer DLP-2 (2 cards)	4,620	22.00	154	133
MASS STORAGE					
B 9484-51	Dual Disk Pack Drive; 130.4 megabytes	21,000	132.00	815	664
B 9494-41	Dual Fixed-Disk Drive; 402 megabytes	25,200	94.50	847	643
B 9494-42	Dual Fixed-Disk Data Bank; includes two dual-spindle B 9494-41 drives; 804 megabytes	42,000	187.00	1,694	1,286
B 9494-43	Dual Fixed-Disk Data Bank; includes three B 9494-41 drives; 1206 megabytes	59,850	259.00	2,541	1,929
B 9494-44	Dual Fixed-Disk Data Bank; includes four B 9494-41 drives; 1608 megabytes	78,750	334.00	3,388	2,572
B 9987-1	Dual Port Feature for B 9494-41	5,880	23.20	188	155
B 9387-43	Controller for B 9484-51 and B 9494-41; 1 x 8; includes disk exchange	42,000	72.90	1,360	1,151
B 9387-44	Controller; 2 x 8; includes disk exchange	57,488	221.00	1,883	1,605
B 9387-45	Controller; 2 x 16; includes disk exchange	68,408	228.00	2,319	1,943
B 9387-47	Controller; 4 x 16; includes disk exchange	138,916	424.00	4,929	3,885
B 9387-48	Controller; 6 x 16; includes disk exchange	220,973	636.00	7,711	6,336
B 9484-12	Disk Pack Drive; 252 megabytes	30,000	120.00	1,430	1,070
B 9987-2	Dual Port Feature for B 9484-12	2,000	—	85	65
B9494-5	Fixed-Disk Drive; 542 megabytes	33,000	105.00	1,615	1,210
B 9987-3	Dual Port Feature for B 9494-5	2,000	—	85	65
B 9387-51	Controller for B 9484-12 and B 9494-5 drives; 1 x 8	20,000	60.00	905	680
B 9387-52	Controller; 2 x 8	30,000	90.00	1,355	1,015
B 5387-12	Disk Exchange; required when more than two B 9387-51/-52 controllers are configured	20,000	60.00	900	675
B 5387-13	Port Expansion Feature; required when more than four B 9387-51 controllers or two B 9387-52 controllers are configured	5,350	15.00	240	180
B 9987	Dual Host Switch for B 9387-51/-52	5,000	15.00	230	170
MAGNETIC TAPE UNITS					
B 9495-32	GCR/PE Tape Unit; 75 ips, 470/120 KBS	21,736	158.00	880	621
B 9495-32M	GCR/PE Tape Unit with Formatter	50,258	266.00	1,970	1,572
B 9495-33	GCR/PE Tape Unit; 125 ips, 780/200 KBS	24,917	166.00	1,000	704
B 9495-33M	GCR/PE Tape Unit with Formatter	53,440	273.00	2,075	1,656
B 9499-21	GCR/PE Controller; 1 x 8	42,634	232.00	1,444	1,154
B 9499-22	GCR/PE Controller; 2 x 8	85,288	462.00	2,900	2,302
B 9499-23	GCR/PE Controller; 3 x 8	127,899	696.00	4,335	3,457
B 9499-24	GCR/PE Controller; 4 x 8	170,553	928.00	5,772	4,610
B 9499-42	2 x 16 Electronics Exchange for B 9499-22/-23/-24	7,571	23.20	275	213
B 9499-43	3 x 16 Electronics Exchange	9,680	31.00	357	294
B 9499-44	4 x 16 Electronics Exchange	11,356	31.00	419	332
B 9999-3	Dual Host Switch	5,624	16.20	174	141

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EQUIPMENT PRICES

		Purchase	Monthly Charges** Monthly Maint.*	1-Year Lease	5-Year Lease
MAGNETIC TAPE UNITS (Continued)					
B 9495-82	PE Tape Unit; 75 ips, 120 KBS	18,100	135.00	705	547
B 9495-83	PE Tape Unit; 125 ips, 200 KBS	22,447	154.00	895	693
B 9999-4	PE/NRZ Feature for B 9495-82/-83	788	6.60	29	24
B 9499-50	1 x 4 Master Electronics Exchange for B 9495-82/-83	19,100	123.00	729	557
B 9499-51	1 x 8 Master Electronics Exchange	21,060	123.00	770	589
B 9499-52	2 x 8 Master Electronics Exchange	51,240	258.00	2,089	1,211
B 9499-53	2 x 16 Master Electronics Exchange	53,940	258.00	2,198	1,401
B 9499-54	3 x 16 Master Electronics Exchange	83,310	382.00	3,260	2,210
B 9499-55	4 x 16 Master Electronics Exchange	110,200	505.00	4,267	2,910
CARD READERS					
B 9115	Card Reader; 300 cpm	8,608	66.50	332	255
B 9116	Card Reader; 600 cpm	11,372	93.30	442	339
B 9117	Card Reader; 800 cpm	12,952	114.00	499	383
B 9915	51-column Read Feature	844	—	26	20
PRINTERS					
B 9246-6	Band Printer; 650 lpm	14,700	182.00	551	423
B 9246-12	Band Printer; 1250 lpm	42,500	420.00	1,635	1,360
B 9246-21	Train Printer; 2000 lpm	69,300	600.00	3,255	2,625
B 9247-14	Train Printer; 1100 lpm	25,000	495.00	1,544	1,230
B 9247-15	Train Printer; 1500 lpm	33,000	567.00	2,096	1,686
B 9942-10	Additional Train Module for B 9247-14/-15	3,408	43.20	138	113
DATA COMMUNICATIONS					
B 5369	Network Support Processor; 256K bytes of memory	27,000	150.00	1,181	1,015
B 5369-2	Line Support Processor, Sub-Broadband	7,875	27.50	260	227
B 5369-7	Line Support Processor, Broadband	9,800	40.00	442	351
B 5369-3	Quad Line Adapter (Character)	5,350	27.50	179	154
B 5369-4	Quad Line Adapter (Bit)	5,350	27.50	179	154
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	—	—	—
Inter-System Control Subsystem:					
B 5320-2	Host Control 2 (HC2)	11,866	62.90	431	354
B 9320-4	HUB4; can connect up to 4 HC2s	8,085	42.40	293	238
B 9320-5	HUB16; can connect up to 16 HC2s	8,610	46.00	321	260
B 9320-6	HUB Expansion; one each required for third and subsequent HC2s	735	5.00	34	27
B 9320-9	Independently Powered Auxiliary Cabinet; used to house HUB4 or HUB16	21,210	114.00	767	624

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SOFTWARE PRICES

			Unlimited Time Plan		Limited Time Plan
			One-Time License Fee	Annual License Fee	Monthly License Fee
➤	SSF	System Software Facility; includes B 5000 Master Control Program (MCP), utilities, Network Definition Language II (NDL II), Generalized Message Control System (GEMCOS), System Management Facility II (SMF II) Site Management, and choice of one compiler	$40,000	$8,360	$1,469
	COB	Cobol 68 Compiler	3,300	690	121
	C74	Cobol 74 Compiler	3,300	690	121
	BSC	Basic Compiler	3,300	690	121
	PL/1	PL/1 Compiler	3,300	690	121
	FOR	Fortran Compiler (IBM Level H compatible)	3,300	690	121
	F77	Fortran 77 Compiler	—	—	138
	APL	APL/700 Compiler	3,300	690	121
	RPG	RPG II Compiler	—	—	121
	DM2	Data Management System II (DMS II)	25,575	5,346	941
	DI2	DMS II Inquiry	4,950	1,036	182
	DIC	DMS II Data Dictionary	5,940	1,247	218
	DBA	DMS II DBANALYZER	4,400	920	160
	DBM	DMS II DBMONITOR	4,400	920	160
	DMT	DMS II DMINTERPRETER	—	—	138
	DMC	DMS II DBCERTIFICATION	—	—	110
	RJE	Remote Job Entry	1,980	418	72
	CDE	Command and Edit Language (CANDE)	3,300	690	121
	BAR	Burroughs Activity Reporting System (BARS)	2,475	521	92
	LOG	System Logger	1,650	346	61
	TDG	Test Data Generator	8,330	1,742	328
	EDI	Editor	—	—	138
	BSL	Billingsupport	—	—	33
	SSL	Securitysupport	—	—	33
	NDA	NDL II Analyzer	—	—	55
	DIA	Diagnostic Message Control System	1,650	346	61
	MCT	GEMCOS (Total)	24,824	5,189	976
	MCA	GEMCOS (Advanced)	20,689	4,325	813
	MCF	GEMCOS Format Generator (requires MCT or MCA)	4,760	996	187
	SMR	System Management Facility II (SMF II) System Resource Management	8,000	1,672	358
	RP2	REPORTER II	8,330	1,742	328
	ARP	Advanced REPORTER II	13,126	2,744	516
	AUD	Audit REPORTER	17,946	3,751	706
	RPO	On-Line REPORTER (requires AUD, ARP, or RP2)	1,226	257	49
	RNS	Remote Network Services (includes BDLC Station Group)	—	—	220
	B25	X.25 Station Group (requires RNS)	—	—	165
	LNS	Local Network Services (requires ISC or GMS)	—	—	165
	ISC	Inter-System Control (ISC) Station Group (requires LNS)	—	—	110
	GMS	Global Memory Subsystem (GMS) Station Group (requires LNS)	—	—	110
	ITS	IBM to Burroughs Translation System	10,000	1,210	396
	UTS	Univac to Burroughs Translation System	10,000	1,210	396
	HTS	Honeywell to Burroughs Translation System	10,000	1,210	396
	BTS	Burroughs to Burroughs Translation System	10,000	1,210	396
	BBT	Burroughs Cobol 68 to Burroughs Cobol 74	4,000	484	160 ■